A study of factors explaining blood glucose control in patients with insulin-treated type 2 diabetes

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A Study of Factors Explaining Blood Glucose Control in Patients with Insulin-Treated Type 2 Diabetes

by

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Abstract

Background

Many people with type 2 diabetes (T2DM) require insulin therapy to manage glucose levels and reduce the risk of diabetes complications. However, a significant proportion of patients with T2DM receiving insulin therapy do not achieve adequate control over their glucose levels, which increases their risk of complications. It is important, therefore, to increase our understanding of factors that may influence insulin use in the T2DM population to improve the insulin support provided to patients. As most insulin care for T2DM is now provided in primary care by Practice Nurses (PNs) and General Practitioners (GPs), it is important to consider these factors in that context. Therefore, this study set out to provide an integrated analysis of the perspectives of both patients and primary care healthcare professionals (PC HCPs) based on their experiences of current insulin care provision.

Methods

A mixed-methods approach was used to examine perspectives of insulin-treated T2DM patients and HCPs recruited from a range of general practices in terms of size and diabetes expertise within the practice teams. The research incorporated: a cross-sectional postal survey of insulin-using patients with T2DM, with supplemental structured telephone interviews; and in-depth semi-structured face-to-face qualitative interviews with patients and PC HCPs (PNs and GPs). The survey and structured interview data were analysed statistically in SPSS v22 to provide: descriptive data detailing the patient characteristics associated with different levels of glycaemic control (glycated haemoglobin; HbA1c); and bivariate analyses and logistic regression to model the associations between patient-level factors and glycaemic control. The qualitative interview data were analysed thematically using the interpretive phenomenological approach.

Findings

Of those invited, 50% (*n* = 201) of eligible patients, mean age 70 years (range 37–90), completed the primary survey, of which 62% (*n* = 124) participated in the supplemental structured telephone interviews. The mean HbA1c of the survey participants was 64 mmol/mol (*SD* = 16.9, range 37-168), and duration of T2DM

and of insulin was 17 years (*SD* = 7.58) and eight years (*SD* = 6.15) respectively. The participants were grouped by HbA1c as follows: optimal control (HbA1c ≤59 *n* = 95, 47%); moderate control (HbA1c >59 to ≤69, *n* = 50, 25%); and suboptimal control (HbA1c >69, *n* = 56, 28%). A regression analysis using a dichotomised HbA1c (≤59 mmol/mol = 1 and >59 mmol/mol = 0) indicated that depression scores (Patient Health Questionnaire-9; PHQ-9) (*p* = .03) and diabetes duration (*p* = .04) were negatively and positively associated with glycaemic control, respectively. The interview data indicated that the following factors were important in moderating insulin use and its impact on glucose control: patient understanding of insulin and associated self-management behaviours; patient motivation; the expertise and support of the HCPs; and the type/level of insulin support provided by the primary care team.

Conclusions

The study findings have revealed the factors that mediate the impact of insulin on glycaemic control are multifactorial, residing at the patient, health professional and system level. The study also highlights the importance of individualising the insulin management plan in respect of insulin choice, glucose targets and most importantly the patient's preference and capacity to self-manage. This has highlighted areas where future developments are required to improve the provision of insulin support in primary care and these include enhanced educational support for both patients and professionals, with an emphasis on patient-centred integrated care models.

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Abbreviations

4-T	Treating to Target in Type 2 Diabetes study
ACCORD	Action to Control Cardiovascular Risk in Type 2 Diabetes (study)
ACR	Albumin-creatinine ratio
ANOVA	Analysis of variance
AT.LANTUS	A Trial Comparing Lantus Algorithms to Achieve Normal Blood Glucose Targets in Subjects With Uncontrolled Blood Sugar With Type 2 Diabetes Mellitus
AUC	Area under the ROC curve (used for analyses of diagnostic accuracy)
BB	Basal-bolus
BMI	Body Mass Index
BS	Blood Sugar
C&C	Canterbury & Coastal (Clinical Commissioning Group)
CASP	Critical Appraisal Skills Programme
CBT	Cognitive behaviour therapy
CCG	Clinical Commissioning Group
CI	Confidence Interval
CKD	Chronic Kidney Disease
CLAHRC	Collaboration for Leadership in Applied Health Research and Care
COPD	Chronic Obstructive Pulmonary Disease
COREQ	COnsolidated criteria for REporting Qualitative research (checklist)
CVD	Cardiovascular disease
DCCT	Diabetes Control and Complications Trial
DiRECT	Diabetes Remission Clinical Trial
DNT15	Diabetes Numeracy Test
DPP4i	Dipeptidyl Peptidase-4 Inhibitor
DSC-type 2	Diabetes Symptom Checklist-type 2
DSN	Diabetes Specialist Nurse
DVD	Digital versatile disc
DVLA	Driver and Vehicle Licensing Agency
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
EFA	Exploratory Factor Analysis

ENTREQ	ENhancing Transparency in Reporting the synthEsis of Qualitative research (reporting guidance)
FDA	Food and Drug Administration
FPG	Fasting plasma glucose
GLP-1 RA	Glucagon-like Peptide-1 Receptor Agonist
GOAL A1C	The Glycemic Optimization with Algorithms and Labs at Point of Care study (US)
GP	General Practitioner
HADS	Hospital Anxiety and Depression Scale
HADS-D	Depression component of the HADS
HbA1c	Glycated haemoglobin (IFCC mmol/mol or DCCT percentage)
HCP	Healthcare Professional
IDF	International Diabetes Federation
IFCC	International Federation of Clinical Chemistry
IPA	Interpretative Phenomenological Analysis
ITAS	Insulin Treatment Appraisal Scale
ITEQ	Insulin Treatment Experience Questionnaire
ITSQ	Insulin Treatment Satisfaction Questionnaire
LOA	Letter of Access (for research)
MDI	Multiple daily injection (of insulin)
MI	Motivational Interviewing
NHS	National Health Service
NICE	National Institute for Health and Care excellence
NIHR	National Institute for Health Research
NPH	Neutral Protamine Hagedorn [insulin]
OHA	Oral Hypoglycaemic Agent
OR	Odds ratio
PAID	Problem Areas in Diabetes Scale (tool to measure diabetes-related emotional distress); PAID-5 is the shortened version of this tool
PC HCP	Primary Care Healthcare Professional
PCP	Primary Care Physician
PHE	Public Health England
PHQ-9	Patient Health Questionnaire-9 (screening tool for depression)
PIS	Participant Information Sheet

POMS-SF	Short Form of the Profile of Mood States (tool to measure psychological distress)
PN	Practice Nurse
PPI	Patient and public involvement
PREDICTIVE	Name of a Global, Prospective Observational Study to Evaluate Insulin Detemir Treatment in Types 1 and 2 Diabetes
PRIME-MD	Primary Care Evaluation of Mental Disorders (tool to measure mental ill-health)
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses (reporting guidance)
PZI	Protamine zinc insulin
QIP	Quality Improvement Programme
QOF	Quality and Outcomes Framework
QOL	Quality of life
RCT	Randomised controlled trial
REALM	Rapid Estimate of Adult Literacy in Medicine
REC	Research Ethics Committee
RMGC	Research Management and Governance Consortium
ROC	Receiver Operating Characteristics Curve (used in analyses of diagnostic accuracy)
SD	Standard deviation
SF-12	12-item Short Form Health Survey (measuring self-reported health)
SF-12 MCS	Mental Health Composite Scale scores component of the SF-12
SF-12 PCS	Physical Health Composite Scales scores of the SF-12
SF-20	20-item Short Form Health Survey (measuring self-reported health)
SF-36	36-item Short Form Health Survey (measuring self-reported health)
SLS	Short Literacy Survey
SMBG	Self-monitoring of Blood Glucose
SNS-3	Subjective Numeracy Scale
SGLT2i	Sodium-Glucose Cotransporter-2 Inhibitor
S-TOFHA	Short Test of Functional Health Literacy in Adults
SU	Sulfonylurea
T1DM	Type 1 diabetes (mellitus)
T2DM	Type 2 diabetes (mellitus)

TDU	Total Daily Units
UK	United Kingdom
UKPDS	United Kingdom Prospective Diabetes Study
VS	Versus
WRAT4	Wide Range Achievement Test-4

The abbreviations used to report the statistics are based on those recommended by the American Psychological Association.

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1. INTRODUCTION

1.1 Background

The number of patients with type 2 diabetes (T2DM) requiring insulin therapy is increasing. This increase relates both to the overall rise in the prevalence of T2DM and to the need to achieve optimal glycaemic control in these patients to prevent complications (Evans *et al.* 2010, Holman *et al.* 2008). Most patients with T2DM will require insulin six to nine years following diagnosis, with a mean eight years to initiation of insulin after the start of their last oral hypoglycaemic agent (OHA) in people taking two or more OHAs (Khunti *et al.* 2013a). Basu *et al.* (2019) estimate that the insulin required to treat T2DM is expected to increase by more than 20% from 2018–2030, even with consideration of higher glycated haemoglobin (HbA1c) targets for older people and access to newer OHAs and glucagon-like peptide-1 receptor agonists (GLP-1 RAs). Hence, the demand for insulin therapy will continue to rise over the coming decades. Insulin is currently the most potent glucose-lowering medicine and can lower glucose in a dose-dependent manner, although this is limited by the risk of hypoglycaemia and, in T2DM, is moderated by the level of insulin resistance (Davies *et al.* 2018). Therefore, insulin is an important therapy to improve glycaemic control in this population and has the potential to help reduce costly diabetes complications. However, despite evidence of its effectiveness, many patients with insulin-treated T2DM still have suboptimal glycaemic control and increased risk of complications (Harris *et al.* 2010, Khunti *et al.* 2016, Tong *et al.* 2015). After more than three years of insulin therapy, 20% (n = 76) of T2DM individuals in a study by Harris *et al.* (2010) still had suboptimal control with HbA1c >9% (75 mmol/mol) with prevalence of comorbidities and complications rising from 74% to 94% during the study period (median duration 3.9 years).

The reason for suboptimal glycaemic control in people with T2DM may be related to some of the complexities of effective management for both patients and healthcare providers. Insulin therapy demands significant changes in patient self-management, including more rigorous glucose monitoring and diligence in insulin timing, dietary management and insulin administration (Davies *et al.* 2013). To support patients on insulin, healthcare professionals (HCPs) need to provide

education to help them titrate and adjust their insulin and to avoid side effects such as hypoglycaemia and weight gain (Khunti *et al.* 2013b, NICE 2015).

While insulin initiation and management in T2DM were traditionally undertaken by hospital-based specialist diabetes teams, they are now largely delivered in primary care. In many parts of the UK, insulin initiation and intensification are conducted by Practice Nurses (PNs) and General Practitioners (GPs) (Chadder 2013, Dale *et al.* 2010). The advantages of this shift are that care is moved nearer to the patient to ensure they use the therapy optimally and there is more frequent contact than is feasible in specialist settings. While some practices have developed special provision for such insulin initiation clinics (Burden & Burden 2007, Ellis *et al.* 2011) to deal with the increased clinical needs of patients treated with insulin, there is consistent evidence to show that insulin may not be used to optimal effect in primary care. Indeed, many patients receiving insulin often have inferior glycaemic control to those on OHAs (Hermanns *et al.* 2012). While this may be in part attributable to disease progression, with those requiring insulin generally having longer disease duration, it has also been linked with treatment inertia, characterised by delays in starting insulin and inadequate titration or application of the therapy (Dale *et al.* 2010, Harris *et al.* 2010, Khunti *et al.* 2016).

1.1.1 Optimal Glycaemic Control

To prevent diabetes complications, it is important to optimise blood glucose control to achieve normal or near-normal glycaemia. However, definitions of optimal glucose control vary from country to country and, over recent years, this has become more individualised in view of studies showing that too stringent control can increase risks (ACCORD Study Group 2008, ADVANCE Collaborative Group 2008, Huang *et al.* 2014). This has led to higher blood glucose levels for certain groups, such as frail older people with longer diabetes duration, and lower levels for the younger, fitter people with shorter diabetes duration (Davies *et al.* 2018, Forbes *et al.* 2017, Gadsby *et al.* 2017). Hence, guidance includes advice to adopt an individualised approach (Davies *et al.* 2018, IDF 2013, NICE 2015) and these factors have also been considered in this research. The optimal glycaemic target recommended by the UK Quality and Outcomes Framework (QOF) at the time of study was HbA1c ≤59 mmol/mol

(BMA & NHSE 2015) and was therefore used for the purpose of this research. However, as the study progressed, it became important to also allow for individualised targets. Therefore, the participants were also grouped by HbA1c as follows: optimal control (HbA1c ≤59 mmol/mol; moderate control (HbA1c >59 mmol/mol to ≤69 mmol/mol); and suboptimal control (HbA1c >69 mmol/mol).

1.1.2 Type 2 Diabetes

The prevalence of diabetes in the UK has more than doubled from 1.4 million in 1996 to around 3.8 million today (Diabetes UK 2019). In addition, one million people have diabetes but have not yet been diagnosed and 12.3 million are at risk of diabetes. Following current trends, it is estimated that more than five million people will have diabetes by 2025 (PHE 2016). This increase is largely being driven by an ageing population and increasing numbers of overweight and obese individuals (Massó-González *et al.* 2009). T2DM accounts for around 90% of all cases of diabetes (Jones *et al.* 2010). While occurring mostly in those aged over 40 years, it is increasingly seen in younger obese people and young South Asians (Tillin *et al.* 2013). Moreover, Indian Asian and African Caribbean migrants to the UK have at least twice the risk of developing diabetes compared with British Europeans (Tillin *et al.* 2013).

T2DM is a chronic, progressive, long-term condition associated with insulin resistance, increasing beta-cell dysfunction and subsequent diminishing insulin production (Krebs & Parry-Strong 2013). It is strongly linked with obesity, hypertension, dyslipidaemia and cardiovascular disease (CVD) (Dyson *et al.* 2019, Khunti *et al.* 2018). However, obesity, linked to excess energy intake and increasingly sedentary lifestyles, is the most potent risk factor for T2DM accounting for 80–85% of overall risk (Krebs & Parry-Strong 2013). The pattern of metabolic dysfunction observed in these patients is initially insulin resistance followed by decreased insulin sufficiency. The insufficiency increases over time contributing to the need for exogenous insulin therapy as beta-cell function declines and blood glucose levels increase (Jones *et al.* 2010).

1.1.3 Complications and Costs of Type 2 Diabetes

The landmark United Kingdom Prospective Diabetes Study (UKPDS) (Adler *et al.* 2000, Holman *et al.* 2008, Stratton *et al.* 2000, UKPDS 1998) demonstrated the progressive nature of T2DM. The study found irreversible complications occurring over time when blood glucose levels were raised, and that complications were reduced when blood glucose levels decreased. The complications of T2DM are manifest in most bodily systems and approximately divided into micro and macrovascular complications, although the two are often interrelated as they are primarily driven by hyperglycaemia, dyslipidaemia and hypertension (Gæde *et al.* 2016, Khunti *et al.* 2018, Paul *et al.* 2015, UKPDS 1998). Common complications include: CVD; stroke; renal disease; eye disease; and peripheral vascular disease. These complications are costly both in economic and human terms.

Because T2DM develops insidiously with gradually increasing glucose levels, people often have no immediate symptoms, which presents a challenge to its identification and management (Winkley *et al.* 2013). Therefore, it can be present several years before diagnosis with many having complications at presentation (Stratton *et al.* 2000). However, with more active screening and earlier detection of diabetes, the level of complications observed at diagnosis has declined. A recent cohort study of an urban multi-ethnic population suggests a lower than expected prevalence of people with complications at diagnosis (Winkley *et al.* 2013): again, this is likely to be explained by more intense screening for people with impaired glucose regulation. Evidence from the UKPDS demonstrated how more intensive glucose control reduced the risk of complications and mortality. National UK HbA1c targets are based on such studies, with the initial goal being HbA1c ≤48 mmol/mol and level for further intensification including insulin therapy set at ≥58 mmol/mol (NICE 2015).

It is estimated that 10% of the annual spend of the National Health Service (NHS) budget is on diabetes-related treatment (Hex *et al.* 2012). Costs are predicted to rise further as prevalence increases, costs of complications grow, and with newer, more expensive medicines including analogue insulins. In the financial year 2017/2018 in England, drugs used in diabetes made up more than 11% of primary care net ingredient costs. There were 53 million items prescribed for diabetes at

a total cost of £1,012 million, which was up by 23 million prescription items and £422 million since 2007/08 (NHS Digital 2018). Given the rising insulin therapy costs, it is important to ensure that these therapies are used well to ensure that they are offset against reduction in costlier complications.

1.1.4 Managing Type 2 Diabetes

The primary focus of clinical management in T2DM is to prevent complications, and this requires a multifaceted approach (Gæde *et al.* 2016). The most common therapeutic interventions include: lifestyle; OHAs; incretin-based injectable therapies; and insulin therapy. Increasingly, it is recognised that multiple therapies are required. Lifestyle intervention remains an important focus at all stages of the disease but particularly early in the diagnosis. There is now unequivocal evidence that T2DM can be delayed, prevented and can lead to remission by following a well-structured diet and physical activity, generally resulting in weight loss, although this can be a challenge to maintain (Dyson *et al.* 2018, Lean *et al.* 2018). Weight loss was shown to be the cornerstone for remission by Lean *et al.* (2018) for almost 50% of participants at 12 months with a very low-calorie formula diet (823–853 kcal/day) for 3–5 months followed by stepped food reintroduction over 2–8 weeks and support for long-term weight loss. Bariatric surgery is increasingly used in severely obese patients and can lead to remission in T2DM in up to 80% of patients (Knop & Taylor 2013). In addition to glucose-lowering management, T2DM also requires enhanced lipid and blood pressure management as these contribute significantly to cardiovascular, eye and kidney complications (Gæde *et al.* 2016).

While the focus of this study will be on insulin, it is important to recognise there are other important treatment pathways. It is also important to acknowledge the contribution of self-management support and patient education for T2DM. Offering patients structured education at or around diagnosis, with annual reinforcement is recommended as a key priority by the National Institute for Health and Care Excellence (NICE 2015). This has been shown to offer benefits in terms of physical activity, weight reduction, improvements in HbA1c, and treatment satisfaction in people newly diagnosed and those with established diabetes (Davies *et al.* 2008, Deakin *et al.* 2006, He *et al.* 2017). A meta-analysis

by He *et al.* (2017) suggests self-management education can also reduce all-cause mortality risk. Structured education has glucose-lowering benefits and can improve confidence in self-management in people with insulin-treated T2DM (Hermanns *et al.* 2017, Houghton & Kay 2016).

NICE (2015) guidance advises that, if the initial HbA1c target of 48 mmol/mol (or individualised target) has not been reached at 3–6 months following diagnosis, then Metformin is the OHA of first choice. Metformin enhances endogenous insulin sensitivity by increasing peripheral utilisation of glucose and decreasing gluconeogenesis (Rena *et al.* 2013). Achieving glucose control early in the diagnosis is important. Paul *et al.* (2015) found that a one-year delay in treatment intensification among newly diagnosed T2DM patients was associated with a significantly increased risk of cardiovascular events. Similarly, Holman *et al.* (2008) reported the beneficial legacy effects of glucose lowering early in the diagnosis, in terms of preventing overall complications and reducing risk of death from any cause. Treatment with metformin can be intensified if HbA1c of 58 mmol/mol is not reached by adding additional OHAs to boost endogenous insulin, further enhance insulin sensitivity, or increase urinary glucose excretion and aid weight reduction. The injectable GLP-1 RAs can also reduce blood glucose and assist with weight loss (Drucker 2005, Geiger *et al.* 2012). However, owing to the progressive nature of diabetes with increasing beta-cell dysfunction leading to higher blood glucose levels, insulin therapy is generally required to achieve control. The next section presents a brief overview of insulin therapy in T2DM.

1.2 Insulin

Insulin is the oldest of the currently available blood glucose-lowering medicines and, therefore, the treatment with which we have the most clinical experience (Best & Scott 1923, Herring & Russell-Jones 2018). It is the most potent glucose-lowering medicine in T2DM; it can reduce HbA1c near or close to therapeutic targets; and there is no maximum dose beyond which a therapeutic effect will not occur, although risk of hypoglycaemia must always be considered if the therapy is to be used safely (Davies *et al.* 2018, Nathan *et al.*, 2009).

However, despite the therapeutic benefits of insulin, the commitment required to self-administer insulin and monitor blood glucose levels, in addition to the associated time and inconvenience involved, should not be underestimated (Davies *et al.* 2013). Moreover, people can experience side effects such as hypoglycaemia, pain, skin reactions, and weight gain (Barendse *et al.* 2012, Fisher *et al.* 2018, Fu *et al.* 2009, Haastrup *et al.* 2018, Herring & Russell-Jones 2018), which can impact negatively on treatment adherence and can increase the risk of mortality. These hazards have led to advances both in insulin delivery systems and in patient support.

Since insulin was first discovered in 1921, advances in development have led to the introduction of practical regimens and delivery systems, to improve usability and reduce side effects (Bretzel *et al.* 2008, Heise *et al.* 2000, Lipska *et al.* 2018). These developments include more sophisticated insulin regimens aimed at improving glycaemic control while helping to reduce risk of hypoglycaemia (Borgoño & Zinman 2012, Herring & Russell-Jones 2018). An in-depth examination of insulin use in T2DM will follow in the next chapter.

In summary, the number of patients with T2DM progressing to insulin will continue to increase as more people develop T2DM and most insulin management is undertaken by PNs and GPs. Insulin is currently the most potent glucose-lowering medicine and there are now practical insulin regimens and delivery systems to improve usability. Moreover, national guidelines, linked to GP QOF targets, include clear pathways for initiating and intensifying insulin therapy with agreed individualised HbA1c goals. Yet, despite evidence of its effectiveness in T2DM, many people receiving insulin have suboptimal control increasing their risks of diabetes complications (Harris *et al.* 2010, Khunti *et al.* 2016). Therefore, the intention of this study is to gain an understanding of the factors that may contribute to suboptimal glycaemic control in people with insulin-treated T2DM, and to help identify how the insulin support provided to this population can be enhanced.

1.3 Factors Impacting on Insulin Utilisation

To identify current knowledge and establish how the study could build on the evidence, a scoping review of the literature was conducted in 2014 to identify what is already known about the factors that may contribute to insulin utilisation in primary care. These factors relate to: the individual patient, the HCP, and their interaction with one another. A brief summary of the findings now follows.

1.3.1 Patient Factors

A number of factors were found to contribute to insulin utilisation and treatment adherence. Adherence to treatment refers not just to the act of taking medicines or injecting insulin but also the way it is administered including timing, frequency and dosage (Boas *et al.* 2014, Helena *et al.* 2008). Factors include polypharmacy, particularly in older people with multimorbidiy (Lee *et al.* 2006, Piette & Kerr 2006, Wolff *et al.* 2002), social factors, fear of hypoglycaemia and weight gain, disliking injections (Davies *et al.* 2013, Pontiroli *et al.* 2011), psychological factors (Brod *et al.* 2009, Khunti *et al.* 2013b, Polinski *et al.* 2013) and comorbid depression (Aikens *et al.* 2008, Lerman *et al.* 2009, Mollema *et al.* 2001, Woudenberg *et al.* 2012).

1.3.2 Healthcare Professional Factors

HCP-related factors impacting on insulin use broadly relate to clinical inertia, described as the failure to initiate or intensify treatment when indicated (Zafar *et al.* 2014), and insulin-related expertise. Clinical inertia can lead to collusion between HCP and patient to delay starting or intensifying insulin therapy, resulting in the continual increase in blood glucose levels (Goodall *et al.* 2009, Jeavons *et al.* 2006, Karter *et al.* 2010, Khunti *et al.* 2013a, Polinski *et al.* 2013). Clinician inexperience and knowledge of insulin types can be a barrier to progress patients to more intensive regimens (Polinkski *et al.* 2013). Conversely, PNs and GPs, with insulin-related skills will often communicate positively about the therapy and feel confident in supporting patients to intensify their insulin (Burden & Burden 2007, Goderis *et al.* 2009, Polinkski *et al.* 2013). However, the level of support is not always maintained following insulin initiation, as motivation of both HCP and patient declines (Dale *et al.* 2010).

1.3.3 Healthcare Professional–Patient Interaction

Finally, the interaction between patient and HCP can impact on the ability of patients to use their insulin. The use of effective communication with respect to trust and a patient-centred approach both have a positive contribution to insulin utilisation (Janes *et al.* 2013, Vinter-Repalust *et al.* 2004).

1.3.4 Summary

In summary, the scoping review identified multiple factors contributing to insulin utilisation and glycaemic control. However, few studies focused only on patients with T2DM already receiving insulin and whose insulin was managed primarily in UK general practices. Therefore, a better understanding was required using a holistic and systematic approach.

1.4 The Case for The Study

This section presents the rationale for the study, reflecting on the issues identified above, setting out the problem to be addressed and the study aim and objectives.

1.4.1 The Problem

Delivering effective insulin support to people with T2DM in primary care settings can be challenging. While there are many advantages to primary care-based insulin delivery for people with T2DM, there is often significant clinical inertia in the initiation of insulin and inadequate insulin intensification. In consequence, as discussed earlier, increasing numbers of individuals receiving insulin therapy have suboptimal glucose control. This study examines both patient-centred and healthcare delivery factors in relation to insulin use to provide an integrated assessment of which factors impact on insulin use in primary care to inform the development of a supportive intervention to enhance the use of insulin within this setting. While there have been some studies addressing these factors this study will build on those studies with an integrated analysis of both patient, professional and system level factors.

1.4.2 Building on Existing Knowledge

This study seeks to build on current knowledge by adopting additional perspectives that will enhance our understanding of insulin use in primary care settings.

This study focuses on people with T2DM who are already using insulin; there are relatively few studies with a unique focus on this population, as most studies have focused on people starting insulin. The potential insights generated by the study are further extended by the adoption of a multi-method approach. No other study could be found that used this approach in the context of the UK health system. The uses of multiple data sources, particularly the qualitative element, are important as few studies have included such data.

The potential of this study to add new insights on this topic is further strengthened by the inclusion of primary care professionals. Consideration of professionals' perspectives is important to expose any constraints on the current support provided and the interactions with care systems that may shape the provision of support. The study will provide useful insights into the competence, skills and wider factors that influence insulin care delivery. In addition, by including both patients and HCPs, it will be possible to consider how the interactions between them influence how people with T2DM use their insulin.

1.5 Study Aim, Objectives and Research Questions

This study was undertaken to add new knowledge on the problems associated with insulin use in patients with T2DM in primary care. The aim of the study was to identify factors associated with glycaemic control in people with T2DM treated with insulin from the perspectives of patients and HCPs. The study objectives were:

1. to determine barriers to insulin titration at the patient and HCP level;
2. to explore with patients their explanations for their current glycaemic control;
3. to elicit from patients, the reasons, behaviours and practices they believe contribute to their glycaemic control;
4. to explore specific beliefs and practices related to use of insulin;

5. to examine the association between insulin utilisation and patient-level factors in relation to glycaemic control;
6. to explore the attitudes and practices of PC HCPs in insulin management in T2DM;
7. to identify and explore system-level factors that contribute to insulin management in primary care; and
8. to consider the interaction between patients, professionals and system-level factors in insulin management in primary care.

1.5.1 Research Questions

The study was designed to address the following questions.

1. What are the associations between patient-level clinical and sociodemographic characteristics of patients with insulin-treated T2DM and glycaemic control?
2. What do patients understand about the need for insulin, managing their insulin and how active are they in undertaking this role?
3. What are the associations between patient insulin beliefs, psychosocial factors and glycaemic control in insulin-using people with T2DM?
4. How do patients perceive the insulin-related support they receive from their PNs and GPs?
5. What are the experiences, attitudes, confidence and skills of PNs and GPs in supporting insulin-receiving patients with T2DM?
6. How do system-level factors impact on the glycaemic control of patients with insulin-related T2DM?

1.6 Summary

Many people with T2DM treated with insulin have suboptimal control, with associated elevations in their risk of diabetes complications. Gaining new insights into the perspectives of both patients and HCPs may help to elicit explanations as to why this is the case. The insights generated from this study could help to identify new strategies for enhancing the insulin support provided for people with T2DM. The next chapter will examine the literature relevant to the study.

2. LITERATURE REVIEW

This chapter presents a review of the literature detailing current empirical knowledge and policy relevant to the conduct of the study. The chapter comprises the following:

- An overview of insulin therapy in type 2 diabetes (T2DM);
- Current clinical and policy guidance for the use of insulin in T2DM;
- A thematic synthesis of factors associated with insulin use in T2DM;
- A review of interventions to support people with T2DM to use their insulin.

2.1 Insulin Therapy In Type 2 Diabetes

In order to set the context for use of insulin in T2DM, consideration is given to the following areas: history of insulin therapy; development of insulin types; differences in insulin requirements in type 1 diabetes (T1DM) and T2DM; and insulin models used in T2DM.

2.1.1 Historical Overview of Insulin Therapy

Diabetes was recognised as a disease as early as 1550 BC but the link with the pancreas was identified later by Mering & Minkowski (1890) who induced a diabetic phenotype in dogs after pancreatectomy. The discovery of insulin was subsequently made in Canada by Frederick Banting and Charles Best in 1921. Following the successful therapeutic use of bovine insulin on a 14-year-old patient with T1DM, a commercially viable method was developed by extracting insulin from bovine and later porcine pancreases (Best & Scott 1923). Insulin therapy subsequently became widely available in North America and Europe to treat young people with insulin deficiency who previously faced almost certain death (Kirby 2009, Polonsky 2012). Its limited impact on the survival of those diagnosed at age fifty years or more was thought to be due to the high cardiovascular disease (CVD) mortality associated with late onset diabetes (Gale 2014).

2.1.2 Development of Insulin Types

In normal physiology, insulin has multiple secretory phases in maintaining glucose homeostasis. These phases can be organised into two main areas of

action: rapid insulin release to respond to elevated glucose in the fed state; and lower secretion in the non-fed state to sustain glucose bioavailability and prevent the expenditure of stored energy (Hirsch 2005). Hence, attempts have been made to modify manufactured insulin to provide both short-acting (and later rapid-acting) insulin and intermediate or long-acting insulins to cover these two phases.

The first insulins to be developed in the 1920s were short-acting insulins: these were injected subcutaneously, acting within 30–60 minutes, peaking between 1–4 hours but lasting up to nine hours (Joint Formulary Committee 2019). Slower, longer-acting insulins were introduced in the 1930s using protamine and zinc to prolong the glucose-lowering effects of regular porcine and bovine insulin (Hagedorn *et al.* 1936, Himsworth 1937, Lawrence & Archer 1936, Lawrence & Oakley 1953). In 1946, a neutral crystalline suspension of protamine insulin later known as Neutral Protamine Hagedorn (NPH) or isophane insulin, became available (Owens *et al.* 1984). NPH injected subcutaneously acts within 2–4 hours, peaks between 4–10 hours, and lasts 12–18 hours (Hirsch 2005). The later addition of zinc to protamine insulin (PZI) prolonged the action to at least 24 hours (Lawrence & Oakley 1953). As the production of NPH increased, the usage of zinc preparations gradually declined. People injected short-acting and intermediate-acting (or long-acting) insulin as either separate injections or by mixing short-acting with intermediate-acting insulin in the same syringe. Premixed formulations with fixed ratios were later developed combining the two types in vials and cartridges (Borgoño & Zinman 2012).

2.1.2.1 Human Insulin

Human insulin preparations, manufactured from recombinant DNA technology, became available in the 1980s (Borgoño & Zinman 2012). They were introduced to reduce immunogenicity, injection-site allergies and immune-mediated lipoatrophy observed in animal insulins. However, a Cochrane review found no clinically relevant differences between animal and human insulin (Richter & Neises 2005). Nevertheless, people were increasingly transferred to human insulin and the use of animal insulins declined.

2.1.2.2 Analogue insulins

Analogue insulins were introduced later to improve on the pharmacological properties of human insulin and better approximate endogenous insulin secretion to provide stable action with flexibility of injection timing (Hompesch *et al.* 2019). Rapid-acting analogue insulins, licensed in the 1990s, have a faster onset action than short-acting insulin, working within (depending on type) 2–20 minutes of injection, enabling them to be administered just before or up to 20 minutes after meals. They also have a shorter duration of 2–5 hours (Hirsch 2005, JFC 2018). Long-acting insulin analogues lasting up to, or longer than, 24 hours followed in 2000.

In terms of long-acting analogue types, their proposed advantages over NPH were their smooth, peakless profiles with prolonged duration, reduced risk of nocturnal hypoglycaemia, lower weight gain, and, in some, requirement for only once-daily administration (Davies *et al.* 2008, Horvath *et al.* 2007, Riddle *et al.* 2003, Rosenstock *et al.* 2008, Swinnen *et al.* 2011). Despite the proposed advantages, Horvath *et al.* (2007) found only minor clinical benefits compared with NPH in T2DM. This was later confirmed by Lipska *et al.* (2018) who found that analogues (detemir and glargine) were not associated with a reduced risk of hypoglycaemia-related emergency department (ED) visits or hospital admissions, or with improved glycaemic control. Their study did not include insulin degludec, which has a more consistent glucose-lowering effect beyond 42 hours with variable dosing intervals of 8–40 hours, and similar safety and efficacy profile as glargine (Goldman-Levine *et al.* 2013, Hollander *et al.* 2015, Meneghini *et al.* 2013). Glargine and degludec are also available as 300 units/ml and 200 units/ml respectively. The smaller volume might have some indication in highly insulin-resistant patients.

2.1.2.3 Injection Devices

The development of devices for insulin injections has advanced since the early reusable glass syringes which placed demands on the patient to clean and sterilise (Ahmann *et al.* 2014, Lewis 1949, Selam 2010). In T2DM, options include single-use syringes (rarely used now), pen devices (prefilled single use or refillable cartridge pens) and a prefilled device with a dial. Insulin pumps for

continuous subcutaneous insulin infusion are used in T1DM but rarely in T2DM as available data do not justify this (Monami *et al.* 2009). Insulin pen injectors, introduced in 1985, are now the most common device used in the UK (Selam 2010).

2.1.2.4 Blood Glucose Monitoring

Self-monitoring of blood glucose (SMBG) has advanced from the less informative urine glucose testing to the use of glucometers with innovative technology to assist patients to adjust their insulin dose appropriately (Gretton & Honeyman 2016, NICE 2015, Ong *et al.* 2014). Capillary glucose concentrations obtained by finger pricking or, more recently, by continuous glucose monitoring via skin sensors, are recorded on digitally enhanced glucometers which can be linked to and viewed on computers, mobile phones or online platforms by patients and healthcare professionals (HCPs) (Hanley *et al.* 2015, Hortensius *et al.* 2012). Glucometers with audible recordings are particularly helpful for visually impaired patients. Despite the new technologies and support from HCPs, many T2DM patients still find injecting insulin and performing SMBG to be inconvenient and burdensome (Mehmet *et al.* 2015, Ong *et al.* 2014).

2.1.3 Insulin Requirements in Type 2 Diabetes

This section reviews the pathophysiology of T2DM to identify the rationale for the current therapeutic insulin models.

2.1.3.1 Pathophysiology of Type 2 Diabetes

The distinction between insulin-sensitive and insulin-resistant diabetes was first made in the 1930s. Himsworth (1936) proposed that many patients with diabetes have insulin resistance rather than insulin deficiency. He described the differences between the insulin-sensitive type and the insulin-insensitive type, now known as T1DM and T2DM respectively. Unlike T1DM, with destruction of insulin-producing pancreatic beta cells thought to be immune-mediated (Atkinson *et al.* 2014), T2DM is a heterogeneous syndrome of polygenic origin involving both insulin resistance and defective insulin secretion (Henry 1998, Poitout & Robertson 2002). The disorder is progressive, with increasing insulin resistance and declining pancreatic beta-cell function (Barnett *et al.* 2008, Jones *et al.* 2010).

With the complex interplay of genetic and environmental factors, people with a family history of T2DM are 2–6 times more likely to develop the condition (Scott *et al.* 2014).

Progressive insulin resistance can start years before the onset of T2DM and is generally triggered by obesity, a major contributory factor, due to excessive calorie intake and sedentary lifestyles in genetically susceptible people (Gadsby 2002, Krebs & Parry-Strong 2013, Polonsky 2012). Hyperinsulinaemia occurs in the pre-diagnostic phase but diminishes over time, with patients subsequently being insulin-resistant and deficient (Gadsby 2002, Henry 1998). Once diabetes is established, chronic hyperglycaemia and hyperlipidaemia exert deleterious effects on beta-cell function further diminishing insulin production (Poitout & Robertson 2002). Glucotoxicity and lipotoxicity contribute over time to further deterioration of glucose homeostasis, hyperglycaemia and insulin deficit (Poitout & Robertson 2002, Polonsky 2012).

The pathogenesis of T2DM, therefore, indicates that though T2DM individuals may have hyperglycaemia, they will still have some circulating endogenous insulin, depending on their disease progression, comorbidities and age. Insulin requirements will also vary with older frail people requiring less (Andrews & O'Malley 2014, Tseng *et al.* 2014).

2.1.3.2 Exogenous Insulin Requirements

As endogenous insulin is normally secreted at two different rates – the background/basal rate and the prandial/bolus rate – to prevent the body from spending its stored energy (gluconeogenesis and glycolysis), basal insulin is secreted throughout the day. Bolus secretion is when a large surge of insulin is released by the beta cell triggered by a rising glucose level, usually related to the dietary consumption of energy (Hompesch *et al.* 2019, Jones *et al.* 2010). Therefore, basal secretion acts to suppress gluconeogenesis in the liver, the prandial (mealtime) insulin, to enable glucose uptake into peripheral tissues. The aim of exogenous insulin therapy is to approximate this physiological insulin profile, but can be challenging in T2DM as insulin resistance and requirements

can vary considerably between patients with risk of both hypoglycaemia and weight gain, which is undesirable (Boas *et al.* 2014, Borgoño & Zinman 2012).

In summary, the underlying pathogenic changes associated with T2DM mean that many patients become insulin requiring. This is generally established when oral hypoglycaemic agents (OHAs) fail to achieve adequate glycaemic control or if they are suffering from symptomatic hyperglycaemia (IDF 2017, Davies *et al.* 2018, NICE 2015). There are multiple models of insulin delivery in T2DM but generally patients start on basal insulin, depending on their needs. The next section examines the different insulin models used in T2DM and the underpinning evidence.

2.1.4 Insulin Models in Type 2 Diabetes

Diet remained the mainstay of T2DM treatment until the introduction of OHAs in the 1950s (Gale 2014). It was not until the 1980s that insulin therapy had an increasing role in T2DM and was influenced by the landmark United Kingdom Prospective Diabetes Study (UKPDS) running from 1977–1997 (Turner *et al.* 1983, Holman *et al.* 2008). Previously, there was little consensus about the most appropriate glucose-lowering therapy for use in T2DM (Knatterud *et al.* 1978, Turner *et al.* 1983). Now there are clear glucose-lowering pathways including the use of different insulin regimens (IDF 2012, Davies *et al.* 2018, NICE 2015), which are now examined.

2.1.4.1 Insulin as Monotherapy

While insulin is generally used in combination with other glucose-lowering medicines, there is some evidence indicating the benefits of insulin as a monotherapy. In the UKPDS study, Turner *et al.* (1999) randomised newly diagnosed T2DM patients to diet alone, long-acting or NPH insulin, sulfonylurea (SU), or metformin to target fasting plasma glucose (FPG) <6 mmol/L. Short-acting was added to basal insulin for hyperglycaemia. At nine years, basal insulin was superior at reducing FPG than diet or OHAs but not as effective in reducing glycated haemoglobin (HbA1c) as anticipated. The researchers concluded that most patients need multiple combined therapies to address post-prandial escalations and attain glycaemic targets in the longer term. The benefits of insulin

were confirmed in a later retrospective study by Evans *et al.* (2010), finding that patients with baseline HbA1c ≥8.5% switching from two OHAs to an insulin-based regimen achieved a 0.28% greater HbA1c reduction than increasing to three OHAs. The authors suggested that in routine practice, for patients with HbA1c >8.5%, further OHA escalation is unlikely to achieve an HbA1c ≤7.0%. While more types of OHAs and injectable therapies have since become available, the message here seems to be that insulin may be better introduced earlier and generally in combination with other therapies.

2.1.4.2 Insulin and Oral Combination Therapy

As suggested, insulin therapy is generally used in combination with different OHAs, but it should be noted that dietary and lifestyle measures remain a constant even when insulin is added (Boocock 2013). More recently, in the Diabetes Remission Clinical Trial (DiRECT) study, reduced calorie intake with weight loss in T2DM of less than six years duration, led to remission in more than a third of participants (Lean *et al.* 2019). The findings of a review by Goudswaard *et al.* (2004) showed that insulin–OHA combinations were generally superior to insulin monotherapy and reduced total insulin requirements. Metformin ± sulfonylureas and NPH resulted in statistically less weight gain compared with insulin alone and showed no significant difference in the frequency of hypoglycaemia. These and later studies (Van Avendonk & Rutten 2009) support the addition of a daily basal insulin to an OHA when insulin is required. There is now an increasing trend towards combining basal insulin with other OHAs such as dipeptidyl peptidase-4 inhibitors (DPP4is), sodium-glucose cotransporter-2 inhibitors (SGLT2is), or with glucagon-like peptide-1 receptor agonists (GLP-1 RAs) (Davies *et al.* 2018).

As discussed earlier, several basal insulin types are licensed for use in T2DM including NPH and long-acting analogues. While the use of long-acting insulin analogues in T2DM has increased significantly in recent years (Cohen & Carter 2010, NHS Digital 2018), there have been concerns regarding their clinical and cost-effectiveness in T2DM compared with NPH (Cameron *et al.* 2009, Horvath *et al.* 2007, Lipska *et al.* 2018). Therefore, when basal insulin is required, NPH continues to be recommended as first choice for the majority of T2DM patients.

2.1.4.3 Basal-Bolus Regimens

Basal-bolus or multiple daily injection (MDI) regimens aim to replicate the physiological profile of the healthy non-diabetic (Borgoño & Zinman 2012, Hompesch *et al.* 2019). The basal component consists of a once or twice-daily basal insulin while the bolus element comprises short-acting soluble or rapid-acting analogue prandial insulin to address post-prandial glucose escalations (Barnett *et al.* 2008, Owens 2013). Though more injections are required, basal-bolus regimens offer flexibility with timing of meals and dose-adjustment.

As diabetes progresses, patients already receiving basal insulin with OHAs can have stepwise intensification by adding and progressively increasing the number of prandial injections administered each day (Davidson *et al.* 2011, Raccah *et al.* 2017). This method can also reduce patient concerns associated with regimens requiring MDIs.

2.1.4.4 Premixed Insulin Regimens

The final regimen type is a premixed (biphasic) insulin regimen consisting of a combination of rapid-acting (or short-acting insulin) and intermediate-acting insulin (Janka *et al.* 2005, Holman *et al.* 2009, Koivisto *et al.* 2011). Premixed insulin regimens evolved from the need for patients to combine short and long-acting insulins using a syringe and vial (Oakley *et al.* 1966, Selam 2010). Various ratios of short-acting or rapid-acting to intermediate-acting are available (JFC 2019). Though usually administered twice a day at mealtimes, some are licensed for 1–3 times daily administration.

In a review comparing premix insulin with either OHAs, other insulin mixes, or long-acting insulin, Van Avendonk & Rutten (2009) reported that glycaemic control with premix insulin was generally better but was associated with more hypoglycaemic episodes. Analogue premix provided similar control but had lower post-prandial glucose levels compared with human premix, without increasing hypoglycaemia or weight gain. In the Treating to Target in T2DM (4-T) study (Holman *et al.* 2009), T2DM patients were randomised to receiving a twice-daily premix analogue, three-times daily rapid-acting prandial insulin, or once-daily (twice if required) basal analogue. A second insulin was added for unacceptable

hyperglycaemia. At three years, HbA1c levels were similar but with fewer hypoglycaemic episodes and less weight gain in the basal group. Anyanwagu *et al.* (2017) compared premix with basal-bolus regimens in both randomised controlled trial (RCT) and real-world settings. The study revealed greater reduction in HbA1c with basal-bolus than with premix insulin in both settings but the difference was more marked in the RCT than in real-world settings. This suggests some patients may prefer a less burdensome twice-daily premix insulin injections to a basal-bolus regimen.

2.1.4.5 Insulin Intensification

Insulin therapies demand constant adjustment and blood glucose monitoring to ensure they are safe and effective. Titration is particularly important following insulin initiation as patients are generally started on a low dose to reduce any risks of hypoglycaemia. This section presents some of the evidence of self-management by active dose titration.

Algorithms to support titration of insulin have become increasing available (Floyd *et al.* 1990, Khunti *et al.* 2013b, Ligthelm 2009, Meneghini *et al.* 2011, Riddle *et al.* 2003) using treat-to-target approaches. Khunti *et al.* (2013b) reviewed the numerous research-based algorithms, both physician and patient-driven, but some individuals may find these too complicated whereas an easily taught self-titrate protocol can allow more to self-titrate appropriately.

An RCT by Floyd *et al.* (1990) compared T2DM patients receiving lente or NPH insulin using a simple patient-led algorithm with physician-led adjustment. Mean HbA1c in the patient group became normal (defined as 5.5–8.5%) while remaining above this range in the physician-led group. In the 'AT.LANTUS' RCT, Davies et al. (2005) compared a physician-led four-step algorithm with weekly adjustments with a simple two-step patient-led algorithm with adjustments every three days. At 24 weeks, there was a significant HbA1c reduction with a greater decrease with the patient-led algorithm (-1.22 vs. -1.08%) and lower incidence of hypoglycaemia. While dose-adjustment systems can improve control, other contributory factors could have been the regular, frequent support in study conditions. Other trials supporting self-adjustment using basal analogues include

the ‘GOAL A1C’ (Glycemic Optimization with Algorithms and Labs at Point of Care) study (Kennedy *et al.* 2006) and the ‘PREDICTIVE’ (global, prospective observational study to evaluate insulin detemir treatment in types 1 and 2 diabetes) study (Lüddeke *et al.* 2007, Meneghini *et al.* 2007). Studies have also demonstrated effectiveness of self-titration of prandial insulin (Meneghini *et al.* 2011) and premixed regimens (Ligthelm 2009, Oyer *et al.* 2009). Despite the evidence, outside of studies, many patients do not adjust their insulin doses for a variety of reasons including lack of knowledge and HCP support, inconvenience, or fear of hypoglycaemia (Anyanwagu *et al.* 2017, Davies *et al.* 2013).

2.1.5 Summary of Insulin in Type 2 Diabetes

Insulin therapy has advanced considerably since it was first developed and has been proven to be effective in T2DM. It is increasingly initiated and intensified by Practice Nurses (PNs) and General Practitioners (GPs). When a decision is made to commence insulin, adding a basal insulin to OHAs is an appropriate starting point, later adding prandial insulin to address post-prandial hyperglycaemia. Research supports patient-led dose titration to achieve glucose targets, helping to reduce complications. Despite the advances, many T2DM patients still find injecting insulin, SMBG and dose-adjustment to be a challenge. Access to support by appropriately trained HCPs is critical to help ensure patients utilise their insulin treatment to optimal effect and further supports the basis for the study.

2.2 Current Clinical and Policy Guidance

An outline is now given of the clinical and national UK policy for insulin use in T2DM, underpinned by the National Institute for Health and Care Excellence (NICE 2015) guidelines. Reference is also made to other guidance (IDF 2013, Davies *et al.* 2018). This review includes the indication for starting insulin, preferred insulin regimens, and insulin intensification. The terms *good* or *optimal,* and *poor* or *suboptimal glycaemic control* included in the guidance are understood to mean the glucose level to aim for to prevent complications.

2.2.1 The Indication for Insulin Initiation

Current NICE (2015) guidance recommends starting insulin treatment when the HbA1c level is persistently ≥58 mmol/mol despite optimal OHAs, or at any stage when the person presents with symptomatic hyperglycaemia. The evidence upon which this recommendation is based relates to that accrued from large scale trials of glucose-lowering therapies. In the context of T2DM, the largest study to date was the UKPDS study (Stratton *et al.* 2000). Data from the UKPDS showed that intensifying glucose levels reduces diabetes complications. In a sub-analysis of the UKPDS data, Stratton *et al.* (2000) demonstrated that each 1% (11 mmol/mol) reduction in mean HbA1c was incrementally associated with reductions in risk of 21% for any diabetes-related endpoint, 21% for diabetes-related deaths, 14% for myocardial infarction and 37% for microvascular complications. It should be noted that the 1% reduction in mean HbA1c refers to the Diabetes Control and Complication Trial (DCCT) percentage and not the actual percentage. For example Stratton *et al.* (2000), is referring to a 1% (11 mmol/mol) reduction from a mean HbA1c of 9% (75 mmol/mol). Hence, until recently, optimal standards for glycaemic control to reduce the risk of complications were based on the levels achieved in the UKPDS, leading to the recommended treatment target of HbA1c ≤53 mmol/mol. The long-term follow-up data from the UKPDS have also demonstrated that the benefits of early intensive glucose-lowering are enduring, being sustained at 10-year follow up. Holman *et al.* (2008) found that, despite convergence in the glycaemic control levels in the intervention and control arms of the study at the end of the trial, a sustained legacy effect of intensive glucose control was observed with continuing lower micro and macrovascular complications and mortality in the intervention group.

However, subsequent to the UKPDS, other studies of glucose intensification in T2DM have raised questions about the safety and benefits of aiming for near-normal glucose concentrations. The Action to Control Cardiovascular Risk in Type 2 Diabetes (ACCORD) Study Group (2008) randomly assigned T2DM patients to intensive or standard therapy, targeting HbA1c to <6% (<42 mmol/mol) and 7–7.9% (53–63 mmol/mol) respectively. Fewer patients experienced cardiovascular events in the intensive group (352 *vs* 371) but with a higher mortality (257 *vs* 203) leading to an early discontinuation of intensive therapy. A

specific explanation for the hazard observed in this study was not identified, although sub-analysis of the data pointed to high levels of hypoglycaemia and weight gain in the intervention arm of the study as a result of the aggressive nature of the intervention and rapid reductions in glucose levels (Riddle 2010). In contrast, the ADVANCE Collaborative Group (2008) randomly assigned T2DM patients to standard or intensive glucose control to achieve HbA1c ≤6.5% (≤48 mmol/mol). At five years, mean HbA1c was 6.5% (48 mmol/mol) *vs* 7.3% (56 mmol/mol) respectively. The intensive group yielded a 10% relative reduction in combined major macrovascular and microvascular events (18% *vs* 20%) but this was primarily due to a 21% relative reduction in nephropathy.

Further concerns over the safety of aiming for normal glucose levels were raised in an observational study by Currie *et al.* (2010) who undertook a retrospective analysis of data (1986–2008) of patients receiving OHAs and those receiving insulin-based regimens. They found a U-shaped association of risk with both low and high HbA1c of 6.1–6.6% (43–49 mmol/mol) and 10.1–11.2% (87–99 mmol/mol) respectively. The researchers concluded that an HbA1c of approximately 7.5% (58 mmol/mol) was associated with lowest all-cause mortality and progression to large-vessel disease, although subsequent analyses have questioned the accuracy of these estimates (Forbes *et al.* 2017).

The net consequence of the findings of recent intensification trials and observational data have prompted the adoption of more individual targets that take a broader view of the relative hazards and benefits for each individual (Davies *et al.* 2018). Guidelines now suggest that less stringent targets are adopted, reflecting factors such as comorbidity, polypharmacy, frailty, older age, and ability to benefit dependent on anticipated life expectancy. Such considerations are viewed as being particularly important in older people with diabetes as they are more likely to have multimorbidity and polypharmacy with higher risk of hypoglycaemia particularly in renal insufficiency, and their ability to benefit in the longer term may be reduced (Tseng *et al.* 2014). The International Diabetes Federation (2013) suggested that, in younger people or functionally independent older people (aged ≥70 years), the target should be for HbA1c 53–

59 mmol/mol and in those with frailty or dementia, an HbA1c up to 70 mmol/mol is acceptable.

In terms of insulin initiation, an individualised, patient-centred approach should always be used. In those receiving optimal glucose-lowering therapy, this means considering starting insulin for younger healthy people, and older people with high functionality, when HbA1c level is ≥58 mmol/mol. For older people who are frail or have dementia (or younger people with multimorbidity and limited lifespan), insulin could be delayed until HbA1c is ≥70 mmol/mol. But insulin should be considered for any individual at any stage who presents with strong symptoms of hyperglycaemia.

2.2.2 Primary Care

The implementation of the guidance in primary care is largely driven by the Quality and Outcomes Framework (QOF) with linked HbA1c targets (BMA & NHSE 2015). As discussed earlier, this has further led to the shift of insulin initiation and management of patients with T2DM from hospital-based specialists to primary care where it is increasingly undertaken by PNs and GPs (Burden & Burden 2007, Chadder 2013, Dale *et al.* 2010, Ellis *et al.* 2011). The preferred choice of insulin therapy by NICE (2015) is outlined next.

2.2.2.1 Choice of Insulin Regimen

The preferred choice of insulin regimen is evidence-based, while considering overall patient benefits, preferences, and cost-effectiveness. For initiation, this is generally a once-daily NPH insulin. Metformin is continued while reviewing the continued need for other OHAs. A long-acting analogue insulin can be considered as an alternative if assistance is needed to inject, lifestyle is restricted by recurrent hypoglycaemia, or a twice-daily NPH insulin is needed. If HbA1c is ≥75 mmol/mol (≥9%), then a short-acting insulin can be started simultaneously either separately or as a premixed solution. A rapid-acting analogue insulin or an analogue-based biphasic preparation is an option if the person prefers injecting just before a meal or if hypoglycaemia is a problem. Patients commenced on a basal-only regimen should be monitored for the need to add a prandial-based insulin or change to a premixed regimen to address post-prandial glucose

escalations. Patients receiving biphasic insulin may require an additional prandial insulin or a change to a basal-bolus regimen.

2.2.2.2 Patient Education

UK policy favours a structured educational programme when insulin is started, with active dose titration. Within the context of general practice, this is generally given on a one-to-one basis by the PN or GP (Burden & Burden 2007, Dale *et al.* 2010). A comprehensive checklist of topics includes: injection technique; continuing telephone support; self-monitoring; dose titration to target levels with SMBG; dietary understanding; Driving and Vehicle Licensing Agency (DVLA) guidance; management of hypoglycaemia, management of acute changes in glucose control; and support from an appropriately trained experienced HCP. An integral part of insulin initiation and ongoing management is for patients to self-manage their insulin treatment with proactive support and access to help if needed.

2.2.3 Summary of National Policy

In summary, national UK policy for insulin use is led by NICE (2015). More PNs and GPs are initiating and managing insulin using local protocols based on the guidance, which is underpinned by a patient-centred approach with clinical and cost-effectiveness. The general HbA1c level for starting or intensifying insulin therapy is 58 mmol/mol using flexibility for people at high risk of hypoglycaemia or who would benefit less. In strongly symptomatic people, however, insulin-rescue therapy should be started at any stage. NPH insulin alongside metformin is the preferred starting regimen but a daily long-acting analogue can be considered. For those with higher HbA1c levels, a more intensive regimen is advised. Structured education is generally on a one-to-one basis with a requirement to give patients ongoing proactive support, to help them self-manage their insulin regimen. The next section describes a thematic synthesis of insulin use and support.

2.3 Thematic Synthesis of Factors Associated with Insulin Use In Type 2 Diabetes

In this section, a review and thematic synthesis of the views of people with insulin-treated T2DM and primary care healthcare professionals (PC HCPs) on insulin use and adherence is presented. A publication of this synthesis (Ellis *et al.* 2018) can be viewed in Appendix 16. The synthesis formed an integral part of the design of the study. It formed the basis of the conceptual framework and theoretical understanding underpinning the research question in seeking to understand the factors contributing to glycaemic control. The review was designed to address the following questions:

1. What are the perceptions and everyday experiences of people with T2DM in relation to insulin treatment use and supportive care?
2. What are the perceptions of PC HCPs of insulin treatment use and care for people with T2DM?
3. What potential patient–professional interactions impact on insulin use in T2DM?

2.3.1 Review method

A systematic literature search was used to identify studies that addressed the review questions. Included studies were subjected to a thematic synthesis to provide a deeper understanding of the themes identified. The synthesis was broadly based on the method of Thomas & Harden (2008).

Thematic synthesis is a process of identifying new insights by integrating data from original studies and is one of a range of methods for synthesising diverse forms of evidence (Dixon-Woods *et al.* 2005, Forbes & Griffiths 2002, Noblit & Hare 1988, Pedersen *et al.* 2011, Thomas & Harden 2008). Thematic synthesis generally refers to the integration of findings from qualitative studies but has also been used to integrate quantitative and qualitative research, including studies using descriptive or interpretive phenomenological approaches (Barley *et al.* 2011, Carroll 2017, Mold & Forbes 2013, Pedersen *et al.* 2011).

Thomas & Harden's (2008) approach was used as a framework for this synthesis, but with the inclusion of quantitative in addition to qualitative studies. There are three stages: the coding of text line-by-line; the development of descriptive themes; and the generation of analytical themes. The authors describe stage three as the equivalent stage in meta-ethnography: that is, the development of third-order interpretations which go beyond the content of original studies (Britten *et al.* 2002, Campbell *et al.* 2003). The review first progressed in three steps.

2.3.1.1 Step 1. Identification of Studies

Reports of qualitative and quantitative studies were sought from various publications including peer-reviewed journals, conference reports, and theses.

Inclusion Criteria:

Papers were required to report on studies of insulin-related experiences and/or perceptions of adults aged ≥18 years with insulin-treated T2DM or of PC HCPs. Publications were excluded if the focus was on insulin initiation. Study design eligibility included qualitative and descriptive quantitative studies such as surveys, including those with lower or unreported response rates.

Search Strategy

A protocol-based search was performed on 1 October 2014, updated on 31 March 2015, to retrieve articles from electronic databases including CINAHL, Cochrane Library, EMBASE, MEDLINE, PsycINFO and Web of Science. The search was structured by terms for: T2DM; insulin therapy; primary care; general practitioner; physician; and practice nurse. Discrete searches were also performed with terms for PC HCPs. There was no limit to the year of publication, but articles were required to be published in English. The electronic database search strategy is presented in Appendix 1. The search was supplemented with open web-based searches such as Google Scholar and EthOs; citation and key author searching; and hand searches of journals. The retrieved publications were downloaded to EndNote7 bibliographic software for screening.

Screening

Initial screening of titles and abstracts was undertaken, rejecting studies not fulfilling the inclusion criteria. Full-text versions of the remaining articles were then fully assessed for eligibility before the final selection. To help ensure lack of bias, the research student's academic supervisors reviewed the search strategy, studies generated, and final selection; and agreement was reached between the reviewers. In the absence of a standard guideline for reporting syntheses combining qualitative and quantitative studies, this report followed the principles of the ENTREQ (Enhancing Transparency in Reporting the Synthesis of Qualitative research) and PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidance (Moher *et al.* 2009, Tong *et al.* 2012) along with their checklists.

2.3.1.2 Step 2. Content Extraction and Appraisal

Key information was extracted from selected studies using standardised extraction tables (Cronin *et al.* 2008, Whiting 2009). Separate tables were used for the qualitative and quantitative studies, categorising studies with patients, HCPs, or with both patient and HCP participants.

Methodological quality and risk of bias for studies with qualitative designs were assessed using the Critical Appraisal Skills Programme (CASP 2014) checklist. CASP tools were selected because of their evidence-based approach and they were piloted with HCPs. There was a lack of a similar tool for observational studies; therefore, permission was sought and granted to use a checklist devised by Barley *et al.* (2011) based on the STROBE statement (von Elm *et al.* 2007) and assessment tools reviewed by Sanderson *et al.* (2007).

2.3.1.3 Step 3. Synthesis of the extracted content

A thematic synthesis of the included studies was undertaken in three stages.

Stage 1

Findings of the qualitative studies were scrutinised for concepts, themes and authors' interpretations relating to managing insulin-treated T2DM. Themes were

developed inductively, and the text coded manually. Next, the main themes from the quantitative studies were identified, and categorised separately.

Stage 2

Descriptive themes and sub-themes from the qualitative studies were inductively developed from the coded text and organised into two primary thematic frameworks, one for patients and the other for HCPs. The main finding clusters from the quantitative studies were then mapped onto these frameworks, to integrate themes from the different data sources.

Stage 3

Analytical themes were generated from the descriptive themes for patients and for HCPs to further address the aims of the review and identify areas for further research.

2.3.2 Findings

The searches identified 147 papers for screening, of which 70 were fully appraised for eligibility. Although the numbers retrieved were lower than anticipated, this was attributed to the inclusion criteria with its focus on perceptions of T2DM participants already established on insulin, and perspectives of HCPs based in primary care. Thirty-four of the screened studies fulfilled the inclusion criteria, with 36 being rejected with reasons (Table 1). Of the included studies, 12 used qualitative methodologies (nine with patient participants and three with HCPs) and 22 followed a survey design (14 with patient participants, three with HCPs and five with both patients and HCPs). Three of the surveys formed part of one multinational study (Brod *et al.* 2012a, Brod *et al.* 2012b, Leiter *et al.* 2014) and two were part of another (Peyrot *et al.* 2012a, Peyrot *et al.* 2012b). The selection process is shown in a PRISMA flow chart in Figure 1.

Table 1 Rejected Studies with Reasons

Author	Year	Reason for Rejection
Aloumanis	2013	The focus is on clinical outcomes rather than perceptions and experiences.
Bahrmann	2014	The focus is on psychological insulin resistance in insulin-naïve patients compared to those established on insulin.
Balkau	2012	The patient participants are insulin-naïve.
Beresford	2011	Insufficient data specific to insulin-treated T2DM.
Beverly	2012	Insufficient data specific to insulin-treated T2DM.
Brod	2013b	It was not possible to differentiate data specific to insulin-treated T2DM.
Carbone	2007	It was not possible to differentiate data specific to insulin-treated T2DM.
Chai	2012	Conference abstract only. No other data available.
Chai	2013	Conference poster only. No other data available.
Chai	2014	Conference abstract only. No other data available.
Chan	2014	The patient participants are insulin-naïve.
Choudhury	2014	It was not possible to differentiate data specific to insulin-treated T2DM.
Cramer & Pugh	2005	The focus is on insulin prescriptions issued and not on perceptions or experiences.
Gaborit	2011	The focus is on knowledge rather than experiences of insulin adjustment.
Hermanns	2010	The focus is on comparing barriers of insulin-naïve patients.
Hinder & Greenhalgh	2012	Insufficient data specific to insulin-treated T2DM.
Frei	2012	The focus is on clinical characteristics and demographics.
Hunt	1998	Insufficient data specific to insulin-treated T2DM.
Khattab	2010	The focus is on clinical characteristics and demographics.
Lai	2007	It was not possible to differentiate data specific to insulin-treated T2DM.
Lakkis	2013	The focus is on attitudes of clinicians towards initiating insulin.
Mollem	1996	It was not possible to differentiate data specific to insulin-treated T2DM.
Morris	2005	Patients only recently initiated with insulin therapy.

Author	Year	Reason for Rejection
Munro	2013	There is no information specific to insulin-treated T2DM.
Oliveria	2007	The focus is on patients who did not start or continue insulin therapy.
Peyrot	2005	Patient participants are insulin-naïve. Perceptions of clinicians relate to insulin initiation.
Peyrot	2006	Insufficient data specific to insulin-treated T2DM.
Peyrot	2013	Insufficient data specific to insulin-treated T2DM.
Pooley	2001	No data specific to insulin-treated T2DM.
Ritholz	2011	Insufficient data specific to insulin-treated T2DM.
Shiu & Wong	2000	It was not possible to differentiate data specific to insulin-treated T2DM.
Thomson	1991	The focus is on knowledge rather than experiences or perceptions of hypoglycaemia.
Wendel	2014	The focus is on incidence of hypoglycaemia and prescribing behaviour rather than perceptions of hypoglycaemia.
Wong	2011	Patients were insulin-naïve.
Yoshioka	2014	The focus is on insulin initiation.
Zafar	2015	Insufficient data specific to insulin-treated T2DM.

Key: T2DM = type 2 diabetes

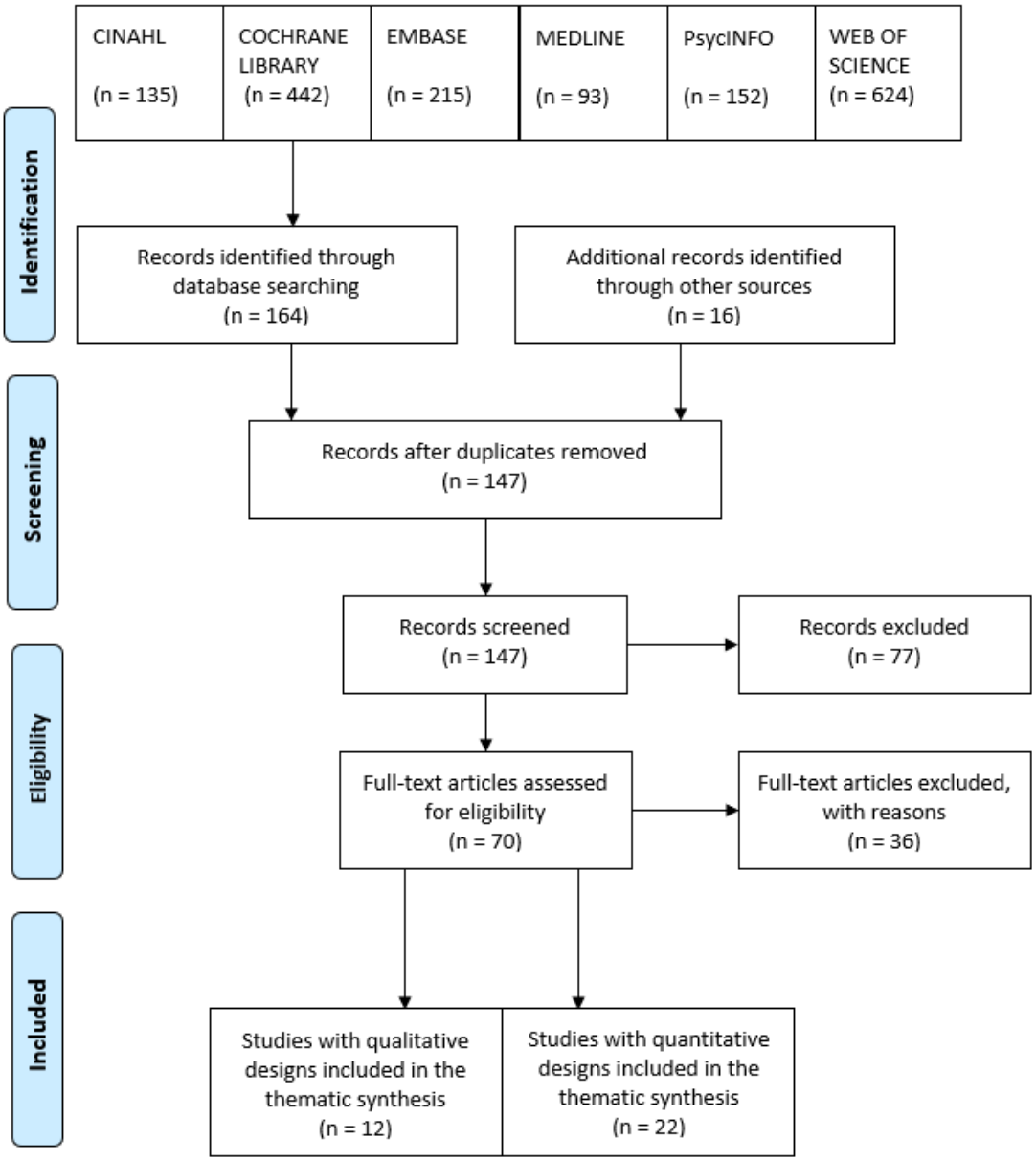


Figure 1 PRISMA Flow Diagram

2.3.2.1 Summary of the Selected Studies

Overview

The qualitative studies included data from 173 patients with insulin-treated T2DM, aged 23–90 years. The HCP studies included: GPs (*n* = 65); endocrinologists (*n* = 2); PNs (*n* = 8); diabetes nurse educators (*n* = 3); and pharmacists (*n* = 1). Their methodologies varied and included focus groups, and in-depth and semi-structured interviews conducted mainly face-to-face, with one study using both telephone interviews and focus groups. Most studies used a thematic, descriptive approach, with some using other methods such as grounded theory, theoretical frameworks, and interpretative phenomenological methods of enquiry.

Studies with a quantitative methodology were survey-based with mainly cross-sectional designs. Participants included: 13,476 patients with T2DM receiving insulin, aged 41–99 years; GPs (*n* = 4,176); diabetes consultants (*n* = 2,192); general physicians (*n* = 166); general nurses (*n* = 51); Diabetes Specialist Nurses (DSNs) (*n* = 50); and diabetes educators (*n* = 100). Most surveys were web-based with some undertaken as face-to-face questionnaires or by telephone.

A number of studies took place in multiple sites and in two or more countries. The qualitative research sites included: Asia (*n* = 4); Australia (*n* = 1); Europe (*n* = 7); New Zealand (*n* = 1); and North America (*n* = 1). Those of the quantitative studies included: Asia (*n* = 7); Australia (*n* = 1); Europe (*n* = 15); North America (*n* = 12); South America (*n* = 2); and South Africa (*n* = 1).

Critical Appraisal

The methodological and reporting quality of the qualitative studies were generally good with scores ranging from 8–10 (Table 2); the quantitative studies were of moderate strength with scores ranging from 3–7 (Table 3). Where available, the survey response rate was entered. Survey limitations included pharmaceutical company support, recruitment bias with sampling from research panels and self-selection in online surveys, and self-reporting of clinical data. However, it was decided to include the surveys because of their contribution to the overall themes of the synthesis. An overview of the qualitative studies is displayed in Table 4 and Table 5, while the surveys are summarised in Appendix 2.

Table 2 Qualitative Studies' Appraisal Scores using CASP (2013)

First Author (year) Score	Q1 Was there a clear statement of the aims of the research?	Q2 Is a qualitative methodology appropriate?	Q3 Was the research design appropriate to address the aims of the research?	Q4 Was the recruitment strategy appropriate to the aims of the research?	Q5 Was the data collected in a way that addressed the research issue?	Q6 Has the relationship between researcher and participants been adequately considered?	Q7 Have ethical issues been taken into consideration?	Q8 Was the data analysis sufficiently rigorous?	Q9 Is there a clear statement of findings?	Q10 How valuable is the research?
Abu Hassan (2013) 10/10	1	1	1	1	1	1	1	1	1	1
Brod (2014) 8/10	1	1	1	1	1	0	1	0	1	1
Brown (2007) 10/10	1	1	1	1	1	1	1	1	1	1
Browne (2013) 10/10	1	1	1	1	1	1	1	1	1	1
Goderis (2009) 9/10	1	1	1	1	1	1	0	1	1	1
Hortensius (2012) 9/10	1	1	1	1	1	0	1	1	1	1
Janes (2013) 10/10	1	1	1	1	1	1	1	1	1	1
Jeavons (2006) 9/10	1	1	1	1	1	1	0	1	1	1

First Author (year) Score	Q1 Was there a clear statement of the aims of the research?	Q2 Is a qualitative methodology appropriate?	Q3 Was the research design appropriate to address the aims of the research?	Q4 Was the recruitment strategy appropriate to the aims of the research?	Q5 Was the data collected in a way that addressed the research issue?	Q6 Has the relationship between researcher and participants been adequately considered?	Q7 Have ethical issues been taken into consideration?	Q8 Was the data analysis sufficiently rigorous?	Q9 Is there a clear statement of findings?	Q10 How valuable is the research?
Jenkins (2011) 10/10	1	1	1	1	1	1	1	1	1	1
Lee (2013) 10/10	1	1	1	1	1	1	1	1	1	1
Ong (2014) 10/10	1	1	1	1	1	1	1	1	1	1
Vinter-Repalust (2004) 9/10	1	1	1	1	1	0	1	1	1	1

Key: The score of 1 was given where the study answered most parts of the CASP question; CASP = Critical Appraisal Skills Programme.

Table 3 Quantitative Studies' Appraisal Scores using Barley's (2011) Tool

First Author (year) Score	Screening Question: Was there a clear aim?	Q1 Was the selection of the participants appropriate?	Q2 Was the measurement of variables appropriate?	Q3 Was there appropriate control of bias?	Q4 Was the use of statistics appropriate?	Q5 Was the study free of conflict of interest?	Q6 List any other limitations of the study
Ary (1986) 7/7	1	1	1	1	1	1	1
Brod (2012a) 3/7	1	RR Patients: 27.5% RR HCPs: 14% 0	0	1	1	0*	Self-reported hypo data
Brod (2012b) 3/7	1	RR Patients: 27.5% RR HCPs: 14% 0	0	1	1	0*	Self-reported dosing irregularities
Brod (2012c) 4/7	1	1	0	1	1	0*	Self-reported hypo data
Brod (2013a) 4/7	1	1	0	1	1	0*	Self-reported hypo data
Cefalu (2008) 4/7	1	1	0	0	1	0*	1
Cuddihy (2011) 4/7	1	1	0	1	0	0*	1
Diago-Cabezudo (2013) 4/7	1	1	0	0	1	0*	1
Fulcher (2014) 4/7	1	1	1	1	0	0*	Self-reported hypo data
Leiter (2005) 5/7	1	1	1	1	1	0*	Self-reported hypo data

First Author (year) Score	Screening Question: Was there a clear aim?	Q1 Was the selection of the participants appropriate?	Q2 Was the measurement of variables appropriate?	Q3 Was there appropriate control of bias?	Q4 Was the use of statistics appropriate?	Q5 Was the study free of conflict of interest?	Q6 List any other limitations of the study
Leiter (2014) 4/7	1	1	0	1	1	0*	Self-reported dosing irregularities
Mehmet (2015) 4/7	1	RR 100% 1	0	1	0	1	No information on funding or NHS Ethics
Mitchell (2013) 5/7	1	1	1	1	1	0*	Self-reported clinical data
Mollema (2001) 6/7	1	RR 49.5% 1	1	1	1	1	Self-reported clinical data
Mosnier-Pudar (2009) 6/7	1	RR 77% 1	1	1	1	0*	1
Peyrot (2012a) 4/7	1	1	0	1	1	0*	Self-reported adherence data
Peyrot (2012b) 4/7	1	1	0	1	1	0*	Self-reported adherence data
Rubin (2009) 4/7	1	1	0	1	1	0*	Self-reported clinical data
Shiu (2004) 7/7	1	RR 70% 1	1	1	1	1	1
Siminerio (2007) 5/7	1	1	0	1	1	0*	1
Van Avendonk (2009) 5/7	1	RR 42% 1	0	1	1	0*	1

First Author (year) Score	Screening Question: Was there a clear aim?	Q1 Was the selection of the participants appropriate?	Q2 Was the measurement of variables appropriate?	Q3 Was there appropriate control of bias?	Q4 Was the use of statistics appropriate?	Q5 Was the study free of conflict of interest?	Q6 List any other limitations of the study
Zambanini (1999) 6/7	1	1	1	0	1	1	1

*The study was supported and/or funded by a diabetes-related pharmaceutical or medical device company.
Key: RR = response rate (included if available); HCP = healthcare professional; Hypo = hypoglycaemia.

For all questions except Question 6, the score of 1 was given where the study answered most of the tool's question.
For Question 6, 1 = no other limitation.

Table 4 Overview of the Qualitative Studies with Patients

First Author	Year	Country	Diabetes Type	Aim	Sample and Setting	Data Collection	Data Analysis
Abu Hassan	2013	Malaysia	Insulin T2DM	To explore patients' reasons for accepting insulin and their initial barriers.	Patients with insulin T2DM (n=21) Primary Care Clinic	In-depth interviews Focus groups	Thematic analysis
Brod	2014	Canada, China & Germany	T1DM & Insulin T2DM	To examine unintentional insulin dosing and injection irregularities due to forgetting among people with diabetes.	Patients with T1DM (n=22) Insulin T2DM (n=42) At least twice in the last three months of forgetting injection, or time/amount taken, or questioning if insulin was taken. Research recruitment databases	Telephone interviews Focus groups	Thematic analysis with grounded theory
Brown	2007	UK	Insulin T2DM & Non-Insulin T2DM	To gain an understanding of how health beliefs influence how African-Caribbean's manage their T2DM.	T2DM adults (n=16) Insulin T2DM (n=6) Self-help groups and general practices Inner-city African-Caribbean community	In-depth interviews	Thematic analysis
Browne	2013	Australia	Insulin T2DM & Non-Insulin T2DM	To explore the social experiences of adults with T2DM, focusing on the perception &	T2DM adults (n=25) Insulin T2DM (n=5)	Semi-structured interviews	Thematic analysis with an inductive approach.

First Author	Year	Country	Diabetes Type	Aim	Sample and Setting	Data Collection	Data Analysis
				experience of diabetes-related stigma.	State diabetes organisation		
Hortensius	2012	Netherlands	T1DM & Insulin T2DM	To investigate patients' perspectives of SMBG & all relevant aspects influencing SMBG.	Insulin-treated diabetes patients (n=28) T1DM (n=13) T2DM (n=15) Outpatient clinic (T1DM) General practices (T2DM)	In-depth interviews	Thematic analysis with grounded theory.
Janes	2013	New Zealand	Insulin T2DM	To better understand barriers to glycaemic control from the patient's perspective.	Insulin-treated patients T2DM (n=15) Diabetes clinic	Semi-structured interviews .	Thematic synthesis with a patient-centred framework. Interpretative phenomenological method of enquiry
Jenkins	2011	UK and Ireland	Insulin T2DM	To explore participants' experiences of intensifying insulin therapy during the Treating to Target in T2DM (4-T) trial.	T2DM patients (n=41) Whose insulin was intensified in 4-T trial. Primary care	In-depth interviews	Thematic analysis with grounded theory.

First Author	Year	Country	Diabetes Type	Aim	Sample and Setting	Data Collection	Data Analysis
Ong	2014	Malaysia	Insulin T2DM	To explore the barriers and facilitators to SMBG, in insulin T2DM patients.	Insulin-treated T2DM patients (n=15) Primary care clinic	Semi-structured interviews	Thematic analysis
Vinter-Repalust	2004	Croatia	Insulin T2DM & Non-insulin T2DM	To explore patients' attitudes, thoughts, & fears of their illness; expectations of the healthcare system; and problems while adhering to the therapeutic regimen.	Patients with T2DM (n=49) Insulin T2DM (n=13) General practice	Focus group discussions.	Inductive thematic analysis

Key: SMBG = self-monitoring of blood glucose; T1DM = type 1 diabetes; T2DM = type 2 diabetes; Insulin T2DM = insulin-treated type 2 diabetes.

Table 5 Overview of the Qualitative Studies with HCPs

First Author	Year	Country	Aim	Sample and Setting	Data Collection	Data Analysis
Goderis	2009	Belgium	To evaluate barriers and facilitators to high-quality diabetes care by GPs participating in a quality improvement programme promoting compliance with international guidance.	GPs participating in the programme (n=20) General Practice .	Semi-structured interviews	Thematic analysis with an implementation and behavioural change model.
Jeavons	2006	UK	To determine doctors' and nurses' attitudes and beliefs on treating T2DM with less than ideal control.	GPs (n=15) Practice Nurses (n=8) General Practice	Focus groups .	Thematic analysis with grounded theory.
Lee	2013	Malaysia	To explore the views of Malaysian healthcare professionals on the barriers faced by patients using insulin.	Primary care doctors (n=20) Family medicine specialists (n=10) Policymakers (n=5) Diabetes educators (n=3) Endocrinologists (n=2) Pharmacist (n=1) Primary and secondary care	In-depth interviews Focus group discussions	Thematic analysis

Key: GP = General Practitioner; HCP = healthcare professional; T2DM = type 2 diabetes.

Integrated Themes

In total, 12 themes with 46 sub-themes from the patient studies and 14 themes with 54 sub-themes from the HCP studies were included in the primary thematic frameworks. The mapping of the themes across the studies are included in Appendix 3. The synthesis integrated the two thematic frameworks to form 12 primary themes expressed in three domains: patient perceptions; HCP perceptions; and HCP–patient relationships. Figure 2 illustrates the organisation of the themes.

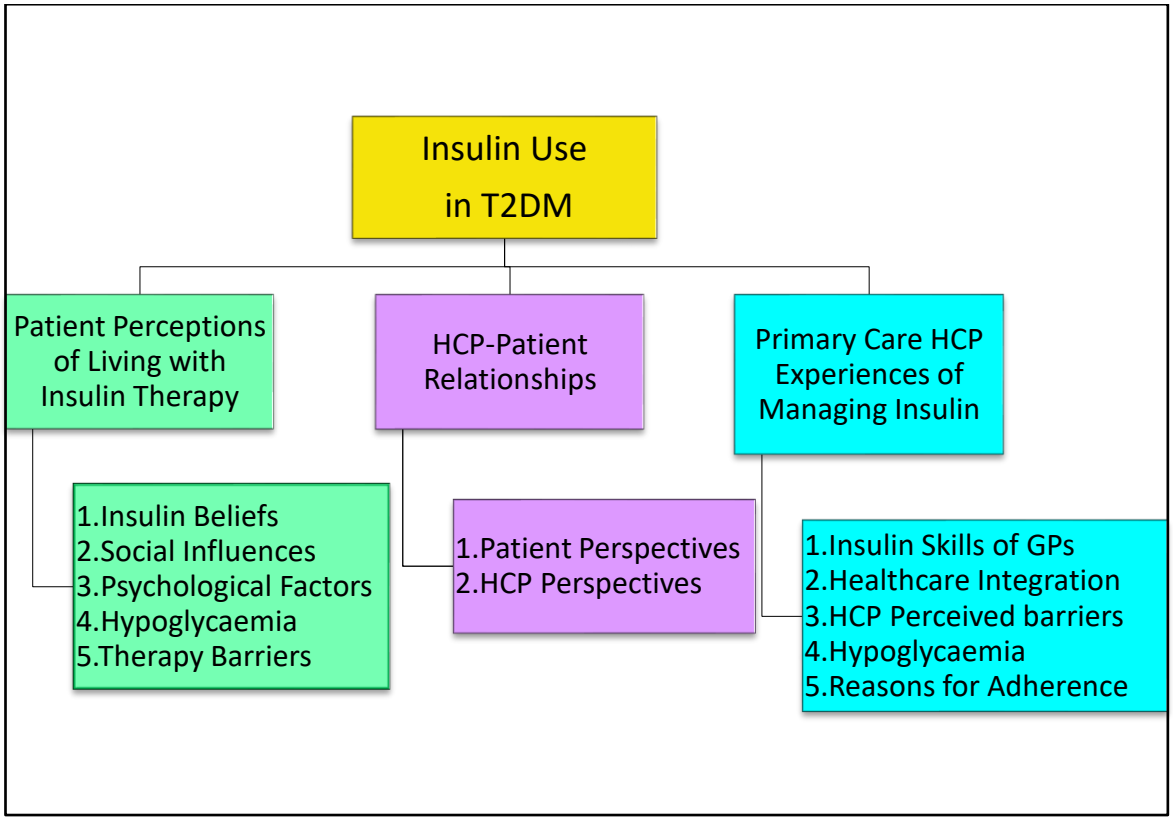


Figure 2 The 12 Primary Themes
Key: GPs = General Practitioners; HCP = healthcare professional; T2DM = type 2 diabetes.

The themes for each domain are described next with linkage to the source data from qualitative studies (with participant comments) and from surveys (which are identified). Each theme was associated with insulin use, adherence and support. The wider understanding of adherence was used, applying not only to whether or not an insulin injection was administered, but also to whether the dose or timing was appropriate and, if the insulin injection was missed, the reasons why (Boas *et al.* 2014, Davies *et al.* 2013).

2.3.2.2 Domain 1. Patient Perceptions and Experiences

This domain consists of the findings related to patient perceptions and experiences of insulin therapy. It comprises five identified themes associated with insulin adherence which are illustrated in Figure 3. These were drawn from 28 publications, nine of which used a qualitative methodology.

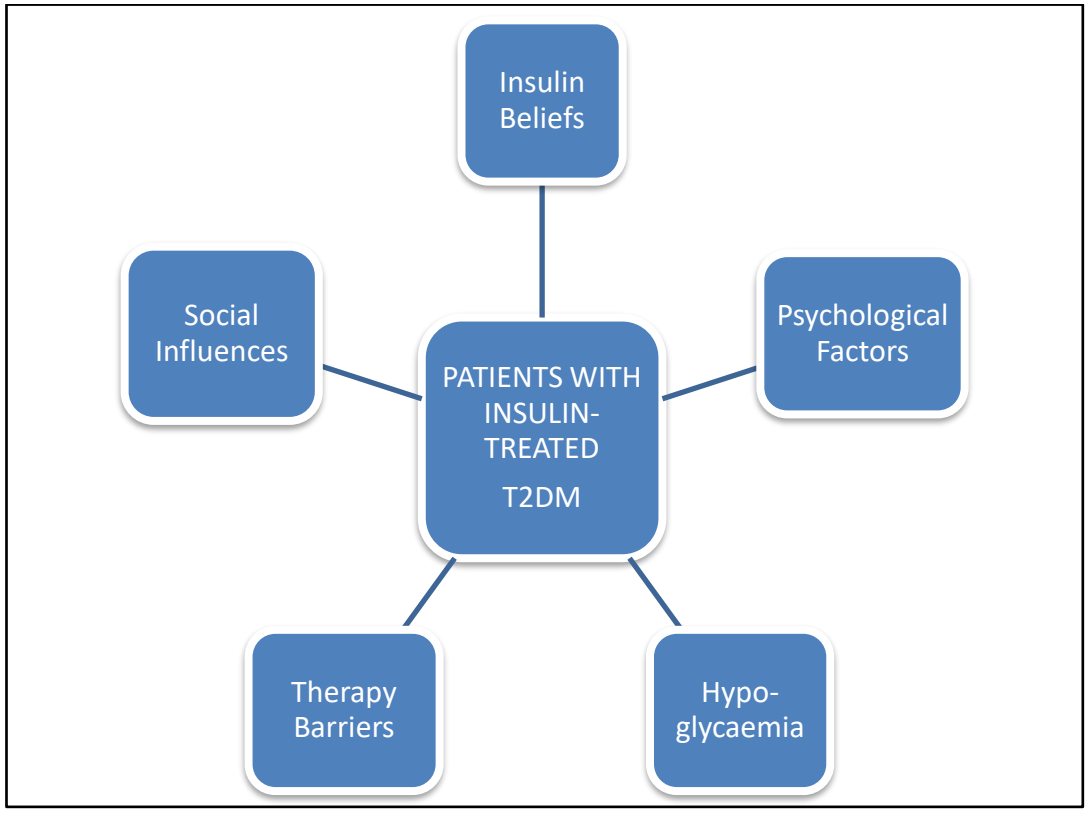


Figure 3 Patient perspectives: for managing insulin
Key: T2DM = type 2 diabetes.

Theme 1. Insulin-Related Beliefs

The data showed that a patient's beliefs about insulin can mediate their orientation to using insulin. These beliefs include illness severity, cultural beliefs, and insulin-specific beliefs.

Illness Severity

Many patients reported that when insulin was first suggested, they believed it meant their diabetes had suddenly become very serious (Abu Hassan *et al.* 2013, Brown *et al.* 2007, Janes *et al.* 2013). One patient receiving insulin for three years said:

> *"My friends and siblings told me that people who received insulin were very serious. They might die soon."* (Abu Hassan *et al.* 2013)

Another reported:

> *"…I felt like once you hit insulin you are on a slide to … you know [death]."* [Participant 13] (Janes *et al.* 2013)

Survey respondents also described their perceived seriousness of the condition (Mosnier-Pudar *et al.* 2009).

Cultural Beliefs

Cultural beliefs can influence insulin adherence negatively, particularly when cultural traditions conflicted with underlying constructions about what insulin was and how diabetes should be treated (Abu Hassan *et al.* 2013, Brown *et al.* 2007, Janes *et al.* 2013). These cultural beliefs can lead patients to consider insulin as being unnecessary. One patient from a UK African-Caribbean community said:

> *"I'm telling you I've known people take insulin here and they go back to the Caribbean and don't take insulin.… they don't have the pollution that you have here, your body perspires more so all the impurities or all the stuff that it retains in your body keeps coming out…"* [Interview 16] (Brown *et al.* 2007)

Janes *et al.* (2013) described one insulin-receiving patient whose cultural beliefs were in direct conflict with using drugs and needles. She preferred to rely on traditional Maori beliefs and medicinal plants for healing:

> *"The body is tapu [restricted]… it makes me not like poking holes in it [with needles]"* [Participant 13]

Theme 2. Social Influences

The ability of many participants to continue to administer their insulin each day was affected by social influences including social stigma, family and friends, economics, work, and social activities.

Stigma

Perceived stigma relating to injecting in public was associated with reduced insulin adherence (Abu Hassan *et al.* 2013, Browne *et al.* 2013, Janes *et al.* 2013, Jenkins *et al.* 2011, Mehmet *et al.* 2015, Ong *et al.* 2014). For some, this stigma was reflected in the belief that others perceived injecting insulin as being associated with drug addiction (Abu Hassan *et al.* 2013, Janes *et al.* 2013, Jenkins *et al.* 2011):

> *"Our society is quite ignorant of insulin therapy and they might associate insulin injection with drug addicts"* [2 years of insulin use] (Abu Hassan *et al.* 2013)

Perceived stigma brought about by injecting in public was associated with poorer insulin adherence for some (Abu Hasan *et al.* 2013, Browne *et al.* 2013, Janes *et al.* 2013, Jenkins *et al.* 2011, Mehmet *et al.* 2015, Ong *et al.* 2014). In the 4-T study, Jenkins *et al.* (2011) observed that reduced adherence was not a result of increasing the number of daily injections per se; rather, it reflected the increased likelihood of having to inject in public. Of the T2DM patients (*n* = 27) in Mehmet *et al.'s* survey (2015), the majority (*n* = 20) also experienced problems injecting in public, the main reason being worry about upsetting or offending others. Patients developed various strategies to adjust for this stigma:

> *"If I go out with anybody I always go and do it (inject) in the toilet. I won't ever do it outside*." [Participant 26] (Jenkins *et al.* 2011)

Family and Friends

Patients were influenced by family and friends in managing their insulin (Abu Hassan *et al.* 2013, Janes *et al.* 2013, Ong *et al.* 2014, Vinter-Repalust *et al.* 2004). For some, this created barriers to use as they would have to adapt to the requirements and routines of the family over mealtimes and when they could inject. In contrast, others identified the potentially positive influence of family support and guidance (Abu Hassan *et al.* 2013). Contact with other people using insulin could also be beneficial as patients could observe how they coped with, and benefited from, insulin (Abu Hassan *et al.* 2013):

> *"I always refer to these two 'specialists' (my father and older brother who are on insulin) when it comes to insulin"* [6 years of insulin use]

> *"I gained a lot of knowledge from self-reading and relatives who are on insulin"* [2 years of insulin use]

Some family members played a practical role:

> *"He [husband] helps me, helps me to test the blood sugar, helps me to inject insulin at night. I can't do it on my own."* [Patient 12, age 71 years] (Ong *et al.* 2014)

Economic Burden

Economic factors (such as cost of blood-testing strips, loss of earnings, and employment disruption) were associated with attending clinic appointments to support insulin use (Janes *et al.* 2013, Ong *et al.* 2014, Vinter-Repalust *et al.* 2004).

> *"Cost is a problem. If I went to the doctor plus medication, that was my week's pay gone."* [Participant 15, 8 years of insulin use] (Janes *et al.* 2013)

Some experienced difficulties following their insulin regimen at work, especially working shifts or finding somewhere private to inject. Others felt supported by their co-workers (Janes *et al.* 2013, Vinter-Repalust *et al.* 2004).

> *"I would come off an '18 hour' and the day-shift boss would ring me up, says, 'hey, can you come in and do a couple of hours, bro.'… Insulin was not easy to take and you would pop it in, but no, I had to wait between shifts like smoko or lunchtime*." [Participant 11 changing shifts at the meat-works] (Janes *et al.* 2013)

Social Activities

The impact of insulin use on travel, leisure, and social activities was perceived negatively by patients (Abu Hassan *et al.* 2013, Ary *et al.* 1986, Brown *et al.* 2007,

Browne *et al.* 2013, Hortensius *et al.* 2012, Janes *et al.* 2013, Jenkins *et al.* 2011), as it restricted their social interactions and influenced their insulin injecting behaviours when in social settings:

> *"I wouldn't go out to lunch with them (friends) and in the end I had to tell them why. I said, 'I can't. I have got to have insulin. And I am not going to go into a toilet'."* [Participant 23] (Jenkins *et al.* 2011)

Theme 3. Psychological Factors

Psychological factors related to fear and anxiety, shame and depression. These often led to barriers to injecting insulin.

Fear

Fear and anxiety about hypoglycaemia (see Theme 4), injection pain, and weight gain were perceived by many individuals as significant mediators in insulin utilisation (Abu Hassan *et al.* 2013, Brod *et al.* 2014, Brown *et al.* 2007, Hortensius *et al.* 2012, Janes *et al.* 2013, Ong *et al.* 2014, Vinter-Repalust *et al.* 2004, Zambini *et al.* 1999), including survey participants (Cefalu *et al.* 2008, Mollema *et al.* 2001, Rubin *et al.* 2009). In Zambini *et al.*'s (1999) survey, of T2DM patients (n = 35), 14% identified anxiety as a factor in avoiding injections and 29% expressed concern at having to inject more frequently.

> *"I am scared of needle…you know, the poking itself, it is painful...using needle some more, and you poke yourself... it is painful."* [3 years of insulin use] (Abu Hassan *et al.* 2013)

Shame

Feelings of shame and self-blame were evident in some participant accounts (Browne *et al.* 2013, Janes *et al.* 2013). These feelings were linked to the perceptions that they had somehow caused their disease and that their need for insulin was because they had not properly controlled their diabetes:

> *"A good diabetic is one who controls their diabetes …I am not a good diabetic."* [Participant 7, 3 years of insulin use] (Janes *et al.* 2013)

Depression

Negative emotions such as depression also impacted on insulin use. Mollema *et al.'s* (2001) survey found an association between reduced insulin injecting adherence and blood glucose monitoring, and higher levels of anxiety and depression in insulin-treated T2DM individuals. These patients also reported more fear of hypoglycaemia and higher levels of diabetes-related distress, with 11% showing major depression. In the qualitative studies, negative emotions were often identified in the context of low patient activation in relation to self-management:

> *"In that period of depression I was just happy when I felt good and that things were moving again, and that I could do my job again …and for me that was enough. The diabetes just wasn't that important for me. I actually made the choice to just let it be there for what it was."* (Hortensius *et al.* 2012)

Theme 4. Hypoglycaemia

Hypoglycaemia was identified in survey participants as a key barrier and concern for patients with impact on their emotional state, daily functioning and engagement with insulin (Brod *et al.* 2012a, Brod *et al.* 2012c, Brod *et al.* 2013a, Diago-Cabezudo *et al.* 2013, Fulcher *et al.* 2014, Leiter 2005, Leiter *et al.* 2014, Mitchell *et al.* 2013, Shiu 2004). In consequence, patients reported injecting smaller doses to keep their blood glucose elevated. The survey studies identified that a fear of hypoglycaemia was common and associated with reduced adherence (Brod *et al.* 2012a, Brod *et al.* 2012c, Leiter *et al.* 2005). The patient accounts in the qualitative studies gave many examples of these behavioural responses to hypoglycaemia:

> *"When I am hypoglycaemic, I feel wretched. ... I don't really have a problem with high sugar levels, but the low ones are quite bothersome."* (Hortensius *et al.* 2012)

> *"to avoid hypos… I won't have my insulin"* [Participant 4] (Janes *et al.* 2013).

Theme 5. Therapy Barriers

The inherent complexities of using and managing insulin were found to impede insulin adherence in several surveys (Ary *et al.* 1986, Brod *et al.* 2012b, Mosnier-Pudar *et al.* 2009, Peyrot *et al.* 2012a); these reported associations between insulin non-adherence and practical barriers, injection difficulties and regimen inflexibility.

Injection Omission

Peyrot *et al.* (2012a & 2012b) found that insulin omission/non-adherence was common and was associated with practical barriers, injection difficulties and regimen inflexibility. Reasons reported by insulin-treated T2DM patients for missing injections in a survey by Ary *et al.* (1986) included being too busy (12%), forgetting (12%), negative physical reasons (12%), and non-supportive and challenging conditions (37.5%). Patients remembering whether they had taken their insulin was another factor, with people omitting injections if they were unsure whether they had taken them or not. One patient observed:

> *"I am type 2 and when I forget my insulin in the morning, then I skip it and take my next insulin with my next meal."* (Brod *et al.* 2014)

SMBG

The challenges associated with sustaining regular SMBG were also identified as impeding insulin behaviours (Hortensius *et al.* 2012, Ong *et al.* 2014). Some patients reduced SMBG once they had established a dose that they felt was right for them, such that they could not monitor any changes in their insulin requirement:

> *"Beginning [SMBG] yes, beginning very keen, now no. I'm just simply lazy to do it."* [P06] (Ong *et al.* 2014)

Hortensius *et al.* (2012) explained how patients' perceptions of SMBG ranged along a continuum from "friend" to "foe". Some described how it helped their insulin use to achieve personal goals, undertaking SMBG frequently to make the required dose-adjustments, and detect hypoglycaemia. Others perceived this as a burden.

> *"During December, nothing [SMBG not done], I dare not [participant laughed], I dare not check, because I was also eating sweets. I was also having a little bit of wine."* [P01] (Ong *et al.* 2014)

Insulin Titration

A further area of therapy complexity relates to dose titration and adjustment of insulin. Five qualitative studies (Brod *et al.* 2014, Hortensius *et al.* 2012, Jenkins *et al.* 2011, Ong *et al.* 2014, Vinter-Repalust *et al.* 2004) and several quantitative ones reported that patients struggled with this aspect, often ignoring titration instructions or adopting their own approach. There was some divergence between patients as to whether they wanted the HCP to make insulin changes or whether they preferred to control it themselves:

> *"I never change the therapy my doctor prescribed! I trust him, that's his job, not mine!"* [67-year-old woman] (Vinter-Repalust *et al.* 2004)

One patient became more confident after receiving appropriate HCP support (Vinter-Repalust *et al.* 2004):

> *"At first I was very afraid about changing my dosage of insulin. But then my doctor explained to me how... In the beginning, I used to call him, but now I frequently change the dosage on the basis of my own physical activity, diet, and sugar levels."* [55-year-old woman] (Vinter-Repalust *et al.* 2004)

Jenkins *et al.* (2011) found that, while patients were recommended to use a treat-to-target dose titration algorithm with HCP support, they did not always follow these recommendations. Some patients experienced tension between their goals and those of their HCP, believing professionals focused more on strict control whereas patients had to balance this with their own quality of life (QOL) (Hortensius *et al.* 2012).

Summary of Patient Perceptions

Most themes related to barriers to insulin use. Insulin beliefs had negative associations for a number of patients, with the perception that being prescribed

insulin meant their diabetes was very serious. Cultural factors led to some using traditional therapies instead of, or as well as, insulin. Injecting in public was a significant social barrier for many. While the influence of family and friends was perceived by some as problematic, others benefited. Associated costs, employment restrictions, and work-shift patterns, could impact negatively on insulin use. A range of negative emotions including fear and anxiety and worries about hypoglycaemia played a central role in insulin utilisation. Administering insulin was a challenge with subsequent missed injections followed by a range of corrective actions. Finally, SMBG and dose-adjustment was undertaken in a variety of ways, and with varying levels of adherence with insulin use in general. The perspectives of PC HCPs are examined next.

2.3.2.3 Domain 2. Primary Care Healthcare Professional Perspectives

Eleven publications reported studies with HCP participants of which three adopted a qualitative approach. Five key themes emerged (Figure 4).

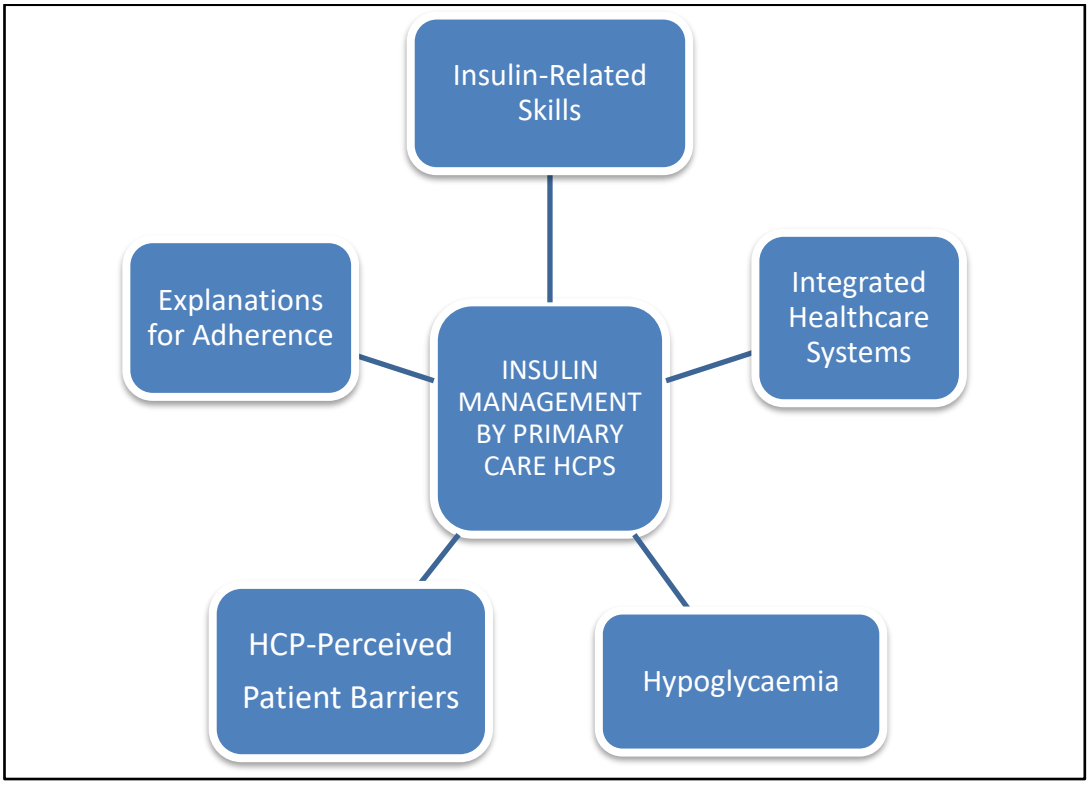


Figure 4 Insulin management by Primary Care Healthcare Professionals
Key: HCPs = healthcare professionals.

Theme 1. Insulin-Related Skills

This theme relates to the skills required by PC HCPs to initiate and intensify insulin therapy, and to provide ongoing support for patients. While many HCPs were positive about helping patients to manage insulin, others felt they lacked the skills to do so effectively (Goderis *et al.* 2009, Jeavons *et al.* 2006). They believed insulin-related training was important, but also wanted ongoing support from a diabetes specialist. GP attitudes seemed to change when they had acquired insulin-related skills, increasing their motivation and confidence in supporting patients:

> *"My attitude about insulin therapy onset has changed. Before the start of the project, I tried too long oral antidiabetics, but the courses have changed my attitude. I became confident in starting insulin therapy, whereas before I would never initiate insulin therapy."* [GP12] (Goderis *et al.* 2009)

However, some GPs felt excluded by specialists who they believed wanted to continue to manage insulin-treated patients themselves:

> *"Specialists gain too much control of referred patients and often exclude GPs from direct patient care. This is especially true of patients on insulin who get free instructions and monitoring kits at the diabetes centres, unlike patients in primary care. So, it's nearly impossible for GPs to hold on to patients on insulin*." [GP1] (Goderis *et al.* 2009)

In one survey (Cuddihy *et al.* 2011), there was disagreement regarding who was responsible for intensification, but most diabetes specialists and primary care physicians (PCPs) agreed that doctors in primary care should become more involved in managing insulin. In another (Siminerio *et al.* 2007), nurses and physicians concurred that nurses should take a larger role in managing diabetes.

Theme 2. Healthcare Integration

The level of integration between the different components of the healthcare system was identified as playing a key role in how patients were supported in using insulin (Goderis *et al.* 2009, Jeavons *et al.* 2006). This GP reported how a

quality improvement programme (QIP) incorporating integration improved work satisfaction and care:

> *"This is a big change from the usual 'let us do our work; after all we are the specialists and you may help a little bit'. We collaborate as one team – there's mutual support! We're on the same wavelength and feel we work together toward the same objectives."* [GP13] (Goderis *et al.* 2009)

Better integration between primary and secondary care was considered by most physicians in an international survey (Cuddihy *et al.* 2011) as one of the most important factors in improving insulin treatment in T2DM. When there is a failure of integration, PC HCPs may lose the clinical interaction with patients and feel somewhat redundant:

> *"The trouble that I've found is that when they're [patients] on [insulin], I don't know what's happening. In fact, sometimes they don't want to see me. They just come and collect medicine. Then I say, 'Hey, haven't seen you for a long time, what happened?'"* [GP] (Lee *et al.* 2013)

The systems in which PC HCPs worked influenced how involved they were in insulin management. GPs and PNs identified that a lack of resources and familiarity with starting and managing insulin impacted negatively on the insulin support they could provide (Jeavons *et al.* 2006). One large Dutch survey of GPs (*n* = 1,621) by Van Avendonk *et al.* (2009) found that it was the more structured practices who employed a PN with a designated Diabetes Clinic who were more likely to manage insulin therapy themselves rather than refer patients to diabetes specialists.

Theme 3. Healthcare Professional Perceptions of Patient Barriers

HCPs reported that patient-level factors heavily influenced insulin use, echoing many of those voiced by patients, including beliefs, culture, economics and psychological barriers. Additionally, they believed that patient education impacted positively on insulin use (Goderis *et al.* 2009, Jeavons *et al.* 2006, Lee *et al.* 2013).

Beliefs

HCPs felt that, for patients, insulin treatment represented failure and a more serious stage of the illness:

> *"I think probably they think it's the end, that's it, there's nothing else they can have after that*." [PC HCP] (Jeavons *et al.* 2006)

They also identified how patients often altered their insulin behaviours subjectively based on how they felt, rather than by following their targets (Lee *et al.* 2013).

Culture

Some HCPs found it challenging when dealing with patients from different ethnic backgrounds. They reported how some cultural beliefs created barriers to insulin use:

> *"We see patients twice a year and the family and friends are there all the time, you know, I mean, we are supposed to be more powerful figures, but I mean, it's quite difficult to overcome very different beliefs within the family."* [PC HCP] (Jeavons *et al.* 2006)

Cost

HCPs perceived that SMBG for insulin optimisation was moderated by fear and that, in some countries, cost was an important consideration (Lee *et al.* 2013):

> *"Those who can afford, also don't see that it's important to invest on the glucometer … When we talk about meter and everything, you have to talk about fear of pricking. That's another barrier."* [Family medicine specialist]

> *"How come when we give all [insulin and pens], we provide everything free, but the glucometer is not given, test-strips are not given, and how are they [patients] monitoring the blood glucose?"* [GP]

Psychological Barriers

Psychological factors identified by the HCPs again reflected the insulin-related fears and anxieties reported by patients, such as hypoglycaemia, concerns about weight gain, and fear of injection pain (Goderis *et al.* 2009, Jeavons *et al.* 2006, Lee *et al.* 2013, Mollema *et al.* 2001, Rubin *et al.* 2009, Zambanini *et al.* 1999).

> *"Surely, one of the biggest barriers is this fear of going onto needles for the rest of your life. I think the effect of getting older is that they hate the idea of hypoglycaemia as well."* [HCP] (Jeavons *et al.* 2006)

Education

HCPs believed patients had insufficient understanding of diabetes in general and needed much more input in relation to insulin titration and dose-adjustment if they were going to use insulin effectively. Though time consuming, a better provision of resources for education was believed to be necessary and could aid adherence (Cuddihy *et al.* 2011, Goderis *et al.* 2009, Jeavons *et al.* 2006, Lee *et al.* 2013, Peyrot *et al.* 2012b).

> *"So … the most common thing, what happen is, people start insulin, but after that, they don't optimize and specify the regimen. The patient who started just on one regimen for, like, many years and nobody have actually taught the patient how to do the self-titration of the insulin too …."* [Family medicine specialist] (Lee *et al.* 2013)

> *"...people have a better understanding of what HbA1c is...people are afraid of needle sticks and this fear has decreased because of the project, thanks to the nurse educator."* [GP2] (Goderis *et al.* 2009)

Theme 4. Hypoglycaemia

HCPs identified fear of hypoglycaemia, particularly in those with past experience, as a significant issue in optimising insulin, reported in surveys (Brod *et al.* 2012a, Cuddihy *et al.* 2011, Leiter *et al.* 2014, Peyrot *et al.* 2012b) and interviews (Jeavons *et al.* 2006, Lee *et al.* 2013).

"What happened was I think he skipped his breakfast, so he went into a hypoglycaemic coma while he was driving. So, they stopped the car at the traffic lights … so lucky you know, the passers-by take him to hospital. After that, until now, he refuses to take insulin. [GP] (Lee *et al.* 2013)

Theme 5. Explanations for Insulin Adherence

HCP explanations for low insulin adherence included: being too busy; travelling; the timing of meals; stress or emotional problems; public embarrassment; and the patient's perception of their diabetes control. Lee *et al.* (2013) interviewee explanations included:

"….so it depends how their [patients'] lifestyle... It depends on their work also…their working and mealtimes. Their mealtimes also … they will tell us." [Family medicine specialist]

"They said, 'I am better, so I can stop now.'" [GP2]

Some participants reported how the level of involvement of patients in intensifying their insulin could positively influence adherence:

"I sometimes can see an improvement in compliance when they switch to insulin which underlines the fact that they contribute to the management of their illness. And they decide they've got to contribute a bit more to the management of their illness." [HCP] (Jeavons *et al.* 2006)

HCPs in surveys (Brod *et al.* 2012b, Peyrot *et al.* 2012b) reported that their typical patient did not take their insulin as prescribed citing similar reasons as patients. In one survey, although 38% of patients reported basal insulin dosing irregularity, prescribers did not routinely discuss basal adherence patterns with their basal-bolus patients (Brod *et al.* 2012b).

Summary of Healthcare Professional Perceptions

Themes related to how equipped and confident PC HCPs felt to support insulin use. Many diabetes consultants and GPs agreed that GPs should become more

involved in starting and intensifying insulin. Barriers to fulfilling this role included negative GP attitudes, skill deficits, a lack of integrated team working, and of a clearly defined role of GPs to manage insulin. When healthcare systems were designed to enable integrated care and GPs were equipped with insulin-related skills, more patients started insulin in general practice and received appropriate support. HCP perceptions of patient-perceived barriers and adherence to insulin included beliefs, culture, fear or anxiety, cost, and hypoglycaemia. Next, an account is given of how HCP–patient relationships are perceived.

2.3.2.4 Domain 3. The Healthcare Professional–Patient Relationship

This domain identifies the role of the HCP–patient relationship in relation to insulin therapy utilisation. For patients, communication and relational care were important in shaping their insulin views and behaviours. From the HCPs' perspective, their interactions with patients were influenced by their personal confidence in managing insulin therapy. The domain comprises two themes.

Theme 1. Patient Perspectives of Relational Care

The quality of the relationship and communication with HCPs was valued by patients. In many of the qualitative studies, it was identified as an important factor contributing to their adherence to insulin (Abu Hassan *et al.* 2013, Brown *et al.* 2007, Hortensius *et al.* 2012, Vinter-Repalust *et al.* 2004) and, also, in surveys (Brod *et al.* 2013a, Mosnier-Pudar *et al.* 2009). The nature of the relationship could contribute positively or negatively on the patient's insulin behaviours. Key factors influencing the quality of the relationship were: how the HCP communicated insulin-related information; whether they elicited and responded to patient concerns; the time available for the consultation; and how accessible and relevant the support provided was to the patient:

> *"I have got a good doctor… but they are busy, real busy, and I suppose you have not got time to talk."* [Patient 8] (Janes *et al.* 2013)

> *"…we discussed about the issues of insulin, my worries and thoughts about insulin. I became less apprehensive and was ready to start on insulin therapy"* [2 years of insulin use] (Abu Hassan *et al.* 2013)

With regard to the way in which HCPs supported patients to manage and adjust their doses, some patients preferred to be led by their doctor, while others drove the self-management process:

> *"I never change the therapy my doctor prescribed! I trust him, that's his job, not mine!"* [Participant] (Vinter-repalust *et al.* 2004)

> *"Nothing changed until the moment that I, myself, started saying, come on guys, something has to be done. Then things started happening, and they [HCPs] started thinking along with me."* [Participant] (Hortensius *et al.* 2012)

Another aspect of the relationship was reflected in the divergent agenda of the HCP and the patient. While HCPs tended to focus on tightening glycaemic control, patients were more concerned with their wider life needs and QOL. This was reflected in the way that patients moderated their behaviour to try and appease the HCPs:

> *"I have been using it [SMBG] every day because I know I have got an appointment coming up, so I better behave [participant giggled]. So that I can tell the doctor, you know, I want to bring down the insulin dose."* [P01] (Ong *et al.* 2014)

Theme 2. Healthcare Professional Perspectives of Relational Care

In this second theme, HCP perceptions of their relationship with patients included the impact of integrated care working, the time available for providing insulin-related support, their own ambivalence about insulin therapy, and whether they had the required skills (Goderis *et al.* 2009, Jeavons *et al.* 2006, Lee *et al.* 2013); this also included surveyed HCPs (Siminerio *et al.* 2007, Van Avendonk *et al.* 2009). It was perceived that their relationships with patients were enhanced when GPs were equipped with insulin-related skills with good support from diabetes specialist services:

> *"Diabetes patients themselves feel much more appreciated; because of that, the link between us and our patients has strengthened."* [GP17] (Goderis *et al.* 2009)

When the clinician adopted a patient-centred approach in their relationship, this could enhance insulin use:

> *"…Because when we negotiate, you know, some, they said okay, after negotiating, then they're okay."* [Family medicine specialist] (Lee *et al.* 2013)

Summary of Healthcare Professional–Patient Relationships

For patients, communication and relational care were important in shaping their insulin views and behaviours. This included the trust they had in their clinician and how well their HCP communicated in the often-limited time that they had. From the HCPs' perspective, they believed their relationships and communication improved once they had the insulin-related skills to provide appropriate support. However, they shared with their patient the perception of too little available time to provide sufficient support.

2.3.2.5 Analytical Themes

This final section of the synthesis outlines four analytical themes, which were generated from the integrated themes. These interpretations provided new perspectives to identify modifiable mechanisms that could be modified to enhance insulin use and adherence. The themes are interrelated as expressed in the model outlined in Figure 5.

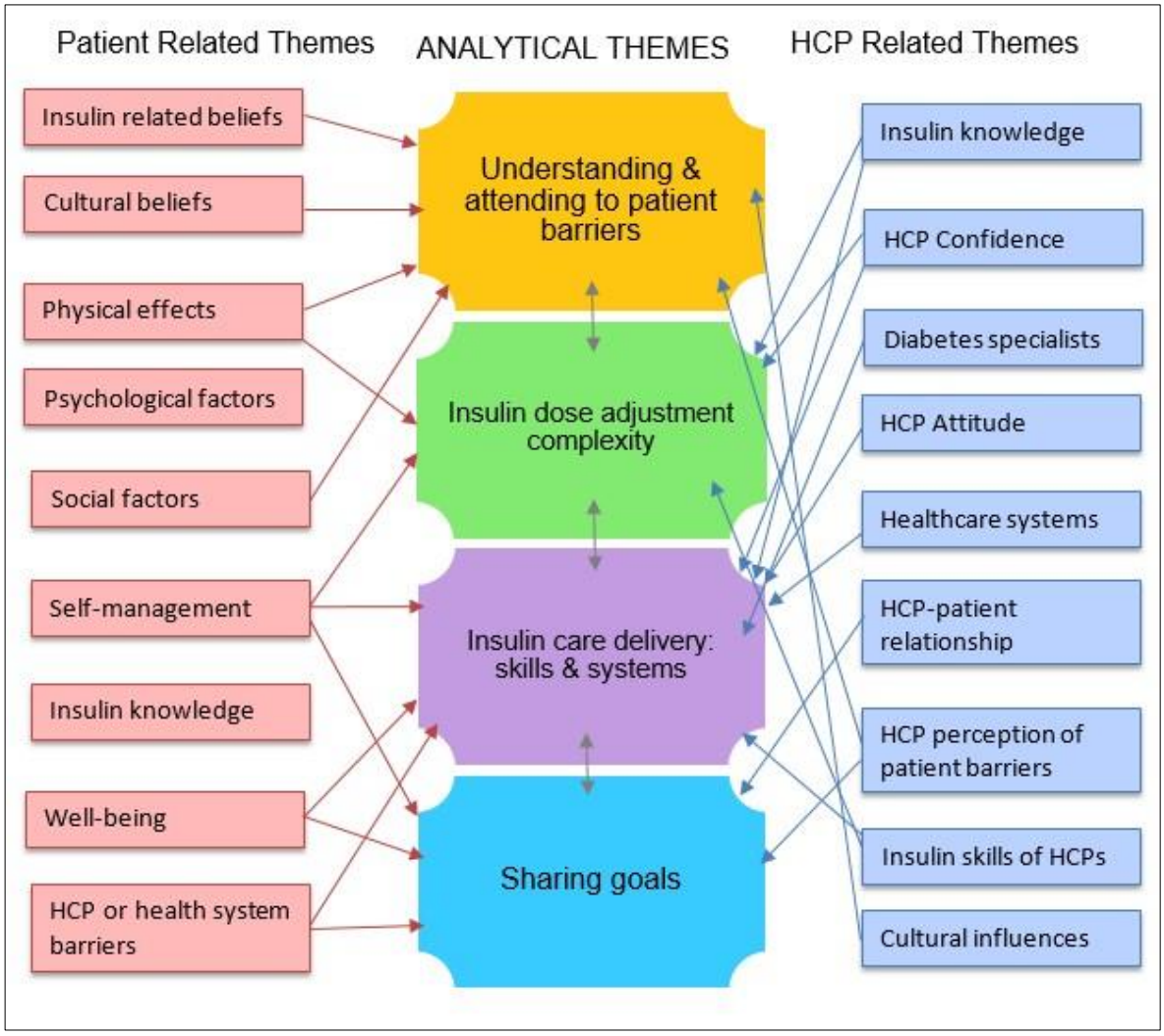


Figure 5 Analytical Model and the Interrelated Themes
Key: HCP = healthcare professional.

Theme 1. Understanding and Attending to Patient Barriers

It is evident that there are multiple barriers to insulin uptake and utilisation in patients with T2DM. These barriers are common and are multi-levelled, with major factors being: psychological issues such as fear or hypoglycaemia and negative beliefs about insulin; and social factors such as external prejudice, stigma and life disruption/constraints. Despite being aware of most patient-level barriers to insulin adherence, the PC HCP accounts did not identify strategies for addressing them. If these barriers are to be overcome, a multi-modal approach providing targeted support to patients and enhancing PC HCP skills is required, with key components being: patient-centred education and self-management support addressing patient-level barriers; training for PC HCPs to enhance their confidence in using insulin and in being able to elicit and respond to patient needs in relation to insulin self-management.

Theme 2. Insulin Dose-Adjustment Complexity

The collected data suggest that current methods of insulin dose titration are not always systematic but are often suboptimal with suboptimal adherence. Dose-adjustment seems to be further complicated by patient perceptions on insulin use which can be subjective and influenced by factors such as avoiding hypoglycaemia by administering suboptimal doses, and the management of wider aspects of their social and working lives. Hence, if insulin titration is to be more optimally managed then there is a need for a simpler patient-centred approach. This approach needs to ensure patients have a clear perspective of the process, its importance, and what they hope to achieve.

Theme 3. Sharing Goals

The data identified that there may be some divergence between the patient's blood glucose goals and those of their HCPs. Patients perceived HCPs to be focusing more on achieving a tighter glycaemic target whereas subjectively they may feel better with higher glucose levels. Hence, insulin use may be enhanced if there is a stronger connectivity between the patient and the HCP in setting and agreeing therapy goals.

Theme 4. Insulin Care Delivery: Skills and Systems

The skills and attitudes of PC HCPs may be significant in determining insulin use and outcomes achieved. The skills are not isolated to the individual HCP, as the data suggest that the context of practice is important too, placing an emphasis on systemic factors including integration and teamwork. Where available, the specialist support could also be provided by practices already experienced and skilled in insulin initiation/intensification. Therefore, if insulin therapy is to be better delivered within primary care, GPs and their teams will need training, with support systems that are internally (a team approach) and externally (specialist support) integrated.

Summary of Analytical Themes

Four analytical themes were generated from the integrated themes. These related to the HCPs' understanding of, and attending to, patient-related barriers, the suboptimal approaches to insulin dose-adjustment, the disparity of blood glucose goals between HCPs and patients, and insulin care delivery with regard

to the skills of primary care clinicians and the healthcare systems in place. To address barriers to managing insulin therapy, a multi-modal approach providing targeted support to patients and enhancing the PC HCPs' skills is required.

2.3.3 Discussion

The synthesis identified a wide range of factors that modify the use of insulin in people with T2DM. These illustrated how and why many individuals do not use their insulin to optimal effect and how PC HCPs are often underutilised to support them. The factors can be broadly divided into three interrelated levels: the patient; the HCP; and the care system. The use of data derived from both patients and HCPs enhances the analytical potential of the synthesis to consider the interactive components expressed from these different perspectives. These generated the potential development of newer services for patient benefit.

2.3.3.1 Patients

The findings of the review identified a wide range of factors driving patients' insulin-related behaviours. These include: beliefs; psychosocial factors; self-management skills and knowledge; and experiences in using insulin. While many factors have been reported in previous reviews (Barendse *et al.* 2012, Davies *et al.* 2013, Fu *et al.* 2009, Gherman *et al.* 2011), this review considered how these factors are expressed and interact in patient experiences, with the added perspective of how they relate to the views and behaviours of HCPs. This latter element is important as it is the interaction between patients and HCPs where many challenges and barriers for effective insulin use reside. The review also highlighted problems and issues affecting patients' use of insulin. Addressing these issues is important and needs to be considered in patient education and self-management support for patients.

The findings suggest that, as well as the technical aspect of self-management, support needs to consider patients' underlying beliefs, their psychological orientation to insulin and influence of wider social factors. Addressing the problem of clinical and psychological inertia of insulin intensification is a key part of the process (Khunti *et al.* 2016, Zafar *et al.* 2015). Given that factors such as perceived stigma restricts use of insulin, it may be important to help patients develop strategies to ameliorate those feelings. Wider factors such as family

dynamics also need to be considered. Therefore, to support patients to use insulin effectively, the factors highlighted in the review need to be incorporated into the insulin assessment process and attended to in self-management support. It is also necessary to establish whether a patient wishes or is able to self-manage their insulin titration as some may prefer to be led by their HCP as was apparent in this synthesis (Jenkins *et al.* 2011, Vinter-Repalust *et al.* 2004).

2.3.3.2 Healthcare Professionals

The HCPs' accounts were predominantly those of PCPs. While these were derived from studies undertaken in different healthcare systems, as with patients, they too shared similar perspectives on insulin management. The two key factors governing insulin care delivery were HCP skills and time available. The former would suggest a need for professional education. Given the findings of the patient accounts, this needs to offer more than the technical aspects of insulin and should include an understanding of the psychosocial factors that may influence insulin use.

In relation to time, it may be important to identify the role of other team members in delivering insulin support such as DSNs supporting the primary care team, and PNs, who already initiate and manage insulin therapy in many general practices. The benefits of a multidisciplinary team approach were highlighted in a study by Ritholz *et al.* (2011) but the physician participants stressed the necessity of regular, ongoing communication among team members to ensure patients received consistent information. This review also identified that interactions between HCPs and patients are pivotal in determining whether insulin is used effectively. The relational aspects of care and continuity of support seem particularly important. The review identified how patients and HCPs can sometimes have divergent views particularly in glycaemic targets, highlighting the need for agreeing glucose goals in a collaborative way. Therefore, PC HCPs can have an important contribution to ensure effective use of insulin, provided they are appropriately trained, with time needed to deliver care and supportive health systems.

2.3.3.3 Healthcare Systems

The synthesis revealed how integrated healthcare systems, teamwork, the way general practices were organised and, in one study, the presence of a PN (Van Avendonk *et al.* 2009) all facilitated the role of general practice in insulin-treated T2DM. Diabetes specialists also shared this view. The synthesis identified that the support of diabetes specialist teams, can help PC HCPs deliver insulin support. Therefore, to ensure that insulin is used optimally in primary care, the findings of the review indicate that the care system needs to be designed to ensure that patients are assessed and followed up by an appropriately trained HCP, who can provide continuity of care with sustained proactive support. The system also needs to consider how to integrate specialist diabetes support to help the primary care teams in their clinical decision making and in building the resources that patients will need to support their insulin use.

2.3.3.4 Limitations

This review has several limitations. The principal one is the reliance on the quality of the data from the primary studies; most studies were not exclusive to T2DM patients; and not all based only in primary care. In mitigation, data were only included from participants with insulin T2DM in primary care. Another limitation was that many studies were biased towards the perspectives of PCPs and identifying more accounts from other team members would have enhanced the findings. From a UK perspective, more accounts of the contribution from PNs would have been desirable. It was also noted that, while it was possible to elicit barriers to effective insulin utilisation, there were few studies identifying potential facilitators of insulin management, although the review was able to theorise these based on the nature of the identified barriers. Another potential source of bias was that some surveys were supported by insulin-related companies, although no evidence of bias were related to product evaluation. The inclusion of both qualitative and quantitative studies is a further weakness, particularly with the variety of qualitative approaches included, incorporating interpretive and descriptive approaches. However, this integration could also be viewed as a strength as identifying common themes in the different data sources adds to the likely generalisability of the findings.

Finally, the literature search was completed in March 2015 and further studies have since been identified. These include: a patient survey of frequency of self-treated hypoglycaemia (Frier *et al.* 2016); a focus group study of insulin-treated T2DM patients identifying fear of hypoglycaemia (Grammes *et al.* 2017); qualitative interviews with patients to explore personal impact of insulin, and attitudes to future insulin intensification (Holmes-Truscott *et al.* 2016); qualitative interviews and focus groups of patients and HCPs ascertaining perspectives on psychological insulin resistance (Krall *et al.* 2015); interviews with patients to establish barriers and enablers for insulin self-titration (McBain *et al.* 2016); interviews with patients with insulin-treated T2DM to detect their reasons for poor glycaemic control (Tong *et al.* 2015); and, finally, a cross-sectional survey to evaluate perceptions of people with T2DM and physicians toward insulin therapy (Cosson *et al.* 2019). Despite these limitations, the synthesis provided some novel insights into the collective factors impacting on insulin-treated T2DM patients in primary care. These will be a helpful reference for further exploratory studies in developing new interventions to address the following research questions in Table 6.

Table 6 Questions for Future Research

1. How can GPs and PNs consult better to enable T2DM patients to express their concerns about administering insulin?
2. What interventions can help people overcome barriers to injecting in front of other people?
3. What strategies can be developed for supporting patients to monitor and adjust their insulin doses in a more effective and sustained manner without fear of hypoglycaemia?
4. In what way can GPs and PNs be encouraged to share glycaemic goals with their patients without health detriment?
5. How can more GPs and PNs acquire skills to initiate, manage, and intensify insulin treatment?

Key: GP = General Practitioner; PN = Practice Nurse; T2DM = type 2 diabetes

2.3.4 Conclusion

Insulin use and glycaemic control are often suboptimal in people with T2DM and associated with risk of complications and increased mortality. This review reveals

the burden experienced by T2DM patients receiving insulin and the skills needed to equip PC HCPs to support them. Integrated healthcare systems with appropriate resources could help facilitate this but patient-centred care by appropriately skilled GPs and PNs is also required.

Interventions to support insulin use are next explored in the final section of the review of the literature.

2.4 A Review of Interventions to Support Insulin Use

In this section, a review of interventions to support insulin use and adherence in people with T2DM is presented. The wider meaning of adherence was applied, encompassing self-management functions, such as whether the dose or timing was appropriate and, if the insulin injection was missed, the reasons why (Boas *et al.* 2014, Davies *et al.* 2013, Vermeire *et al.* 2005). Hence, the interventions that aim to enhance treatment adherence are mediated through strategies to support these behaviours. This broader concept was used to identify the interventions that follow.

A scoping review was conducted using the same databases as those used for the thematic synthesis described in the previous section. Search terms included T2DM, insulin, adherence, self-management and interventions. A summary is next given of some of the key interventions identified: mobile apps; telehealth; insulin regimens and devices; psychological therapies; education programmes; and peer support.

2.4.1 Mobile App-Based Interventions

To assist adherence to self-management with self-titration, a variety of tools with algorithms have been developed, as it has been recognised that self-titration by the patient is generally superior to HCP-based models for many patients (Khunti *et al.* 2013b). With the advance of smartphone (mobile telephone) technologies, a number of insulin self-adjustment applications (apps) have also emerged.

Huckvale *et al.* (2015) undertook a literature review to explore the accuracy and clinical suitability of apps for calculating medication doses, focusing on insulin calculators for prandial-based regimens. Of the apps identified for evaluation,

(*n* = 46), none performed adjustments for basal regimens or for combined oral and insulin therapy. All performed simple calculations for carbohydrate intake, blood glucose levels and insulin dose. Hence, most of the identified applications would not be suitable for people with T2DM. Indeed, the authors were concerned that many of these applications could increase the risk of hypoglycaemia as they had limited safety features to adjust for actual blood glucose levels.

Wu *et al.* (2017) reviewed 12 RCTs of mobile applications to develop and validate a risk taxonomy of apps for self-management. The RCTs compared apps with usual care. All included monitoring, lifestyle modification, medicine management (OHAs and insulin) and prevention of complications. Three apps were determined to be of high risk for having a clinical decision-making function recommending treatment such as OHAs and insulin, without the participation of an HCP.

These reviews suggest that apps which include insulin decision-making support are more reliable when linked to web-based technology incorporating HCP support such as telehealth discussed next.

2.4.2 Telehealth

Telehealth covers a range of technologies that support remote interactions between patients and HCPs (Gretton & Honeyman 2016). Applied to insulin support in diabetes, these include: downloadable glucose monitors; mobile and computer-based applications for data transferring; and virtual consultations. Two studies reporting on the use of telehealth to provide insulin support to patients are detailed below:

Wild *et al.* (2016) investigated whether HCP review of telemetrically transmitted self-monitored results improved glycaemic control. Patients with T2DM (*n* = 321) and HbA1c ≥58 mmol/mol recruited from family practices in the UK (*n* = 42) were randomised to the telemonitoring intervention (*n* = 160; *n* = 26 insulin-treated) or usual care (the control, *n* = 161; *n* = 25 insulin-treated). The results were transmitted twice weekly to a secure website for review by family practice clinicians. Primary care nurses checked the results weekly and organised treatment changes based on national guidance. At nine-month follow-up, there were significant improvements in glycaemic control with mean HbA1c reduced

from 74.1 at baseline to 63 mmol/mol in the intervention and from 73 to 67.8 mmol/mol in the usual care group with mean adjusted reduction of –5.60 mmol/mol in support of telemonitoring (p = .007). Interviews were conducted to explore the experiences of patient and HCP participants (Hanley *et al.* 2015). The data supported self-care and medical treatment decisions. The convenience of home monitoring was very acceptable to patients, but HCPs had some concerns that telemonitoring could increase workload and costs.

In the other study, Larsen *et al.* (2010) investigated the feasibility of a mobile-phone-based system for insulin-receiving T2DM patients (n = 22 of an initial 23 completing the study) from nine general practices in Oxfordshire, UK. Patients had HbA1c >7.5% (>58 mmol/mol) and received a basal insulin regimen. Data were transmitted electronically and reviewed by a DSN, who contacted the patient if glucose levels were raised. At six months, there was a mean HbA1c reduction of 0.69% from 9.5% (80 mmol/mol) to 8.81% (73 mmol/mol) (p = .05). A high level of glucose monitoring compliance was observed which remained constant throughout (43–100%), with 21 patients demonstrating compliance ≥75%. The insulin recording compliance matched the phone-use compliance at 45%. Blood glucose levels improved during the study with a consistent level of monitoring compliance but decreasing phone usage, indicating that glycaemic control and appropriate insulin usage may have continued despite reduced use of the system.

These studies indicate that telehealth could have a role in supporting adherence to insulin use in terms of support with dose titration to target glucose levels.

2.4.3 Insulin Regimens and Devices

The type of insulin regimen and device used can lead to improved levels of injection adherence with impact on glycaemic control. This is discussed next.

2.4.3.1 Regimens

In an observational study of insulin-treated T2DM patients, Donnelly *et al.* (2007) found an inverse linear relationship between levels of adherence and number of injections. Those requiring one injection a day had greater adherence than those receiving four a day (78.3%±17.8 *vs* 60.8%±21.7; p < .001). The type of insulin can also aid adherence. Basal insulin does not require timing in relation to meals,

unlike prandial insulin types, which can lead to insulin omission or mistiming by individuals reluctant to inject in public (Jenkins *et al.* 2011, Mehmet *et al.* 2015). However, once or twice-daily injections of basal insulin may not be sufficient to provide optimal glucose control in patients with post-prandial glucose escalations indicating the need for a prandial-based insulin regimen.

Although basal-bolus regimens can lead to superior glycaemic control by lowering post-meal glucose escalations, some patients might adhere more to twice-daily premixed insulin. This was highlighted earlier in a study by Anyanwagu *et al.* (2017). Additionally, premix analogue insulin can support adherence by providing more flexible timing, as injections can be administered shortly before or after meals, unlike short-acting or human biphasic insulin with a longer onset period (Liebl *et al.* 2009). These differences underline the importance of joint decision-making with the patient when a change of insulin regimen is indicated.

2.4.3.2 Devices

The insulin injection device and pen needles can also support insulin use. Graff & Mclanahan (1998) conducted two surveys of insulin-receiving patients. One assessed the effects of patients using a prefilled pen device, while the other assessed attitudes and perceptions of individuals using a reusable pen device with insulin cartridges. Both were compared with patients using a vial and syringe. Of individuals using the prefilled pen and cartridge pen, 92% and 98% respectively reported the systems were easy to use. In the first survey, 85% reported that they missed no injections compared with 72% of patients using vial and syringe. In the second, 77% of pen users found it easier to comply with their regimen. Lee *et al.* (2006) evaluated the impact of converting from a vial and syringe to a pen device in T2DM patients. Adherence significantly improved after conversion from 62% to 69% ($p < .01$) and the proportion of patients considered adherent was significantly higher compared with before ($p < .01$).

Pen devices have developed further to enhance adherence with memory aids integrated with the device, or as a separate attachment, to record and store doses administered (Klausmann *et al.* 2013, Selam 2010). Other devices have dials to address difficulties with dexterity or visual impairment (Fox *et al.* 2002, Shelmet

et al. 2004), or needle phobia by using needle-free devices (Fu *et al.* 2009). Smaller diameter needles can further support adherence in patients with greater perception of injection pain and anxiety (Iwanaga & Kamoi 2009, McKay *et al.* 2009, Nagai *et al.* 2013).

In summary, the type of injection device and needle is important in supporting insulin use and subsequent glycaemic control. Where there are suspicions that a patient is experiencing injection problems, then opening a conversation about this could provide an opportunity to improve adherence with an alternative device.

2.4.4 Psychological Interventions

In this section, an overview of psychological interventions to support insulin use is presented. These interventions have been shown to improve glycaemic control, but at the time of this review, no interventions were identified that were specific to insulin-treated T2DM patients. In their review of trials of psychological interventions, Alam *et al.* (2009) undertook a meta-analysis of 19 studies reporting HbA1c and found a reduction in HbA1c of 0.54%. Psychological therapies suggesting support for insulin use included motivational interviewing, cognitive behavioural therapy (CBT), or a combination of both.

The use of CBT on glycaemic control and psychological outcomes suggested possible benefits in a systematic review by Uchendu & Blake (2016), which included patients with T1DM and T2DM. They identified RCTs (n = 12) for review, of which nine were included in a meta-analysis. The CBT varied in terms of format and duration. In five studies, there was significant short-term reduction in mean HbA1c in the CBT groups and, in six trials, there was significant medium-term reduction in mean HbA1c but not in long-term reduction when compared with controls.

These studies suggest potential benefits of psychological interventions in supporting adherence and glycaemic control in insulin-treated T2DM patients.

2.4.5 Education Programmes

The review identified only three studies assessing the impact of education programmes specifically for insulin-treated T2DM patients.

Hermanns *et al.* (2012) demonstrated how a comprehensive education programme ('MEDIAS2 ICT') led by diabetes educators, which included dose-adjustment based on carbohydrate intake was more effective in glycaemic lowering of the T2DM participants receiving multiple daily injections than a more traditional programme. Mean HbA1c decrease at six months was 6 vs 4 mmol/mol in favour of MEDIAS2 ICT. However, when adjusted for baseline differences, the difference was not significant (p = .382) but was within the predefined limit for non-inferiority. A later study (Hermanns *et al.* 2017) of a similar intervention ('MEDIAS2 BSC') for patients receiving non-intensive insulin therapy resulted in a greater glycaemic benefit compared with the control. The mean adjusted HbA1c reduction was 6.7 mmol/mol vs 3.5 mmol/mol (p = .018) in favour of MEDIAS2 BSC.

Houghton & Kay (2016) described the development of a structured programme for insulin-treated T2DM patients (T2ONIC) led by a DSN and diabetes specialist dietitian. The emphasis was on patient-centred care with encouragement to self-manage. It consisted of 10 hours of education over three weeks and one-hour follow-up at three months. Data at three months revealed 94 out of 99 people who had blood tests reduced their HbA1c by 11 mmol/mol. Patients gained from attending the programme and the facilitators enjoyed delivering the course, despite challenges in relation to time and resources to develop it.

These studies suggest that education programmes run by diabetes specialists to support insulin self-management in T2DM patients may be effective in reducing glycaemic control. No studies were identified in which GPs or PNs delivered insulin education within a general practice setting.

2.4.6 Peer Support

The final intervention identified in the review was peer support. Heisle *et al.* (2010) compared diabetes control and reciprocal peer support (RPS) with nurse management in an RCT. All participants (n = 244), including 56% (n = 136) who received insulin, were given the same training including insulin adjustment but with additional peer-related training for the RPS group. Each participant was paired with another of the same age. At six months, the RPS group's mean HbA1c reduced by 3 mmol/mol compared with the usual care group whose mean

HbA1c had increased by 3 mmol/mol. The researchers concluded that the intervention was effective in bridging service gaps while increasing the quality and quantity of self-care support.

Social networking forums have become important sources of knowledge and support for patients living with chronic disease. Greene *et al.* (2011) qualitatively evaluated the content of communication on online Facebook communities focusing on diabetes. They gave examples of posts (conversations on a central group web page) which included information-sharing about insulin glargine, their individual experiences, and links for support. Their study offered tentative support for diabetes management from peers. However, the researchers noted the inability to verify the identity of a contributor presented a significant problem to the trustworthiness of information. This can be addressed by HCPs engaging in these forums (Cooper & Kar 2014).

These studies suggest overall benefits of support for insulin use by peers who have received appropriate training. This would also address the concerns expressed by HCPs about peers giving inappropriate advice about insulin use.

2.4.7 Summary of Interventions

A range of interventions were identified to support people taking insulin. The strategies include mobile apps, telehealth support, psychological interventions, education programmes, and peer support. An important consideration is the appropriateness of the strategy to the individual patient with regard to age, ability and preference.

2.5 Summary of The Review of The Literature

Overall the current literature shows that insulin management in T2DM can be complex and challenging. The literature review provided a more in-depth insight into current understanding in comparison to the scoping review summarised in Chapter 1. By exploring the development of insulin types and regimens, clinical and policy guidance, perceptions of everyday experiences of insulin-receiving T2DM individuals and PC HCPs who support them, these confirmed the gaps in existing knowledge in relation to the potential impact on insulin use and glycaemic control. It identified additional gaps in research relating to people with T2DM

established on insulin therapy and the sparsity of studies within the context of general practice relating to the role played by PNs and GPs within the UK and internationally. This knowledge influenced and refined the questions identified from the scoping review in Chapter 1, integrating them with the questions formulated from the synthesis. Aims and objectives were subsequently developed for each of the study phases outlined next in Chapter 3, within the context of UK general practice.

While there are general guidelines indicating when insulin therapy should be considered in this population, these do not address some of the complexities that arise in making decisions for different individuals in such a heterogeneous population. Hence, identifying how insulin support is currently delivered in primary care settings may help to identify factors that might be important for PNs and GPs to consider when providing this care. The thematic synthesis within the review enabled the formulation of a preliminary conceptual framework (Figure 6) identifying some of the factors that might influence the use of insulin in patients with T2DM. The framework highlights multifactorial elements that can influence how effective insulin therapy can be at both patient and HCP-levels. This framework was used to inform the study design and as an analytical tool to support data interpretation and integration.

The review also identified a variety of interventions to support insulin adherence in T2DM which is important for driving glycaemic control, helping to prevent complications, and to reduce healthcare costs. However, few interventions were specific to insulin-treated T2DM and some were more successful than others in terms of improving blood glucose levels, self-management behaviour and psychological wellbeing.

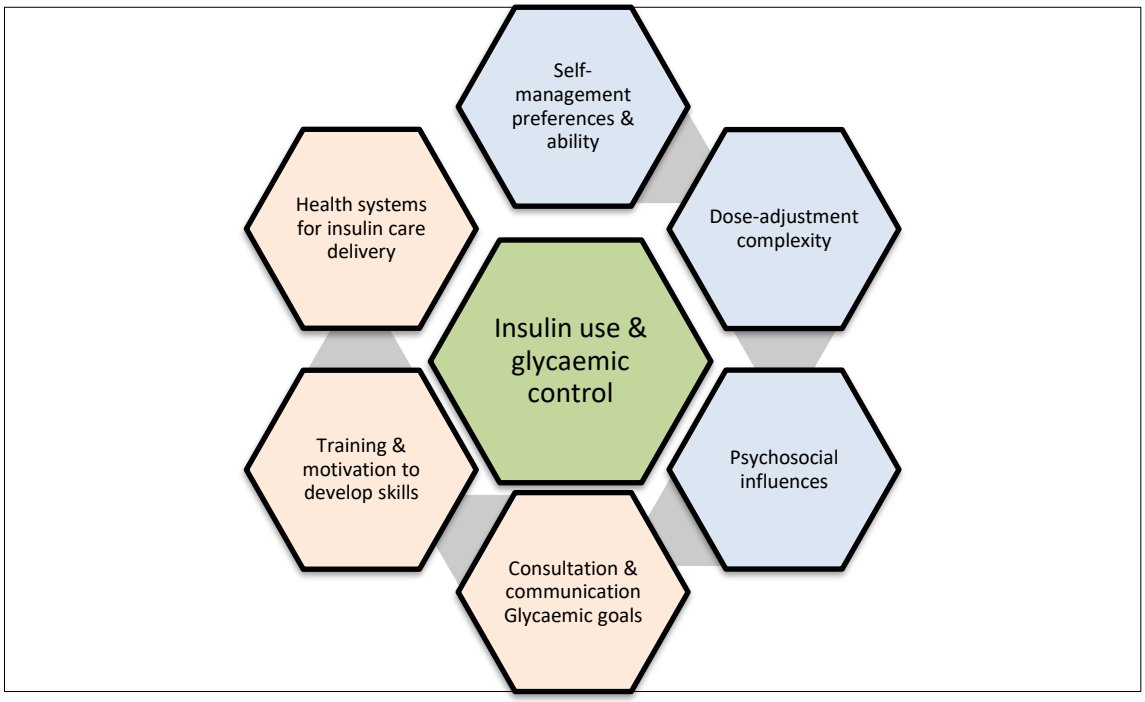


Figure 6 Conceptual and Theoretical Framework: Insulin Use & Glucose Control

Key: = Patient-level factors
= HCP-level factors

In summary, the prevalence of T2DM continues to increase and, while lifestyle modification focusing on weight loss remains the most important intervention to reduce blood glucose levels, many patients are progressing to insulin therapy. Among those already established on insulin treatment, many have suboptimal control. This research project aimed to address these areas by exploring perceptions of patients with T2DM established on insulin treatment, the views of GPs and PNs in UK general practice who increasingly support them, and to gain an insight into the associated healthcare systems in order to develop future interventions to support insulin use. It was evident from the literature review that there are limited studies within this context and also internationally outside of the UK. Therefore, the planned study built on existing knowledge.

Next, the methodology for the research project is described in Chapter 3.

3. METHODS

In this chapter, the methods used to address the research questions outlined in Chapters 1 and 2 are presented. This chapter explains the adopted methods and provides justification for the study approach and design. The chapter is organised as follows:

1. Study approach and design;
2. Study methods;
3. Research ethics and governance;
4. Patient and public involvement.

3.1 Study Approach and Design

As demonstrated in the previous chapters, initiation and utilisation of insulin in primary care settings are inherently complex and multifaceted. Therefore, the best way to develop an understanding of how to enhance insulin support in this context is to take multiple perspectives, to identify factors associated with insulin utilisation, and to explore how the views and beliefs of patients and healthcare professionals (HCPs) shape insulin behaviours. To address these multiple perspectives, a mixed-methods design was used, incorporating both quantitative and qualitative methods to generate data on both the utilisation of insulin in primary care, and the factors and phenomena that impact on how insulin is used (Creswell & Plano Clark 2011, Greene *et al.* 1989, Green & Thorogood 2014, Murphy *et al.* 1998). The mixed-method study used a quantitative method (cross-sectional survey) to exam the factors associated with insulin use, and qualitative methods (in-depth interviews) to provide an in-depth assessment of the views and experiences of patients and HCPs on insulin use in this population. The next section provides an overview of the mixed-methods approaches adopted and outlines the approach and design used for this research.

3.1.1 Mixed-Methods

Mixed-methods research involves collecting, analysing, and integrating quantitative and qualitative research in a single study or longitudinal programme of enquiry, with the intention of providing a better understanding of a research problem or issue than either approach in isolation (Creswell & Plano Clark 2011). Johnson *et al.* (2007) observed how mixed-methods research had become

increasingly recognised as an important research approach, by drawing on both the qualitative and quantitative traditions of research to enhance the capacity of a study to develop a deeper understanding of the problem being observed. The need for multiple perspectives is particularly important in addressing the kind of complexity associated with multifaceted areas of health enquiry such as how patients use insulin.

3.1.2 Structure

There are multiple definitions of mixed-methods research with varying perspectives on the underpinning research process, philosophy and methods for data integration (Johnson *et al.* 2007). Johnson *et al.* (2007) formed a general definition based on their analysis of 19 established definitions by research leaders in the field. They defined mixed-methods as research in which the researchers combine elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration. The authors positioned it on a qualitative-quantitative continuum (Figure 7) with the centre representing the strongest or purest form, with equal status given to both qualitative and quantitative methods. This research positioned itself at the centre of the model.

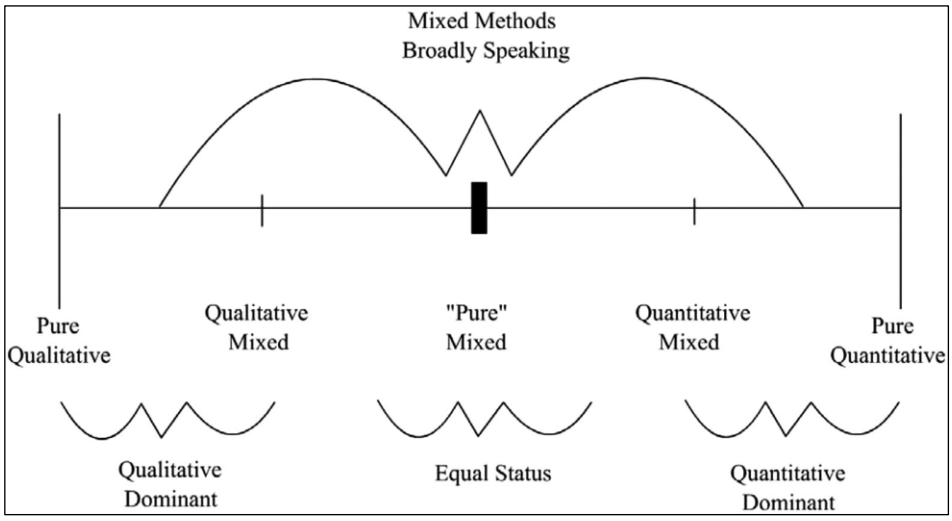


Figure 7 The Three Major Research Paradigms of Mixed-Methods (Johnson et al. 2007, p112)

3.1.3 Triangulation

The use of two or more approaches to research a question is known as triangulation (Morse 1991, Johnson *et al.* 2007). Heale & Forbes (2013) explain

how it can increase confidence in the findings through the confirmation of a proposition, avoiding potential biases from using a single methodology, and can also determine the completeness of data. Methodological triangulation, the most common type, can include two or more sets of data collection using the same methodology (such as two qualitative datasets) or by using two different data collection methods, as with this study, such as qualitative and quantitative approaches (Maxwell 2016, Morse 1991).

A key consideration in a mixed-methods study is the order of data collection and analysis; whether this should be sequential or simultaneous; and at which stage the quantitative and qualitative phases are connected and results integrated (Creswell & Plano Clark 2011, Ivankova *et al.* 2006, Morse 1991). Ivankova *et al.* (2006) discuss the procedure for conducting a sequential explanatory design. This involves collecting and analysing first the quantitative data and secondly the qualitative data. By exploring and interpreting the statistical results, the qualitative data can then help explain or elaborate on the quantitative findings. Thus, the point where the mixing of the data occurs is between phases one and two, with the second phase building onto the first. Conversely, a concurrent triangulation design involves collection and analysis of quantitative and qualitative data simultaneously, with limited interaction during the process but merging the results from each dataset at the end (Brannen 2005, Morse 1991). The results are merged using data transformation, by the quantification of qualitative data (Jick 1979). There are several possible outcomes: corroboration of results; elaboration of the quantitative data by the qualitative data; complementary results; or contradiction, where both types of data conflict (Brannen 2005).

The preferred approach for this study was sequential triangulation in order to optimise the use of data collected from the participants. The qualitative interviews followed the analysis of the quantitative postal survey, enabling the interviews to expand upon, enhance, and validate the survey data. In turn, the patient interviews expanded upon the HCP interviews conducted before them. The findings were then integrated and synthesised following the analysis of each dataset to address the study questions.

3.1.4 Summary

In summary, the chosen methodology was a sequential mixed-method, multiphase approach, combining quantitative and qualitative methods. There were five integrated elements: a literature review and thematic synthesis; a cross-sectional survey; qualitative interviews with General Practitioners (GPs) and Practice Nurses (PNs); qualitative interviews with patients; and, finally, further triangulation and integration. The study flowchart is shown in Figure 8. The method for each phase is detailed next.

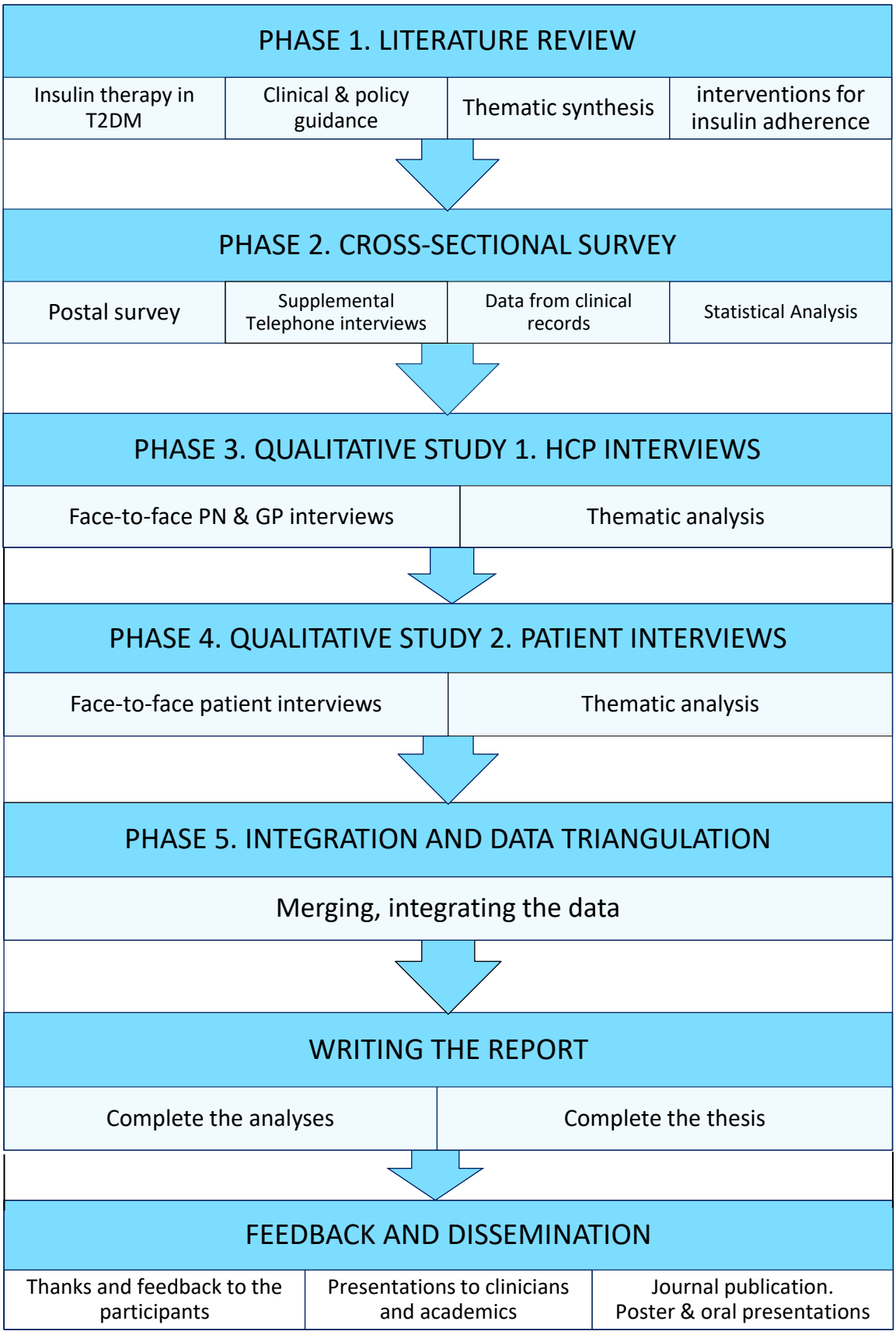


Figure 8 Study Flow Chart

Key: GP = General Practitioner; HCP = healthcare professional; PN = Practice Nurse; T2DM = type 2 diabetes.

3.2 Study Methods

This section describes the methods and rationale for each study phase, beginning with the literature review.

3.2.1 Phase 1: Literature review

The literature review was an integral part of the overall study design, as it provided an important conceptual and theoretical platform for the study and in the analysis and interpretation of data in the empirical phases. The methods and findings of the review were outlined in Chapter 2. Conceptual frameworks are described by Jabareen (2009) as products of qualitative processes of theorisation. Theory-driven conceptual frameworks have been used for qualitative research and as the basis for mixed-method evaluation designs (Greene *et al.* 1989, MacFarlane & O'Reilly-de Brún 2012). A framework developed from this review was illustrated in Chapter 2, Figure 6. This enabled the conceptual outputs from the thematic synthesis to integrate the review findings with the rest of the study, and to inform the overall analysis for further conceptual modelling.

3.2.2 Phase 2: Cross-Sectional Survey

The purpose of the quantitative component was to identify factors associated with glycaemic control in people with insulin-treated type 2 diabetes (T2DM) in East Kent with the following objectives:

1. To determine the prevalence of suboptimal glycaemic control in people with insulin-treated T2DM in primary care;
2. To determine biopsychosocial and clinical factors associated with glycaemic control in this population;
3. To examine how patients perceive their insulin treatment, level of glucose control and HCP support.

3.2.2.1 Hypothetical model

This was an exploratory study designed to test a hypothetical model (Figure 9), informed by the theoretical framework, identifying some of the factors that may explain glycaemic control in insulin-treated T2DM patients. The factors were used as independent variables to test their contribution to the observed variance in

glycaemic control, with glycated haemoglobin (HbA1c) as the dependent variable. The key variables explored related to biodemographic factors, insulin behaviours, appraisal of insulin, psychological factors, and care processes. To integrate data within the multi-method approach, these variables were also addressed as constructs in the qualitative phases of the mixed-methods study. The rationale for the cross-sectional survey design is explained next.

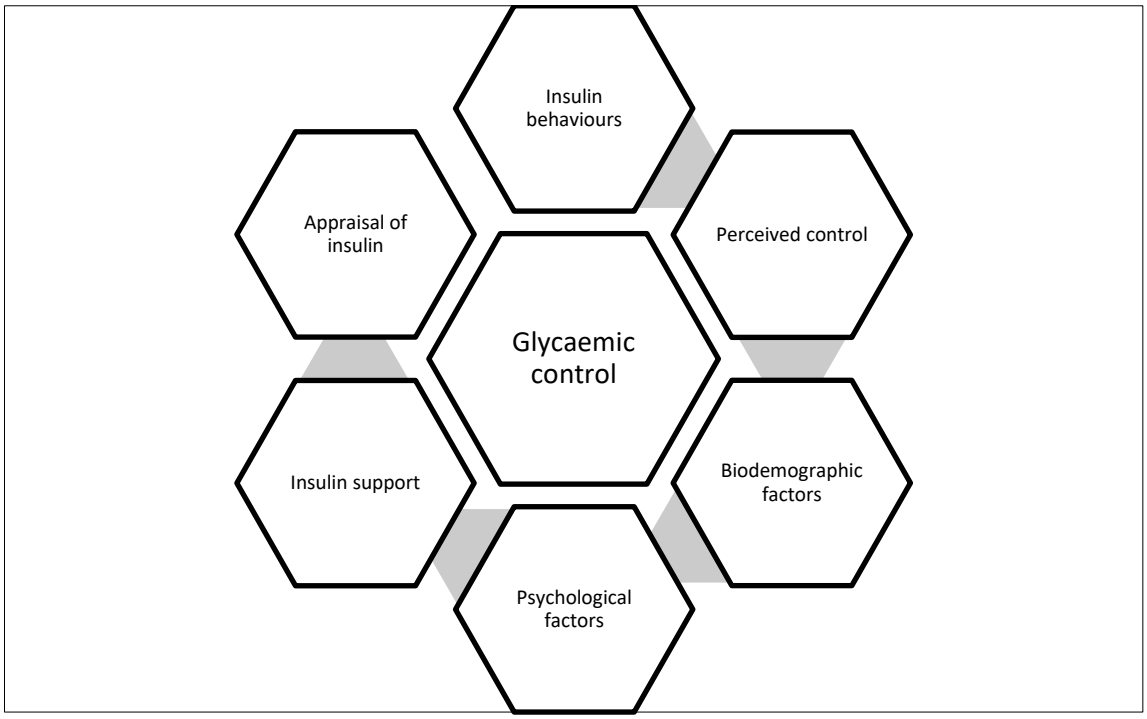


Figure 9 Hypothetical Model to Test Factors Explaining Glucose Control

3.2.2.2 Observational Studies

Cross-sectional studies are one of several observational approaches for investigating health-related events in a given population and time period (Calnan 2007, Carlson & Morrison 2009, Vandenbroucke *et al.* 2007, von Elm *et al.* 2007). Observational studies can be retrospective, prospective or cross-sectional (Song & Chung 2010, p.10), thereby providing different temporal perspectives. Retrospective and prospective studies are described as either cohort studies or case-control studies. In the former, there is a common exposure to a health event or condition and, in the latter, exposed patients are compared to non-exposed patients. Observational studies can be undertaken to examine many types of health-related events, including disease or disease remission, disability or complications, death or survival, and the occurrence of risk factors

(Vandenbroucke *et al.* 2007). Observational study methodologies are summarised next and considered within the context of this study.

Cohort Studies

In cohort studies, investigators follow large populations over time who have a common experience or characteristic such as being born in the same year or living in a specific area (Vandenbroucke *et al.* 2007). A variety of temporal perspectives can be adopted. Investigators follow up people, often for years, obtaining information about them and their exposures, and then assessing different outcomes. These might include the development of diabetes or heart disease in people exposed to a sedentary lifestyle, poor diet or smoking, such as in the Framingham Study (Kannel & McGee 1979). Cohort studies can also be retrospective by accessing past information such as medical records in patients receiving basal insulin (Khunti *et al.* 2016). A longitudinal cohort study involves a collection of data at more than one point in time, involving different temporal perspectives (Bowling 2002). A cohort study for this research was rejected because the aim was to determine the factors contributing to glycaemic control at a specific point in time. A further disadvantage was the loss to follow-up within a cohort study. The limited resources and time available were also contributing factors.

Case-Control Studies

In case-control studies, investigators compare exposures between people with a particular disease outcome (cases) and those without (controls) (Vandenbroucke *et al.* 2007). Because the investigator is starting with the disease or exposure and relating it to past behaviour these are retrospective, but they can then be followed-up over time to observe the progress of a condition (Carlson & Morrison 2009, Jones 2002). A case-control design was not suitable for this research project because all participants were required to have the condition (insulin-treated T2DM) and the aim was to identify contributors (exposures) to glycaemic control. Thus, a comparator or control group was not required.

Cross-Sectional Studies

Cross-sectional study investigators assess each individual in a sample at one point in time to examine the prevalence of exposures, risk factors or disease

(Vandenbroucke *et al.* 2007). Some studies, such as this project, are analytical, aiming to quantify associations between exposures and disease that may indicate potential causation. Data are extracted from a variety of sources including: medical records; national medical databases; insurance databases; postal questionnaires; or surveys administered by researchers (Calnan 2007, Jones 2002). A key advantage is that a large sample of a population of interest can be studied in a convenient way, within an appropriate time-frame, and with the resources available (Carlson & Morrison 2009, von Elm *et al.* 2007). The main limitation is that it is not possible to establish causality of an exposure with an outcome. However, this was primarily an exploratory study aiming to identify factors associated with, but not necessarily causing, a specific level or trend of HbA1c. Therefore, a cross-sectional study was identified as the most appropriate and feasible approach for the quantitative component. The inclusion of a survey was considered next.

Surveys

Surveys are used to collect high-level observations across a large sample (Bowling, 2002). They can be conducted online, face-to-face, by telephone, postal, or other self-completed methods (Gillham 2007). Cross-sectional studies often use descriptive surveys to measure phenomena, events, behaviour, or attitudes in a specific population (Calnan 2007). In health research, measures can include the prevalence of symptoms or reported use of health service users. Bowling (2002) outlines two key objectives: first, to estimate population parameters such as levels of health or sociodemographic characteristics and, secondly, to test a statistical hypothesis about a population such as people in lower socio-economic groups being more likely to report poorer health status. Surveys can include validated questionnaires to measure health or disease status or constructs such as everyday experiences and treatment satisfaction of patients with insulin-treated T2DM (Moock *et al.* 2010). Surveys are a convenient way for the researcher to elicit patient attitudes and relevant treatment information. Patients can benefit by answering questions in their own home at a time that is convenient for them (Gillham 2007). Limitations include: a lack of control over the order of answering questions (Gillham 2007); low response rates, particularly if questions are long and complex (Asch *et al.* 1997); and difficulties completing the survey for patients with literacy difficulties or linguistic problems

(Schillinger *et al.* 2002) leading to recruitment bias. Tick-boxes can limit information obtained, but boxes can be incorporated for comments. McColl *et al.* (2001) suggest that while information yielded from surveys is subject to error and bias, close attention to the questionnaire design can reduce this. Therefore, for convenience and patient accessibility, a cross-sectional postal survey was identified as a valid strategy for Phase 2. The sampling and recruitment methods are summarised next.

3.2.2.3 Sampling and Recruitment

In cross-sectional surveys, the aim of sampling is to draw a representative group of participants from the population of interest (Bowling 2002). The sampling method is important to ensure external validity of a study and to reduce the chance of random error variations and bias in the study's estimates. A potential limitation of the sampling for this study was that the research was conducted in a single geographic location. However, as the study was contextualised in relation to previous work on this topic, the validity of the evidence generated was supported by comparisons with previous work. Furthermore, the study location was not atypical of many other diabetes care contexts within the UK. To ensure the study focused on the target population, census sampling was used to recruit as many patients as possible who met the inclusion criteria within the study sites.

Inclusion and Exclusion criteria

Recruitment of patients was based on the following inclusion criteria: T2DM aged ≥18 years; receiving insulin for at least six months; and registered with a general practice within the Canterbury & Coastal Clinical Commissioning Group (C&C CCG) in East Kent. The exclusion criteria are presented in Table 7.

Table 7 Exclusion Criteria

- Patients unable to consent
- Patients who are deemed seriously ill
- Patients who are pregnant
- Patients who are unable to understand or speak English
- Patients who are unable to complete a questionnaire in English
- Patients participating in another study
- Members of the patient advisory group

Patients were sampled from five out of 23 general practices in the Clinical Commissioning Groups. The practices were purposively selected to capture patients from a diverse range of different socio-economic contexts. While the local population was predominantly White British and relatively affluent, practices within areas of higher deprivation were included to compensate for this potential bias. Practices were also sampled to ensure a diversity of practice population size, and level of insulin-related expertise and support given by the PNs and GPs. The sampling frame is shown in Figure 10.

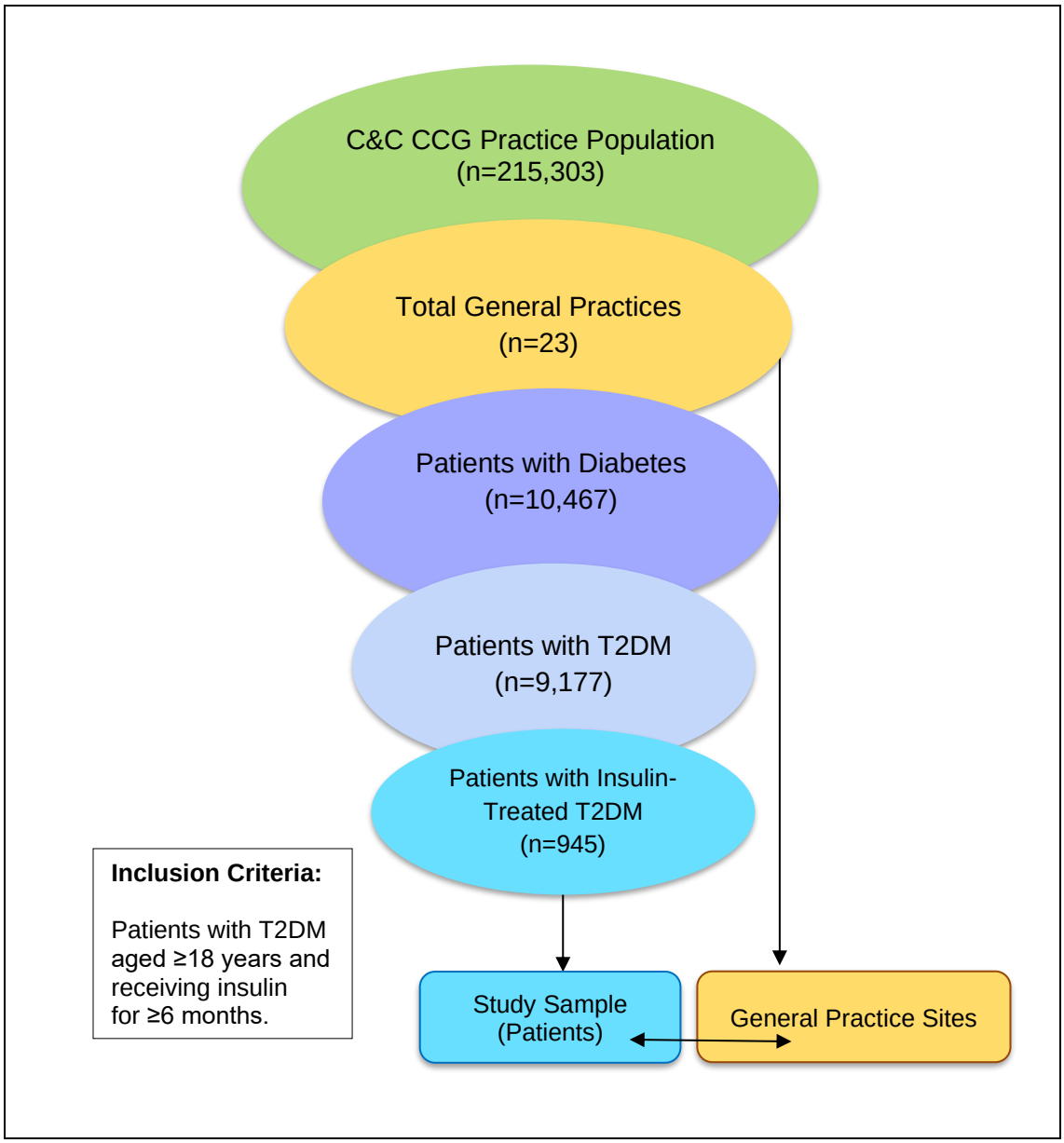


Figure 10 Sampling Frame
Key: C&C CCG = Canterbury & Coastal Clinical Commissioning Groups; GP = General Practitioner; T2DM = type 2 diabetes

The prevalence of diabetes including insulin-treated T2DM, though obtained from local CCG and practice data, was an estimate only as this was reliant on the patient's diagnosis being entered and accurately coded in their record.

Power Calculation

Advice was sought from the university faculty statistician to ensure adequate power for a logistic regression model using HbA1c as a dichotomous dependent variable, measured as optimal (HbA1c ≤59 mmol/mol), or suboptimal (HbA1c >59 mmol/mol), based on the optimal Quality and Outcomes Framework (QOF) target at the time (BMA & NHSE 2015). The power calculation was informed by Peduzzi *et al.*'s (1996) evaluation with additional guidance from the faculty statistician. If four covariates (independent variables) were included in the model, and the proportion of positive cases (patients with HbA1c ≤59 mmol/mol) in the sample was 0.20 (20%), the minimum sample size required would be $n = 10 \times 4/0.20 = 200$. Therefore, allowing for a recruitment rate of at least 50%, it would be necessary to recruit 400 patients, to achieve a sample of 200. The statistician also advised that, as this was an exploratory study, there could be more than four covariates.

Recruitment Method

Recruitment began in August 2015. Eight purposively selected general practices within the CCG were approached directly by the PhD research student, hereafter referred to as the researcher of this study and invited to participate. A copy of the study protocol, practice invitation letter, and Participant Information Sheets (PIS) were forwarded to each. Five practices agreed to participate. Each practice agreed to undertake searches to generate an anonymised list of eligible patients. A covering letter from the GP diabetes lead or Practice Manager was sent to all eligible patients with a study invitation pack (Table 8).

Table 8 Study Invitation Pack

- Covering letter from the practice
- Study invitation letter from the researcher
- Consent Form (coded)
- Participant information sheet
- Questionnaire (coded)
- Reply-paid envelope

Patients agreeing to participate were required to complete the survey together with a consent form to enable the researcher to access their computerised medical records. A reminder letter with a further invitation pack was sent at four

weeks. This has been shown to increase response rates (Edwards *et al.* 2002, McColl *et al.* 2001, Wensing *et al.* 1999). Anonymised characteristics (gender, age, and most recent HbA1c) of the non-responding patients were available in an anonymised coded database to determine potential response bias. See also Research Ethics and Governance for the Caldicott Guardian function of the practices. The next section describes the study measures.

3.2.2.4 Study Measures

Table 9 lists the variables measured in the study. These were generated from the completed surveys and patient computer record, and next described.

Table 9 Explanatory Variables

1. Sociodemographic characteristics
2. Clinical characteristics
3. Insulin management
4. Patient appraisal of insulin
5. Emotional wellbeing
6. Depression
7. Numeracy literacy

Sociodemographic Characteristics

Social and demographic characteristics (Table 10) are summarised next.

Table 10 Sociodemographic Characteristics

1. Age at recruitment in years and categories
2. Gender
3. Ethnicity (classified in line with their medical record: White British, White Other, Black, Asian, Chinese, mixed, other)
4. Employment status (employed, semi-employed, unemployed, retired, other)
5. Living alone (yes/no)
6. Alcohol intake (units per week), smoking status (yes/no/ex-smoker)

Clinical Characteristics

Clinical data include biochemical and monitoring data, and information relating to diabetes and comorbidity.

Biochemical and Monitoring Data

The biochemical data are displayed in Table 11. All tests were performed by the same local laboratory and derived from venous blood samples, except for the albumin-creatinine ratio (ACR) which was measured from an early morning urine specimen. The tests, undertaken as part of the patient's routine clinical care, were the most recently available within the previous 12 months. The HbA1c, the dependent variable, represented the average blood glucose level during the preceding 2–3 months. Serum cholesterol is a surrogate marker for, or risk of, cardiovascular disease (CVD). The estimated Glomerular Filtration Rate (eGFR) and ACR were an indication of chronic kidney disease (CKD). Both CVD and CKD are often coexistent with, and subsequent to diabetes.

Table 11 Monitoring Data and Biochemical Tests

Item	Categories based on QOF indicators
HbA1c (mmol/mol) IFCC units	Dichotomised as ≤59 or >59 and categorised as: ≤59, >59–≤69, >69
Total cholesterol (mmol/L)	Dichotomised as ≤5 or >5
eGFR (mls/min/1.73m2)	CKD stages 3–5
ACR (mg/mmol)	Dichotomised as ≤3 or >3
Blood Pressure (mmHg)	Systolic ≤140 or >140 & diastolic ≤80 or >80
BMI (kg/m^2)	Categories include <30 or ≥39

Key: ACR = albumin-creatinine ratio (microscopic proteinuria); BMI = body mass index; CKD = chronic kidney disease; eGFR = estimated glomerular filtration rate; HbA1c = glycated haemoglobin; IFCC = International Federation of Clinical Chemistry.

Type 2 Diabetes and Comorbidity

Table 12 lists clinical measures for T2DM and comorbidity. Comorbidity was included to assess the burden of other conditions on insulin use and glycaemic control.

Table 12 Clinical Data for Type 2 Diabetes and Comorbidity

1. Onset of T2DM and duration of insulin use (years).
2. Social care: housebound (carer/relative/nurse administers the insulin).
3. Insulin therapy (proprietary name, dose, frequency and device).
4. Other injectable glucose-lowering therapy (Glucogen-like peptide-1 receptor agonist), using the proprietary name.
5. Oral glucose-lowering therapy (generic name).
6. Other medicines (number of oral therapy type taken regularly each day.
7. Bariatric Treatment (gastric bypass/banding).
8. Person or location for diabetes monitoring review (Practice Nurse clinic, General Practitioner, diabetes consultant, Diabetes Specialist Nurse).
9. Target HbA1c level.
10. Severe hypoglycaemia (requiring hospital admission/attendance by a paramedic or doctor).
11. Comorbid disease including diabetes related complications (mental illness, CVD, hypertension, hyperlipidaemia, heart failure, atrial fibrillation, neurological disease, chronic kidney disease, respiratory disease, gastrointestinal disease, thyroid disease, musculoskeletal disease, genitourinary disease, neuropathy, retinopathy, and blood disorders.
12. Other conditions potentially impacting on insulin use and glucose control such as cancer.

Key: CVD = cardiovascular disease; HbA1c = glycated haemoglobin; T2DM = type 2 diabetes.

Insulin Management

The measures listed in Table 13 were obtained from the completed surveys. They related to insulin management, perceived level of glucose control, blood glucose targets, self-management behaviours, and access to support. These were worded and re-worded during the piloting of the survey (see Postal Survey Design).

Table 13 Insight into Glucose Control and Self-Management

1. Blood sugar is controlled (very well/well/moderately/poorly/don't know)
2. Last HbA1c was (HbA1c level/date if known/don't know)
3. Target HbA1c given by a nurse, GP or other health professional (yes/no/target HbA1c level)
4. Target pre-meal blood sugar given by a nurse, GP or other health professional (yes/no/target blood sugar level)
5. Understanding when blood sugars are too high or too low (always/most of the time/sometimes/rarely/never – these were also used for 6-9)
6. Ability to work out how much extra insulin is needed if blood sugar readings are regularly high
7. Making own decision to adjust insulin
8. Preferring a nurse or doctor to advise which dose to give
9. Knowing who to contact when having difficulty with insulin use (PN/GP/other/don't know)

Key: GP = General Practitioner; HbA1c = glycated haemoglobin; PN = Practice Nurse.

For measures of appraisal of insulin treatment, emotional wellbeing, depression, and numeracy literacy, four validated tools were identified. The rationale for their selection and method of validation are next explained.

Patient Appraisal of Insulin

Tool Selection

Measures of how patients perceive their insulin were produced from the scores of the Insulin Treatment Appraisal Scale (ITAS) by Snoek *et al.* (2007). Such measures were included as the effect of insulin on blood glucose levels can be hindered by people having negative feelings about it. Anderson *et al.* (2004) note how self-care and lifestyle restrictions imposed by insulin regimens can affect a patient's success in following treatment recommendations and achieving optimal glycaemic control. Four validated tools were considered.

The first was the Insulin Treatment Satisfaction Questionnaire (ITSQ), a five-factor, 22-item instrument, to assess regimen inconvenience, lifestyle flexibility, glycaemic control, hypoglycaemic control, and satisfaction with the insulin delivery device (Anderson *et al.* 2004). The ITSQ was a plainly worded tool, but it was not specific to T2DM and was, therefore, discarded. Next, the 34-item

T2DM Symptom Checklist (DSC-type 2) was considered. This has six dimensions to assess frequency and perceived burden of diabetes-related symptoms (Grootenhuis *et al.* 1994). The DSC-type2 was also rejected for not being specific to insulin-receiving patients. The third instrument, the Insulin Treatment Experience Questionnaire (ITEQ), comprises 28 items assessing everyday life experience and treatment satisfaction in patients with insulin-treated T2DM (Moock *et al.* 2010). The ITEQ was rejected too, as some domains showed only partial satisfactory psychometric properties, with the tool requiring further evidence of validity.

The fourth tool was the ITAS, a 20-item measure used in insulin-naïve and insulin-treated T2DM patients to assess positive and negative perceptions of insulin and changes therein (Snoek *et al.* 2007). It was conceptualised as a two-dimensional instrument, with appraisal of insulin as a single underlying construct, allowing for calculating a total score and two subscale scores for negatively and positively worded items (n = 16 and n = 4 respectively). Each item has a five-point Likert scale for patients to complete to what extent they agreed with each statement from strongly disagree to strongly agree. The scores range from 16–80 for the negatively worded and 4–20 for the positively worded items. When negatively worded scores are combined with the reverse-coded positively worded scores, the total scores range from 20–100. The higher the score, the more negative or positive attitudes are towards insulin therapy. The ITAS was selected because of the range of questions pertaining to negative and positive beliefs about insulin. Additionally, because the instrument could also assess changes in the appraisal of insulin over time, it would have a potential role in future follow-up studies of this research project.

Validation of ITAS

Two validation studies were assessed. The first was by Snoek *et al.* (2007) in a survey of insulin-naïve (n = 146) and insulin-treated (n = 136) T2DM patients. Respondents completed the Problem Areas in Diabetes (PAID) scale and the World Health Organisation-Five Wellbeing Index (WHO-5). Concurrent validity was assessed by calculating Pearson correlation coefficients which showed moderate correlations in the expected direction between the three tools. Discriminant validity was established by determining that patients using insulin

had significantly fewer negative appraisal scores than insulin-naïve patients. To test reliability, exploratory factor analysis (EFA), internal consistency and item-total correlations were examined. EFA suggested a two-factor structure, separating positively worded items (*n* = 4) and negatively worded items (*n* = 16). For internal consistency, Cronbach's alpha was 0.90 for negative and 0.68 for positive appraisal scales. For the total 20-item scale, Cronbach's alpha was 0.89, suggesting high homogeneity. Item-total correlations were 0.46–0.74 for the negative and 0.34–0.53 for the positive scales. Snoek *et al.* (2007) concluded the results suggested ITAS was a valid instrument for T2DM people with difficulty accepting insulin, and for assessing changes in the appraisal of insulin over time.

The second validation study, by Holmes-Truscott *et al.* (2014), was designed to undertake further psychometric validation in insulin-treated (*n* = 249) and insulin-naïve (*n* = 499) T2DM patients. The authors observed that since Snoek ***et al.'s*** (2007) study, the total ITAS score was the one most frequently reported. They replicated the original analysis and investigated internal consistency separately for each group. Factor analysis supported a two-factor structure with good internal consistency (negative subscale α = 0.90; positive subscale α = 0.69). A one-factor solution was not supported in either sample. Consistent with prior research, Holmes-Truscott *et al.* (2014) demonstrated that negative appraisals were significantly more common among non-insulin compared with insulin-using participants (*d* = 1.04), while the positive subscale score did not discriminate between groups. The findings supported the use of ITAS in insulin-naïve and insulin-treated T2DM patients. However, they recommended using the negative-item subscale score in preference to the total ITAS score, while paying close attention to the relevance of the positive items in the given population. Next, measures of emotional wellbeing are described.

Emotional Wellbeing

Tool Selection

Measures of emotional wellbeing were generated from the World Health Organisation-five Wellbeing Index (WHO-5) (Bech *et al.* 2003, Hajos *et al.* 2013). Adequate glycaemic control is significantly associated with improved mental wellbeing in T2DM; Papanas *et al.* (2010) suggested that it may, therefore, prove useful to identify manifestations of reduced quality of life (QOL) in patients with

worse control. It was also apposite for a tool in the survey to have positive wording in contrast to the Patient Health Questionnaire (PHQ-9), which followed later. Three tools were considered.

The first, the Problem Areas in Diabetes Scale-5 (PAID-5), is designed to measure diabetes-related emotional distress (McGuire *et al.* 2010). It is a reliable shortened version of the full 20-item PAID tool. Despite being brief and succinct, the PAID-5 was not selected because of its negatively worded questions. The second instrument was the Short Form of the Profile of Mood States (POMS-SF), a 37-item version of the full 65-item scale (Curran *et al.* 1995, Reddon *et al.* 1985). This instrument measures psychological distress across six domains (fatigue-inertia, vigour-activity, tension-anxiety, depression-dejection, anger-hostility, and confusion-bewilderment. The POMS-SF was also not chosen because of its length which might have proved too burdensome for some participants to complete.

The third, the WHO-5, is a short, concise 5-item measure of psychological wellbeing developed by the World Health Organisation (1998) from a longer 10-item index (Bech *et al.* 1996). It can also be used to track changes in wellbeing over time (Bech *et al.* 2003, Hajos *et al.* 2013, Lowe *et al.* 2004). Respondents are required to complete a six-point Likert-type scale for each item, ranging from 0 (not present) to 5. Items can be totalled and transformed to a 0–100 scale, with lower scales indicating poorer wellbeing. For reasons of widespread use in medical research, including studies with T2DM patients (Munro *et al.* 2013, Papanas *et al.* 2010), and its brevity and upbeat character, the WHO-5 was selected.

Validation of the WHO-5

Two studies evaluated the WHO-5. In the first, Bech *et al.* (2003) assessed validity of the WHO-5 in a Danish sample (n = 9,542), by comparing it with the mental health, role emotional, general health, and bodily pain subscales of the SF-36. Internal consistency of the WHO-5 and the mental health subscale in terms of the Cronbach alpha coefficient was 0.84 and 0.81 respectively. The Loevinger coefficient of homogeneity for both was 0.56 which was above the level of 0.40 for acceptance of unidimensionality. Regarding the intercorrelation

between the SF-36 subscales and the WHO-5, the highest Spearman coefficient was obtained for WHO-5 versus mental health (0.84) while the correlation of role emotional versus WHO-5 or versus mental health showed low coefficients. Bech *et al.* (2003) observed the tool to be significantly superior to the mental health subscale in terms of its sensitivity in differentiating between people whose health had deteriorated over the past year and those whose had not. They concluded that the WHO-5 reflected aspects of wellbeing other than just the absence of depressive symptoms.

In a second study, Hajos *et al.* (2013) examined psychometric and screening properties for depression in type 1 diabetes (T1DM) (*n* = 384) and T2DM (*n* = 549) patients in an outpatient clinic. Concurrent validity of the WHO-5 was assessed by calculating Spearman correlation coefficients with depression scores (PHQ-9), diabetes distress scores (PAID) and mental health status (12-item Short Form Mental Health Composite Scales Score; SF-12 MCS). To assess divergent validity, Spearman correlation with physical health status (SF-12 Physical Composite Scales Score, PCS) was evaluated. Moderate to strong correlations were observed between the WHO-5 and the PHQ-9 scores, the PAID and the SF-12 MCS scores (*rho* = 0.55–0.69, $p < .001$). Receiver operating characteristic (ROC) curves indicated a WHO-5 index cut-off of <50 performed best as an indication for likely depression, with sensitivity compared with PHQ-9 score ≥10 and ≥12 of 79% and 88%, respectively, and specificity of 88% and 76%, respectively. Confirmatory factor analysis confirmed a single factor structure for the WHO-5 in patients with T1DM and T2DM. Cronbach's alpha coefficients were 0.91 and 0.93 for T1DM and T2DM patients respectively. Item-total correlations ranged between 0.71 and 0.82 for T1DM, and 0.75 and 0.84 for T2DM patients. Hajos *et al.* (2013) concluded that the WHO-5 was a psychometrically sound instrument to monitor emotional wellbeing in both T1DM and T2DM patients. Measures of depression are next discussed.

Depression

Tool Selection

To measure psychological status with regard to depression, the PHQ-9 reported by Kroenke *et al.* (2001) was incorporated into the survey. There is extensive research demonstrating the association with and impact of mental health related

comorbidities such as depression, in people with T2DM (Calkin *et al*. 2013, Egede & Hernández-Tejada 2013, Lustman *et al.* 2000). In their meta-analysis, Lustman *et al.* (2000) confirmed a significant association between depression and poor glycaemic control but could not determine the mechanism. Egede & Hernández-Tejada (2013) conducted a review on the effects of depression on QOL in T2DM patients. They observed the combination of depression and T2DM is particularly problematic including those receiving insulin therapy. It was, therefore, relevant to incorporate measures of depression into the survey. Three tools were considered.

The first tool, the SF-12, is a shorter alternative to the 36-item SF-36 measuring eight domains of health including mental health (Ware & Gandek 1998, Ware 2000). The SF-12 was rejected as it was not specific to mental health. The second instrument, the Hospital Anxiety and Depression Scale (HADS), incorporates 14 measures of anxiety and depression in hospital and community settings (Snaith 2003, Zigmond & Snaith 1983). Though an established and widely used tool, this too was rejected in favour of the shorter PHQ-9.

The PHQ-9 (Kroenke *et al.* 2001, Kroenke & Spitzer 2002) is an easily self-administered 9-item diagnostic and severity measure of depression developed from the Primary Care Evaluation of Mental Disorders (PRIME-MD) diagnostic tool (Spitzer et al. 1999). Scores of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and severe depression, respectively. The extra item 10 is a global rating of functional impairment, correlating strongly with QOL, functional, and healthcare usage measures (Kroenke & Spitzer 2002). The PHQ-9 was selected because it is an established screening instrument in medical research, and widely used in general practice for detecting depression and guiding treatment decisions (BMA & NHSE 2015, Cameron *et al.* 2008, Reddy *et al.* 2010). It was therefore familiar to PNs and GPs. Consideration was given to omitting the ninth item inquiring about *"thoughts that you would be better off dead or of hurting yourself in some way"*. Kroenke & Spitzer (2002) note, however, that in primary care, of those patients requiring antidepressant therapy, few endorsing the ninth item have true suicidal ideation. It was, therefore, decided to include it but as a safeguard, patients endorsing the ninth item were contacted and offered a referral to their GP.

Validation of the PHQ-9

Two validation studies were appraised. The first was by Kroenke *et al.* (2001), observing it was half the length of many other depression measures, with comparable sensitivity and specificity, while consisting of the nine criteria upon which the diagnosis of DSM-1V depressive disorders is based. In their survey, the PHQ-9 was completed by patients (*n* = 6,000) in primary care and obstetric clinics. Construct validity was assessed using the 20-item Short-Form Health Survey (SF-20), self-reported sick days and clinic visits, and symptom-related difficulty. As PHQ-9 depression severity increased, a substantial decrease occurred in functional status on all six SF-20 subscales, while symptom-related difficulty, sick days, and healthcare utilisation increased. When examined as a continuous variable, its correlation was 0.39 with disability days, 0.24 with physician visits, and 0.55 with symptom-related difficulty. A PHQ-9 score ≥10 had a sensitivity of 88% and specificity of 88% for major depression. Results in the primary care and obstetric samples were similar. Internal reliability was judged as excellent, with a Cronbach's alpha of 0.89 and 0.86 in the primary care and obstetric sample respectively. Correlation between the PHQ-9 self-completed in clinic and, within 48 hours, by telephone was 0.84, with similar mean scores (5.08 vs. 5.03). Kroenke *et al.* (2001) concluded the PHQ-9 was a reliable and valid tool.

In a later study, Reddy *et al.* (2010) compared the efficacy of the HADS for depression (HADS-D) with the PHQ-9 for depression screening of T2DM patients (*n* = 561) in primary care. The proportion of the total sample completing HADS-D and PHQ-9 was 96.8% *vs.* 82.4% respectively. Using complete data (*n* = 456) from both measures, responders (*n* = 40) showed HADS-D scores in the moderate to severe range, compared with 103 identified by the PHQ-9. Cronbach's alpha coefficient for both scales was acceptable and comparable with previous studies. All item-total correlation measures exceeded 0.4. Only 35 cases were classified in the moderate to severe category by both tools. Items with the highest proportions of positive PHQ-9 responses were related to tiredness and sleeping problems and, on the HADS-D, feeling slowed down. Reddy *et al.* (2010) concluded that the PHQ-9 items contributing to the higher prevalence of moderate to severe depression were a result of diabetes-related symptoms or

sleep disorders, and that GPs should consider causes besides depression. The final tool for the survey assesses numeracy literacy.

Numeracy Literacy

Tool Selection

The adopted measure for numeracy literacy was the Subjective Numeracy Scale (SNS-3) validated by McNaughton *et al.* (2011). This measure was included because low levels of numeracy can result in poorer outcomes and self-management practices in diabetes (Huizinga *et al.* 2008, Osborn *et al.* 2010). Though reading skills are also important, numeracy skills are particularly relevant in the context of insulin use as it is necessary to interpret blood glucose meter data and insulin dose-adjustment based on glucose readings and/or carbohydrate intake. Huizinga *et al.* (2008) describe how poor numeracy skills in diabetes patients can lead to suboptimal glycaemic control, increased hypoglycaemia episodes or widely varying glucose values. Several validated tools were considered. The two most suitable for inclusion in the survey were the Diabetes Numeracy Test (DNT15) and the SNS-3.

The 15-item DNT15, a shortened, more time-efficient version of the 43-item DNT (Huizinga *et al.* 2008) evaluates numeracy skills and can also identify patients who may benefit from more targeted materials for ongoing diabetes management (White *et al.* 2010). Despite being targeted at patients with diabetes, the DNT15 instrument was rejected because of its length and complexity. The second tool, the SNS-3, is a brief 3-item version of the full SNS-8 (McNaughton *et al.* 2011, McNaughton *et al.* 2015, Zikmund-Fisher *et al.* 2007) designed to measure self-reported numeracy ability. The first two questions of the SNS-3 focus on self-reported numeracy skills and the third on subject preference. Questions 1 and 2 have a six-point Likert-type scale from 1–6. While 1 represents not good at all, 6 signifies extremely good. Question 3 also has a scale of 1–6 but 1 represents never while 6 indicates very often. If each question is answered, the scores range from 3–18. The higher the summed score, the greater the subjective assessment of numeracy ability. Because of its simplicity and brevity, the SNS-3 (McNaughton *et al.* 2015) was selected.

Validation of the SNS-3

To evaluate the reliability and validity, McNaughton *et al.* (2011) conducted a survey of adults attending an emergency department (ED) (*n* = 207). This included: subjective measures of general health literacy (Short Literacy Survey [SLS]); subjective measures of numeracy (Subjective Numeracy Scale-8 [SNS-8]); objective tests of literacy (Short Test of Functional Health Literacy in Adults [S-TOFHLA], the Rapid Estimate of Adult Literacy in Medicine [REALM]); and objective tests of numeracy (Wide Range Achievement Test-4 [WRAT4]). The SLS and SNS-8 had good internal reliability, with Cronbach's alphas of 0.74 and 0.82, respectively. The SLS Spearman's rank order correlation coefficient was 0.33, 95% confidence interval (CI) [0.20, 0.45] for the S-TOFHLA, with a standardized beta coefficient of 0.36 ($p < .05$). The SLS correlation coefficient was 0.26, 95% CI [0.13, 0.38] for the REALM, with a standardised beta coefficient of 0.38 ($p < .05$). The area under the ROC curve (AUC) for the SLS was 0.74, 95% CI [0.68, 0.80] compared to the S-TOFHLA and 0.72, 95% CI [0.65, 0.78] when compared to the REALM. The SNS-8 predicted numeracy well, with a correlation coefficient of 0.57, 95% CI [0.47, 0.65] for the WRAT4, a standardised beta coefficient of 0.30 ($p < .05$), and an AUC of 0.77, 95% CI [0.70, 0.82]. McNaughton *et al.* (2011) concluded that the SNS-8 and SLS were reliable, valid tests. In an exploratory sub-analysis, they confirmed the SNS-3 could function as well as the SNS-8 in the research setting.

McNaughton *et al.* (2015) later described the validation of the SNS-3 in seven different study datasets of patients (*n* = 3,536). Internal reliability was demonstrated by Cronbach's alpha which ranged from 0.67–0.86 (median alpha = 0.78), compared with 0.80–0.87 (mean alpha = 0.83) for the SNS-8. For criterion validity, the SNS-3 correlated very highly (range 0.89–0.95; median = 0.91) with the SNS-8. Both demonstrated significant correlations with the other numeracy measures. The authors concluded the SNS-3 was a sufficiently reliable and valid measure of subjective numeracy.

The next considerations were the sources for data collection, the questionnaire and medical record audit.

3.2.2.5 Data Collection

The two principal data sources were: the completed postal surveys; and an audit of the medical computer records. A third source was added later in the form of a supplemental Telephone Questionnaire. This was subsequent to a larger than expected response of patients wishing to be interviewed. In this section, the design of the survey is described followed by the patient record audit.

Postal Survey Design

To support validity, the survey needed to address the topics and constructs of interest to the study. Therefore, it needed to yield sufficient data to be able to answer the research questions. The topics of interest relating to the study questions are summarised in Table 14.

Table 14 Topics of Interest

1. What are the sociodemographic and clinical characteristics of the patients?
2. What is their insulin regimen?
3. How do they rate their blood glucose control?
4. Have they been given glycaemic targets by an HCP?
5. Do they know who to contact for insulin-related help?
6. Can they interpret their blood glucose readings?
7. Do they decide when and how to adjust their insulin dose, or does their HCP make the decision?
8. How do they perceive their insulin therapy?
9. What is their numeracy ability?
10. What is the assessment of their emotional wellbeing?
11. Is there evidence of depression?

Key: HCP = Healthcare professional

The organisation of the questionnaire in relation to the ordering and linking of the questions are next discussed.

Sequencing

The ordering sequence can ensure a respondent feels able to complete each section, increasing the likelihood of an adequate response rate (Dunn *et al.* 2003, Edwards *et al.* 2002). In a review of questionnaires designs, McColl *et al.* (2001) recommended general questions should precede specific ones, beginning with the easier ones, and working through to the more difficult. They also suggested leaving the personal demographic questions to the end. In the way question

categories are linked, one section can set the context for the next; conversely, respondents' answers to later questions can be influenced by those preceding them (Dunn *et al.* 2003). Therefore, the survey was carefully constructed to lessen these possibilities, as follows.

An outline of the purpose of the survey was included on the first page with contact details and completion instructions, and the participant identification (ID) code. The remaining pages included the question categories ordered in the sequence displayed in Table 15.

Table 15 The Postal Survey Sections

1. Questions about the patient's insulin use and blood glucose
2. WHO-5 Wellbeing Index
3. Insulin Treatment Appraisal Scale (ITAS)
4. Patient Health Questionnaire-9 (PHQ-9)
5. Subjective Numeracy Scale (SNS-3)
6. Questions relevant to the sociodemographic data

In keeping with McColl *et al.*'s (2001) findings, general enquires about a patient's insulin and blood glucose control were included in Part 1, which began with simple questions about when their diabetes was diagnosed and insulin commenced, before progressing to more detailed ones about their control, HCP support, and insulin titration. The WHO-5 came next in Part 2 because, it was brief with five positive, upbeat and undemanding questions. It was, therefore, considered that patients were more likely to complete the tool if it was positioned near the beginning and would feel encouraged to continue to the longer ITAS tool in Part 3. The PHQ-9, though brief, was negative and downbeat, and therefore came next in Part 4 rather than at the start. In contrast, the brief SNS-3 followed on in Part 5. Therefore, each set of questions contrasted with the next to sustain interest and motivation to complete the survey.

The sociodemographic questions were assigned to Part 6 on the final page because of their potentially sensitive nature. These questions related to age, employment status, self-reported ethnicity, if living alone, and smoking status. A

tick box was also incorporated for respondents to indicate their agreement to be contacted for interview. Text boxes were included for patients to add comments and further information about their responses. Tick boxes, such as those in the Likert scales, can limit information obtained from respondents, but by including a box for comments, responses can be enhanced with further information (Gillham 2007, McColl et al, 2001).

In addition to how a questionnaire is structured, the format can influence the response rate, introduce bias, and affect the validity of a study (Edwards *et al.* 2002); this is next outlined.

Questionnaire Format

A comprehensive and systematic approach was used to consider and address formatting factors described by McColl *et al.* (2001 p82). These include the length of the questionnaire, pagination, paper colour and quality, cover design, question and response category format, and instructions.

To enhance the design, wording and formatting, patients were actively involved at the beginning and throughout the study as part of Patient and Public Involvement (PPI). The National Institute for Health Research (NIHR 2014) recommends that researchers use PPI in study design by involving patients as advisers during the research process. This involvement is detailed later in the chapter. In summary, a small research advisory group made up of patients with insulin-treated T2DM helped to design and pilot the survey. Members of a local Diabetes UK group also contributed, and advice was sought from GPs, PNs and the academic supervisors. Following the pilot, discussions took place with patients and clinicians, and amendments were made in relation to the ordering of the questions, sentence construction, and formatting. Further piloting was conducted opportunistically with patients attending the Diabetes Clinic and this led to further revisions. Table 16 gives examples of amendments.

Table 16 Examples of Questionnaire Amendments

Items	Before	Amended following piloting and PPI discussions
Length of questionnaire	Too many questions	Reduced the number of questions
Pagination	Several one-sided pages stapled together	A4 double sided booklet
	Few pages with two parts per side	Each part on one side
Paper colour and quality	Small fonts all the same size	Larger fonts, larger size for headings
	All black print close together	Coloured lettering in parts and illustrations added
Cover design	Plain writing	Addition of lines and sections with illustrations
Question and response category format	The same throughout, with no lines between questions	Spaces and lines added to questions Colour and pictures added. Clearer numbering
Instructions	Title on cover included: *factors explaining poor control* Absence of telephone contact No detail of duration to complete	Wording on title page changed to: *factors explaining blood glucose control* Telephone contact added Approximate duration time added

Audit of the Medical Records

The next source of data was an audit of the clinical information in the patients' computer record. This was undertaken systematically by the researcher who accessed the record of each participant following their consent. The data collected were based on the study measures outlined earlier and used to validate survey responses, such as date of their diabetes diagnosis and duration of insulin therapy. Regarding comorbidity, consideration was given to using a comorbidity indicator such as the Charlson Comorbidity Index (Charlson *et al.* 1994) which is widely utilised in medical research. However, because of inconsistent and incomplete coding in patient records to ensure an accurate score, it was decided instead to enter key comorbidities which included general systems and specific conditions such as mental illness (depression, anxiety), neurological conditions (epilepsy), CVD (angina), respiratory (asthma, chronic obstructive pulmonary disease [COPD]), and diabetes-specific (retinopathy, neuropathy) conditions.

The design of the third data source, the supplemental Telephone Questionnaire is summarised separately in this chapter. The study invitation letters, PIS, Postal

Questionnaire, and Telephone Questionnaire are included in Appendices 4–7. The data analysis is summarised next.

3.2.2.6 Data Analysis

Data preparation and analysis play an essential role in providing accurate results and require a systematic approach (Argyrous 2007). These progressed in seven steps broadly based on Pallant (2016) and are shown in Table 17.

Table 17 Steps for the Data Analysis

1. Preparing the codebook
2. Creating the data file
3. Entering the data
4. Cleaning and checking the data file
5. Preliminary analyses
6. Modifying variables for further analysis
7. The statistical analysis

Step 1. Preparing the Codebook

Pallant (2016) highlights the importance of preparing a codebook or summary of the instructions used to convert the information obtained from each subject or case into a format compatible with IBM SPSS ('Statistical Package for the Social Sciences'). This involved defining and labelling each of the variables and assigning numbers to each of the possible responses. An extract from the codebook is presented in Appendix 8.

Step 2. Creating the Data File

Two anonymised databases were created as follows. The first was a coded database using Microsoft Excel 2015 with columns for the study code and the demographic and clinical characteristics. The second was a coded dataset created using IBM SPSS version 22 incorporating the variables from the codebook. These were accorded scale, ordinal, or nominal measures in line with the variable type. The data display was then developed and amended in accordance with the relevance and ordering of the variables.

Step 3. Data Entry

Excel Spreadsheet

First, minimal available data (age, gender and most recently recorded HbA1c) were entered onto the spreadsheet of all patients fulfilling the study inclusion criteria and who were invited to participate. Next, the researcher entered the audit data directly from their clinical computer record.

SPSS Dataset

The Excel spreadsheet data were then extracted and entered onto the SPSS dataset, and subsequently scrutinised for errors. Additional variables indicated agreement to participate, and agreement to be contacted for interview. A professional, reputable, academic data entry company known to the university, entered the responses from the anonymised coded postal surveys onto a separate SPSS file with only variables used for responses to the four validated questionnaires in the survey. This file was then incorporated into the main SPSS dataset. The postal survey comments were later analysed with the qualitative patient interview transcripts in Phase 4 of the study.

Step 4. Cleaning and Checking the Data

Data cleaning is described by Van den Broeck *et al.* (2005) as the process used for detecting, diagnosing, and editing faulty data. The procedure is an essential aspect of quality assurance and a determinant of study validity. This involves screening for and diagnosing lack/excess of data (due to errors and missing data); outliers/inconsistencies (due to true but unusual patterns); and suspect analysis results (no diagnosis but still suspect). A two-step process was used, based on that described by Pallant (2016) while adopting the key principles outlined by Van den Broeck *et al.* (2005) as follows.

1. Checking for errors

Each variable was checked for out-of-range scores; first, the categorical and then, the continuous variables. The ‘Explore’ function in SPSS was used to check the accuracy of the variables. Each was then scrutinised for errors with attention to the minimum and maximum values, and the mean score. Where necessary, each was manually checked.

2. Finding and correcting the error in the data file

On identifying errors in the data file, the value was either corrected or deleted.

Step 5. Preliminary Analyses

This step involved the processes for providing the descriptive statistics, dealing with the missing data, and assessing normality.

Descriptive Statistics

Descriptive statistics are the numerical, graphical and tabular techniques for organising, analysing and presenting data such as graphs, tables and numerical measures (Argyrous 2007). Descriptive data for this study included sociodemographic (for example, employment status, gender) and clinical variables (such as HbA1c level, insulin type, comorbidity). Measures include range, mean, standard deviation, proportions (%), kurtosis, skewness, and minimum and maximum figures. The categorical variables were analysed first followed by the continuous variables using the procedures for each outlined in Step 4, but with the addition of skewness and kurtosis statistics for the continuous data to provide information about the shape of the distribution (Bowers 2014). Skewness relates to the symmetry of the distribution, while kurtosis provides information about its 'peakedness' (Kirkwood & Sterne 2003).

Missing Data

It was important to consider how to deal with missing values as this could have a significant impact on the results. If any items for these tools had missing data, the overall score would be missing. A decision was made to keep this as the default as the total responses for each of the validated instruments exceeded 91% which was considered acceptable. To confirm this, when calculations were conducted for minimum (rather than total) completed items (WHO-5: at least four of five items, ITAS-negative: at least 12 of 16 items, ITAS-positive: at least three of four items, and PHQ-9: at least seven of nine items), there were no significant differences between those and the total scores. If any of the items were considered to be of importance (such as a high score for item 9 of the PHQ-9, *Thoughts that you would be better off dead or of hurting yourself in some way* or there was a high total PHQ-9 score but with missing items), then those were

analysed individually to assess a potential impact on insulin use or glycaemic control and, if necessary (as the PHQ-9), the patient contacted.

Assessing Normality

Histograms and box plots were generated for various groups (e.g. HbA1c, age, duration of insulin use) in order to plot the levels, assess trends and check for outliers. The box plots identified cases that had very high or very low extremes levels (such as HbA1c) as these could affect the analysis. Visually, the charts were helpful in comparing patients with HbA1c categories and to identify an element of responder bias by comparing variables of responders with non-responders.

Step 6. Modifying variables for further analysis

Once assured of accuracy of the data, the next stage was to undertake some data transformation to facilitate the analysis. This included creating categorical variables from continuous variables (such as age, CKD, and scores relating to insulin management), and ensuring that the appropriate measure (scale, nominal, or ordinal) was allocated to a variable. The total scores of the responses to each of the validated instruments were also calculated, considering that some of the items within different scales were inversely scaled (for example, the ITAS).

Step 7. Statistical Analysis

This section explains the tests used to identify associations of the independent variables with HbA1c as the dependent variable. These include tests for differences, correlations, and logistic regression.

Tests for Differences within HbA1c Categories

Statistics are used to evaluate the association between an exposure variable and the outcome of interest, to measure the association in the data collected from the sample, and then make inferences from the population from which the sample was derived (Kirkwood & Sterne 2003). The outcome of interest for this study was the dichotomised HbA1c classified as optimal (≤59 mmol/mol: yes = 1) or suboptimal (>59 mmol/mol: no = 0), reflecting the optimal QOF target at the time. However, it was also important to allow for individualised targets for groups such as frail older people (IDF 2013, NICE 2015). This became more evident as the

study progressed with increasing evidence for benefits of less rigid glucose targets in the higher risk groups (Hambling et al. 2017, McAlister et al. 2017). Therefore, the HbA1c was further categorised into three groups (≤59 mmol/mol; >59–≤69 mmol/mol; >69 mmol/mol).

The tests were used to compare differences between variables (demographic and clinical characteristics, and scores for WHO-5, ITAS, PHQ-9, and SNS-3) grouped within the HbA1c categories using Chi-Square (χ^2) for the categorical variables (a Yates Continuity Correction was used for 2 x 2 tables) and one-way between-groups analysis of variance (ANOVA), 95% CI for continuous variables. The level of significance was determined by an alpha of 0.05 (Pallant 2015). The tests were also used to assess the differences between the responders compared with non-responders. Where significance was found, an ANOVA post-hoc comparison was conducted to determine where the differences lay.

To assess the consistency and reliability of the HbA1c, two levels from the patients' medical records were evaluated: the most recent and the one before this (referred to as the *past* HbA1c). A paired-samples t-test revealed a statistically non-significant decrease from the past mean HbA1c (64.6 mmol/mol, *SD* = 16.5) to the most recent (64 mmol/mol, *SD* = 17), t (197) = 0.67, p = .507 (two-tailed). The mean decrease in HbA1c was 0.52 mmol/mol, 95% CI [1.01, 2.04]. As this was a marginal reduction, it was not considered necessary to adjust for this.

Correlations with HbA1c

To better assess the nature of the relationship between each covariate and HbA1c, scatterplots were generated. The variables were then correlated with the HbA1c (as a dichotomised and continuous variable) and with one another using the Pearson product-moment correlation coefficient (r). The strength of the relationship was determined by the size of the value of the coefficient, suggested by Cohen (1988 pp 79–81) with small (r = 0.10–0.29), medium (r = 0.30–0.49), and large (r = 0.50–1.0). For the 2 x 2 tables, Chi-Square was used, with the effect size determined by *phi* (small = 0.10–0.29, medium = 0.30–0.49, large = 0.50–1.0).

The Statistical Model

Logistic regression was performed to assess the impact of insulin-level factors and other potentially mediating factors with respect to the patients' glycaemic control, adjusting for confounders, with glycaemic control defined as the dichotomised HbA1c. As described earlier, this was an exploratory study and a number of variables were tested for the model based on those in the hypothetical model (Figure 9). This would then identify factors potentially contributing to glycaemic control in the sample population.

Argyrous (2007) discusses the use of logistic regression analysis when seeking to explain the relationship between a dependent binary variable and one or more independent variables. It can also be extended to consider complex relationships involving three or more variables. The use of logistic regression was therefore an appropriate choice for this analysis.

The next section summarises the methods used for the supplemental telephone questionnaire.

3.2.2.7 The Telephone Questionnaire

Design

The telephone questionnaire generated data relating to information that was expected to be easily retrieved from patients' clinical records but was found not to be easily identifiable or had not been recorded. Data included involvement of carers in administering insulin, hypoglycaemic episodes, and insulin use. Patients were also asked what they found most difficult or challenging about their insulin treatment, and what they believed to be of most help. The questions were piloted and amended using a similar process as that used for the survey questionnaire. The telephone survey was then undertaken by the researcher and a research assistant. The responses were entered directly onto a separate Excel spreadsheet and the data were incorporated into the main SPSS dataset.

Analysis

The steps used for the data preparation and analysis were also the same as those for the postal survey, but the categories and statistical tests (correlation, Chi-square test for independence, and ANOVA) were specific to the telephone

responses. These included establishing relationships between incidence of hypoglycaemia and insulin use, and with glycaemic control, as determined by the dichotomised HbA1c. The incidence of hypoglycaemia was then triangulated with the survey data to investigate its relationship with insulin management.

The qualitative responses about what patients found most challenging and most helpful were subjected to a content analysis. Content analysis, first used in the 19th century, is used today in research areas such as healthcare (Downe-Wamboldt 1992, Elo & Kyngäs 2008, Forbes *et al.* 2007). The data can be simplified and analysed to form categories that reflect the subject of the study in a reliable manner. The categories were incorporated into the SPSS dataset to facilitate the content analysis. Next, the way validity and reliability are supported is summarised.

3.2.2.8 Validity and Reliability

Validity in research refers to the extent to which the operationalised indicator is measuring the concept it is intended to measure and whether it is a valid empirical indicator of the theoretical concept (Bowling 2002, Calnan 2007), such as the use of ITAS in the survey, in determining a patient's negative appraisal of their insulin treatment. Concurrent validity tests whether the scores on the index are similar to other instruments which theoretically support the same construct (Hajos *et al.* 2013).

Reliability in relation to surveys, is described by Calnan (2007) as when a similar result is obtained in response to a particular question, or indicator, on repeated occasions. A range of factors can cause unreliability, such as poorly worded or ambiguous questions (Bowling 2002). Pallant (2016) summarises two frequently used indicators of a scale's reliability: test-retest and internal consistency. High test-retest correlations of scores obtained from the same people on two different occasions indicate a more reliable scale. Internal consistency is defined by the author as the degree to which the items in the scale are all measuring the same underlying attribute, the most commonly used statistic being Cronbach's coefficient alpha.

To support validity and reliability in the survey, instruments evidenced by validity studies were included. While it was not possible or appropriate to undertake a comprehensive psychometric evaluation of the questions that were developed for the survey (and telephone questionnaire), attempts were made to establish some validity in the instrument development work. To help support validity and reliability of these questions, patient, academic and health professional advice was sought on the phrasing and relevance of the questions. The questions were also piloted with patients and feedback sought from them on how understandable and relevant the questions were. These procedures enhanced both the face and content validity of these elements of the survey (Rattray & Jones (2007). To support internal validity in reducing selection bias (Creswell & Plano Clark 2011), patients were invited from a range of practices followed by second invitations for those who had not initially responded. External validity is the generalisability of the findings to the wider population of interest by selecting a representative sample (Creswell & Plano Clark 2011). For this study, the sample was limited to a population from one CCG in East Kent, but it added to existing knowledge of insulin use in T2DM.

3.2.2.9 Summary

In summary, a cross-sectional postal survey with a supplemental telephone questionnaire was designed to test a hypothetical model (drawn from the theoretical framework for insulin use) identifying a number of factors that might explain glycaemic control in insulin-treated T2DM within the context of general practice. Patients were recruited from practices with a range of population sizes and insulin-related skills. Statistical analysis tested for differences within HbA1c categories, correlated HbA1c with a number of variables and, finally, logistic regression was used to identify key variables that might explain glycaemic control. The analysis of the telephone questionnaire added to the findings. Next, the methods for the qualitative phases of the research are summarised.

3.2.3 Phases 3 & 4: The Qualitative Practice Nurse, General Practitioner and Patient Interviews

In these phases of the study, explanations for glycaemic control and insulin use in individuals with insulin-treated T2DM were explored by conducting face-to-face, semi-structured qualitative interviews with PNs and GPs, and then with patients. The conceptual and theoretical framework for insulin use, drawn from the synthesis, formed the basis of enquiry in the interviews. The aims and objectives are first summarised followed by the methodology.

3.2.3.1 Aims and Objectives

The Practice Nurse and General Practitioner Interviews

The aim was to identify factors associated with blood glucose control from the perspectives of GPs and PNs who consulted with insulin-receiving T2DM patients.

The objectives were:

- to explore the associated role of the HCPs and the related healthcare system within which they practiced;
- to identify the extent of their insulin-related knowledge, skills and experience;
- to establish interprofessional relationships and support they had with one another and with the diabetes specialists;
- to explore the way in which they consulted with insulin-treated T2DM patients, how they intensified insulin, and if or how they shared blood glucose goals;
- to examine their explanations for optimal /suboptimal glucose control and possible solutions; and
- to explore their views on inspiring other HCPs to acquire insulin-related skills.

The Patient Interviews

The aim of the patient interviews was to explore with insulin-treated T2DM patients their explanations of their glycaemic control by undertaking in-depth face-to-face interviews.

The objectives were:

1. to determine barriers to insulin titration from the patient perspective;
2. to explore with patients their knowledge and explanations for their current glycaemic control;
3. to elicit from patients the reasons, behaviours and practices they believed contributed to their glycaemic control;
4. to explore specific beliefs and practices related to use of insulin;
5. to explore how they self-managed their insulin therapy;
6. to identify how patients interacted with HCPs and accessed insulin-related support within the primary care setting.

The next section examines the use of qualitative methods used in health research followed by the rationale for selecting face-to-face in-depth interviews as the chosen methodology for the qualitative components of the study.

3.2.3.2 The Qualitative Methods Considered

Qualitative research, Bowling (2002) explains, is a method of naturalistic enquiry which aims to study people in their natural social settings. Its focus is on the meanings the participants attach to their world. Green & Thorogood (2014) characterised qualitative studies as seeking answers to questions about the what, how, or why of a phenomenon, rather than questions about how much or how many (such as how PNs and GPs might elicit patients' insulin-related concerns in a time-limited consultation or Diabetes Clinic). Theory is central to qualitative research, as it can be used to provide practitioners with a broader understanding of the study findings in relation to the phenomena being considered and the context of the enquiry (Reeves *et al.* 2008). Theory can take many forms and operate at different levels, including grand theory (universal or societal level), mid-range (local or cultural level) or micro-level (individual action).

For this study, two approaches were considered to support the qualitative enquiry. The first related to mid-range theory, examining primary care healthcare systems associated with insulin management in T2DM patients, with an observational ethnography in general practice settings. The second incorporated micro-level theory by interviewing patients, HCPs, and administrative staff in

general practice. Theoretical models were also considered such as the health belief model (Becker 1974), or the conceptual, theoretical framework for insulin use developed from the synthesis. The decision was made to use micro-level theory incorporating qualitative interviews, underpinned by a conceptual and theoretical framework (Figure 6) developed from the thematic synthesis.

Ethnography

Observation of behaviours, actions, activities, and interactions is a tool for understanding more than what people say about complex situations, and help understanding (Bowling 2002). Qualitative observations are referred to as ethnography. The most common ethnographic approach is participant observation where the researcher becomes immersed in the setting for extensive periods, recording comprehensive observations and field notes (Green & Thorogood 2014, Greenhalgh & Taylor 1997). Green & Thorogood (2014) describe how this provides the researcher with an emic perspective of an insider, with an explanation of a social world by being a participant within it. Alternatively, an ethnographic researcher can be a passive observer, watching behaviour and listening to people talk; providing a more etic perspective, which is that of an analyst. Ethnography requires periods of time observing, listening and writing accounts of observations and reflections. Despite the advantages of an ethnographic design in providing a more complete picture, this approach was discounted because of the limited resources and time available for the project.

Qualitative Interviews

Overview

Qualitative methods aim to make sense of, or interpret, phenomena in terms of the meanings people bring to them (Greenhalgh & Taylor 1997). Britten (1995) explains that qualitative interviewers aim to go below the surface of the topic under discussion, exploring what people say in as much detail as possible. Importantly, the interviewer aims to discover the participant's own framework of meanings while avoiding imposing the researcher's structures and assumptions as far as possible, using open-ended, neutral, sensitive, and clear questions. Interviews can be unstructured with one or two issues covered in detail, based mainly on what the interviewee says. This approach was rejected as it could take away the focus on insulin use and blood glucose control. Alternatively, semi-

structured, in-depth interviews incorporate a list of topics and can include open-ended questions for further exploration (Green & Thorogood 2014). This was the favoured method for HCPs and patients so that the interviewees could be guided towards the key topics of interest.

Interpretative Phenomenology

A qualitative interview is one whose purpose is to gather descriptions of the 'life-world' of the interviewee with respect to interpretation of the meaning of the described phenomena (Kvale 1983). Phenomenology, a theory developed by Edmund Husserl, is used to explain how individuals give meanings to social phenomena in their everyday lives (Reeves *et al.* 2008). It is the study of the lived experience or the life world (what people experience pre-reflectively) and often includes what is taken for granted or those things that are common sense (Husserl 1913, Laverty 2003). Interpretative phenomenological analysis (IPA) has its roots in psychology and recognises the central role of the analysis in making sense of the personal experiences of research participants (Pringle 2011). Because of the focus on subjectivity, this approach is popular in qualitative research in nursing; and enables nurses and other HCPs to reach, hear and understand the experiences of participants (Green & Thorogood 2014, Lopez & Willis 2004). The theory of knowledge (epistemology) is another consideration (Lapadat & Lindsay 1999, Shinebourne 2011). For this study, this can relate to a patient's knowledge of how insulin works based on their cultural beliefs and influences. Conversely, an HCP with a science background might focus mainly on the absorption, action and duration of insulin therapy. Therefore, an interpretive phenomenological approach was selected for the interviews which also encompassed the belief and knowledge of HCPs and patients.

Context

Interviews can be face-to-face or at a distance (Opdenakker 2006). Telephone interviews have the benefits of extended geographical access and can include hard-to-reach populations, but with reduced social cues; they were, therefore, rejected. Email interviews have wide geographical access, while giving the interviewer time to formulate questions; these were discounted for similar reasons, and because the responses can be less spontaneous (Opdenakker 2006). Face-to-face interviews require the interviewer to be extra attentive,

focusing on questions to be asked and answers given, but offer the overall advantages of social signals such as body language and voice (Britten 1995, Opdenakker 2006). Video links can also afford these benefits while interviewing at a distance (Deakin H. & Wakefield 2014) but having the dialogue in a patient's home (and for the HCP, at their practice site), can provide a more meaningful context (Britten 1995, Deakin H. & Wakefield 2014). Face-to-face interviews with the participant present was, therefore, the chosen method for HCPs and patients.

Summary

In summary, an interpretive analytical phenomenological approach was the chosen methodology to explore perceptions and experiences of insulin use during in-depth, semi-structured qualitative interviews undertaken face-to-face with PNs, GPs and patients. The conceptual and theoretical framework for insulin use developed from the thematic synthesis underpinned the interviews and analysis for this study, as this added new knowledge, by further integrating the review findings with the overall findings of the research. The method for sampling and recruitment is detailed next.

3.2.3.3 Sampling and Recruitment

Practice Nurses and General Practitioners

Purposive sampling was used to recruit at least one GP and one PN from each of the participating practice sites (except for the HCPs from the researcher's employing practice. The GPs were those who consulted with these patients either in their routine surgery appointments or who had a specialist interest in diabetes; while the PNs ran the Diabetes Clinics or had, in addition, received training and developed expertise in initiating and intensifying insulin treatment.

Recruitment

The PNs and GPs were contacted directly by the researcher who agreed a date and time for their interview. Each was offered the option of being interviewed at their own surgery or that of the researcher, and to be interviewed with their practice colleague or individually. Study information, including the HCP PIS, was then emailed to each.

Patients

Purposive sampling was used to recruit 30 or more patients, or until data saturation, from the survey participants who indicated on their questionnaire their agreement to be contacted for interview. Unlike quantitative research, a smaller sample can be appropriate for qualitative research (Marshall 1996). Green & Thorogood (2014) suggest that, while there is no specific number required, this is dependent on the aims of the research, the type of analysis, and resources available. However, the goal of purposeful sampling in any qualitative study is to obtain cases which are information-rich for the purpose of the research (Sandelowski 2000). Therefore, a sampling frame was developed to optimise the richness and variety of the subsequent interview data.

The Sampling Frame

Yardley (2000) describes how for qualitative research it is often preferable to employ theoretical sampling of small numbers of people chosen for their specific attributes of the phenomena of interest, rather than a representative sample requiring larger numbers. The primary intention for this study was to acquire a sample of patients (men and women) from each site, with a range of ages, insulin regimens, glycaemic control, and to include people from ethnic minority groups. The sampling frame is displayed in Figure 11.

Recruitment

The sample was drawn from the survey respondents who had indicated their agreement to be contacted for interview. They were recruited by the researcher who telephoned them directly to arrange a time and place for interview.

The next section outlines the development and piloting of the interviews.

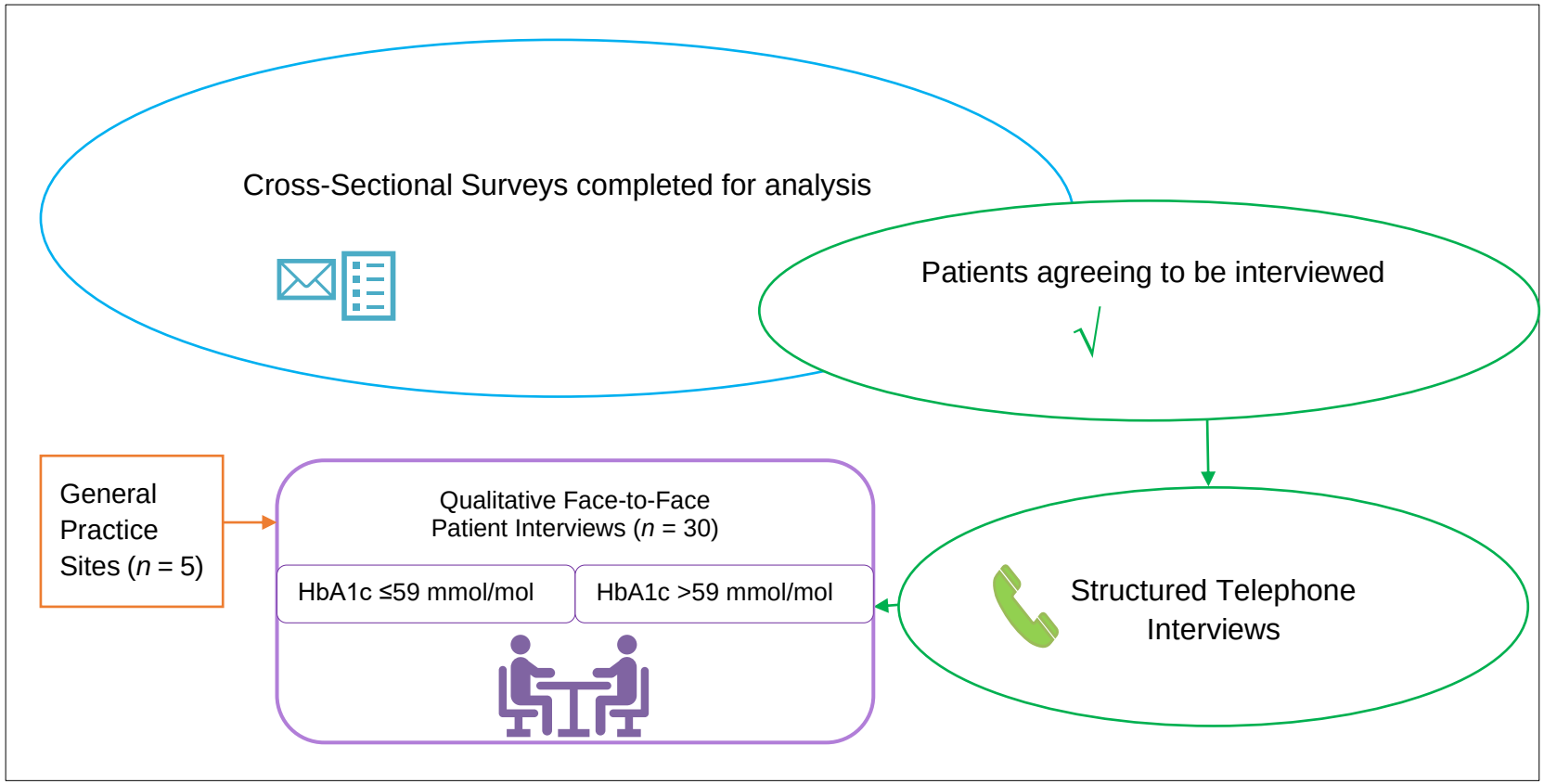


Figure 11 Sampling Frame for the Patient Interviews
Key: HbA1c = glycated haemoglobin

3.2.3.4 Planning the Interviews

In-depth and semi-structured interviews give the interviewer flexibility in how to ask questions, but careful preparation is needed to determine what to ask and how to ask it, in order to generate the most useful information (Green & Thorogood 2014). A two-step process was used to plan the interviews. The first step was to develop a topic guide each for the HCPs and patients and the second was to pilot the interviews. The process for each group is illustrated in Figure 12 and Figure 13.

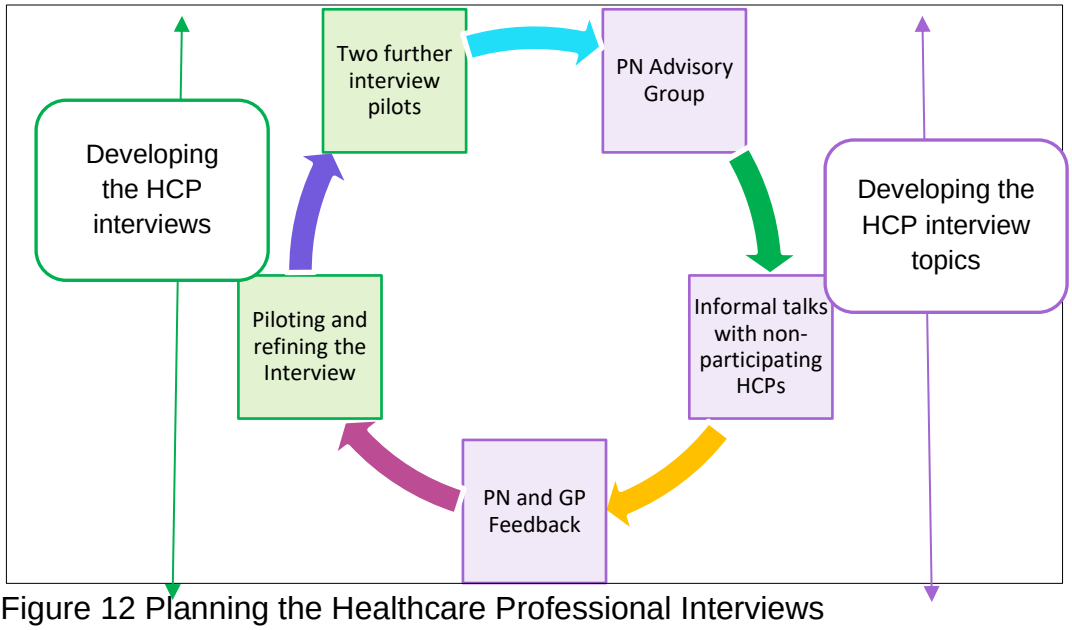


Figure 12 Planning the Healthcare Professional Interviews
Key: GP = General Practitioner; HCP = healthcare professional; PN = Practice Nurse.

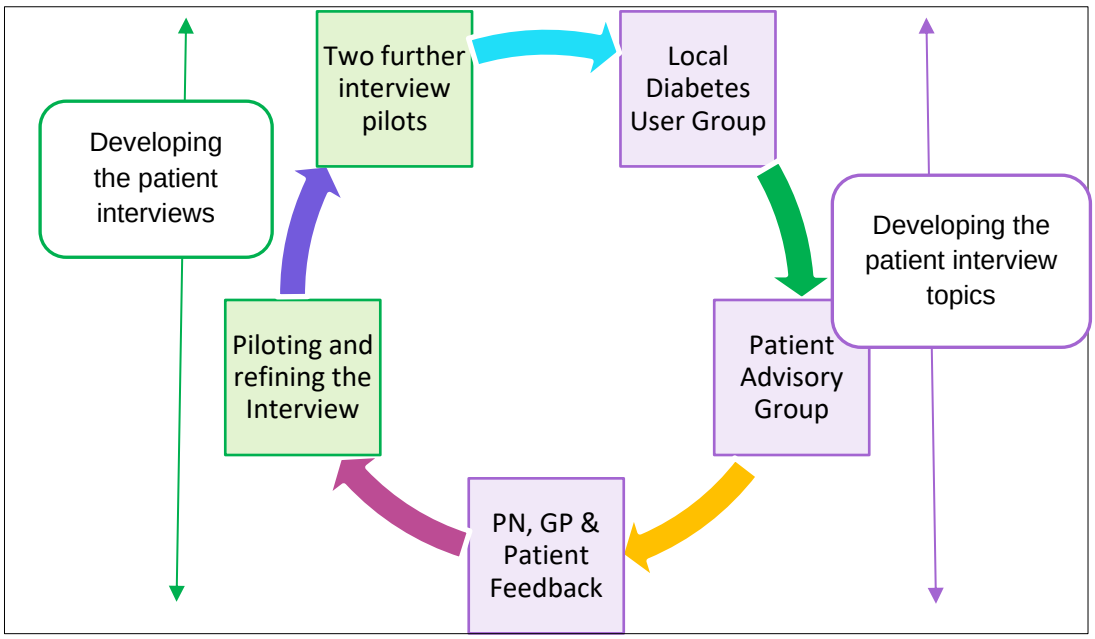


Figure 13 Planning the Patient Interviews
Key: GP = General Practitioner; PN = Practice Nurse.

Step 1: The Topic Guide

Healthcare Professional Topics

Developing a good topic guide was essential as the structure of an interview should, at the very least, be informed by the research question (Low 2007). The interview questions led to the study outcome in understanding the perspectives of the HCPs. It was especially important to gain an in-depth insight into their level of insulin-related skills, how they managed insulin therapy, and their subjective views around patient-related barriers. Information regarding insulin-related healthcare systems within the general practice setting was also necessary. A topic guide facilitated this by directing the interviews toward the issues under discussion.

The theoretic framework for insulin use, developed from the thematic synthesis, provided the topics on which to build further. A PN advisory group was formed by PNs not participating in the interviews. These HCPs then participated in a focus group to generate ideas for interview topics and for the structure of the interviews. A GP lead for diabetes commented further on the topics. The HCP topic guide is presented in Table 18 with the style of questioning used. As the interviews progressed, using an inductive process, further items were identified.

Table 18 Healthcare Professional Interview Topic Guide

Key Topics	Detail and Prompts	Questioning Style
BACKGROUND	Role Insulin-related training/experience/ confidence	Mainly structured
SYSTEMS	Clinics Insulin in-house or refer Communications with DSN/Consultants/Paramedics Patients discharged on insulin Accessing help Housebound	Semi-structured
CONSULTING	How HbA1c targets – shared or set Adjusting	Mainly open-ended
REASONS FOR SUBOPTIMAL CONTROL	Patient Barriers Self-Management Insulin dose-adjustment Timing of injections	Combination
PRACTICE PLANS	Insulin training for HCPs Inspiring others	Mainly structured
IDEAS	Eliciting patient concerns Overcoming barriers Insulin adjustment Agreeing targets Other practices Other	Mainly open-ended

Key: DSN = Diabetes Specialist Nurse; HbA1c = glycated haemoglobin; HCPs = healthcare professionals.

Patient Topics

The aim was to generate rich data and enable in-depth descriptions of patients' lived experiences of receiving insulin therapy each day, how they viewed their diabetes control and access to HCP support (Greenhalgh & Taylor 1997, Kvale 1983, Lowe 2007). As with the HCP topics, the subject guide was based on the themes identified from the theoretical framework for insulin use, discussions with patients and clinicians, and comments included in the completed surveys. The involvement of PPI, as for the postal survey, supported the process in helping to plan the topic guide. Opinions were also sought opportunistically with non-insulin receiving T2DM patients seen in clinic. The subject guide for patients is displayed

in Table 19. Following the HCP interviews, and as more patients were interviewed, the topic guide was further extended. Piloting the interviews for step 2 is now described.

Table 19 Patient Interview Topic Guide

Key Topics	Detail and Prompts	Questioning Style
BACKGROUND	Demographics Social setting, housebound, carer Diabetes /Insulin duration Insulin Type, regimen, dose Comorbidity and disability	Mainly structured
SYSTEMS	PNs and GPs, DSN, or hospital clinic Accessing advice Insulin relate admissions Housebound	Combination
UNDERSTANDING OF CONTROL	About diabetes and insulin About control, HbA1c Hypoglycaemia Side effects	Combination
CONSULTING	How, Insulin-related knowledge Listened to Understanding HbA1c targets – share or set Confidence to self-manage Dose-adjusting Information given	Mainly open-ended
EVERYDAY	What helps? what hinders? What's the worst thing? In Public Other insulin-treated patients? Diabetes groups?	Mainly open-ended
ADHERENCE TO INSULIN	Forgotten? Time given? Not given as feeling better? Extra dose as feeling worse? Insulin ran out? Ever not given for reasons other than being advised by HCP?	Mainly open-ended
IDEAS	Eliciting concerns Overcoming barriers Injecting in public SMBG and Insulin adjustment Agreeing targets HCP Support Patient Groups	Mainly open-ended

Key: DSN = Diabetes Specialist Nurse; GP = General Practitioner; HbA1c = glycated haemoglobin; HCP = healthcare professional; PN = Practice Nurse; SMBG = self-monitoring of blood glucose.

Step 2 Piloting the Interviews

Considerations

Factors to consider during qualitative interviewing are the setting, identity of the researcher, recording during the interview, order of topics, and the questioning style. The interview pilots played a role in addressing these areas with some slight differences between the patient and HCP participants, which are next described. The initial order of topics was represented in the interview guides. However, as Britten (1995) observes, qualitative interviewers aim to explore what is said and to uncover new areas or ideas that were not anticipated. Therefore, although the order of topics was planned, a flexible, inductive approach was adopted, allowing the order to vary and going back to issues already discussed, if appropriate.

The style adopted by the interviewer plays a central role in facilitating rich interview data, as follows. To help build a rapport it was important to put the interviewee at ease (Green & Thorogood 2014). Therefore, before the start, the researcher reminded each participant about the purpose of the interview, outlining the topics for discussion and giving assurance that the recording could be stopped at any time if requested and any concerns raised. Whyte's (1982) Directiveness Scale (Table 20) presents ways in which the interviewer can encourage and clarify the participant responses. The dialogue generated two key types of data requiring different styles of questioning. The first was the objective information and the second type were the rich data enabling in-depth descriptions and interpretations, requiring more open-ended questioning which typifies the style of qualitative interviewing (Low 2007). Figure 14 and Figure 15 give examples of dialogue styles.

Table 20 Whyte's Directiveness Scale

1. Making encouraging noises
2. Reflecting on remarks made by the informant
3. Probing on the last remark by the informant
4. Probing an idea preceding the last remark by the informant
5. Probing an idea expressed earlier in the interview
6. Introducing a new topic
(1 = least directive, 6 = most directive)

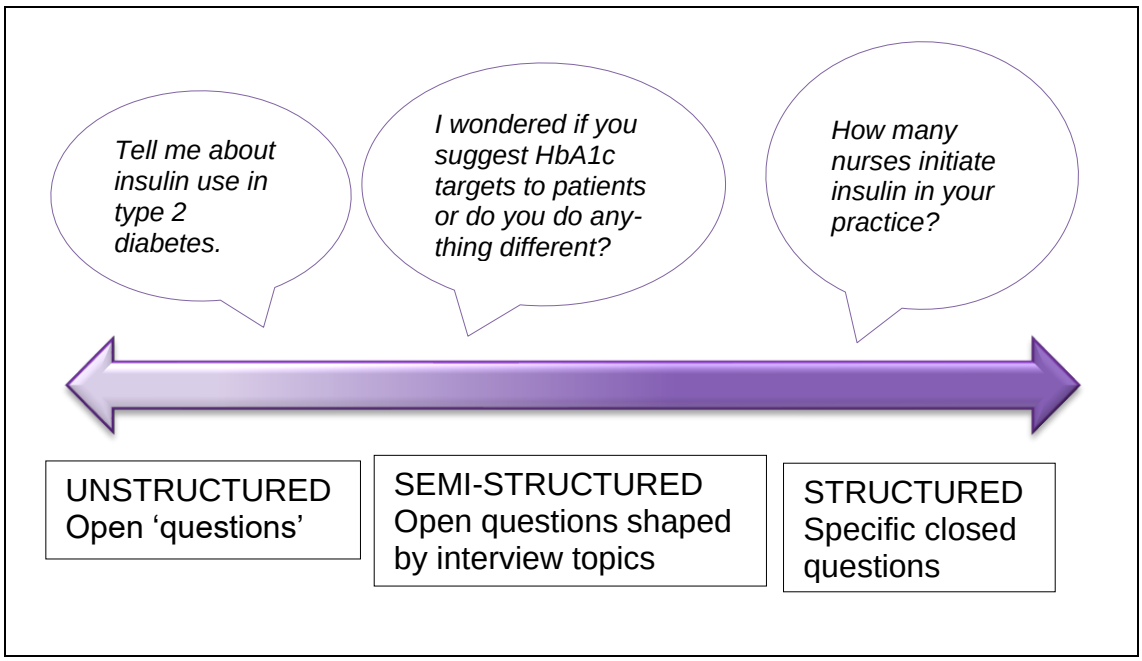


Figure 14 Healthcare Professional Interview Structure Continuum
Key: HbA1c = glycated haemoglobin

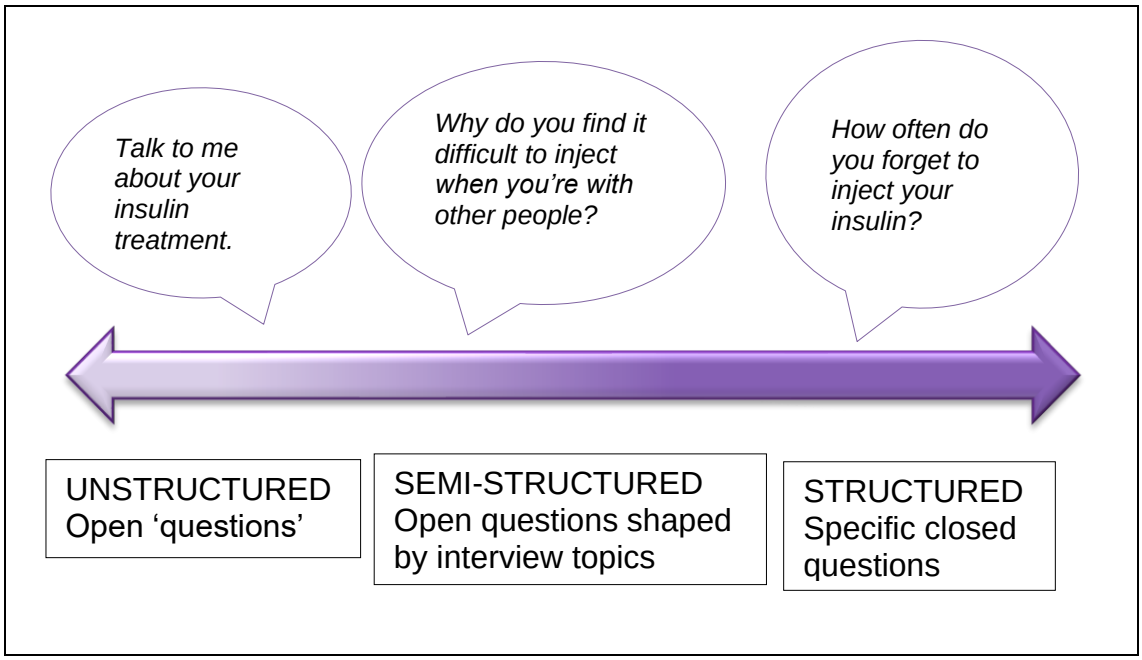


Figure 15 Patient Interview Structure Continuum

The Pilots

For the HCPs, three pilot interviews were conducted with members of the PN advisory group. The first was not recorded and had a fluid, more informal structure. This involved the interviewer stopping periodically to discuss certain aspects such as how questions were asked, and the order of the topics. The second and third interviews were audio-recorded, aiming to reflect the way in which the research interviews would be conducted. These included how consent

would be obtained. Discussion and reflections followed each, and subsequent refinements were made.

Before the pilot patient interviews, lay people (friends and colleagues) and non-insulin receiving T2DM patients were interviewed informally. Feedback from, and discussions with, the interviewees led to appropriate modifications to areas such as the ordering of topics and style of questioning. Digitally audio-recorded pilot interviews were then undertaken with two patients from the advisory group. Discussion with each interviewee was undertaken and further refinements were made for the interviewing style.

Summary

In summary, the pilot interviews enabled the researcher for this study to consider specific areas which enhanced the dialogue with participants and helped generate rich and meaningful interview data. The areas involved the interviewing style, whether open or leading questions were posed, if cues were picked up or ignored, and if interviewees were given enough time to explain what they meant. This also helped to prevent the researcher imposing their own views on the interviewee. Finally, while being open to a change of direction when it contributes to the research, the interviewer considered the need to maintain control of the dialogue by keeping the focus on its purpose; what needed to be found, asking the right questions, and giving appropriate verbal and non-verbal feedback. (Green & Thorogood 2014, Kvale 1983). The methods of data management are outlined next.

3.2.3.5 Interview Data Management

This involved two parts: data collection; followed by transcribing the interviews.

The interviews

To provide a more holistic perspective, the PN and GP interviews were conducted by the researcher at their respective practice sites while, for patients, these were undertaken at their home where possible or at the researcher's surgery according to patient preference. A carer or partner could be present if they chose. The discussions were digitally audio-recorded and could last up to one hour but stopped at any time if requested. At their conclusion, each participant was invited

to contact the researcher later if they wished to add any further information. Field notes were taken by the researcher following the interviews.

Transcribing the Interviews

The interview recordings were transcribed verbatim by the researcher while removing any identifiable information and entering the participant study code. While some aspects of a recording can add meaning to a transcription such as laughter or pauses, others have no bearing on the content and can obfuscate the participants' meanings (Oliver *et al.* 2005). Therefore, when certain responses such as "*uh huh, mm*" did not add meaning, these were excluded from the transcripts. The format of each document was standardised, based on the conventions highlighted by Green & Thorogood (2014) in Table 21.

Table 21 Transcript Conventions

Symbols	Meaning
I	Start of each new utterance by interviewer
R*	Start of each new utterance by respondent
?**	Beginning of utterance by unidentified speaker
wo-	Hyphen indicates a word interrupted by next utterance
(word)	Word(s) in round brackets indicate transcriber's guess at unclear word
CAPITALS	Words spoken more loudly than others
(...)	Indicate unclear material omitted by transcriber
In extracts reported in paper and reports:	
[ ]	Square brackets enclose material added by author
[...]	Indicate material omitted by author

*For this study, 'R' was replaced by 'PN' or 'GP'
**For this study, '?' was replaced by 'H' (husband) or 'W' (wife) if present at the interview

NVivo Software

Digital tools are increasingly used to support qualitative research analysis (Davidson *et al.* 2016). NVivo11 software was used to code and manage the data for this study as follows.

The transcripts were uploaded onto the software first, followed by the addition of the postal survey comments and qualitative data from the telephone questions. Next, any communication from the participants subsequent to their interview was entered and, finally, the researcher's field notes were used to add annotations to the data, if applicable. A systematic process then followed to link the transcripts to the individual participants and related information, as follows (the italics refer to the NVivo data locations).

The transcripts, project information, local CCG data, and site information were uploaded to the *Internal Sources*. Coded anonymised databases were located in the *Case Classifications* for each of the two groups of participants. The patient database was imported from the Excel spreadsheet set up for the postal questionnaire. A new database was developed for the HCPs. To ensure confidentiality, each participant was given a pseudonym. Each transcript was then linked to the related participant. The *Source Classifications* were the locations for the databases containing the interview information (date, place, duration) for each group of participants. These were also linked to the participant's individual transcript. Field notes were also located here. The *Nodes* were the coded themes and sub-themes developed for each participant group to contain the nodes formed during the analysis, which is next described.

3.2.3.6 Thematic Analysis

A framework analysis was used, while adopting an IPA approach throughout. By personally interviewing the patients and HCPs, and transcribing the interviews herself, the researcher had a clearer understanding of their lived experience of the topic that mattered to them (using insulin or supporting others to use it). Shinebourne (2011) explains that IPA recognises the role of the researcher in making sense of the experiences of the participants. This is known as the *double hermeneutic* (Smith *et al.* 2009), whereby the researcher tries to make sense of the participant trying to make sense of their personal and social world. The process of reflection and reflexiveness was used throughout the analysis to help prevent the researcher from imposing her own preconceptions or interpretive bias onto the data (Rodham 2015).

Framework Analysis

Framework analysis, developed in the 1980s by social policy researchers to analyse qualitative data in policy research, is popular in medical and health research (Gale *et al.* 2013, Smith & Firth 2011). It sits within a broad family of methods termed thematic analysis or qualitative content analysis (Gale *et al.* 2013). These approaches identify commonalities and differences in qualitative data before focusing on relationships between different parts of the data. They can generate unanticipated insights and allow for social as well as psychological interpretation of data (Braun & Clarke 2008).

The process for this research involved summarising and classifying data within a thematic framework (Green & Thorogood 2013, Ritchie & Lewis 2003). A coding frame was drawn up, grounded in the theoretical framework. This involved reading and re-reading the transcripts, reflecting on them, coding and classifying data into themes and sub-themes, while looking at relationships between the codes. Emerging themes and sub-themes were then identified inductively and incorporated into the coding frame. Throughout the analysis, in keeping with IPA, reflections were used to find meaning and understanding in the lived experiences of the participants. A five-step approach was used based on Green & Thorogood's (2014) process (Table 22) with modifications for integrating the themes into the NVivo software.

Table 22 The Framework Analysis Steps

1. Familiarisation with the data	Reading and re-reading the transcripts to become familiar with descriptive summaries including skills, confidence, insulin regimens, healthcare systems
2. Thematic analysis	Emerging themes identified and coded with themes becoming labels for codes.
3. Indexing	Systematically applying the codes to the whole data set
4. Charting	Rearranging the data according to the thematic content case by case, or theme. Charts contain summaries of the data to enable data to be compared across the interviews and within each interview.
5. Mapping and Interpretation	Exploring relationships between the codes. A model will illustrate the relationships between the concepts and typologies

Step 1. Familiarisation with the Data

This involved reading and re-reading the transcripts and the field notes to enable the researcher to become familiar with them in their entirety. Brief descriptive summaries were made of the participants which included the experience and confidence in insulin use, and the practice systems in place for insulin initiation and management.

Step 2. Identifying Themes and Developing Codes

Emerging themes were identified and coded by taking each section of coding in turn. Themes became labels for the codes, in keeping with the theoretical framework. In-vivo categories (phrases using the participants' own words) were used as codes to stay true to the data (Smith & Firth 2011) and were incorporated into the NVivo software as more themes and sub-themes developed.

Step 3. Indexing

This involved systematically reading, reflecting, and interpreting the remaining transcripts, linking extracts into the existing themes while developing new themes as these emerged from the interpretations. These were integrated directly into the NVivo *nodes* adding new ones when the interpretations required these.

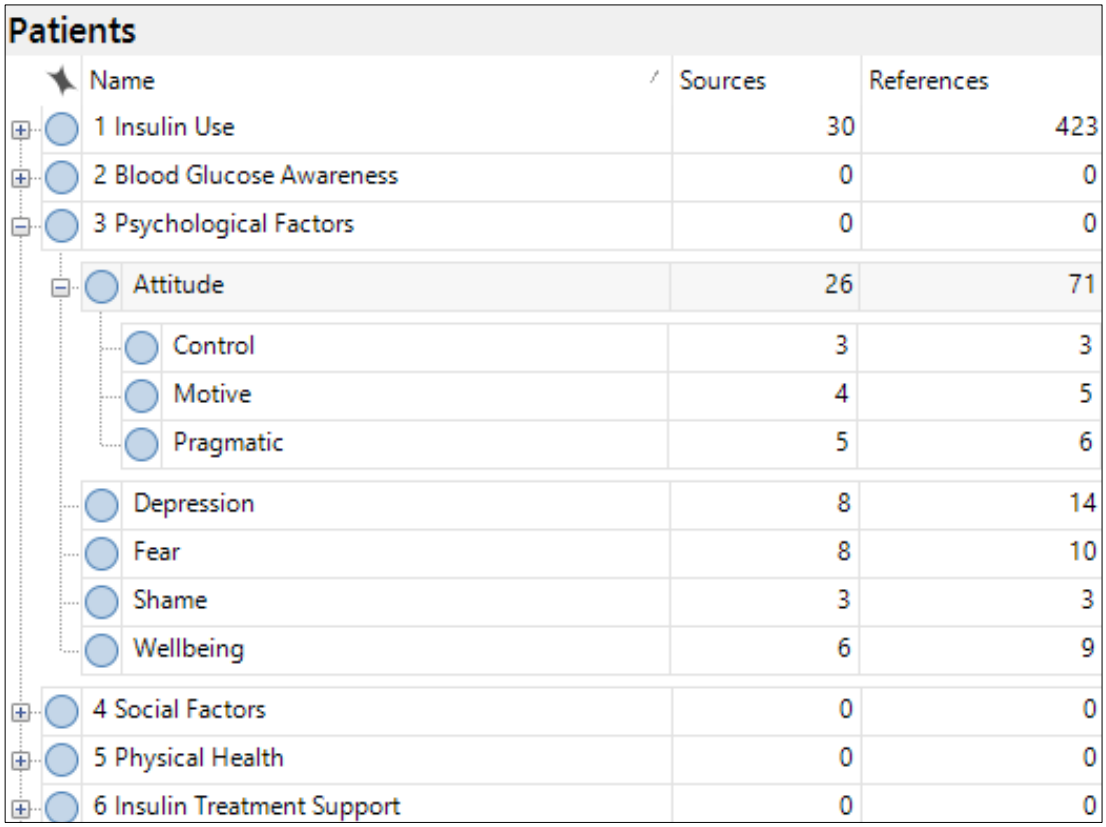
Step 4. Charting

Charting involved rearranging the data according to the thematic content, case by case, theme and sub-theme. The NVivo software facilitated such re-arrangement as these contained the transcript extracts, linking these to the individual participants. This also enabled data to be compared across the interviews and within each interview.

Step 5. Mapping and Interpretation

The final step, mapping and interpretation, involved looking at relationships between the *nodes*, and their association with insulin use and blood glucose control. Diagrams and tables from NVivo were used to explore and illustrate the relationships between the concepts and typologies. The rich data drawn from each theme would enable an in-depth descriptive account of the findings to answer questions posed by the research. An extract of the NVivo coding for the patient participants is shown in Figure 16.

An account of optimising the validity and reliability of the data is summarised next.



Patients

Name	Sources	References
1 Insulin Use	30	423
2 Blood Glucose Awareness	0	0
3 Psychological Factors	0	0
Attitude	26	71
Control	3	3
Motive	4	5
Pragmatic	5	6
Depression	8	14
Fear	8	10
Shame	3	3
Wellbeing	6	9
4 Social Factors	0	0
5 Physical Health	0	0
6 Insulin Treatment Support	0	0

Figure 16 An Extract from the NVivo Nodes.

3.2.3.7 Validity and Reliability

This section details how the validity and reliability of the qualitative data was supported in relation to the conduct of the interviews and in the analysis.

Conducting the Interviews

Green & Thorogood (2014) explain the differences between qualitative research and quantitative studies in determining validity. Qualitative studies consist of accounts of the world, and not direct representations of that world. The authors advise that interview data can still be valid if they are treated as contextual accounts. Validity was supported in the study by careful planning and considering such issues as the settings, presence of a recorder, and the style of questioning (Britten *et al.* 1995). This helped participants to be more relaxed in the discussions and share their views more truthfully. To aid the credibility of the interpretation, attention was paid to the quality and the techniques used during interview and for the analysis.

Noble & Smith (2015) discuss strategies to protect against bias and enhance the reliability of qualitative findings, such as accounting for personal biases and maintaining meticulous records of observations, and these support reliability in the present context. The process of reflexiveness by reflections, field notes, and discussions with academic supervisors was used to help prevent the researcher imposing her own preconceptions and viewpoints. Accurate records were maintained, supported by immediate transcriptions of the interview recordings.

The influence of the researcher could play a role in the integrity of the study (Britten 1995, Coar & Sim 2006). For the HCPs, the potential for bias of the researcher, as a fellow professional, was reduced as follows. The researcher was aware of her own insulin-related perspectives and avoided imposing those viewpoints during the discussions, while remaining non-judgemental. HCP participants can view interviews as a test of their professional knowledge with possible scrutiny of their practice, or they might see the interviewer as an authoritative source of clinical information (Coar & Sim 2006). To mitigate this effect, the researcher acknowledged her role at the start of the interview, assuring the participant that there were no right or wrong answers. Further, the researcher's HCP colleagues were excluded from the interviews.

For patient interviewees, it was also important for the researcher to consider how she was perceived, and to explain her role as a researcher before starting the interview. Boynton *et al.* (2004) discuss how participants rarely view the interviewer as a dispassionate scientist and may erroneously associate them with the organisation that delivers care. Patient participants may want to please the nurse researcher by giving the responses they think the interviewer wants (Britten (1995). To alleviate this effect, patients were given permission and encouraged to say what they thought, and not corrected if they said things the researcher believed to be incorrect, unless there was a risk of harm, which would be discussed at the end of the interview. To further reduce the interviewer's influence, patients who had consulted with the researcher within the previous 12 months were excluded from the face-to-face interviews.

Developing the Codes and Themes

There is currently no consensus on how to conduct thematic analysis using the IPA approach (Rodham *et al*. 2015, Pringle *et al*. 2011). There are, however, some principles to consider. While IPA is inductive in nature allowing ideas and themes to emerge from personal accounts, analytical trustworthiness and the process of reaching consensus in IPA is still important in supporting reliability and validity (Green & Thorogood 2014, Rodham *et al.* 2015). Within this it is important to acknowledge that interpreting an individual's understanding or experiences may be influenced by the researcher's own. (Reeves *et al.* 2008, Rodham et 2015). To test trustworthiness of the qualitative data coding, a COREQ (COnsolidated criteria for REporting Qualitative research) 32-item checklist developed by Tong et al (2007) was completed (

Table 23). This helped to ensure that important aspects of the researcher's role, the study methods, context of the study, findings, analysis and interpretations were reported in the thesis.

Analytical trustworthiness to support validity and reliability was incorporated into the coding process following some of the processes advocated by Rodham *et al.* (2015) as follows. The researcher having conducted the interviews and transcribed the recordings verbatim developed the initial coding while maintaining a *curious stance* and engaging in reflexivity. She continued to acknowledge how her own experiences could biase her interpretation of participant reports during the cording process. She then shared the interview transcripts with her two supervisors who in turn offered their own interpretations suggesting alternative coding. Detailed discussion followed, between the supervisors and the researcher with each offering the reasons behind their interpretations before coming to a consensus. It was important for each to be open to one another's interpretation. An example of how there was collaboration to reach agreement both in terms of interpretation and coding relates to the following extract from a PN:

> *"A lot of the diabetic patients definitely appear to have memory lapses…I had a chap only this week, I'd actually written it in red in his blood sugar diary to increase his lunch-time insulin to fourteen…he did it for three*

days, and then he turned over the page and he'd gone back to twelve and when I asked him he said, 'Oh I've done it wrong haven't I?'…"

The researcher interpreted this as a sense of frustration expressed by the PN, in addition to memory loss. The supervisors' interpretations related to the capacity of a patient in general to self-adjust insulin therapy, how blood glucose fluctuations were dealt with, educational approaches used to support self-adjustment, and barriers to self-adjustment. Consensus was reached and it was finally agreed to use the following codes (NVivo nodes): *self-adjust capacity, HCP-support,* and *HCP-suggested barriers*. This was then integrated into themes which included *addressing blood glucose variability and perceived insight of patients.* This process, used to increase validity and reliability of the analysis, supported the development of the coding and themes throughout the HCP and patient interviews. A comprehensive discussion took place between the researcher and her supervisors to ensure there was consistency between the data presented and the findings.

Table 23 The Completed COREQ Checklist

Topic	Item No.	Guide Questions/Description	Reported on Chapter (Ch) and Headings
Domain 1: Research team and reflexivity			
Personal Characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Ch3 METHODS, Phases 3 & 4, Interview data management
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Ch3 METHODS, Role of the researcher
Occupation	3	What was their occupation at the time of the study?	Ch3 METHODS, Role of the researcher
Gender	4	Was the researcher male or female?	Ch3 METHODS, Role of the researcher
Experience and training	5	What experience or training did the researcher have?	Ch3 METHODS, Role of the researcher
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	Ch3 METHODS, Phases 3 & 4, Sampling and recruitment, Validity and reliability Ch3 METHODS, Role of the researcher
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Appendix 5, Participant information sheets
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Ch3 METHODS, Role of the researcher
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Ch2 LITERATURE REVIEW, Thematic synthesis Ch3 METHODS, Figure 6 Conceptual and Theoretical Framework Ch3 METHODS, Qualitative interviews, Interpretative phenomenological analysis
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Ch3 METHODS, Phases 3 & 4, Sampling and recruitment
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Ch3 METHODS, Phases 3 & 4, Sampling and recruitment

Sample size	12	How many participants were in the study?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings
Non-participation	13	How many people refused to participate or dropped out? Reasons?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Ch3 METHODS, Phases 3 & 4, Interview data management, The interviews
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Patient characteristics
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Patient characteristics Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Characteristics of PNs and GPs
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Ch3 METHODS, Planning the interviews
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	Not Applicable
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Ch3 METHODS, Interview data management
Field notes	20	Were field notes made during and/or after the interview or focus group?	Ch3 METHODS, Interview data management
Duration	21	What was the duration of the interview or focus group?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Patient characteristics, Table 44 The interviews Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Table 44 HCP Database.
Data saturation	22	Was data saturation discussed?	Ch3 METHODS, Phases 3 & 4, Sampling and recruitment, Patients

Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	Ch3 METHODS, Phases 3 & 4, Interview data management, The interviews
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	Ch3 METHODS, Phases 3 & 4, Validity and reliability, Developing the codes and themes
Description of the coding tree	25	Did authors provide a description of the coding tree?	Ch3 METHODS, Phases 3 & 4, Thematic analysis including Figure 16 Extract from NVivo Nodes Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings
Derivation of themes	26	Were themes identified in advance or derived from the data?	Ch3 METHODS, Phases 3 & 4, Thematic analysis
Software	27	What software, if applicable, was used to manage the data?	Ch3 METHODS, Phases 3 & 4, Thematic analysis, NVivo Software
Participant checking	28	Did participants provide feedback on the findings?	Ch8 DISCUSSION, Dissemination
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Ch3 METHODS, Phases 3 & 4, Validity and reliability, Developing the codes and themes.
Clarity of major themes	31	Were major themes clearly presented in the findings?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Ch5 VIEWS AND EXPERIENCES OF PATIENTS, Interview findings

			Ch6 VIEWS AND EXPERIENCES OF PNs AND GPs, Interview findings Ch7 INTEGRATION AND SYNTHEIS OF PATIENT AND HCP PERSPECTIVES, Integrated experiences

Key: GPs = General Practitioners; HCP = Healthcare professional; PNs = Practice Nurses.

3.2.3.8 Summary

In summary, semi-structured in-depth face-to-face interviews were conducted by the researcher using IPA to understand and interpret the lived experiences of the participants. Thematic analysis was systematically undertaken underpinned by the theoretical framework for insulin use to contribute to the findings of the overall research. The methods used for the final phase, the integration and triangulation of the research findings, are now outlined.

3.2.4 Phase 5: Triangulation and Integration

The rationale for using sequential triangulation to optimise the use of the data generated from each phase of the study was discussed at the start of the chapter. Briefly, in order to optimise the data collected from the participants in this study, it was necessary for the qualitative HCP interviews to build on the quantitative survey of the patients, and in turn, the patient interviews built on those of the HCPs. This connects one set of findings with the next (Creswell *et al.* 2011). Using methodological triangulation in this way helps to find meaning and address the aims of the research (Caracelli & Green 1993, Morse 1991).

3.2.4.1 Aims and Objectives

The aim of sequential triangulation for this research was to enable the merging, integration and validation of the quantitative and qualitative findings to address the aims of the research in determining the different factors associated with glycaemic control and insulin use.

3.2.4.2 The Process

The process of the sequential triangulation is described in four parts based on an approach used by Ivankova *et al.* (2006).

Quantitative Phase

On completion of the quantitative cross-sectional postal survey, the statistical analysis was conducted. The findings were interrogated to identify areas for the HCP interviews to build on and clarify, such as the responses to the insulin management items in Part 1 of the postal survey and, similarly, for the findings of the supplemental telephone questionnaire.

Qualitative Phases

During the thematic analysis of the HCPs, the topic guide of the patients was extended to build on and explain some of the findings. Additionally, the patient interviews clarified responses from the postal survey and telephone questionnaire.

Integrating the Data

The third part of the sequence was the integration of all the findings using strategies to merge and connect the analysis. The results of each component can be brought together in a variety of ways (Creswell *et al.* 2011). Specific data from each dataset can be combined by merging them through data transformation by the quantification of qualitative data, referred to by Jick (1979) as scaling. The qualitative data of each group of participants can be synthesised together to identify similarities and divergence. Brannen (2005) identifies the different outcomes: corroboration of results; elaboration of the quantitative data by the qualitative data; complementarity results; or contradiction, where both types of data conflict. Data integration for this study was undertaken as follows.

Data Transformation

Data transformation of the qualitative data was used to combine them with the quantitative data to further explore and enhance the understanding of the patient perspectives of insulin use and blood glucose levels. The patient interview data relating to insulin management and support were quantified then coded and entered as variables on the SPSS dataset. These were first analysed for descriptives and then with tests for differences with variables from the postal survey and telephone questionnaire (HbA1c, demographic characteristics, insulin type, hypoglycaemia, and depression scores) using Chi-Square and ANOVA.

Synthesis of the Qualitative Data

Themes identified generated from the patient and HCP interviews were integrated and synthesised to identify areas of convergence and divergence with examples of interview extracts. These included experiences of self-management, consultation style, and healthcare systems. Their ideas for service improvements were also integrated.

Interpreting the Findings

The final part involved interpreting how the results answered the research questions and then identifying potential interventions to better support patients with insulin-treated T2DM.

3.2.4.3 Summary

In summary, sequential triangulation was undertaken to connect each study phase with each other, building on the next. Integration of the findings was undertaken by integrating qualitative and quantitative phases together using data transformation, and by synthesising the qualitative interview data of both patients and HCPs. The findings (identification of factors providing possible explanations for blood glucose control) were then used to identify ways to help patients optimise their insulin therapy and glycaemic control.

3.3 Research Ethics and Governance

3.3.1 Applications for Approval

Applications for National Health Service (NHS) research ethics and governance approval were sought from South East Scotland Research Ethics Proportionate Review Sub-Committee 02 (SE Scotland REC 02) on 18/04/15, and Kent & Medway Research Management and Governance Consortium (RMGC) on 16/07/15. Assurance of governance was received on 29/07/15.

Following a provisional favourable ethical opinion received on 28/04/15, agreed amendments were made and approved by the Research Ethics Sub-Committee on 11/05/15. The amendments included protocol wording, to make it more comprehensible to lay members, the addition of housebound patients, and agreeing to issue just one (instead of two) reminders to patients. A further

amendment was approved to include a tool in the survey to assess numeracy ability. The study began on 03/08/2015 and, as it progressed, one further substantial and two non-substantial amendments were approved. A summary of the amendments and related documents are included in Appendix 9.

3.3.2 Informed Consent

Informed consent was obtained in accordance with NHS research guidance (Medical Research Council 2014). The guidance highlights that for consent to be considered both legal and ethical it must be: given by a person with capacity; voluntarily given with no undue influence; given by someone who has been adequately informed; and a fair choice.

The patients who chose to participate in the postal survey completed the consent form and survey, returning both in the reply-paid envelope provided. Another signed consent form was obtained at the face-to-face interviews with patients and HCPs. Consent is a continuous process. All participants were informed that they could be excluded from the survey if they changed their mind and, similarly, during the interviews, they could request the recordings to be halted.

3.3.3 Data Handling and Confidentiality

Data handling was conducted in a confidential and secure way in keeping with local policy, NHS guidance, and the Data Protection Act 1998 (Department of Health 2016, NHS England 2014) later enhanced by the General Data Protection Regulations introduced in 2018, and in accordance with the Declaration of Helsinki (World Medical Association 2013).

The searches for potential participants in all the sites, were undertaken by the practices. The researcher did not access the patient medical record without prior consent. Upon receipt of the completed surveys, the consent forms were separated and kept in a locked secure place. Other identifiable data were stored securely in a locked cabinet and/or password-secured computer files. All participants were advised that they would not be identifiable in any future published reports.

3.3.3.1 Caldicott Guardian Function Of The Practices

This section outlines the Caldicott Guardian function of the practice sites in the provision of data for the research. A summary is first given of the development of the Caldicott Principles which underpin information governance, confidentiality and data sharing.

The Caldicott Principles

Following a review, chaired by Dame Fiona Caldicott, of how patient information was handled across the NHS, six Caldicott Principles were developed in 1997 (UK Caldicott Guardian Council 2017). Organisations are required to follow these Principles to ensure that information which can identify a patient is protected and should use the principles as a test when deciding whether they need to use information that would identify these individuals. Following the completion of the Information Governance Review led again by Dame Fiona Caldicott, known as the Caldicott 2 Report (Department of Health 2013, UKCGC 2019), a seventh principle was developed to encourage health and social care professionals to share information across teams when deemed to be in the best interest of patients and service users, to maximise safety and quality of care. From 2002 local authorities, and later health organisations, such as general practices, were required to appoint a Caldicott Guardian to ensure the protection of confidential information and that it was shared wisely including in research-related areas (UKCGC 2017). Table 24 lists the seven Principles.

Table 24 The Caldicott Principles (UK Caldicott Guardian Council 2017, p5)

Principle 1.	Justify the purpose (s) for using confidential information
Principle 2.	Don't use personal confidential data unless it is absolutely necessary
Principle 3.	Use the minimum necessary personal confidential data
Principle 4.	Access to personal confidential data should be on a strict need-to-know basis
Principle 5.	Everyone with access to personal confidential data should be aware of their responsibilities
Principle 6.	Comply with the law
Principle 7.	The duty to share information can be as important as the duty to protect patient confidentiality.

The Provision of Data for Research

The Caldicott Guardian function of the practices in providing data for research was underpinned by the Caldicott principles as follows. Each practice required assurance that the research had undergone NHS Research Ethics Committee review and Governance approval. This was evidenced by the researcher providing each Practice Manager with a copy of the letters confirming the favourable opinion by SE Scotland REC 02 dated 18/04/15 and *Assurance of Governance* from RMGC for Kent & Medway dated 29/07/15, with a copy of the research protocol. Additionally the researcher's employing Practice Manager wrote a letter to each Practice Manager confirming her employment and pre-engagement checks including Criminal Records Bureau check. The Caldicott Guardian function of the practices next included the provision of a Letter of Access (LOA) for Research signed by the Practice Manager or GP lead of each practice site. This outlined the legal requirements of the researcher to ensure all patient and staff information remained secure and strictly confidential at all times, in keeping with the NHS Confidentiality Code of Practice and Data Protection Act 1998 (Department of Health 2016, NHS England 2014), therefore, ensuring the researcher had no access to patient identifiable data without the patient's consent. The related documents are included in Appendix 9. During recruitment, a member of the practice team, delegated by the Practice Manager, undertook the searches to identify eligible patients, eliciting any objections to receiving a study invitation from the researcher. Invitations were sent to those not objecting as follows.

- The name, address, gender, age and most recent HbA1c were exported onto an Excel database by a member of the healthcare team.
- Each of the five sites was allocated a study site number by the researcher (1, 2, 3, 4, 5). Each practice used their allocated number to code the patient list, for example: Site 1 listed patients as 100l, 1002, 1003, 1004 onwards, Site 2 listed patients as 2001, 2002, 2003, 2004 onwards.
- A coded anonymised database was generated by removing all identifiable data. The anonymised list included only gender, age and most recent HbA1c alongside the study code.

- The healthcare team member was asked to address the study invitation packs (previously coded by the researcher) to match the coded anonymised list, after undertaking final checks for serious illnesses or deaths before posting.
- The researcher addressed uncoded envelopes for patients who consented for her to do so when they were contacted by the member of their healthcare team. The coded packs were then enclosed into these.
- On receiving the coded completed surveys and signed coded consent forms from patients agreeing to participate, the researcher accessed the patient's medical records to collect data and enter it onto the anonymised database under the matching code.
- The remaining coded non-responders with age, gender and HbA1c on the database were sent a reminder at four weeks.

The researcher confirmed with each Practice Manager that she observed confidentiality at all times as required by the Caldicott Principles, complying with the legal requirements set out in the LOA, and she did not breach patient and practice confidentiality.

3.3.4 Funding

While the study was self-funded, the researcher was awarded a Band Trust Research Scholarship by the Florence Nightingale Foundation, and a PhD Fee Support Award by the NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC) South London to support her PhD.

3.3.5 The Role of the Researcher

The researcher had both a research and clinical role. The project was undertaken by the researcher for her doctorate at King's College London. Her research activities for this study have already been outlined in each of the study phases. Her clinical role is as a Lead Nurse and Advanced Nurse Practitioner employed by one of the participating practices. To alleviate potential concerns of the participants, this was addressed as follows:

- the PIS included an assurance to patients that that their healthcare would not be affected whether or not they chose to participate;
- the researcher did not interview patients who had consulted with her within the last 12 months;
- PNs employed by the researcher's practice and their GP diabetes lead were excluded from the study.

The last section of this chapter relates to the contribution of PPI to the study.

3.4 Patient and Public Involvement

The use of PPI was observed by Mockford *et al.* (2012) to be an integral part of healthcare, with its emphasis on involving individuals and communities in the shaping of health and social care services. The National Institute for Health Research (NIHR 2014) highlights the value of patient contributions in research. Patients can make judgements based on their understanding of their condition that HCPs and researchers may not have considered. This section summarises their contribution.

3.4.1 Patient Diabetes Group

The researcher attended meetings of a small Diabetes UK group outside of the study area, to engage with its members and elicit ideas and suggestions for the patient interviews. At the first meeting, a presentation was given by the researcher about insulin-treated T2DM and some of the challenges experienced by patients. This was followed up at a later meeting when the researcher facilitated discussions about interview topics. A feedback information leaflet summarising their suggestions and ideas, and distributed to the members, is featured in Appendix 10. The researcher met several times with the group to update them on the study and elicit comments and ideas as the research progressed.

3.4.2 Patient Advisory Group

A small research advisory group was established consisting of patients with insulin-treated T2DM. The role of the group was to advise on the development of documents and interview topics for the study. Patients also helped to pilot the

surveys and interviews. In addition, the group provided a forum for discussion and advice on the progress of the study.

3.4.3 Practice Nurse Advisory Group

Clinicians also contributed to the research development. A small PN group was established to discuss ideas for interview topics, comment on the Participant Information Sheet and pilot the interviews. The patient and clinician topic guides were subsequently amended. Associated suggestions and advice were also sought from a GP with a specialist interest in diabetes.

The next chapter outlines the findings of the quantitative Cross-Sectional Survey.

4. FINDINGS OF THE CROSS-SECTIONAL SURVEY

This chapter presents the findings of the Cross-Sectional Study in two parts: the first part details the findings from the main postal survey; and the second part details the findings from the supplemental telephone questionnaire.

4.1 The Postal Survey

The Postal Survey is described under the following headings

1. The Practice Sites
2. The Participants
3. The Survey Findings and Analysis

4.1.1 Practice Sites

The five sites had a total patient population size (*n* = 66,584) ranging from 2, 784 to 35,090. Five percent of patients (*n* = 3,170) had a recorded diagnosis of type 2 diabetes (T2DM). The prevailing ethnicity of the patients in the participating sites was White British. On the index of multiple deprivation, three practices were on the fifth least deprived decile and two practices were on the third least deprived decile.

Each practice provided diabetes management and monitoring clinics run by one or more Practice Nurses (PNs) with varying degrees of autonomy. The three largest practices (Sites 1, 3 and 5) had PNs and General Practitioners (GPs) who conducted insulin initiation and intensification for T2DM patients, while the two smallest ones (Sites 2 and 4) referred such patients to the Community Diabetes Specialist Nurse (DSN) or to a Diabetes Consultant. The practice site data are presented in Table 25.

Table 25 Characteristics of the General Practice Sites

Site Characteristics	Total	Site 1	Site 2	Site 3	Site 4	Site 5
Practice population *n*	66584	16178	5310	7222	2784	35090
Index of multiple deprivation decile*	-	5th	5th	3rd	5th	3rd
Patients registered with T2DM *n* (% of practice population)	3170 (5)	671 (4)	324 (6)	280 (4)	133 (5)	1762 (5)
Patients with Insulin-treated T2DM *n* (% of T2DM)	473 (15)	70 (10)	54 (17)	50 (18)	17 (13)	282 (16)
Insulin initiation provided by the practice *Yes/No*	-	Yes	No	Yes	No	Yes
GPs trained and experienced in insulin initiation and intensification *n*	3	1	0	1	0	1
PNs trained and experienced in insulin initiation and intensification *n*	6	2	0	1	0	3
PNs who reviewed patients with T2DM *n*	11	2	1	2	1	5

*On a scale of 1–10, 1 represents the least deprived decile and 10, the most deprived.

Key: GP = General Practitioner; PN = Practice Nurse; T2DM = type 2 diabetes.

4.1.2 Participants

Following exclusions (*n* = 61), 412 patients were invited to participate in the survey (see recruitment flow chart in Figure 17). A total of 210 of these patients completed and returned the surveys, but nine were excluded because they did not meet the inclusion criteria. The remaining sample was 201 eligible patients, giving a 50% response rate.

4.1.2.1 Differences Between Responders and Non-Responders

The differences between patients who responded to the questionnaire and those who did not are shown in Table 26. In summary, responders were slightly older, with mean age 70 (range 37–90) vs 68 (range 37–93) years; *p* = .075) and had a significantly lower mean glycated haemoglobin (HbA1c) (63.9 mmol/mol, *SD* = 16.9 vs 68.4 mmol/mol, *SD* = 17.4, *p* = .009) than non-responders. There was also a significantly higher percentage of responders with HbA1c within the Quality and Outcomes Framework (QOF) target level of ≤59 mmol/mol and a lower percentage with HbA1c >69 mmol/mol compared with the non-responders (*p* = .025). The male to female ratio was similar in both groups, with 58% (*n* = 117) males in the participating sample, and 57% (*n* = 116) males in the non-participating sample (*p* = .953). The demographic and clinical characteristics of the participants are next described.

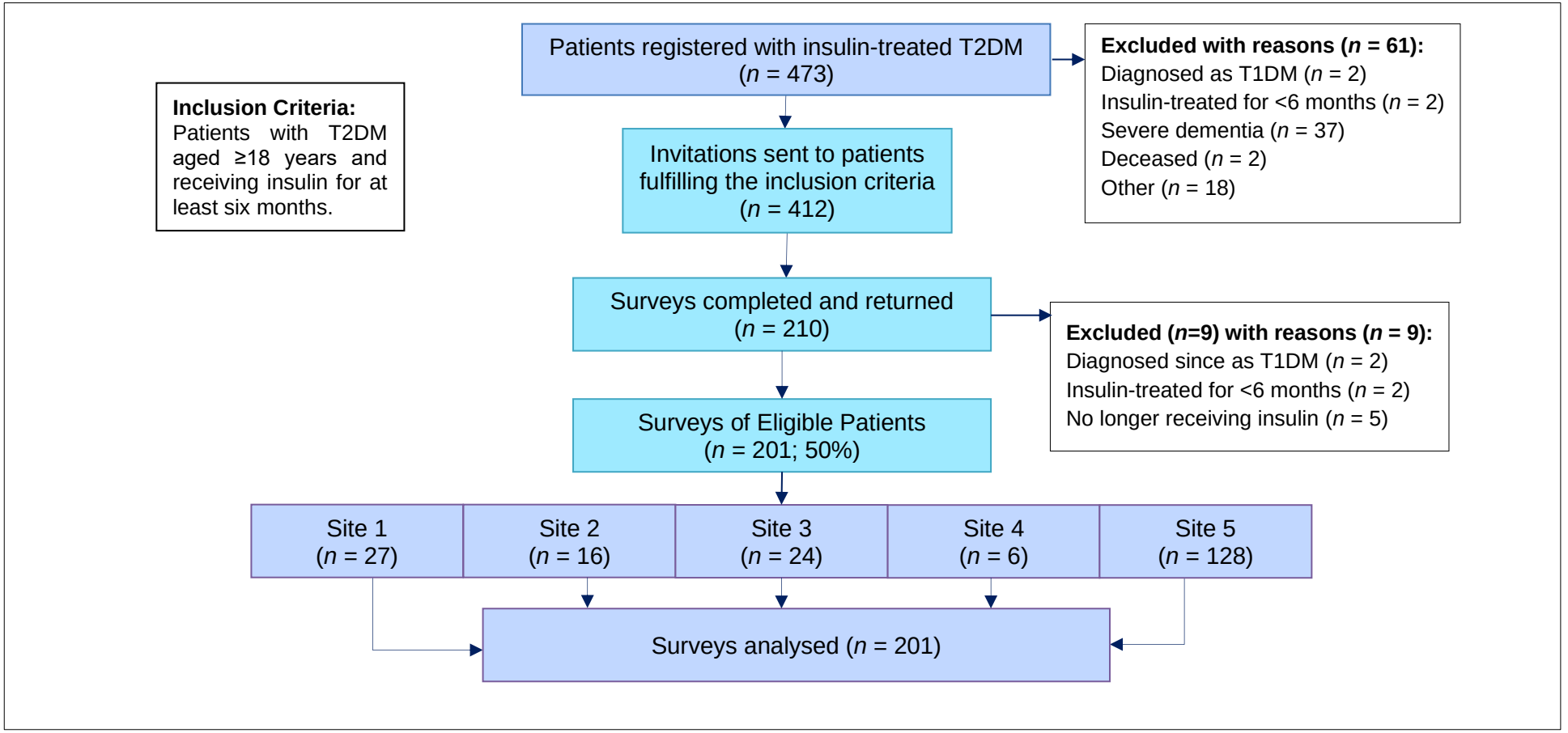


Figure 17 Recruitment Flow Chart

Key: *n* = number of patients; % = response rate of eligible patients; T2DM = type 2 diabetes.

Table 26 Differences Between Responders and Non-Responders

Characteristic	Responders	Site 1	Site 2	Site 3	Site 4	Site 5	Non-Responders	Site 1	Site 2	Site 3	Site 4	Site 5	Tests for differences* χ^2 or ANOVA**
Responses *n* (%)	201 (50)	27 (13)	16 (8)	24(12)	6 (3)	128 (64)	202 (50)	36 (18)	24 (12)	19 (9)	8 (4)	115 (57)	χ^2 = 4.446, *df* = 4, *p* = .349
Gender *n* (%)													
Male	117 (58)	12 (44)	10 (63)	16 (67)	3 (50)	76 (59)	116 (57)	18 (50)	11 (46)	13 (68)	6 (75)	68 (59)	χ^2 = 0.003, *df* = 1,
Female	84 (42)	15 (56)	6 (37)	8 (33)	3 (50)	52 (41)	86 (43)	18 (50)	13 (54)	6 (32)	2 (25)	47 (41)	*p* = .953
Age *years*	70.1	69.4	70.4	68.6	70.3	70.5	68.1	67.2	67.7	63.5	70.1	69.2	*F* = 3.194, *df*1,
Mean (SD) Range	(10.3)	(11.4)	(9.13)	(10.3)	(10.5)	(10.4)	(11.6)	(11.1)	(9.63)	(14.6)	(7.10)	(11.8)	*p* = .075
	37–90	48–87	50–58	51–88	55–87	37–90	37–93	37–85	50–85	38–85	57–77	42–93	
Categories *n* (%)													
30–39	1 (1)	-	-	-	-	1 (1)	2 (1)	1 (3)	-	1 (5)	-	-	χ^2 = 8.171, *df* = 6,
40–49	4 (2)	1 (4)	-	-	-	3 (2)	10 (5)	1 (3)	-	3 (16)	-	6 (5)	*p* = .209
50–59	26 (13)	5 (18)	2 (12)	5 (21)	1 (16)	13 (10)	38 (19)	6 (17)	4 (17)	3 (16)	1 (12)	24 (21)	
60–69	67 (33)	8 (30)	5 (31)	11 (46)	3 (50)	40 (31)	53 (26)	13 (36)	10 (41)	4 (21)	3 (38)	23 (20)	
70–79	58 (29)	6 (22)	7 (45)	2 (8)	1 (17)	42 (33)	62 (31)	9 (25)	6 (25)	5 (26)	4 (50)	38 (33)	
80–89	43 (21)	7 (26)	2 (12)	6 (25)	1 (17)	27 (21)	34 (17)	6 (17)	4 (17)	3 (16)	0	21 (18)	
≥90	2 (1)	-	-	-	-	2 (2)	3 (1)	-	-	-	-	3 (3)	
HbA1c mmol/mol													
Mean (SD) Range	63.9	63.7	60.4	58.3	56.5	65.7	68.4	73.7	70.3	72.8	68.1	65.6	***F* = 6.977, *df*1,**
	(16.9)	(24.3)	(12.9)	(11.4)	(9.38)	(16.3)	(17.4)	(19.1)	(17.1)	(17.1)	(11.7)	(16.9)	***p* = .009****
	37–168	42–168	48–100	39–86	46–70	37–115	30–128	45–120	44–110	51–121	48–83	30–128	
Categories *n* (%)													***χ²* = 7.390, *df* = 2,**
≤59	95 (47)	16 (59.3)	10 (62.5)	13 (54.2)	4 (66.7)	52 (40.6)	76 (38)	10 (27.8)	8 (33.3)	3 (15.8)	2 (25)	53 (46)	***p* = .025****
>59 to ≤69	50 (25)	5 (18.5)	4 (25)	7 (29.2)	1 (16.7)	33 (25.8)	44 (21)	9 (25)	5 (20.9)	7 (36.8)	2 (25)	21 (18.3)	
>69	56 (28)	6 (22.2)	2 (12.5)	4 (16.7)	1 (16.7)	43 (33.6)	82 (41)	17 (47.2)	11 (45.8)	9 (47.4)	4 (50)	41 (35.7)	

*The tests are for differences between the responders and non-responders and are not site-related. **Level of significance is .05 or less

Key: ANOVA = analysis of variance; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; *p* = p-value; HbA1c = glycated haemoglobin.

4.1.2.2 Demographic Characteristics

The survey participants were predominantly White British (*n* = 187, 93%) and had a mean age of 70 years (*SD* = 10.3, range 37–90) There were more males than females (*n* = 117, 58% vs *n* = 84, 42%), the majority were retired (*n* = 148, 74%), and a quarter lived alone (*n* = 46, 23%). Over 58% (*n* = 117) had a body mass index (BMI kg/m^2) of ≥30, with an overall mean weight of 94.1 kgs (*SD* = 21.5) and BMI of 32.7 (*SD* = 7.63).

There were no significant differences in the demographic characteristics of the participants who took part in the telephone questionnaire (*n* = 124, 61.7%) compared to those who did not in terms of gender, age, ethnicity, employment, smoking status, weight and BMI. A significantly higher percentage of interviewees went to work compared with non-interviewees (25% vs 12%, *p* = .039), while a slightly lower percentage lived alone (20% vs 28%; *p* = .272).

4.1.2.3 Clinical Characteristics

In terms of glycaemic control, the mean HbA1c of participants was 63.9 mmol/mol (*SD* = 16.9). Regarding comorbidity, 49% (*n* = 99) of participants had three or more comorbid conditions and many had diabetes-related complications. The duration of T2DM ranged from 2–45 years (mean 17, *SD* = 7.58) and of insulin therapy from 1–40 years (mean 7.92, *SD* = 6.15). More than 50% (*n* = 102) had lived with diabetes for >15 years, and 10% (*n* = 20) had received insulin for >15 years.

Insulin Therapy

Three insulin regimens were similarly distributed across the sample, with a slightly higher percentage (37%) receiving a basal-bolus regime (once or twice-daily basal insulin with a prandial (mealtime) insulin with one or more meals) than those injecting a premix insulin 1–3 times a day (33%), or basal-only regime once or twice-daily (30%). A variety of insulin types were in use, including Neutral Protamine Hagedorn (NPH) insulin, long and rapid-acting analogue insulin, and human and analogue-based premix regimes. Individuals used either pre-filled or reusable injectable devices. Total daily units (TDU) ranged from 7–300 (mean 71.6, *SD* = 51.8) with the highest mean TDU injected by those using premix insulin.

Other Glucose-Lowering Therapies

Oral hypoglycaemic agents (OHAs) were taken by 73.6% (*n* = 148) alongside insulin, with metformin being the most common (64%, *n* = 129). As metformin, if tolerated, is generally continued alongside insulin in the absence of chronic kidney disease (CKD) stage 4 or more, this was lower than expected (NICE 2015). A Chi-square test for independence showed that a significantly higher percentage of patients who were not prescribed metformin had CKD stages 3–5 (as measured by eGFR ≤30), compared with those who were prescribed metformin (51% *vs* 34%, *p* = .025). This consideration may explain the lower than expected percentage of those receiving metformin.

Other OHAs included sulfonylureas, dipeptidyl peptidase-4 inhibitors (DPP4is) sodium-glucose cotransporter-2 inhibitors (SGLT2is) and thiazolidinediones. Insulin regimes for those receiving sulfonylureas (*n* = 38, 19%) were basal-only (*n* = 30), basal-bolus (*n* = 5), and premix (*n* = 3). Nine patients (4.5%) injected a glucagon-like peptide-1 receptor agonist (GLP-1 RA) alongside their insulin. Most participants also took other medications for comorbid conditions ranging from 1–13 different agents per day (Median [*Md*] = 6, Interquartile range [IQR]: 4, 7).

Clinicians seen for Diabetes Review

Eighty-nine percent (*n* = 179) of all participants were registered with a practice which provided PN and GP-led insulin support services. Most patients (*n* = 161, 80%) saw the PN only to review their diabetes, while a smaller number had also, or instead, been reviewed by their GP, a Community DSN or a Diabetes Consultant. There was no recorded review within 18 months for one patient. A significant variation across the sites was evident. Lower proportions in Sites 1 and 2 (59%, *n* = 16 and 44%, *n* = 7) saw the PN only for review, compared with a relatively large proportion in Site 5 (90%, *n* = 115).

The clinical characteristics of patients taking part in the telephone questionnaire were not significantly different from those not taking part. Mean HbA1c was slightly higher in the interviewees (mean 64.4 mmol/mol, *SD* = 15.8 *vs* 62.5 mmol/mol, *SD* = 15.3, *p* = .357), with a lower percentage at ≤59 mmol/mol (*n* = 55, 44% *vs n* = 39, 50.6%).

The demographic and clinical characteristics are presented in Appendix 11.

4.1.3 The Study Findings

4.1.3.1 Insulin Use

In this section, the data relating to patient-level factors and the potential mediators for insulin use and glycaemic control are presented, considering the different areas of measurement included in the questionnaire.

Patient-Level Factors in Insulin Use

Insulin Management

Forty-four percent (*n* = 89) of all participants reported being given a target HbA1c level and 35% (*n* = 71) were able to specify what their target HbA1c was. The target HbA1c level was not identified in any of the patient records. Fewer patients reported having been given a target pre-meal blood sugar level (*n* = 52, 26%). Half or the responders perceived their blood sugar as *moderately* or *poorly* controlled and half thought they were *well* or *very well* controlled. Of those that responded (*n* = 166), 71% (*n* = 117) did not know their most recent HbA1c. Of those who did know the value (*n* = 49), 55% (*n* = 27) were within 5 mmol/mol of their most recently recorded clinic value, and of these, 56% (*n* = 15) had HbA1c ≤59 mmol/mol.

In terms of recognising glucose levels, 89% (*n* = 175 of 197 who responded) stated they could understand when their blood sugar readings were too high or too low *most of the time* or *always*, although a lower proportion (66%, *n* = 124 of 188 who responded) knew how much insulin to give to correct hyperglycaemia. Regarding the decision to adjust their insulin dose, 63% of responders (*n* = 72 of 192) reported making this decision *most of the time* or *always*. Forty-four percent of those answering (*n* = 80 of 183) preferred a nurse or doctor to advise them on the dosage *most of the time* or *always*. In relation to whom patients would contact if they were having difficulties with insulin, 50% (*n* = 98 of 197 who responded) would contact a PN, 5% (*n* = 10) their GP, 36% (*n* = 70) both GP and PN, 4% (*n* = 8) other, and the remainder (6%, *n* = 11) did not know. The data are displayed in Table 27.

Table 27 Managing Insulin Treatment

Items	Responders	Scores		
		1 /2	3 /4	*Md,* IQR
	n (%)	Poorly /Moderately *n (%)*	Well /V. Well *n (%)*	
My BS is controlled	196 (97.5)	98 (50)	98 (50)	*Md* = 2.5, IQR: 2, 3
	n (%)	Entered HbA1c *n (%)*	Don't know *n (%)*	
My last HbA1c was	166 (82.6)	49 (29.5)	117 (70.5)	
	n (%)	No *n (%)*	Yes *n (%)*	
I have been given a target HbA1c	151 (75.1)	62 (41.1)	89 (58.9)	
I have been given a target pre-meal BS	137 (68.2)	85 (62)	52 (38)	
		1/2/3	4/5	
	n (%)	Never/Rarely/Sometimes *n (%)*	Most of the time/Always *n (%)*	
I understand when my BS readings are too high or too low	197 (98)	22 (11.2)	175 (88.8)	*Md* = 4, IQR: 4, 5
I can work out how much extra insulin to inject if my BS are regularly high	188 (93.6)	64 (34)	124 (66)	*Md* = 4, IQR: 3, 5
I make the decision to adjust my insulin	192 (95.5)	72 (37.5)	120 (62.5)	*Md* = 4, IQR: 3, 5
I prefer a nurse or doctor to advise me on which dose to give	183 (91.9)	103 (56.3)	80 (43.7)	*Md* = 3, IQR: 2, 5

Key: BS = blood sugar; HbA1c = glycated haemoglobin; Md = median; IQR = interquartile range.

Appraisal of Insulin Treatment

Appraisal of insulin therapy, as calculated by the Insulin Treatment Appraisal Scale (ITAS) scores (Snoek *et al.* 2007), was fully completed by 92% (*n* = 184), and 96% (*n* = 192) of respondents for the 16-item negative subscale and 4-item positive subscale respectively, and by 91% (*n* = 182) for all 20 items. The mean summed score of the negative subscale was 38.6 (*SD* = 8.44) out of a maximum score of 80, and for the positive subscale, this was 14.2 (*SD* = 2.57), of a maximum of 20. All 20 items were fully completed by 91% (*n* = 182) of participants. The mean score was 47.9 (*SD* = 9.18) out of a maximum possible score of 100, which was similar to the negative subscale score. Figure 18 illustrates the scores.

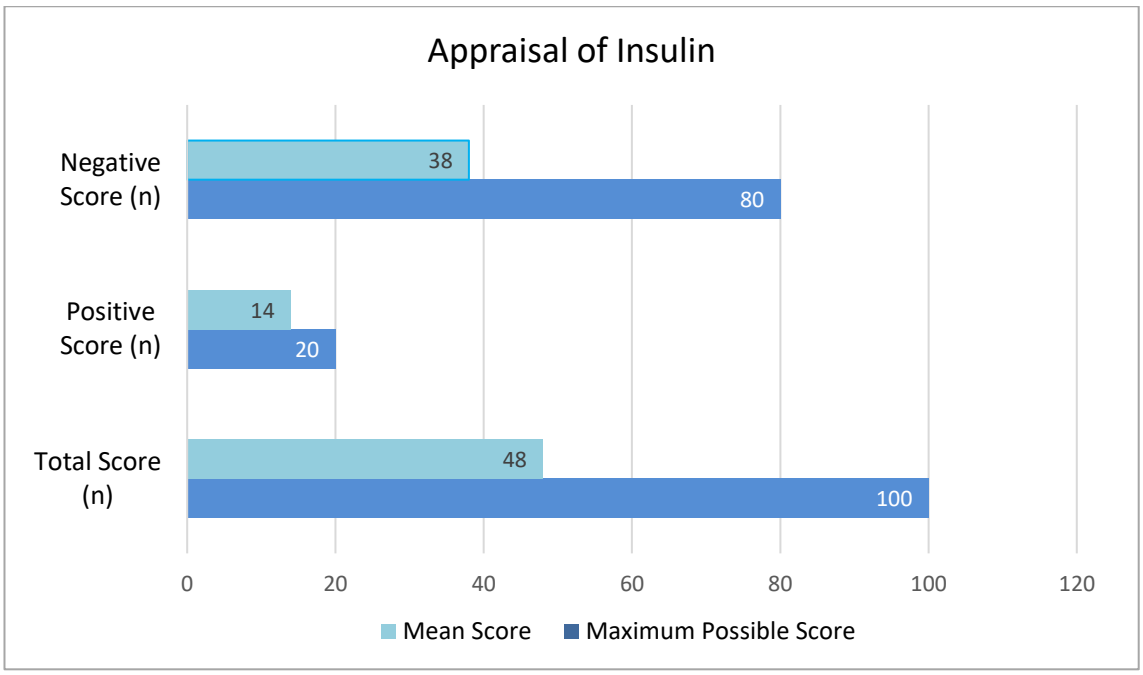


Figure 18 Patients' Appraisal of Insulin (ITAS)

Potential Patient Mediators in Insulin Use

Mediators included emotional wellbeing, presence of depression, and numeracy ability.

Emotional Wellbeing

Emotional wellbeing, as determined by the World Health Organisation-Five Wellbeing Index (WHO-5) score (Bech *et al.* 2003), was based on the completion of all five items (*n* = 196, 98%). The mean raw score was 14.5 (*SD* = 6.11) which represented a mean percentage score of 58 (*SD* = 24.4) with 0% representing the worst and 100% being the best possible quality of life (QOL). Four categories of the QOL scores are presented in Table 28. Of these, the largest proportion of patients (37%) were in category three, while the smallest (14%) were in category one – the category with the lowest wellbeing scores.

Table 28 Patients' Perceived Quality of Life (WHO-5)

	QOL Categories *n* = 196 (97.5%)	Score range	*n*	(%)
1	Worst QOL	0–25	27	(13.8)
2		26–50	40	(20.4)
3		51–75	73	(37.2)
4	Best QOL	76–100	56	(28.6

Key: QOL = quality of life; WHO-5 = World Health Organisation-Five Wellbeing Index

Depression

Level of depression, as measured by the Patient Health Questionnaire-9 (PHQ-9) score (Kroenke & Spitzer 2002), was considered in patients answering all nine questions (*n* = 183, 91%). Their mean total raw score was 6.15 (*SD* = 6.49, range 0–27, *md* = 4, IQR: 1, 9). Of these, 21% (*n* = 39) had a score of 0, indicating no depression, while the remaining 79% were grouped into five severity levels (Table 29). This compared with 21% (*n* = 43 of total 201) of the participants with a recorded diagnosis of depression, suggesting an under-diagnosis. However, when the scores were dichotomised based on Kroenke ***et al.'s*** (2002) recommendation of a score of ≥10 as a screening cut-off point (0 = 0–9, 1 = 10–27), 78% (*n* = 142) had scores <10, and 22% (*n* = 41) scored ≥10 (Figure 19), which was similar to the percentage diagnosed with depression. Fourteen percent (*n* = 25) scored ≥1 for: *Thoughts that you would be better off dead or of hurting yourself in some way*.

Table 29 Depression Severity

	PHQ-9 Severity *n* = 183 (91%)	Score ranges	*n*	*(%)*
0	No depression	0	39	(21)
1	Non-severe	1–4	60	(33)
2	Mild	5–9	43	(24)
3	Moderate	10–14	17	(9)
4	Moderately severe	15–19	16	(9)
5	Severe	20–27	8	(4)

Key: PHQ-9 = Patient Health Questionnaire-9.

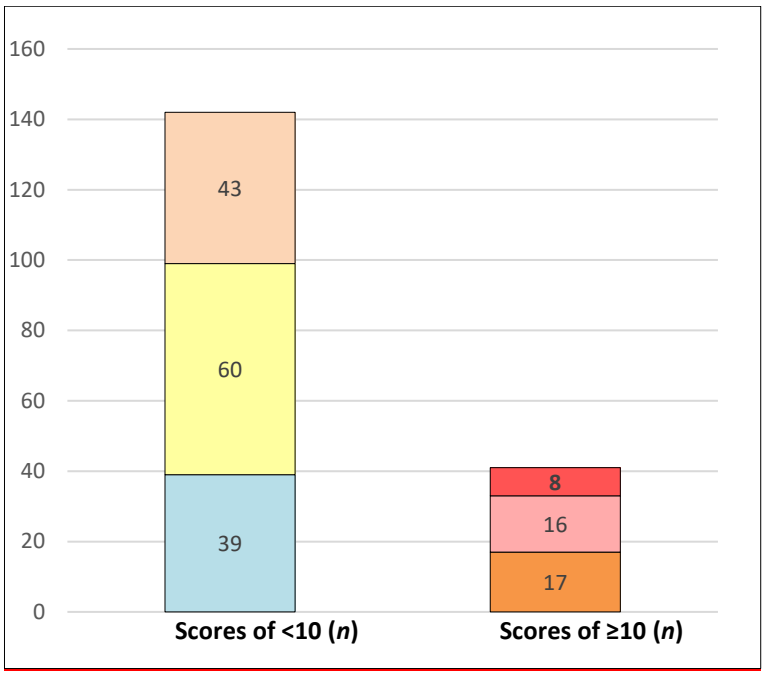


Figure 19 Dichotomised PHQ-9 Scores with Severity Levels
Key: PHQ-9 = Patient Health Questionnaire-9.

Functional impairment, as assessed by responses to: *If you have ticked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?,* ranged from 0–3, with nought representing no functional impairment and three signifying an extreme impairment. Of 87% (*n* = 175) completing this item, mean score was 0.53 (*SD* = 0.81, *md* = 0, IQR: 0, 1) indicating a low level of functional impairment (Table 30).

Table 30 Perceived Functional Impairment

Patients *n* = 175 (87%)	*n*	%
No impairment	109	62.3
Somewhat difficult	49	28.0
Very difficult	8	4.6
Extremely difficult	9	5.1

In summary, a similar percentage of patients were identified as having depression using dichotomised PHQ-9 scores to patients with recorded diagnoses of depression. However, the totalled PHQ-9 scores suggested that depression was

under-diagnosed in this sample. For most patients, their problems had no impact on their everyday functioning, although 28% found the problems *somewhat difficult*.

To investigate the relationship between the variables associated with insulin management and depression (as measured by a dichotomised PHQ-9 score), a Pearson product-moment correlation coefficient (*r*) was conducted. There was a moderate negative correlation between depression and perceived control (r = -.339, n = 181, p < .001) and a small negative correlation with understanding when blood glucose levels were too high or too low (r = -.261, n = 181, p < .001). A Chi-Square (χ^2) with Yates Continuity Correction) also indicated a similar effect (χ^2 = 19.2, p < .001, *phi* = -.339 and χ^2 = 10.2, p = .001, *phi* = -.261, respectively). This suggested that moderate to severe depression was associated with a perception that diabetes was moderately or poorly controlled, and with being less likely to recognise fluctuations in blood glucose levels.

Numeracy Ability

Numeracy ability as estimated by the Subjective Numeracy Scale (SNS-3) (McNaughton *et al.* 2015) was assessed in respondents who completed all three items (n = 196, 98%). Their mean summed numeracy score was 13.2 (SD = 4.31) and ranged from 3–18 out of the maximum possible score of 18. The scores indicated that these individuals, in general, perceived that they had good numeracy skills.

The data for the ITAS, WHO-5, PHQ-9 and SNS-3 scores are shown in Table 31.

Table 31 Scores for ITAS, WHO-5, PHQ-9 and SNS-3

Assessment Tools	*n* (%)	Normative Value ±*SD**	Mean	Range	Standard Deviation	Median (*Md*) Interquartile Range (IQR)
ITAS Negative 16-item subscale	184 (91.5)	41.2 ± 9.6	38.2	16–62	8.44	*Md* = 38, IQR: 33, 43
ITAS Positive 4-item subscale	192 (95.5)	14.8 ± 2.6	14.2	4–20	2.57	*Md* = 15, IQR: 13, 16
ITAS (all items)	182 (90.5)	50.20 ± 10.3	47.9	24–75	9.18	*Md* = 48, IQR: 43, 53
		Normative Value ±*SD* **				
WHO-5	196 (97.5)	12.9 ± 6.4	14.5	0–25	6.11	*Md* = 15, IQR: 10, 19
WHO-5 (as a percentage score)	196 (97.5)	-	57.8	0–100	24.44	*Md* = 60, IQR: 40, 76
		Normative Value ±*SD* ***				
PHQ-9	183 (91.0)	6.32 ± 5.4	6.15	0–27	6.49	*Md* = 4, IQR: 1, 9
PHQ-9 Functional impairment (Q10)	175 (87.1)	-	0.53	0–3	0.81	*Md* = 0, IQR: 0, 1
		Normative Value ±*SD* ****				
SNS-3	196 (97.5)	9.83 (*SD* = 4.21)	13.2	3–18	4.31	*Md* = 14, IQR: 10, 17

*Holmes-Truscott *et al.* (2014), **Hermanns *et al.* (2010), ***Aikens *et al.* (2008), ****McNaughton *et al.* (2015)

Key: ITAS = Insulin Treatment Appraisal Scale; PHQ-9 = Patient Health Questionnaire-9; SD = standard deviation; SNS-3 = Subjective Numeracy Scale; WHO-5 = World Health Organisation-Five Wellbeing Index.

4.1.3.2 Relationship Between Patient Factors and Glycaemic Control

In this section, the link between the variables and glycaemic control is explored to identify a possible association. The first section describes the HbA1c categories (HbA1c ≤59 mmol/mol, HbA1c >59 to ≤69 mmol/mol, and >69 mmol/mol) of the patient factors; the second section explains their correlation with HbA1c level; and the third section describes the statistical analysis using logistic regression.

Blood Glucose Categories

Patient Characteristics

There were no significant differences between HbA1c categories and patients' demographic characteristics in relation to gender, age, employment status, whether they lived alone, smoking status, weight, and BMI.

Most of the variation across the glycaemic control groups and clinical characteristics was not significant. However, there was an effect size of TDU, which ranged from 7 to 300 (*SD* = 51.8). An analysis of variance (ANOVA) post-hoc comparison between-groups using a Bonferroni adjusted alpha level of 0.017 suggested that the greatest difference was seen between patients with HbA1c ≤59 mmol/mol compared to those with HbA1c >69 mmol/mol. The individuals with HbA1c ≤59 mmol/mol injected significantly less TDU (mean 60, *SD* = 41) compared to those with HbA1c >69 mmol/mol (mean 84, *SD* = 52, *p* = .017). The effect size of TDU was significant (*p* = .001) in participants who used premix insulin (33%, *n* = 66). See Table 32 and Table 33 for the post-hoc analyses. The HbA1c categories of the demographic and diabetes-related data are displayed in Table 34 and Table 35.

Table 32 ANOVA Post-Hoc Comparison of Total Daily Units of Insulin

HbA1c *mmol/mol*	HbA1c *mmol/mol*	Mean Difference	Std. Error	Sig.	98.3% Confidence Interval	
					Lower	Upper
≤59	>59 to 69	-17.892	8.991	.144	-43.04	7.26
	>69	**-24.117***	8.615	**.017**	-48.22	-.02
>59 to 69	≤59	17.892	8.991	.144	-7.26	43.04
	>69	-6.224	9.963	1.000	-34.10	21.65
>69	≤59	**24.117***	8.615	**.017**	.02	48.22
	>59 to 69	6.224	9.963	1.000	-21.65	34.10

*The mean difference is significant at the 0.017 level (Bonferroni adjustment).
Key: ANOVA = analysis of variance; HbA1c = glycated haemoglobin.

Table 33 ANOVA Post-Hoc Comparison of Total Daily Units of Premix Insulin

HbA1c *mmol/mol*	HbA1c *mmol/mol*	Mean Difference	Std. Error	Sig.	98.3% Confidence Interval	
					Lower	Upper
≤59	>59 to 69	-19.414	11.724	.308	-53.02	14.19
	>69	**-35.114***	9.165	**.001**	-61.38	-8.85
>59 to 69	≤59	19.414	11.724	.308	-14.19	53.02
	>69	-15.700	12.663	.659	-52.00	20.60
>69	≤59	**35.114***	9.165	**.001**	8.85	61.38
	>59 to 69	15.700	12.663	.659	-20.60	52.00

*The mean difference is significant at the 0.017 level (Bonferroni adjustment).
Key: ANOVA = analysis of variance; HbA1c = glycated haemoglobin.

Table 34 Demographic Characteristics and HbA1c

Data HbA1c *mmol/mol*	All Participants (*n* = 201)	HbA1c ≤59 mmol/mol *n* = 95 (47%)	HbA1c >59 to ≤69 mmol/mol *n* = 50 (25%)	HbA1c >69 mmol/mol *n* = 56 (28%)	Tests for differences* χ^2 or ANOVA
Gender *n* (%)					χ^2 = 1.633, *df* = 2,
Male	117 (58)	51 (54)	32 (64)	34 (61)	*p* = .442
Female	84 (42)	44 (46)	18 (36)	22 (39)	
Age *years*					
Mean (SD) Range	70.1 (10.4) 37–90	71.1 (10.1) 45–90	70.5 (11.2) 43–88	68 (11.5) 37–90	*F* = 1.687, *df*2, *p* = .188
	Md = 70, IQR: 63, 78	*Md* = 71, IQR: 64, 78	*Md* = 69, IQR: 63, 80	*Md* = 68, IQR: 61, 76	
Categories *n* (%)					χ^2 = 12.215, *df* = 12
30–39	1 (1)	-	-	1 (2)	*p* = .429
40–49	4 (2)	1 (1)	2 (4)	1 (2)	
50–59	26 (13)	10 (11)	7 (14)	9 (16)	
60–69	67 (33)	30 (31)	17 (34)	20 (36)	
70–79	58 (29)	33 (35)	9 (18)	16 (28)	
80–89	43 (21)	20 (21)	15 (30)	8 (14)	
≥90	2 (1)	1 (1)	-	1 (2)	
Ethnicity *n* (%)					
White British	187 (93)	88 (93)	46 (92)	53 (95)	
White other	7 (4)	2 (2)	3 (6)	2 (3)	
Asian	2 (1)	2 (2)	-	-	-
Chinese	1 (0.5)	1 (1)	-	-	
Other	3 (1)	1 (1)	1 (2)	1 (2)	
Missing	1 (0.5)	1 (1)	-	-	
Lives alone *n* (%)					χ^2 = 2.396, *df* = 2,
Yes	46 (23)	17 (18)	13 (26)	16 (29)	*p* = .302
No	153 (76)	76 (80)	37 (74)	40 (71)	
missing	2 (1)	2 (2)	-	-	

Data HbA1c *mmol/mol*	All Participants (*n* = 201)	HbA1c ≤59 mmol/mol *n* = 95 (47%)	HbA1c >59 to ≤69 mmol/mol *n* = 50 (25%)	HbA1c >69 mmol/mol *n* = 56 (28%)	Tests for differences* χ^2 or ANOVA
Employed *n* (%)					χ^2 = 1.532, *df* = 2,
Yes	40 (20)	16 (17)	10 (20)	14 (25)	*p* = .465
No	158 (79)	78 (82)	39 (78)	41 (73)	
missing	3 (1)	1 (1)	1 (2)	1 (2)	
Smoking status *n* (%)					χ^2 = 4.649, *df* = 4,
Never Smoked	79 (39)	36 (38)	22 (44)	21 (38)	*p* = .325
Ex-smoker	102 (51)	53 (56)	23 (46)	26 (46)	
Smoker	20 (10)	6 (6)	5 (10)	9 (16)	
Weight *kilogrammes*					
Mean (SD) Range	94.1 (21.5) 42.3–165 *Md* = 92, IQR: 80, 102	90.9 (20.6) 42.3–165 *Md* = 92, IQR: 80, 102	97.1 (22.2) 58.3–155 *Md* = 90, IQR: 77, 100	97.1 (22) 49.9–152 *Md* = 97, IQR: 81, 110	*F* = 2.073, *df*2, *p* = .129
BMI kg/m^2					
Mean (SD) Range	32.7 (7.63) 18.6–61 *Md* = 31, IQR: 28, 37	31.9 (7.12) 19.6–52 *Md* = 31, IQR: 27, 35	32.9 (6.68) 23–50.3 *Md* = 31, IQR: 28, 37	33.95 (9.088) 18.6–61 *Md* = 33, IQR: 28, 39	*F* = 1.297, *df*2, *p* = .276
Categories *n* (%)					χ^2 = 5.886, *df* = 8,
<25	24 (12)	12 (13)	4 (8)	8 (14)	*p* = .660
25 to <30	59 (29)	32 (34)	16 (32)	11 (20)	
30 to <40	85 (42)	37 (38)	22 (44)	26 (46)	
≥40	32 (16)	13 (14)	8 (16)	11 (20)	
missing	1 (1)	1 (1)	-	-	

*Level of significance is .05 or less

Key: ANOVA = analysis of variance; BMI = body mass index; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; HbA1c = glycated haemoglobin; IQR = interquartile range; *Md* = median; *p* = p-value.

Table 35 Diabetes Characteristics and HbA1c

Diabetes-related Data HbA1c *mmol/mol*	All Participants (*n* = 201)	HbA1c ≤59 mmol/mol *n* = 95 (47%)	HbA1c >59 to ≤69 mmol/mol *n* = 50 (25%)	HbA1c >69 mmol/mol *n* = 56 (28%)	Tests for differences* χ^2 or ANOVA
T2DM duration *years* *Mean (SD) Range*	17 (7.58) 2–45 *Md* = 16, IQR: 12, 22	17.6 (8) 4–43 *Md* = 17, IQR: 12, 21	17.8 (7.78) 5–45 *Md* = 17.5, IQR: 13, 22	15.2 (6.43) 2–33 *Md* = 14, IQR: 10.3, 19.8	*F* = 2.110, *df*2, *p* = .188
Insulin duration *years* *Mean (SD) Range*	7.92 (6.15) 1–40 *Md* = 7, IQR: 3, 11	8.17 (5.75) 1–30 *Md* = 7, IQR: 4, 11	8.40 (7.85) 1–40 *Md* = 6, IQR: 3, 11	7.05 (5) 1–21 *Md* = 7, IQR: 3, 10	*F* = 0.788, *df*2, *p* = .456
Insulin Regime *n* (%) Basal-only Basal-bolus Premix	 61 (30) 74 (37) 66 (33)	 27 (28) 33 (35) 35 (37)	 19 (38) 20 (40) 11 (22)	 15 (27) 21 (37) 20 (36)	χ^2 = 3.965, *df* = 4, *p* = .411
Total daily insulin injections *Mean (SD) Range*	2 (1.16) 1–5 *Md* = 2, IQR: 1, 3	2 (1.13) 1–5 *Md* = 2, IQR: 1, 3	2 (1.23) 1–5 *Md* = 2, IQR: 1, 4	2 (1.27) 1–5 *Md* = 2, IQR: 2, 3	*F* = 0.100, *df*2, *p* = .905
Number of injections per day *n* (%) 1 /day 2 /day 3 /day 4 /day 5 /day	 51 (25.4) 79 (39.3) 25 (12.4) 39 (19.4) 7 (3.5)	 24 (25.3) 39 (41.1) 11 (11.6) 19 (20) 2 (2.1)	 16 (32) 13 (26) 8 (16) 12 (24) 1 (2)	 11 (20) 27 (48) 6 (11) 8 (14) 4 (7)	χ^2 = 10.053, *df* = 8, *p* = .267
Total daily units of insulin (TDU) *Mean (SD) Range*	72 (52) 7–300 *Md* = 68, IQR: 38, 99	60 (41) 8–200 *Md* = 50, IQR: 29, 80	78 (66) 7–300 *Md* = 62, IQR: 31, 109	84 (52) 12–210 *Md* = 81, IQR: 41, 114	***F* = 4.472, *df*2, *p* = .013***
Regime-specific TDU *Mean (SD) Range* Basal-only	 35 (24) 7–110 *Md* = 26, IQR: 17, 49	 32 (24) 8–110 *Md* = 24, IQR: 16, 42	 34 (22) 7–70 *Md* = 27, IQR: 17, 55	 40 (26) 12–100 *Md* = 36, IQR: 18, 60	*F* = 0.500, *df*2, *p* = .609

Diabetes-related Data HbA1c *mmol/mol*	All Participants (*n* = 201)	HbA1c ≤59 mmol/mol *n* = 95 (47%)	HbA1c >59 to ≤69 mmol/mol *n* = 50 (25%)	HbA1c >69 mmol/mol *n* = 56 (28%)	Tests for differences* χ^2 or ANOVA
Basal as part of (Basal-bolus)	50 (28) 7–144 *Md* = 50, IQR: 30, 68	41 (23) 7–100 *Md* = 38, IQR: 22, 60	56 (32) 8–144 *Md* = 60, IQR: 25, 75	57 (27) 8–120 *Md* = 60, IQR: 36, 70	*F* = 2.823, *df*2, *p* = .066
Rapid	55 (44) 4–240 *Md* = 43, IQR: 24, 66	47 (36) 4–150 *Md* = 38, IQR: 21, 53	70 (58) 10–240 *Md* = 50, IQR: 30, 109	53 (39) 6–135 *Md* = 48, IQR: 20, 78	*F* = 1.790, *df*2, *p* = .175
Premix	69 (36) 14–180 *Md* = 64, IQR: 42, 89	56 (24) 14–110 *Md* = 58, IQR: 34, 72	75 (34) 40–140 *Md* = 67, IQR: 48, 109	91 (44) 28–180 *Md* = 91, IQR: 58, 114	***F* = 7.514, *df*2, *p* = .001***
Oral hypoglycaemic agents Types per day *n* (%)					χ^2 = 9.631, *df* = 6, *p* = .154
0 OHA	53 (26)	29 (31)	11 (22)	13 (23)	
1 OHA	109 (54)	53 (56)	25 (50)	31 (56)	
2 OHAs	35 (18)	12 (12)	11 (22)	12 (21)	
3 OHAs	4 (2)	1 (1)	3 (6)	-	

*Level of significance is .05 or less

Key: ANOVA = analysis of variance; BMI = body mass index; χ^2 = Chi-square value; df = degrees of freedom; F = F statistic; HbA1c = glycated haemoglobin; IQR = interquartile range; Md = median; OHA = oral hypoglycaemic agent; p = p-value; T2DM = type 2 diabetes; TDU = total daily units.

Patient-Level Factors

Insulin Management

No significant differences were observed between the glycaemic control groups and most of the insulin management variables, namely: perceived ability to identify fluctuations in blood glucose levels; being able to calculate the additional insulin required when blood sugars are high; deciding whether to adjust the insulin dose personally; or preference for receiving dosage advice from a doctor or nurse. However, there were significant differences in patients' perceived blood glucose control. A Chi-square test for independence suggested the greatest difference between categories was in patients with HbA1c ≤59 mmol/mol which had a higher percentage of patients who perceived their diabetes as being *well* or *very well* controlled compared with each of the other categories (Table 36). The HbA1c categories of the insulin management data are shown in Table 37.

Table 36 Perceived Control: Cross-Tabulation with HbA1c.

My BS is controlled	HbA1c *mmol/mol*	≤59	>59 to ≤69	>69	Total
Moderately/poorly	Count	27_a	25_b	46_c	98
	Expected Count	47	24	27	98
	% within the category	28.7%	52.1%	85.2%	50%
	Adjusted Residual*	**-5.7***	0.3	6.1	
Well/very well	Count	67_a	23_b	8_c	98
	Expected Count	47	24	27	98
	% within the category	71.3%	47.9%	14.8%	50%
	Adjusted Residual*	**5.7***	-0.3	-6.1	
Total	Count	94	48	54	196
	Expected Count	94	48	54	196
	% within the site	100%	100%	100%	100%

*Indicate cases significantly larger (or less) than expected at the .05 level.
Key: BS = blood sugar; HbA1c = glycated haemoglobin.

Table 37 Insulin Management and HbA1c

Items	All Participants (*n* = 201) *n (%)*	HbA1c ≤59 mmol/mol *n (%)*	HbA1c >59 to ≤69 mmol/mol *n (%)*	HbA1c >69 mmol/mol *n (%)*	Tests for differences* χ^2
My BS is controlled (*n* = 196)					
Moderately/poorly	98 (50)	27 (29	25 (52)	46 (85)	**χ^2 = 43.845, *df*=2, *p* < .001***
Well/very well	98 (50)	67 (71)	23 (48)	8 (15)	
I can understand when my BS are too high or low (*n* = 197)					
Never/rarely/sometimes	22 (11)	8 (9)	5 (10)	9 (16)	χ^2 = 2.193, *df* = 2, *p* = .334
Mostly/always	175 (89)	86 (91)	43 (90)	46 (84)	
Can work out extra insulin if my BS readings are high (*n* = 198)					
Never/rarely/sometimes	64 (34)	29 (33)	16 (35)	19 (36)	χ^2 = 0.173, *df* = 2, *p* = .917
Mostly/always	124 (66)	60 (67)	30 (65)	34 (64)	
I make the decision to adjust insulin (*n* = 192)					
Never/rarely/sometimes	72 (37)	32 (35)	18 (38)	22 (41)	χ^2 = 0.466, *df* = 2, *p* = .792
Mostly/always	120 (63)	59 (65)	29 (62)	32 (59)	
I prefer a nurse or doctor to advise dose (*n* = 183)	*n (%)*	*n (%)*	*n (%)*	*n (%)*	
Never/rarely/sometimes	103 (56)	52 (58)	26 (59)	25 (50)	χ^2 = 1.109, *df* = 2, *p* = .574
Mostly/always	80 (44)	37 (42)	18 (41)	25 (50)	

*Level of significance is .05 or less

Key: BS = blood sugar; *df* = degrees of freedom; χ^2 = Chi-square value; HbA1c = glycated haemoglobin; *p* = p-value.

Appraisal of Insulin Treatment

Significant differences were seen in the HbA1c categories for how patients appraised their insulin, as estimated by the mean ITAS negative subscale. An ANOVA post-hoc comparison between-groups using a Bonferroni adjusted alpha level of 0.017 suggested that the greatest difference was seen in patients with HbA1c ≤59 mmol/mol (*n* = 86, mean score 36, *SD* = 8). These had a significantly lower mean negative appraisal of insulin score than patients with HbA1c >59 to 69 mmol/mol (*n* = 46, mean score 40, *SD* = 9, *p* = .013) and those with HbA1c >69 mmol/mol (*n* = 52, mean score 41, *SD* = 9, *p* = .002). See Table 38.

Table 38 ANOVA Post-Hoc Comparison of ITAS Negative Scale

(HbA1c *mmol/mol*	HbA1c *mmol/mol*	Mean Difference	Std. Error	Sig.	98.3% Confidence Interval	
					Lower	Upper
≤59	>59 to 69	**-4.291***	1.491	**.013**	-8.46	-.12
	>69	**-4.887***	1.434	**.002**	-8.90	-.87
>59 to 69	≤59	**4.291***	1.491	**.013**	.12	8.46
	>69	-.596	1.652	1.000	-5.22	4.03
>69	≤59	**4.887***	1.434	**.002**	.87	8.90
	>59 to 69	.596	1.652	1.000	-4.03	5.22

*The mean difference is significant at the 0.017 level (Bonferroni adjustment).
Key: ANOVA = analysis of variance; HbA1c = glycated haemoglobin; ITAS = Insulin Treatment Appraisal Scale.

Potential Mediators in Insulin Use

Significant differences were evident between HbA1c categories and level of depression, as assessed by the mean PHQ-9 scores, and the dichotomised severity scale (absence or presence of moderate to severe depression symptoms). An ANOVA post-hoc comparison between-groups with a Bonferroni adjusted alpha level of 0.017 indicated that the greatest difference was seen in patients with HbA1c ≤59 mmol/mol. (*n* = 88) and those with HbA1c >69 mmol/mol (*n* = 50). Individuals with HbA1c ≤59 mmol/mol had significantly lower mean depression scores and lower levels of moderate to severe symptoms than patients in the highest HbA1c category (*p* = .005). See Table 39.

Table 39 ANOVA Post-Hoc Comparison of PHQ-9 Score

HbA1c *mmol/mol*	HbA1c *mmol/mol*	Mean Difference	Std. Error	Sig.	98.3% Confidence Interval	
					Lower	Upper
≤59	>59 to 69	-2.890	1.155	.040	-6.12	.35
	>69	**-3.574***	1.116	**.005**	-6.70	-.45
>59 to 69	≤59	2.890	1.155	.040	-.35	6.12
	>69	-.684	1.295	1.000	-4.31	2.94
>69	≤59	**3.574***	1.116	**.005**	.45	6.70
	>59 to 69	.684	1.295	1.000	-2.94	4.31

*The mean difference is significant at the 0.017 level (Bonferroni adjustment).
Key: ANOVA = analysis of variance; HbA1c = glycated haemoglobin; PHQ-9 = Patient Health Questionnaire-9.

No significant differences were observed between HbA1c categories and mean scores for emotional wellbeing (WHO-5) or perceived numeracy ability (SNS-3). The related data are displayed in Table 40.

.

Table 40 WHO-5, ITAS, PHQ-9, SNS-3 and HbA1c

Questionnaires Responders (*n*)	All Responders *Mean (SD) Range*	HbA1c ≤59 mmol/mol	HbA1c >59 to ≤69 mmol/mol *Mean (SD) Range*	HbA1c >69 mmol/ml	Tests for differences* χ^2 or ANOVA
WHO-5 (*n* = 196)	14.5 (6.12) 0–25 *Md* = 15, IQR: 10, 19	15.4 (5.91) 0–25 *Md* = 16, IQR: 11, 20	14 (5.52) 1–25 *Md* = 16, IQR: 9, 18	13.2 (6.74) 0–25 *Md* = 14, IQR: 7, 18	*F* = 2.468, *df*2, *p* = .087
ITAS Negative subscale (*n* = 184)	38.2 (8.44) 16–62 *Md* = 38, IQR: 33, 43	35.7 (7.6) 16–55 *Md* = 37, IQR: 31, 40	40 (8.64) 23–62 *Md* = 39.5, IQR: 34, 47	40.6 (8.62) 24–61 *Md* = 40, IQR: 35, 46	***F* = 7.364, *df*2, *p* < .001***
ITAS Positive subscale (*n* = 192)	14.2 (2.57) 4–20 *Md* = 15, IQR: 13, 16	14.5 (2.72) 4–20 *Md* = 15, IQR: 13, 16	13.9 (2.5) 7–19 *Md* = 14, IQR: 13, 16	14 (2.33) 8–19 *Md* = 14, IQR: 13, 15	*F* = 1.265, *df*2, *p* = .285
PHQ-9 (*n* = 183)	6.15 (6.48) 0–27 *Md* = 4, IQR: 1, 9	4.47 (4.93) 0–2.44 *Md* = 3, IQR: 0, 7	7.36 (6.84) 0–25 *Md* = 6, IQR: 2, 12	8.04 (7.79) 0–27 *Md* = 5, IQR: 2, 13	***F* = 6.211, *df*2, *p* = .002***
PHQ-9, Q10 *Perceived difficulties* (*n* = 175)	0.53 (0.81) 0–3 *Md* = 0, IQR: 0, 1	0.44 (0.65) 0–3 *Md* = 0, IQR: 0, 1	0.48 (0.88) 0–3 *Md* = 0, IQR: 0, 1	0.72 (0.97) 0–3 *Md* = 0, IQR: 0, 1	*F* = 1.974, *df*2, *p* = .142
PHQ-9 (*n* = 183) Dichotomised scores 0 = 0–9 1 = 10–27	*n* (%) 142 (78) 41 (22)	*n* (%) 75 (85) 13 (15)	*n* (%) 33 (73) 12 (27)	*n* (%) 34 (68) 16 (32)	***χ^2* = 6.067, *df*=2, *p* = .048***
Total SNS-3 (*n* = 196)	13.2 (4.31) 3–18 *Md* = 14, IQR: 10, 17	13.6 (3.9) 3–18 *Md* = 14, IQR: 12, 17	12.45 (4.36) 3–18 *Md* = 14, IQR: 10, 17	13 (4.92) 3–18 *Md* = 15, IQR: 10, 17	*F* = 1.265, *df*2, *p* = .284

* Level of significance is .05 or less

Key: χ^2= Chi-square value; *df* = degrees of freedom; *F* = F statistic; HbA1c = glycated haemoglobin; IQR = interquartile range; ITAS = Insulin Treatment Appraisal Scale; *Md* = median; p = p-value; PHQ-9 = Patient Health Questionnaire-9; SNS-3 = Subjective Numeracy Scale; WHO-5 = World Health Organisation-Five Wellbeing Index.

Summary

Patient characteristics were found to vary for some, but not many, of the HbA1c categories. Of the differences observed, patients with HbA1c ≤59 mmol/mol injected a significantly lower number of TDU than those with HbA1c >69 mmol/mol. There was also a significantly higher percentage of patients with HbA1c ≤59 mmol/mol who perceived their blood glucose to be *well* or *very well* controlled than in the other categories. Similarly, patients with lower HbA1c had a significantly lower mean negative appraisal of insulin treatment and lower levels of depression. Next, the correlations with glycaemic control are described.

Correlations with Glycaemic Control

This section details the results of the correlation analyses to investigate the relationship between the study variables and level of glycaemic control, as determined by the HbA1c as a continuous and as a dichotomous variable with HbA1c ≤59 mmol/mol (yes = 1 or no = 0) representing optimal or suboptimal control respectively. The rankings of the strength of the associations of the key covariates (n = 17) with glycaemic control using a Pearson product-moment correlation coefficient (r) are presented in Table 41 and are next summarised.

Table 41 Ranking by Strength of Associations with Glycaemic Control

	HbA1c as a continuous variable		Hba1c ≤59 mmol/mol as a dichotomous variable (0=no, 1=yes)	
1	My BS is controlled	-.467**M	TDU Premix Insulin	-.419**M
2	TDU Premix Insulin	.391**M	My BS is controlled*** (*phi* = .41)	.409** M
3	ITAS negative subscale	343**M	TDU Basal insulin as part of basal-bolus	-.275* S
4	PHQ-9	.319**M	ITAS negative subscale	-.273**S
5	TDU Basal insulin as part of basal-bolus	.301* M	PHQ-9	-.251**S
6	WHO-5	-.228**S	TDU of insulin	-.205*S
7	Age	-.198**S	WHO-5	.151*S
8	SNS-3	-.177*S	Weight	-.143*S
9	TDU of insulin	.170*S	SNS-3	.104
10	T2DM Duration	-.157*S	BMI	-.102
11	I understand when BS are high /low	-.147*S	Age	.095
12	I make the decision to adjust insulin	-.094	Gender [female]*** (*phi* = .08)	.087
13	I prefer nurse or doctor to advise dose	.090	I understand when BS are high /low*** (*phi* = .08)	.081
14	I can work out insulin if BS are high	-.090	T2DM Duration	.076
15	Weight	.043	I make the decision to adjust insulin*** (*phi* = .05)	.046
16	BMI	.037	I prefer nurse or doctor to advise dose*** (*phi* = -.042)	-.042
17	Gender [female]	-.026	I can work out insulin if BS are high*** (*phi* = .29)	.029

*Correlation is significant at the .05 level **Correlation is significant at the .01 level.

The strength of relationships based on the Pearson correlation coefficient (r) is: small (*r* = 0.10–0.29), medium (*r* = 0.30–0.49), and large (*r* = 0.50–1.0) indicated by **S, M, L**.

***A Chi-Square (χ^2) with Yates Continuity Correction was used in addition for the 2 x 2 tables, with the effect size determined by *phi* (small = 0.10–0.29, medium = 0.30–0.49, large = 0.50–1.0).

Key: BS = blood sugar; BMI = body mass index; HbA1c = glycated haemoglobin; ITAS = Insulin Treatment Appraisal Scale; PHQ-9 = Patient Health Questionnaire-9; SNS-3 = Subjective Numeracy Scale; T2DM = type 2 diabetes; TDU = total daily units of insulin; WHO-5 = World Health Organisation-Five Wellbeing Index.

Patient Characteristics

Of the patient characteristics, a small correlation between age and duration of T2DM with HbA1c was observed (p = .005). Older age and longer duration of T2DM were each associated with lower blood glucose levels. This effect was not evident when the HbA1c was dichotomised. A small negative correlation was also seen between patient weight and dichotomised HbA1c (p = .043), with lower weight associated with HbA1c ≤59 mmol/mol. Similarly, TDU showed a small correlation with HbA1c (p = .017). Higher doses of insulin were associated with both higher levels of HbA1c, and suboptimal control (dichotomised) (p = .004). This was specific to TDU premix and to TDU basal insulin (as part of a basal-bolus regimen), with a moderate (p = .001) and small (p = 019) negative correlation respectively, with a dichotomised HbA1c.

Patient-Level Factors in Insulin Use

High levels of perceived glucose control were moderately associated with lower HbA1c levels and with optimal control (p < .001). There was a small association between lower blood glucose levels and the ability to understand blood glucose fluctuations (p = 040) but this was not evident with a dichotomised HbA1c. No significant correlations were found between ability to adjust dosage, or preference to self-manage insulin treatment and HbA1c. Regarding the appraisal of insulin treatment (ITAS), negative subscale scores were positively correlated with HbA1c (p < .001) and with suboptimal control (p < .001). The higher scores were associated with poorer control (p < .001).

Potential Mediators in Insulin Use

Scores for emotional wellbeing (WHO-5) and perceived numeracy ability (SNS-3) correlated negatively with HbA1c (p = .001 and .013 respectively). A small positive association was seen between WHO-5 and optimal control (p = .034) which was not evident with the SNS-3. Higher levels of emotional wellbeing were associated with better control. For depression (PHQ-9), there was a moderately positive correlation with HbA1c (p < .001) and a small negative correlation with optimal control (p = .001). The higher levels of depression were associated with poorer control.

The next section provides a summary of the logistic regression analysis.

Logistic Regression

Logistic regression was performed to assess the impact of insulin-level factors and other potentially mediating factors in relation to patient glycaemic control, defined dichotomously and adjusted for confounders. The model contained eight independent variables: gender; years since T2DM diagnosis; TDU; ability to understand blood glucose variation; preference for self-adjusting insulin; emotional wellbeing (WHO-5); appraisal of insulin treatment (ITAS negative); and level of depression (PHQ-9). Overall, the model was statistically significant, X^2 (8, n = 162) = 28.5, p < .001, explaining between 16.1% and 21.5% of glycaemic control, while correctly classifying 66.7% of cases. Two independent variables made a statistically significant contribution to the model: level of depression and years since diagnosis of T2DM.

The strongest predictor, level of depression, had a negative relationship with optimal glycaemic control (Hba1c ≤59 mmol/mol): odds ratio *(OR)* 0.91, 95% confidence interval (CI) [0.83, 0.99], p = .030. For every extra point scored in the PHQ-9, the odds of having optimal blood glucose control decreased by a factor of 0.91, all other factors being equal. The second predictor was duration of T2DM diagnosis *OR* 1.05, 95% CI [1.00, 1.11], p = .042). For every extra year since diagnosis, the odds of having optimal control increased by a factor of one, controlling for all other factors in the model. The variables in the equation are presented in Table 42.

Table 42 Regression Model with Variables in the Equation

Independent Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Gender (1)	.773	.371	4.331	1	.037	2.166	1.046	4.483
Duration of T2DM diagnosis (years)*	.052	.025	4.145	1	**.042***	1.053	1.002	1.107
Total daily units of insulin	-.005	.004	1.746	1	.186	.995	.988	1.002
I can understand when my blood sugar readings are too high or too low (1)	.182	.611	.088	1	.766	1.199	.362	3.971
I make the decision to adjust my insulin (1)	.156	.370	.177	1	.674	1.169	.566	2.415
Emotional wellbeing (WHO-5)	-.017	.041	.165	1	.685	.983	.907	1.066
Appraisal of insulin (ITAS-negative)	-.037	.023	2.473	1	.116	.964	.921	1.009
Depression (PHQ-9)*	-.096	.044	4.721	1	**.030***	.909	.833	.991
Constant	1.004	1.425	.496	1	.481	2.728		

Key: (1) = categorical variables entered on step 1; B = regression weight; CI = confidence interval; df = degrees of freedom; Exp(B) = odds ratio; ITAS = Insulin Treatment Appraisal Scale; PHQ-9 = Patient Health Questionnaire-9; SE = standard error; Sig. = significance (p-value); T2DM = type 2 diabetes; Wald = Wald Chi-square test; WHO-5 = World Health Organisation-Five Wellbeing Index.

*Strongest predictors of HbA1c ≤59 mmol/mol

4.1.4 Summary of the Postal Survey Findings

There was a 50% (*n* = 201) response rate among patients eligible to participate in the survey across five GP sites of varying sizes and degrees of insulin-related expertise. Compared with non-responders, the participants were slightly older (mean age 70 *vs* 68 years) and had a significantly lower mean HbA1c (63.9 mmol/mol *vs* 68.4 mmol/mol; *p* =.009). Participants were predominantly White British, were mostly retired, and a minority lived alone. Over half had a BMI ≥30 and nearly 50% had three or more comorbidities, with many having diabetes-related complications. For example, 49% (*n* = 99) had neuropathy and 62% (*n* = 124) had varying degrees retinopathy. Mean duration of T2DM and of insulin therapy was 17 years (*SD* = 7.58) and 8 years (*SD* = 6.15) respectively, while insulin regimes included basal-only, basal-bolus, and premix.

With regard to patient factors in insulin use, 59% (*n* = 89) of participants responding to the question, reported being given a target HbA1c level, although 71% (*n* = 117 of 166 who responded) reported not knowing their most recent HbA1c result. In terms of recognising variation in blood glucose levels, 89% (*n* = 175 of 197 who responded) stated they could understand these levels *most of the time* or *always*, while 63% (*n* = 120 of 192 who responded) indicated they *mostly* or *always* decided on the dose themselves. Mean score for appraisal of insulin treatment (ITAS negative) was 38.6 (*SD* = 8.44) out of a maximum score of 80.

Potential mediators of insulin use included emotional wellbeing which represented a mean percentage score of 58%. For depression, the PHQ-9 scores suggested depression was under-diagnosed in this sample, although for most patients, their problems had no impact on their everyday functioning. A Pearson correlation suggested that perceiving diabetes to be *moderately* or *poorly controlled* and being less able to recognise fluctuations in blood glucose levels were each associated with moderate to severe depression ($p < .001$). Perceived numeracy ability (SNS-3) with mean summed score of 13 (*SD* = 4.31) indicated that responders, in general, considered their aptitude with numbers in a positive way.

In terms of associations between patient characteristics and glycaemic control, most of the variation between the HbA1c categories and patient characteristics was not significant, although age and duration of T2DM had a small negative correlation with HbA1c (p = .05). Older age and longer duration of diabetes was associated with lower levels of HbA1c. This was evidenced in participants with HbA1c <48 mmol/mol (10%, n = 19) of whom 15 were aged >68 years.

Some differences were observed between patient-level factors and HbA1c categories, with a significantly higher percentage of participants whose HbA1c was ≤59 mmol/mol and who perceived their blood glucose to be *well* or *very well* controlled (p < .001). As expected, patients with HbA1c ≤59 mmol/mol also had a lower mean appraisal of insulin treatment (ITAS negative) and lower depression (PHQ-9) scores with p < .001 and p = .002 respectively.

The logistic regression model identified two variables that significantly contributed to patients' glycaemic control: level of depression, and years since diagnosis of T2DM. The strongest predictor, the level of depression, had a negative relationship (*OR* 0.91, 95% CI [0.83, 0.99], p = .030) with glycaemic control, indicating that patients with higher depression scores were more likely to have suboptimal glycaemic control than those with lower scores. The second predictor was duration of T2DM diagnosis, which had a positive relationship with glycaemic control (*OR* 1.05, 95% CI [1.00, 1.11], p = .042), suggesting that the longer the duration of diabetes, the lower the blood glucose levels.

The next section describes the findings of the supplemental structured telephone questionnaire.

4.2 The Telephone Questionnaire

The findings of the telephone survey are described under two headings:

1. Experiences of insulin use; and
2. Difficulties or challenges, and what helped to use or manage insulin.

Of the 201 postal survey participants, 71% (*n* = 142) indicated their agreement to be interviewed and that they were happy to be contacted for this. Of these, 87% (*n* = 124) were interviewed by telephone, and 30 of these participants were also interviewed face-to-face. The recruitment flow chart is presented in Figure 20.

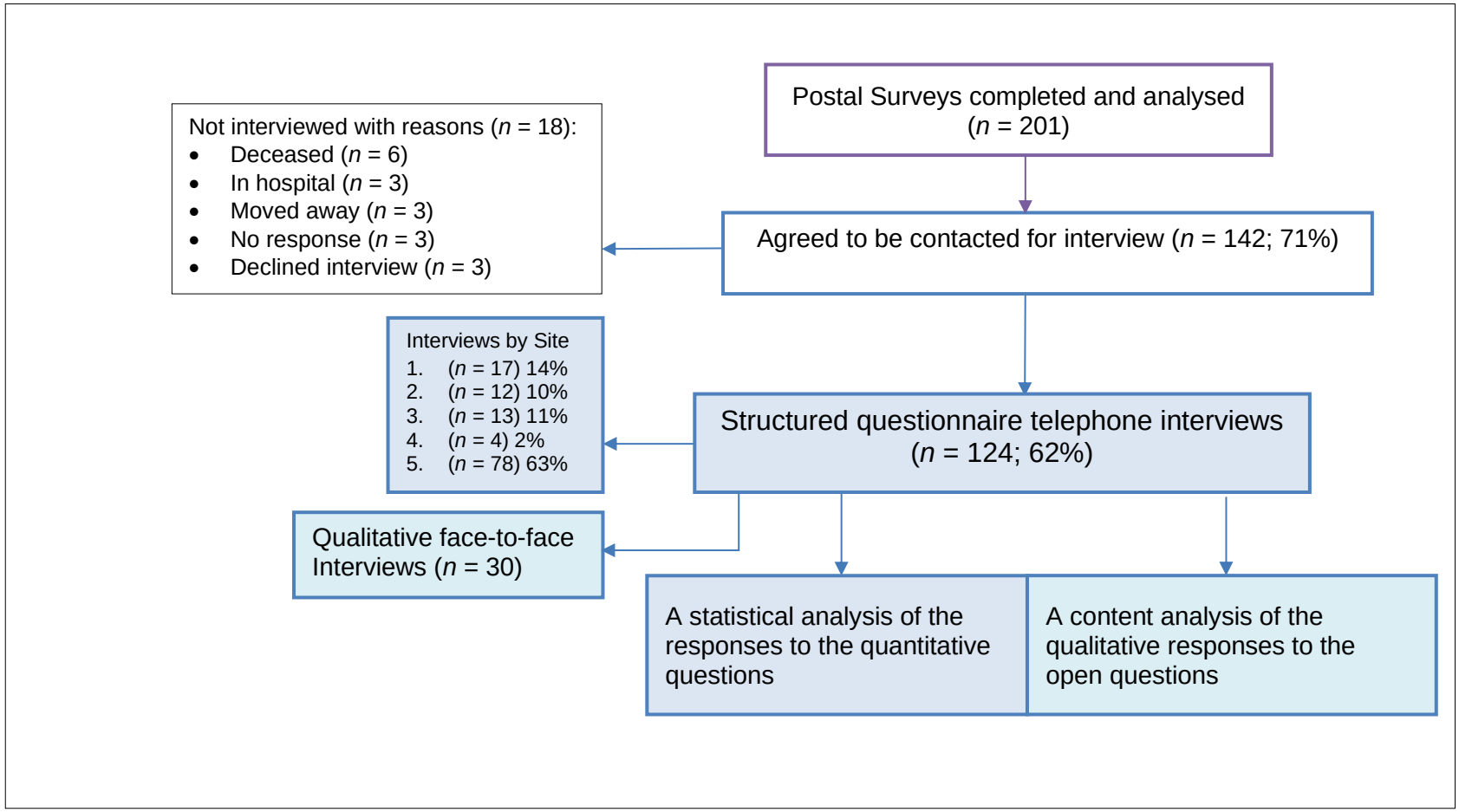


Figure 20 Interview Recruitment Flow Chart

4.2.1 Experiences of Insulin Use

This section relates to patient experiences of hypoglycaemia and of insulin management. All interviewees (*n* = 124) self-administered their insulin; one patient reported that a relative administered their insulin some of the time.

4.2.1.1 Hypoglycaemia

A summary of the related responses is outlined in Table 43. When asked if anyone had explained what hypoglycaemia was and how to treat it, 8% (*n* = 10) said that nobody had explained this. Seventy percent (*n* = 87) reported experiencing one or more *hypo* events and, of these, 35% (*n* = 30) had up to four in the last month, while 83% (*n* = 72) had one or more in the last year. When questioned about severe hypoglycaemia, 15% (*n* = 19) reported having at least one event.

Table 43 Experiences of Hypoglycaemia

HYPOGLYCAEMIA	*n (%)*
Patients who have ever had a hypo:	
no	37 (30)
yes	87 (70)
Hypos in the last month:	
0	57 (65)
1–2	26 (30)
3–4	4 (5)
Hypos in the last year:	
0	15 (17)
1–9	65 (75)
10–9	5 (6)
≥30	2 (2)
Patients who have had a severe hypo:	
No	105 (85)
yes	19 (15)
Months since last severe hypo:	
1–6	8 (42)
7–12	3 (16)
>12	8 (42)
Number of severe hypos since insulin was started:	
1–4	12 (62)
5–10	2 11)
>10	3 (16)
Can’t remember	2 (11)

Key: hypo = Hypoglycaemic episode

Overall, there were no differences in the demographic characteristics of patients who had and those who had never experienced hypoglycaemia, although there were differences in duration of insulin, the insulin type and dosage (Table 44). Patients reporting hypoglycaemia had a significantly longer duration of insulin therapy (p = .016) than those with no history of hypoglycaemia. A higher percentage of the hypoglycaemic group used a basal-bolus regime, while a lower percentage received basal-only insulin (p = .001). Mean TDU of basal insulin within the basal-bolus regime was significantly higher in the hypoglycaemic group (p = .001). Of those receiving sulfonylureas (n = 21), eleven patients reported hypoglycaemia. Of these, six patients received basal-only insulin, three had basal-bolus, and two had premix insulin. Relationships between hypoglycaemia and level of blood glucose control were explored but no significant associations were identified.

Table 44. Hypoglycaemia and Patient Characteristics

Characteristic	Hypoglycaemia *n* = 87 (70%)	No hypoglycaemia *n* = 37 (30%)	Tests for differences* χ^2 or ANOVA
Gender *n* (%)			χ^2 = 0.042, *df* = 1, *p* = .995
Male	50 (57)	22 (60)	
Female	37 (43)	15 (40)	
Age *years*			
Mean (SD) Range	68.8 (10.4) 37–90	71 (11.3) 43–88	*F* = 1.133, *df*1, *p* = .289
Ethnicity *n* (%)			χ^2 = 5.872, *df* = 4, *p* = .209
White British	79 (91)	36 (97)	
Asian	2 (2)	-	
Other	6 (7)	1 (3)	
Living alone *n* (%)			χ^2 = 0.510, *df* = 1, *p* = .639
Yes	23 (26)	31 (84)	
No	64 (74)	6 (16)	
Employment *n* (%)			χ^2 = 3.715, *df* = 5, *p* = .591
Employed	23 (27)	8 (22)	
Unemployed	2 (2)	-	
Retired	59 (68)	26 (72)	
Other	3 (3)	2 (6)	
BMI *kg/m²*			
Mean (SD) Range	31.6 (6.75) 20–58	33.6 (6.82) 24–52	*F* = 2.182, *df*1, *p* = .142
T2DM duration *years*			
Mean (SD) Range	17.2 (7.2) 4–45	15.2 (7.75) 4–43	*F* = 1.939, *df*1, *p* = .166
Insulin duration *years*			
Mean (SD) Range	8.78 (7.13) 1–40	5.70 (4.20) 1–15	***F* = 5.972, *df*1, *p* = .016***
Insulin Regime *n* (%)			***χ²* = 15.054, *df* = 2, *p* = .001***
Basal-only	17 (20)	19 (51)	
Basal-bolus	43 (49)	7 (19)	
Premix	27 (31)	11 (30)	
Total TDU	79 (55) 10–310	67 (63) 10–261	*F* = 1.006, *df*1, *p* = .318
Mean (SD) Range			
Basal-Only	54 (42) 10–160	32 (19)10–70	***F* = 4.304, *df*1, *p* = .046***
Basal (as part of Basal-bolus)	48 (27) 10–120	86 (30) 38–126	***F* = 11.752, *df*1, *p* = .001***
Rapid	52 (47) 8–240	85 (36) 38–135	*F* = 3.083, *df*1, *p* = .086
Premix	64 (38) 18–180	59 (33) 20–118	*F* = 0.132, *df*1, *p* = .719

*Level of significance is .05 or less

Key: ANOVA = analysis of variance; BMI = Body mass index; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; *p* = p-value; *SD* = standard deviation; TDU = Total daily units of insulin

4.2.1.2 Insulin Management

When asked when their last insulin dose was changed (by the patient or healthcare professional [HCP]), 32% (*n* = 40) reported that this was less than a month ago and 72% (*n* = 89) reported that this was within the last year. Nineteen percent (*n* = 23) of patients said that they had not had a dose change for more than a year. Regarding frequency of dose-adjustment (either patient-driven or

HCP-driven), just under 50% (*n* = 58) rarely or infrequently changed their dose, while for 13% (*n* = 16), it was often adjusted. For their most recent dose change, 37% (*n* = 46) of the interviewees said they made the decision to adjust it; for 41% (*n* = 51), it was the doctor or nurse who advised; while 21% (*n* = 26) decided this together with their doctor or nurse. A Chi-square test for independence suggested no significant differences between glycaemic control groups regarding frequency of dose change or who made the decision.

To investigate the relationship between patients ever experiencing hypoglycaemia with managing insulin, the interview data was triangulated with the postal survey responses (perceived control, understanding blood glucose fluctuations, ability to calculate insulin dosage, and preference to self-adjust insulin), and related telephone responses. A Pearson product-moment correlation coefficient (*r*) identified no significant correlations except for one small positive one between experience of hypoglycaemia and preference to self-adjust ($r = .185$, $n = 115$, $p = .048$). However, a Chi-square test for independence and ANOVA revealed no significant differences between the hypoglycaemia groups and insulin use variables, or glycaemic control Table 45.

In the next section, a content analysis is described of what patients found challenging and helpful in using their insulin treatment.

Table 45 Hypoglycaemia and Insulin Management

Characteristics	No hypoglycaemia *n* = 37 (30%)	Hypoglycaemia *n* = 87 (70%)	Tests for differences* χ^2 or ANOVA
HbA1c *mmol/mol*			*F* = 0.256, *df*1, *p* = .614
Mean (SD) Range	63.3 (11.1) 37–88	64.9 (17.3) 39–126	
Preference to self-adjust insulin *n* (%)			χ^2 = 3.143, *df* = 1, *p* = .076
Never /rarely/sometimes	17 (52%)	26 (32%)	
Mostly /always	16 (48%)	56 (68%)	
Explanation given about hypoglycaemia *n* (%)			χ^2 = 5.232, *df* = 2, *p* = .073
Yes	30 (81%)	82 (94)	
No	6 (16)	4 (5)	
Can't remember	1 (3)	1 (1)	
Who decided to change the last insulin dose? *n* (%)			χ^2 = 3.462, *df* = 2, *p* = .177
You	11 (30)	35 (41)	
Doctor/nurse	20 (54)	31 (36)	
You + doctor/nurse	6 (16)	20 (23)	
Months since last dose change *n* (%)			χ^2 = 1.981, *df* = 4, *p* = .739
<1	10 (27)	30 (35)	
1–4	5 (13)	15 (17)	
5–12	11 (30)	18 (21)	
>12	8 (22)	15 (17)	
Can't remember	3 (8)	9 (10)	
Dose frequency categories *n* (%)			χ^2 = 5.701, *df* = 3, *p* = .127
Never /Can't remember	0	4 (4)	
Rarely	24 (65)	38 (44)	
Often	3 (8)	13 (15)	
Variable	10 (27)	32 (37)	

*Level of significance is .05 or less

Key: ANOVA = analysis of variance; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; HbA1c = glycated haemoglobin; *p* = p-value; *SD* = standard deviation.

4.2.2 Challenges and Enablers When Using Insulin

The tables in Appendix 12 summarise the factors patients identified as being either challenging or helpful in their insulin treatment, following a content analysis of their responses to the following questions:

- What is the one most difficult or challenging thing about your insulin treatment?
- What is the one most helpful thing in helping you use or manage your insulin?

The identified categories are outlined next. A patient's response could be assigned to one or more categories; hence, the total number of responses in some of the categories totalled more than the number of patients replying to each question.

4.2.2.1 Challenges of Insulin Therapy

Ninety-five percent (*n* = 118) of interviewees replied to this question. The coded responses (*n* = 142) were formulated into three categories and eight subcategories (Table 46).

Table 46 Challenges of Insulin

Categories	Subcategories	Responses *n*	Cumulative responses *n*	Ranking
Insulin Use	Injection-site problems	40	92	65%
	Remembering to inject	23		
	Insulin management	20		
	Hypoglycaemia	9		
Psychosocial Aspects	Social factors	23	37	26%
	Psychological factors	14		
Physical Health	Food and weight Issues	10	13	9%
	Comorbidity	3		

Insulin Use

Insulin formed the largest category and related specifically to the day-to-day process of injecting, managing doses, and concerns about having low blood glucose levels.

Injection-Site Problems

Difficulties with injection sites formed the largest subcategory, of which half were associated with pain such as *"Pain on injecting"* and *"painful in thighs"*. Bruising and lumps were mentioned by 25% (*n* = 9) of patients reporting these problems: *"Hate it because of bruises from the injections"*. A small number included practical difficulties such as injecting large volumes of insulin and manipulating the injection device.

Remembering to Inject

The majority of responses with respect to memory were *"remembering to inject"*. Some patients indicated that this was contextual to specific activities or changes in their mental capacity; for example, because they were *"out for lunch"* or *"since stroke last year"*.

Insulin Management Difficulties

Difficulties perceived by patients in this section included managing high blood glucose readings *"When the blood sugar spikes"*, titration *"Getting the dose right"*, having sufficient insulin supplies, increasing the number of injections, and self-monitoring of blood glucose (SMBG), *"Monitoring my blood glucose"*. Reference was made to healthcare support, with one person's response suggestive of a need for advice as to whether their insulin dose was appropriate *"as no one's ever told me"*, while others concerned advice given by PNs regarding dose-adjustment and injection sites.

Hypoglycaemia

The difficulties of hypoglycaemia included triggers such as exercise, severe hypoglycaemic episodes with loss of awareness, and worry or concern *"I'm worried about hypos later if I do [increase insulin*]". Two respondents also noted that having lost weight, hypoglycaemia became more of a problem, suggesting a change in their insulin requirement.

Psychosocial Aspects

Social Factors

Social influences mostly accounted for inconvenience as having to plan: *"can't do anything spontaneously"* and *"the nuisance of it all especially as travel a lot"*. Working patterns, family reactions and injecting in public, *"I feel self-conscious"*, also posed difficulties.

Psychological Factors

Psychological factors related to how patients viewed having to use insulin, while accepting the requirement albeit with reluctance. Responses revealed how patients felt *"fed up"* with their insulin treatment, found it *"boring"* or unhelpful, with one reporting *"It's a pain in the neck!"*.

Physical Health

Food and Weight Issues

Food-related challenges included the feeling of *"having to eat regularly"*, needing to "*watch"* food, and enjoying food. "Weight" alone was cited by a few (*n* = 4) to be a challenge when using insulin.

Comorbidity

Comorbidity formed the smallest subcategory. The impact of additional conditions included an oesophageal condition which impacted on swallowing, and arthritis leading to difficulty *"holding the [insulin] pen still".*

In summary, while a wide variety of difficulties were communicated, most challenges related to injection-site problems. The next analysis details factors reported to help when using insulin.

4.2.2.2 What Helped to Use or Manage Insulin

Eighty-one percent (*n* = 101) of patients interviewed identified factors that helped in using or managing their insulin. Additionally, eight interviewees found nothing helped. The coded responses (*n* = 170) were also grouped into three categories (Table 47) with eight subcategories.

Table 47 What Helped to Use or Manage Insulin

Categories	Subcategories	Responses *n*	Cumulative responses *n*	Ranking
Insulin Use	Support for insulin therapy and technologies for delivery	34	80	47%
	Impact on blood glucose levels	25		
	Blood glucose awareness	11		
	Techniques to help remember to inject	10		
Psychosocial Aspects	Psychological factors	61	77	45%
	Social support	16		
Lifestyle Modification	Dietary modification	11	13	8%
	Exercise	2		

Insulin Use

Insulin use again formed the largest category, and was formulated from four subcategories:

Support for Insulin Therapy and Technologies for Delivery

Responses related to the injection procedure, including technique and ease of taking insulin compared with OHAs: *"Being able to adjust insulin unlike tablets"*. The needle size *"small pen needles"*, and the injection device were referred to in many of the responses as facilitating the procedure, *"The pen is so easy to use"* and making it fast and convenient, *"no fuss"*. Changing the insulin regime was perceived to help, adding mealtime insulin, and giving *"two smaller injections instead of one large one".* A few responses referred to *"the Practice Nurse"* as being a helpful support, and one person felt *"a patient group would help and more information"*.

Impact on Blood Glucose Levels

This group mainly alluded to SMBG being of help as it revealed that insulin was *"having an effect"* and *"Seeing the blood sugars improve"*. A small number referred to managing insulin such as dosage *"When taking the right amount, it is good",* timing of the injections, and having sufficient supplies to administer it.

Blood Glucose Awareness

Replies in this category related to how awareness of fluctuations in blood glucose levels helped with using insulin by supporting dose-adjustment: *"If blood sugars are high, I get symptoms; I feel hot"* and *"I can tell when my blood sugar's getting low"*. One said their blood glucose *"has levelled out a lot since having been on it"*, reinforcing their use of insulin. Others relied on the support of relatives to alert them to low blood sugar levels.

Techniques to Help Remember to Inject

Individual strategies helped people to remember to inject. These included habit *"just do it automatically"*, keeping insulin at work, marking in a blood glucose testing diary after injecting, and prompting by others *"now have a partner who reminds me"*.

Psychosocial Aspects

Psychological Factors

This subcategory included many responses related to the positive perceptions of insulin supporting its continual use *"It makes me feel good as if I'm looking after myself"*, knowing insulin could help control blood glucose *"keeps my blood sugar number down"*, effects on health *"keeps me alive"*, and physical wellbeing *"can sleep well since being on insulin"*. Others reported that insulin posed no challenge for them *"Not difficult at all*" and was simply accepted: *"It's part of life*" and *"just get on with it*".

Social Support

Comments in this group included the role of relatives and others in supporting their insulin injections and planning for everyday use of insulin. Responses included grandchildren being *"a distraction when injecting"* by taking their mind of their injection pain, *"wife"* in overseeing injections, and *"An Indian restaurant owner"* who facilitated the privacy of one individual to inject by showing them into a side-room. Planning for everyday use of monitoring and injecting helped *"have three blood glucose meters – in bedroom, lounge and car"*, and keeping needles and insulin at work.

Lifestyle Modification

Dietary Modification

There were more dietary than exercise observations; these included the perceived benefits in supporting insulin management of *"keeping to a diet"*, the subsequent consumption of more food *"which means I can actually eat some sugar in desserts"*, and the support of a slimming group.

Exercise

Just two replies related to how exercise helped insulin use by reducing blood sugars.

In summary, multiple factors contributed to helping patients use their insulin. While most of these formed the insulin use category, it was the psychological factors which many patients felt contributed to their insulin use and glycaemic

control; particularly, their perceived benefits of the insulin and positive approach to the treatment.

4.2.3 Summary of the Telephone Questionnaire Findings

The analysis of the telephone interviews conducted with 62% (*n* = 124) of the postal survey participants explored their experiences of hypoglycaemia and of insulin use. Seventy percent (*n* = 87) of interviewees reported having experienced at least one hypoglycaemic episode. Those interviewees with a history of hypoglycaemia, had received insulin treatment significantly longer than those with no past episodes, and a higher percentage of the hypoglycaemic group used a basal-bolus regimen. Regarding the association of insulin management and hypoglycaemia, a small correlation was identified between preference to self-adjust and history of hypoglycaemia. In terms of dose titration, a small proportion (37%) of interviewees reported self-adjustment while the remainder said they decided this together with their doctor or nurse, or their clinician made the decision.

Finally, patients gave a range of responses when asked to consider what was most difficult or challenging, and what was most helpful, in using or managing insulin treatment. Their replies were subjected to a content analysis. The largest category in each related specifically to insulin use. Key difficulties included injection-site problems, remembering to inject, negative perceptions of insulin, and the day-to-day inconvenience of injecting. The main factors in helping to use insulin included ease of injecting with the pen-device, the perceived benefits of the therapy, and accepting the need for insulin.

The thematic analysis of the face-to-face patient interviews follows in the next chapter.

5. VIEWS AND EXPERIENCES OF PATIENTS ON INSULIN USE AND SUPPORT

This chapter presents the findings from the patient interviews, which were designed to elicit: patients' everyday experiences of insulin treatment; factors contributing to their insulin use and blood glucose levels; and their access to primary care healthcare professionals (PC HCPs). The chapter is organised into two sections:

- Patient characteristics
- Interview findings

5.1 Patient Characteristics

Thirty semi-structured face-to-face interviews were conducted with patients recruited from the telephone interviews (*n* = 124) from each practice: Site 1 (*n* = 7); Site 2 (*n* = 6); Site 3 (*n* = 4); Site 4 (*n* = 3); and Site 5 (*n* = 10). Of these, 70% (*n* = 21) were registered with a practice with both a General Practitioner (GP) and Practice Nurse (PN) who provided insulin support services. The recruitment flow chart was presented in Chapter 4. The majority of interviews (*n* = 26) were performed at the patient's home, with four participants choosing to be interviewed in a general practice surgery. All were interviewed alone, apart from three who had their spouse present for reasons attributed to forgetfulness (*n* = 2) and hearing difficulties (*n* = 1) (see Table 48).

Table 48 The Interviews

Patient name*	Relative present	Site of interview	Date	Duration *minutes:seconds*
Baaz	-	Home	21/11/16	57:29
Beata	Husband	Home	16/12/16	57:50
Christine	-	Home	07/11/16	30:43
Edna	-	Home	29/12/16	18:17
Edward	-	Home	29/12/16	58:51
Elsie	-	Home	21/11/16	39:5
George	-	Home	30/12/16	40:40
Gwen	-	Surgery	04/11/16	37:21
Hilda	-	Home	16/12/16	43:13
Ian	-	Home	09/12/16	34:45
Jack	-	Home	02/11/16	22:32
James	Wife	Home	28/11/16	53:35
Jane	-	Home	19/12/16	22:46
Joan	-	Home	02/12/16	26:30
Joe	-	Surgery	18/11/16	36:10
John	-	Home	28/11/16	59:32
Mary	-	Home	02/11/16	32:55
Muriel	-	Home	25/11/16	41:00
Ned	-	Home	23/11/16	34:23
Patricia	-	Home	18/11/16	46:02
Paul	-	Home	02/12/16	48:04
Ruth	-	Home	30/12/16	18:11
Samuel	Wife	Home	19/12/16	28:16
Sarah	-	Home	20/12/16	28:15
Sharon	-	Home	19/12/16	35:05
Shaun	-	Home	09/12/16	50:44
Sid	-	Home	02/11/16	31:47
Sue	-	Surgery	04/11/16	42:02
Trevor	-	Surgery	12/12/16	46:08
Valerie	-	Home	08/11/16	26:31

*Pseudonyms are used for the names of patients to preserve anonymity.

The participants' mean glycated haemoglobin (HbA1c) was 68.8 mmol/mol (*SD* = 19.9, range 39–126 mmol/mmol), and mean duration of type 2 diabetes (T2DM) and of insulin treatment was 17 years (*SD* = 8.04, range 5–45 years) and nine years (*SD* = 8.82, range 1–40 years) respectively. Insulin regimes included basal-only (*n* = 9, 30%), basal-bolus (basal insulin with prandial [mealtime] insulin injected with one or more meals each day) (*n* = 9, 30%), and premix insulin (*n* = 12, 40%) injected twice (*n* = 10) or three times a day (*n* = 2). Nineteen patients (63%) also received one or more oral hypoglycaemic agents (OHAs) each day. The demographic and diabetes-related characteristics are shown in Table 49 and Table 50. An anonymised interviewee database can be viewed in Appendix 13.

Table 49 Demographic Data

Demographic Data	Face-to-Face Interviewees *n* = 30
Gender *n* (%)	
Male	14 (47)
Female	16 (53)
Age *years*	
Mean (SD) Range	64.73 (10.9) 45–87
Ethnicity *n* (%)	
White British	27 (90)
White other	1 (3)
Asian	1 (3)
Other	1 (3)
Living alone *n* (%)	
Yes	7 (23)
No	23 (77)
Employed *n* (%)	
Works	10 (33)
Does not work	2 (7)
Retired	17 (57)
Missing	1 (3)
Smoking status *n* (%)	
Never smoked	15 (50)
Ex-smoker	10 (33)
Smoker	5 (17)
Weight *kgs. Mean (SD) Range*	92.7 (27.7) 55–158
BMI *kg/m^2 Mean (SD) Range*	31.8 (8.1) 21–50
Obese *n* (%)	16 (53%)

Key: BMI = body mass index; *SD* = standard deviation.

Table 50 Diabetes-Related Data

Diabetes-Related Data	Face-to-face Interviewees *n* = 30
HbA1c *mmol/mol Mean (SD) Range*	68.8 (19.9) 39–126
Categories *n* (%)	
≤59	11 (37)
>59	19 (63)
T2DM duration *years*	
Mean (SD) Range	17 (8.04) 5–45
Insulin duration *years*	
Mean (SD) Range	8.5 (8.82) 1–40
Insulin Regimen *n* (%)	
Basal-only	9 (30)
Basal-bolus	9 (30)
Premix	12 (40)
Total daily units of insulin (TDU)	
Mean (SD) Range	70.3 (56.7) 20–212
Regimen specific TDU	
Mean (SD) Range	
Basal-only	51 (33.5) 20–112
Basal (as part of Basal-bolus)	56 (43.1) 15–116
Rapid	51 (43.4) 8–120
Premix	57 (35.6) 26–134
GLP-1 RA *n*	
Liraglutide, daily	3
Diabetes care managed by: *n* (%)	
Practice Nurse	19 (63)
General Practitioner	3 (10)
Practice Nurse + General Practitioner	2 (7)
Practice Nurse + Diabetes Specialist Nurse	3 (10)
GP/Practice Nurse + Consultant	3 (10)

Key: GLP-1 RA = glucagon-like peptide-1 receptor agonist; HbA1c = glycated haemoglobin; SD = standard deviation; TDU = total daily units.

5.2 Interview Findings

The findings are presented in relation to the identified thematic framework, which comprises five thematic areas. Four of these areas express the factors contributing to insulin self-management in the study population: insulin use; impact on blood glucose levels; psychosocial and physical factors; and insulin treatment support. The fifth area relates to suggested improvements. The areas were formulated from the themes (*n* = 14) and sub-themes (*n* = 18) which emerged from the interview data. Each theme is supported with excerpts from the data, linked to the participant (using a pseudonym to preserve anonymity) with details such as age (years), insulin type or HbA1c (mmol/mol). The thematic framework is presented in Figure 21. A narrative account is given next.

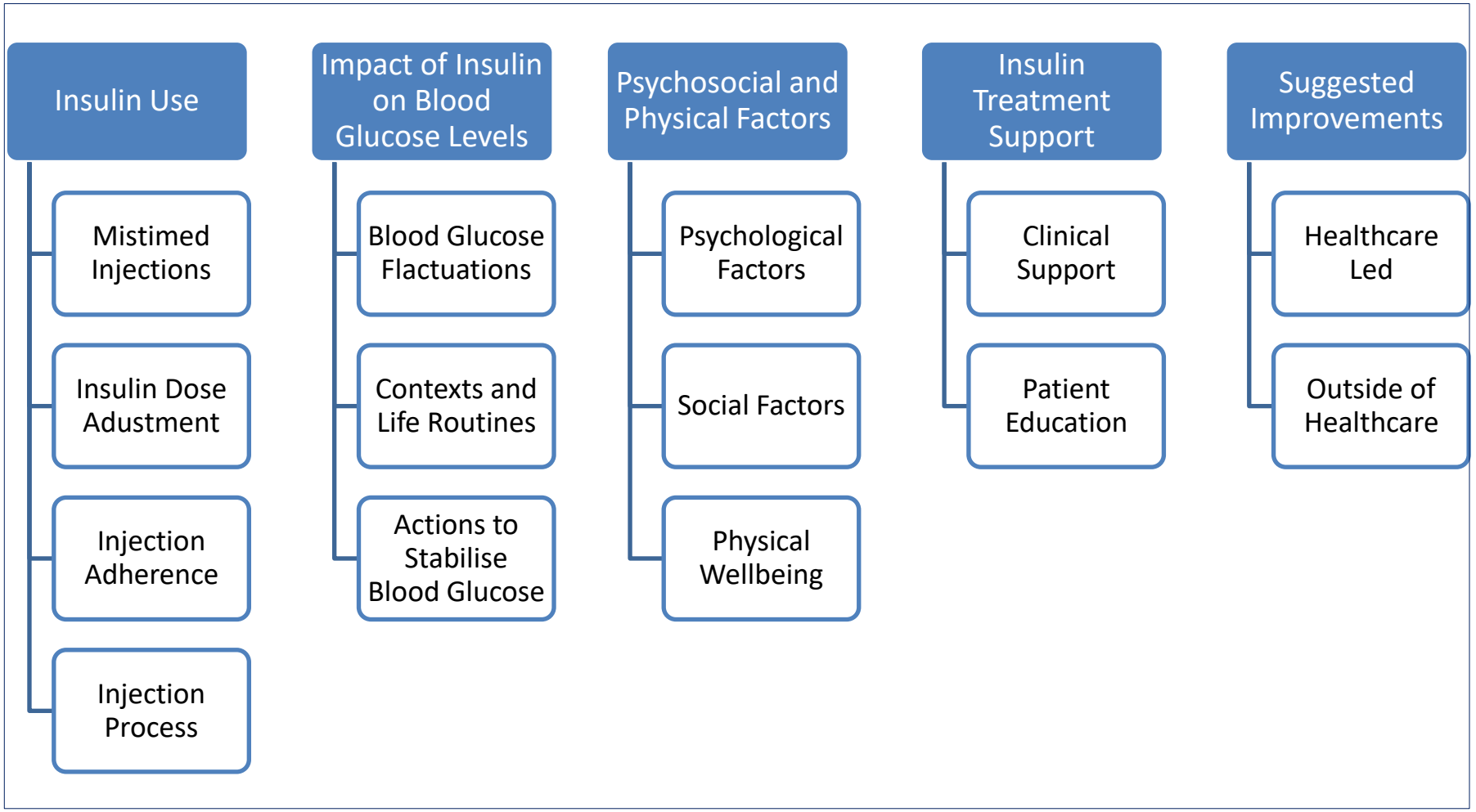


Figure 21 Thematic Framework: Patients

5.2.1 Insulin Use

The accounts revealed that the way in which patients used insulin was influenced by several factors including: their understanding of the action of their insulin type (the speed of onset and duration of prandial insulin); their ability or desire to self-adjust the dose; their adherence to injecting insulin; and the injection process.

5.2.1.1 Mistimed Injections

The impact of a person's knowledge and understanding of how their insulin acted could lead to mistiming of prandial-based regimens with potential for hypoglycaemia and unexpected blood glucose variability. One patient seemed unaware of the differences in action between his current premix insulin compared with his previous basal insulin, while another regularly mistimed his injections:

> *"The insulin was changed while I was in hospital [from Humulin I] … and the nurse in hospital said, this Humulin M3, she thought would suit me better… but it's gone a bit wobbly over the last couple of days."* (George, aged 76, two years on insulin, HbA1c 80 mmol/mol)

> *"When I get up in the morning, I normally inject, come in, and have me breakfast …but in the afternoon, or lunch-time, I inject about an hour or so afterwards [after meal] and then in the evening, inject about an hour after my meal, something like that. So, it's about an hour after I've eaten that I inject."* (Shaun, aged 68, thrice-daily premix insulin, HbA1c 78 mmol/mol)

Others seemed not to understand the reason for injecting prandial insulin at mealtimes, even though this was their usual practice. When eating out, they would intentionally delay administering it until returning home or would inject long before a meal to avoid doing so in public with no apparent awareness of the possibility of triggering hypoglycaemia:

> *"What I normally do is, I have my meal [and then when I go home, I inject [NovoRapid]…you've got half-an-hour or an hour later and I'll be at home and I'll inject."* (Gwen, aged 61, basal-bolus, HbA1c 58 mmol/mol)

"So, we went to the [charity] do the other night...we done it [injected] at about six o'clock, before we left here…we started to eat about half seven or something, or eight o'clock. So that was the time between giving the injection until you eat, so that was, you know, not too long [2 hours]. (Beata, aged 76, NovoMix30, 10 years on insulin, HbA1c 42 mmol/mol)

5.2.1.2 Insulin Dose-Adjustment

There was a variety of ways in which participants adjusted their insulin dose. Some patients expressed a preference or an assumption for the clinician to decide the dose for them while others seemed unaware that there could be an option to self-adjust. Some of the participants who self-adjusted undertook this in a considered, systematic manner, while others adopted a more haphazard approach. Regardless of the titration method, most continued to self-monitor although the frequency and how they acted on the readings varied.

Several patients left the decision to adjust with their clinician-related, expressing no desire or need to self-adjust, even though, at times, some recognised a need to:

"I don't have to adjust it unless my consultant advises me too." (Mary, aged 72, basal-bolus, HbA1c 52 mmol/mol)

"I don't think I need to know that." (Edna, aged 77, basal-only, HbA1c 71 mmol/mol)

"I'm quite comfortable with being told what to give. As a result of what happens [frequent hypoglycaemic episodes] they told me to drop it down to 34." (Edward aged 78, twice-daily premix, HbA1c 39 mmol/mol)

Others, expressed the view that dose-adjustment should be patient-led, although they also identified reasons that people may prefer not to do this:

"I think they're just frightened of it, you know, it's like we live in a society where you want the doctors or the nurses to tell you what to do and that you don't want to do anything yourself. Some might find that difficult or worry about doing the wrong thing. They don't realise that it's your control that's going to make you feel OK." (Christine, aged 62, basal-bolus, HbA1c 52 mmol/mol)

"It's that taking control and I think that's still part of the denial, of getting people to realise that they actually have got diabetes and that they need to take control of it. 'Cause it's easier for some people to pass it on to the diabetes nurse then if anything goes wrong, 'It's her fault it's not mine'…" (Gwen, aged 61)

Some felt more confident once they were shown how to self-adjust. One patient wondered whether she would ever be able to reduce her doses, and seemingly accepted the possible need for prandial insulin in the future:

"I was advised to put it up or down by two units at a time so, though I don't know whether it would ever be able to go down. I mean, generally speaking, it's gone up and I imagine that they'll come a time when I do have to have one [insulin] occasionally with food which I'll have to adjust." (Valerie aged 59, twice-daily basal insulin)

Whether or not individuals had been taught how to self-adjust, there was also a view of the process was *"something you pick up as you go along"* (Christine). One haphazard approach was described by a patient's wife as *"chasing his blood sugars"* instead of *"looking for a pattern…rather than fire-fight":*

"Ok, I'm 20, I've got to knock it right down, I'm low, I've got to give myself less." (James, aged 81, basal-bolus, history of frequent hypoglycaemia, HbA1c 63 mmol/mol)

Others adopted similar methods, choosing to adjust the insulin dose according to the level of blood glucose at the time of testing; giving large correction doses outside of mealtimes; or by *"experimenting"* (John):

> *"Some of the readings I must admit are a bit high...I sometimes take a bit of NovoRapid before I went to bed – just 10 [units] or something if it was running high. But eh talking to the diabetic nurse, she said, 'Don't do that' [laughs]."* (Joe, aged 67, 10 years on insulin, basal-bolus, HbA1c 95 mmol/mol)

> *"I'll take my blood sugar before I do those [twice-daily Levemir injections] and it depends on what they are as to how much I take … if they're high [at the time of injecting] then I give more [Levemir]. I also have some NovoRapid that I'm not supposed to take but if I've got a blood sugar of 14, 15, 16…well, if it's over 10, then I give myself some NovoRapid to bring it down."* (Sue, aged 45, 11 years on insulin, HbA1c 58 mmol/mol)

A few participants perceived a lack of opportunity to be taught how to self-adjust by either a PN or Diabetes Specialist Nurse (DSN) and others who had already been shown how to adjust felt that they needed more explanation:

> *"I said em, 'I'm still only on 30 units a day; 17 in the morning and 13 in the evening of NovoMix30', and I said, 'I've been on this for three years and it's a bit iffy sometimes'. I said, 'and I've been doing the best I can, and I'd like to see her [DSN] to see if maybe the units should go up.' … I didn't know, and I daren't put another unit in, no, not myself… She [DSN] said, 'No, no way. I've worked it all out, even sent a letter to your doctor'…so er, that was that."* (Hilda, aged 88, four years on insulin, twice-daily premix, HbA1c 54 mmol/mol)

> *"Yes… I know I've got a silly little diagram – you're going to inject here, and it won't affect until the morning. If you've got problems with your morning readings, you have to sort your evening reading …but it's never really been explained."* (Muriel, aged 52, five years on insulin, twice-daily premix HbA1c 88 mmol/mol)

Participants who did not act on their readings still monitored their glucose levels so they would know if they were in a specific range. The frequency of monitoring varied, with some increasing the frequency if they were due to attend the PN clinic which could indirectly impact on their insulin use:

> *"Funny enough, I am bad in recording and controlling the levels of the glucose by the test-strips…Having been in contact with the PN [about a high HbA1c result] who said, 'you may have missed some insulin' so that was an indication for me taking a test-strip which came 17.3 this morning, which could have been one of the contributing factors."* (Baaz, aged 60, twice-daily premix, HbA1c 73 mmol/mol)

5.2.1.3 Injection Adherence

Adherence to insulin injections varied between participants and included both intentional and unintentional omission with assorted contributors. Reasons for intentionally missing or delaying injecting was frequently to avoid doing so in public or to prevent hypoglycaemia. Forgetting to inject was attributed by some to feeling well, so perceiving no immediate need for insulin, or forgetting to take their insulin with them if they were going out. This could be a frequent occurrence:

> *"So yes, there are quite a few occasions where I go out … that at times I have forgotten to take the insulin with me so that means I've eaten, and I've missed out taking my shot."* (Baaz, aged 60)

> *"I must admit I do forget…maybe two or three times a week. I think it's because I feel OK. So, like this morning I'd have my breakfast, I'd taken my tablets, but I feel OK, so I haven't injected…It is so easy to forget 'cause you get complacent with it because you feel OK."* (Gwen, aged 61)

Corrective actions for omission of prandial-based regimens included injecting as soon as the person realised they had forgotten, regardless of the time lapse since eating:

"It's normally quite a while. It could be three or four hours after a meal that it suddenly clicks that, 'Oops I haven't' and then I give it. I don't know whether I should or not, but I do. I think, 'well it's better to take it now than not at all'…" (Gwen, aged 61)

"Occasionally I forget to take my insulin with me, so we come back from there [restaurant] …and I'll come straight in and do it [inject]. So that's like probably an hour and a half or an hour after we've eaten." (Edward, aged 78, twice-daily premix)

Others would *"just leave it and carry on as normal the next day"* (Christine). Most participants, however, were clear that they *"don't forget"* (Edna) and have *"never forgotten"* to inject (Elsie).

5.2.1.4 The Injection Process

The effect on insulin use of injecting included the injection device, how the injection was undertaken, and the injection sites. The role of the pen-device in making the process of injecting easier was frequently mentioned, particularly by individuals who had previously seen people using syringes and needles. Others, however, struggled to use the pen due to joint problems and found alternative devices easier for administering their insulin:

"It [pen-device] helped me, yes. I thought, 'Oh it's much easier than when I used to inject [husband]'. Oh God, if only his had been like that, what a difference." (Hilda aged 88 who used to inject her husband's insulin with a glass syringe)

"Because of my hands, my finger joints, I couldn't manage with that [pen-device]…I think people find it difficult to use the syringe…because it's a bigger needle…but if you're doing it with this [Innolet]…the needle is so small; you wouldn't believe it was there hardly you know. You don't feel a thing." (Elsie, aged 84, basal-only, HbA1c 48 mmol/mol)

Injection-site problems led to reticence in some patients to inject and problems with insulin absorption in others which impacted further on their insulin use and

glucose control. Such problems were associated with pain and lumpy injection sites. Regardless of the duration of their insulin treatment, a few individuals found that each time they started injecting they experienced a degree of discomfort either because of the needle or the insulin itself. However, there was a level of persistence and determination to administer it, despite anticipation of pain:

> *"It's usually sort of 'round my stomach. I've tried in my leg, I didn't like that 'cause it hurt…I mean I still don't look; I'm pushing it and I'm like…"* (Sarah, aged 52, five years on insulin, basal-only, HbA1c 84 mmol/mol)

> *"I try and take it and I do take it but it's just, it brings me into tears."* (Ian, aged 54, seven years on insulin, basal-bolus, HbA1c 126 mmol/mol)

Various strategies were adopted to reduce pain including using different injection sites and changing *"the shape and the size of the needle which is much shorter and finer"* (Baaz). One individual, however, found the discomfort to be advantageous:

> *"I usually find a bit of sting or so for a little while afterwards, I can feel that…'oh yes, I have [injected it]'…"* (Sue, aged 45)

Other problems related to injection sites affected by lipohypertrophy (lumps). It was only after experiencing these that people became more mindful of preventing future occurrences by "*changing the sites"* (Jack) or using a site rotation card as part of a system to *"vary the sites"* (Edward, aged 78).

> *"I had actually no control over it whatsoever because I was injecting in the same site…the first thing to do is change your site and try that and if that doesn't work then try something else but it should be the first thing and not the last."* (Trevor, aged 68, 29 years on insulin, basal-bolus, HbA1c 77 mmol/mol)

5.2.2 Impact of insulin on Blood Glucose Levels

This second area involves the interviewees interpreting and relating their experiences of the effects of insulin on their blood glucose levels, and how these were often unanticipated particularly when glucose levels were too high or low. Patients also related the synergistic effects of insulin when combined with their lived experiences (changes in climate, exercise). These fluctuations in glucose levels were also associated with compensating behaviours and emotional responses.

5.2.2.1 Blood Glucose Fluctuations

Patients perceived that high or low fluctuations in blood glucose levels could affect their adherence to insulin and the doses administered. Some related the physical sensations they experienced which they attributed to very high or low levels, and how they could *"sense it"* (Edward) when an apparent fall in their blood glucose was starting without necessarily confirming this on monitoring. Although most of these experiences were attributed to low blood sugars, both extremes could impact negatively on their insulin use and wellbeing, particularly if there was a lack of awareness.

Symptom Recognition

Symptoms of high blood glucose were described such as: fatigue, *"throat's always dry"* (Ian), sleep interference, pain, sluggishness, and mood lability which occurred alongside these. While some interviewees immediately increased their insulin dose when their blood glucose was high on testing, others, when experiencing symptoms, chose to compensate through exercise instead:

> *"If my blood sugars are high … my elbows hurt, and I get very, how can I say it, 'aggressive'. It goes from my elbows and then it creeps up to my shoulders and I get very tight and I get very angry and that's when I know and go for a nice long walk and walk fast.*" (Patricia, aged 55, basal-only, HbA1c 66 mmol/mol)

Patient reports of sensations characteristic of low blood sugar included feeling *"a bit sweaty and shaky"* (Sue), and non-specific indicators such as *"felt low"*

(Christine), with a feeling of certainty that their blood glucose was dipping and, for some, their suspicions were confirmed on testing:

> *"If it goes below three or four, I get shaky and I get an anxious feeling in my stomach."* (Sharon, aged 70, thrice-daily premix, HbA1c, 59, mmol/mol)

For others, however, despite their sensations, a blood sugar reading at the time did not always equate to clinical hypoglycaemia because, in some, blood glucose levels were usually raised. This led to some accepting high blood glucose levels as the norm, with no subsequent desire to increase their insulin dose.

> *"I can feel it coming on and I take dextrose sugar or whatever to take immediate effect and come out of that."* (Trevor, aged 68)

> *"When it goes to what I think is nine or eight, then I start to get the shakes, because I think it's run so high, for so long…I mean I usually run between twelve and seventeen during the day."* (Ruth, aged 55, once-daily basal, HbA1c 65 mmol/mol)

Lack of Recognition

Some had no sensations or, if they did, they did not immediately relate these to blood glucose variability which could, if extreme, adversely impact on their everyday activities. Others described with a sense of frustration how, over time, their previous sensations of falling blood glucose levels altered. While some responded to this by reducing their insulin dose, others chose not to act:

> *"I used to sweat like anything and that was my sign that my sugar levels were going low…I would say the last six years, when I've hypo'd, I've not known anything about it, I've just 'gone'…"* (John, aged 51, basal-bolus, HbA1c 123 mmol/mol)

"It's been down to like maybe three or four but not got the shakes or anything…he'll [son] have been sitting next to me and then, 'Mum, get yourself a drop of milk'…I haven't changed my insulin dose now for about a year." (Patricia, aged 55)

5.2.2.2 Contexts and Life Routines

Several individuals described how different environmental contexts and life routines influenced the effect of insulin on their glucose levels. These included: housework; changes in climate; food content; and exercise. Dietary changes without simultaneously adjusting their insulin, *"I felt hypo when I lost it [weight]"* (Ruth), increased physical activity, and a delay in eating were perceived triggers for *hypos* particularly in older participants. Injecting additional prandial insulin outside of meals, mistiming of insulin, and the injection process (see also Mistimed Injections) also played a role:

"I was still having hypos so she [PN] said, 'it's because you're injecting in the [arm] muscle and you're actually using it up quicker than if you're using the stomach' so I'm now injecting in the stomach and I've got really fine needles which are shorter." (Gwen, aged 61)

Some participants, especially those with memory problems, did not always recognise what triggered hypoglycaemia, such as forgetting they had already injected and would *"inject again"* (James) or forgetting to eat after having injected. Others could not identify a cause such as this patient who was later found to be injecting his meal-time insulin long after he had eaten:

"There must be a reason I suppose, but I can't put my finger on why it [blood glucose drops] does it. That's the thing that puzzles me." (George, aged 76)

5.2.2.3 Actions to Stabilise Blood Glucose

In order to stabilise their blood glucose levels some patients modified their insulin doses in addition to increasing their blood glucose monitoring and eating regularly.

Dose Modification

Dose modifications were instigated by a healthcare professional (HCP) or by patients themselves in several ways depending on the cause and the insulin regimen. For hypoglycaemia, exercise and other activities, the insulin dose was reduced or omitted:

> *"He [GP] was the one who said, 'drop it down to 34' and that's what I've done."* (Edward, aged 78)

> *"I'm going out and I'm going to drive, I would probably take insulin, but only half a dose I would normally anticipate taking…then I would take the second half of that [on return]."* (Paul, aged 70, twice-daily premix, HbA1c 59 mmol/mol)

Dietary Modification

Finally, some patients reported eating extra carbohydrates as a way of supporting the insulin to avoid hypoglycaemia rather than using insulin therapy in response to their food intake. This might have been by choice or because of not knowing how to self-adjust:

> *"It's got to be what you eat. There's nothing else you can do, you gotta eat right [laughs] but you can take something with sugar...Yeh, you got to bring the blood up again a bit, you know, you got to get away from four [laughs]… I can have a chocolate, keep it above four, and that's how you have to eat."* (Hilda, aged 88, twice-daily premix)

> *"You must keep to those [meal] times and sometimes it's not easy, you forget, and you think 'Oh my goodness, I should have eaten at such and such as time'…You're tied, all the time really…but you get used to it and you just have to do it don't you."* (Sharon, aged 70)

5.2.3 Psychosocial and Physical Factors

Psychosocial and physical factors played a role in patients' insulin use and insulin management and, subsequently, had an impact on their glycaemic control. These included: psychological factors (psychological approach to insulin use, and

mental wellbeing); social influences (family and friends, foreign travel, injecting in public, and economic factors); and physical wellbeing (physical health and lifestyle).

5.2.3.1 Psychological Factors

The psychological factors that influenced how people used their insulin included their beliefs about insulin, personal traits, and their psychological orientation towards the treatment. Beliefs about insulin as a means to prevent complications, and personal traits such as pragmatism – *"just have to get used to it"* (Christine) – led some to view insulin in a positive way, while others experienced an element of self-blame about being on the treatment. Pragmatism was manifested in individuals who seemingly accepted a need for insulin and to *"get on and do it"* (Jack), as illustrated by these accounts:

> *"Let it come first, and let people understand that. It's what you've got to live with and that's it. You do, you live with it [insulin treatment]."* (Hilda, aged 88)

> *"It's a way of life. It's not something that I might wake up tomorrow and change is it?"* (Christine, aged 62, retired midwife)

Others had a more purposeful outlook, perceiving insulin as a tool to improve their health and had a sense of determination. Some, however, seemed fearful of the consequences of not administering it. Having first-hand knowledge of a relative or friend who had been affected was a motivator:

> *"I know that if I didn't have the insulin I wouldn't be here."*
> (Gwen, aged 61)

> *"If I don't take it, I'm going to die – as simple as."* (Ian, aged 54)

> *"My father, he had kidney problems because of his diabetes and ended up on dialysis."* (Jane, aged 56, basal-bolus, HbA1c 64 mmol/mol)

A positive stance to self-management was adopted by some who attributed this to their nature and disposition:

> *"I think the person I am, has helped me."* (James, aged 81)

> *"I'm very conscious that I have to try and control it myself, if you like, to make sure I don't go over the top."* (Edward, aged 78)

Psychological orientation towards insulin involved negative feelings triggered by fear of pain and hypoglycaemia, psychological comorbidities creating challenges in coping with insulin therapy, and a sense of positive wellbeing since starting insulin. Injection pain could adversely affect those with existing psychological comorbidity, leading to a reluctance to continue with their injections (see also Insulin Use):

> *"When I go to take my injection it hurts so much, I just well, sometimes I just don't bother."* (Ian, aged 54)

Some would strive to overcome their mood fluctuations, suggesting a desire to continue their insulin treatment and everyday lives:

> *"When you have your down days, it's 'Oh God', but you do get it, it's depressing, I think to meself, 'Come on, you got to do something' and you wait for it to work off."* (Hilda, aged 88)

For others, there was an implied desire to continue insulin because they felt *"absolutely fantastic"* (Patricia) since starting it. There was also a sense of control and empowerment which acted as a further driver for continual use:

> *"Yes, it completely changed my life in six days…that was my first time out of being in the 20's, and I danced 'round the kitchen [laughs]...You feel better."* (Patricia, aged 55)

"'Empowering', that's the word they use nowadays, it empowered me more… I mean it's not a precision science, it still has its drawbacks, when occasionally I have taken a dose and I'm still a little tired, or a little bit muzzy." (Paul, aged 70)

5.2.3.2 Social Factors

Social influences included family and friends, foreign travel, injecting in a public place, and employment.

Family and Friends

The extent to which relatives of some participants took on a supportive role was mainly practical. Rather than helping to adjust their insulin dose, this involved prompting them to inject or eat in a timely way and alerting them to a suspected onset of hypoglycaemia. The friendship of others was perceived as beneficial by sharing experiences, with the potential for mutual insulin use support.

One husband retired early to oversee his wife's insulin use, reminding her to monitor, inject and eat because of her forgetfulness and: *"I don't often feel hungry"* (Beata). For those with less symptom recognition, relatives could be adept at identifying sudden dips in blood glucose:

"Oh my son… he can walk into the room and say, 'Mum you need to eat something' and I go 'Why?', he went 'I can smell you' he said, 'and you look weird'…and he says, 'Come on let's do your blood sugars and get you something to eat'…" (Patricia, aged 55)

However, this did not always impact on how they used their insulin, and unlike their relatives who took on this responsibility, some did not perceive such episodes as burdensome. The partner of one patient with recent, frequent nocturnal hypoglycaemia, later related her distress at helping him to treat these episodes. The patient, meanwhile, seemed to accept a certain inevitability of the situation:

"As I say after 20 years I can generally feel if there's a problem, I can sense it, especially in the night …and I assume it's all part and parcel of insulin problems if you like." (Edward, aged 78).

The potential influence of cultural factors was described by one individual who, having been *"born and brought up in India"*, had been *"living and working in this country [UK]"* for many years:

"I am getting used to the system of this practice of giving insulin but there are lots of talks of an alternative medicine as well…. especially in the Asian medicine where it is widely practised…I've been told about this one, 'Why don't you do this, that or the other?'…As much as I feel excited about going and trying it out, I am not likely to change my insulin for that." (Baaz aged 60)

The support of friends with whom participants shared experiences of using insulin could positively impact on everyday insulin use and glycaemic control. This example of an unexpected experience with a friend who the interviewee had not known to be on insulin added humour as well as the possibility of mutual support:

"Well I just say, 'Oh by the way, I have diabetes and I have an insulin injection kit' and they say, 'Oh, well so have I' [laughs]. It's just a general talk." (Edna, aged 77)

Foreign Travel

The impact of travel on insulin use and potentially on blood glucose related mainly to foreign travel, which was reported as being generally trouble-free provided patients made appropriate plans. This involved preparing *"packages including insulin"* (Baaz), checking accommodation beforehand for refrigeration facilities, and adjusting insulin for time zones. Despite carrying a doctor's letter to confirm the need to keep insulin and related equipment on their person during flights, usually *"nobody asked anything"* (Patricia). Preparation included the journey as well as the destination:

"I manage OK with the insulin when I'm away, I take everything I need with me." (Joe, aged 67)

"I do, I carry my black bag which is full of the injection strips and insulin and so on yes." (Baaz, aged 60)

Some were less vigilant over time:

"I'd been diagnosed for about 18 months I think, and it was all still quite new and em we went to Thailand for six months and I remember booking it. We had to book a room with a fridge because I needed to put my insulin in the fridge and so now, that's the only thing...that's because I'm more flippant about myself…My diabetes kind of dwindles along in the background." (Sue, aged 45)

Another consideration was time zones. Although most felt able to allow for the time differences when injecting their next insulin dose, this was not always convenient:

"The only time I have missed it is when I go to New Zealand, I find that travelling – because the time changes so much – that I might miss one dose (of basal insulin) but that's the only time really." (Christine, aged 62)

The effects of extremes in climate could lead to unpredictable blood glucose variation as for some *"the heat really makes a difference"* (Christine) in triggering low glucose levels, while others experienced no difficulties:

"We've been to India and Africa and not been affected, even the food doesn't affect my sugars, it's unbelievable." (Gwen, aged 61)

Injecting in Public

Injecting in public was perceived to be more problematic. Most chose not to inject in front of others, apart from their relatives. This generally related to those whose insulin regimes were prandial-based and were eating out. Reasons for avoidance

included their own discomfiture, preferring *"to do things in private"* (Beata), concern for others as *"some people, perhaps wouldn't like it"* (Edward) or because of being considered *"a druggie"* (Ian). Several strategies were used to facilitate their privacy. Conversely, many others injected unselfconsciously as they believed *"there's no shame in taking it"* (Sid); moreover, *"people breastfeed in public don't they"* (James).

Injection avoidance strategies were described by many of the interviewees. Some injected at the time appropriate to the insulin but away from the table – generally in the toilets:

> *"I might just go into the ladies and no problem at all."* (Beata, aged 76, twice-daily premix)

> *"I would take my insulin with me and I would go to the loo and just inject."* (Edward, aged 78)

One interviewee openly prepared their pen-device at the table, while going elsewhere to inject to enable privacy. Others would use the toilets for practical reasons:

> *"I prefer to go to the ladies, if it doesn't offend people, there. But usually you prime it at the table because it's usually better lighting than the ladies, and just inject it there [in the ladies]."* (Muriel, twice-daily premix)

> *"Well, the only place to do that [inject] really is in the toilet. I wouldn't want to do that [inject] at the table. I mean if you're going to the toilet, you've got the washbasin, you've got the shelf."* (Joe, aged 67, basal-bolus)

One person received welcome support:

"I needed to inject insulin and the pub that I was in…it was filthy and the toilets were even worse so I went and sat in my car and an Indian gentleman from a restaurant came out and said, 'What are you doing – are you doing what I think you're doing?' and I said, 'I'm not doing drugs' and he said, 'No come on in'. He took me into his restaurant and … he had a nice little area and all his staff were on insulin and all their bits were laid out and he said if there was anything I needed, there was wipes there, injection-site wipes and everything, and a sharps bin… and I was so thrilled." (Patricia, aged 55, basal-bolus at the time)

Another strategy employed to avoid having to inject in public was to inject before going out for a meal or on the return home from one. Although this meant that a longer time period to that recommended had elapsed between the injection and meal, this was not always believed to be a concern (see also Mistimed Insulin Injections):

"No not very long after, normally we'll have the meal then you've got half-an-hour or an hour later and I'll be at home and I'll inject."
(Gwen, aged 61, basal-bolus)

Others would omit the mealtime insulin particularly if they had prior experienced of being challenged by others:

"I don't give it…I used to take it with me everywhere, both injections, and you go out and the amount of people that er, including the police, who come over to you and say, 'So what is it? What you doing?', so now I just don't take my injection… I don't mind them asking, if they ask nicely, it's just when they come up to you…you have to say, 'No I'm not a druggie'…" (Ian, aged 54, basal-bolus)

Several, encountered no difficulties, perceiving it to be acceptable and essential to their diabetes control *"I mean you got to have it"* (Sid):

"I'm quite happy doing it…It's really discreet it's kind of it's just I just go like that (mimes injecting in her stomach)…It's the same as breast feeding really." (Sue, aged 45, basal with occasional prandial insulin)

"I have no problem. It goes along with modern life these days where people aren't abhorrent to things like that, like baby feeding in public, injecting in public, things like that. People don't take any notice of it anymore. It's a lot easier these days to do it. So, people shouldn't worry about injecting themselves in public." (Trevor, aged 68)

Some thought it could depend on the context such as being with friends or with people they had not met before:

"…if it's somewhere that's very open then I just go to the loo but sometimes it's just under the table and you can just pop it in – usually in my tummy yes. I mean to be honest most of my friends are nurses, so they don't mind." (Christine, aged 62)

"I daresay most of my friends they know I'm diabetic and on insulin, so it wouldn't bother them. Mind you I'd probably inject it when I'm away from the main crowd or something like that and do it. It's simple enough to do." (Sid, aged 64, twice-daily premix, HbA1c 59 mmol/mol)

While relatives were often supportive, others' reactions could reinforce the belief that it was better to inject in private:

"Yesterday I was with my mum, she was absolutely mortified that I would lift my top to inject myself in the restaurant. She said, 'you need to go into the bathroom'. She was like really embarrassed." (Sue, aged 45)

Employment

Current working practices or previous employment were described in connection with insulin. Working patterns were not always conducive to insulin use for those on prandial-based regimes, leading some to adapt their working life or insulin regime to one that *"fits in better at work"* (Baaz). A small number of participants

who were currently, or previously, employed as HCPs described the positive impact of their clinical experiences on their own insulin management.

Working hours could conflict with mealtimes, impacting on some who were reluctant to inject in the presence of others:

> *"I don't like breakfast early, I like my breakfast about 10 o'clock in the morning, well that's not practical with the insulin and being at work."* (Muriel, aged 52, twice-daily premix)

> *"I'm in my own office but it's off the communal office so there's always people around… I've got no problem with that at all."* (Jack, aged 57, basal-bolus, HbA1c 62 mmol/mol)

Some later changed their place of work, working pattern or insulin regimen. One interviewee did both:

> *"That was a different insulin but at that time I was on my day job as well which, injecting four times a day, was becoming an enormous task for me to carry on in the civil service…I now run my own business. That gives me more flexibility of choose and pick and do what I can."* (Baaz, aged 60, twice-daily premix changed from basal-bolus, self-employed catering manager)

A few interviewees were current or retired HCPs and described how their professional experiences were advantageous in supporting their insulin management. Some spoke of how current insulin injection devices *"especially pens"* (Christine) compared favourably with *"the syringe and the plunger"* with the "*bigger needle"* (Elsie) they remembered. Recalling these enabled them to have a more positive experience with their current devices, which further supported their insulin use:

"Your needle is not visible 'til you get it in the top of the [Innolet] dial and you turn the dial to however much you're putting in and you just actually, you just press it down, the needle just slips in – you don't realise it's going in, and you press the top and that's it… It's very easy." (Elsie, aged 84, retired nurse)

"In the old days when I was doing my training you had the huge needles and that was what I was really thinking of instead of how tiny the needles are now. I remember on the ward; we were still using the old-fashioned way [syringe & needle]." (Christine, aged 62, retired midwife)

Participants also reported positive support from colleagues who made allowances for the time needed to inject or have an additional snack:

"It was important for me to eat breakfast regularly and they were always really good saying 'Are you sure you're all right – now, do you need to go and have something to eat?'. Then they'd all say to me 'Now have you had your medicine yet, is it time you had your insulin?'…" (Sue, aged 45, midwife)

Some also benefitted from quick access to advice with *"diabetes specialist health professionals at work"* (Sue) or "*One of the nurses [DSNs] up there who is a colleague"* (Valerie). However, some participants felt there were challenges in separating their behaviour towards their own insulin use and their professional experiences. This reflected the view of others that only HCPs who were themselves treated with insulin could fully understand and support them:

"I know lots of stuff about insulin, but I don't always apply it to me, so I have my professional knowledge and I have my work knowledge. I know lots of stuff about insulin, but I don't always apply it to me." (Sue, aged 45, midwife)

"I mean one nurse in [clinic] is diabetic and we have endless chats, not just about diabetes, but about other things and, I listen to her because she is diabetic, she knows what it's about." (John, aged 51)

5.2.3.3 Physical Wellbeing

Interviewees described aspects of their physical wellbeing, which led some to change how they managed their insulin. Aspects included long-term conditions such as *"rheumatoid"* (Elsie), diabetes-related comorbidities, such as renal failure – *"kidney transplant"* (Sid), acute illness such as *"pneumonia"* (Ian), and lifestyle involving exercise and dietary components.

Other Long-Term and Acute Illness

Most interviewees with other comorbidities requiring *"quite a lot of medicines"* (Valerie) were able to fit in their insulin therapy with these as *"part of the day"* (Sid). With some, their condition impacted severely on their memory leading them to administer it again or not at all because of *"forgetfulness"* (James) following stroke. For others, it affected their ability to inject, but instead of relying on others, it was possible to self-administer by individualising the device:

> *"Because of my hands, my finger joints, I couldn't manage with that [pen injector]. So, this is what he put me on [shows box with innolet device]."* (Elsie, aged 84, rheumatoid arthritis)

Acute illness such as pneumonia, cellulitis, and sepsis with extensive hospitalisation led to significant blood glucose fluctuations in some, particularly those with previously high blood glucose levels. This precipitated a change in regimen or dosing, while subsequent weight loss following illness in one individual resulted in severe injection pain:

> *"I lost so much weight…I got ill 'cause I got pneumonia and then I lost just over nine stone in a year, just in a year, and the injections hurt me so much now, that I often just don't give them."* (Ian, aged 54)

Lifestyle Factors

Exercise and dietary modification by several individuals led to a degree of insulin dose-adjustment (see Actions to Stabilise Blood Glucose). Activity levels ranged from: "*not very active*" (Edna), to swimming *"600 metres twice a week"* (Trevor). Dose-adjustments to insulin would be undertaken by some in various ways:

"If I'm going out to do exercise and want to drive, I have to have some insulin. Because the exercise will eat into that [breakfast] em I usually have half what I normally have and then adjust it at lunch-time." (Paul, aged 70, twice-daily premix)

"The only time I adjust it is when I'm going to exercise class on a Monday and Wednesday, and I cut it down in the morning if it is low to start with because I know I'm going to have a hypo otherwise in the swimming pool at aquarobics and swimming." (Joan, aged 67, twice-daily premix, HbA1c 64 mmol/mol)

Dietary factors related to the balance between insulin, food, weight, and glucose control. Many experienced weight gain with insulin treatment and found losing weight to be challenging. Achieving weight loss without simultaneous dose-adjustment resulted in "*many hypos"* (Ruth) with subsequent glucose snacks to correct these (see Blood Glucose Fluctuations). Some believed learning more about insulin dosage alongside carbohydrate intake could help, while others felt able to balance their insulin dose:

"I find, since I've been on the insulin, I've put on weight. My weight is so difficult to take off...I try to lose weight, because I have an overweight problem, I find it harder to control my diabetes and that's why I go off my diet because I find it hard to control it…the blood sugars go down too low." (Ruth, aged 55, BMI 43.7)

"It's [hypoglycaemia] happening less 'cause I'm reducing my insulin [alongside weight loss]." (Gwen, aged 61, BMI 29)

There was a desire to learn more *"about the dietary part of it, the splitting of the carbs etc."* (Muriel) with the related insulin dose to aid weight loss:

"I think it would control your weight…I think it's more a sensible way round [dose according to carbohydrate intake] actually than just putting this fluid [insulin] inside your body." (Muriel, aged 52)

5.2.4 Insulin Treatment Support

In this fourth thematic area, the perceptions of the participants on how they were supported clinically and educationally by HCPs and others are described.

5.2.4.1 Clinical Support

Support for insulin use was provided mainly by GPs and PNs, or diabetes specialists (Community DSNs or Diabetes Consultants). Patients received this reactively in response to their request for advice, opportunistically during their general diabetes review, and sometimes proactively when the support was initiated by their HCP. The way in which their HCP communicated with them was perceived to be important in enabling them to understand how to optimise their insulin use and blood glucose levels. There was some disparity, however, on how this could be achieved in meeting specific blood glucose targets.

Reactive Support

Timely responses to patients' requests were generally by telephone and were reliant on the availability of the clinicians and on their expertise. This was important as it could impact on patients' ongoing insulin use and glycaemic control. Most participants were satisfied with the level of accessibility to *"the nurse [PN] at the health centre*" (Edna) *"or the DSN"* (John) or GP.

> *"I find it good having it (insulin support) because my surgery have it in-house and I've actually got a rapport with [PN] and I can ring her up any time if I'm having any problems."* (Gwen, aged 61)

> *"I find they're, as lovely as the ladies are, the nurses [PNs], I can never get to see them, they're so busy…so I, if I need to, I see the doctor [GP]. She comes in I think it's twice a week eh, but she specialises in diabetes. It's easier to see her than it is to see the diabetic nurse [PN]."* (Joe, aged 67)

It became apparent that some interviewees were not aware of the available support from their GP or PN, while those who were did not always seek the advice they recognised they needed. Two such patients from different practices, each with PNs and GPs available to offer insulin-related support, gave their views:

"I only ever saw him once [GP who started her insulin], I didn't see him again. He just said, 'If you've got any queries, just ring up'…but I haven't seen him since, with regard to that…I suppose if a patient's going to manage things themselves, they'll let them do it." (Elsie, aged 84)

"I feel my diabetes has never been controlled, properly controlled…a lot of it is my own fault. I would find the most helpful thing would be for me to come into the surgery. I mean Doctor [diabetes lead GP] is very good but I know he's busy…But I think I need a big overhaul, I think. I mean it's my own fault because I should have been in before." (Ruth, aged 55)

If a PN or GP did not have the expertise to address a patient's concerns, then a referral was made to the DSN:

"They said, 'Mrs [interviewee], we can take your blood, we can check your feet, we can do anything else for you but we know nothing about whether to put your [insulin] units up or down'…and I said er, 'I wonder if I can get in touch with [DSN]', and they did…and er I was pleased to see her." (Hilda, aged 88)

Opportunistic Support

Insulin-related discussion often took place opportunistically during patients' routine diabetes monitoring with the PN. Patients mostly felt the duration was *"just about right"* (Christine):

"Yes, I'm never pressured when going in to see the diabetic nurse. She doesn't hurry me up or anything like that. There's always sufficient time for me to sort out whatever problems [with insulin] there are." (Trevor, aged 68)

"Yes, it's about right really 'cause if you go in there and have a chat, she gives you all the bits and pieces. There's never a rush or so it's quite comfortable really." (Sid, aged 64)

Insulin-specific conversations, however, formed a very small part of the PN clinic consultation and some participants indicated aspects of their treatment they wished to explore further but had not asked during their review:

> *"Well, 'Am I a diabetic still?', 'Could the insulin go down further?', 'Is it still right to take it at eight o'clock in the morning and six o'clock at night?', 'Should I be doing it perhaps at mid-afternoon?'…That's the sort of questions I might ask."* (Edward, aged 78, twice-daily premix, HbA1c 34 mmol/mol)

Some were satisfied with the opportunity to discuss their insulin during consultations in order to ask questions about their insulin while others decided *"to find out for myself"* (Elsie) through alternative sources of information *"because I read a lot"* (Paul). Some reported a perceived lack of opportunity to question or preferred being led by HCPs as *"the experts"* (Jack):

> *"I wouldn't criticise the surgery because I've never had any reason to. Perhaps they don't ask as many questions as they could. But then on the other hand, they're all very busy."* (Edward, aged 78))

> *"You've got to really accept what they're telling you and if they're telling you in a calm way then you're not going to get offended at them and obviously carry on doing what they're saying."* (Sid, aged 64)

Proactive Support

Participants reported on their experiences of insulin support initiated by a DSN, PN, or GP through either face-to-face or telephone interactions. They found these sessions to be generally valuable as the HCP, with their additional expertise, spent more time helping patients with their treatment as evidenced by these reports:

> *"She [DSN] would ask 'How is it today?', and I'd have to tell her, you know…she was the one clever enough to work it [insulin dose] out, she had to know exactly what I was eating all day."* (Hilda, aged 88)

"I mean [PN] knows, with me, she's had a difficult job because of me, because of the way I look at it [insulin use], but she's found ways…and it's beginning to work." (James, aged 81)

"She's [PN] really good, she's you know, she's really thorough… so she'll say like what she thinks." (Sarah, aged 52)

Communication

Views were expressed on the way in which their HCPs communicated with them, the level of their understanding, and the quality of their insulin-related support. Many were generally positive about the way in which their PNs and GPs communicated, but others expressed concern. Aspects included clarity of their communication, being listened to in a non-judgemental way, and not feeling rushed:

"She [PN] has two things that have helped me. One, she speaks straight, and she speaks in a language I can understand and secondly, she never condemns which I think, to be honest with you, the people who've looked after me [at previous practices], over the time, have always condemned." (James, aged 81)

"I mean it wouldn't be no good whatsoever if the diabetic nurse was to be too abrupt because some people just don't understand [about insulin] and if you got somebody who was abrupt with you then you would ignore them anyway." (Sid, aged 64)

Language that was jargon-free was perceived as important, as well as body language and being involved in insulin treatment decisions:

"To be honest with you, they got to explain it better 'cause, I'm not being… look, the doctors are lovely so are the nurses and everything but it's all medical terms." (Ian, aged 54)

"They [previous general practice before moving] had with their facial expressions, the non-listening, the talking down to me, that I find as an individual not helpful. She [current PN] does not do that. She's just the opposite. She will say, 'To be honest with you, I would recommend you try this' but she doesn't put pressure on you to change your mind." (James, aged 81)

Blood Glucose Targets

Part of the insulin treatment support involved a discussion around blood glucose targets in terms of day-to-day blood glucose range and HbA1c level. In some patients, motivation to meet the targets suggested by their HCP was influenced by their perceived glycaemic control, whether they had agreed on specific goals, or if they felt comfortable with that suggested glycaemic range: *"anything under [HbA1c] 50 is good"* (Christine) or *"the way I feel"* (Edna).

Some individuals knew their most recent HbA1c level while others said that they had not been told and, instead, were given a descriptive account such as *"your HbA1c was good"* (Sharon) or *"everything's fine"* (Jack). Level of understanding of HbA1c ranged from having little knowledge to being able to relate their level to optimising their insulin and preventing complications:

"It's [HbA1c] very important to you to see how you're managing over a longer period of time as opposed to your daily management, or weekly, and although I keep a diary of that, it's important to see what else is going on, 'Oh yes that is important as well'. Because you can be, falling into long-term problems if you don't manage your diabetes as long as you can." (Trevor, aged 68)

"It doesn't mean anything to me. Since nobody really explains that part of it and I sort of think well, again, I go on the attitude that if there's something wrong, they'll tell me. I will just rely on that." (Edward, aged 78)

Several implied a preference for their level being reported as Diabetes Control and Complications Trial (DCCT) aligned, rather than the standardised

International Federation of Clinical Chemistry (IFCC) so they could *match* the number with their self-monitoring blood glucose (SMBG) levels:

> *"They've changed the way they read it haven't they. I did find that a little bit difficult 'cause it's different to how your home monitor reads it. It's different readings isn't it?"* (Jane, aged 56)

There was some inconsistency between the target *"they [HCPs] like it to be"* (Valerie) and what the patient desired. Few reported being involved in agreeing their personalised goals unless, as with this patient, they initiated the discussion:

> *"There's nothing like a target to go for and in the end, they told me that 75 and 79 was high and, in the end, I didn't pester, I just brought it into the conversation. 'Well', I said, 'how far' or something like, 'how low do I have to get?' and they said, 'Well 58, and this time you're 59, so I'll give you that one' [laughs]."* (Paul, aged 70)

Some reports indicated an assumption by the HCP that an individual felt comfortable with the glucose target set for them. Several, however, suggested the target was untenable when translated into their everyday blood glucose levels and associated insulin dose increase, revealing the disparity in wishes between HCP and patients:

> *"Yes, I'm told that every time I have a blood test [that that the blood sugar is high]. Again, I just say to myself that's their target, my body does this, and my body's happy with it."* (John, aged 51)

> *"I don't know how achievable it is to get it to the level they really want without it actually impacting on your work, your life you know, you might have more hypos and things. You'd have to have blood sugars between four and five or something like that a lot of the time."* (Valerie, aged 59)

Some interviewees felt more able to meet their targets than others, with varying levels of certainty:

"Well it's under control I suppose." (Edna, aged 77, HbA1c 71 mmol/mol)

"Well I'm quite proud of myself. It's never above nine. I don't ever eat anything that I shouldn't. I mean once last week I had a mince pie and it went right up to about twelve which is not bad, it doesn't hurt now and again but I wouldn't do it a lot." (Sharon, aged 70, HbA1c 59 mmol/mol)

5.2.4.2 Patient Education

Sources of knowledge and access to information specific to insulin included those accessed within the healthcare setting, which was mainly one-to-one with their HCP, and outside of the healthcare setting such as self-directed learning, peers, family, and the media.

Self-Directed Learning

There were participants who were proactive in finding out more about insulin, while some were cautious, believing *"It's good to be informed but not too informed"* (Trevor) so it didn't become an obsession or too disconcerting. Resources included books, unsolicited mailed leaflets, and online information. Some, however, found it challenging to access sources specific to insulin:

"Information the companies that manufacture the blood sugar meters send you…and Diabetes UK magazine." (Trevor, aged 68).

"Oh no, no, no, there is no books on insulin. There is no books. But what can they write about it?" (Hilda, aged 88)

Several found online information helpful, though some struggled to navigate the sites:

"I'm not very good at it, I'm very basic. I usually just tap in 'diabetes' etc. and see what comes up, and I usually get information from that but I'm not an expert." (Elsie, aged 84)

"Well I have been online to the Diabetes UK site and they've got some information there. If I'm worried about something, then I just go onto the internet." (Jack, aged 57)

While some participants were alarmed after reading about diabetes complications, others believed they benefited by being more aware of the importance of optimising their insulin use:

"I'll tell you what frightens me; reading all the awful things that can happen to you, losing your feet and you know, the insulin floods the organs inside doesn't it. I have read about it a lot." (Sharon, aged 70)

"It's learning, it's educating yourself. You're the one that's in charge, you're the one that's in charge of your body, therefore you have to learn yourself how much. If you're burning a lot of energy up, you know that, you know, that's going to bring your sugar levels down, and if you're doing too much, you need to be careful." (Trevor, aged 68)

Peer support

Conversations with people who also received insulin was perceived to be of value. These included online diabetes forums and patient support groups. Many also gleaned and passed on knowledge opportunistically by sharing experiences with family, friends, or acquaintances:

"She's had lots of problems [with insulin]…so I talk to her about what she's tried to do." (Edward, aged 78)

"Yes, he's [brother] helped me with that. He said to me at the beginning, 'Be careful not to inject into the same place a lot 'cause you'll get a hard lump. So did my friend." (Sharon, aged 70)

Online forums were accessed via social media and diabetes organisations:

"They've got like a forum as well…I haven't really anything to ask but when other people have asked, I comment that oh I've tried this or that." (Sarah, aged 52)

The Media

The media provided another resource and included televised documentaries and printed, online or televised news reports. Despite not being specific to insulin treatment, some included information on this, but they were generally felt to be *"not very informative"* (Elsie), whilst giving out negative messages:

"I find that when they put things on the television like that, most of its scaremongering – they put the bits that they want to panic people about." (Patricia, aged 55)

5.2.5 Suggested Improvements

This final thematic area incorporates suggestions and ideas put forward by the participants, involving ways to improve how insulin treatment could be supported within and outside of healthcare. It was generally believed that knowing more about insulin therapy in T2DM could improve their day-to-day insulin use and subsequent blood glucose control.

"Yes, and the importance of it because I think, because I don't get informed in any other way… But I wasn't fully aware exactly how insulin operates in your system and that would have been interesting to learn…" (Beata, aged 76)

As well as benefiting patients, there were perceived advantages of the family and others also knowing more about insulin use:

"The one thing that I really find is that it would be nice if close family or people that are working with you could actually get some sort of education in what diabetes and insulin means." (Jack, aged 57)

5.2.5.1 Healthcare Led

Suggested ways to improve service support within general practice included the provision of support by GPs and PNs with insulin-related expertise, a simple method of adjusting insulin dosage, access to blood test results, and the provision of group education. Many felt satisfied with their insulin-related support, regardless of whether this was provided by their PN or GP with additional expertise or a diabetes specialist. There were patients, however, whose PNs and GPs did not have the insulin-related expertise, and who thought there could be advantages if they did. What mattered most to some, however, was the *"the individual clinician"* (Christine).

5.2.5.2 Outside of Healthcare

Initiatives to be implemented outside of healthcare were put forward, including peer support with small face-to-face forums, the role of the media, and people in the public eye acting as role models. It was felt that television documentaries could play an educational role for insulin users while giving positive messages and raising public awareness about injecting insulin in a public place. Some individuals felt public figures with insulin-treated diabetes should use their media presence more to support patients and enable the general public to understand the challenges people faced around insulin use.

The ideas put forward by the participants to support insulin use were integrated with the HCP suggestions (Appendix 14).

5.3 Summary

In summary, the participants described a wide range of experiences and views related to their use of insulin therapy in everyday life. These included social influences and psychological factors ranging from the negative impact of depression, to the positive influence of the determination of some, to focus on their insulin treatment. These factors contributed to insulin use and blood glucose levels across the interview sample. Varying levels of support were reported regarding their general practice teams and, for some, their diabetes specialists. Several individuals, whose practices did not provide insulin services, expressed a desire for these. There was general satisfaction, however, with the help received, particularly those whose practices that had PN and GP-led insulin

support. However, the unawareness by some interviewees of the available services, indicated a need for practices to highlight these.

The data revealed several inconsistencies in self-management practices in relation to insulin use. These practices led to perceived or confirmed high and low fluctuations in blood glucose levels in some individuals, placing a burden on some of their partners as well as themselves. The inconsistencies included mistimed insulin injections, haphazard approaches to insulin dose-adjustment, and omitting injections. These findings suggested that, although some perceived themselves to be competent in self-managing, this was inconsistent with their actual practices. The findings revealed that some individuals perceive themselves as competent to self-adjust while, in practice, their self-management practices had potential for harm with risk of hypoglycaemia and overall suboptimal control. This topic is explored further in relation to the HCP interviews in Chapters 7 and 8 (integration and discussion). With regard to day-to-day blood glucose targets and HbA1c goals, several individuals expressed their concern about not being able to achieve or desiring to achieve those targets suggested by their HCPs, preferring higher blood glucose levels instead. This indicated the need for a more formalised agreement, with some compromise by their HCP.

Finally, there was a perceived scarcity of readily available information outside the healthcare setting specific to insulin-treated T2DM. Suggestions were given for improvements to enhance support and provide education for patients and the public. These included increasing the numbers of GPs and PNs with insulin-specific expertise, the instigation of group education in general practice, peer support, and the role of the media. Ultimately, the findings emphasise the need to build on the support available by PNs and GPs by having a more proactive and consistent approach to support insulin use in people with T2DM and to ensure that it is used safely and effectively.

The next chapter describes the thematic analysis of the interviews with the PNs and GPs.

6. VIEWS AND EXPERIENCES OF PRACTICE NURSES AND GENERAL PRACTITIONERS ON SUPPORTING INSULIN USE

In this chapter the findings of the qualitative face-to-face interviews with the Practice Nurses (PNs) and General Practitioners (GPs) are presented thematically. The interviews aimed to explore their views and experiences on supporting patients using insulin in the management of type 2 diabetes (T2DM). The chapter begins with an overview of the participant characteristics, followed by the findings of the thematic analysis.

6.1 Characteristics of Practice Nurses and General Practitioners

Four GPs and five PNs were interviewed at their respective sites. There were variations in the level of insulin-related skills across the study sample. All five PNs had received accredited training in diabetes management, of which two GPs and three PNs received additional training to provide insulin initiation and intensification. This was an optional part of a diabetes service specification which practices could choose to sign up to. Each clinician was interviewed individually according to their preference apart from one GP and PN who chose to be interviewed together. The interview duration ranged from 30 to 60 minutes. An anonymised healthcare professional (HCP) database is presented in Table 51.

Table 51 Healthcare Professional Database

GPs & PNs	Interview date	Interview duration (minutes)	Nurse Independent Prescriber	Initiates and Intensifies Insulin
GP1	01/06/16	60	NA	Yes
GP2	07/07/16	17	NA	No
GP3	30/06/16	40	NA	Yes
GP4	13/06/16	31	NA	No
PN1	06/07/16	33	Yes	Yes
PN11	22/07/16	49	No	Yes
PN2	14/06/16	30	No	No
PN3	30/06/16	40	Yes	Yes
PN4	17/08/16	34	No	No

Key: GP = General Practitioner; NA = Not applicable; PN = Practice Nurse.

6.2 Interview Findings

In total, six thematic areas were identified from the HCP transcripts relating to views and experiences of PNs and GPs who supported patients with insulin-treated T2DM: healthcare systems, level of HCP skills, consultations, insulin use, HCP views of patient-related barriers, and suggested ideas for improvements. Each area contained the themes (*n* = 19) and sub-themes (*n* = 12) that emerged from the interview data. The framework is presented in Figure 22, broadly dividing the thematic areas into system-level, HCP-level, and patient-level themes.

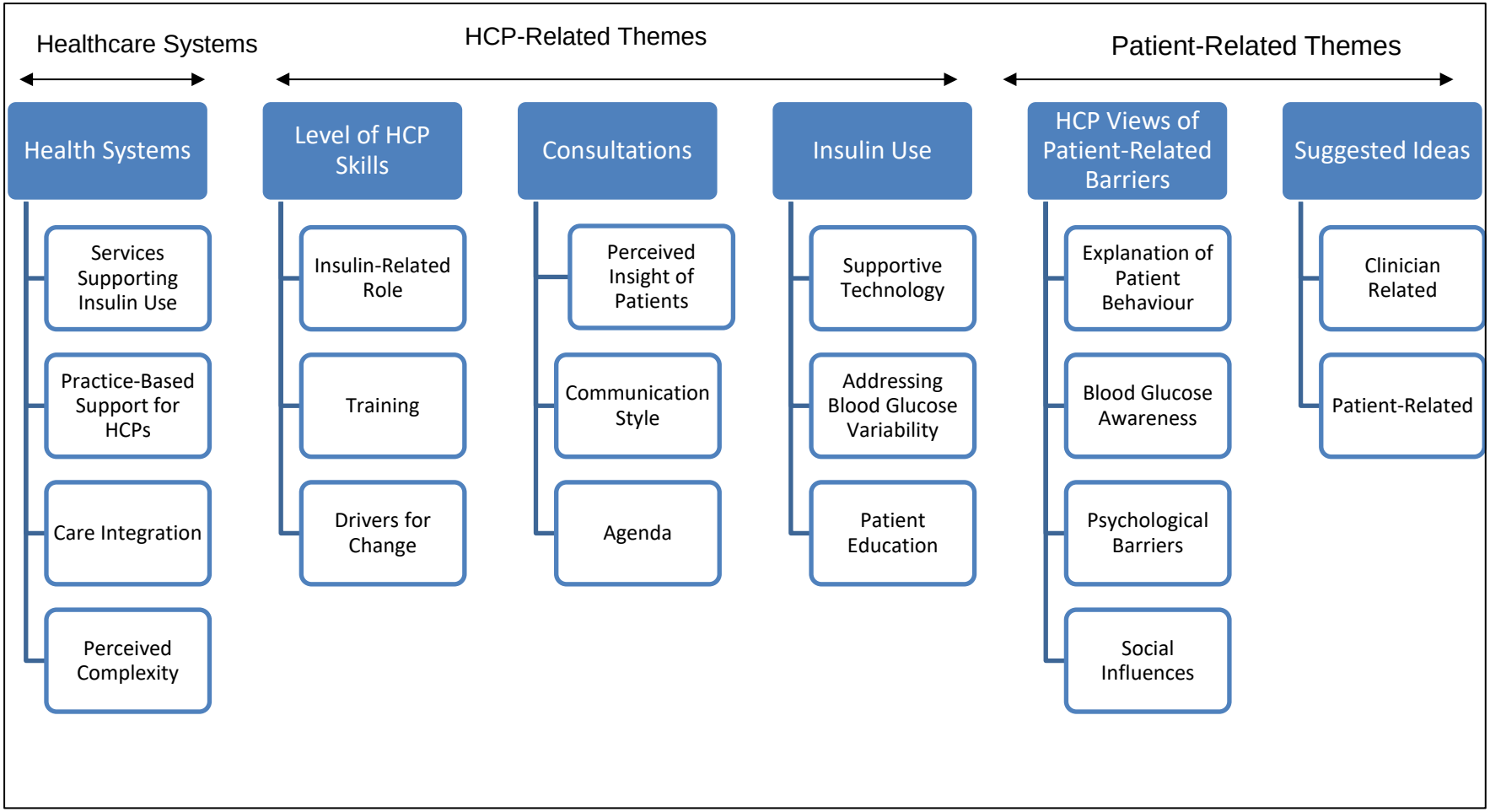


Figure 22 Thematic Framework: Practice Nurses and General Practitioners
Key: HCP = healthcare professional

6.2.1 Healthcare Systems

This first area describes the HCP experiences of managing insulin-support services, practice-based support for HCPs, care integration, and perceived complexity.

6.2.1.1 Insulin-Support Services

Services supporting insulin use involved the service provision, mode of support, the housebound and nursing home patients, and opportunities for patients to access services.

Insulin Treatment Provision

Insulin initiation and intensification, and instigating insulin regimen changes were undertaken by GP and PN interviewees from two of the practice study sites. The HCPs from the other two sites, referred patients requiring these services to the community Diabetes Specialist Nurse (DSN). However, all the interviewees consulted with insulin-treated patients, offering some degree of assistance, according to their level of expertise:

> *"Most of the diabetes care at the moment in this area is done by nurses [PNs] on the ground but the best-case scenario is that the insulin starts are done in the diabetic clinic run by [PNs]."* (GP1)

> *"If they've got background [basal] insulin, if all the levels are high during the day then obviously, they just need the dose increasing but if there are particular times in the day when there are eating issues then yes, you're obviously going to consider adding a short-acting insulin and then I would refer on."* (GP2)

Regardless of whether a practice provided PN and GP-led insulin-related services, there was a perceived increase in demand for support of insulin-treated T2DM patients, with a subsequent change in location of care for those previously managed by the consultant. This was felt by one PN, to be advantageous to patients:

"Well much more [insulin-treated patients] now because I find that you used to have a very clear division between the hospital seeing the patients who are established on insulin and being treated with insulin. They used to look after those in the hospitals, but they're now seen more in general practice and again it's the advantage of being local." (PN2)

Mode of Support

Support for insulin management was either proactively instigated by the HCPs, reactively in response to patients' requests for help, generally by telephone or opportunistically. Much of the opportunistic support was undertaken by the PN within the practice Diabetes Clinic where routine monitoring and screening was conducted. GP support was sometimes prompted by the glycated haemoglobin (HbA1c) results particularly in those practices where the PN had less expertise to address high blood glucose levels.

Opportunistic Support

Though the main purpose of the PN Diabetes Clinic was for monitoring and screening, insulin-related advice was included in these consultations. Some PNs and GPs would proactively follow-up those in need of further help with insulin:

"We did originally have set slots for insulin recognising they need probably at least a three-quarter hour time slot, but we now do it much more on an ad hoc basis." (GP3)

"I should say about 60% of my work is to do with diabetes. Type 2's – plenty of them and lots of them are on insulin. I don't have a specific insulin clinic, but I see them during the diabetic clinic." (PN1)

An HbA1c test result would sometimes prompt a request for the patient to see the GP or, depending on their level of expertise, the PN, to discuss insulin treatment:

"I'm involved with monitoring the patients, seeing whether the HbA1c's going down, reviewing them if they're not well controlled, seeing if there's a problem with compliancy, something to do with their diet, refer them to the appropriate people like our PN or if necessary, the DSN." (GP 2)

"Yes, so they might see the doctor before they actually come and see us for their diabetic check and then there's actually nothing for us to do regarding management. The doctors have already made that decision. So, I've probably taken a bit of a backward step recently." (PN4)

Reactive Support

Patients often sought insulin-specific advice by telephone which was perceived to be particularly helpful for the housebound and their carers:

"Sometimes it's if they're worried that day, somebody's blood sugars through the roof, or hypos etc., they will phone and whoever's here will generally look and see which one of us is here and will leave a note on our screen for us, 'Could you please ring Mr or Mrs so and so?' and then we do that." (PN11)

"By telephone yes…I do say to them you know I'm their first point of contact and if there's anything that I can't help them with I would find that person who can and then I would either call them back or get back in touch or see them or refer them." (PN2)

Proactive Support

Those with insulin-specific training would initiate follow-up if they perceived the need to further explore the way a patient used insulin:

"We're only ever going to know about the things people tell you…sometimes I invite back more often so that we can try and work out things together…so it's a matter of keeping up that contact so they get confident with you. It's more about helping them to manage their diabetes and adjust their insulin" (PN1)

Housebound Patients

To support housebound patients, one practice allocated their diabetes care to the GP diabetes lead, who, in addition to responding to calls for advice, was proactive in managing their insulin. Though there was a perceived need, to actively support insulin use in this group of patients, the process was less systematic in other practices, and tended to be more reactive or it was assumed that others were overseeing their insulin use:

> *"I could say to the District Nurse, 'look could you please give me some blood glucose readings, a profile…email it to me so I can have a look see what I can do.' Also, they can email me and say, 'you know these readings have been really high could you review the insulin dose'…"* (GP1)

> *"I think they [housebound patients] are a gap and we don't get a good handle on those."* (GP3)

Access Opportunity

Opportunities for patients to access insulin support could potentially impact on their insulin management and glycaemic control. The conversations suggested variation in whether patients accessed insulin advice and support in a timely way. This included telephoning for advice or for a clinic appointment. Reasons included availability of the PN or GP with sufficient skills, the clinic being fully booked for two or three weeks, or the patient's telephone call may have been unanswered if made during peak periods. The responses also suggested that much of the requests for help was not part of a standard model of care. While access was perceived by some to be timely, others felt there were limitations. Accounts were given of patients who rarely sought support or attended clinic to review their insulin treatment even though attempts by interviewees had been made to offer appointments. There were different accounts regarding ease of telephone access:

> *"They'd just call into reception and if I'm busy then I would call them back."* (PN3)

"There is no direct line…if I'm not here or if [PN] is more accessible then the call is put through to [PN] for phone calls about insulin adjustment etc. So, most of the time one or other of us are here…but I wouldn't say it was terribly accessible because there's no specific number for them to use but it also depends on the patient and whether they've engaged with us enough to know who we are and who to ask for." (GP1)

Access was also believed to contribute to non-attendance at the clinic for certain groups:

"The appointment system is all very well but well you know a lot of young men out there just do not engage with the business of standing in a line [at reception] and waiting to discuss having an appointment in three weeks' time." (GP1)

Others thought that accessibility might not be the main reason for non-attendance, expressing a sense of frustration:

"We book them an appointment and they don't come and most of the people that do this, have very high HbA1c's - they're the continual DNAs [non-attenders]. Often head-in-the-sand and again I have definitely had ones who say, 'I feel fine, I don't need to see the doctor, I don't need to see a nurse, I'm just fine, I want to carry on as I am'…" (PN11)

"Sometimes they're not even going to answer the telephone…I think it's difficult getting the constant DNA in you know. Or they might just come in and just have their bloods and then don't come for the follow-up and maybe the bloods, you know, they know what their blood results are going to be." (PN4)

6.2.1.2 Practice-Based Support for Healthcare Professionals

GPs and PNs described how they received advice and in turn supported their colleagues to manage insulin therapy within the practice setting. This took place on an ad hoc basis during consultations, in addition to GPs and PNs systematically discussing patients booked into clinics for the following week.

Because of the range of skills, some PNs preferred the GP to make most of the treatment decisions unlike PNs with more knowledge and experience who took the lead, or conversely, some GPs preferred the PN to take the lead:

> *"If they come to the nurse, we tend to say oh, you know, 'It's slightly out of control, make an appointment [with the GP]'…"* (PN4)

> *"The other GPs here are confident in our abilities…They've just said, 'No you guys [PNs] know what you're doing. I'm happy with what decision you make.' and I think it's probably because they don't have an awful lot to do with the diabetic patients because they tend to refer them to the [PN] clinics for us to deal with. They acknowledge that it's our area of expertise and not theirs."* (PN11)

The availability of advice from other colleagues was identified as being important in enabling a timely response:

> *"We have a nominated doctor during the [diabetes] clinic. If there's something, then I can interrupt her, and she can help me and advise me."* (PN2)

> *"I'll go the other way as well and ask the nurse [PN] – it can be two-ways with, 'What do you think – is this right?'…"* (GP3).

Regular structured discussions between the HCPs took place at two of the practices and were felt beneficial to patients and clinicians:

> *"It's great and it's also a great support because, as you know, there are lots of individual diabetic patients who are quite challenging, and you need – I think it's good for the patients – to know that we talk to each other."* (GP1)

"Quite often its [insulin initiation or insulin regimen change] done by myself or we've discussed it at one of our meetings on a Thursday morning, discussing what we're going to use and what's appropriate and then I'll go and put them on the insulin." (PN3)

6.2.1.3 Care Integration

Accounts varied about the level of integrated care and support for insulin use. Collaboration with diabetes specialists (consultants and DSNs), Community Nurses, and Paramedics was considered paramount for insulin management. This helped ensure patients had the correct insulin type and dose, with consistent advice and timely follow-up at discharge, or following a hypoglycaemic episode. Being able to access advice from a specialist at short notice was valued by the interviewees who, in turn were able to support others such as the Community Nurses with insulin dosage.

Diabetes Specialists

While there had been positive experiences of integrated working with secondary care, more recently there was a perceived change. This was particularly noticeable in the information-sharing by hospital diabetes specialists following patients discharged with a change of insulin regimen:

"She came out [of hospital] and the only thing on her prescription was insulin. No needles, nothing else…and it's something which is why general practice and primary care is under so much pressure…it's just 'dump on primary care, get them out of hospital'..." (GP3)

"I don't know what's gone wrong...For a long while she [hospital DSN] was emailing myself and [GP] about anybody that was discharged from hospital with their care plan…and we would follow that up immediately. Just very recently it has changed. I'm not quite sure what's happened." (PN1)

Discharge communication from the hospital DSN was perceived positively and it highlighted how good communication meant that the practice could support the patient without recourse to the Community DSN:

*"Our DSN at the hospital…she emails me a discharge note and so I've got it and I can see immediately what's happened. So, it's really good to have that notification…If they happen to be somebody who's housebound then I'm lucky enough to be able to think about a home visit as well. So that works very well for the people we know of and of course the DSN has a limit to the number of patients she can see" (*GP1)

The participants reported that they frequently sought advice from the diabetes specialists, but accessibility could vary:

"We tend to do it by letter just because it's easier. You can never get hold of them [Diabetes Consultants] on the phone." (GP4)

"I have had the ability to talk to [Diabetes Consultant] because he knows that I've got a basic understanding so when I do cry for help it's actually necessary." (GP3)

"I have very easy access to the DSNs. Again, I've known them over the years." (PN2)

Integrated care was evident in one site whose GP had monthly meetings with the Community DSN, the insulin trained PNs and, when available, a Community Nurse also attended the meetings. As well as providing a means of sharing practice and advice, this had the advantage of "*singing from the same hymn sheet"* (GP1). For others the relationship was not as close as it once was:

"We used to have [DSN] and she used to actually come to the surgery, and you know she would say, 'Oh when's so and so coming in?' and we would do it together because they were still my patients. But when that nurse retired two or three years ago, I haven't got quite the same link…so I have no idea who, or even if I have got a link anymore." (PN4)

Paramedics

Another example of care integration was described in the follow-up of patients following treatment by Paramedics for a hypoglycaemic episode not requiring

hospital admission. A system had been recently introduced in some practices whereby the paramedic would liaise with the GP or PN following such treatment, triggering a review of their insulin, whereas with others communication with them *"was a little bit hit and miss"* (GP3):

> *"Yes, they're (Paramedics) very good. We will always get a message so if it's during surgery hours they'll call straight away. Otherwise they will come in the next morning or fax us the details you know. Yes, and there will be fair play. We've had very good feedback from them."* (GP4*).*

6.2.1.4 Perceived Complexity

How a participant perceived insulin treatment complexity of patients was dependent on the knowledge, skills and experience of the individual HCP. This could lead one GP or PN referring a patient to a diabetes specialist while another felt sufficiently confident to critically assess, decide upon and implement a treatment plan for a similar patient. The need to refer could delay a patient being supported to adjust their insulin dose or change their insulin regimen. Social or psychological factors could further impact on management:

> *"One chap I'm thinking of who I ended up referring to the DSNs because he was young, and I was very worried about him. He has quite severe memory problems but his home life, his lifestyle is so chaotic. He actually, ideally, would need a carer, a one-to-one carer even though he's young."* (GP1*)*

> *"Those that I feel are confused or not confident enough or not understanding then obviously I'll get the DSNs to see them."* (GP4)

One GP perceived most patients on discharge from hospital to be too complex, preferring specialists to continue their insulin management. Conversely, a PN at another site, felt sufficiently confident to support such patients if they had enough discharge information:

"Those that are seen at the hospital well obviously they tend to be the very difficult to control ones, the complex cases so obviously they [Community DSNs] will deal with the medication [insulin] or advise us accordingly of any changes but predominantly, they take over their care." (GP4)

"If they've been into [hospital] then the in-house hospital DSN is normally very good. She will generally email or fax a letter over to me or my colleague saying that this patient's been in and their insulin has been changed and could we please contact the patient to review." (PN11)

Sometimes there were distinct lines of complexity when a diabetes specialist referral was clearly indicated. However, delays in insulin titration or a regimen change in less complex patients could be prevented if the PN or GP had enough expertise to manage their insulin:

"The most recent one, where I think I really was in trouble and I thought it was out of my comfort zone, was a lady who got pregnant while I think she was taking SU's [sulfonylureas] and insulin." (GP3)

"An insulin change, I'll do myself. If someone's on an insulin and sometimes it just doesn't appear to be working that well for them then I'll discuss a different insulin with them and will change them onto that if need be." (PN3)

Once a DSN had overseen a regimen change in hospital or the community, the patient would be referred back to the PN who would reinforce information *"such as hypos and the right correction dose and action."* (PN2). Some participants felt such specialists overestimated their expertise and assumed they had a clear understanding, of what they perceived as a complexity of insulin types: *"Is it long-acting, short-acting, or medium-acting?"* (GP4):

"I think the thing that I find confusing is all the different types of insulin and it keeps changing all the time. And often what I find is that when patients are changed over, the GPs don't get enough information fed-back about how it's different and how to advise the patient…and sometimes it's embarrassing when patients say, 'Well what's the difference between this one and this one?', but I have no idea and it's such as simple question...I think they [diabetes specialists] just presume that we know about all these different types and actually we don't." (GP4)

Amongst those GPs and PNs who could implement and manage such regimen changes, some also felt that the expectations of specialists were unrealistic and beyond their expertise:

"I think we're made out to be experts, but we're people who have taken a slight interest and have now gained experience. But we're not actually experts…Most of us are dabbling in it and are trying to do everything else as well." (GP3)

"The thing is you have to know your limits and your own boundaries, and I think once you get to that limit then you've got to refer on or get the advice from somewhere else." (PN3)

6.2.2 Level of Healthcare Professional Skills

In this section the themes relating to an HCP's level of insulin-related skills are reported. These include: the insulin role, available training, and drivers for developing skills.

6.2.2.1 Insulin-Related Role

This role related to the ability of the PN and GP to initiate and intensify insulin for their diabetes patient population (see Perceived Complexity). The PNs with the skills who were also prescribers, tended to be more autonomous in their insulin treatment decision-making, while others were more reliant on the GP for such decisions. However, each PN and GP had a level of competence to at least intensify doses of insulin and advise on the use.

Advice ranged from *"maybe adjusting dosages, and suggesting they need new treatment"* (PN4), to agreeing with the patient to change their insulin regimen:

> *"Generally, one of the PNs is able to do [insulin initiation or intensification] herself because she's a prescriber but the other one usually comes to me at least once a week to discuss various patients and what insulin to change to."* (GP1)

> *"I make that decision. I was putting patients on insulin before our diabetes lead…so I tended to make those decisions myself as I always had to. And I set up how I do it. It seems to work really well with the patients having the sessions that I do and how I plan."* (PN1)

6.2.2.2 Training

Locally funded insulin-related training *"which is fantastic"* (GP1) with mentoring was already available to equip and update GPs and PNs with the required skills. For others there were regular diabetes updates throughout the year which included insulin-related topics:

> *"The course came up about six or seven years ago and I was lucky enough to be able to do that with a DSN and so was able to start some of my own patients on insulin…and so we decided that as the practice was such a large practice with…quite a number of insulin-treated diabetics it would be a good idea if we tried to set up a team…which now consists of myself and two diabetic nurses [PNs]."* (GP1)

> *"I wouldn't mind further updates on that and actually, there's these meetings that are being held on a regular basis. I access them although I don't instigate or put anybody on insulin, I still go to the meetings."* (PN2)

6.2.2.3 Drivers for Developing Insulin Skills

The uptake of insulin-related training was dependent on a clinician's motivation, their workload *"we're just swamped with even basic things"* (GP4), the size of the practice population as *"smaller practices probably don't have the numbers of*

patients to put on insulin" (PN3), and perceived need *"especially if you've got services outside already laid on"* (GP2) by diabetes specialists. The population size was a large contributor and a source of frustration particularly those who were keen to develop new skills and to maintain them:

> *"Us being so small, having one patient [starting insulin] every two years, then I'm not going to keep my competencies up by doing that… I did work for a slightly larger surgery…so I did the [insulin] course, but I didn't have enough patients to do the practical so that's when it stopped*." (PN4)

> *"We decided that as the practice was such a large practice with over 800 diabetics and quite a number of insulin-treated diabetics it would be a good idea."* (GP1)

There was a perception, however, that in larger practices where these services were in place, clinicians tended to specialise, and this may have meant that other practice HCPs did not develop insulin management skills. This could be problematic when the specialising staff were not available and also meant that the service was very dependent on one or two individuals, and should they leave, this would leave a gap in provision:

> *"I think even in our own practice I find it's, 'OK someone's taken it [insulin-related support] on, it's complicated we've got so much other things to do so why do that when someone else is doing it?'…"* (GP3)

> *"Sometimes, possibly in a bigger practice, where people specialise in different things there's not the incentive to do it because somebody else is already doing it."* (PN11)

For some clinicians, attending the course occurred by chance:

> *"I fell into diabetes, did the [insulin course]...we had a nurse come in to do the clinics with us initially, and really just progressed on from there."* (PN3).

One GP found the knowledge gained to be particularly helpful to support patients in out-of-hours work:

> *"It's where we get insulin queries, you know, 10 o'clock at night with, 'My sugar level's this or that, what do I do next?'…"* (GP3)

Meanwhile, those equipped with the skills expressed how much they enjoyed the role and were clearly enthusiastic:

> *"It's actually a really interesting area, it's challenging, it's interesting and I love it, I love it. I love looking after them."* (PN1)

> *"It's a great subject. An absolutely great thing to be involved in so I'm enjoying it."* (GP1)

6.2.3 Consultations

The third area consisted of themes linked to consultations. These included HCP views of why patients with persistently high blood glucose levels were reluctant to engage with them, their style of communication, and the consultation agenda.

6.2.3.1 Perceived Insight of Patients

Opinions were given on why some patients with high HbA1c levels did not access help with their insulin, despite frequent written and telephone invitations to attend. Concern and frustration were expressed that while such individuals recognised their problematic glucose control with potential health detriment, they chose not to access help to better use their insulin:

> *"Some patients are in some form of denial about the whole condition and what's happening to them…They just seem to have switched off. It's as if they don't seem to want to know. It's probably a psychological issue which is not surprising."* (GP3)

> *"We've had one or two that obviously have a complete loss of control... In fact, some of them declined [referral to DSN] despite the…potential damage they are according to themselves."* (GP2)

Some thought this was linked to gender:

> *"I do find the men are worse. They'll always give excuses for why they don't come in; they've got to go to work, they can't get appointments, all these different things or they just are, I don't know, maybe a bit more head-in-the-sand than women."* (PN11)

6.2.3.2 Communication Style

Consulting in partnership with patients was an aspiration of most interviewees. This involved eliciting patient preferences *"to try and coax rather than tell them what to do"* (PN11) and helping them in the limited time available. It was necessary to first engage and connect with them, developing trust over time:

> *"I think it's just about getting a rapport with your patient…I have patients that say, 'Oh yes I always want to see you'…because you do get that rapport with them. I think that key, really, is making sure that they are confident and trust you and it's only through meeting them a few times that I think you know where to pitch it…there's no point in saying 'Do this this and this' because if you do they're not going to come back…It is always about your therapeutic relationship.*" (PN11)

One GP believed patients were more forthcoming about their insulin with PNs because of this rapport and relationship:

> *"I think with the PNs, they establish a very good rapport with them [patients]. So often, when they come and see us, they won't say much but when they see [PN], they open up. So often [PN] will tell me things and I'm thinking, 'well I've just seen this patient, but they didn't say that to me'. So yes, more so with the nurse than with the GP, definitely."* (GP4)

6.2.3.3 Consultation Agenda

The PN Diabetes Clinic agenda generally involved screening for complications, monitoring and addressing cardiovascular risk factors, discussing the patient's glycaemic control and, if competent to, reviewing and prescribing their medicines,

including insulin therapy. This often left very little time for discourse about their insulin. If indicated, and if the PN had the required skills, the patient would be followed-up for an insulin-specific review soon after. Discussion was reported to be related to blood glucose targets or goals (day-to-day levels and most recent HbA1c) and helping patients to manage their insulin therapy to achieve them. The PNs described how well patients understood the concept of the HbA1c test, the basis on which targets were made or agreed, disparity of preferred levels, and how targets were communicated.

Level of Knowledge

There were variable perceptions of how clearly a patient understood the meaning of an HbA1c test. The way it related to a blood glucose range was believed by one GP to be *"quite a difficult concept"* (GP1) to grasp for some patients. Others explained how they would *"always make sure they [patients] know what their number is"* (PN2) as *"otherwise it's a bit like trying to drive a car without a speedometer - if they haven't got the result, they don't know what's going on."* (GP2). Explanations varied but understanding the implications of their HbA1c result was considered necessary in helping them to optimise their insulin treatment:

> *"Well I do tell them it gives them an idea of what their blood sugar levels have been like over the last one to three months rather than just immediately."* (GP2)

> *"I explain exactly what an HbA1c is so they know exactly what it's about and they realise that it will be checked again if it's you know [high] in three months' time. They know the side effects of high sugar. They are told every time, you know, that obviously the damage is being done and that we really need to work together to try and get it to target for their sakes."* (PN1)

There was added confusion when the result, previously given as a DCCT percent, was now reported as IFCC mmol/mol though some HCPs related it to the DCCT percent measure:

"People often have this mismatch between the blood glucose readings and the HbA1c and they really don't get it and of course you need both for a good management of a patient." (GP1)

"Obviously when they changed over from percentage to mmols, I got confused and now the patients have as well, so I tend to still transfer it back into percentage anyway for them." (PN4)

Some found informing patients of their generally raised glucose levels (indicated by a high HbA1c) could be challenging, when those same individuals *"write down beautiful blood sugar levels in a diary but their HbA1c does not reflect it at all"* (PN1). Moreover, there was a view that not all patients wanted to be given a detailed explanation but instead preferred a descriptive result:

"Some of them want to know, some of them don't. As long as they're controlled, they don't care. And I think that as far as they're concerned you know; they want to know that what they're doing is OK." (PN4)

Decision-Making

Deciding on HbA1c targets was generally based on the national indicators of the quality outcome framework (QOF) but there was also a perceived clinical need to *"disentangle that from the financial penalty of doctors not meeting targets"* (GP3). The interviewees described individualising targets with a more relaxed approach for frail, older people, and others *"for all the well-established clinical reasons"* (GP3). This could involve having HbA1c levels *"up to about 64 mmol/mol"* (PN1) or higher, exercising caution when advising on insulin dose titration.

"We go through every person coming in a week before their appointment. So, we look at the HbA1c and say, 'they're 40 years and its over 60 mmol/mol, that's not good enough, they're not meeting a personal target' whereas an 80-year-old, we are not pressing for anywhere near as tighter control…It's expensive and dangerous to keep people on a too low HbA1c." (GP3)

"It all depends on how long they've had the diabetes; how much damage has been done, what the sugar levels are. It really is an individual…very individual thing and you need to discuss it with the patient. But I don't tend to hammer the levels right down on very elderly people because it's too dangerous. Most of them are living on their own, they are frail, their appetite can suddenly decline." (PN1)

How this individualised approach in target-setting translated into a conversation with a patient, involved specifying or agreeing on the target HbA1c and discussing how to achieve this with their insulin treatment and in relation to their home blood glucose monitoring. Some participants were pragmatic in their discussions, some with a sense of vexation, while others communicated this in more general terms:

"I've tried to explain to the patient that this is what it's stands for, this is what it should be, this is what it is." (PN4*)*

"I think if the levels are OK, it's safe, then as far as they're [the patient] concerned and myself, it's normal." (PN3)

Patients were often encouraged to take part in the decision-making:

"We're trying to start doing that [joint decision-making], 'What's your fasting blood glucose range. What's your target fasting blood glucose range? What's your target HbA1c?' and we're working towards that. I think we're just about starting to bring that in now." (GP1)

"We discuss that. That's a joint decision with us and the patient. We work it out together what they feel they can manage and what we suggest is, you know, at least an appropriate level for them." (PN1)

Disparity of Targets

Despite joint decision-making, there were occasions when a mismatch occurred between what the clinician felt was an achievable goal and what the patient desired. Reasons cited by the HCPs for patients preferring higher blood glucose levels included concern about hypoglycaemia and not feeling an immediate need

to reduce them because they did not feel ill. There was also a perception that, many older individuals who had been *"so uncontrolled for so long"* were *"perfectly happy and they don't want to change anything"* (GP1). The GPs and PNs strove to rectify this by emphasising the adverse impact high blood glucose levels could have on health:

> *"Because they don't feel unwell, they think 'No I feel fine'…I will say, 'I know you probably feel fine but, unfortunately, the damage it's doing to your heart, your kidneys', etc. 'by the time you actually have the [feeling ill] effect, it's too late then. So, we need to try and get it down now'…"* (PN11)

> *"It's more important obviously as we know to get the younger people down as close to target as possible, but we have a few who have been on insulin for donkeys' years where, with all the good will in the world, you do struggle to get it."* (PN1)

For patients reluctant to increase their insulin dose because of concern about their glucose levels falling, some HCPs felt it was better to reach agreement by accepting their preference for a more relaxed target, while maintaining focus on reducing their cardiovascular risk:

> *"They'll say for instance 'it's 8 or 9 before meals' and I'll say, 'it should be lower than that', but they'll say, 'I don't want it to get below 6 or. I might have a hypo'. So, yes there is that fear there."* (PN11)

> *"We have had to say to the established diabetics, 'we've moved the goalposts' that we're not looking for quite as tight a control and also re-educating them that it's the whole package…it's also the blood pressure, its looking at the renal function, all the other things."* (GP3)

Communicating Targets

While in most practices the day-to-day glucose goals were generally written by the PN in the patient's glucose-monitoring diary, the level of detail communicated in relation to their insulin use, varied. Within the Diabetes Clinic, some PNs gave

their patients a print-out of their management plan, or by *"writing it in their personal [handheld] record"* (PN11):

> *"At the front of every [monitoring] diary, when she starts a new diary, I always write, 'BMs [blood glucose levels] before breakfast should be… BMs after your meal should be…Before bed should be'…"* (PN11)

> *"There's this new community diabetes pack that we start all our newly diagnosed diabetics on and within that there's a record book, so I would be trying to keep them looking at their numbers with the record book there."* (PN2)

Though some PNs said there was insufficient time left to enter the HbA1c result and target by hand, others developed a plan to print for the patient and save in their medical record with targets and a dose-adjustment guide.

> *"It is the time factor. You need an hour to be able to go through the book [handheld record], and, you know, discuss a goal, 'Well what do you want to do, your HbA1c or your weight?' you know, it's usually one or the other. But I did really try and use that book, but I've stopped again now."* (PN4)

> *"We have a diabetic management plan which has all their details on it. It will have what we've done on that day whether it be foot checks, weight, etc…It will also tell them what their most recent HbA1c is, or should be…We print it off and hand that to them…For example, 'Discussed HbA1c today, higher than desired, advised do this dose, this, and this'…"* (PN11)

A target HbA1c might be agreed with a strategy for achieving it. However, apart from the QOF exception coding, no individualised coded or recorded target HbA1c was identified from any of the participants' records though there was a perceived need:

> *"Oh yes, I think so I think that's got to come and then I think we're starting to do that and absolutely, and everybody knows where they are, and it should be on the patient record and it should be something that the patient knows and that we know that's very useful."* (GP1)

6.2.4 Insulin Use

This section describes themes related to insulin use with regard to blood glucose monitoring, tackling blood glucose variation and educating patients on managing insulin.

6.2.4.1 Supportive Technology

Self-monitoring of blood glucose levels (SMBG) was perceived as an integral part of patients' insulin therapy by *"helping them to manage their diabetes and adjust their insulin"* (PN1), to establish level of glycaemic control *"to get people safe"* (GP1) and enable the HCP and patient to *"try and work things out together"* (PN1). Testing-frequency varied according to regimen, dosage stability, driving status, and other factors. It was acknowledged that many did not monitor regularly as *"some people don't particularly like doing it."* (PN2), because of inconvenience, and feeling *"frustrated if things don't work"* (GP1). For those who did bring their blood glucose readings to clinic, this was sometimes discordant with their recent HbA1c result, which PNs found challenging to discuss (see also Consultation Agenda) although most tried to support patients in a non-judgemental way:

> *"We just work through it together so it's a matter of keeping up that contact, so they get confident with you and that you're there actually not to tell them off which is what a lot of people are always frightened of, that they're going to get told off. It's more about helping them to manage their diabetes and adjust their insulin."* (PN1)

Ensuring individuals were aware of, and complied with, the legal requirements for driving could be problematic when consulting with those who *"don't particularly like doing it [monitoring]"* (PN2) or who had concerns about cost implications:

"We've had problems with one or two patients declaring to the DVLA that they're on insulin. They think their insurance policies are going to be put through the roof, but I've spoken to the DVLA and they've said, 'no that shouldn't happen'…" (GP2)

"That is an issue especially for those who need their car, for example, for jobs, for work, or if they're the main carer for their spouses, whatever. That has been, yes, a challenge but you know, they are aware of their responsibilities and the regulations…Whether they choose to follow that or not obviously we can only advise and document it." (GP4)

6.2.4.2 Addressing Blood Glucose Variability

Reports were given by clinicians of how they systematically supported patients to self-adjust insulin to stabilise their blood glucose levels. They described the various methods patients adopted over time, observing how some appeared to have forgotten how to dose-adjust or were reluctant to do this at all. This was despite *"very much trying to empower and educate"* (GP3) patients to self-manage. It was suggested that some had never been told to so *"didn't realise that they could"* (PN3) or *"they don't want to"* (PN4).

Forgetfulness over time was another factor necessitating the need to reinforce information *"and go through it again and try and explain again"* (PN1) and recording it for them:

"It's just education and confidence. Always just going over and if there's anything they don't understand you know you ask them to try and explain what they would do if they found a sugar high here or low there, what they think they might do and then try and work with them." (PN1)

"It's written down for them, so they know when to increase it or lower it… you know, there's more education out there and it's encouraging them to take control." (PN3)

Some HCPs aimed to simplify the process for patients, while encouraging patients to reduce the dose if glucose levels were low because *"some patients think they can only adjust it up but not down."* (PN2*)*

> *"Look there's nothing dangerous about this – two units of insulin every two or three days. You go up, you go down."* (GP3)

However, there was a perception that some patients would still have difficulties self-adjusting and that perhaps there were unrealistic expectations on their ability to self-manage:

> *"Basically, yes you're trying to turn people into endocrinologists really in some respects which they haven't got the capability of – that isn't meant to be arrogant – of taking it on board."* (GP3)

> *"I'll write 'If not [to target], increase by two units' or 'If low reduce by two units' and…there's a couple that literally get all in a tizzy or they'll go the wrong way…If it's high they'll suddenly lower their insulin."* (PN11)

Memory was believed to play a role in negating the process:

> *"A lot of the diabetic patients definitely appear to have memory lapses…I had a chap only this week, I'd actually written it in red in his blood sugar diary to increase his lunch-time insulin to fourteen…he did it for three days, and then he turned over the page and he'd gone back to twelve and when I asked him he said, 'Oh I've done it wrong haven't I?'…"* (PN11)

The level of responsibility for managing insulin was perceived by some to be associated with the age of the patients. It seemed that older ones, preferred to hand over the responsibility of managing their insulin to their GP or PN, or needed their decision to self-adjust confirmed first:

"I've had a couple of patients and, you know, you see that they've seen the DSN and she's said titrate according to home sugars and like, they come to me you know, 'I'm still getting 9's and 10's what do I do?'. I say, 'Well have you titrated two units?', they say, 'Well I didn't like to'. I say, 'She's written it here that you can'. But they didn't want to until someone else told them to." (PN4)

"I think it could also be an age thing. Medicine has changed from, you know, 'the doctor says do that' and people wanting to be told to what the doctor says or the nurse. Whereas over the last 10,15 years it's been very much trying to empower, educate them, make sure that, 'No it's not just because the doctor or the nurse says that you do that, it's what you think might be right'…" (GP3)

6.2.4.3 Patient Education

Education supporting insulin use was generally one-to-one with a PN or DSN. A carer or relative might also be present. Literature included that developed by interviewees, professional diabetes organisations, and pharmaceutical companies who sometimes produced digital recordings. These were all in addition to the hand-written notes entered by the HCP in a patient's glucose testing diary. The perceived level of understanding of patients was felt to impact on how much they could retain, and this could lead to a sense of frustration by the clinician:

"We produce an awful lot of leaflets and a lot of stuff you know…well I really have to say that you know I can talk about it to people and I might get through to some individuals…" (GP1)

"I can talk to patients; I can tell that they're not registering it and I'm having to write down instructions or give photos or sometimes you refer them to videos you know just different ways of trying to get that message across." (GP4)

Attempts were made to adapt approaches and provide information in a way which, the individual patient or carer, could grasp as *"some people need a*

practical approach and some people need a much more emotional approach." (GP1). It was first important, however, to identify any problematic areas:

> *"I think it's an individual thing. It's about teasing things out and something just comes out and its 'Oh hang on your doing that?'..."* (GP3)

> *"I would hope to try and get to the bottom of anything that we feel we can change talking with them but, and sometimes it is just education and understanding."* (PN2)

6.2.5 Healthcare Professional Views of Patient Barriers

Themes incorporated into this fifth area relate to patient-level barriers to insulin use and glycaemic control as perceived by the HCPs. Views included insulin-related behaviour, blood glucose awareness, psychological barriers, and social influences.

6.2.5.1 Explanation for Patient Behaviour

Explanations for insulin-related behaviour were associated with level of adherence and understanding of insulin.

Adherence

Intentional and unintentional non-adherence to insulin treatment was felt to adversely impact on blood glucose levels and included all aspects of insulin. Influences on unintentional adherence were reported to include comorbidity, polypharmacy and poor memory with patients forgetting to inject *"especially the older ones, they get confused"* as *"they do tend to be on lots of different things as well as their insulin."* (GP4). The participants also described factors contributing to patients intentionally omitting insulin injections or administering suboptimal doses. There was a perception that some patients were not sufficiently motivated, while others with memory problems might attribute blame to others. This led to a feeling of vexation for one PN:

"We have certainly had a couple of cases…that we have struggled with and unfortunately they've had the complications of the diabetes which have led to amputations etc. because they didn't bother to, you know, comply with the medication properly so it's always a worry." (GP4)

"He said, 'My blood sugar's all over the place, I haven't taken my insulin for the last month'…because of his wife, 'She forgot to remind me'. I said, 'But you're telling me that you know [that his wife forgot to remind him]'. So, we went 'round in circles and I said, 'When you realised why didn't you just start yourself on a low dose?'… 'No, I thought I'd just wait 'til I came to see you.' I said, 'Well what are your blood sugars?'…'Well I haven't done them either because I've forgotten to'…" (PN11)

While some patients might not be forthcoming about forgetting their injections, a non-confrontational approach was identified as being important in eliciting this behaviour, so that it could be addressed:

"Some patients forget it, so just make them feel relaxed, so they can often tell you more if they feel really relaxed about say, I would forget tablets in the middle of the day, so I feel sure they would forget insulin in the middle of the day." (PN1)

"I do have some patients if they've brought their blood sugar diary for instance and I say, it might be high and I say, 'What happened there?' and as they look on the day they might say, 'Oh well actually I went out and I forgot my insulin' so they may not volunteer the information but sometimes they will actually say, 'Oh yes I did forget it'…" (PN11)

Strategies were suggested to help them remember:

"It's trying to find strategies if they forget it, like putting the pen next to the tea caddy ready for the morning. Just simple things…It's always about, 'What do you do regularly? Do you take your tablets regularly? Well put your insulin pen next to your tablets if that's the time of day you have to take your insulin.'..." (PN1)

Level of Understanding

Several believed that a limited understanding of how insulin acted, could be a significant barrier and potentially hazardous. One example was giving additional doses of a premix insulin before bed following inadvertently missing a mealtime dose, or as a correction dose for a raised blood glucose level:

> *"Although a lot of patients have got a very good grasp, sometimes they don't fully understand that there is a long-acting ingredient in it [premix] so that by giving it an extra shot just before they go to bed might actually put them at risk of a hypo because of the long-acting component."* (GP3)

> *"They just see the high blood sugar and they think they need to get it down there and then. They don't think of the risk of the hypo overnight."* (PN3)

It was believed that limited knowledge also impacted on how patients titrated insulin, such as injecting extra units of basal insulin to compensate for forgetting to administer their prandial (mealtime) insulin earlier on, or feeling confused altogether:

> *"I do have some patients that will say either they forgot or chose not to give their [prandial] insulin or they then decided they'd just have a bit more of their Levemir or Lantus at night to counteract it [high glucose reading]. They'll be the ones that self-adjust all the time."* (PN2)

6.2.5.2 Blood Glucose Awareness

Some participants viewed a heightened awareness and concern about having low blood glucose levels as limiting to insulin use. While being potentially advantageous in preventing hypoglycaemia, it was perceived as a possible hindrance particularly in those with past experiences of hypoglycaemia who worried about recurrences at night. Others were thought to keep their levels unnecessarily high to alleviate their family's concern:

“I don’t think they think of hypos until maybe if it's happened to them then they’ll worry about it, but funnily enough it's one of the things we will always mention but it's not a concern that they come up with themselves. More so their carers or their families might raise that concern whereas they’ve read up about it.” (GP4)

“Most of them are worried about becoming hypo especially at night, the middle of the night.” (GP2)

The HCPs explained how this led some patients to significantly reduce their dose, and then become accustomed to high blood glucose levels. Clinicians found creative ways of helping them to understand this. Others described how patients’ concern about not being able to drive was another reason for keeping their levels raised:

“Some of them will say, ‘Well if it goes down below seven, I don’t feel right’ and again trying to educate them, saying to them in terminology they can understand. I normally say, ‘Your brain thermostat has reset itself at the wrong level; it now thinks you should be running at that level. Well it's not. We’ve got to slowly bring you back down, so you don’t feel like that.’...” (PN11)

“I suppose there’s always bad publicity isn’t there of someone on insulin who’s had a car crash and that’s the thing that they’ll remember, and they’ll say, ‘I’d rather run high than not be able to drive’…” (PN4)

6.2.5.3 Psychological Barriers

Psychological barriers of patients to optimise their insulin were perceived to be a lack of confidence, memory problems and not perceiving an immediate need for insulin because of feeling well and. Level of acceptance of insulin was believed to be more of a barrier early on in the treatment but with acceptance increasing over time and with age:

"I think to be honest, once they're on insulin most of the people I've seen, their concern seems to be beforehand…I don't think I've had anybody that's actually come back to me and said, 'No I don't want to take this anymore'…" (PN2)

"The majority of my old patients take note of what you say you know, they're not rebels, you know. They're in their 70's, 'Yeh I'll do what the nurse tells me'…" (PN4)

However, the HCPs said that concerns, such as fear or worry about hypoglycaemia or pain, reduced acceptance: *"their main fear is actually the injection itself."* (GP4). Shame at having to inject insulin because of having failed, and *"low self-esteem – not feeling worthy"* (GP1) further lowered acceptance:

"I think some patients still view it as a failure on their part that they're having to go onto insulin. I do point out to them that we're only palliating the disease and there's no cure and so it's not surprising that it's going to advance at some point and they're going to need more intensive treatment." (GP2)

6.2.5.4 Social influences

Perceived social-related barriers included eating out, attitude of family and friends, concern about weight gain, career distractions, and living environment. An example of the impact of problematic living arrangements was reported:

"I think he's forgetting it [insulin]…he's in a sort of hostel environment though he says people are stealing his pens and it's so chaotic." (GP1)

Career distractions took priority over insulin, particularly in younger patients:

"We do very often get young motivated individuals, motivated in their career, not in their health who are distracted elsewhere and don't prioritise their management of insulin." (GP1)

Families, though generally supportive to patients who could not self-administer insulin, *"they'll have spouses or carers who'll do it"* (GP4), were on occasions viewed as a hindrance and needing support themselves:

> *"We recently had an adult protection issue where a wife, well it was suggested she wasn't giving insulin to her husband who has memory problems, so we managed to persuade her that the District Nurse really should be doing injections for him."* (GP1)

> *"This daughter who was absolutely terrified of taking away her mother for two or three days you know, I was actually able to give her a lot of confidence. I said, 'I want to know what the regimen is', but they didn't understand the basics."* (GP3)

Injecting when eating out was believed to be problematic for patients using prandial-based regimens who avoided testing and injecting in front of others by injecting ahead of a meal or delaying administering it until they returned home:

> *"They'll vary it sometime, sometimes they'll take it before or if they've gone out, they'll take it after…when they get back home."* (PN3)

> *"I can recall a patient who doesn't like to do it when she's out and about and she's in her bag checking what her sugars are, but she doesn't want to be seen that she's doing this so yes."* (PN2)

The HCPs suggested *"finding strategies really to do it discretely, so they don't feel embarrassed"* (PN1) and *"public education as well. It's just like the breast-feeding debate"* (GP3). Sometimes the barrier was felt to be related more to the inconvenience of taking the insulin equipment out with them, and timing the injection, rather than embarrassment:

"Is it that they can't be bothered to take the pen with them or is it because they're embarrassed or what is it exactly? For some of them who are embarrassed they could wear a two-piece outfit rather than a dress. You can just lift your top and give it very discretely in a corner somewhere." (PN1)

"I did have this with my aunt who went to a wedding and my aunt is type 2 diabetic…and we had issues making sure that her insulin was given at the right time for the meal and checking so it's not being afraid to let catering staff know that this person needs to have their meal first. Again, its public education and in the restaurant trade as well." (GP3)

The consequence of obesity from insufficient lifestyle modification and *"physiological insulin resistance"* (GP3) were believed to be further barriers to optimising insulin, with fear of further weight gain but felt this could be overcome with support and advice:

"It's [weight gain] obviously an issue. Obviously, they're told that when they start insulin that perhaps they need to be a bit more careful with their diet and exercise." (PN1)

6.2.6 Suggested Improvements

This final thematic area summarises the suggested ideas to support insulin use put forward by the participants. These related to both patients and HCPs, within and outside of healthcare systems.

6.2.6.1 For Patients

Ideas proposed for patients involved tools for self-adjusting insulin, drop-in clinics, and group education though some also relayed that *"A lot of patients don't like group stuff"* (PN4) and there was also ambivalence about their confidence and capacity to be group educators. Some suggested that peer support may be helpful *"buddying them up with other patients"* (PN2). Participants suggested that creating self-help resources and using the social and public media constructively could help:

"If it's on the television things like that do have a bit of an impact - especially if they are quite dramatic." (PN11).

"There are older people who are very IT literate who would use apps and things like that." (GP3);

"A Fix-It Manual…You know, 'you're on this kind of insulin if this goes up and that goes down then you've eaten then, then you need to do this or that'..." (GP1)

6.2.6.2 For Healthcare Professionals

Ideas related to HCPs included how GPs and PNs with insulin-related expertise could support colleagues in other practices to develop skills to initiate and manage insulin though concern was expressed about the resources required for practice-to-practice support. Training introduced early for all new GP registrars and for new PNs and Community Nurses was also proposed:

"I would say about 50% [of PNs] would say, 'No that's not for me.' But if they're the sort who will interact with people then I think that yes it would be good but some people out there, no they think it's not their thing." (PN11)

"Oh it would be fine…if there was commissioning for that, if money's around." (GP2)

The ideas put forward by the PNs and GPs to support insulin use are integrated with the patient suggestions and included in Appendix 14.

6.3 Summary

The PNs and GPs described a range of experiences of supporting patients and views on their insulin-related behaviours and perceived barriers. Their accounts revealed enthusiasm and commitment to their insulin-related role with occasional frustration at the way some patients self-adjusted their treatment. Key points for further enquiry are next described. While all interviewees, consulted with insulin-receiving patients, the extent to which they supported them was dependent on

their expertise and if the practice provided PN and GP-led insulin services. Those PNs who did not have an insulin-specific role were sufficiently motivated to develop the skills had their diabetes patient population been large enough to gain experience, and if their practice signed up to provide the service.

While some support was provided proactively, help was mostly given in response to patients seeking advice or opportunistically in the PN Diabetes Clinic. Those PNs and GPs with the skills, were able to provide a more insulin-focused face-to-face consultation. The HCPs aspired to consult in partnership with patients about their insulin use, building a rapport over time. Blood glucose targets were based on national guidance, agreeing on higher levels for some, particularly the frail older people. While there was no standard system for entering targets in the patient's electronic record, they wrote these in the patient's monitoring diary or included them in a printed management plan. Though joint decision-making was the aspiration, clinicians recognised disparity between glucose targets agreed or assumed and those desired by patients.

The interviewees encouraged patients to self-manage, supporting them to self-adjust and reinforcing the guidance but expressed frustration on encountering the different ways patients undertook this. Some believed they had unrealistic expectations of some patients in this respect. There were also occasions when the HCPs in turn, felt that diabetes specialists had too high an expectation on their ability to support insulin use in those with more complex needs.

Suggestions for ideas and service improvements included group education specific to insulin-treated T2DM, peer support, and a simple self-adjustment tool. The media, particularly television, was perceived to have a potential role for raising public awareness about insulin and educating patients. The findings identify areas to further improve support for patients and optimise their insulin use and glucose control. These include the way PNs and GPs offer patients choice to self-manage and agree glucose targets, the provision of proactive support and education, and enabling more practices to provide insulin services.

The integrated findings of the quantitative and qualitative study phases are outlined in the chapter that follows.

7. INTEGRATION AND SYNTHESIS OF PATIENT AND HEALTHCARE PROFESSIONAL PERSPECTIVES

In this chapter the survey and interview data are brought together to add to current knowledge and inform models for future care. There are three sections:

1. Integrated experiences of patients and primary care healthcare professionals (PC HCPs).
2. Ideas for service improvements.
3. Models for future interventions.

7.1 Integrated Experiences

In this first section consideration is given to the convergent and divergent perspectives of the healthcare professionals (HCPs) and patients in respect of insulin management support. The key areas of integration identified were: healthcare systems, self-management, HCP–patient communication, barriers to insulin use, and understanding of insulin. A summary table with transcription extracts can be viewed in Appendix 15.

7.1.1 Healthcare Systems

The accounts of the HCPs and patients revealed shared perspectives on how the care system mediates the support provided to people with type 2 diabetes (T2DM) in relation to insulin and its use. These perspectives converged in two areas: care integration and insulin service provision.

7.1.1.1 Care Integration

This related to the shared perspectives of care provided by the hospital and community diabetes specialist teams, how this was communicated to the General Practitioner (GP) and Practice Nurse (PN), and the subsequent impact on the patient. Overall the accounts suggested that communication between services could either have a positive or a negative impact on insulin care and subsequent glycaemic control. On the negative side, the GPs and PNs regarded the hospital discharge process as becoming more fragmented, with incomplete or missing information about a patient's insulin therapy. From the patient perspective, this related to not having a full understanding of any changes to their insulin regimen.

Collectively these deficits in understanding from both patients and professionals could result in suboptimal insulin management or even error. The accounts also indicated that when communication between the community Diabetes Specialist Nurse (DSN) and PC HCP was effective, this had a positive effect on insulin care although it was suggested that this communication was infrequent. These data emphasise the importance of communication between HCPs, diabetes teams, and patients in providing effective insulin care.

7.1.1.2 Insulin Service Provision

Positive perceptions of having PN and GP-led insulin support, were shared by patients and HCPs, including some whose practices did not provide these services. Their value to patients included familiarity, convenience and direct access to support without needing a referral. GPs and PNs also identified these advantages, and additionally felt the extended role enhanced their job satisfaction with more appropriate use of skills. However, this view was not shared by all PNs and GPs whose practices did not provide these services, with some feeling challenged or overwhelmed at the prospect of providing additional insulin-related support. Hence, thought needs to be given as to how such services might be best initiated and supported in practices, with the need to consider how to do this in smaller practices being particularly important.

Accessibility to insulin support related to telephone advice and clinic attendance. Access to telephone advice in terms of timeliness and quality was perceived positively by most HCPs and patients. Patients' views were aligned to those of PNs for being easily able to access telephone advice although some patients were unaware of the support provided or did not access this support. GPs, however, were perceived to be less accessible. Perspectives were shared by patients and HCPs on the inflexibility of clinic times for face-to-face support. The data suggests that certain patient groups were not fully able to take advantage of the help available.

7.1.2 Self-Management

Areas where common and divergent perspectives were expressed on self-management included: the expectation of HCPs for a patient to self-manage, how patients self-managed, and the setting of blood glucose targets.

There were opposing and shared perspectives of preferences amongst the HCP and patient participants in relation to self-management expectations. The HCPs encouraged and expected most patients to self-manage while being available to support them. While some patients concurred with this view, believing they should take control of their insulin treatment rather than depend on their HCP; others either preferred not to self-manage or were unaware that they could, as they expected to be directed by HCPs. This emphasises the need to consider the individual's capacity and motivation to engage in insulin self-management when planning care.

When considering dose-adjustment methods of patients who did self-manage, there was dissonance with the methods and advice given to patients by the HCPs. The patient accounts revealed that while some patients followed a systematic model targeting fasting glucose levels to titrate their insulin, others used a more haphazard approach often based on random blood glucose readings or using insulin to respond to hyperglycaemia. Consequently, some patients used large correction doses and mistimed their prandial-based (mealtime) insulin frequently. Moreover, what was regarded by the HCPs to be a straightforward process, was perceived by some patients to be confusing and complicated. This suggests a possible underestimate of the ability of some individuals to undertake self-adjustment without more support. This again emphasises the importance of assessing a patient's understanding of self-adjustment and the need to consider whether they may need more HCP-led support.

There were opposing preferences on the blood glucose targets patients were supported to aim for and perceptions of how these were agreed. The PNs and GPs perceived concordance on blood glucose goals based on joint decision-making in partnership with the patient. Conversely, many patients perceived the targets preferred and expected by their HCP, to be generally lower than those they desired for themselves. This discordance was a likely contributor to suboptimal management of insulin therapy and subsequent glycaemic control, indicating the need for a clearer agreement on the target appropriate to the patient and one that individual can manage without impacting on quality of life (QOL). It may also indicate that patient behaviours in respect of glucose levels

may be influenced by other factors such as a fear of hypoglycaemia, and that these are largely unaddressed in the support provided.

7.1.3 Healthcare Professional–Patient Communication

The participants reported different perspectives on HCP-patient communication including the style of consulting and the methods used to communicate to patients their level of glycaemic control.

7.1.3.1 Consultation Style

The HCPs reported that they used similar approaches to providing insulin support in their consultations, although the patient accounts reported more variation in the consultations they experienced. The GP and PN perspectives, included: engaging with the patient at their level of understanding; and consulting in partnership with them, using a non-judgemental approach. Most patients shared these perspectives, particularly those whose practice provided insulin-support services. Some individuals reported a less concordant consulting style or did not understand explanations given about their insulin use and control.

7.1.3.2 Communicating Level of Glycaemic Control

This area relates to the shared perspectives of how PNs and GPs explained to patients their most recent glycated haemoglobin (HbA1c) blood test and day-to-day blood glucose levels. Some PNs described how they recorded and explained the test result, in relation to their day-to-day blood glucose levels. Others provided instead, a more subjective description of the result, depending on their perception of the patient's level of understanding and preference. While this converged with most patient accounts, some views differed, perceiving their HCPs assumed they desired only a brief description when they would have preferred a more detailed explanation.

This suggests that while the HCPs aspired to consult in partnership and engage with patients, there were occasions when they misjudged an individual's level of understanding and preference for clear explanations of insulin treatment choices and level of glycaemic control. This also suggests a missed opportunity for patients to better optimise their insulin use. For example, a patient who prefers to know their HbA1c level (which might be higher than target) might be more

motivated to focus on their insulin use and be more open to discussion, after being given the result. Conversely, it may be that giving a target which is not achieved could foster a sense of failure and be demotivating, hence how targets are given should be negotiated with patients and relayed in a positive way.

7.1.4 Barriers to Insulin Use

The perspectives and views on patient perceived barriers to insulin use were mainly shared by HCPs and patient participants. They relate to influences on intentional, and unintentional non-adherence to the therapy in terms of injection timing, insulin omission or administering less insulin than had been recommended.

7.1.4.1 Intentional Non-Adherence

The shared perspectives on intentional non-adherence to insulin included omitting or delaying prandial insulin (to avoid embarrassment or offence to others), injecting suboptimal doses (because of fear of hypoglycaemia or perceived hypoglycaemia), and perceiving no immediate need for insulin (in the absence of symptoms). Psychological barriers such as feeling a failure and fear of pain on injecting were also perceived by HCPs and patients. Many individuals, however, made efforts to overcome such factors, and still gave their insulin.

Regarding weight, while HCPs perceived patient concern about gaining weight to be a barrier once they increased their insulin dose, some patients viewed loss of weight as a barrier. This was because weight loss subsequent to dietary modification, triggered their blood glucose levels to drop too low. Instead of reducing their insulin dose, however, patients increased their food intake, regaining their weight. This suggests that when counselling patients to lose weight, HCPs might not have reinforced the need to reduce their insulin alongside a consistent fall in blood glucose.

7.1.4.2 Unintentional Non-Adherence

Both groups regarded general memory loss as a key factor for forgetting their insulin injection. Other causes were attributed to comorbidity (HCPs also ascribed this to the associated burden of polypharmacy), being busy, going out (forgetting equipment), and feeling well. Though the HCPs understood most barriers to

insulin use as perceived by patients, they may not have understood the explanations for, frequency of, or their potential impact on the subsequent glycaemic control.

7.1.5 Knowledge of Insulin Type

The last area of integration involves a patient's knowledge and understanding of the actions of the insulins they are using, particularly the time and duration of the effect of prandial insulin. The intentional mistiming of prandial-based injections, (such as to avoid injecting in public or administered later when remembering a forgotten injection) indicated an incomplete appreciation by patients of the reasons for injecting prandial-based insulin to cover meals. While the PNs and GPs were aware of this behaviour, the interviews imply they may not have fully appreciated the frequency or extent of the occurrences.

7.1.6 Summary

The integrated experiences suggest that most perceptions of HCPs aligned with those of patients, such as the value placed on the PN and GP-led insulin-support services. However, some views were less convergent. These mainly related to the differing expectations of the HCPs for patients to self-manage insulin, their preferred blood glucose targets, and the level of detail given to individuals about their recent HbA1c level in relation to the targets. This suggests there was less conversation around these topics and would require clearer HCP communication to establish patient preferences.

7.2 Suggestions for Ideas

This section summarises the integrated suggestions of patients and HCPs for improving insulin use and enhancing support in general practice. The suggestions, summarised in Figure 23, comprise five areas:

There are five suggested areas:

1. Insulin services in general practices
2. Insulin management tools
3. Group education
4. Peer support
5. The media

7.2.1 Insulin Services in General Practices

The participants suggested increasing the number of practices with PN and GP-led insulin services would improve access to support. This would be facilitated by the continued provision of locally funded courses, Clinical Commissioning Group (CCG) funding, practice-to-practice support, and introducing insulin-related education for new GP registrars, PNs and Community Nurses. Including practical information on hospital discharge letters about the insulin type a patient was prescribed, such as timing and dose-adjustment, was suggested to help GPs with less insulin-related expertise to better advise patients. Improving access by having an evening PN or GP-led drop-in clinic for insulin support was put forward to reach out to patients who were reluctant to attend or who did not want to book an appointment in advance. This could also enable those individuals with unpredictable work patterns or other commitments, to attend at short notice

7.2.2 Insulin Management Tools

Several insulin self-adjustment tools were proposed. These included: simple tools to enhance insulin optimisation, such as diagrams or flow charts with easy-to-read instructions; a titration instruction tool in a credit card sized format; an easy-to-use App for self-adjustment; and a Fix-It Manual for problem-solving with self-adjustment. It was thought this would be further enhanced by patients having automatic access to HbA1c results prior to attending a clinic appointment. It was not indicated which groups of patients might be best suited to which tools, this would need some consideration based on the self-management capacity of the individual patient.

7.2.3 Group Education

Group education specific to patients with insulin-treated T2DM was proposed which was based in general practice and led by GPs and PNs, though other health settings were also thought to be of benefit. It was also suggested that family, friends or work colleagues should be invited to attend these sessions as it was felt that people who were treated with insulin, such as older individuals, often rely on the support of others.

7.2.4 Peer Support

A small forum for patients with insulin-treated T2DM to support each other and share ideas, was another proposed initiative. A clinician could facilitate the group to guide and help ensure the advice was appropriate. A buddy-type system would be included to provide support, for example, for injecting in public or for those having difficulties with injections.

7.2.5 The Media

The role of the media was put forward to raise public awareness of insulin treatment and as a way of educating patients. These included televised documentaries which gave positive messages, while highlighting challenges such as injecting insulin in a public place. Public figures with insulin-treated diabetes could use their media presence on television and newspapers to encourage patients and enable the general public to understand the challenges around insulin use.

7.2.6 Summary

In summary, several ideas were suggested by the participants and, while some were practical, such as the self-adjustment tools, the others might be more challenging to implement in terms of resources and practicality. Regardless, it was essential to individualise the approach to the patient, considering their preferences, QOL and potential health benefits.

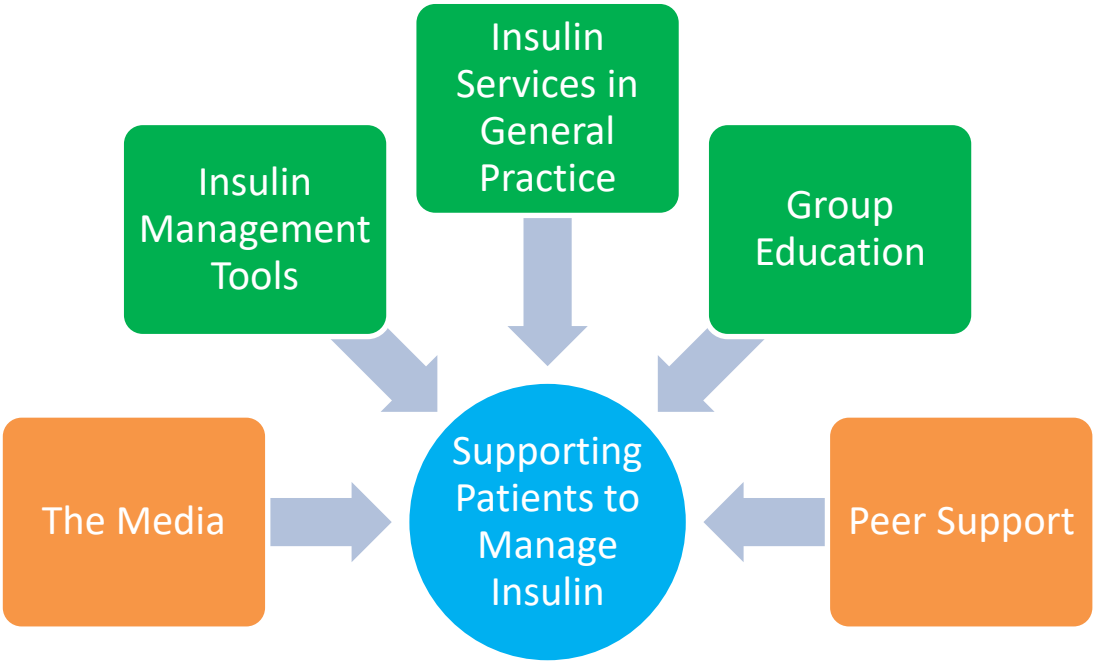


Figure 23 Patient and Healthcare Professional Suggestions
Key: = Healthcare driven; = Outside of healthcare.

7.3 Models for Future Interventions

This final section outlines four models to explore for future interventions to help optimise the support provided to patients in using insulin to enhance blood glucose control to a level that reduces the risks for individual patients. The strategies aim to address the modifiable factors identified in this study relating to how patients use insulin, and the support they receive in primary care from PNs and GPs. Non-modifiable factors such as age, comorbidity and ethnicity, are also factored into these models, with an emphasis on individualising glycaemic goals and personalising the interventions. The models involve the development of:

1. An Insulin Action Plan
2. Insulin self-adjustment tools
3. Group Education with peer support
4. The Media.

7.3.1 Model 1 Insulin Action Plan

This first model focuses on designing an Insulin Action Plan that is owned and developed by the patient or their carer, in partnership with their PN or GP. This is informed by the findings as follows. There was an identified need to establish

patient preference and ability to self-manage, their preferred glucose goals, and the level of detail they desired about their insulin. There is no consensus on how best to develop a diabetes management plan in general practice, or one that is insulin specific. This should be an evolving document, responding to the patient's health needs, preferences and changes over time. Moreover, it should enable PNs and GPs to record coded elements of the plan for the patient, and for other clinicians to access via the electronic medical record. The components of a potential plan are summarised in Table 52, although in taking such a plan toward an optimal approach would be to engage patients and HCPs in a co-design process to enhance its utility in primary care settings.

Table 52 Proposed Insulin Action Plan

Component	Suggested Content	Rationale
Treatment	Insulin regimen/type + OHAs	To facilitate support by others
Glycaemic goals	Agreed HbA1c and day-to-day blood glucose targets	To facilitate: • Patient choice • Standardised management by other HCPs
Self-management	Preference and ability to self-manage	To facilitate and record patient choice
Insulin dose-adjustment	1. Insulin titration guide 2. Action for hypoglycaemia 3. Sick-day rules	For the patient, carers or HCPs
Review	A review date alert	For timely review of: • Blood glucose targets • Self-management preference • The need to continue or change or stop insulin
Method of agreement	1. Patient or carer and HCP 2. Date agreed 3. Date for review	Governance and continuity of care
Design	Suggested Process	Rationale
Format	1. Printed copy 2. Electronic Medical Record (EMR) 3. An App	To facilitate: • Easy access by patient, carers and HCPs • Access to links to insulin-related information
Method	Use an EMR template with prompts and fields to import into the plan	To facilitate: • Standardisation • Ease of creating and updating • Read coding for audit

Key: HCPs = healthcare professionals; OHAs = oral hypoglycaemic agents.

7.3.2 Model 2. Insulin Self-Adjustment Tools

This model centres around the identification or development of simple and accessible self-adjustment tools (see Figure 24). The findings revealed a variety of ways insulin was self-adjusted, and the difficulties some patients experienced. Though PNs and GPs advised on and reinforced dose-adjustment methods, there was an identified need to improve access to these and to better individualise them. The tools should therefore be shaped to the preferences and abilities of patients and carers. To facilitate these and the support of PNs and GPs, it would be advantageous to involve this group and their HCPs in a co-design method. The design should consider the following patient-level factors:

- Health literacy
- Level of understanding
- Knowledge of Insulin type
- Health status
- Format
- Accessibility to the tool

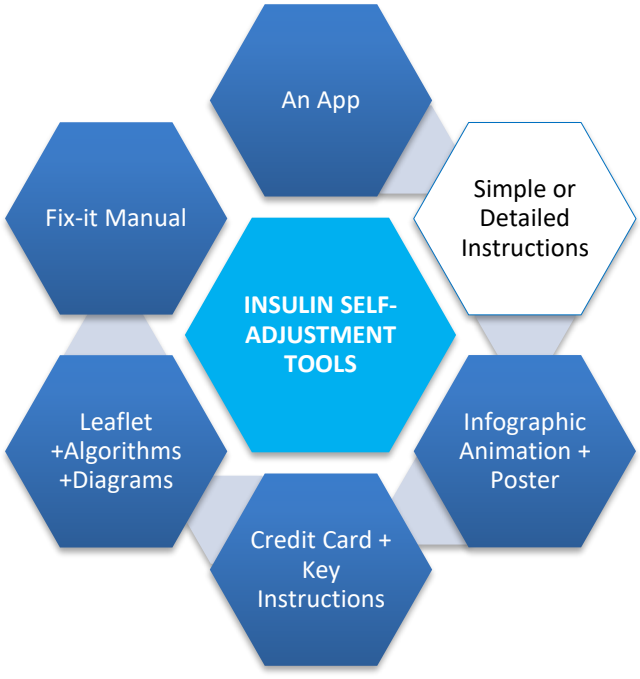


Figure 24 Tools to Facilitate Insulin Adjustment

7.3.3 Model 3. Group Education

This model was informed by the identified need for more patient information on insulin use and suggested ideas for this. It involves the development of group education specific to insulin-treated T2DM which could also facilitate peer support. This could be based in general practice led by PNs and GPs or positioned externally in a multidisciplinary format. Accessing the support of HCPs already involved in group education would facilitate the development of the format, and training of PNs and GPs to deliver group education. An important consideration are the resources available to support such a programme. Table 53 provides a sketch of the potential content and delivery processes for a group education programme, although these would need to be refined and developed further with the input of patients and HCPs.

Table 53 Group Education: Examples of Topics

Examples of Topics	Healthcare Professionals
Diabetes Insulin types and actions Discussing patient thoughts/concerns Titration and glucose goals	Practice Nurses, General Practitioners Diabetes Specialists
Self-management	Invited Speakers
Action Plans Lifestyle Peer support	Patients Dietician Exercise referral assessors Peer supporters Local diabetes group Psychologist

7.3.4 Model 4. The Media

The final model relates to the role of the media in raising public awareness of insulin therapy and in providing education and support for patients receiving insulin. Diabetes is often reported in the media, particularly within the context of increasing numbers being diagnosed with T2DM and rising treatment costs to the NHS. In keeping with the study findings and interviewee preferences, the message should be a positive one with a focus on insulin-treated T2DM. It would also need to be easily accessible. Media formats could vary and include television documentaries, online news and newspapers, and social media. These are summarised with the proposed content and media platforms in Table 54. To achieve this, would require engaging with media providers and professional organisations.

Table 54 Role of The Media

Purpose	Format	Contacts and Resources
To raise public awareness	• Televised documentary • Newspaper	• Media providers • News agencies
To provide education related to insulin-treated type 2 diabetes	• Social media forum • An app • You Tube • Infographic poster • Infographic animations	• Professional organisations • NHS England
Role of public figures with insulin-treated type 2 diabetes	• Television • Newspapers • Diabetes organisations	Agencies Diabetes UK

7.4 Summary

The integrated findings of the study phases identified some important mediating factors in how insulin is used, and the support provided to patients. These factors provide some explanation as to why many people with T2DM have suboptimal glycaemic control. The participants generally agreed there were advantages to patients (timely and convenient support) and HCPs (work satisfaction with appropriate use of skills) in having insulin services led by PNs and GPs rather than in specialist services, although they also identified some important areas where this support could be improved. Communication and support between general practices, patients and diabetes specialists was valued, but was perceived to be less frequent and fragmented. Views on aspects of self-

management were more diverse. While HCPs aimed to consult in partnership with patients, some patients were unaware of the choice to self-manage or agree on their preferred glucose goals. The clinicians' view of patient-perceived barriers mostly aligned with those of patients. While the HCPs recognised that patients did not fully understand the actions of prandial-based insulin, they did not fully appreciate the extent or frequency of mistimed insulin injections.

The findings have generated four models for potential future interventions based on the patient and HCP accounts. The aim of these strategies, should be to support patients to optimise their insulin use in an individualised way in order to safely improve their glucose levels in a manner that improves both their QOL and health. The interventions would also increase the support provided by PNs and GPs. Consideration would need to be given in the way they are designed with a focus on an individualised approach. A co-design process, involving patients, their carers and HCPs, would support this within the context of general practice.

A detailed discussion of this study now follows in Chapter 8.

8. DISCUSSION

This chapter outlines how this study filled some gaps in current knowledge, identified in the research questions outlined in Chapters 1 and 2, developed new knowledge, made recommendations for clinical practice, and identified strategies for potential future research. This study set out to identify and explore factors associated with insulin use in people with type 2 diabetes (T2DM) and to consider how those factors may contribute to glycaemic control. In-so-doing the study has built a detailed picture of the factors that mediate the way insulin use is supported in primary care settings, incorporating the perspectives of both patients and healthcare professionals (HCPs). The study has provided new insights into the challenges of supporting people with T2DM to use insulin optimally and safely. These insights provide some explanation as to why insulin-treated patients with T2DM often continue to have suboptimal glycaemic control (Holman *et al.* 2008, Khunti *et al.* 2016, Lasserson *et al.* 2009).

The study focused on primary care as the setting where most people with T2DM receive their care, as specialist diabetes services have now become more centred on complex patients and those with type 1 diabetes (T1DM). Hence, Practice Nurses (PNs) and General Practitioners (GPs) are now increasingly providing insulin initiation and support as part of their diabetes care provision (Ellis *et al.* 2011, Sterzi *et al.* 2017). By incorporating the perspectives of both patients and HCPs from primary care this study has been able to elicit some potential novel approaches for enhancing insulin support in primary care. In this chapter the key findings that have emerged from the study are discussed with reference to previous studies and clinical practice. The chapter is organised as follows:

1. Interpreting the findings
2. Study limitations and strengths
3. Considerations for clinical practice
4. Considerations for future research
5. Conclusions

8.1 Interpreting the Findings

The study findings have identified that the factors that mediate insulin use and glycaemic control were multifactorial, and were observed at the patient, HCP and system levels. At the patient level, factors associated with physical and demographic characteristics were identified, together with psychological and behavioural factors. At the HCP level, there were factors related to the professional confidence of the practitioner and their perceptions of patients in respect of their capacity and performance in using insulin. At the system level, factors were related to structural issues such as accessibility to support in terms of clinic times and location of services. It was also evident that there were interactions between these levels such as the level of support provided to the patient and their ability to access it, seemed to mediate their ability and confidence in using insulin. The findings for each of these levels are discussed in the sections below, followed by a consideration of how these factors might interact in regulating insulin in this population in order to identify some potential strategies for enhancing insulin support in primary care settings.

8.1.1 Patient-Level Factors

Key findings associated with patient-level factors included characteristics, psychological factors, and self-management.

8.1.1.1 Characteristics

The patient-level characteristics associated with glycaemic control were age and duration of diabetes, both of which exhibited a negative correlation with glycated haemoglobin (HbA1c). This suggests that older patients with longer duration of diabetes were more likely to have lower glucose levels. The reasons for older patients having lower blood glucose levels are multifactorial. It has been observed in previous studies that older people, particularly those who develop diabetes in old age, tend to have better glycaemic control compared to those who develop diabetes in middle age (Benoit *et al.* 2005, Huang 2016). Previous studies have suggested some explanations for this difference. In part it may be related to some evidence that older people are more adherent in using their insulin therapy compared to younger people (Peyrot *et al.* 2012a); and that their routines may be more structured with fairly fixed mealtimes, compared to the younger patients who may still be working. While this latter explanation was not evident in the

patient interviews it was offered as an explanation by the HCPs. However, the fact that the older participants had lower glycaemia is not necessarily related to insulin use nor is it necessarily a good thing. The lower glycaemic level might be associated with an increased risk of hypoglycaemia. In older age particularly in patients with frailty, there is a consensus that glucose targets should be relaxed to reduce risk of hypoglycaemia (Sinclair *et al.* 2015). The findings of this study identified a proportion of participants with tight glycaemic control (HbA1c <48 mmol/mol), who were older and therefore could be at increased risk of hypoglycaemia. Furthermore, it also raises the question as to whether these patients did in fact need to be on insulin with the benefits being outweighed by the risks (falls, hospital admissions, increased cardiovascular hazard and impaired mental function) (Gadsby *et al.* 2017, Huang *et al.* 2014, Sinclair *et al.* 2018, Strain *et al.* 2018, Tseng *et al.* 2014). It has also been observed in studies that HCPs might not consider tight glycaemic control in older and frail people as a cause for concern, requiring an ameliorating intervention either by reducing, simplifying or stopping insulin therapy (Caverly *et al.* 2015; McAlister *et al.* 2017).

Hence, more consideration needs to be given in relation to insulin management in respect of both those with evidently high glucose levels and those who may be at greater hazard of hypoglycaemia such as the older frail person. Therefore, a more proactive approach is required by HCPs and PNs for the early identification of HbA1c levels which are not consistent with age, frailty and multimorbidity, such as the use of electronically triggered alerts and regular audit. Patient preference should also be considered alongside a clear explanation by HCPs of the risks and benefits of optimising insulin use and glycaemic control.

8.1.1.2 Psychological Factors

The data suggests that psychological factors such as depression, wellbeing, beliefs, fear of hypoglycaemia, and personal attitudes to insulin use may be influential in determining how effectively insulin is used to regulate glucose levels. The regression model showed that depression (as indicated by the PHQ-9 score) to be the strongest predictor of suboptimal glycaemic control in the study participants. The higher the PHQ-9 score of a patient, the more likely they were to have suboptimal control. The contribution of depression was also evident in the qualitative data, with some participants identifying how their mood influenced

their interest in managing their diabetes and their use of insulin. The survey data also suggested that low mood was associated with a negative perception of how well they thought their diabetes was controlled and how well they understood or engaged in their insulin self-management. Again this was consistent with the qualitative data with some patients' accounts relating to how their mood influenced their use of insulin, and how their sense of frustration in trying to regulate their glucose levels affected their mood. This observation concurs with previous qualitative studies which have suggested that mood can moderate self-management behaviours and that glycaemic control can affect mood. In a study of insulin-treated patients with T2DM (*n* = 17), Tong *et al.* (2015) found that participants believed their poor control was attributable to personal problems which caused them to feel anxious, stressed, and sad, with a loss of motivation.

The findings of this study, however, also suggested that depression does not necessarily impede diabetes management behaviours associated with insulin use. The qualitative data revealed how some patients did not let their depressive feelings impact on their insulin use and blood glucose levels:

> *"But you do get it [feeling down], it's depressing, I think to meself, 'Come on, you got to do something'…"* (Hilda, aged 88)

The HCP data suggested that while some appreciated how psychological issues could negate insulin use, citing denial and a lack of motivation or engagement; most did not appear to consider the potential role of depression or other psychological factors as contributing to the patient's self-management performance or glycaemic control.

Many previous studies have reported on the association between depression and diabetes. In a meta-analysis of studies to determine the relationship of depression with glycaemic control, Lustman *et al.* (2000) found that depression was associated with significantly worse blood glucose levels, though the affect was modest. In another review Snoek *et al.* (2015) observed that there could be a bidirectional association with depression and T2DM over time. They also suggest that depression and diabetes distress, a psychological concept related to depression, might adversely affect glycaemic control via dysregulation of stress

hormones or via impaired self-care behaviours. Hence it is difficult to consider whether the association between depression and glycaemic control was independent of insulin use, or whether the depression was either related to the introduction of insulin, or whether it impacted on insulin use. In the absence of studies exclusive to people with T2DM using insulin (with and without depression) this relationship is unexplained, although the qualitative data does indicate that mood may regulate a person's self-management performance in using their insulin effectively in some patients but not others.

Other psychological factors observed in the data potentially leading to higher blood glucose levels included fear of hypoglycaemia or pain, cognitive function, and the perceived benefits of insulin. The qualitative interviews identified how a fear of hypoglycaemia influenced the use of insulin. This fear led patients to administer suboptimal doses of insulin to keep their blood glucose levels elevated. Some became so accustomed to higher levels that they felt *"hypo"* even though their blood glucose was elevated. Despite this fear, less than 40% (*n* = 73) of patients completing the ITAS tool *agreed* or *strongly agreed* that taking insulin increases the risk of hypoglycaemia. Research has shown that fear of hypoglycaemia can have negative effects on quality of life (QOL) and insulin management (Grammes *et al.* 2017). Such fear is usually triggered by past experiences of hypoglycaemia and the memory of that sensation especially in insulin-receiving patients (Fisher *et al.* 2018, Frier *et al.* 2016, Wild *et al.* 2007). In their review, Wild *et al.* (2007) found this to be particularly prevalent in patients who have had severe hypoglycaemic episodes, noting that the more unpleasant or traumatic the event, the more likely someone is to develop anxiety and fear of a repeat episode. This can lead to over-compensatory behaviours such as injecting less insulin or eating more (Barendse *et al.* 2011, Wild *et al.* 2007), as with the patients in this study who accepted persistently elevated glucose levels with an understanding of the risk to their health. There was recognition of this fear by HCPs in this study who strove to help patients overcome this but perceived this to be a challenge. This suggests the need for continued support and for PNs and GPs to intervene early following a hypoglycaemic episode to establish the cause and help prevent a recurrence in a considered way. It also suggests that more thought needs to be given in how hypoglycaemia is addressed with patients at insulin initiation and in diabetes education, as a failure to attend to patients

concerns or leaving patients unprepared for such occurrences, may have a negative impact on future insulin use.

Another source of fear was identified in the face-to-face and telephone interviews; this was associated with injection pain as a contributor to injecting suboptimal insulin doses. As with fear of hypoglycaemia, the findings suggested that fear of injection pain was a real concern for some participants. Evidence suggests that insulin injection pain with fear and anxiety, can be triggered by several factors including needle device, the insulin itself (or excipient) triggering a sensitivity reaction, or injection technique leading to lipohypertrophy (Grassi *et al.* 2014, Haastrup *et al.* 2018, Zambanini et al. 1999). This can often be resolved by eliciting such fears from a patent, identifying the cause of the pain, and finding a solution. Grassi et al. (2014) identified how smaller needle size, changing the needle for each injection and rotating sites helped support comfort and glucose control. Similarly individuals in this study also reported how this helped to relieve their pain and improve control, with support from their HCP. Other solutions include reducing the volume of insulin injected by splitting the dose (as one interviewee reported) or using a concentrated insulin type (Herring & Russell-Jones 2018). In addition, when initiating insulin, fear of pain could be discussed with strategies to ameliorate the problem.

Reduced cognitive function with memory loss adversely impacted on glycaemic control in some patients leading them to forget to inject their insulin and, of concern, with the potential to inadvertently inject twice. The cause included comorbidity such as stroke, but forgetfulness also related to feeling well without a perceived need for insulin or being distracted by everyday activities. Unintentional non-adherence because of forgetfulness is considered to be more prevalent than previously thought. A survey by Aikens *et al.* (2013) revealed that forgetfulness was one of the most frequent reasons for non-adherence in both insulin-receiving and non-insulin receiving individuals and impacted adversely on control. Brod *et al.* (2014) described some of the corrective actions used by patients after forgetting their insulin; these included: doing nothing; testing blood glucose and not injecting; and testing blood glucose then injecting a dose-adjusted to the result, as with the patients in this study. However, corrective actions reported by this study's participants also included injecting their prandial-

based insulin as soon as they realised they had forgotten, regardless of the time lapse since eating, and with the potential for hypoglycaemia. It is therefore important for HCPs to regularly support patients to understand: the action of their prandial-based insulin; the importance of correct injection-timing in relation to a meal; and the appropriate corrective action to take when forgetting to inject.

Adherence to insulin is important in optimising control and preventing both high and low fluctuations in glucose levels. It was evident in this study that forgetting to inject was not only associated with loss of cognitive function but also because of everyday activity. Therefore it is crucial for HCPs to elicit occurrences from patients of forgetfulness and offer solutions such as indicating injecting in their monitoring diary (as in this study) and using mobile phone alerts. In addition, assessing cognitive function should be mandated in older frailer patients and considered for others as there is a known association between both cognitive impairment and dementia in diabetes, and these may be undiagnosed (Borson *et al.* 2005, Sinclair *et al.* 2013). Sinclair *et al.* (2013) suggested how the use of the Mini-Cog screen for this purpose could easily be integrated into a diabetes review by a PN. In the consideration of any cognitive deficits, safety of insulin use must become a high priority. If insulin is clinically mandated in such patients then third-party administration should be considered, with less stringent glucose targets.

The data also suggest that the patients' orientation and attitudes toward having to use insulin may also mediate insulin use. The ITAS scores showed that high negative self-appraisal of insulin was associated with poorer glycaemic control. This was reflected in the qualitative data where individuals reported feeling *fed up* or *bored* with administering insulin. Conversely, some patients reported a sense of wellbeing induced by the normalisation of blood glucose with insulin led to feeling *"absolutely fantastic"*, and to a sense of control described as *"empowering"* in others, thus enhancing insulin use and glycaemic control. Such data may indicate that underlying personal traits play a role in the way that patients use insulin and their acceptance of it. Further, the participant scores for emotional wellbeing (WHO-5) demonstrated a small negative correlation with HbA1c. Some of the respondents indicated a stronger sense of determination and pragmatism toward using insulin, beliefs that were associated with their motivation to inject and manage their insulin *"You just have to get used to it"* and

"I don't like doing it [injecting] but I know I have to". However, the data also included examples of patients who used their insulin despite the distress it caused them, suggesting unresolved negative emotions in respect of insulin:

> *"As soon as I take it I gotta lie down and have a cry".* (Ian, aged 54)

Previous studies have revealed how a patient's orientation toward having insulin can impede insulin use. Further, Snoek (2002) reported, 'good behaviour' such as adhering to insulin treatment, does not always pay off and can potentially lead to frustration and diabetes burnout which could account for some interviewees in this study feeling fed up or bored. Browne *et al.* (2013) described how patients felt shame and blame for having T2DM and injecting insulin. Similar emotions were reported by patients in this research, triggered by a perception of having to start insulin but also persisting long after. Further, Holmes-Truscott *et al.* (2018) found an association of such stigma with a high negative appraisal of insulin treatment identifying the need to minimise this. The findings in this study suggest a need to acknowledge and build on the benefits of having a positive orientation towards insulin use with improved QOL, and to support patients to overcome negative feelings. This should include psychological assessment with access to interventions to help reduce the emotional burden associated with insulin treatment.

In summary, psychological factors such as depression, fear, forgetfulness, and personal attitudes were found to influence insulin use and subsequent control. These factors should be considered, identified and acknowledged by HCPs when supporting patients to manage their therapy. Moreover, positive psychological traits are as important to recognise and acknowledge when consulting with such patients.

8.1.1.3 Self-Management

This study has identified that perhaps the most important mediating factor in insulin use, is the patient's understanding, capacity, ability and motivation (including self-efficacy and confidence) to attend to the self-management behaviours in insulin use. An important distinction was observed between patients who were more autonomous in self-managing their insulin and those who

deferred more to the advice of an HCP to direct them. In the survey data this was seen in respect of those who relied less on their HCP for advice in respect of insulin doses, who trended toward better glycaemic control. While this was not a significant finding in the survey, the qualitative data did indicate that this may be an important phenomenon, expressed as the expectation of HCPs for patients to self-manage, how patients self-adjusted their insulin, and their knowledge of insulin.

In terms of the patient's expectations of their role and the role of their HCP, the accounts suggest that there may be some divergence in the perspectives of the patients and HCPs. PNs and GPs taught patients how to self-manage when they initiated insulin therapy. They continued to encourage and expected most patients who were already established on insulin, to self-manage while recognising that some individuals may not wish to, or be capable of, self-management. There was, however, a disconnect between the HCP accounts and those of patients. While many individuals did self-manage, there were some who said they did not realise this was an option or preferred not to, even though their high or low blood glucose levels indicated a need to adjust. They chose instead to wait for their HCP to advise when they next attended, with the subsequent potential to adversely impact on their glycaemic control.

Disparity of accounts between patients and HCPs in relation to insulin management have been reported in previous studies (Munro *et al.* 2013, Rubin *et al.* 2009). A UK survey conducted by Munro *et al.* (2013) of HCPs and people with diabetes regarding the interaction or involvement, and support received, revealed that people with diabetes reported less enquiry by HCPs, including that related to individualised management plans, than HCP themselves. This supports the findings of this study, and while patients may have been taught self-management at insulin initiation, they may have forgotten this, especially if they had started insulin several years before. Attitudes of individuals who did self-manage were strongly held by some and aligned with those of their HCPs in believing it was their responsibility to take charge of their treatment rather than leaving this to their HCP. The GPs and PNs similarly expressed how it was important to empower and educate patients to make their own decisions about insulin treatment and to discuss this in partnership with patients using joint

decision-making. Patient decision-aids can help patients to make informed decisions, for example to intensify insulin therapy. Mathers *et al.* (2012) demonstrated in an RCT how patients using an infogram decision-aid became more autonomous in making decisions about whether to start insulin. Similar aids could be used to facilitate decision-making about a change of insulin dose or regimen.

Research has demonstrated the value of self-management education in insulin therapy in improving glucose control and QOL (Hermanns *et al.* 2012, Hermanns *et al.* 2017, Khunti *et al*. 2013b). This study's findings suggest that patient preference and choice are important, indicating a more patient-centred model of care and the educational support that is provided. A study by Jane et al. (2013) has demonstrated how a patient-centred approach by HCPs to consultations can support insulin management by facilitating shared decision-making. This study's findings also indicate that HCPs should regularly ask patients whether they are happy to self-manage their insulin rather than assume this. Individuals who feel unable or unwilling to self-manage could then be offered an alternative approach with a greater level of input from HCPs.

Self-adjustment of insulin doses to target glucose levels were taught by HCPs, as part of self-management. The process was regularly reinforced by PNs and GPs with the related expertise, proactively and opportunistically as the need arose. Regardless, the patients used a range of methods with some diverging from those taught by HCPs. Many individuals self-adjusted methodically and consistently, but others seemingly developed their own modes of titration which included haphazard approaches with the potential for harm. This involved:

- Erratic dose titration (varying daily and based intuitively on the blood glucose levels at the time of testing).
- Correction doses (high doses of prandial insulin administered before bed or between meals, in order to rapidly reduce unexpectedly high blood glucose levels).
- Mistiming of prandial-based insulin types (injecting rapid-acting or premix insulin 30 minutes or longer after or between meals in a planned way to avoid injecting in public, as a corrective action following a forgotten dose, or routinely because this was thought to be correct).

The evidence for self-adjustment for improving glycaemic control in study conditions is strong (Khunti *et al.* 2013b) and many of the algorithms developed were adapted for patient use (Davies *et al.* 2005, Floyd *et al.* 1990, Kennedy *et al.* 2006, Ligthelm *et al.* 2009, Meneghini *et al.* 2007, Oyer *et al.* 2009). An early study by Floyd *et al.* (1990) using an algorithm based on adjustments of basal insulin indicated significant improvements in HbA1c levels. Later research for self-adjustment of prandial-based (mealtime) insulin types was also successful in improving glycaemic control including premix (Ligthelm *et al.* 2009) and basal-bolus (Meneghini *et al.* 2011) regimens. Adequate numeracy skills are important in glucose management and can support self-adjustment (Huizinga *et al.* 2008, Osborn *et al.* 2010). In this study, scores for perceived numeracy ability (SNS-3) exhibited a small negative correlation with HbA1c. This research supports the evidence for systematic self-adjustment, indicated by the lower HbA1c level of patients who systematically self-titrated when compared with those who used a more haphazard approach. The qualitative interviews suggested some of the erratic methods used by patients evolved gradually, unintentionally and intuitively, such as injecting doses of basal or prandial insulin-based on the glucose level at the time of injecting or administering large doses of prandial insulin outside of meals to immediately reduce a high blood glucose level. While there was a degree of insight, however, there seemed to be a lack of awareness of the potential for hypoglycaemia.

Self-titration outside of study conditions have been reported previously. McBain *et al.* (2016) interviewed T2DM patients who attended a Diabetes Specialist Nurse (DSN) service for support. These included individuals who also self-titrated but did not always do so in the desired direction, and the nature of those intentions did not always correspond with recommendations, as in this study. Chadder (2013) emphasises the important role GPs and PNs have in supporting the ongoing process of insulin adjustment to target. The PNs and GPs in this research were clearly committed to methodically explaining and reinforcing the titration process to patients and were often perplexed as to why, when there was a clear indication to increase or decrease the dose, an individual instead chose: not to adjust, used a haphazard approach, increased the wrong insulin type, or increased their insulin when their persistently low blood glucose levels required a reduced dose. The findings indicate that while HCPs should continue to support

patients with insulin adjustment, if the patients are going to titrate their own insulin, their preference, confidence and competence to do so should be regularly reviewed.

The level of patient understanding of a prandial-based compared with basal insulin type, could further impede the way they self-managed their insulin, with subsequent impact on their control. This was revealed in the patient interviews. As most interviewees who used a haphazard approach for self-adjustment, received prandial-based regimens. It became apparent that this limited understanding led to mistiming of insulin without realising the potential for hypoglycaemia. To avoid injecting in a public place, or as a corrective action after a forgotten injection, injecting could be up to two hours before or after a meal. A change of basal insulin to a premix regimen during a hospital admission was another contributor to mistimed injections but there were other individuals who routinely mistimed their insulin in the mistaken belief that they should administer it this way. Although some HCPs recognised this practice was used, their accounts suggest they did not fully appreciate the extent and regularity of the occurrence.

The consequences of not fully understanding prandial-based insulin types have been documented previously with the use of corrective actions employed by patients (Brod *et al.* 2014, Mehmet *et al.* 2015), discussed earlier (see Psychological Factors). A survey of patients by Mehmet *et al.* (2015) identified the extent to which patients did not feel comfortable about injecting in front of others, and Jenkins *et al.* (2010) described how this was a consistent source of anxiety for patients following intensification with prandial insulin. The strategies they used included injecting in toilets, and advancing or delaying mealtime insulin, as with patients in this study. These findings again highlight the need for patients using prandial-based regimens, to be asked more frequently by HCPs about timing of their injections and to be reminded of the actions of their treatment. PNs and GPs could also advise individuals of possible strategies to help overcome social barriers when introducing a prandial insulin type. The findings also reveal how patients' control can be negated because they struggle to use, or use inappropriately, a prandial-based regimen and could benefit from more support

and education. Alternatively, their control and QOL might be improved if their regimen was changed to a basal-only insulin type.

In summary, most patients felt well supported by their PNs and GPs in managing their insulin therapy and helping to optimise their glycaemic control, particularly if their clinician had additional insulin-related skills. Patient-level factors contributing to suboptimal control and insulin use include shorter diabetes duration, younger age, psychological influences, while having a positive attitude supported insulin management and glycaemic control. The key findings relate to the impact of patient preference, ability and expectation of their HCP to self-manage, their method of self-adjustment and level of understanding of insulin, and the value they placed on the support of their HCP.

8.1.2 Healthcare Professional-Level Factors

Three main areas were identified from the findings involving HCP-level factors: insulin-related expertise, consultation style, and blood glucose targets.

8.1.2.1 Insulin-Related Expertise

It was evident that there were different levels of insulin-related expertise and experience among the HCPs. The PNs and GPs who were trained in managing insulin had less need to refer to diabetes specialists and these PNs were more autonomous in their clinical decision-making than others. While other PNs and GPs could support patients to titrate their basal insulin, if further intensification was required then they would refer to the DSN who would then refer back, following a period of support. Nevertheless, there was a clear level of commitment and enthusiasm among all the HCP participants in supporting insulin-treated patients.

Research shows how PNs and GPs are increasing their skills to better support insulin-receiving patients within and outside of the UK (Burden & Burden 2007, Dale *et al.* 2010, Furler *et al.* 2017, Goderis *et al.* 2009, Van Avendonk *et al.* 2009). There is, however, a wide variation in the knowledge and skills of those delivering that care (Diggle 2012) as was evident in this study. The qualitative findings revealed several drivers for HCPs to develop insulin-related expertise. In addition to providing a more holistic and convenient service for patients, this

included the job satisfaction revealed in their enthusiasm for the role. Not developing expertise was mainly because the practice population was of an insufficient size to gain experience and maintain skills. There was also a perception of there not being a need, while a community diabetes specialist team was in place to take on the management of insulin.

Research into how PNs and GPs who manage insulin perceive their related role also reveals positive experiences (Burden & Burden 2007, Chadder 2013, Goderis *et al.* 2009). Chadder (2013) described the high confidence scores, including all aspects of insulin management, reported by PNs and GPs in supporting insulin use following training and experience. The GPs in the study by Goderis *et al.* (2009) also felt more confident and positive about insulin management after receiving insulin-related education. As with the HCPs in this study, they recognised the limit of their competence, referring to specialists when indicated. Another factor that relates to confidence in insulin management among primary care HCPs was identified by Diggle (2012), which is that proficiency in insulin management requires dealing regularly with sufficient numbers of patients to gain adequate competence and confidence in-so-doing. Some of the HCP participants in the study cited this reason as an obstacle in taking on a role in insulin support. In such circumstances, it may be a way forward for smaller practices to collaborate and provide across-practice insulin support, thereby providing the clinical scale needed for the HCP to consolidate their skills.

In summary, developing expertise in managing insulin is important as more individuals receiving insulin are being supported in general practice. These findings reveal the disparity of skills among the HCPs, the drivers to develop expertise and the benefits to patients in terms of optimising insulin use and glycaemic control. This supports the need to encourage more PNs and GPs to extend their role with support from the more experienced HCPs.

8.1.2.2 Consultation Style

The study has highlighted that the approach to consultation may have an important impact on insulin use. Most of the HCPs in this study reported using a patient-centred style of consultation which was generally well received by patients, although some individuals preferred a more directive approach led by

the professional. This observation is reflective of the wider literature on consultation models which indicate the trend away from a paternalistic approach to a shared, co-productive one, with studies suggesting that the co-productive model may be optimal when introducing insulin, and in agreeing blood glucose targets and self-management goals (Hsu *et al.* 2016, Janes *et al.* 2013, Mathers *et al.* 2012). However, such an approach may not be universally suitable. To address this, Serrano *et al.* (2016) proposed three approaches for diabetes-related consultations: the first focuses on the provision of information to progress treatment; the second, is centred on providing patient choice; and the third involves patients and clinicians discussing together how to address problems. Hence, it may be that some blend of all three of these methods is needed for patients on an individual basis, and in some cases, this may indicate a more directive HCP model.

In summary, while it is reassuring that HCP communication was generally well received, there were suggestions that this was not always perceived (see also Self-Management and Blood Glucose Targets). It is important for HCPs to reflect on how they communicate with patients to enable the conversations to influence patients' use of insulin in a positive way which accords with the preferences of that individual.

8.1.2.3 Blood Glucose Targets

The final HCP-level contributor relates to the blood glucose targets given to patients expressed as an HbA1c level and/or day-to-day readings. There were two notable findings which were the basis on which the targets were set or agreed, and how targets of individual patients could be readily identified from the clinical record by other clinicians who consulted with them.

It was evident from the HCP accounts that in setting HbA1c targets, the national targets indicated in the Quality Outcome Framework for general practice (QOF) were a consideration, although HCPs also reported that they individualised targets; with more stringent targets for younger individuals with shorter T2DM duration and less stringent targets for the older frail patients. This observation, is in keeping with the increasing evidence for the need to individualise targets to enable younger patients with shorter duration of T2DM to benefit from tighter

blood glucose targets and reducing excess hazards from over-intensification of glucose levels in; the older frail; those with multimorbidity; the end-of-life care; those with a high risk of adverse events; and in others where over-intensification may create QOL deficits (Gadsby *et al.* 2017, IDF 2013, Sinclair *et al.* 2018). Based on the evidence, the IDF (2013) identified specific HbA1c targets for older people with T2DM based on their functional category to ensure benefit and help reduce risk of hypoglycaemia. Although, as previously outlined, the study data did reveal a high proportion of older people with a low HbA1c.

The study also revealed some divergence between what patients and HCPs identified as an appropriate glucose target. Previous studies have also identified mismatches between patients and HCPs in respect of glucose levels (Hortensias *et al.* 2012, Janes *et al.* 2013, Ong *et al.* 2014, Tong *et al.* 2015). Hortensius *et al.* (2012) reported how patients experienced a tension between achieving good glycaemic control and QOL, and deliberately made their own choices as to what glucose levels they were satisfied with. Similarly, Leiter *et al.* (2005) reported that patients experiencing a hypoglycaemic episode reported greater fear of recurrence and kept their subsequent levels higher than recommended. This reflects accounts of interviewees in this study. There is, therefore, a need for HCPs and patients to have clear discussions in agreeing their blood glucose targets which, may involve a degree of compromise on the part of the HCP. The study data also suggest that many patients may not understand what the HbA1c means or why they have a target. This also needs to be considered in conversations and explanations about glucose targets and the associated hazards for the individual patient. An online survey by Cefalu *et al.* (2008), revealed that 63% (n = 294) of participants using insulin (n = 469) were not able to report their most recent HbA1c, a finding similar to the 71% of patients who could not recall their HbA1c in this study.

In summary, the PNs and GPs were committed and enthusiastic in supporting patients. To further support and optimise insulin use in a way conducive to QOL and benefits to health, there is a need for HCPs to agree and review together with patients their glucose targets on a regular basis as preferences and health needs change. To ensure an individualised target can be easily identified from a patient

record, the target should be recorded in the computer record as a code. This would help ensure consistent practice and support safety.

8.1.3 System-Level Factors

The discussion in this third section centres on how factors connected to healthcare systems impacted on optimising insulin use and subsequent glucose levels. There are three sections: insulin-support services, care integration and how practices, in turn, were supported.

8.1.3.1 Insulin-Support Services

The study identified two types of service provision for insulin support: firstly, a dedicated service; and secondly, reactive provision. The former type was concentrated in larger practices with the capacity to provide such a service and the latter in the smaller practices. Although the reactive provision was evident in all practices, a more formal provision was bound to specific clinics, as such patients often required additional support outside of this provision. Reactive was also driven by events such as a recent high HbA1c level. Hence, patients may experience variations in care with potentially different approaches that may not always be harmonised. This could lead to patients becoming confused about their insulin use.

It was also evident that insulin support was often delivered virtually through different media most commonly the telephone. Telephone consultations were used to support patients who were unable to attend clinic appointments and as a means to manage the increasing demands of care. This trend towards virtual care delivery using e-health (electronic or digital health) and m-health (mobile health technology) approaches in diabetes is growing (Baron *et al.* 2017, Hanley *et al.* 2015, Hanley *et al.* 2018, Turner *et al.* 2009, Wild *et al.* 2016). The use of telehealth in a study by Hanley *et al.* (2015) which included patients using insulin therapy, concluded that while patients generally responded favourably to this way of delivering care, HCPs raised concerns about: the increased workload and cost involved; and the loss of the value of a face-to-face consultation. Hence, consideration needs to be given to both the potential benefit of such approaches in terms of meeting increased demand and the potential impact on care quality and patient safety.

In summary, the participants received most of their insulin support in general practice by the PN and GP. Though there was general accessibility, some individuals could have benefitted by a more flexible appointment system, and with innovative technology systems such as the use of telehealth and web-based support.

8.1.3.2 Care Integration

Integrated care featured in the findings in relation to communication between PNs and GPs with diabetes specialists in secondary care, Community DSNs and Nurses, and inter-practice communication. This influenced how seamlessly patients were transferred from one area of care to another with sufficient support for their insulin. Integration was variable and at times inconsistent.

There was a perceived change in the timeliness and completeness of communication following hospital discharge. Previously this was viewed as being efficiently and fully transmitted. This change could impact adversely on glucose levels as it led to patients not being able to be fully advised by their PN or GP about a change in their insulin during admission. This could be particularly difficult for HCPs with less insulin-related expertise if they were unable to contact the hospital diabetes specialists. A contributor was thought to be changes in staffing levels with people retiring, which could have explained the inconsistency of accounts by other PNs and GPs who reported being easily able to communicate with specialists. The Community DSNs were perceived to be more accessible though the duration of their support for patients was time-limited.

Diabetes care integration can reduce referrals to specialists and improve diabetes care overall (Kar, 2012, Walsh *et al.* 2015). The requirement for easy access to advice from diabetes specialists to help support decisions and optimise management was described by Walsh *et al.* (2015) in their evaluation of a community initiative involving integrated diabetes care. Each consultant was linked with several general practices, which facilitated support and advice by email and twice-yearly visits. This ease of access was reflected more in the communication with the Community DSNs in this study. In an integrated model of care described by Kar (2012) a dedicated phone line was in place each weekday evening for PNs and GPs to use to further support integrated care

outside of hours. This would have been particularly helpful for the HCPs in this study with less expertise. However, more resources would be required to fund the additional specialist time to answer calls and provide support. This type of support might be able to be given across practices by those PNs and GPs experienced in insulin management, especially if more HCPs developed expertise. Information flow with the Community Nurses by email, was generally more consistent in relation to the insulin they administered to the housebound when they required an updated prescription from a PN prescriber or the GP to increase an insulin dose. In one practice, a GP participant was responsible for insulin management for all the housebound insulin-receiving patients. This seemed an effective and consistent approach for this group.

Equally important was the inter-practice communication between the GPs and PNs. Findings from the HCP interviews revealed how communication was undertaken systematically each week between GPs and PNs at two of the sites to discuss cases. When possible a DSN and Community Nurse would also attend. This worked well and provided standardised care. In their description of role extension in general practice, Manski-Nankervis *et al.* (2014) describe the challenges in acceptance of new roles. They explain the strongest relationships and communication occur with levels (systems) of care with regard to physicians and nurses because of good working relationships and shared knowledge. This was reflected in this study in the way GPs and PNs supported one another, sharing knowledge and ideas around insulin therapy to the benefit of the patient. This was further seen in the relationship PNs had with DSNs who were accepting of the insulin-related role of the PN.

In summary, insulin management provided by some PNs and GPs was well established and though they had less need of specialist support than those with less expertise, interprofessional communication was still a necessary part of care integration such as when a patient was discharged home with a change of insulin regimen. Community Nurse and DSN communication with practices was felt to be good though duration of DSN support was limited which might have proven challenging for those HCPs with less expertise. Communication with hospital specialists was variable and at times inconsistent. It seems logical that those

practices with less expertise could benefit from advice of those more skilled, in the form of practice-to-practice support.

8.1.3.3 Practice Support

Practice support related to insulin-related training and funding to provide the support services for patients. The study found that there were positive incentives for PNs and GPs to both develop skills and provide insulin services both in terms of access to training and funding through general practice service specifications. There were locally funded accredited courses with mentoring available for those wishing to start their training which included updates for the more experienced.

A barrier often raised by general practice is the lack of resources and time for training and service provision of insulin (Cuddihy *et al.* 2011, Jeavons *et al.* 2006, Lee *et al.* 2013, Van Avendonk *et al.* 2009), and this was raised by a GP in this study. However, this view is changing (Dale *et al.* 2010, Chadder 2013, Furler *et al.* 2017), as the need increases for more patients to receiving insulin support in general practice. Peer-to-peer support in insulin-related training for HCPs was shown by Deed *et al.* (2016) to reduce barriers to practice in diabetes management and could be of benefit to the HCPs in this study who had not yet received training. Furler *et al.* (2014) described an Australian initiative to train up PNs and GPs to initiate and intensify insulin therapy which they reported as successful in improving glucose control while making better use of scarce healthcare resources, reflecting the healthcare systems in this study.

There is currently no standardised training in insulin management in T2DM in general practice, although it is reassuring to note that many of the locally developed courses are university accredited with a requirement to meet educational standards. The level of insulin training for GPs and PNs was reviewed by Chadder (2013), who felt this to be generally effective. Diggle (2012) highlights the importance of maintaining insulin skills with sufficient patient numbers to support this, which was identified as essential by participants in this study.

In summary, resources for PNs and GPs to extend their skills to provide insulin services were already in place at the time. Moreover, some of the PNs and GPs

had undertaken training several years before and were already experienced in providing insulin services for their local population. It would seem to be of benefit to patients, while resources were available, for more PNs and GPs to take up the opportunity to extend their skills with the support of PNs and GPs with existing expertise.

8.1.4 Summary of the Findings

In summary, this research built on the conceptual framework (Chapter 2) by addressing the research questions and adding new knowledge. It identified some important factors mediating insulin use and glycaemic control in the patient population which are presented in Figure 25. The main contributors suggest benefits of involving patients more in their preference to self-manage and elicit their understanding of insulin. Their personal traits and motivation could also have a role such as a determination to overcome obstacles. Age, duration of T2DM and psychological factors further impacted use and should be taken into consideration when deciding together with a patient their individualised blood glucose target. The indication to record and code a target in the medical record (in addition providing the patient with this) to enable it to be easily identifiable is important in terms of safety and health benefit. The enthusiasm and commitment of the PNs and GPs further influenced insulin use and subsequent control. Other key mediators related to their insulin-related expertise, consultation style and motivation to extend their role. Finally, health systems in place to fund training for HCPs to provide PN and GP-led services in their practices were still available at completion of the study suggesting the need for those PNs and GPs with insulin expertise to support and encourage those from other practices to take advantage of this education for patient benefit.

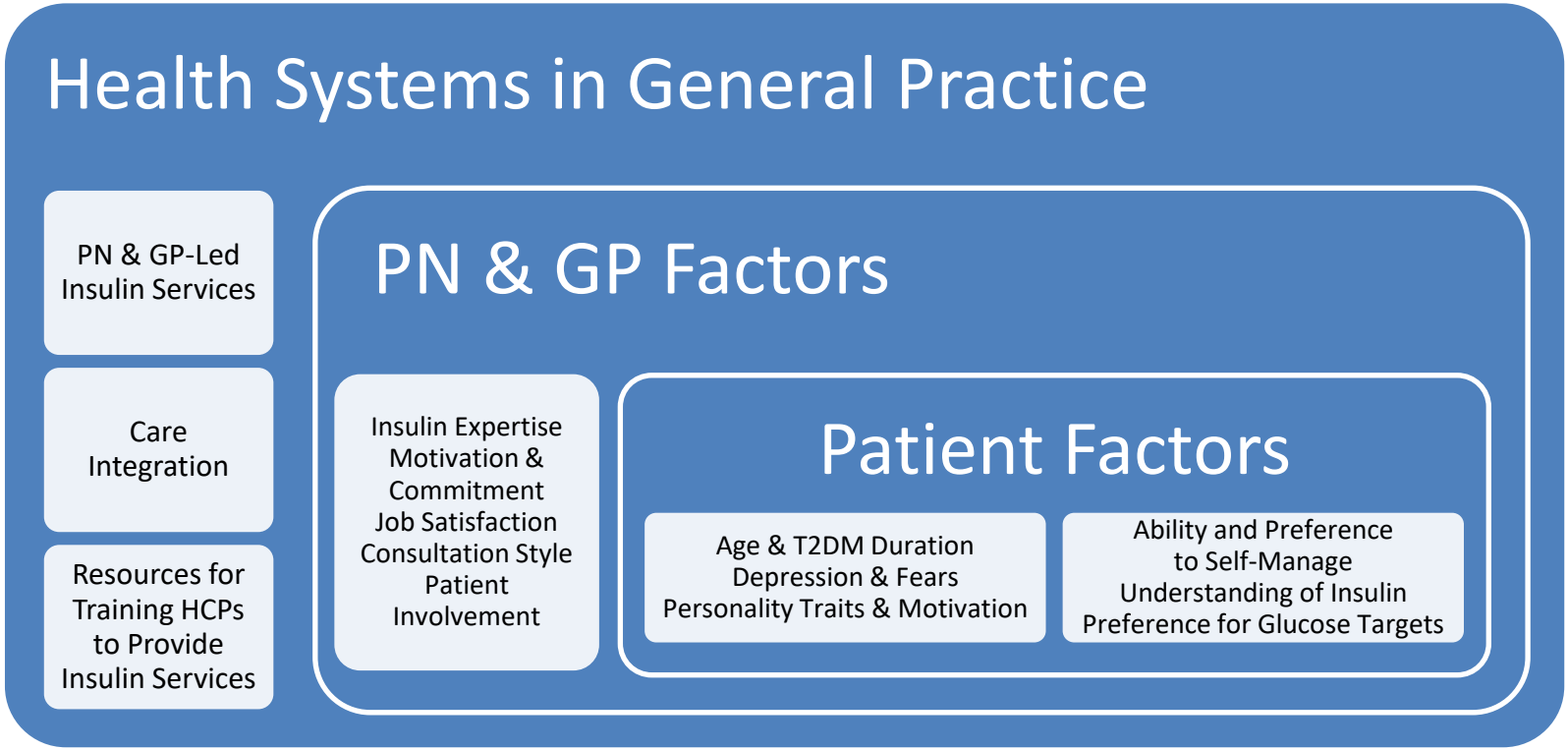


Figure 25 Factors Contributing to Insulin Use and Glycaemic Control
Key: GP = General Practitioner; PN = Practice Nurse; T2DM = type 2 diabetes.

8.2 Study Limitations and Strengths

8.2.1 Limitations

As with all research there are a number of limitations to consider in respect of how the findings of the study should be interpreted. The first limitation was the potential influence of the researcher who is a nurse in one of the research sites. It could be that the closeness of the researcher to the study context and participants could have influenced interpretations and potentially made participants to be less candid than they may have been with someone unfamiliar to them. To reduce the potential for this bias: the researcher used reflexivity to consider her own thoughts and actions during the research, and to avoid imposing her own assumptions by discussing these with her academic supervisors, the researcher did not interview patients who she had consulted with in the previous year, and GP and PN colleagues were excluded from the study.

The second limitation was the selection bias of the patient participants who were slightly older than the non-participants (mean age 70 vs 68 years), with a significantly lower mean HbA1c (63.9 mmol/mol vs 68.4 mmol/mol, p = .009). It was not possible to identify any other differences in characteristics as the researcher was not a member of the other healthcare teams. In mitigation, of those fulfilling the study criteria, there was a 50% response rate and though opinion is divided over what constitutes an adequate or acceptable survey response rate (Kelley *et al.* 2003, McColl *et al.* 2001), this would seem acceptable.

Thirdly, the study was limited to one geographical location in East Kent, UK with a predominantly white British population. However, participants were recruited from a range of practice sites in terms of population size and insulin-related expertise, providing a rich insight into the way insulin-receiving patients are supported in general practice. Therefore, the findings would be representative of similar areas in the UK, and as revealed in the discussion, the findings also fill a gap within the international context, relating to those from different settings and countries with different healthcare systems.

A further biasing affect could be that most of the patient participants were registered with practices who provided insulin services. Such services are not a

universal provision and hence the patient responses may have been atypical. However, the development of such services has increased since the completion of the study; smaller local practices have merged with larger ones and now provide such services. Hence, the findings are reflective of the national trend for the development of insulin provision in general practice making them perhaps more relevant.

Finally, the views of other HCPs were not included in the interviews. By omitting professionals such as DSNs and Community Nurses, a complete picture of the factors mediating insulin use in primary care and in the home, may not have been captured. The primary reason for this was time and cost. Nevertheless, it would be reasonable to assert that most of the key roles relevant to insulin support in primary care were included.

8.2.2 Strengths

A key strength of this research was the inclusion of only those patients with insulin-treated T2DM, and the PNs and GPs who supported them. Most previous studies have been conducted in specialist settings, and exclude PNs or GPs, with many focusing on insulin initiation. The increasing requirement to focus on managing patients already receiving insulin has been established in previous studies which have highlighted that it is following initiation that problems with insulin use can occur (Khunti *et al.* 2016). Therefore these findings contribute to the evidence by providing a unique insight into UK general practice in one single study. The second area is the mixed-methods approach used which facilitated the integration of quantitative findings with rich qualitative data which is increasingly used in healthcare research.

Thirdly, the number of survey participants agreeing to be interviewed enabled a range of characteristics and experiences of interviewees. This also supported a supplemental telephone interview study which provided enhanced depth to the survey findings. The fourth strength is the researcher being a nurse in general practice within the locality of the participating sites which facilitated access and trust from the HCP participants. Further, interviews with fellow HCPs can be broader in scope and generate richer and more personal accounts of attitudes and behaviour in clinical practice (Chew-Graham *et al.* 2002, Coar & Sim 2006),

which was evident in this study. Finally, the most important strength is the involvement of patients in the study design and in providing feedback during the research. This helped to facilitate a patient-centred approach and modification of the postal survey questionnaires and other study documentation which helped contribute to the response rate.

8.3 Considerations for Clinical Practice

Some key recommendations subsequent to the findings are next considered. These can help identify how patients can be further supported to optimise their insulin and glycaemic control. There are six areas: self-management preference, agreeing targets, review of self-adjustment, educational opportunities, proactive support, and role development.

8.3.1 Self-Management Preference

The first recommendation is for an HCP to establish with the patient, and code in the medical record, their preference and ability to self-manage their insulin. A review of this preference should be undertaken at least yearly.

This consideration is drawn from findings revealing the frustration of some PNs and GPs when a patient did not self-adjust their insulin in response to sustained very low or very high blood glucose levels. The HCP data suggests how patients, who they felt were competent to, were supported to self-manage soon after starting their insulin therapy but with the passing of time, many may have forgotten how, no longer had the confidence to, or felt they needed permission from their HCP. Their changing physical and mental health needs could also have been a contributing factor such as memory loss following stroke.

Sinclair *et al.* (2013) investigated the feasibility and diagnostic accuracy of the Mini-Cog test as a cognitive screen in people with diabetes (*n* = 201) aged 55 years or over. They found that one in six participants were screen positive indicating a need for further assessment and the likelihood of requiring extra help with their management. This test would therefore be appropriate for older patients as part of their assessment for ability to self-manage. During the conversation about self-management. A study by Hertroijs *et al.* (2019) of patients with T2DM (*n* = 288) from 30 Dutch practices, investigated their preferences for their

management. This revealed their preference for traditional care models with guidance from their healthcare provider and spending less time on self-management. The preference was stronger in insulin-receiving patients than non-insulin-treated individuals. The findings of this study suggest that preference for less self-management might have been strong.

In summary, the ability and preference to self-manage insulin should be established at least yearly and coded in the patient record. This would then enable patients who were unable to or chose not to self-manage, to receive increased proactive support.

8.3.2 Agreeing Targets

The next recommendation is for formal discussions to be undertaken to agree, code and record blood glucose targets individualised to the patient with respect to their overall health needs and preferences. These should also be regularly reviewed and audited. While the interviews indicate that the PNs and GPs were committed to individualising care, in partnership with patients, no HbA1c targets were identified from their records. While HCPs reported agreeing goals many patients preferred higher levels.

There is strong evidence for younger people with shorter duration of diabetes to benefit by having tighter control than older people with frailty. A cohort study of older people with T2DM by Hambling *et al.* (2017) revealed overtreatment with sulfonylurea and insulin treatment was common. This was evident in a small number of participants in this study. Previous studies identified different preferences between patients and HCPs in respect of glucose goals. Janes *et al.'s* (2013) study revealed patients who said that their clinicians had not negotiated mutually agreed goals, as in this study. A meta-analysis by Khunti *et al.* (2018) of 24 studies, determining achievement of guideline targets in T2DM individuals, found only one study (Issam Diab *et al.* 2013) which collected data on recorded individualised targets but of 305 patients, Issam Diab *et al.* (2013) found none with a recorded individualised HbA1c target. No identified HbA1c targets were recorded or coded in the records of this study's participants.

In summary, a formal discussion, negotiating preferred and appropriate individualised blood glucose targets is necessary. By coding and recording the target in the clinical record, it will be clearer to the patient and other HCPs. Reviewing the target at least yearly will tailor it more to the changing health needs of the patient and audit will identify patients needing review.

8.3.3 Review of Self-Adjustment

The third consideration for practice relates to self-adjustment of insulin. The patient's method of self-adjustment, their understanding of their insulin type, and frequency of mistiming should be reviewed at least yearly. This is drawn from the study findings revealing how many patients used a systematic method of dose-adjustment method. Other patients however used haphazard approaches, while some did not understand their prandial-based insulin therapy, indicated by the intentional mistiming in relation to meals with unawareness of the potential for hypoglycaemia.

A study by McBain *et al.* (2016), revealed that 14 of 18 interviewees expressed an intention to self-titrate, but did not always do so in the desired direction. Participants self-adjusted similarly in this study. In a study by Brod *et al.* (2014), discussed earlier, participants reported on corrective actions they took after realising they had forgotten their insulin dose which reflect some of the actions taken by this study's participants. In this study, however, in addition to sometimes forgetting a dose, patients intentionally mistimed their meal-time insulin for reasons of social embarrassment, injecting a long time ahead of, or delaying the injection until much later after a meal.

In summary, while acknowledging the systematic titration approaches used by some patients, it was important to address the haphazard and unsafe methods adopted by others. Reviewing the self-adjustment method at least yearly could support safe practice and optimise control. This might lead some patients to have their insulin type changed, in order to simplify self-adjustment, from prandial-based to basal-only, or to have HCP-led titration.

8.3.4 Educational Opportunities

The fourth consideration for care delivery is the recommendation for HCPs to use available opportunities to continue to provide insulin-related education for patients at a one-to-one level, referral to group education (if available) and by making use of other formats. The data revealed, while many patients optimised their use of insulin in a safe and effective manner, other patients needed more support to better understand their insulin treatment.

In the study by Hertroijs *et al.* (2019) T2DM patients preferred individual-based education provided by a healthcare provider over group-based education though this was not specific to insulin. Lawal & Lawal (2016) note traditionally health education is delivered on a one-to-one basis as with the patients in this study. The authors concluded they did not argue in favour of any method but either should be tailored to meet the learning needs of the individual. Having established there was no provision of structured education for people with T2DM on insulin in their area, DSNs Houghton & Kay (2016) developed a programme which was successful in reducing HbA1c in 27-35% of attendees. Patients in this study may therefore benefit by attending a similar programme. The 40% of people who did not attend the education suggested that group-based education was not suitable for everyone and the authors plan to develop a DVD which includes carbohydrate- counting for people using prandial-based regimens. Patients in this study expressed a desire for this. The authors highlighted the importance of assessing psychological needs prior to education to identify depression and refer for counselling if indicated. There was evidence from the survey, of undiagnosed depression in patients in this study.

In summary, one-to-one educational opportunities should be taken using the resources available to support insulin use. While education support is recommended for insulin initiation, it is also of value for people established on insulin. Where available, patients can be offered group education specific to insulin use. This would help in their day-to-day insulin use such as injecting in public. The requirement for psychological assessment and referral for psychological support should also be considered.

8.3.5 Proactive Support

Proactive support should be increased by PNs or GPs, if sufficiently resourced, for patients identified as requiring closer support. This recommendation builds on the support already given by PNs and GPs, particularly those with insulin-related expertise.

There is a nation-wide drive to increase the use of digital healthcare (Department of Health & Social Care (2018). This can support the increasing demands on primary care to support those with long-term conditions. Research has demonstrated its capacity for supporting insulin-receiving T2DM patients, using web-based and mobile technology. Wild *et al.* (2016) reported on the 'Telescot' study which resulted in improved glycaemic control, with patient satisfaction. Though HCPs had concerns about workload and the potential for error, this could be mitigated by system design facilitating integration with GP systems (Davidson *et al.* 2013). A recent pilot study by Davidson & Davidson (2019) of an intervention utilising computerised insulin adjustment algorithms found it saved time for providers and patients and improved glycaemia. Use of digital health technology could potentially support patients requiring extra help in this study if they were happy to engage with this.

In summary, the proactive support provided by PNs and GPs should be increased, focusing on those in more need of this with suboptimal control. While telephone consultations can facilitate this while the use of digital healthcare technology, if available, would provide help for others who were happy to engage with this.

8.3.6 Role Development

To support the continual shift of insulin services to general practice, consideration should be given for HCPs with insulin expertise to encourage other PNs and GPs to extend their role and supporting them during their training. This would enable more insulin-receiving patients to benefit from easily accessible support from their PN or GP. This consideration is drawn from findings which include the systems already in place to facilitate PN and GP-led insulin support with funding for training and enhanced services.

Drugs and monitoring devices used in diabetes at £1,000 million made up 11% of total prescribing costs in 2017/18, of which costs for insulins were over £350 million (NHS Digital 2018). For reasons of cost and health benefit, it is therefore important for patients to optimise their insulin use and glycaemic control appropriate to their individual needs and preferences. As many patients receive their diabetes care in general practice, they could be better supported if more PNs and GPs had additional insulin-related expertise. Since the start of this study, in addition to the UK, other countries have introduced insulin management into general practice. Furler *et al.* (2017) described an initiative in Australia involving an enhanced PN role in insulin initiation and initial intensification with mentoring. Their PNs did not prescribe insulin or manage insulin dosing without liaison with the GP. Some PNs in this study, however, had a prescribing qualification and were more autonomous in their insulin-related practice. This study focused on the perspectives of patients already receiving insulin and on those of the PNs and GPs who support them. In the study of GPs by Goderis *et al.* (2009) who initiated insulin in Belgium, there were no PNs. The survey of Dutch GPs by Van Avendonk *et al.* (2009) mentioned the likelihood of GPs who employed a PN with a designated Diabetes Clinic being more likely to manage insulin therapy themselves but, unlike this study, did not have PN participants. Therefore, this study by comprehensively exploring the perspectives of patients, PNs and GPs, has detailed how the associated factors might contribute to insulin use and glycaemic control, thus filling a gap within the international context in addition to that of the UK. Ritholz *et al.* (2011) explored physicians' perceptions (primary care physicians and endocrinologists) about the T2DM multidisciplinary team. The findings highlighted their mainly positive views. Care integration in this study, however, was variable and at times inconsistent leading to less positive perceptions by some of the PNs and GPs.

In summary, other practices should be encouraged to provide enhanced PN and GP-led insulin services for their patients to meet the increasing demands for support of insulin-receiving patients. Resources should be available for training and providing the services. To mitigate the limited practice population size to enable sufficient experience, smaller practices could link up with others. Additionally, if health systems enable this, PNs and GPs with current expertise could provide practice-to-practice support giving advice when needed.

8.4 Considerations for Future Research

Four models were outlined to consider for future interventions which were informed by the findings of this study. The aim of these was to address the modifiable factors identified in the research which related to how patients use their insulin and the support they receive from their PN and GP. Non-modifiable factors such as age, comorbidity and ethnicity, are also factored into these models, by individualising glycaemic goals and personalising the interventions. These include the development of an Insulin Action Plan which is regularly reviewed with the changing healthcare needs of the patient, a personalised insulin adjustment tool, insulin-specific group education, and the use of the Media to raise public awareness and provide an educational resource.

Personalising the interventions to the individual patient will not be easily achievable without the involvement in their development of PNs, GPs, patients, carers, and other stakeholders. Patient and public involvement is reported by Mockford *et al.* (2012) to be an integral part of healthcare with an emphasis on empowering individuals and communities in shaping health and social care services. Co-design is more specific and described by Goodyear-Smith *et al.* (2015) to involve collaboration between researchers and end-users from the onset, in question-framing, research design and delivery, and influencing strategy. The authors also highlighted the defining feature of its emergent and adaptive nature. A co-design process should therefore be used to develop these interventions.

8.5 Conclusions

In conclusion, the research findings identified that contributors to insulin use and glycaemic control in the study population were multifactorial. In-so-doing, this has built on current research and added new knowledge of insulin use in T2DM patients within the context of general practice and related this to other countries. Factors were at the patient, PN and GP, and system-level. Patient-related factors included clinical and demographic characteristic, and psychological and behavioural factors. The insulin-related skills varied across the HCP participants. PN and GP-level factors included their competence in supporting insulin-

receiving patients, their assessment of the patient ability to understand and self-adjust insulin, and their perceived patient-related barriers. A key finding was the characteristics of some patients in their determination to continue to administer their insulin despite barriers. The HCPs were clearly committed to supporting their patients and those with insulin-related expertise enjoyed this enhanced role. PNs and GPs encouraged self-management, taught self-adjustment at insulin initiation, and assumed patients would continue to do so. While many patients continued to self-manage, some did not, others were reluctant to, while a number did not realise, they could. The study findings generated a number of recommendations for clinical practice and models for potential future interventions to help support patients. In conclusion, increasing numbers of patients are progressing to insulin therapy and, despite the evidence, many patients have suboptimal glycaemic control above levels appropriate to the individual. To meet healthcare demands, more practices are providing PN and GP-led insulin-support services and this trend is likely to continue. It is therefore important to build on the existing HCP support and motivation, in order to improve services, and optimise insulin use and glycaemic control.

8.6 Dissemination

8.6.1 Presentations and Publication

Presentations of the study data have been made to patient groups involved in the design of the study, local HCPs, and to a university diabetes research group. Poster abstracts have been displayed at professional conferences, and the findings of the thematic synthesis published in a peer review journal (Table 55 and Appendix 16). There are plans for future publications to include findings of the cross-sectional survey, and patient and HCP interviews. Further presentations will be made to include patients and HCP participants, local HCP meetings, and meetings of diabetes research groups. Oral and further poster presentations will be developed and submitted to professional conferences.

Table 55 Publication and Poster Abstracts

Publication
Ellis K., Mulnier H. & Forbes A. (2018) Perceptions of insulin use in type 2 diabetes in primary care: a thematic synthesis. *BMC Family Practice* **19**(70). https://doi.org/10.1186/s12875-018-0753-2.
Poster Presentations
Ellis K. (2016) Factors explaining blood glucose control in insulin treated type 2 diabetes: A mixed methods research study. Florence Nightingale Foundation Annual National Conference, London.
Ellis K., Mulnier H., & Forbes A. (2017) Perceptions of insulin therapy in type 2 diabetes: A thematic synthesis. Florence Nightingale Foundation Annual National Conference, London.
Ellis K., Winkley K., & Forbes A. (2019) Patient experiences and views of insulin use and support: A thematic analysis of interviews with patients who have type 2 diabetes. Diabetes UK Professional Conference, Liverpool.

8.6.2 Awards

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- Band Trust Research Scholarship from the Florence Nightingale Foundation
- PhD Fee Support Award from NIHR CLAHRC, South London

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10. APPENDICES

Appendix 1. Literature Search Strategy

The Electronic Databases

CINAHL

1. Diabetes Mellitus, Type 2
2. Insulin
3. S1 and S2
4. Patients or “patients”
5. Advanced Practice Nurses or “practice nurses”
6. Nurses or “nurses”
7. Physicians or “doctors”
8. “general practitioners”
9. “health care professional”
10. S4 or S5 or S6 or S7 or S8 or S9
11. S3 and S10
12. Perception or “perception”
13. “experiences”
14. Health Behaviour or “health behaviour”
15. Health Beliefs
16. Patient Compliance or “adherence”
17. S12 or S13 or S14 or S15 or S16
18. S11 and S17

COCHRANE LIBRARY

1. Diabetes Mellitus, Type 2
2. Insulin
3. #1 and #2
4. “insulin treated type 2 diabetes”
5. #3 or #4
6. Patients
7. Nurses
8. “practice nurse*
9. General Practitioners
10. “general practitioner*
11. Patient Care Team
12. “health care professional* or “patients”
13. #6 or #7 or #8 or #9 or #10 or #11 or #12
14. #5 and #13

EMBASE

1. exp non-insulin dependent diabetes mellitus/ or “insulin treated type 2 diabetes”
2. exp insulin/
3. 1 and 2
4. exp patient/ or “patients”
5. exp health care personnel/ or “health care professional*” or exp physician/ or exp nurse/
6. 4 or 5
7. 3 and 6
8. exp perception/ or “perception*”
9. exp experience/ or exp personal experience/ or “experience*
10. health behaviour/ or attitude to health/ or patient compliance/ or health belief/ or “health belief*”
11. “understand*” or “adherence” or “concordance”
12. 8 or 9 or 10 or 11
13. 7 and 12
14. exp primary medical care/ or “primary care”
15. exp general practice/ or “general practice”
16. 14 or 15
17. 13 and 16

MEDLINE

1. exp Diabetes Mellitus, Type 2/ or “insulin treated type 2 diabetes”
2. exp Insulin/
3. 1 and 2
4. Patients/ or “patient”
5. exp Delivery of Health Care/ or “health care professional*” or exp Physicians/
6. exp Physicians, Family/ or exp General Practitioners/ or “general practitioner*”
7. exp Nurses/ or “nurse”
8. exp Nurse Practitioners/ or “practice nurse*” or exp Nursing Staff/
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp Perception/ or “perception*”
12. exp Attitude to Health/ or exp Health Behaviour/ or “health behaviour”
13. exp Compliance/ or Patient Compliance/ or “compliance”
14. exp Medication Adherence/ or Patient Compliance/ or “adherence”
15. “understand*” or “experience*” or “concord*”
16. 11 or 12 or 13 or 14 or 15
17. 10 and 16
18. exp Family Practice/ or General Practice/ or “general practice”
19. exp Primary Health Care/ or “primary care”
20. 18 or 19
21. 17 and 20

PsycINFO

1. exp Diabetes Mellitus/ or “insulin treated type 2 diabetes”
2. exp Insulin/ or “insulin”
3. 1and 2
4. exp Nurses/ or “practice nurse* or exp General Practitioners/
5. exp Physicians/ or “doctor*”
6. exp Health Personnel/ or exp Health Care Delivery/ or “health care professional*”
7. patient selection/
8. exp Patient Selection/ or “patient*”
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. “experience*” or “perception*”
12. exp Health Behaviour/or exp Behaviour Change/ or exp Health Attitudes/ or “health behaviour”
13. exp Treatment Compliance/ or “adherence”
14. 11 or 12 or 13
15. 10 and 14

WEB OF SCIENCE

1. Type 2 Diabetes and Insulin
2. “experience*” or “perception*” or “understand*”
3. #2 and #1
4. “primary care” or “general practice” or “community”
5. #4 and #3

Appendix 2. Summary of the Survey Publications

Summary of the Survey Publications from The Thematic Synthesis

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
PTs	Hypoglycaemia	Brod (2012c)	To determine how non-severe nocturnal hypoglycaemic events (NSNHEs) affect diabetes management, sleep quality, functioning, and to assess if these impacts differ by diabetes type or country.	T1DM and T2DM patients (n=1086) who experienced NSNHE in the last month: T1DM (n=676) Non-Insulin T2DM (n=124) Insulin T2DM (n=286)	• Of 1,086 respondents experiencing ≥1 NSNHE while asleep at night, 38.9% (n=422) reported experiencing their most recent NSNHE in the past week, 30.5% in the last 2 weeks, and 30.7% reported experiencing their NSNHE in the last month, but more than 2 weeks prior. • T2DM respondents required significantly more time than T1DM to recognise and respond to the event (1.5 vs 1.1 hours), 25.7% (T1DM), • NSNHEs were associated with a substantial impact on diabetes management, sleep quality, and next-day functioning
	Hypoglycaemia	Brod (2013a)	To explore the burden and impact of NSNHEs on diabetes management, patient monitoring and wellbeing to better understand the role NSNHEs play in caring for people with diabetes and to facilitate optimal diabetes treatment strategies.	Patients (n=2,108) with: T1DM or T2DM. T1DM (n=692) Non-insulin T2DM (n=543) Insulin T2DM (n=873)	• NSNHEs have serious consequences for patients including affecting sleep, next day functioning, driving, and reduced wellbeing. • Participants were late or absent for work, missed a meeting or work appointment, or had not finished a task on time. • All were likely to take additional SMBG and decreased their insulin dose.
	Hypoglycaemia	Diago-Cabezudo (2013)	To evaluate the effects of hypoglycaemia on the lives of patients with DM and determine if SMBG to prevent hypoglycaemic is an appealing	Insulin-treated patients (n=1,848) T1DM (n=924) Insulin T2DM (n=924)	• Approximately 1/3 of patients were not always able to recognise symptoms of hypoglycaemia when having an episode, about 1/4 had no warning signs.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
			and widely accepted concept.		• 37% tended to maintain their blood glucose levels above physician recommended levels to help avoid hypoglycaemia. • 80% said they would value a meter that provides high or low glucose warnings at specific time points during the day. • Overall, people with T1DM and insulin-treated T2DM had a positive perception about and were keen to adopt tools designed to facilitate the identification, management and prevention of hypoglycaemia while helping to avoid hyperglycaemia and an increased risk of diabetes complications.
PTs	Hypoglycaemia	Fulcher (2014)	To understand the impact of nocturnal and daytime non-severe hypoglycaemic events on healthcare systems, work productivity & QOL in T1DM or T2DM.	T1DM (n=64) Non-insulin T2DM (n=76) Insulin T2DM (n=160)	• Findings suggest nocturnal and daytime non-severed hypoglycaemic events have a large financial and psychosocial impact. • Diabetes management that minimizes hypoglycaemia while maintaining good glycaemic control might positively impact on the psychological wellbeing of people with diabetes, as well as reducing healthcare costs and increasing work productivity.
	Hypoglycaemia	Leiter (2005)	To assess impact of mild, moderate and severe hypoglycaemia and fear of future episodes on patients with T1DM or insulin-treated T2DM	Adults with insulin-treated T2DM (n=335) T1DM (n=202) insulin T2DM (n=133)	• More T1DM patients reported increased fear of future hypoglycaemia (37.8%) than insulin-treated T2DM patients (29.9%). • Subsequent to a severe hypoglycaemic episode, 84.2% of T2DM vs 63.6% of T1DM patients reported greater fear of future hypoglycaemia. • The most common management strategy for

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
					hypoglycaemia of any severity was self-treatment.
PTs	Hypoglycaemia	Mitchell (2013)	To characterize hypoglycaemic events in T2DM and assess the relationship between the experiences and health outcomes.	T2DM adults (n=1,329) of which: Insulin T2DM (n=301)	• The prevalence of ≥1 hypoglycaemic event within a 4-week period was 27.5% for the sample overall, higher among insulin users than those not using insulin (43.5% vs 22.8%, $p < .001$). • Baseline comparisons showed that worse HbA1c, greater diabetes-related healthcare resource use, greater fear of hypoglycaemia, and impaired health outcomes were associated with hypoglycaemia in the 4weeks prior to baseline. • Hypoglycaemia was associated with worse self-reported glycaemic control, behaviours that contributed to worse glycaemic control, and impairment in patient-reported outcomes.
	Hypoglycaemia Glycaemic control	Shiu (2004)	To examine the relationship between a sense of coherence (SOC), fear of hypoglycaemia and metabolic control to identify whether other variables including: age, hypoglycaemic experience and adherence to self-care practice, confounded the findings from two Swedish studies.	Insulin-treated T2DM adults (n=72)	• The higher the SOC (a construct explaining good health and positive adjustment which is on a continuum between “ease” and “disease”), the lower the fear of hypoglycaemia. • There was no significant correlation between SOC and HbA1c. • Findings suggested that respondents with high or low SOC demonstrated no significant difference in difficulties in managing their illness. • The results agreed with that of the Swedish studies that SOC contributes to lower fear of hypoglycaemia.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
	Injecting in public	Mehmet (2015)	To determine if patients report problems with injecting insulin/SMBG in front of others and explore reasons why.	Insulin T2DM (n=27) T1DM (n=49)	• Patients reporting problems injecting had T1DM (n=29) T2DM (n=20). • Over 1/3 almost never felt comfortable performing injections/SMBG in public. • 50% almost never inject insulin in front of work colleagues. Most felt comfortable with injections & SMBG in front of family. • Patients of all ages, genders, diabetes type and duration, reported problems injecting & SMBG in front of others. The most common reason was being worried about upsetting or offending others.
PTs	Injection problems	Mollema (2001)	To examine functioning and self-management of insulin-treated patients suffering from extreme fear of self-injecting (FSI) and/or fear of self-testing (FST).	Patients with insulin-treated diabetes (n=1,275) of which: T1DM (n=740) T2DM (n=535)	• People with extreme FSI/FST scores compared to the other patients reported higher levels of anxiety and depression. This group also reported more fear of hypoglycaemia and diabetes related distress, had lower levels if general wellbeing, and reported less frequent SMBG. • A second survey showed 11.1% with extreme FSI/FST scores indicating major depression. • Extreme levels of FSI and/or FST were associated with high diabetes-related distress, poor general wellbeing, and psychological comorbidity, and poorer treatment adherence to the diabetes treatment.
	Injection problems	Zambanini (1999)	To assess: prevalence of phobia and anxiety-related to insulin injections; association between insulin injection anxiety symptoms with level of general	Insulin-treated patients (n=115) of which: T1DM (n=80) and Insulin T2DM (n=35)	• T1DM patients were most likely to inject 4 times a day than those with T2DM (44; 55% vs 4; 11%) • Injections had been avoided secondary to anxiety in 14% in both T1DM and T2DM. 42% expressed concern at having to inject more frequently.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
			anxiety in the study group; and evaluate their influence of, on glycaemic control.		• An injection anxiety score (IAS) of ≥3 was seen in 28% of patients (21 had T1DM [27% of all T1DM] and 12 with T2DM [34% of all T2DM]). Of these, 66% injected insulin 1-2 times a day, and 45% had avoided injections, and 70% would be bothered by more frequent injections. • A general anxiety score (GAS) of ≥8 was seen in 25% (22 had T1DM [27% of all T1DM] and 7 had T2DM [20% of all T2DM]) • No significant correlation was seen with HbA1c and IAS or GAS in T1DM or T2DM.
PTs	Insulin intensification	Cefalu (2008)	To understand patients' perspectives to achieving good glycaemic control and determine how their perceptions of insulin may affect their decisions to initiate or intensify insulin.	T2DM adults (n=1,444) of which: Insulin T2DM (n=469)	• 54%-60% were not aware of their recent HbA1c or declined to answer. • Of those on insulin, 120 /175 (69%) reporting HbA1c ≥7%, was unrelated to using pens or syringes. • The majority wished there was another way to take insulin whether currently using insulin or not. • Improving patients' perceptions and acceptance. of insulin could encourage earlier insulin use and assist in achieving and maintaining long-term glucose control.
	Insulin adherence	Ary (1986)	To assess levels of regimen adherence and reasons for non-adherence.	Patients with T1DM (n=24) Non-insulin T2DM (n=125) Insulin T2DM (n=59)	• The top four reasons for insulin non-compliance were being in a bus/plane/car (23%), away from home (13%), being in a restaurant (10%), and on a trip (10%) • Most frequent barriers were being in a bus/plane/car in transit (14%), negative physical reactions (11%) and being in a restaurant (8%)

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
	Insulin adherence	Peyrot (2012a)	To examine factors associated with insulin injection omission/ non-adherence	Insulin-treated DM adults (n=1,530) of which: T1DM (n=110) T2DM (n=1,420)	• 35% reported one or more days of insulin omission/non-adherence. • Omission/non-adherence differed widely across countries (range=20–44%); Most risk factors had similar relationships with insulin omission/non-adherence across countries. • Omission/non-adherence was more frequent among respondents who were male, younger, had T2DM or more frequent hypoglycaemia, were less successful with other treatment tasks, regarded insulin adherence as less important, had more practical/logistical barriers and difficulties with insulin adherence, were concerned that insulin treatment required lifestyle changes or were dissatisfied with flexibility of injection timing.
PTs	Perceptions of T2DM	Mosnier-Pudar (2009)	To describe T2DM from the patient's standpoint in a representative French panel	T2DM Patients (n=1,092) of which: Non-Insulin (n=885) Insulin T2DM (n=207)	• Mean time from diagnosis to insulin was 13.8 years • Disease knowledge improved with treatment intensification and experience. It was greater in insulin-treated patients than in patients with OHAs. • 50% perceived T2DM as serious including those treated with insulin/ • The impact on daily life tended to be greater in patients with longer disease duration, poorer glycaemic control, in women and those treated with insulin.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
					• Patients became partners in their healthcare process and engaged in a more bilateral patient-provider relationship when on insulin (40% vs 24%)
PTs & HCPs	Hypoglycaemia	Brod (2012a)	To estimate the prevalence of self-treated hypoglycaemia in patients using basal analogues. To identify demographic treatment-related and behavioural risk factors. To describe patient and physician responses to these.	T2DM Patients using basal insulin analogues (n=3,042) Physicians (n=1,222): Specialists (45%) PCPs (55%)	• Self-treated hypoglycaemia was common in approximately one third of patients using insulin analogues. • Self-treated hypoglycaemia was associated with clinically significant effects on patient wellbeing and functioning, patient and physician management and healthcare utilisation.
	Insulin dosing irregularities	Brod (2012b) .	To describe basal insulin analogue dosing irregularities; the effect on patient functioning, wellbeing and management; and the identification of patients most at risk in the study.	T2DM Patients using basal insulin analogues (n=3,042) Physicians (n=1,222): Specialists (45%) PCPs (55%)	• Basal insulin dose irregularities including missed, mistimed and reduced doses were common. • A significant proportion of patients also report undertaking these irregular dosing behaviours at a frequency that would be considered by prescribers to negatively impact diabetes management. • Physicians reported that the frequency of basal insulin dosing irregularities in the last 30 days that they perceived to have a significant impact on glucose control was missed, mistimed, or reduced basal insulin doses for patients treated with a basal insulin or a basal-bolus regimen.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
	Dosing irregularities Hypoglycaemia	Leiter (2014)	To assess the frequency and impact of dosing irregularities and self-treated hypoglycaemia in T2DM patients treated with insulin analogues in the GAPP2 study.	Patients with Insulin-treated T2DM (n=156) Physicians (n=202) Of which: PCPs (n=160) Specialists (n=42)	• Concern about hypoglycaemia was the most common reason for intentional dosing irregularities by patients. • 26% of patients reported experiencing a dosing irregularity (missed, mistimed or reduced a basal insulin dose) in the previous 30 days. • Up to 60% reported risk for hypoglycaemia as the reason for intentional dosing irregularities. • 80% reported experiencing a self-treated hypoglycaemic event, and 33% recalled having at least one event in the previous month. • HCPs recorded similar levels of patient-reported dosing irregularities. • Over 90% indicated they recommended patients to temporarily reduce their insulin doses to deal with hypoglycaemia.
PTs & HCPs	Insulin adherence	Peyrot (2012b)	To examine patient and physician beliefs regarding insulin therapy and degree to which patients adhere to insulin regimens	Insulin-treated DM adults (n=1,530) of which: T1DM (n=180) T2DM (n=1,350) Physicians (n=1,250) of which Specialists (n=600) PCPs (n=650)	• More patients reported positive than negative impact on life, except finances ($p < .05$) but the trend was stronger for patients with T1DM than with T2DM. • 33.2% of patients reported insulin omission/non-adherence at least 1 day in the last month with average of 3.3 days. • 72.5% of physicians reported their typical patient does not take their insulin as prescribed, with a mean 4.3 days per month of basal insulin omission/non-adherence and 5.7 days /month of prandial Insulin omission/non-adherence.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
					• Patients & providers indicated same five most common reasons for omission⁄non-adherence: too busy; travelling; skipped meals; stress⁄ emotional problems; public embarrassment. • Most physicians reported many insulin-treated patients did not have adequate glucose control (87.6%) and would treat more aggressively if not for concern about hypoglycaemia (75.5%). • Though a majority of patients and physicians regarded insulin as restrictive, more patients saw it as having positive than negative impacts.
PTs & HCPs	Injection problems	Rubin (2009)	To compare patients' perceptions of injection-related problems with clinicians' estimates of those problems.	Insulin-treated adults (n=501) of which T2DM (n=385) PCPs (n=101) Endocrinologists (n=100) Diabetes Educators (n=100)	• The majority of patients would like to reduce numbers of injections taken each day. • Almost 50% would be more likely to take insulin regularly if a product were available to ease pain. A smaller proportion reported: injections were a serious burden, they were dissatisfied with the way of taking insulin, injections had a substantial negative impact on QOL, they skipped injections, or injection-related problems affected injection number they were willing to take. • Awareness of products among HCPs was high, but not effectively communicated to patients.
HCPs	Insulin intensification	Cuddihy (2011)	To investigate the opinions of PCPs (primary care professionals) and diabetes specialists on their perceived role in tackling T2DM and the challenges they face,	Diabetes specialist physicians (n=300) PCPs (n=300)	Insulin intensification is defined as "adding a different insulin or an additional injection to the current insulin regimen" • 21% PCPs never initiate/modify insulin in T2DM • Main barriers of insulin intensification cited were lack of experience and time to educate patients.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
			particularly to insulin intensification.		• There was discord between PCPs and specialists regarding who they considered primarily responsible for insulin intensification. • Better primary and secondary care collaboration was considered to be one of the most important factors to improve insulin treatment of T2DM.
HCPs	HCP perception of nurse involvement	Siminerio (2007)	To examine nurse and physician perceptions of nurse involvement in diabetes care.	General Nurses(n=51) DSNs (n=50) Generalist Physicians (n=166) Diabetes Specialist Physicians (n=50)	• Nurses & physicians agreed nurses should take a larger role in managing diabetes. • Most common difference identified between nurses & physicians were that nurses provide better education, spend more time with patients, were better listeners, and knew their patients better than physicians. • Specialist nurses talk to patients about self-management, teach medicine management (including insulin therapy), have a higher level of involvement in prescribing, and are more willing to take on additional responsibilities than generalist nurses.
	Insulin management in general practice	Van Avendonk (2009)	To investigate the organisation of insulin therapy in general practice and assess factors associated with providing insulin in T2DM patients.	Dutch GPs (n=1,621)	• 67% of GPs start insulin in patients with T2DM. • Male GPs, GPs > 40 years, and GPs working in a health centre are more inclined to start insulin themselves. • GPs working in urban regions less often start insulin than GPs in rural areas. • The most often mentioned barriers to start and/or monitor insulin in general practice are lack of time and knowledge of insulin and insufficient financial incentives.

PTs or HCPs	Topic	First Author (year)	Aim	Participants	Summary of the Findings Relevant to Insulin-treated T2DM
					• The presence of a practice nurse and diabetes clinics is positively associated with providing insulin therapy in general practice

Key: DSN = Diabetes Specialist Nurse; PN = Practice Nurse; GP = General Practitioner; HCPs = healthcare professionals; NSNHE = Non-severe nocturnal hypoglycaemic event; OHA = oral hypoglycaemic agent; PCPs = primary care physicians; Pts = patients; QOL = quality of life; SMBG = self-monitoring of blood glucose; T1DM = type 1 diabetes; T2DM = type 2 diabetes; Insulin T2DM = insulin-treated type 2 diabetes.

Appendix 3. Mapping of Themes

Mapping of Patient-Related Themes from the Thematic Synthesis

References	Insulin beliefs		Barriers to insulin management					Facilitators for insulin management				
First author (year)	1. Specific insulin beliefs	2. Cultural beliefs	3. Physical effects	4. Psycho-logical factors	5. Social factors	6. Self-man of insulin & SMBG	7. HCP or system barriers	8. Insulin know-ledge	9. Well-being	10. Social factors	11. Self-man of insulin & SMBG	12. HCP or system facilitator
Qualitative Studies												
Abu Hassan (2013)	1A		3A	4A	5A 5C 5D	6A		8A 8B 8C 8D	9A	10A	11A 11C 11D	12A 12B
Brod (2014)			3B	4A	5C	6A 6B 6E					11B 11E 11F	
Brown (2007)	1A	2A 2B 2C	3A 3C		5C		7A 7B	8D			11C	12A 12B
Browne (2013)				4B 4C	5D		7A					
Hortensius (2012)			3B	4A	5C	6A 6C 6D 6H	7C	8B 8C 8D			11D 11E 11F 11G	12A
Janes (2013)	1A	2A 2B 2C 2D	3B	4A 4B 4C	5A 5B 5C 5D 5E	6B 6D	7A 7B 7C 7D					
Jenkins (2011)				4A	5A 5D	6E 6H					11B 11D 11E 11H	

References	Insulin beliefs		Barriers to insulin management					Facilitators for insulin management				
First author (year)	1. Specific insulin beliefs	2. Cultural beliefs	3. Physical effects	4. Psycho-logical factors	5. Social factors	6. Self-man of insulin & SMBG	7. HCP or system barriers	8. Insulin know-ledge	9. Well-being	10. Social factors	11. Self-man of insulin & SMBG	12. HCP or system facilitator
Ong (2014)			3A 3B	4D	5D 5E	6A 6F 6G 6H	7C			10A	11F	
Vinter-Repalust (2004)			3A	4A		6E 6H	7A	8B 8C		10A 10B	11C	12B 12C
Quantitative Studies												
Ary (1986)						Adherence						
Brod (2012a)			Hypos									
Brod (2012b)						Adherence/ Adjustment						
Brod (2012c)			Nocturn hypo			Adjust-ment						
Brod (2013)												
Cefalu (2008)			Perceptions of insulin management									
Diago-Cabezudo (2013)			Loss of hypo awareness								SMBG to prevent hypos	
Fulcher (2014)			Night & day non-severe hypos: psychosocial & financial impact								SMBG to prevent hypos	
Leiter (2005)			Hypos								SMBG to prevent hypos	
Leiter (2014)			Dosing irregularities and self-treated hypoglycaemia									
Mehmet (2015)			Perceptions of injecting & SMBG in public									
Mitchell (2013)			Hypos									
Mollema (2001)			Fear of self-injecting or self-testing									

References	Insulin beliefs		Barriers to insulin management					Facilitators for insulin management				
First author (year)	1. Specific insulin beliefs	2. Cultural beliefs	3. Physical effects	4. Psycho-logical factors	5. Social factors	6. Self-man of insulin & SMBG	7. HCP or system barriers	8. Insulin know-ledge	9. Well-being	10. Social factors	11. Self-man of insulin & SMBG	12. HCP or system facilitator
Mosnier-Pudar (2009)	Turning point, severity of T2DM		Perceptions of insulin management/Adherence/ Adjustment									Positive effect of HCPs
Peyrot (2012a)			Perceptions of insulin management/Adherence/ Adjustment									
Peyrot (2012b)			Perceptions of insulin management /adherence/adjustment									
Rubin (2009)			Barriers to insulin therapy									
Shiu (2004)								Perceptions of positive adjustment to insulin				
Zambanini (1999)			Injection related anxiety									

Key: A–H = Sub-theme codes [see table below]; HCP = healthcare professional; Hypo = hypoglycaemia; Nocturn = nocturnal; Self-man = self-management; SMBG = self-monitoring of blood glucose; T2DM = type 2 diabetes.

Patient-Related Coded Sub-Themes

1. Specific insulin beliefs	2. Cultural beliefs	3. Physical effects	4. Psychological factors	5.Social factors	6.Self-management of insulin & SMBG	7.HCP or system barriers
A. Insulin means T2DM is a serious illness	A. Fear of insulin as a Western drug B. Medicinal plants rather than insulin C. Body perceived as being restricted (from needles) D. When visits own country, insulin is no longer needed	A. Injection pain B. Hypoglycaemia C. Weight gain	A. Anxiety or fear B. Guilt C. Depression or shame D. Inertia	A. Embarrassment of injecting in public B. Policing by family or friends C. Travel, leisure, or lifestyle restrictions D. Social stigma E. Work	A. Inconvenience B. Insulin non-adherence C. Hypo unawareness D. Imposed routine E. Insulin intensification F. Costs G. Frustration at seeing high blood glucose H. Lack of knowledge of, or need for, insulin adjustment	A. Communication problems B. Lack of support C. HCP imposed goals D. Time constraints

8.Insulin knowledge	9.Wellbeing	10. Social factors	11.Self-management of insulin & SMBG	12.HCP or health system facilitators
A. Acceptance of insulin Information from: B. HCP C. Media D. Family, friends, peers	A. Feeling better on insulin	A. Family and friends	A. Knowledge of insulin benefits B. Action taken for missed doses C. Fear of complications D. HCP-driven dose-adjustment E. Patient-driven adjustment F. Hypo symptoms G. Hypo unawareness	A. Communication by HCPs B. Quality of the relationship Environmental factors

Mapping of HCP-Related Themes from The Thematic Synthesis

References	**Facilitators for insulin-related support**						**Barriers to insulin-related support**						**Perceptions of patient barriers**	
First author (year)	1. HCP Insulin skills	2. HCP Insulin knowledge	3. HCP Confidence	4. Specialist	5. Systems	6. HCP-Patient relation	7. HCP Insulin skills	8. HCP Insulin knowledge	9. HCP Attitude	10. Specialist	11. Systems	12. HCP-Patient relation	13. Patient Barriers	14. Culture
Qualitative Studies														
Goderis (2009)	1A 1B	2A	3A 3B	4A 4C 4D 4E 4F	5A 5B 5C 5D 5E 5F	6A 6B	7A	8A 8B	9A 9B 9C 9D	10A 10B 10C	11A 11B 11C 11D	12A	13A 13E 13F	
Jeavons (2006)	1C	2A		4B		6A 6C	7A	8A 8B	9A 9B 9C 9D	10C	11E	12B	13A 13B 13D 13E 13G 13F	14A 14B
Lee (2013)											11F 11G 11H	12C	13A 13B 13C 13E 13G 13H 13I 12J	
Quantitative Studies														
Brod (2012a)	Basal Insulin types in relation to hypoglycaemia													
Brod (2012b)														

References	Facilitators for insulin-related support						Barriers to insulin-related support						Perceptions of patient barriers	
First author (year)	1. HCP Insulin skills	2. HCP Insulin knowledge	3. HCP Confidence	4. Specialist	5. Systems	6. HCP-Patient relation	7. HCP Insulin skills	8. HCP Insulin knowledge	9. HCP Attitude	10. Specialist	11. Systems	12. HCP-Patient relation	13. Patient Barriers	14. Culture
Cuddihy (2011)							Lack of experience and skills in insulin management. Discord between primary & secondary care.					Lack of time		
Leiter (2014)	HCP advice regarding treatment of hypoglycaemia and basal insulin													
Peyrot (2012b)													Insulin adherence	
Rubin (2009)													Barriers to insulin therapy	
Siminerio (2007)				General Nurse and DSN roles										
Van Avendonk (2009)	The organisation and provision of insulin therapy in general practice													

Key: A–H = Sub-theme codes [see table below]; DSN = Diabetes Specialist Nurse; HCP = healthcare professional; SMBG = Self-monitoring of blood glucose.

HCP-Related Coded Sub-Themes

1. HCP Insulin-related skills	2. HCP Insulin-related knowledge	3. HCP Confidence	4. Specialists	5. Healthcare systems	6. HCP-Patient relationships
A. Insulin skills B. GP role C. GP and Nurse skills	A. HCP Education	A. Managing insulin B. GP confidence	A. Diabetes specialists B. Diabetes nurse C. Nurse educator D. Support E. Relationship Communication	A. Audit B. Integrated care C. Protocol D. Quality Improvement programme E. HCP Roles F. Service provision	A. GP Positive re insulin B. Consistent message C. Patient education
7. HCP Insulin skills	8. HCP Insulin knowledge	9. HCP Attitude	10. Specialists	11. Healthcare Systems	12. HCP-Patient relationship
A. Lack of insulin-related skills	A. Lack of knowledge B. Lack of training and resources	A. Fear of insulin B. Lack of confidence C. Inertia D. Reluctance	A. Competition B. Lack of teamwork C. Lack of support	A. Lack of SMBG finance B. Unfavourable incentives C. Lack of defined roles D. Lack of integrated care E. Lack of resources for insulin services F. No continuity of care G. Financial problems H. Insulin devices	A. Inertia to change B. Collusion C. Patient education

13. HCP perception of patient-related barriers	14. Culture
A. Fear of needles B. Fear of hypoglycaemia C. Fear of weight gain D. Aversion to insulin E. Limited knowledge of insulin and T2DM F. Unaware of complications G. Receiving insulin means T2DM is a serious illness H. Insulin adherence I. Unaware of the need for SMBG J. Cost	A. Family influence B. Belief that fat is healthier

Appendix 4. Study Invitation Letters

NHR REC Ref: 15/SS/0080 Insulin Study Invitation [patient] v2, 01/05/15

Dear [Patient]

A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes: A Questionnaire

You are being invited to participate in a research project which forms part of my PhD research study at King's College London. This involves completing the enclosed questionnaire and consent form. You are also invited to take part in an interview. **However, if you prefer, you need only complete the questionnaire or only part of the questionnaire.** There is no obligation to take part and if you do you can withdraw at any time.

To help us find ways to improve diabetes care and develop future services, we are particularly interested in:

- How you feel about managing your diabetes with insulin
- The way this affects your everyday life
- How you might adjust your insulin doses
- The type of support you receive

You have been invited to take part in this study because we are interested in understanding the experiences of patients who use insulin as part of their diabetes treatment. We believe your experiences and views of insulin treatment will contribute greatly to the research. The enclosed information sheet tells you what the study involves. Please read it carefully.

If you decide to complete all or part of the questionnaire:

Please complete, sign and return the consent form with the completed questionnaire in the reply-paid envelope. On the final page of the questionnaire you can indicate if you agree to be interviewed.

Thank you for your time. Please contact me if you would like any further information.

Yours sincerely

Kathy Ellis
Advanced Nurse Practitioner
Whitstable Medical Practice
&
PhD Student, King's College London
Mobile 0776 037 3923
kathyellis@nhs.net & kathy.ellis@kcl.ac.uk

Dear [GP or Practice Nurse]

A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes

You are being invited to participate in a research project which forms part of my PhD research study at King's College London. There is no obligation to take part and if you do, you can withdraw at any time.

Insulin has been proven to be an effective treatment in people with poorly controlled type 2 diabetes (T2DM). Yet many patients receiving insulin still have poor glucose control leading to complications. The aim of this study is to find out what makes it difficult for some people to control their blood glucose and what can help, from the perspectives of patients, GPs and Practice Nurses. The study involves single or group interviews with Practice Nurses who run diabetes clinics and with their GP diabetes lead.

To help us find ways to improve diabetes care and develop future services, we are particularly interested in:

- How often you see patients in your clinic or surgery with insulin treated T2DM
- How confident you feel about managing their insulin, and the support you receive
- What you believe to be the key factors contributing to poor glucose control

If you decide that you will take part:

Please complete and sign the attached form, and return it in the Reply-paid envelope. We will then contact you to arrange the interview.

Thank you for taking the time to consider taking part in this study.

Yours sincerely

Kathy Ellis
Advanced Nurse Practitioner
Whitstable Medical Practice
&
PhD Student, King's College London
Mobile 0776 037 3923
kathyellis@nhs.net & kathy.ellis@kcl.ac.uk

Appendix 5. Participant Information Sheets

Participant Information Sheet

A Study of Factors Explaining Blood Glucose Control in Patients With Insulin Treated Type 2 Diabetes

PATIENT INFORMATION

Invitation to take part in a research project

- You are being invited to participate in this research project which forms part of a PhD research study at King's College London.
- Before you decide whether to take part, it is important to understand why this research is being done and what is involved.
- Please take the time to read this leaflet carefully. Discuss it with friends, relatives and your GP if you wish.
- There is no obligation to take part. If you do participate you can withdraw at any time. Choosing not to will not affect the care you receive from your GP or Practice Nurse.
- Please ask if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

The aim of this study is to find out what makes it difficult for some people to control their blood sugar and what can help. The study involves completing the enclosed questionnaire and, if you choose, an interview. We are particularly interested in:

- How you feel about managing your diabetes with insulin
- The way this affects your everyday life
- How you might adjust your insulin doses
- The type of support you receive

The findings of this study will help us find ways to improve diabetes care and to develop future services.

Why have I been invited to take part?

You have been invited to take part in this study because we are interested in understanding the experiences of patients who use insulin as part of their diabetes treatment. We want to understand how you use insulin, the support you have received and what might make using insulin easier for you.

For more information please contact: Kathy Ellis kathy.ellis@kcl.ac.uk, Tel: 0776 037 3923

Do I have to take part?

Participation is voluntary. You do not have to take part. You should read this information sheet and if you have any questions you can contact us or an Independent Advisor.

- Taking part or declining to take part will not affect your health care.
- If you do take part, you are free to withdraw from the study at any time without giving a reason.

What are you asking me to do?

- We are asking you to complete the enclosed questionnaire which should only take about 15 minutes.
- Relevant diabetes information from your medical notes will be obtained for the study but will be anonymised so you cannot be identified.

- You are also invited to take part in an interview regarding your experience of using insulin. However if you prefer you need only complete the questionnaire and return it with the consent form indicating that you do not wish to be interviewed.
- There is no obligation to take part and if you do, you can withdraw at any time.

- If you decide to take part in the interview, we will contact you to arrange a time convenient for you. You can have a carer or relative present if you wish.
- The interview will take place in your home or, if you prefer, in a GP practice. You will be asked to sign another consent form to indicate your willingness to participate in the interview.
- The interview will take up to one hour but can be shorter if you wish and stopped at any time. It will be recorded, if you agree and the recording deleted after the interview has been written up.
- Your identity will be protected in the study. Nothing you say will be directly attributable to you.

What are the possible risks of taking part?

- There are no foreseeable risks. The main disadvantage is the time you give to complete the questionnaire, and/or to be interviewed.
- Some people might find it upsetting to discuss certain issues during the interview. Though unlikely, if it were to occur then the interview can be stopped at any time and if you wish we will pass on your concerns to an appropriate health professional to support you with any concerns that arise.

What are the possible benefits of taking part?

There are no direct benefits in participating. However, your participation in the research will help us improve the future management of people with insulin treated diabetes

The study has received a favourable opinion from the NHS Research Ethics Service

Will my taking part be kept confidential?

Yes. The UK Data Protection Act 1998 will apply to all the information you give in the questionnaire and/or interview. It will be regarded as strictly confidential and held securely on password-locked computer files and locked cabinet. Any written information will have your name and address removed so you cannot be identified from it. If you change your mind, you are free to stop your participation and to have your data withdrawn without giving reasons up to 12 months after completing the questionnaire or following interview.

What will happen to the results of the study?

The study will be reported to King's College London and a summary of the main findings will be sent to you. We also plan to circulate the research findings through publication in medical journals and conferences.

Who should I contact for further information?

Kathy Ellis
Who is an Advanced Nurse Practitioner with Whitstable Medical Practice and is conducting this study as part of her PhD with King's College London.

Chestfield Medical Centre
Reeves Way
Whitstable,
Kent CT5 3QU
kathyellis@nhs.net Tel: 0776 037 3923 kathy.ellis@kcl.ac.uk

Jackie Bell
Who is a Lay Member of the Canterbury & Coastal Clinical Commissioning Group
And is the Independent Advisor for participants of this study.

Email: jackie.bell7@nhs.net Tel: 01227 795024

If you wish to make a complaint about the conduct of the study you can contact King's College London using the details below.

Professor Angus Forbes
Florence Nightingale Faculty of Nursing and Midwifery
James Clerk Maxwell Building
57 Waterloo Road
London SE1 8WA
angus.forbes@kcl.ac.uk Tel: 0207 8483367

I have decided to take part. What do I do now?

Please sign the consent form, complete the enclosed Questionnaire and return both in the reply-paid envelope

Thank you for taking the time to consider taking part in this study.

Participant Information Sheet

A Study of Factors Explaining Blood Glucose Control in Patients With Insulin Treated Type 2 Diabetes

GP AND NURSE INFORMATION

Invitation to take part in a research project

- You are being invited to participate in this research project which forms part of a PhD research study at King's College London.
- Before you decide whether to take part, it is important to understand why this research is being done and what is involved.
- Please take time to read this leaflet carefully and discuss it with others if you wish.
- You are free to decide whether to take part; choosing not to will not disadvantage you in any way.
- There is no obligation to take part and if you do, you can withdraw at any time.
- Please ask if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

Insulin has been proven to be an effective treatment in people with poorly controlled type 2 diabetes. Yet many patients receiving insulin still have poor glucose control leading to complications. The aim of this study is to find out what makes it difficult for some people to control their blood glucose and what can help, from the perspectives of patients, GPs and Practice Nurses. The study involves single or group interviews with diabetes clinic Practice Nurses and their GP lead for diabetes.

We are particularly interested in:

- How often you see patients in your clinic or surgery with insulin treated type 2 diabetes.
- How confident you feel about managing their insulin, and the support you receive.
- What you believe to be the key factors contributing to poor glucose control.

The study findings will help us to improve diabetes care and develop future services.

Why have I been invited to take part?

You have been invited to take part in this study because the management of insulin treated patients is increasingly provided by GPs and Practice Nurses such as you.

For more information please contact: Kathy Ellis kathy.ellis@kcl.ac.uk, Tel: 0776 037 3923

Do I have to take part?

Participation is voluntary. You do not have to take part. You should read this information sheet and if you have any questions you can contact me. You should not agree to take part in this research until you have had all your questions answered satisfactorily

- Taking part or declining to take part will not affect the care you give to your patients.
- If you do take part, you are free to withdraw from the study at any time without giving a reason.

What are you asking me to do?

- We are asking you to take part in an interview. You can be interviewed individually or, if preferred, with your GP and/or Practice Nurse colleagues.

- The interview will take up to one hour, but can be shorter if you wish and stopped at any time. It will be recorded, if you agree and the recording deleted after the interview has been written up.
- If you decide to take part in the interview, we will call you to discuss the procedure and arrange a time convenient for you.

- The interview will take place at your practice surgery or an alternative but private venue, for confidentiality reasons. You will be asked to sign a consent form.
- Your identity will be protected in the study. Nothing you say will be directly attributable to you.

What are the possible risks of taking part?

- There are no foreseeable risks. The main disadvantage is the time you give to be interviewed.
- Some people might find it upsetting to discuss certain issues. Though unlikely, if it were to occur then the interview can be stopped at any time and, if you wish, we will pass on your concerns to an appropriate health professional to support you with any concerns.

What are the possible benefits of taking part?

There are no direct benefits in participating. However, your participation in the study will help us improve the future management of people with insulin treated type 2 diabetes.

The study has received a favourable opinion from the NHS Research Ethics Service

Will my taking part be kept confidential?

Yes. The UK Data Protection Act 1998 will apply to all the information you give in the interview. It will be regarded as strictly confidential and held securely on password-locked computer files and locked cabinet. Any written information will be coded, and identifiable information removed so you cannot be identified from it. If you change your mind, you are free to stop your participation and to have your data withdrawn without giving reasons, up to twelve months following the interview.

What will happen to the results of the study?

The study will be reported to King's College London and a summary of the main findings will be sent to you. We also plan to circulate the research findings through publication in medical journals and conferences.

Who should I contact for further information?

Kathy Ellis,
Who is an Advanced Nurse Practitioner with Whitstable Medical Practice and is conducting this study as part of her PhD with King's College London

Chestfield Medical Centre
Reeves Way
Whitstable,
Kent CT5 3QU
kathyellis@nhs.net Tel: 0776 037 3923 kathy.ellis@kcl.ac.uk

Jackie Bell
Who is a Lay Member of the Canterbury & Coastal Clinical Commissioning Group
And is the Independent Advisor for participants of this study

Email: jackie.bell7@nhs.net Tel: 01227 795024

If you wish to make a complaint about the conduct of the study you can contact King's College London using the details below:

Professor Angus Forbes
Florence Nightingale Faculty of Nursing and Midwifery
James Clerk Maxwell Building
57 Waterloo Road
London SE1 8WA
angus.forbes@kcl.ac.uk Tel: 0207 8483367

I have decided to take part. What do I do now?

Please complete and sign the enclosed form, and return it in the Reply-paid envelope. We will then contact you to arrange the interview.

Thank you for taking the time to consider taking part in this study.

Appendix 6. Postal Questionnaire

NHS REC Ref: 15/SS/0080 Insulin Patient Questionnaire v3, 01/07/15

PATIENT QUESTIONNAIRE

A Study of Factors Explaining Blood Glucose Control in Patients With Insulin Treated Type 2 Diabetes

Please complete this questionnaire after you have read the Information Sheet

ABOUT THIS QUESTIONNAIRE

This questionnaire will help us find what makes it difficult for people to control their blood sugar with insulin, and what can help. Your opinion is important. We believe your experience of insulin treatment will contribute greatly to the research and help find ways to improve diabetes care. The questionnaire should take about 15 minutes to complete and, if you choose, you can take part in an interview. There are six parts:

1. Your insulin and blood sugar
2. Who-5 Well-Being Index
3. Insulin Treatment Appraisal
4. Patient Health Questionnaire
5. Numeracy Questionnaire
6. The last part includes a few questions about you. You can also indicate your agreement to be or not be interviewed.

Most of the questions ask you to circle answers or tick boxes. There are some spaces for you to write extra comments if you wish. You do not have to answer all the questions.

THIS INFORMATION IS CONFIDENTIAL AND YOUR ANONYMITY WILL BE MAINTAINED. It will not be possible to identify you in any written reports from this questionnaire.

If you have any questions or require further information, please contact:

Kathy Ellis, Whitstable Medical Practice, Tel: 01227 795130

Or email: kathyellis@nhs.net or kathy.ellis@kcl.ac.uk

When you have answered the questions please return the Questionnaire and Consent Form in the reply-paid envelope

Thank you for taking the time to consider taking part in this study.

[Study code]

PART 1. YOUR INSULIN AND BLOOD SUGAR

We are interested in what you know about your insulin and blood sugar control. For each statement, **Tick or write in the column/s** that best describes what you think. You can use the box at the bottom of the page if you wish to add further information to your answers

		(write year if known)	(write year if known)
1.	The year my diabetes was diagnosed: ……		The year I started on insulin: ……

		Once	Twice	Three times	Four times	Five times	Other
2.	The number of times I give insulin each day is usually (tick one box)	☐	☐	☐	☐	☐	☐

		Very well	Well	Moderately	Poorly	Don't know
3.	My blood sugar is controlled (tick one box)	☐	☐	☐	☐	☐

		HbA1c	Date if known	Don't know
4.	My last HbA1c (long term blood sugar) was (write if known, tick box if not known)	…….	……	☐

		(tick one box)		(Write target level or range if known)
		Yes	No	
5.	I have been given a target HbA1c (a recommended level or range) by my nurse, GP or other health professional	☐	☐ My target HbA1c is: …….....	
6.	I have been given a target pre-meal blood sugar level or range by my nurse, GP or other health professional	☐	☐ My target pre-meal blood sugar is: …….……....	

		A Practice Nurse	My GP	Other	Don't know
7.	If I am having difficulties with my insulin I can contact (tick all that apply)	☐	☐	☐	☐

		(tick one box)				
		Always	Most of the time	Sometimes	Rarely	Never
8.	I can understand when my blood sugar readings are too high or too low	☐	☐	☐	☐	☐
9.	I can work out how much extra insulin I need to inject if my blood sugar readings are regularly high	☐	☐	☐	☐	☐
10.	I make the decision to adjust my insulin	☐	☐	☐	☐	☐
11.	I prefer a nurse or doctor to advise me which dose to give	☐	☐	☐	☐	☐

Please write in this box if you would like to add further information to your answers. For example, if you have ticked the "other" box, or if a carer administers your insulin.

PART 2.

THE WORLD HEALTH ORGANIZATION (FIVE) WELL-BEING INDEX

Mental well-being is an important part of our overall health. This is particularly true in people with type 2 diabetes. The WHO (Five) index is a brief but reliable measure of current well-being.

- Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. Notice that higher numbers mean better well-being.

- Example: If you have felt cheerful and in good spirits more than half of the time during the last two weeks, put a tick in the box with the number 3.

	Over the last two weeks	All of the time	Most of the time	More than half of the time	Less than half of the time	Some of the time	At no time
1	I have felt cheerful and in good spirits	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
2	I have felt calm and relaxed	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
3	I have felt active and vigorous	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
4	I woke up feeling fresh and rested	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0
5	My daily life has been filled with things that interest me	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0

PART 3. INSULIN TREATMENT APPRAISAL SCALE (ITAS)

The following questions are about your perception of taking insulin for your diabetes. Please indicate to what extent you agree or disagree with each of the following statements. Tick one box for each statement that best describes your own opinion.

		Strongly Disagree	Disagree	Agree nor Disagree	Agree	Strongly Agree
1.	Taking insulin means I have failed to manage my diabetes with diet & tablets	☐	☐	☐	☐	☐
2.	Taking insulin means my diabetes has become worse	☐	☐	☐	☐	☐
3.	Taking Insulin helps to prevent complications of diabetes	☐	☐	☐	☐	☐
4.	Taking insulin means other people see me as a sicker person	☐	☐	☐	☐	☐
5.	Taking insulin makes life less flexible	☐	☐	☐	☐	☐
6.	I'm afraid injecting myself with a needle	☐	☐	☐	☐	☐
7.	Taking insulin increases the risk of low blood glucose levels (hypoglycaemia)	☐	☐	☐	☐	☐
8.	Taking insulin helps to improve my health	☐	☐	☐	☐	☐
9.	Insulin causes weight gain	☐	☐	☐	☐	☐
10.	Managing insulin injections takes a lot of time and energy	☐	☐	☐	☐	☐

		Strongly Disagree	Disagree	Agree nor Disagree	Agree	Strongly Agree
11.	Taking insulin means I have to give up activities I enjoy	☐	☐	☐	☐	☐
12.	Taking insulin means my health will deteriorate	☐	☐	☐	☐	☐
13.	Injecting insulin is embarrassing	☐	☐	☐	☐	☐
14.	Taking insulin is painful	☐	☐	☐	☐	☐
15.	It is difficult to inject the right amount of insulin correctly at the right time every day	☐	☐	☐	☐	☐
16.	Taking insulin makes it more difficult to fulfil my responsibilities (at work, at home)	☐	☐	☐	☐	☐
17.	Taking insulin helps to maintain good control of blood glucose	☐	☐	☐	☐	☐
18.	Being on insulin causes family and friends to be more concerned about me	☐	☐	☐	☐	☐
19.	Taking insulin helps to improve my energy level	☐	☐	☐	☐	☐
20.	Taking insulin makes me more dependent on my doctor	☐	☐	☐	☐	☐

PART 4. PATIENT HEALTH QUESTIONNAIRE-9

Some people with type 2 diabetes can often feel depressed. The PHQ-9 questionnaire is a helpful measure of psychological well-being and is often used in research.

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)				
Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people (tick one box)?

Not difficult at all	Somewhat difficult	Very difficult	Extremely Difficult
☐	☐	☐	☐

Developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke and colleagues, with an educational grant from Pfizer Inc.

PART 5. SUBJECTIVE NUMERACY SCALE (SNS-3)

Some patients are happy to adjust their insulin dose whilst others have difficulty. These questions assess what you think of your ability to work with numbers in general and how useful you find numerical information.

For each of the following questions please **tick the box** that best reflects how good you are at doing the following things:

	(Range from 1–6)	**Not good at all**					**Extremely good**
1.	How good are you at working with fractions?	☐1	☐2	☐3	☐4	☐5	☐6

	(Range from 1–6)	**Not good at all**					**Extremely good**
2.	How good are you at figuring out how much a shirt will cost if it is 25% off?	☐1	☐2	☐3	☐4	☐5	☐6

	(Range from 1–6)	**Never**					**Very often**
3.	How often do you find numerical information to be useful?	☐1	☐2	☐3	☐4	☐5	☐6

McNaughton C.D., Cavanaugh K.L., Kripalani S., Rothman R.L. & Wallston K.A. (2015) Validation of a Short, 3-Item Version of the Subjective Numeracy Scale. *Medical Decision Making.*

Please write in this box if you wish to add further information to your answers on ANY of the pages in this questionnaire.

Please turn the page.

PART 6. ABOUT YOU

Please tick the boxes that best describe you

1. Your age: ☐ 18-29 ☐ 30-49 ☐ 50-69 ☐ 70-89 ☐ 90 or over

2. Are you: ☐ Employed ☐ Unemployed ☐ Retired
☐ Semi-employed ☐ Other: …….....

3. Do you live on your own? ☐ Yes ☐ No

4. How would you describe your ethnic origin?
☐ White British ☐ White Other ☐ Black
☐ Asian ☐ Chinese ☐ Mixed ☐ Other: .....

Interview

Please indicate your agreement to be or not be interviewed. This will be conducted in a confidential way either at your home, a GP surgery, or a place of your choosing.

I am happy for you to contact me to be interviewed: ☐ Yes ☐ No

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When you have answered the questions please return the Questionnaire and Consent Form in the reply-paid envelope

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If you have any questions or require Further information then please contact:

Kathy Ellis, Whitstable Medical Practice, Tel: 01227 795130

or email: kathyellis@nhs.net or kathy.ellis@kcl.ac.uk

Thank you for taking part in this study.

Your answers will contribute to helping us improve standards in diabetes care and develop future services.

Appendix 7. Telephone Questionnaire

TELEPHONE QUESTIONNAIRE SCRIPT

I'm phoning from King's College London about the insulin survey which you kindly completed via [name GP Practice where patient is registered].

You indicated on your questionnaire that you would be willing to be interviewed about your insulin. This involves answering a few brief questions over the telephone and takes 5-10 minutes, are you still happy to do this? [if *yes*] Is it convenient for you to answer the questions now or would you prefer a different time?

Thank you and just to emphasize, any information you give us will be anonymous and what you say will not be linked to you or revealed to a third party unless you request it. OK we have five questions for you.

1. **a)** Do you inject your insulin yourself? *(Yes or No)*

   b) If not, then who does?
2. **a)** I'd like to ask you about 'hypo's. Have you ever had a low sugar, sometimes called a hypo – a reading of less than 4mmols? *(Yes or No).*

   (If Yes) How often has that happened to you?

   b) *In the last month*: (*n =)*?

   c) *In the last year* (*n =)*?

   d) Has anyone ever explained what a hypo is and how to treat it? *(Yes or No)*

   e) Have you ever had a severe hypo where your blood sugar was low you weren't with-it or didn't realise it was happening, and someone had to give you something to bring your sugar level up? *(Yes or No)*

   f) *(If yes)* How long ago was the last one?

   g) How often has that happened since you started insulin (*n =)*?
3. **a)** What's the name of your insulin and what's your current dose?

   b) (*If on more than one type of insulin)* What's the name of your other insulin & dose?

   c) When did you last change your insulin dose?

   d) Did you decide to do this or were advised to by a doctor or nurse?

   e) How often do you *(or your doctor or nurse)* change the insulin dose?
4. What is the one most difficult or challenging thing about your insulin treatment?
5. What is the one most helpful thing in helping you use or manage your insulin?

Thank you very much for your time.

Appendix 8. SPSS Dataset Code Book

Extracts from the SPSS Dataset Code Book

SPSS Name	Variable	Coding Instructions	Measurement
Study_ID	Study identifier	Study code allocated to each participant	Scale
Practice_ID	Practice identifier	1 2 3 4 5	Ordinal
Contact	Agrees to be contacted for interview	1 = yes 0 = no	Nominal
Gender	Gender	1 = Female 0 = Male	Nominal
Age	Age	Age in years	Scale
Lives_alone	Lives alone	1 = yes 0 = no	Nominal
Works	Employment status	1 = employed 2 = semi-employed 3 = unemployed 4 = retired 5 = other	Nominal
Insulin_years	Duration of insulin treatment	Years receiving insulin	Scale
HbA1c_recent	Most recent HbA1c	HbA1c level in mmol/mol	Scale
BMI	Body Mass Index	Body Mass Index measured in kg/m^2	Scale
Smokes	Smoking Status	0 = never smoked 1 = ex-smoker 2 = smoker	Nominal
Insulin_type	Insulin regimen type	1 = basal-only 2 = basal-bolus 3 = premix	Nominal
BP	Hypertension	1 = yes 0 = no	Nominal
CHD	Coronary Heart Disease	1 = yes 0 = no	Nominal
Resp	Respiratory disease	1 = yes 0 = no	Nominal
Joint	Joint problems	1 = Joint problems	Nominal

Appendix 9. NHS Research Ethics Documents

Summary of Substantial Amendment Applications

Approval date & protocol version (v)	Amendments approved by SE Scotland Research Ethics Committee 02
28/04/15 Protocol v1	Provisional ethical opinion was given subject to clarification of specific issues and changes to the related documents. These related to protocol wording, recruitment, housebound patients, reminder letters, fate of audio-recordings, provision of an Independent Advisor, and the role of the researcher.
11/05/15 Protocol v2	Changes to the protocol v1 and study documents as requested on 28/04/15.
15/07/15 Protocol v3	The addition of the subjective numeracy scale (SNS-3) to the postal questionnaire v3
29/09/16 Protocol v5	Changes to the protocol to interview the clinicians first, and for the addition of telephone interviews with patients.
	Rejected Application
05/11/15	Telephone reminder to postal survey non-responders at 6-8 weeks.

Summary of Non-Substantial Amendment Applications

Approval date and protocol version (v)	Amendments approved by Kent & Medway Research Management and Governance Consortium
28/07/15 Protocol v4	Minor wording changes in the protocol
	Non-Substantial amendments approved by the Health Research Authority
14/12/16 Protocol v6	Extension of the study to 31/03/17 to enable the interviews to be completed and for the addition of a research assistant.

Lothian NHS Board

South East Scotland Research Ethics Committee 02

Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG
Telephone 0131 536 9000

www.nhslothian.scot.nhs.uk

Date 28 April 2015
Your Ref
Our Ref

Enquiries to: Joyce Clearie
Extension: 35674
Direct Line: 0131 465 5674
Email: Joyce.Clearie@nhslothian.scot.nhs.uk

27 March 2015

Professor Angus Forbes
Florence Nightingale Faculty of Nursing & Midwifery, King's College London
James Clerk Maxwell Building
57 Waterloo Road, London
SE1 8WA

Dear Professor Forbes

Study title: **A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes**
REC reference: **15/SS/0080**
IRAS project ID: **165620**

The Proportionate Review Sub-Committee of the South East Scotland REC 02 reviewed the above application on 24 April 2015.

Provisional opinion

The Sub-Committee would be content to give a favourable ethical opinion of the research, subject to clarification of the following issues and/or the following changes being made to the documentation for study participants:

- The Committee would prefer for the initial approach to be made by a member of each patient's healthcare team. Please provide clarification on recruitment process particularly to points raised by the Committee in their discussion. See below.
- The exclusion of housebound people should be explained.
- Unless a compelling reason to do so can be provided, the investigators are discouraged from issuing reminder letters to prospective participants.
- Wording of the invitational letter(s) should be revised to avoid the possibility of these seeming to be coercive.
- The invitational letter(s) and PIS should be clear that there is no obligation to take part, and that participants can withdraw at any time.
- The fate of audio recordings should be explained in the PIS.

- The role of the REC should be explained correctly in the PIS.
- Provision of an Independent Advisor should be considered, and the role of Kathy Ellis explained in the PIS.
- Where appropriate documentation should be revised to reflect any changes made e.g. protocol, information sheets, invitational letter etc. (There is no requirement to re submit the IRAS REC form or have it re authorised)

Lothian NHS Board

South East Scotland Research Ethics Committee 02

Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG
Telephone 0131 536 9000

www.nhslothian.scot.nhs.uk

Date 11 May 2015
Your Ref
Our Ref

Enquiries to: Joyce Clearie
Extension: 35674
Direct Line: 0131 465 5674
Email: Joyce.Clearie@nhslothian.scot.nhs.uk

11 May 2015

Professor Angus Forbes
Florence Nightingale Faculty of Nursing & Midwifery, King's College London
James Clerk Maxwell Building
57 Waterloo Road, London
SE1 8WA

Dear Professor Forbes

Study title:	**A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes**
REC reference:	**15/SS/0080**
IRAS project ID:	**165620**

Thank you for your letter of 1st May 2015, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved by the sub-committee.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this favourable opinion letter. The expectation is that this information will be published for all studies that receive an ethical opinion but should you wish to provide a substitute contact point, wish to make a request to defer, or require further information, please contact the REC Manager Ms Joyce Clearie, joyce.clearie@nhslothian.scot.nhs.uk. Under very limited circumstances (e.g. for student research which has received an unfavourable opinion), it may be possible to grant an exemption to the publication of the study.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Lothian NHS Board

South East Scotland Research Ethics Committee 02

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Date 15 July 2015
Your Ref
Our Ref

Enquiries to: Joyce Clearie
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Direct Line: 0131 465 5674
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15 July 2015

Professor Angus Forbes
Florence Nightingale Faculty of Nursing & Midwifery, King's College London
James Clerk Maxwell Building
57 Waterloo Road, London
SE1 8WA

Dear Professor Forbes

Study title:	**A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes**
REC reference:	**15/SS/0080**
Amendment number:	**AMO1 SA1**
Amendment date:	**08 July 2015**
IRAS project ID:	**165620**

The above amendment was reviewed by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

No significant ethical issues were raised with this amendment.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Covering letter on headed paper [cover letter to ethics re AMO1 SA1]	3	09 July 2015
Notice of Substantial Amendment (non-CTIMP) [AMO1 SA1 8th July 2015]	1	08 July 2015
Other [Insulin questionnaire]	3	01 July 2015
Research protocol or project proposal [Insulin experience	3	01 July 2015

Lothian NHS Board

South East Scotland Research Ethics Committee 02

Waverley Gate
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Date 28 July 2015
Your Ref
Our Ref

Enquiries to: Joyce Clearie
Extension: 35674
Direct Line: 0131 465 5674
Email: Joyce.Clearie@nhslothian.scot.nhs.uk

28 July 2015

Professor Angus Forbes
Florence Nightingale Faculty of Nursing & Midwifery, King's College London
James Clerk Maxwell Building
57 Waterloo Road, London
SE1 8WA

Dear Professor Forbes

Study title:	**A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes**
REC reference:	**15/SS/0080**
Amendment number:	**AMO2 MA1**
Amendment date:	**22 July 2015**
IRAS project ID:	**165620**

Thank you for your emails of 22 and 27 July 2015, notifying the Committee of the above amendment.

The Committee does not consider this to be a "substantial amendment" as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	*Version*	*Date*
Letter from sponsor [Sponsor confirmation MA]		22 July 2015
Notice of Minor Amendment [Notice of MA]		22 July 2015
Research protocol or project proposal [Protocol]	4	20 July 2015

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

Lothian NHS Board

South East Scotland Research Ethics Committee 02

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Enquiries to: Joyce Clearie
Extension: 35674

29 September 2016

Kathy Ellis
Whitstable Health Centre
Harbour Street
Whitstable
CT5 1BZ

Dear Kathy,

Study title:	**A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes**
REC reference:	**15/SS/0080**
Amendment number:	**AM03 (REC Ref 15/SS/0080/AM04)**
Amendment date:	**14 September 2016**
IRAS project ID:	**165620**

The above amendment was reviewed on 23 September 2016 by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

The Committee raised no ethical concerns regarding this amendment.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Notice of Substantial Amendment (non-CTIMP)		14 September 2016
Research protocol or project proposal [Insulin experience protocol with tracked changes]	5.0	14 September 2016
Research protocol or project proposal [Insulin experience protocol clean]	5.0	14 September 2016

Letter of Assurance of Governance for the Five Practice Sites

National Institute for Health Research

RM&G Consortium for Kent & Medway
No 6, The Courtyard
Campus Way
Gillingham Business Park
Kent ME8 0NZ
Phone: 01634 350402
Email: rmgconsortium.km@nhs.net

Mrs Kathy Ellis
[redacted]

29th July 2015

Dear Mrs Ellis,

Research study: assurance of governance

I am writing to inform you that we have carried out research governance in relation to the following research study. We are satisfied that there are no ethical or regulatory reasons for the study not to take place at independent primary care providers listed below. This letter only provides NHS R&D assurance to the independent primary care provider that the governance has been completed. Therefore you must ensure that you seek permission from the practice manager in the first instance and provide them with a copy of this letter (refer to condition 1 below).

It is the responsibility of the Sponsor or study team (as delegated by the sponsor) to provide your site with the correct current set of documents for use in the study.

This is updated version of the original letter (dated 16/7/15). Condition 4 (Researcher authorisation) has been updated to make clear responsibilities for issuing Letter of Access or Honorary Research Contract (f required).

Study details:

Study Title	A study of factors explaining blood glucose control in patients with insulin treated type 2 diabetes
Chief Investigator	Professor Angus Forbes
Sponsor name	King's College London
RMG Consortium's study no.	15-059
Sponsor's reference number	N/A
IRAS number	165620
REC number, REC name	15/SS/0080, South East Scotland REC 02

The RM&G Consortium for Kent & Medway provides services to independent primary care providers in Kent and Medway, Kent Community Health NHS Trust, Medway Community Healthcare CIC, Kent & Medway NHS & Social Care Partnership Trust and South East Coast Ambulance NHS Trust

Participating NHS organisations and locations

Geographic area of Independent primary care provider	Date of Assurance	Site or sites to which assurance applies
NHS Canterbury & Coastal CCG	16/7/15	[redacted]

Amendments to date	Amendment number (local ref)
	1 (V01)

Assurance is provided on the understanding that the study is conducted in accordance with the Research Governance Framework and the Data Protection Act. Assurance is only provided for the activities for which a favourable opinion has been given by the Research Ethics Committee (REC).

The following local conditions will apply

1. **Addition of GP surgeries** — You must ensure that you obtain permission from the practice manager in the first instance and provide them with a copy of this study assurance letter. Please also inform our office so that our records are complete.
2. **Sponsorship of study** — The research sponsor will be the organisation named above; the management and design of the study is not the responsibility of the independent primary care provider.
3. **Confidentiality** — You are required to ensure that all information regarding participants remains secure and *strictly confidential* at all times. You must ensure that you understand and comply with the requirements of the Data Protection Act (1998) and the NHS Confidentiality Code of Practice (www.dh.gov.uk/assetRoot/04/06/92/54/04069254.pdf). Furthermore, you should be aware that under the Act, unauthorised disclosure of information is an offence and such disclosures may lead to prosecution.
4. **Researcher authorisation** — **Important**. Only those researchers holding a Letter of Access or Honorary Research Contract, as appropriate, issued by the independent primary care provider may have direct contact with the participants of the study, unless they already hold a substantive or honorary clinical contract with the independent primary care provider.
5. **Urgent safety actions** — The research sponsor, or the Chief Investigator, or the Principal Investigator or members of the practice which is a research site, may take appropriate urgent safety measures in order to protect research participants against any immediate hazard to their health or safety. You must notify the RM&G Consortium that such measures have been taken. The notification should also include the reasons why the measures were taken and the plan for further action. You should notify the RM&G Consortium within the same time frame as notifying the REC and any other regulatory bodies.

6.	**Serious adverse events (SAE)**	Should an SAE occur during the course of the project, You must immediately notify the RM&G Consortium. This is in addition to your legal duty to report such events to the Sponsor.
7.	**Amendments**	All amendments (whether substantial or minor and including changes to the local research team) need to be submitted in accordance with guidance in IRAS. You should inform this office at the same time as REC is notified to avoid unnecessary delays.
8.	**Indemnity**	You must check with the Sponsor that the indemnity arrangements, as confirmed in the Sponsor's Declaration and described in the application forms, are in place before any participants are recruited.
9.	**Study progression**	You will inform us of any significant developments that occur as the study progresses. You will complete and return any report forms that we send and provide up-to-date information on the number of participants recruited when asked.
10.	**Audit of Study**	Participating sites may also be subject to a random audit of research which will involve a site visit, a requirement to view study documents and a request to interview researchers. A request to audit a research study will be made in writing to you, the Sponsor and the practice manager.
11.	**Study completion**	You will notify the Chief Investigator and this office when the study has completed recruiting participants and when the study is finally finished at your site. You will complete and return the final report that we send and inform us of any publications relating to the study.

Finally, I wish you every success with the study.

Yours sincerely,

Richard Collins

RM&G Manager, RM&G Consortium for Kent and Medway
Copies to Professor Angus Forbes (CI)

Letter of Access for Research to the Researcher from each Practice Site

[Practice letter heading]

Date:

Dear Kathy Ellis

Letter of Access for Research

[Practice name] confirms your right of access to conduct research through their organisation for the purpose and on the terms and conditions set out below. This right of access commences on … and ends on … unless terminated earlier in accordance with the clauses below.

As an existing General Practice employee you do not require an additional honorary research contract with the participating organisation. The organisation is satisfied that the research activities that you will undertake in the organisation are commensurate with the activities you undertake for your employer *[employing practice]*. Your employer is fully responsible for ensuring such checks as are necessary have been carried out and has confirmed this in writing to this organisation.

You have a right of access to conduct such research as confirmed in this letter of permission for research from this organisation. You are considered to be a legal visitor to *[practice name]* premises. You are not entitled to any form of payment or access to other benefits provided by *[employing practice]* to employees. While undertaking research through *[practice name]* you will remain accountable to your employer *[employing practice]* but you are required to follow the reasonable instructions of your nominated manager at *[practice name]* or those given on her/his behalf in relation to the terms of this right of access.

Where any third party claim is made, whether or not legal proceedings are issued, arising out of or in connection with your right of access, you are required to co-operate fully with any investigation by this organisation in connection with any such claim and to give all such assistance as may reasonably be required regarding the conduct of any legal proceedings. You must act in accordance with *[practice name]* policies and procedures, which are available to you upon request, and the Research Governance Framework.

You are required to co-operate with *[practice name]* in discharging its duties under the Health and Safety at Work etc Act 1974 and other health and safety legislation and to take reasonable care for the health and safety of yourself and others while on *[practice name]* premises. Although you are not a contract holder, you must observe the same standards of care and propriety in dealing with patients, staff, visitors, equipment and premises as is expected of a contract holder and you must act appropriately, responsibly and professionally at all times.

You are required to ensure that all information regarding patients or staff remains secure and strictly confidential at all times. You must ensure that you understand and comply with the requirements of the NHS Confidentiality Code of Practice and the Data Protection Act 1998. Furthermore you should be aware that under the Act, unauthorised disclosure of information is an offence and such disclosures may lead to prosecution.

This letter may be revoked and your right to attend the organisation terminated at any time either by giving seven days' written notice to you or immediately without any notice if you are in breach of any of the terms or conditions described in this letter or if you commit any act that we reasonably consider to amount to serious misconduct or to be disruptive and/or prejudicial to the interests and/or business of the organisation or if you are convicted of any criminal offence.

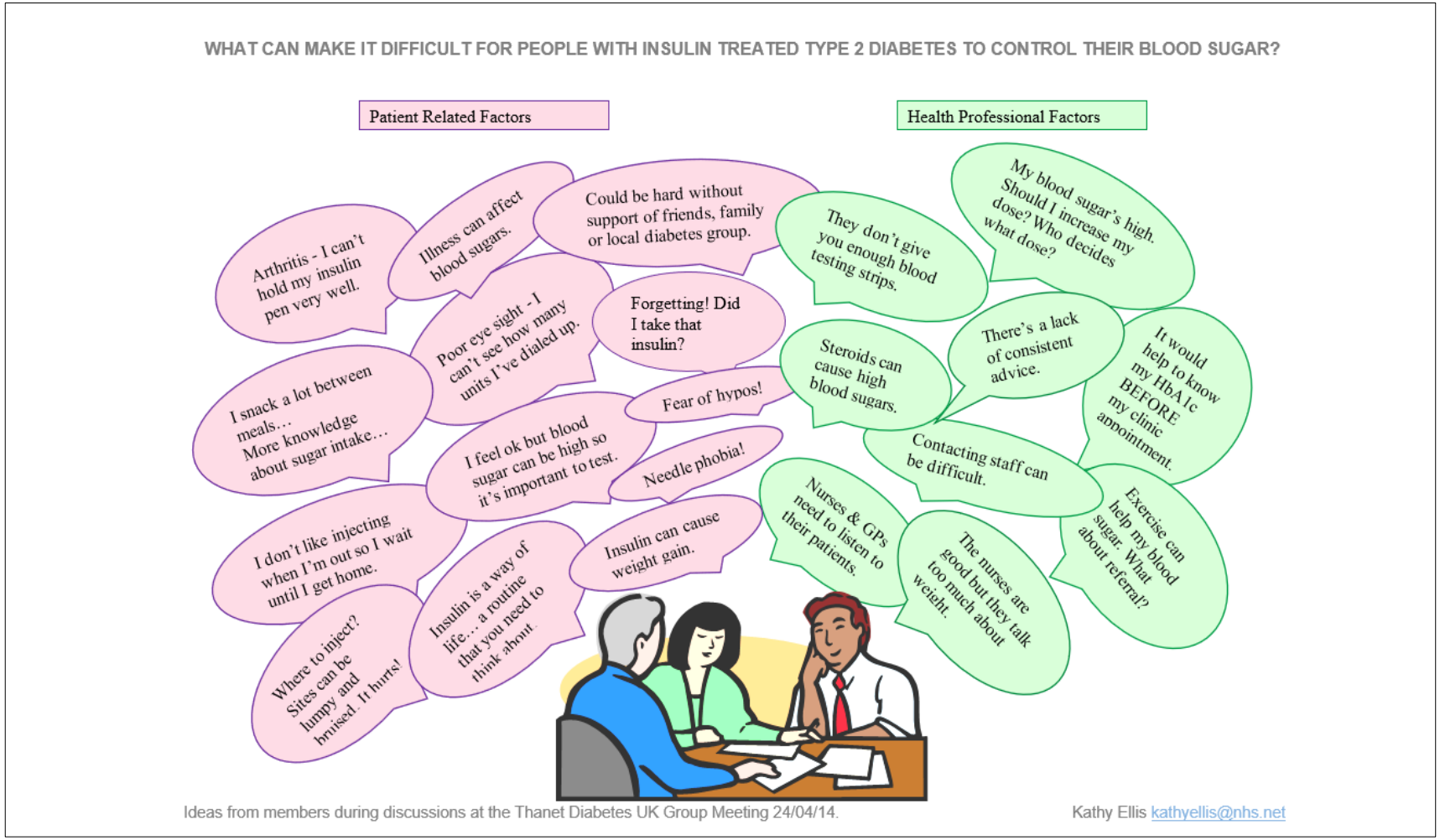
Yours sincerely

[practice manager or lead GP]
[practice name]

cc: Practice Manager *[researcher's employing practice]*

Appendix 10. Patient and Public Involvement Feedback

Feedback information leaflet distributed to the Thanet Diabetes UK group, summarising their suggestions and ideas for the interview topics.



WHAT CAN MAKE IT DIFFICULT FOR PEOPLE WITH INSULIN TREATED TYPE 2 DIABETES TO CONTROL THEIR BLOOD SUGAR?

THEMES WHICH EMERGED FROM YOUR DISCUSSIONS

KNOWLEDGE	INJECTING	DIET & EXERCISE	EVERYDAY LIFE	SUPPORT	HEALTHCARE PROVISION
Glucose Control: • What it means • Its importance • Knowing HbA1c • Effect of illness	• Needle phobia • Fear of pain • Fear of hypos • Remembering • Timing of insulin	• Snacking too little or too much • Knowledge about sugar intake • Balanced diet	**Injecting in public** • Embarrassment • Ashamed • Disapproval • Wait until home	**Support from** • Other Patients • Friends • Family	**Nurses and GPs** • Should listen and take time • Discuss other issues not just weight
Complications: • Nerve endings • Eye sight • Amputations	**Injection difficulties** • Arthritis • Poor vision • Tremors	• The effect of exercise and diet on blood glucose levels • Weight gain with insulin	• Travel abroad • Driving • Eating out • Working	**Support and Information from:** • Local Diabetes Group • Magazines	**Nurses & GPs** • HbA1c result • Insulin teaching e.g. adjusting the dose • Frequency of appts
High Blood Glucose: • Feeling well despite it being high • The reasons why • The need for testing • More insulin?	**Injection sites:** • Lumpy sites • Painful • Bruising • Skin reaction • Where to inject	**Co-existing conditions** • Multiple Sclerosis can restrict exercise • Arthritis can affect ability to inject • Effect of steroids		**Health Professionals:** • How to contact • Inconsistent advice • Nurse and GP skills	**Glucose Test Strips** Strong feelings about prescribing restrictions: • Quantity prescribed • Reasons for not prescribing
Low Blood Glucose • How to manage • How to prevent		**More Information:** • Group education • Exercise Referral • Healthy Walks			**Referrals to** • Dietician • Diabetes specialists

WHAT MY RESEARCH IS ABOUT

The discovery of insulin in 1921 is considered to be one of the greatest medical advances. Insulin therapy has been proven to be an effective treatment in those with poorly controlled type 2 diabetes. Yet many individuals receiving insulin still have poor glucose control, leading to complications. My research seeks to identify contributing factors by examining perspectives of patients, their clinicians, and local health care systems, in order to improve clinical care and to develop future services.

THANK YOU for your enthusiasm during the discussions. Your ideas will help me develop interview topics to use in my research.

Appendix 11. Characteristics of the Survey Participants

Demographic Characteristics of the Postal Survey Participants with Differences Across the Sites

Demographic Data	All *n* = 201	Site 1 *n* = 27 (13%)	Site 2 *n* = 16 (8%)	Site 3 *n* = 24 (12%)	Site 4 *n* = 6 (3%)	Site 5 *n* = 128 (64%)	Tests for differences* (χ^2 or ANOVA)
Gender *n* (%)							χ^2 = 3.167, *df* = 4, *p* = .530
Male	117 (58)	12 (44)	10 (63)	16 (67	3 (50)	76 (59)	
Female	84 (42)	15 (56)	6 (37)	8 (33)	3 (50)	52 (41)	
Age *years*							
Mean (SD) Range	70.1 (10.3) 37–90	69.4 (11.4) 48–87	70.4 (9.13) 50–88	68.6 (10.2) 51–88	70.3 (10.5) 55–87	70.5 (10.4) 37–90	*F* = 0.196, *df*4, *p* = .940
Ethnicity *n* (%)							χ^2 = 28.501, *df* = 20, *p* = .098
White British	187 (93)	24 (89)	15 (94)	23 (96)	6 (100)	119 (93)	
White other	7 (3.5)	-	-	-	-	7 (5)	
Asian	3 (1.5)	2 (7)	-	-	-	1 (1)	
Other	3 (1.5)	-	1 (6)	1 (4)	-	1 (1)	
Missing	1 (0.5)	1 (4)	-	-	-	-	
Living alone *n* (%)							χ^2 = 5.884, *df* = 4, *p* = .208
Yes	46 (23)	10 (37)	5 (31)	3 (12)	1 (17)	27 (21)	
No	153 (76)	16 (59)	11 (69)	21 (88)	4 (66)	101 (79)	
Missing	2 (1)	1 (4)	-	-	1 (17)	-	

Demographic Data	All *n* = 201	Site 1 *n* = 27 (13%)	Site 2 *n* = 16 (8%)	Site 3 *n* = 24 (12%)	Site 4 *n* = 6 (3%)	Site 5 *n* = 128 (64%)	Tests for differences* (χ^2 or ANOVA)
Employment *n* (%)							χ^2 = 19.216, *df* = 20, *p* = .508
Employed	40 (20)	3 (11)	4 (25)	6 (25)	1 (17)	26 (20)	
Unemployed	4 (2)	1 (4)	-	1 (4)	-	2 (2)	
Retired	148 (74)	19 (70)	11 (69)	16 (67)	5 (83)	97 (75)	
Other	6 (3)	3 (11)	1 (6)	-	-	2 (2)	
Missing	3 (1)	1 (4)	-	1 (4)	-	1 (1)	
Smoking status							χ^2 = 9.526, *df* = 8, *p* = .300
Never smoked	79 (39)	11 (41)	8 (50)	11 (46)	3 (50)	46 (36)	
Ex-smoker	102 (51)	12 (44)	7 (44)	8 (33)	2 (33)	73 (57)	
Smoker	20 (10)	4 (15)	1 (6)	5 (21)	1 (17)	9 (7)	
Weight kilogrammes							*F* = 1.686, *df*4, *p* = .155
Mean (SD) Range	94.1 (21.5) 42.3–165	87.7 (19.1) 66–152	88.4 (14.7) 55–104	102 (30) 59–165	93.9 (18.5) 76–126	94.8 (20.7) 42–152	
BMI *kg/m2*	32.7 (7.63)	30.1 (6.13)	30.8 (4.92)	33.9 (9.51)	34.7 (8.82)	33.2 (7.68)	*F* = 1.392, *df*4, *p* = .238
Mean (SD) Range	18.6–61	21–49.6	21–37.6	18.6–50.9	28–52	19.6–61	
Categories *n* (%)							χ^2 = 22.503, *df* = 16, *p* = .128
<25	24 (12)	4 (15)	2 (13)	4 (17)	-	14 (11)	
25 to <30	59 (29)	10 (37)	5 (31)	8 (33)	2 (33)	34 (27)	
30 to <40	85 (42)	10 (37)	9 (56)	4 (17)	3 (50)	59 (46)	
≥40	32 (16)	2 (7)	-	8 (33)	1 (17)	21 16)	
Missing	1 (1)	1 (4)	-	-	-	-	

*Level of significance is .05 or less

Key: ANOVA = analysis of variance; BMI = body mass index; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; *p* = p-value.

Clinical Characteristics of the Postal Survey Participants with Differences Across the Sites

Clinical Data	All *n* = 201	Site 1 *n* = 27	Site 2 *n* = 16	Site 3 *n* = 24	Site 4 *n* = 6	Site 5 *n* = 128	Tests for differences* χ^2 or ANOVA
HbA1c *mmol/mol* *Mean (SD) Range*	63.9 (16.9) 37–168	63.7 (24.3) 42–168	60.4 (12.9) 48–100	58.3 (11.4) 39–86	56.5 (9.38) 46–70	65.7 (16.3) 37–115	*F* = 1.513, *df*4, *p* = .200
Categories *n (%)* ≤59 *>59 to ≤69* >69	 95 (47) 50 (25) 56 (28)	 16 (59.3) 5 (18.5) 6 (22.2)	 10 (62.5) 4 (25) 2 (12.5)	 13 (54.2) 7 (29.2) 4 (16.7)	 4 (66.7) 1 (16.7) 1 (16.7)	 52 (40.6) 33 (25.8) 43 (33.6)	χ^2 = 8.865, *df* = 8, *p* = .354
T2DM duration *years* *Mean (SD) Range*	17 (7.58) 2–45	15.8 (9.19) 4–45	16.5 (5.6) 7–30	15.3 (5.08) 5–30	19.8 (5.88) 12–28	17.4 (7.88) 2–43	*F* = 0.823, *df*4, *p* = .512
Insulin duration *years* Mean (SD) Range	7.92 (6.15) 1–40	9.39 (8.82) 1–40	8.37 (5.3) 1–17	7.46 (5.25) 1–24	7.83 (5.08) 2–15	7.64 (5.8) 1–30	*F* = 0.502, *df*4, *p* = 0.734
Insulin Regimen *n* (%) Basal-only Basal-bolus Premix	 61 (30) 74 (37) 66 (33)	 7 (25.9) 12 (44.4) 8 (29.6)	 3 (18.8) 4 (25) 9 (56.3)	 7 (29.2) 7 (29.2) 10 (41.7)	 1 (16.7) 2 (33.3) 3 (50)	 43 (33.6) 49 (38.3) 36 (28.1)	χ^2 = 7.947, *df* = 8, *p* = .439
Total daily units of insulin (TDU) *Mean (SD) Range*	72 (52) 7–300	68 (44.6) 18–210	79 (38.9) 16–134	69 (42.1) 20–166	60 (41.1) 7–110	72 (56.9) 8–300	*F* = 0.209, *df*4, *p* = .933
Total Cholesterol *mmol/L* *Mean (SD) Range*	4 (1) 2–10.5	4.57 (1.52) 2.9–10.5	3.73 (0.856) 2.2–5.5	3.64 (0.716) 2.3–5.1	3.95 (0.809) 3.2–5.4	3.99 (0.897) 2–6.9	***F* = 3.404, *df*4, *p* = .010***
Categories *n (%)* ≤5 >5	 180 (90) 21 (10)	 21 (78) 6 (22)	 15 (94) 1 (6)	 23 (96) 1 (4)	 5 (83) 1 (17)	 116 (91) 12 (9)	χ^2 = 5.720, *df* = 4, *p* = .221

Clinical Data	All *n* = 201	Site 1 *n* = 27	Site 2 *n* = 16	Site 3 *n* = 24	Site 4 *n* = 6	Site 5 *n* = 128	Tests for differences* χ^2 or ANOVA
Blood Pressure (BP) *mmHg*							
Mean Systolic (SD) range	134 (14.5) 99–199	125 (10.7) 100–150	136 (9.27) 118–150	132 (18.9) 100–199	126 (10.8) 108–138	136 (14.4) 99–188	***F* = 3.510, *df*4, *p* = .009*** χ^2 = 6.989, *df* = 4, *p* = .136
Categories *n (%)*							
≤140	166 (83)	26 (96)	13 (81)	21 (88)	6 (100)	100 (78)	
>140	35 (17)	1 (4)	3 (19)	3 (12)	-	28 (22)	
Mean Diastolic (SD) range	71.6 (9.21) 42–102	70.9 (8.24) 56–88	72.6 (9.68) 56–93	72.8 (9.84) 50–102	74.5 (4.18) 70–80	71.3 (9.46) 42–100	*F* = 0.347, *df*4, *p* = .846 χ^2 = 4.049, *df* = 4, *p* = .399
Categories *n (%)*							
≤80	188 (93)	26 (96)	13 (81)	22 (92)	6 (100)	119 (93)	
>80	15 (7)	1 (4)	3 (19)	2 (8)	-	9 (7)	
eGFR *ml/min/1.73m²*							
Mean (SD) Range	63.3 (20.8) 7–93	57.3 (25) 7–90	59.3 (19.3) 22–90	71.5 (19.6) 29–93	57.5 (16) 32–78	63.8 (20.1) 8–90	*F* = 1.819, *df*4, *p* = .127 χ^2 = 13.274, *df* = 16,
Categories *n (%)*							
≥90	31 (15)	4 (15)	1 (6)	7 (30)	-	19 (15)	*p* = .653
60-89	89 (44)	9 (34)	8 (50)	8 (33)	3 (50)	61 (48)	
30-59 (CKD 3)	66 (34)	10 (37)	6 (38)	8 (33)	3 (50)	39 (30)	
15-29 (CKD 4)	11 (5)	2 (7)	1 (6)	1 (4)	-	7 (6)	
<15 (CKD 5)	4 (2)	2 (7)	-	-	-	2 (1)	
Comorbidities**							
Categories *n (%)*							χ^2 = 20.839, *df* = 12,
0–1	47 (23)	2 (7)	4 (25)	5 (21)	1 (17)	35 (27)	*p* = .053
2	55 (28)	2 (7)	5 (31)	8 (33)	3 (50)	37 (29)	
3	52 (26)	10 (37)	3 (19)	6 (25)	2 (33)	31 (24)	
≥4	47 (23)	13 (49)	4 (25)	5 (21)	-	25 (20)	

*Level of significance is .05 or less **Comorbidity includes any of the following categories: Cardiovascular disease, Hypertension, CKD (chronic kidney disease), Endocrine, Gastrointestinal, Respiratory, Neurological, Cancer and Mental Illness.
Key: ANOVA = analysis of variance; χ^2 = Chi-square value; *df* = degrees of freedom; *F* = F statistic; HbA1c = glycated haemoglobin; IQR = interquartile range; *Md* = median; *p* = p-value.

Characteristics of the Telephone Survey Participants

Characteristics	**Interviewees (*n* = 124) *n* (%)**
Gender *n* (%)	
Male	72 (58)
Female	52 (42)
Age *years*	
Mean (SD) Range	69.5 (10.7) 37-90
Ethnicity *n* (%)	
White British	115 (93)
White other	5 (4)
Asian	3 (2)
Other	1 (1)
Living alone *n* (%)	
Yes	25 (20)
No	99 (80)
Employment *n* (%)	
Employed	31 (25)
Unemployed	2 (2)
Retired	85 (68)
Other	5 (4)
Missing	1 (1)
Smoking status *n* (%)	
Never smoked	50 (40)
Ex-smoker	60 (49)
Smoker	14 (11)
Weight *kgs. Mean (SD) Range*	93.21 (20) 54.2–158
BMI *kg/m2 Mean (SD) Range*	32.17 (6.80) 19.9–57.6
HbA1c *mmol/mol Mean (SD) Range*	64.4 (15.8) 37-126
Categories *n* (%)	
≤59	55 (44)
>59 to ≤69	33 (27)
>69	36 (29)
T2DM duration *years*	
Mean (SD) Range	16.3 (7.4) 4–45
Insulin duration *years*	
Mean (SD) Range	7.86 (6.54) 1–40
Insulin Regimen *n* (%)	
Basal-only	36 (29)
Basal-bolus	50 (40)
Premix	38 (31)

Key: BMI = body mass index; HbA1c = glycated haemoglobin.

Appendix 12. Challenges and Enablers When Using Insulin

Difficulties or Challenges of Insulin Therapy

CATEGORIES (responses *n*)	Subcategories (responses *n*)		Coded Responses (*n*)
1. INSULIN USE (*n* = 92)	Injection Site Problems (*n* = 40)	Injection pain (*n* = 21)	Pain (*n* = 21)
		Sites affected (*n* = 9)	Bruising (*n* = 4)
			Lumps (*n* = 3)
			Reactions (*n* = 2)
		Dislike (*n* = 6)	Fear or dislike (*n* = 6)
		Practical difficulties (*n* = 4)	Injection ability (*n* = 2)
			Insulin volume (*n* = 2)
	Remembering to Inject (*n* = 23)		Remember to give (*n* = 14)
			Forget when out (*n* = 4)
			Forget at meals (*n* = 3)
			Forget at work (*n* = 1)
			Forget since stroke (*n* = 1)
	Insulin Management (*n* = 20)	Daily management (*n* = 7)	High blood sugars (*n* = 3)
			Number of injections (*n* = 2)
			Insulin supply (*n* = 1)
			OHAs (*n* = 1)
		Dose-adjustment (*n* = 10)	Titration (*n* = 6)
			SMBG (*n* = 4)
		HCP support (*n* = 3)	Practice Nurse (*n* = 2)
			Lack of information (*n* = 1)
	Hypoglycaemia (fear and avoidance) (*n* = 9)		Hypo worries (*n* = 4)
			Severe hypos (*n* = 3)
			Hypo triggers (*n* = 2)

CATEGORIES (responses *n*)	Subcategories (responses *n*)		Coded Responses (*n*)
2. PSYCHOSOCIAL ASPECTS (*n* = 37)	Social Factors (*n* = 23)	Inconvenience (*n* = 11)	Inconvenient (*n* = 7)
			Having to plan (*n* = 2)
			Busy (*n* = 1)
			Travel (*n* = 1)
		Injecting in public (*n* = 7)	Injecting in public (*n* = 7)
		Work (*n* = 3)	Work (*n* = 3)
		Family & friends (*n* = 2)	Family & friends (*n* = 2)
	Psychological Factors (*n* = 14)	Perceptions of insulin (10)	Antipathy (*n* = 2)
			Nothing helps (*n* = 8)
		Reluctant acceptance (*n* = 4)	Bored with (*n* = 2)
			Fed up with (*n* = 2)
3. PHYSICAL HEALTH (*n* = 13)	Food and Weight Issues (*n* = 10)	Food (*n* = 6)	Food (*n* = 6)
		Weight (*n* = 4)	Weight (*n* = 4)
	Comorbidity (*n* = 3)		Comorbidity impact (*n* = 3)

Key: HCP = healthcare professional; hypos = hypoglycaemia; OHAs = oral hypoglycaemic agents; SMBG = self-monitoring of blood glucose.

What Helped to Use or Manage Insulin

CATEGORIES (responses *n*)	Subcategories (responses *n*)		Coded Responses (*n*)
1. INSULIN USE (*n* = 80)	Support for insulin therapy and technologies for delivery (*n* = 34)	Ease of taking (*n* = 25)	Prefer to OHAs (*n* = 7)
			Needle size (*n* = 3)
			Number of injections (*n* = 1)
			Pen-device (*n* = 8)
			Quick & convenient (*n* = 4)
			Injection technique (*n* = 2)
		Healthcare Support (*n* = 7)	Diabetes Review (*n* = 2)
			Practice Nurse (*n* = 4)
			Educational need (*n* = 1)
		Insulin regimen (*n* = 2)	Change of insulin type (2)
	Impact on blood glucose levels (*n* = 25)	Self-management insulin (*n* = 8)	Sufficient supplies (*n* = 2)
			Timing of insulin (*n* = 2)
			Titration (*n* = 4)
		SMBG (*n* = 17)	Monitoring helps (*n* = 4)
			Reward (*n* = 1)
			Seeing improved control (*n* = 10)
			Shows high blood sugars (*n* = 1)
			Sufficient meters (*n* = 1)
	Blood Glucose Awareness (*n* = 11)		Hyper-awareness (*n* = 2)
			Being prepared (*n* = 1)
			Hypo-awareness (*n* = 4)
			Number of hypos (*n* = 2)
			Other people (*n* = 2)

CATEGORIES (responses *n*)	Subcategories (responses *n*)		Coded Responses (*n*)
	Techniques to Help Remember Injections (*n* = 10)	Habit (*n* = 5)	Habit (*n* = 5)
		Techniques (*n* = 5)	Keep at work (*n* = 1)
			Needle reminder (*n* = 1)
			Reminded by others (2)
			Marking in diary (*n* = 1)
2. PSYCHOSOCIAL ASPECTS (*n* = 77)	Psychological Factors (*n* = 61)	Perceptions (*n* = 50)	Perceived benefits (23)
			Positive view (*n* = 2)
			No difficulties (*n* = 25)
		Insulin acceptance (*n* = 11)	Don't deny myself (*n* = 1)
			Mental orientation (*n* = 6)
			Used to it (*n* = 4)
	Social Support (16)	Family and friends (*n* = 9)	Family and friends support (*n* = 9)
		Planning (*n* = 5)	Injecting in public (*n* = 1)
			Going out with insulin & meter (*n* = 1)
			Keeping insulin & meter at work (*n* = 1)
			Meters in house & car (*n* = 1)
			Preparing to treat hypos (*n* = 1)
		Working (*n* = 2)	Work (*n* = 2)
3. LIFESTYLE MODIFICATION (*n* = 13)	Dietary Modification (*n* = 11)		Diet (*n* = 7)
			Diet support groups (*n* = 1)
			Weight + food (*n* = 3)
	Exercise (*n* = 2)		Exercise (*n* = 2)

Key: HCP = healthcare professional; hypos = hypoglycaemia; OHAs = oral hypoglycaemic agents; SMBG = self-monitoring of blood glucose

Appendix 13. Database of the Patient Interviewees

Database of the patients interviewed face-to-face

Patient name*	Gender	Age years	Ethnicity	Lives alone	Work	T2DM years	Insulin years	HbA1c mmol/mol	BMI kg/m^2	Insulin	TDU	GLP-1 RA	Comorbidity *n*
Baaz	male	60	Asian	no	works	14	9	73	24.7	Premix	60		3
Beata	female	76	WO	no	retired	15	11	42	35.3	Premix	46		1
Christine	female	62	Asia	no	retired	18	7	52	21.0	Basal-Bolus	26		1
Edna	female	77	WB	yes	retired	8	2	71	31.9	Basal-only	26		3
Edward	male	78	WB	no	retired	21	20	39	22.8	Premix	68		1
Elsie	female	84	WB	yes	retired	13	2	48	24.5	Basal-only	50		4
George	male	76	WB	no	retired	15	2	80	28.0	Premix	45		3
Gwen	female	61	WB	no	retired	23	7	58	29.0	Basal-Bolus	50		1
Hilda	female	88	WB	yes	retired	17	4	54	28.8	Premix	30		2
Ian	male	54	WB	yes	not working	15	7	126	21.0	Basal-Bolus	130		6
Jack	male	57	WB	no	works	9	4	62	45.7	Basal-Bolus	200		4
James	male	81	WB	no	retired	45	40	63	26.2	Basal-Bolus	28		3
Jane	female	56	WB	no	not working	22	3	64	44.9	Basal-Bolus	210		2
Joan	female	67	WB	no	works	23	18	64	36.2	Premix	32		2
Joe	male	67	WB	no	works	11	10	95	35.7	Basal-Bolus	212		4
John	male	51	WB	yes	retired	11	7	123	28.6	Basal-Bolus	62		5
Mary	female	72	WB	no	retired	20	11	52	34.7	Basal-only	112		4
Muriel	female	52	WB	no	works	6	5	88	46.2	Premix	30		2
Ned	male	59	WB	no	missing	16	2	80	35.2	Basal-only	34		2
Patricia	female	55	WB	no	works	18	15	66	32.3	Basal-only	22	yes	3
Paul	male	70	WB	no	retired	26	6	59	32.6	Premix	68		2

Patient name*	Gender	Age years	Ethnicity	Lives alone	Work	T2DM years	Insulin years	HbA1c mmol/mol	BMI kg/m^2	Insulin	TDU	GLP-1 RA	Comorbidity *n*
Ruth	female	55	WB	no	works	16	5	65	43.7	Basal-only	56		4
Samuel	male	78	WB	no	retired	23	6	63	23.8	Premix	26		5
Sarah	female	52	WB	no	works	8	5	83	31.4	Basal-only	40		2
Sharon	female	70	WB	no	retired	8	2	59	36.8	Premix	134	yes	2
Shaun	male	68	WB	yes	retired	26	10	78	49.6	Premix	118		1
Sid	male	64	WB	yes	retired	19	10	59	21.0	Premix	30		3
Sue	female	45	WB	no	works	13	11	58	31.9	Basal**	100	yes	1
Trevor	male	68	WB	no	retired	31	29	77	27.0	Basal-Bolus	45		3
Valerie	female	59	WB	no	works	15	2	64	23.8	Basal-only	20		2

*Pseudonyms are used to preserve anonymity. **Patient occasionally used prandial insulin in addition to her GLP-1.

Key: BMI = Body Mass Index; GLP-1 RA = Glucagon-like peptide-1 receptor agonist; HbA1c = glycated haemoglobin; TDU = total daily units of insulin; T2DM = type 2 diabetes; WB = White British; WO = White Other.

Appendix 14. Suggested Ideas to Support Insulin Use

Ideas to Support Insulin Use: Integration of the Patient and HCP Suggestions

What the participants would like to see	Patient Suggestions	GP and PN Suggestions
1. INSULIN SERVICES IN GENERAL PRACTICE		
Increased PN and GP-Led Insulin-Support Services		
Insulin-support services in more practices. Reduce referrals made from one health professional to another	Access to insulin support in own general practice. Be able to see a PN that understands insulin to help sort out problems. The person consulted with was as important as the system	Encourage more PNs and GPs to upskill by continuing to provide and advertise local courses for insulin management. Provide practical education at foundation level for insulin management in primary care for new GP Registrars, PNs and Community Nurses.
Practice-practice-support		Commission larger, skilled practices to support colleagues in other practice to: help manage their patients and inspire those GPs and PNs to upskill
Improved Access to Support		
Improved access to insulin support for patients who are reluctant or unable to attend at other times.	To be able to attend for insulin-related advice and support at short notice. Not having to book an appointment in advance.	An evening drop-in clinic for patients with insulin-treated T2DM led by a PN or GP.
2. INSULIN MANAGEMENT TOOLS		
Self-Adjustment Tools		
A simple insulin self-adjustment tool	A simple diagram or flow chart with instructions to show how to adjust dose.	A credit card size tool with simple instructions for when to increase or decrease doses.
An App for self-adjusting insulin, specific to T2DM patients.		An easy-to-use app for self-adjustment of insulin doses suitable for a range of ages.
A fix-it manual		A book with practical diagrams and explanations of how to problem-solve and self-adjust insulin.
Access to Test Results		
Access to HbA1c blood test result before consultation	To have automatic access to most recent HbA1c result before attending for diabetes review.	

What the participants would like to see	Patient Suggestions	GP and PN Suggestions
3. GROUP EDUCATION		
Group education for patients established on insulin	A small group-based in general practice for insulin-treated T2DM, led by a GP or PN. Include family, work colleagues, and others	Group education for insulin-treated T2DM based within or outside of general practice. Led by a healthcare professional.
4. PEER SUPPORT		
Peer support for insulin-treated T2DM	A small forum of people to sit and talk with others who use insulin. They could support one another and share experiences and of using insulin. Involve a health professional.	People listening to each other, so they know what to do. Involve a healthcare professional to ensure the advice is appropriate.
Buddy-type peer support	A one-to-one buddy system to support those with difficulties.	Buddying up with other patients in the practice so they don't feel so alone. To help tackle everyday challenges of insulin.
5. THE MEDIA		
Televised programmes and documentaries	Use television to raise public awareness of insulin treatment such as for injecting in public. To provide insulin-related education (with positive messages) for insulin-treated T2DM patients.	Television for educational support for insulin use.
Public Figures	Public figures with insulin-treated diabetes could use their media presence to support patients and enable the general public to understand the challenges around insulin use.	

Key: GP = General Practitioner; PN = Practice Nurse; T2DM = type 2 diabetes.

Appendix 15. Integration of Patient and Healthcare Professional Perspectives

PATIENTS	GPs AND PRACTICE NURSES
1. HEALTHCARE SYSTEMS	
Care Integration	
I found it very frustrating, because I wasn't able to bring it [different insulin] back from hospital. I had to get it prescribed. Fortunately, Doctor [name of GP] was absolutely brilliant and managed to get it from a local chemist. (George)	*They've been discharged from hospital before the in-house nurse could have time to finish off what she was doing with them, so they were suddenly out in the community with this pen.* (PN1)
Insulin Service Provision	
They said, "Mrs…we can take your blood, we can check your feet, we can do anything else for you, but we know nothing about whether to put your [insulin] units up or down". (Hilda)	*An insulin change, I'll do myself. If someone's on an insulin and sometimes it just doesn't appear to be working that well for them then I'll discuss a different insulin with them and will change them onto that if need be.* (PN3)
I find it good having it because my surgery have it [insulin support] in-house and I've actually got a rapport with [PN] and I can ring her up any time if I'm having any problems. (Gwen)	
If there was somebody within the surgeries that I belong to that could say, "Now what's happening to you? Come on let's get this sorted out. I'll tell you your numbers" and then, "that's where you're going wrong". (Paul)	*We don't need to as there are already services [diabetes specialists] out there.* (GP2)
Access to Support	
I can normally see a PN within the week or if it's more serious than that, I get a phone call from one of them to see if it's something immediate that needs to be sorted. If not, then it's OK. (Trevor)	*By telephone yes…I do say to them you know I'm their first point of contact and if there's anything that I can't help them with I would find that person who can and then I would either call them back or get back in touch or see them or refer them.* (PN2)

PATIENTS	GPs AND PRACTICE NURSES
I only ever saw him once [GP who started her insulin], I didn't see him again. He just said, "If you've got any queries, just ring up" …but I haven't seen him since, with regard to that…I suppose if a patient's going to manage things themselves, they'll let them do it. (Elsie)	*There is no direct line…if I'm not here or if [name of PN] is more accessible then the call is put through to [name of PN] for phone calls about insulin adjustment etc. So, most of the time one or other of us are here…but I wouldn't say it was terribly accessible because there's no specific number for them to use. (GP1)*
As lovely as the ladies are, the nurses [PNs], I can never get to see them, they're so busy. (Joe)	*The appointment system is all very well but well you know a lot of young men out there just do not engage with the business of standing in a line [at reception] and waiting to discuss having an appointment in three weeks' time." (GP1)*
2. SELF-MANAGEMENT	
Self-Adjustment of Insulin	
My biggest problem … understanding the insulin and how to adjust it to the food. (Gwen)	*They'll get very confused. If it's high they'll suddenly lower their insulin and you say, "Why did you do that?", "Well because it was high", "But you should have increased your insulin", "Oh yes I got it the wrong way 'round haven't I".* (PN11)
If you've got problems with your morning readings, you have to sort your evening reading …but it's never really been explained. (Muriel)	*It's written down for them, so they know when to increase it or lower it.* (PN3)
I just know it [insulin] hasn't worked so I then "fire-chase" [injects additional prandial insulin]. (James)	*Look there's nothing dangerous about this – two units of insulin every two or three days. You go up, you go down.* (GP3)
I'll take my blood sugar before I do those [twice-daily Levemir injections] and it depends on what they are as to how much I take … if they're high [at the time of injecting] then I give more [Levemir]. I also have some NovoRapid that I'm not supposed to take but if I've got a blood sugar of fourteen, fifteen, sixteen…well if it's over 10 then I give myself some NovoRapid to bring it down. (Sue)	

PATIENTS	GPs AND PRACTICE NURSES
Some of the readings I must admit are a bit high...I sometimes take a bit of NovoRapid before I went to bed – just 10 [units] or something if it was running high. But eh talking to the diabetic nurse, she said, "Don't do that." (Joe)	*Yes and its basically empowering the patient…but basically yes, you're trying to turn people into endocrinologists really in some respects which they haven't got the capability of – that isn't meant to be arrogant – of taking it on board.* (GP3)
Expectation to Self-Manage	
They [PNs] can only do so much, and the onus is really on the patient rather than the Practice Nurse to look after yourself. (Trevor)	*It's encouraging them to take control.* (PN3)
I'm quite comfortable with being told what to give. (Edward)	
It's like we live in a society where you want the doctors or the nurses to tell you what to do and that you don't want to do anything yourself. Some might find that difficult or worry about doing the wrong thing. They don't realise that it's your control that's going to make you feel OK. (Christine)	*You have to have a shifting of minds you know to get people to own their own illness and diabetes.* (GP1)
I thought, "I don't know, sometimes it's up, sometimes it's down, maybe, I need a bit more [insulin]". I didn't know, and I daren't put another unit, no, not myself, I wouldn't do that. (Hilda)	*There have been patients [who could self-manage], some because they didn't realise that they could.* (PN2)
Target Setting	
Yes, I'm told that every time I have a blood test [that the HbA1c is high]. Again, I just say to myself that's their target, my body does this, and my body's happy with it. (John)	*We discuss that. That's a joint decision with us and the patient. We work it out together what they feel they can manage and what we suggest is, you know, at least an appropriate level for them.* (PN1)
	At the front of every diary, when she [the patient] starts a new diary, I always write, "BMs [blood glucose] before breakfast should be … BMs after your meal should be …. Before bed should be". (PN11)
	I've been here a while and I've tried to explain to the patient that this is what it's stands for, this is what it should be. (PN4)

PATIENTS	GPs AND PRACTICE NURSES
Because there's nothing like a target to go for…and in the end, they told me that 75 and 79 was high and, in the end…I didn't pester, I just brought it into the conversation. "Well", I said, "how far" or something like, "how low do I have to get?" (Paul)	*Actually, a lot of them know what the target should be, to be fair, and if it is running a bit high, then we discuss it and I basically discuss at the particular point, the benefits of it being a bit high for them. A lot of them know because they've had diabetes for quite some time.* (PN3)
3. HCP-PATIENT–COMMUNICATION	
Consultation Style	
She has two things that have helped me. One, she speaks straight, and she speaks in a language I can understand and secondly, she never condemns which I think to be honest with you, the people who've look after me, over the time, have always condemned. (James)	*I think it's just about getting a rapport with your patient…it's only through meeting them a few times that I think you know where to pitch it and there's no point in saying "Do this, this and this" because if you do they're not going to come back and see you again…It is always about your therapeutic relationship.* (PN11)
To be honest with you, they got to explain it better 'cause, I'm not being… look, the doctors are lovely so are the nurses and everything but it's all medical terms. (Ian)	*I think with the Practice Nurses they establish a very good rapport with them. So often when they come and see us, they won't say much but when they see [PNs], they open up. So often [PN] will tell me things and I'm thinking, "well I've just seen this patient, but they didn't say that to me". So yes, more so with the nurse than with the GP.* (GP4)
Communicating the Level of Glycaemic Control	
Because I ask [for HbA1c result]. You would get generalisms…or, "Your cholesterol's good" which it always is, "and your HbA1c oh, yes now that's given us cause for concern" and gradually I teased numbers out of them. (Paul)	*Yes, otherwise it's a bit like trying to drive a car without a speedometer. If they haven't got the result, they don't know what's going on. Then we look at what's going on.* (GP2)
It's [HbA1c] very important to you to see how you're managing over a longer period of time as opposed to your daily management, or weekly, and although I keep a diary of that, it's important to see what else is going on - oh yes that is important as well. Because you can be, falling into long-term problems if you don't manage your diabetes as long as you can. (Trevor)	*We have a diabetic management plan which has all their details on it…It will also tell them what their most recent HbA1c is or should be…We print it off and hand that to them.* (PN1)

PATIENTS	GPs AND PRACTICE NURSES
It doesn't mean anything to me. Since nobody really explains that part of it and I sort of think well, again, I go on the attitude that if there's something wrong, they'll tell me. I will just rely on that. (Edward)	*Some of them want to know, some of them don't. As long as they're controlled, they don't care. And I think that's as far as they're concerned you know; they want to know that what they're doing is OK.* (PN4)
4. BARRIERS TO INSULIN USE	
Intentional Non-Adherence	
Social Factors	
Well, the only place to do that [inject] really is in the toilet. I wouldn't want to do that [inject] at the table. (Joe)	*They'll vary it sometime [when eating out], they'll take it before or if they've gone out, they'll take it after…when they get back home.* (PN3)
We done it [injected] at about six o'clock, before we left here [to eat out] …we started to eat about half seven or something or eight o'clock. So that was the time between giving the injection until you eat, so that was, you know, not too long [2hours after injecting premix]. (Beata)	
I find, since I've been on the insulin, I've put on weight. My weight is so difficult to take off...I try to lose weight, because I have an overweight problem, I find it harder to control my diabetes and that's why I go off my diet because I find it hard to control it…the blood sugars go down too low (Ruth)	*It's [weight gain] obviously an issue. Obviously, they're told that when they start insulin that perhaps they need to be a bit more careful with their diet and exercise.* (PN1)
Psychological Factors	
So, like this morning I'd have my breakfast, I'd taken my tablets, but I feel OK, so I haven't injected. (Gwen)	*When we actually explain to people and say, "Your HbA1c is high; it should be this" blah, blah, blah, more than half will come back and say, "Well, I feel fine". Because they don't feel unwell, they think "No, I feel fine"* (PN11)

PATIENTS	GPs AND PRACTICE NURSES
I felt like I was a failure then because if I'd have go myself in control when I was actually just managed by tablets, if I'd have got control of it then, I wouldn't have got to the insulin stage, but I just felt, "Stupid, you stupid woman". (Gwen)	*I think some patients still view it as a failure on their part that they're having to go onto insulin. I do point out to them that we're only palliating the disease and there's no cure and so it's not surprising that it's going to advance at some point and they're going to need more intensive treatment.* (GP2)
I know the understanding is if I don't take it, I'm going to die – as simple as. And I try and take it and I do take it but it's just, it brings me into tears. As soon as I take it I gotta lie down and have a cry. (Ian)	*I think their main fears is actually the injection itself.* (GP4)
Hypoglycaemia	
I don't know how achievable it is to get it to the level they really want without it actually impacting on your work, your life you know, you might have more hypos and things. You'd have to have blood sugars between four and five or something like that a lot of the time. (Valerie)	*Most of them are worried about becoming hypo especially at night, the middle of the night.* (GP2)
Unintentional Non-Adherence	
It's normally quite a while. It could be three or four hours after a meal that it suddenly clicks that 'Oops I haven't' and then I give it…Occasionally I forget to take my insulin with me [when eating out] (Gwen)	*A lot of the diabetic patients definitely appear to have memory lapses.* (PN11)
	The older ones, they get confused…they do tend to be on lots of different things as well as their insulin. (GP4)

PATIENTS	GPs AND PRACTICE NURSES
5. UNDERSTANDING OF INSULIN TYPE	
Are there many different types of insulin than what I have? That's the sort of knowledge I'd like to have. Why are there different types, what are their usefulness for being different because so far, I'm just aware of, that's it, that's the only insulin [NovoMix30] but I understand there are different types? (Beata)	*Although a lot of patients have got a very good grasp, sometimes they don't fully understand that there is a long-acting ingredient in it [premix] so that by giving it an extra shot just before they go to bed might actually put them at risk of a hypo because of the long-acting component.* (GP3)
In the afternoon or lunch-time, I inject [prandial insulin] about an hour or so afterwards [after meal] and then in the evening, inject about an hour after my meal…So, it's about an hour after I've eaten that I inject. (Shaun)	*I do have some patients that will say either they forgot or chose not to give their [prandial] insulin or they then decided they'd just have a bit more of their Levemir or Lantus at night to counteract it.* (PN2)

Key: GP = General Practitioner; HbA1c = glycated haemoglobin; HCP = Healthcare professional, PN = Practice Nurse.

Appendix 16. Publication of The Thematic Synthesis

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RESEARCH ARTICLE Open Access

Perceptions of insulin use in type 2 diabetes in primary care: a thematic synthesis

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Abstract

Background: Increasing numbers of patients with type 2 diabetes mellitus are progressing to insulin therapy, and despite its potency many such individuals still have suboptimal glycaemic control. Insulin initiation and intensification is now often conducted by Practice Nurses and General Practitioners in many parts of the UK. Therefore, gaining insight into perspectives of patients and primary care clinicians is important in determining self-management and engagement with insulin. A thematic synthesis of studies was conducted exploring the views and experiences of people with type 2 diabetes and of healthcare professionals on insulin use and management in the context of primary care.

Methods: Protocol based systematic searches of electronic databases (CINAHL, Cochrane Library, EMBASE, MEDLINE, PsycINFO, and Web of Science) were performed on 1 October 2014 and updated on 31 March 2015, to identify studies that identified the views and experiences of adults with type 2 diabetes or primary care clinicians on the use of insulin in the management of type 2 diabetes. Studies meeting the review inclusion criteria were critically appraised using the CASP qualitative research checklist or Barley's checklist for survey designs. A thematic synthesis was then conducted of the collected studies.

Results: Thirty-four studies were selected. Of these, 12 used qualitative interviews (nine with patients and three with healthcare professionals) and 22 were survey based (14 with patients, three with healthcare professionals, and five with both). Twelve key themes were identified and formed three domains, patient perceptions, healthcare professional perceptions, and health professional-patient relationships. The patient-centred themes were: insulin-related beliefs, social influences, psychological factors, hypoglycaemia, and therapy barriers. The clinician-related themes were: insulin skills of general practitioners, healthcare integration, healthcare professional-perceived barriers, hypoglycaemia, and explanations for adherence. Healthcare professional-patient relationship themes were drawn from the perspectives of patients and from clinicians.

Conclusions: This review reveals multiple barriers to optimal insulin use in primary care at both the patient and healthcare professional levels. These barriers indicate the need for multimodal interventions to: improve the knowledge and competencies of primary care professionals in insulin use; provide more effective patient education and self-management support; and introduce integrated insulin support systems.

Keywords: Insulin, Type 2 diabetes, Patients, General practice, Primary care, Perceptions

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Background

Many patients living with type 2 diabetes mellitus (T2DM) require insulin as an adjunct to lifestyle interventions and oral hypoglycaemic agents [1–3]. As the population of people affected by T2DM increases, the number of those requiring insulin therapy also increases. While insulin therapy was traditionally managed by specialist diabetes services it is now largely managed in primary care by Practice Nurses (PNs) and General Practitioners (GPs) [4–7].

While insulin is a very effective glucose lowering therapy, it has been shown that many people with insulin treated T2DM have poor glycaemic control (8, 9, 10). There are a number of factors that may explain this problem. Firstly, that there may be some clinical inertia in introducing insulin, as it is often introduced after patients have had poor glycaemic control for some time. Secondly, it has been suggested that both patients and clinicians are reluctant to start insulin due to what has been termed psychological insulin resistance [4, 8, 9]. There is a perception that insulin: represents the last line of treatment and is associated with failure; increases the patient's self-management burden; and imposes hazards such as hypoglycaemia and weight gain [10]. Hence, despite improvements in insulin delivery and support systems, insulin is often not used optimally in primary care settings, increasing the patients risks of complications. [1, 11, 12]. Therefore, developing a better understanding as to what factors influence insulin use in primary care is important to shape interventions to enhance insulin management in this setting.

While previous reviews have explored some of the factors related to why insulin use often fails to deliver good outcomes [10, 13–18], these factors have not been considered systematically in the context of the management of T2DM in primary care from both the patient and healthcare professional perspectives collectively. In this paper, we present a synthesis of the views of patients already established on insulin treatment, and health professionals within primary care, to elicit mechanisms that may explain the use of the therapy and to consider how these may be addressed through more optimal strategies for insulin management in this population.

The aim of the review was to identify and synthesise studies exploring the views and experiences of people with insulin treated T2DM and healthcare professionals (HCPs) within the context of primary care on insulin use to elicit the factors that contribute to sub-optimal insulin use in primary care. The review addressed the following questions:

1. What are the perceptions and experiences of people with T2DM in relation to insulin treatment and use?
2. What are the perceptions and experiences of primary care HCPs on insulin treatment use in people with T2DM?
3. What potential patient-professional interactions impact on insulin use in T2DM?

Methods

Thematic synthesis is a process of identifying new insights by integrating data from original studies and is one of a range of methods available for synthesizing diverse forms of evidence [13, 19–26]. Thematic synthesis generally refers to the integration of findings from qualitative studies, but it has also been used to integrate quantitative and qualitative research; including studies using descriptive or interpretive phenomenological approaches [20, 24, 27–29]. While integrating findings derived from different methods can be challenging and subject to criticism [20, 23, 26, 30], the approach can allow a more expansive interpretation of what is known about the studied phenomena. In this review a narrative synthesis was used to identify the key themes, as an established method for integrating across study types [20, 21, 23–25, 27–29]. Thomas & Harden's [26] approach was observed as a framework for the analysis, but with the inclusion of quantitative in addition to qualitative studies. This progressed in three steps.

Step 1. Identification of studies

Reports of qualitative and quantitative studies addressing the review questions were identified from peer-reviewed journals, conference reports and theses.

Inclusion criteria

Papers were required to report on studies of insulin-related experiences and/or perceptions in either adults aged ≥18 years with insulin treated T2DM or of primary care HCPs. It was also required that the study should focus on patients already receiving insulin therapy, and not on insulin initiation. Study design eligibility included qualitative and descriptive quantitative studies such as surveys and included those with lower or unreported response rates (which may not be apparent especially in web-based surveys).

Search strategy

A protocol-based search was performed by KE on 1 October 2014 and updated on 31 March 2015, to retrieve articles from electronic databases including CINAHL, Cochrane Library, EMBASE, MEDLINE, PsycINFO and Web of Science. The search was structured by terms for T2DM; insulin therapy; and primary care. Discrete searches were also performed with terms for primary care HCPs. The electronic database search strategy can be viewed in Additional file 1. There was no

limit to the year of publication but they were required to be published in English. The search was supplemented with: open web-based searches (Google Scholar and EthOs); citation and key author searching; and hand searches of journals. Using EndNote X7 bibliography software, titles and abstracts were screened for inclusion. Full-text articles of the remaining reports were then fully assessed for eligibility by KE before the final selection. To help ensure lack of bias, AF and HM reviewed the search strategy, studies generated, and the final selection; and agreement was reached between the reviewers. In the absence of a standard guideline for reporting thematic syntheses with combined qualitative and quantitative studies [27], the principles of ENTREQ and PRISMA were applied and their study reporting checklists used [31, 32].

Step 2. Content extraction and appraisal

Data were extracted by KE using standardized extraction tools [33, 34], one for qualitative designs and one for surveys. Methodological quality and risk of bias for studies with qualitative designs were assessed using the Critical Appraisal Skills Programme (CASP) qualitative research checklist [35] whilst the survey studies were assessed with Barley et al.'s tool [28]. A score of one was given where the study answered most parts of the appraisal tools' questions.

Step 3. Synthesis of the extracted content

The included studies were subjected to a thematic synthesis by KE, and reviewed by HM and AF until agreement was reached. This was undertaken in 3 stages.

Stage 1 Findings of the qualitative studies were scrutinized for concepts, themes and authors' interpretations relating to managing insulin treated T2DM. Themes were developed inductively, and the text was then coded manually. Next, the main themes from the quantitative studies were identified, and categorized separately.

Stage 2 Descriptive themes and sub-themes from the qualitative studies were inductively developed from the coded text and organized into two primary thematic frameworks one for patients and the other for HCPs. The main finding clusters (including thematic analysis of survey comments) from the quantitative studies were then mapped onto these frameworks, to integrate themes from the different data sources.

Stage 3 Analytical themes were then generated from the descriptive themes for patients and HCPs, to further address the aims of the review, and to identify areas for further research.

Results

Summary of the selected studies

The search strategy identified 147 papers for screening, 70 of which were fully appraised for eligibility. Though the numbers retrieved were lower than anticipated, this was attributed to the inclusion criteria with its focus on experiences and perceptions of T2DM participants already established on insulin and primary care HCPs. Thirty-four of the screened studies fulfilled the inclusion criteria with 36 being rejected with reasons (see Table 1.). Of the included studies, 12 were qualitative [36–47] (nine with patient participants and three with HCPs) and 22 were surveys [48–69] (14 with patient participants, three with HCPs and five with both patients and HCPs). Five of the surveys were discrete reports from two larger studies.

The qualitative studies included data from 173 patients with insulin treated T2DM, aged 23–90 years. The HCP studies included: GPs (n = 65); endocrinologists (n = 2), PNs (n = 8), diabetes nurse educators (n = 3) and pharmacist (n = 1). Their methodologies varied and included focus groups; and in-depth and semi-structured interviews conducted mainly face-to-face, with one study using both telephone interviews and focus groups. The majority of these studies used a thematic, descriptive approach, with some using other methods such as grounded theory, theoretical frameworks, and interpretative phenomenological methods of inquiry.

The quantitative studies were survey-based with mainly cross-sectional designs and included: 13,476 patients with T2DM receiving insulin, aged 41–99 years; GPs (n = 4,176); diabetes consultants (2,192); general physicians (n = 166); general nurses (n = 51); Diabetes Specialist Nurses (DSNs) (n = 50); and diabetes educators (n = 100). The majority of the surveys were web-based with some being undertaken as face-to-face questionnaires or by telephone.

A number of studies took place in multiple sites and in two or more countries. The qualitative research sites included: Asia (n = 4), Australia (n = 1), Europe (n = 7), New Zealand (n = 1), and North America (n = 1). Those of the quantitative studies included: Asia (n = 7), Australia (n = 1), Europe (n = 15), North America (n = 12), South America (n = 2), and South Africa (n = 1).

The methodology and reporting quality of the qualitative studies was generally good with scores ranging from 8 to 10; the quantitative studies were of moderate strength with scores ranging from 3 to 7. Tables 2, 3, 4. present an overview of the included studies, and the selection process is shown in a PRISMA flow chart in Fig. 1. The appraisal scores are presented in Additional file 2. Where available, the survey response-rate has been entered although this was not available in many of the surveys which were reported

Table 1 Rejected Studies with Reasons

Author & Reference	Year	Reason for Rejection
Aloumanis [83]	2013	The focus is on clinical outcomes rather than perceptions and experiences.
Bahrmann [9]	2014	The focus is on psychological insulin resistance in insulin naïve patients compared to those established on insulin.
Balkau [84]	2012	The patient participants are insulin naïve.
Beresford [85]	2011	Insufficient data specific to insulin treated T2DM.
Beverly [86]	2012	Insufficient data specific to insulin treated T2DM.
Brod [87]	2013b	It was not possible to differentiate data specific to insulin treated T2DM.
Carbone [88]	2007	It was not possible to differentiate data specific to insulin treated T2DM.
Chai [89]	2012	Conference abstract only. No other data available.
Chai [90]	2013	Conference poster only. No other data available.
Chai [91]	2014	Conference abstract only. No other data available.
Chan [92]	2014	The patient participants are insulin naïve.
Choudhury [93]	2014	It was not possible to differentiate data specific to insulin treated T2DM.
Cramer & Pugh [94]	2005	The focus is on insulin prescriptions issued and not on perceptions or experiences.
Gaborit [95]	2011	The focus is on knowledge rather than experiences of insulin adjustment.
Hermanns [96]	2010	The focus is on comparing barriers of insulin naïve patients.
Hinder & Greenhalgh [97]	2012	Insufficient data specific to insulin treated T2DM.
Frei [98]	2012	The focus is on clinical characteristics and demographics.
Hunt [99]	1998	Insufficient data specific to insulin treated T2DM.
Khattab [100]	2010	The focus is on clinical characteristics and demographics.
Lai [101]	2007	It was not possible to differentiate data specific to insulin treated T2DM.
Lakkis [102]	2013	The focus is on attitudes of clinicians towards initiating insulin.
Mollem [103]	1996	It was not possible to differentiate data specific to insulin treated T2DM.
Morris [104]	2005	Patients only recently initiated with insulin therapy.
Munro [73]	2013	There is no information specific to insulin treated T2DM.
Oliveria [105]	2007	The focus is on patients who did not start or continue insulin therapy.
Peyrot [106]	2005	Patient participants are insulin naïve. Perceptions of clinicians relate to insulin initiation.
Peyrot [107]	2006	Insufficient data specific to insulin treated T2DM.
Peyrot [108]	2013	Insufficient data specific to insulin treated T2DM.
Pooley [109]	2001	No data specific to insulin treated T2DM.
Ritholz [72]	2011	Insufficient data specific to insulin treated T2DM
Shiu & Wong [110]	2000	It was not possible to differentiate data specific to insulin treated T2DM.
Thomson [111]	1991	The focus is on knowledge rather than experiences or perceptions of hypoglycaemia.
Wendel [112]	2014	The focus is on incidence of hypoglycaemia and prescribing behaviour rather than perceptions of hypoglycaemia
Wong [113]	2011	Patients were insulin naïve.
Yoshioka [74]	2014	The focus is on insulin initiation.
Zafar [8]	2015	Insufficient data specific to insulin treated T2DM.

online. Survey limitations include pharmaceutical company support, recruitment bias with sampling from research panels and self-selection in online surveys; and self-reporting of clinical data. However, it was decided to include the surveys because of their contribution to the overall themes of the synthesis.

In total, 12 themes with 46 sub-themes from the patient studies; and 14 themes with 54 sub-themes from the HCP studies were included in the primary thematic frameworks.

Integrated themes

The synthesis integrated the two thematic frameworks to form 12 primary themes expressed in three domains: patient perceptions, HCP perceptions, and HCP-patient relationships (see Fig. 2.). The themes

Table 2 Overview of the Included Qualitative Studies with Patient Participants

Author & Reference	Year	Country	Diabetes Type	Aim	Sample and Setting	Data Collection	Data Analysis
Abu Hassan [36]	2013	Malaysia	Insulin T2DM	To explore patients' reasons for accepting insulin and their initial barriers.	Patients with insulin T2DM (*n* = 21) Primary Care Clinic	In-depth interviews Focus groups	Thematic analysis
Brod [37]	2014	Canada, China & Germany	T1DM & Insulin T2DM	To examine unintentional insulin dosing and injection irregularities due to forgetting among people with diabetes.	Patients with T1DM (*n* = 22) Insulin T2DM (*n* = 42) At least twice in the last three months of forgetting injection, or time/amount taken, or questioning if insulin was taken. Research recruitment databases	Telephone interviews Focus groups	Thematic analysis with grounded theory
Brown [38]	2007	UK	Insulin T2DM & Non-Insulin T2DM	To gain an understanding of how health beliefs influence how African-Caribbeans manage their T2DM.	T2DM adults (n = 16) Insulin T2DM (n = 6) Self-help groups and GP practices Inner-city African-Caribbean community	In-depth interviews	Thematic analysis
Browne [39]	2013	Australia	Insulin T2DM & Non-Insulin T2DM	To explore the social experiences of adults with T2DM, focusing on the perception & experience of diabetes- related stigma.	T2DM adults (*n* = 25) Insulin T2DM (n = 5) State diabetes organisation	Semi-structured interviews	Inductive thematic analysis
Hortensius [40]	2012	Netherlands	T1DM & Insulin T2DM	To investigate patients' perspectives of SMBG & all relevant aspects influencing SMBG.	Insulin treated DM patients (*n* = 28) T1DM (*n* = 13) T2DM (*n* = 15) Outpatient clinic (T1DM) GP practices (T2DM)	In-depth interviews	Thematic analysis with grounded theory.
Janes [41]	2013	New Zealand	Insulin T2DM	To better understand barriers to glycaemic control from the patient's perspective.	Insulin treated patients T2DM (n = 15) Diabetes clinic	Semi-structured interviews.	Thematic analysis with a patient-centred framework. Interpretative phenomenological method of inquiry
Jenkins [42]	2011	UK and Ireland	Insulin T2DM	To explore participants' experiences of intensifying insulin therapy during the Treating to Target in T2DM (4-T) trial.	T2DM patients (*n* = 41) Whose insulin was intensified in 4-T trial. Primary care	In-depth interviews	Thematic analysis with grounded theory.
Ong [43]	2014	Malaysia	Insulin T2DM	To explore the barriers and facilitators to SMBG, in insulin T2DM patients.	Insulin treated T2DM patients (n = 15) Primary care clinic	Semi-structured interviews	Inductive thematic analysis
Vinter-Repalust [44]	2004	Croatia	Insulin T2DM & Non-insulin T2DM	To explore patients' attitudes, thoughts, & fears connected with their illness; expectations of the healthcare system; and problems while adhering to the therapeutic regime.	Patients with T2DM (*n* = 49) Insulin T2DM (n = 13) General practice	Focus group discussions.	Inductive thematic analysis

Key: *DSN* diabetes specialist nurse, *PN* practice nurse, *GP* general practitioner, *HCP* health care professional, *OHAs* oral hypoglycaemic agents, *PCPs* primary care physicians, *QOL* quality of life, *SMBG* self-monitoring of blood glucose, *T1DM* type 1 diabetes mellitus, *T2DM* type 2 diabetes mellitus, *Insulin T2DM* insulin treated type 2 diabetes mellitus

Table 3 Overview of the Included Qualitative Studies with HCP Participants

Author & Reference	Year	Country	Aim	Sample and Setting	Data Collection	Data Analysis
Goderis [45]	2009	Belgium	To evaluate barriers and facilitators to high quality diabetes care by GPs participating in a quality improvement programme promoting compliance with international guidance.	GPs participating in the programme (n = 20) General Practice.	Semi-structured interviews	Thematic analysis with an implementation and behavioural change model.
Jeavons [46]	2006	UK	To determine doctors' and nurses' attitudes and beliefs on treating T2DM with less than ideal control.	GPs (*n* = 15) Practice Nurses (n = 8) General Practice	Focus groups.	Thematic analysis with grounded theory.
Lee [47]	2013	Malaysia	To explore the views of Malaysian healthcare professionals on the barriers faced by patients using insulin.	Primary care doctors (*n* = 20) Family medicine specialists (*n* = 10) Policymakers (n = 5) Diabetes educators (*n* = 3) Endocrinologists (n = 2) Pharmacist (n = 1) Primary & secondary care	In-depth interviews Focus group discussions	Inductive thematic analysis

Key: *DSN* diabetes specialist nurse, *PN* practice nurse, *GP* general practitioner, *HCP* health care professional, *OHAs* oral hypoglycaemic agents, *PCPs* primary care physicians, *QOL* quality of life, *SMBG* self-monitoring of blood glucose, *T1DM* type 1 diabetes mellitus, *T2DM* type 2 diabetes mellitus, *Insulin T2DM* insulin treated type 2 diabetes mellitus

for each domain are described below with linkage to the source data from qualitative studies (with participant comments) and surveys (which are identified). A summary of the survey findings will then follow. There were more themes relating to barriers than to facilitators to managing insulin.

Domain 1. Patient perceptions

In this domain five themes relating to patient perceptions of insulin emerged from the synthesis: insulin-related beliefs, social influences, psychological factors, hypoglycaemia, and therapy barriers.

Theme 1. Insulin-related beliefs

The data showed that a patient's beliefs about insulin can mediate their orientation to using insulin. These beliefs include: illness severity; cultural beliefs; and insulin specific beliefs. Many patients reported how when insulin was first suggested, they believed it meant their diabetes had suddenly become very serious [36, 38, 41, 62].

> *"…I felt like once you hit insulin you are on a slide to … you know [death]."* [Participant 13] [41]

Survey respondents also reported their perceived seriousness of the condition [62].

Cultural beliefs can influence insulin adherence negatively, particularly when cultural traditions conflicted with the underlying constructions about what insulin was and how diabetes should be treated [36, 38, 41]. One patient from a UK African-Caribbean community said:

> *"I'm telling you I've known people take insulin here and they go back to the Caribbean and don't take insulin.... they don't have the pollution that you have here, your body perspires more so all the impurities or all the stuff that it retains in your body keeps coming out .."* [Interview 16] [38]

Janes et al. described how cultural beliefs could be in direct conflict with using drugs [41]. One individual relied on traditional Maori beliefs and medicinal plants for healing:

> *"The body is tapu [restricted]... it makes me not like poking holes in it* [with needles]*"* [Participant 13]

Theme 2. Social influences

Social factors included stigma, family and friends, economics, work and social activities. Perceived stigma relating to injecting in public was associated with insulin adherence [36, 39, 41–43, 59]. For some this stigma was reflected in the belief that others perceived injecting insulin as being associated with drug addiction [36, 41, 42].

> *"Our society is quite ignorant of insulin therapy and they might associate insulin injection with drug addicts"* [2 years of insulin use/ 5 years of having diabetes] [36]

Table 4 Overview of the Included Quantitative Studies with Patients, HCPs, or Patients and HCPs

Author & Reference	Year	Country	Diabetes Type Patients or HCPs	Aim	Sample and Recruitment	Data Collection
Ary [48]	1986	USA	Insulin T2DM & Non-insulin T2DM Patients only	To assess levels of regime adherence and reasons for non-adherence in T1DM and T2DM	Patients with T1DM ($n = 24$) Non-insulin T2DM ($n = 125$) Insulin T2DM ($n = 59$) Recruited by doctors, newspaper adverts & American Diabetes Association meetings	Face-to-face Questionnaire
Brod [49]	2012a	USA, Canada, Japan, Germany, UK and Denmark	Insulin T2DM Patients and HCPs	To estimate the prevalence of self-treated hypoglycaemia in patients using basal analogues. To identify demographic treatment-related and behavioural risk factors. To describe patient and physician responses to these in the Global Attitude of Patients and Physicians 2 (GAPP2) study.	T2DM Patients using basal insulin analogues ($n = 3,042$) Physicians ($n = 1,222$): Specialists (45%) PCPs (55%) Online research panel	Cross-sectional online questionnaire
Brod [50].	2012b	USA, Canada, Japan, Germany, UK and Denmark	Insulin T2DM Patients and HCPs	To describe basal insulin analogue dosing irregularities; the effect on patient functioning, well-being and management; and the identification of patients most at risk in the GAPP2 study.	T2DM Patients using basal insulin analogues (n = 3,042) Physicians (n = 1,222): Specialists (45%) PCPs (55%) Online research panel	Cross-sectional online questionnaire
Brod [51]	2012c	USA, UK, Germany and France	T1DM, Insulin T2DM & Non-insulin T2DM Patients only	To determine how non-severe nocturnal hypoglycaemic events (NSNHEs) affect diabetes management, sleep quality, functioning, and to assess if these impacts differ by diabetes type or country.	T1DM and T2DM patients ($n = 1086$) who experienced NSNHE in the last month: T1DM ($n = 676$) Non-Insulin T2DM ($n = 124$) Insulin T2DM ($n = 286$) Online venues	Web-based survey
Brod [52]	2013a	USA, UK, Germany, Canada, France, Italy, Spain, Netherlands and Sweden	T1DM, Insulin T2DM & Non-insulin T2DM Patients only	To explore the burden and impact of NSNHEs on diabetes management, patient monitoring and well-being to better understand the role NSNHEs play in caring for people with diabetes and to facilitate optimal diabetes treatment strategies.	Patients ($n = 2,108$) with: T1DM or T2DM. T1DM ($n = 692$) Non-insulin T2DM ($n = 543$) Insulin T2DM ($n = 873$) Online venues	Web based survey
Cefalu [53]	2008	USA, Mexico, UK, France, Germany, Spain and Brazil	Insulin T2DM & Non-Insulin T2DM Patients only	To understand patients' perspectives to achieving good glycaemic control and determine how their perceptions of insulin may affect their decisions to initiate or intensify insulin.	T2DM adults ($n = 1,444$) of which: Insulin T2DM ($n = 469$) Online databases	Structured online and telephone survey.
Cuddihy [54]	2011	Germany, Japan, Spain, Turkey, UK and USA	HCPs Only	To investigate the opinions of PCPs and diabetes specialists on their perceived role in tackling T2DM and the challenges they face, particularly to insulin intensification.	Diabetes specialist physicians ($n = 300$) PCPs ($n = 300$) Recruited by telephone and online panels	Online survey

Table 4 Overview of the Included Quantitative Studies with Patients, HCPs, or Patients and HCPs *(Continued)*

Author & Reference	Year	Country	Diabetes Type Patients or HCPs	Aim	Sample and Recruitment	Data Collection
Diago-Cabezudo [55]	2013	Europe	T1DM & Insulin T2DM Patients only	To evaluate the effects of hypoglycaemia on the lives of patients with DM and determine if SMBG to prevent hypoglycaemic is an appealing and widely accepted concept.	Insulin treated patients (n = 1,848) T1DM (n = 924) Insulin T2DM (n = 924) Online databases	Online survey
Fulcher [56]	2014	Argentina, Australia, Brazil, Israel, Mexico and South Africa	T1DM, Insulin T2DM & Non-insulin T2DM Patients only	To understand the impact of nocturnal and daytime non-severe hypoglycaemic events on healthcare systems, work productivity & QOL in T1DM or T2DM.	T1DM (n = 64) Non-insulin T2DM (n = 76) Insulin T2DM (n = 160) Recruited from online panels and by HCPs	Online and face-to-face surveys
Leiter [57]	2005	Canada	T1DM & Insulin T2DM Patients only	To assess impact of mild, moderate and severe hypoglycaemia and fear of future episodes on patients with T1DM or insulin-treated T2DM	Adults with insulin treated T2DM (n = 335) T1DM (n = 202) insulin T2DM (n = 133) Diabetes Clinics	Self-administered questionnaire
Leiter [58]	2014	Canada	Insulin T2DM Patients and HCPs	To assess the frequency and impact of dosing irregularities and self-treated hypoglycaemia in T2DM patients treated with insulin analogues in the GAPP2 study.	Patients with Insulin treated T2DM (n = 156) Physicians (n = 202) Of which: PCPs (n = 160) Specialists (n = 42) Online panels and HCP registers	Online survey
Mehmet [59]	2015	UK	T1DM & Insulin T2DM Patients only	To determine if patients report problems with injecting insulin/ SMBG in front of others and explore reasons why.	Insulin T2DM (n = 27) T1DM (n = 49) Hospital Clinic	Self-completed questionnaire
Mitchell [60]	2013	UK	Insulin T2DM & Non-insulin T2DM Patients only	To characterize hypoglycaemic events in T2DM and assess the relationship between the experiences and health outcomes.	T2DM adults (n = 1,329) of which: Insulin T2DM (n = 301) Research survey panel	Longitudinal online survey
Mollema [61]	2001	Netherlands	T1DM & Insulin T2DM Patients only	To examine functioning and self-management of insulin treated patients suffering from extreme fear of self-injecting and/or fear of self-testing.	Patients with insulin treated diabetes (n = 1,275) of which: T1DM (n = 740) T2DM (n = 535) Randomly drawn from the Dutch Diabetes Association	Cross-sectional postal questionnaire
Mosnier-Pudar [62]	2009	France	Insulin T2DM & Non-insulin T2DM Patients only	To describe T2DM from the patient's standpoint in a representative French panel in 2008.	T2DM Patients (n = 1,092) of which: Non-Insulin (n = 885) Insulin T2DM (n = 207) From a polling institute in France	Postal questionnaire
Peyrot [63]	2012a	China, Japan, USA, Germany, Spain, France, Turkey & UK	T1DM & Insulin T2DM Patients only	To examine factors associated with insulin injection omission/ non-	Insulin treated DM adults (n = 1,530) of which: T1DM (n = 110)	Cross-sectional telephone survey

Table 4 Overview of the Included Quantitative Studies with Patients, HCPs, or Patients and HCPs *(Continued)*

Author & Reference	Year	Country	Diabetes Type Patients or HCPs	Aim	Sample and Recruitment	Data Collection
				adherence in the Global Attitude of Patients and Physicians (GAPP) Study.	T2DM (n = 1,420) Research panels	
Peyrot [64]	2012b	China, Japan, USA, Germany, Spain, France, Turkey & UK	T1DM & Insulin T2DM Patients and HCPs	To examine patient and physician beliefs regarding insulin therapy and degree to which patients adhere to insulin regimes in the GAPP Study.	Insulin treated DM adults (n = 1,530) of which: T1DM (n = 180) T2DM (n = 1,350) Physicians (n = 1,250) of which Specialists (n = 600) PCPs (n = 650) Research panels	Cross-sectional telephone survey
Rubin [65]	2009	USA	T1DM & Insulin T2DM Patients and HCPs	To compare patients' perceptions of injection-related problems with clinicians' estimates of those problems.	Insulin treated adults (n = 501) of which T2DM (n = 385) PCPs (n = 101) Endocrinologists (n = 100) Diabetes Educators (n = 100) Chronic illness panel, Medical Register and Research database.	Online survey
Shiu [66]	2004	Hong Kong	Insulin T2DM Patients only	To examine the relationship between a sense of coherence, fear of hypoglycaemia and metabolic control to identify whether other variables including age, hypoglycaemic experience and adherence to self-care practice, confounded the findings from two Swedish studies.	Insulin treated T2DM adults (n = 72) Diabetes Centre	Cross-sectional face-to-face questionnaire
Siminerio [67]	2007	USA	HCPs only	To examine nurse and physician perceptions of nurse involvement in diabetes care.	General Nurses(n = 51) DSNs (n = 50) Generalist Physicians (n = 166) Diabetes Specialist Physicians (n = 50) Professional directories and listing	Cross-sectional survey conducted face-to-face or by telephone.
Van Avendonk [68]	2009	Netherlands	HCPs only	To investigate the organisation of insulin therapy in general practice and assess factors associated with providing insulin in T2DM patients.	Dutch GPs (n = 1,621) University Medical Centre database.	Postal questionnaire
Zambanini [69]	1999	UK	T1DM & Insulin T2DM Patients only	To assess: prevalence of phobia and anxiety-related to insulin injections; association between insulin injection anxiety symptoms with level of general anxiety in the study group; and evaluate their influence of, on glycaemic control.	Insulin treated patients (n = 115) of which: T1DM (n = 80) and Insulin T2DM (n = 35) Hospital diabetes clinic.	Questionnaire administered by HCPs

Key: *DSN* diabetes specialist nurse, *PN* practice nurse, *GP* general practitioner, *HCP* health care professional, *OHAs* oral hypoglycaemic agents, *PCPs* primary care physicians, *QOL* quality of life, *SMBG* self-monitoring of blood glucose, *T1DM* type 1 diabetes mellitus, *T2DM* type 2 diabetes mellitus, *Insulin T2DM* insulin treated type 2 diabetes mellitus

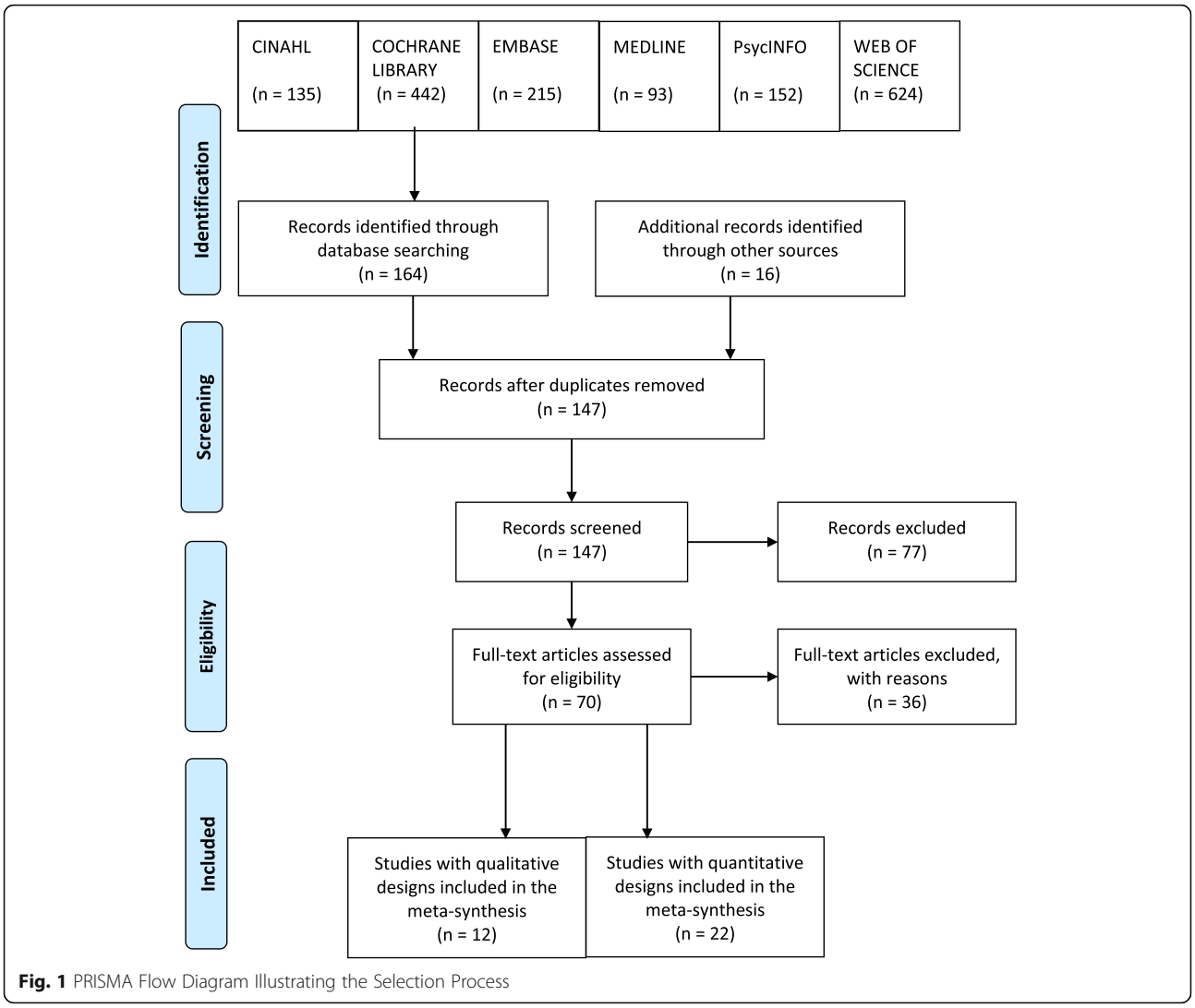

Fig. 1 PRISMA Flow Diagram Illustrating the Selection Process

Of the T2DM patients (n = 27) in Mehmet et al.'s survey [59] the majority (n = 20) also experienced problems injecting in public, the main reason being worry about upsetting or offending others.

Patients developed various strategies to adjust for this stigma adding to the complexity of insulin use:

> *"If I go out with anybody I always go and do it (inject) in the toilet. I won't ever do it outside."* [Participant 26] [42]

Patients were influenced by family and friends in managing their insulin [36, 41, 43, 44]. For some this created barriers to insulin use, as they had to observe the requirements and routines of the family over mealtimes impacting on their insulin behaviours. However, others identified the potentially positive influence of family support [36]:

> *"I always refer to these two 'specialists' (my father and older brother who are on insulin) when it comes to insulin"* [6 years of insulin use/ 10 years of having diabetes]

> *"I gained a lot of knowledge from self-reading and relatives who are on insulin"* [2 years of insulin use/ 5 years of having diabetes]

Economic factors (such as the cost of blood-testing strips and loss of earnings) and employment disruption were both identified as socially specific mediators of insulin use [41, 43, 44]:

> *"Cost is a problem. If I went to the doctor plus medication, that was my week's pay gone."* [Participant 15] [41]

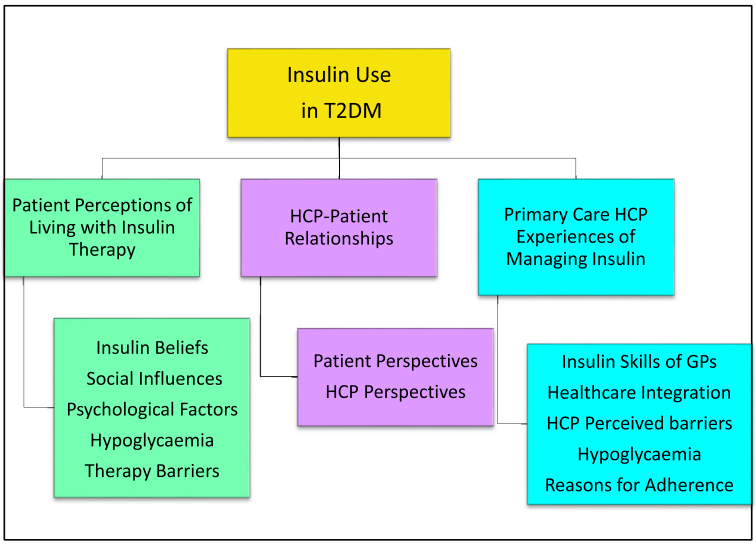

Fig. 2 Twelve Primary Themes formed from the Thematic Frameworks. Key: HCP = Healthcare Professional; T2DM = type 2 diabetes mellitus

"I would come off an '18 hour' and the day shift boss would ring me up, says 'hey, can you come in and do a couple of hours, bro.'... Insulin was not easy to take and you would pop it in, but no, I had to wait between shifts.." [Participant 11] [41]

Others, however, felt supported at work [36].

The impact of insulin use on travel, leisure, and social activities was perceived negatively by patients [36, 38–41], as it restricted their social interactions and influenced their insulin injecting behaviours when in social settings:

"I wouldn't go out to lunch with them [friends] and in the end, I had to tell them why. I said, 'I can't. I have got to have insulin. And I am not going to go into a toilet'." [Participant 23] [42]

Theme 3. Psychological factors

Psychological factors related to fear and anxiety, shame and depression. Fear and anxiety about hypoglycaemia (see Theme 4), injection pain, and weight gain were perceived by many participants as significant mediators in insulin utilisation [36–38, 40, 41, 43, 44] and included survey participants [53, 61, 65, 69].

"I am scared of needle.. you know, the poking itself, it is painful.. using needle some more, and you poke yourself... it is painful" [3 years of insulin use/ 6 years of having diabetes] [36]

Feelings of shame and self-blame were evident in the participant accounts of some studies [38, 41]. These feelings were linked to the perceptions that they had somehow caused their disease and that their need for insulin was because they had not properly controlled their diabetes:

A good diabetic is one who controls their diabetes ...I am not a good diabetic. [Participant 7] [41]

Negative emotions such depression also had an impact on insulin use. In one large survey depression was the strongest predictor of the severity of fear of self-injecting [61]. In the qualitative studies, negative emotions were often identified in the context of low patient activation in relation to self-management:

"In that period of depression I was just happy when I felt good and that things were moving again, and that I could do my job again ...and for me that was enough. The diabetes just wasn't that important for me." [Participant] [40]

Theme 4. Hypoglycaemia

Hypoglycaemia was identified in survey participants as a key barrier and concern for patients with impact on their emotional state, daily functioning and engagement with their insulin [45, 49, 51, 52, 55–58, 60, 66]. In consequence patients reported injecting smaller doses to keep their blood glucose elevated. The survey studies identified that a fear of hypoglycaemia is common and is associated with reduced adherence [49, 51, 57]. The patient accounts in the qualitative studies gave many examples of these behavioural responses to hypoglycaemia:

"When I am hypoglycaemic, I feel wretched. ... I don't really have a problem with high sugar levels, but the low ones are quite bothersome." [Participant] [40]

"to avoid hypos... I won't have my insulin" [Participant 4] [41]

Theme 5. Therapy barriers

The inherent complexities of managing insulin, was often an impediment to insulin adherence in several surveys [48, 50, 62, 63] which reported associations between insulin non-adherence and practical barriers, injection difficulties and regimen inflexibility. Patients remembering whether they had taken their insulin was another factor, with people omitting injections if they were unsure whether they had taken it or not:

"I am type 2 and when I forget my insulin in the morning, then I skip it and take my next insulin with my next meal." [Germany, Male] [37]

The challenges associated with sustaining regular self-monitoring of blood glucose (SMBG) were also identified as impeding insulin behaviours [40, 43]:

"Beginning [SMBG] yes, beginning very keen, now no. I'm just simply lazy to do it." [P06, 69-year-old female retiree, diabetes for 15 years] [43]

While some patients found SMBG to be helpful in achieving better glycaemic control and in detecting hypoglycaemia, others perceived it as a burden [40]. Some patients reduced SMBG once they established a dose they felt was right for them, such that they could not monitor any changes in their insulin requirement [43].

A further area of therapy complexity was in the titration of the insulin dose. Five qualitative studies [37, 40, 42–44] and several surveys [50, 52, 53, 58], reported that patients struggled with titration, often ignoring instructions, or adopting their own approach. There was some divergence between patients as to whether they wanted the HCP to make insulin changes or whether they preferred to control it themselves:

"I never change the therapy my doctor prescribed! I trust him, that's his job, not mine!" [67-year-old woman] [44]

One patient became more confident after receiving appropriate HCP support:

"At first I was very afraid about changing my dosage of insulin. But then my doctor explained to me how... In the beginning, I used to call him, but now I frequently change the dosage on the basis of my own physical activity, diet, and sugar levels." [55-year-old woman] [44]

Whilst a majority of patients and physicians regarded insulin therapy as restrictive in one survey [64], more patients saw insulin treatment as having positive than negative impacts on their life though this trend was less in T2DM than T1DM individuals.

Domain 2. HCP perceptions

Five themes emerged in relation to HCP perceptions: insulin-related skills of GPs, healthcare integration, HCP perceptions of patient-related barriers, hypoglycaemia, and HCP explanations for insulin adherence.

Theme 1. Insulin-related skills

This theme relates to the skills required by primary care HCPs to initiate and intensify insulin therapy, and to provide ongoing support for patients. While many HCPs were positive about helping patients to manage insulin, others felt they lacked the skills to do so effectively [45, 46]. They believed insulin-related training was important, but they also wanted ongoing support from a diabetes specialist. GP attitudes seemed to modify when they had acquired insulin-related skills, increasing their motivation and confidence in supporting patients:

"My attitude about insulin therapy onset has changed. Before the start of 0f the project, I tried too long oral anti diabetics, but the courses have changed my attitude. I became confident in starting insulin therapy, whereas before I would never initiate insulin therapy." [GP12-S3] [45]

However, some felt excluded, believing that specialists wanted to continue to manage insulin treated patients themselves:

"Specialists gain too much control of referred patients and often exclude GPs from direct patient care. This is especially true of patients on insulin who get free instructions and monitoring kits at the diabetes centres, unlike patients in primary care. So, it's nearly impossible for GPs to hold on to patients on insulin." [GP1-S2] [45]

In one survey [54], there was disagreement regarding who was responsible for intensification but the majority of both diabetes specialists and primary care physicians agreed that doctors in primary care should become more

involved in managing insulin. In another [67] nurses and physicians agree that nurses should take a larger role in managing diabetes.

Theme 2. Healthcare integration

The level of integration between the different components of the health system was identified as having a key role in how patients were supported in using insulin [45, 47] as illustrated by this GP:

> *"This is a big change from the usual 'let us do our work; after all we are the specialists and you may help a little bit'. We collaborate as one team – there's mutual support! We're on the same wavelength and feel we work together toward the same objectives."* [GP13-S4] [45]

Better collaboration between primary and secondary care was considered by most physicians in Cuddihy et al. 's survey [57] as one of the most important factors in improving insulin treatment of T2DM.

The systems in which primary care HCPs work influenced how involved they are in starting and/or managing insulin therapy. GPs and PNs identified that a lack of resources and familiarity with starting and managing insulin impacted negatively on the insulin support they could provide [46]. One large Dutch survey observed that the more structured practices employing a PN and with a designated diabetes clinic were more likely to manage insulin therapy themselves [68].

Theme 3. HCP perceptions of patient barriers

HCPs reported that patient-level factors heavily influenced insulin use, echoing many of those voiced by the patients, including: beliefs, culture, economics and psychological barriers. In addition, they believed patient education impacted positively on insulin use [45–47]. They felt, that for patients, insulin treatment represented failure and a more serious stage of the illness:

> *"I think probably they think it's the end, that's it, there's nothing else they can have after that."* [HCP] [46]

They also identified that patients often altered their insulin behaviours subjectively based on how they felt, rather than by following their targets [47]. Some found it challenging when dealing with patients from different ethnic backgrounds [46]. They reported how some cultural beliefs created barriers to insulin use:

> *"We see patients twice a year and the family and friends are there all the time, you know, I mean, we are supposed to be more powerful figures, but I mean, it's quite difficult to overcome very different beliefs within the family."* [HCP] [46]

HCPs perceived that SMBG for insulin optimisation was moderated by fear and in some countries cost:

> *"Those who can afford also don't see that it's important to invest on the glucometer … When we talk about meter and everything, you have to talk about fear of pricking. That's another barrier."* [Family medicine specialist, public health clinic] [47]

> *"How come when we [public health clinics] give all [insulin and pens], we provide everything free, but the glucometer is not given, test strips are not given, and how are they [patients] monitoring the blood glucose?"* [GP, private general practice] [47]

The psychological factors identified by the HCPs again reflected the insulin-related fears and anxieties reported by patients, such as: hypoglycaemia, concerns about weight gain, and fear of injection pain.

> *"Surely, one of the biggest barriers is this fear of going onto needles for the rest of your life. I think the effect of getting older is that they hate the idea of hypoglycaemia as well. They get very frightened of that."* [HCP] [46]

HCPs believed patients had insufficient understanding of diabetes and needed much more input in relation to insulin titration and dose adjustment if they were going to use insulin effectively [46, 47]:

> *"So … the most common thing, what happen is, people start insulin, but after that, they don't optimize and specify the regime. The patient who started just on one regime for, like, many years and nobody have actually taught the patient how to do the self-titration of the insulin too …."* [Family medicine specialist, public health clinic] [47]

Theme 4. Hypoglycaemia

HCPs identified fear of hypoglycaemia as a significant issue in optimal insulin use in surveys [54, 58, 64] and interviews [46, 47].

> *"I think the effect of getting older is that they hate the idea of hypoglycaemia as well. They get very frightened of that."* [HCP] [46]

Theme 5. Explanations for insulin adherence

HCP explanations for low insulin adherence included: being too busy; travelling; the timing of meals; stress or emotional problems; public embarrassment; and the patient's perception of their diabetes control:

> *"....so it depends how their [patients'] lifestyle... It depends on their work also ... how's their working and meal times. Their mealtimes also ... they will tell us."* [Family medicine specialist, public health clinic] [47]

> *"Maybe they [patients] will continue [using insulin] for a while, they will get better, they said, No, I don't want injection anymore."* [R1, GP, private general practice] [47]

> *"They said 'I am better, so I can stop now.'"* [R2, GP, private general practice] [47]

HCPs in surveys [50, 64] reported that their typical patient did not take their insulin as prescribed citing similar reasons as patients [64]. Prescribers did not routinely discuss basal adherence patterns with their basal-bolus patients [50].

Domain 3. HCP-patient relationships

This domain identifies the role of the HCP-Patient relationship, with regard to insulin therapy utilisation. For patients, communication and relational care were important in shaping their insulin views and behaviours. From the HCPs perspective, their interactions with patients were influenced by their personal confidence in using insulin therapy. The domain is comprised of two themes.

Theme 1. Patient perspectives of relational care

The quality of the relationship and communication with HCPs was valued by patients. In many of the qualitative studies it was identified as an important factor contributing to their adherence to insulin [36, 38, 40, 44] and in surveys [52, 62]. The nature of the relationship could contribute positively or negatively on the patient's insulin behaviours depending. Key factors that influenced the quality of the relationship were: how the HCP communicated insulin-related information; whether they elicited and responded to patient concerns; the time available for the consultation; and how accessible and relevant the support provided was to the patient:

> *"I have got a good doctor... but they are busy, real busy, and I suppose you have not got time to talk."* [Patient 8] [41]

> *"..we discussed about the issues of insulin, my worries and thoughts about insulin. I became less apprehensive and was ready to start on insulin therapy"* [2 years of insulin use/ 5 years of having diabetes] [36]

Another aspect of the relationship was reflected in the divergent agenda of the HCP and the patient. While HCPs tended to focus on tightening glycaemic control, patients were more concerned with their wider life needs and their quality of life (QOL). This was reflected in the ways patients moderated their behaviour to try and appease the HCPs:

> *"I have been using it [SMBG] every day because I know I have got an appointment coming up, so I better behave [participant giggled]. So that I can tell the doctor, you know, I want to bring down the insulin dose."* [P01, 57-year-old female clerk] [43]

Theme 2. HCP perspectives

HCP perceptions of their relationship with patients included the impact of integrated care working, the time available for providing insulin-related support, their own ambivalence about insulin therapy, and whether they had the required skills [45–47] and included surveyed HCPs [67, 68]. It was perceived that the relationship between GPs and patients was enhanced when the GPs were equipped with insulin-related skills with good support from diabetes specialist services:

> *"Diabetes patients themselves feel much more appreciated; because of that, the link between us and our patients has strengthened."* [GP17-S4] [45]

When the HCP adopted a patient-centred approach in their relationship, this could enhance insulin use:

> *"...Because when we negotiate, you know, some, they said okay, after negotiating, then they're okay. Then they try to follow."* [Family medicine specialist] [47]

Summary of the survey findings

The surveys reported a number of factors that might mediate insulin use. In the patient based surveys (n = 14) these included: hypoglycaemia [49, 52, 55–57, 60, 66] glycaemic control [66], injecting in public [59], problems with injections [61, 69], insulin intensification [53], insulin adherence [48, 63], and perceptions of T2DM [62]. Studies with both patients and HCPs (n = 5), identified hypoglycaemia [49, 58], dosing irregularities [50, 58], insulin adherence [64], and injection-related problems [65].

HCP surveys (n = 3) included: insulin intensification [54], HCP perceptions of nurse involvement in T2DM [67], and insulin management in general practice [68]. A table of the findings and key topics can be viewed in Additional file 3.

Patient-related themes

Hypoglycaemia Hypoglycaemic events associated with insulin, particularly nocturnal hypoglycaemia, were reported as having a disrupting effect on: diabetes self-management; sleep quality and next-day functioning; work performance and driving; and personal well-being [49, 52]. It was also reported that many patients with T2DM had no warning signs of hypoglycaemia [55]. Some studies reported that hypoglycaemia had negative financial consequences and impact on QOL [49, 56, 66]. Severe hypoglycaemic episodes led people to fear future events [57] with subsequent worse self-reported glycaemic control [60]. Exposure to insulin-related hypoglycaemia was reported to lead to poor insulin adherence and omission [48, 49, 58, 63, 66].

Injection-related problems Patients in Mehmet et al.'s [59] study reported problems injecting in front of others, most commonly because they worried about upsetting or offending them. Others experienced anxiety and fear of injections [61]. Zambanini et al. [69] found insulin injections were avoided in 14% of participants because of related anxiety.

Adherence to insulin Insulin non-adherence was common taking the form of dosing irregularities and insulin omission [50, 58, 64, 65]. Factors contributing to insulin adherence, included: being in a public place or travelling; fear of hypoglycaemia; and therapy complexity [48, 63].

The majority of patients surveyed by Cefalu et al. [53]; wished there was another way to take insulin whether they were using insulin (n = 371;79%) or not (n = 782; 80%). Non-adherence was also associated with dosing irregularities, reduced doses, and mistimed doses [50, 58, 64, 65].

HCP-related themes

Adherence to insulin Physicians (55% from primary care and 45% specialists) reported that glucose control was negatively impacted by the level of insulin adherence, with missed, mistimed, or reduced insulin doses being identified [50]. Despite acknowledging the clinical relevance of irregular dosing, 32% of physicians reported not routinely discussing these with their basal insulin patients and 29% with their basal-bolus patients.

Hypoglycaemia was identified by HCPs as having an effect on insulin adherence [49, 58]. In Peyrot et al.'s study [64], patients and physicians agreed the five most common reasons for insulin omission or non-adherence was being too busy; travelling; skipped meals; stress or emotional problems; and public embarrassment. Rubin et al. [65] reported 50% of their patients would be more likely to take insulin regularly if the pain of injecting could be ameliorated.

Insulin-related role Cuddihy et al. [54] surveyed 600 physicians (50% from primary care and 50% specialists) and found that notable proportions of primary care physicians never initiate or modify insulin and never or rarely intensify it mainly because of lack of experience and lack of time to educate patients. There was also disagreement regarding who was responsible for intensification. However, 86% of all the physicians agreed that primary care physicians should become more involved in managing insulin. In another study [67] nurses and physicians agreed, nurses should take a larger role in managing diabetes. Finally, in a survey by Van Avendonk et al. [68] of Dutch GPs (n = 1621) 67% started and managed insulin therapy in T2DM. Associated factors were being male, above age 40 years, working in a health centre, and working together with a Practice Nurse.

Analytical themes

Four analytical themes, the equivalent of third-order interpretations in meta-ethnography [19, 26], were then generated from the integrated themes. These interpretations provided new perspectives to identify modifiable mechanisms that could be manipulated to enhance insulin use and adherence. The themes are interrelated as expressed in the model outlined in Fig. 3.

Theme 1. Understanding and attending to patient barriers

It is evident that there are multiple barriers to insulin uptake and utilisation in patients with T2DM. These barriers are common and are multi-levelled, with major factors being: psychological issues such as fear or hypoglycaemia and negative beliefs about insulin; and social factors such as external prejudice, stigma and life disruption/constraints. Despite being aware of these patient level barriers to insulin adherence, the primary care HCP accounts did not identify strategies for addressing them. If these barriers are to be overcome a multi-modal approach providing targeted support to patients and enhancing the primary care HCP's skills in overcoming these are required, with key components being: patient centred education and self-management support addressing patient level barriers; training for primary care HCPs to enhance their confidence in using insulin and in being able to elicit and respond to patient needs in relation to insulin self-management.

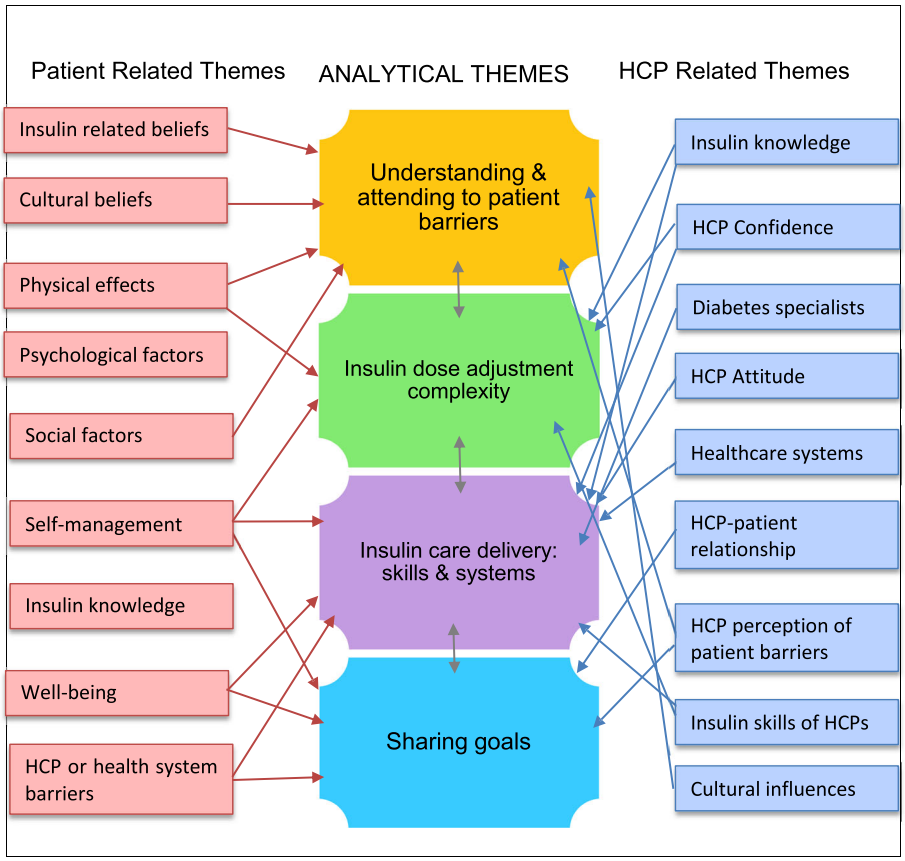

Fig. 3 Analytical Model and the Interrelated Themes. Key: HCP = Healthcare Professional

Theme 2. Insulin dose adjustment complexity

The collected data suggests that current methods of insulin dose titration are not always systematic but are often suboptimal with poor adherence. Dose adjustment seems to be further complicated by patient perceptions on insulin use which can be subjective and are influenced by factors such as avoiding hypoglycaemia and the management of wider aspects of their social and working lives. Hence, if insulin dose adjustment is to be more optimally managed then there is a need for a simpler patient centred approach. This approach again needs to attend to potential behavioural confounders and ensure that patients have a clear perspective on the process, its importance and what they hope to achieve.

Theme 3. Sharing goals

The data identified that there may be some divergence between the patient's blood glucose goals and those of their HCPs. Patients identified that HCPs focussed more on achieving a glycaemic target whereas subjectively they may feel better with higher glucose levels. Hence, insulin use may be enhanced if there is a stronger connectivity between the patient and the HCP in setting and agreeing therapy goals.

Theme 4. Insulin care delivery: Skills and systems

The insulin-related skills and attitudes of primary care HCPs may be significant in determining the use of insulin and the outcomes achieved. The skills are not isolated to the individual HCP, as the data suggest that the context of practice is important too, placing an emphasis on systemic factors including care integration and teamwork. This emphasis is further reinforced by the data highlighting continuity and consistency in the support provided to patients. There were also data suggesting the need to integrate specialist support within the system to help primary care professionals optimise care delivery. Where available, the specialist support could also be provided by those practices already experienced and skilled in insulin initiation/intensification. Therefore, if insulin therapy is going to be better delivered within primary care not only will the HCPs need better training, they will also need to develop support systems that are internally (a team approach) and externally integrated (specialist support).

Discussion

This synthesis has identified a wide range of factors that modify the use of insulin in people with T2DM. These

factors can be broadly divided into three interrelated levels, the patient, the HCP and the care system. The use of data derived from both patients and HCPs enhances the analytical potential of the synthesis to consider the interactive components expressed from these different perspectives. These generated the potential development of newer services for patient benefit.

Patients

The findings of the review have identified a wide range of factors that drive patients' behaviours in relation to insulin use. These factors include: underlying beliefs about insulin; psychosocial factors; the self-management skills and knowledge of the patient; and their experiences in using insulin. It is also clear from the review that many of these factors are interactive. While many of these factors have been reported in previous reviews [10, 13, 16, 70] this review has considered how these factors are expressed and interact in the experiences of patients with the added perspective of how they relate to the views and behaviours of health professionals. This latter element is important as it is the interaction between patients and health professionals where many of the challenges and barriers for effective insulin use in patients with T2DM reside. The review has also highlighted the problems and issues that affect patients' use of insulin. Addressing these issues is important and they need to be considered in the patient education and self-management support provided to patients. The findings suggest that as well as the technical aspect of self-management, the support provided needs to consider the patients' underlying beliefs, their psychological orientation to insulin and the influence of wider social factors. Addressing the problem of clinical and psychological inertia of the intensification of insulin therapy is key part of the process [8, 12, 71]. Given that factors such as perceived stigma in their use of insulin restricts how they use it, it may be important to help patients develop strategies to ameliorate those feelings. Wider factors such as family dynamics also need to be considered. Therefore, if patients are going to supported in using insulin effectively the barriers and factors highlighted in the review need to be incorporated into the insulin assessment process and attended to in the self-management support provided. It is also necessary to establish whether or not a patient wishes or is able to self-manage their insulin titration as some patients may prefer to be led by their HCP as was apparent in this synthesis [42, 44],

HCPs

The HCPs accounts utilised within the review were predominantly those of primary care physicians. While these accounts were derived from studies undertaken in different healthcare systems, they shared similar perspectives on insulin management. The two key factors that governed the delivery of insulin care were the skills of the HCP and the time available. The former would suggest that there is a need for professional education. Given the findings of the patient accounts, this education needs to offer more than the technical aspects of insulin and should include an understanding of the psychosocial factors that may influence insulin use. In relation to time, it may be important to identify the role of other team members in delivering insulin support such as primary care nurses or diabetes specialist nurses supporting the primary care team. These benefits were highlighted in a study by Ritholz et al. [72] but the physician participants stressed the necessity of regular and ongoing communication among team members to ensure patients received consistent information. The review has also identified that the interactions between HCPs and patients are pivotal in determining whether insulin is used effectively. The relational aspect of care and continuity of support seem to be particularly important. In keeping with other studies [73, 74], the review identified that patients and HCPs can sometimes have divergent views in some areas, in particular glycaemic targets, highlighting the need for agreeing blood glucose goals in a collaborative way when supporting patents to adjust their insulin. Serrano et al. [75] illustrated some effective approaches to shared-decision making to enhance patient understanding of choices in diabetes management. Therefore, primary care HCPs can have a very important contribution to make in using insulin effectively provided they have the appropriate training, the time needed to deliver care and supportive health systems.

Healthcare systems

The evidence presented in this thematic synthesis revealed how integrated healthcare systems, teamwork, the way GP practices were organised, and in one study, the presence of a Practice Nurse [68], all facilitated the role of general practice in insulin treated T2DM. Diabetes specialists also shared this view. The thematic synthesis identified that the support of diabetes specialist teams, can help primary care HCPs to deliver insulin support. Therefore, to ensure that insulin is used optimally in primary care, the findings of the review indicate that the care system needs to be designed to ensure that patients are assessed and followed up by an appropriately trained HCP, who can provide continuity in their care experience. The system also needs to consider how to integrate specialist diabetes support to help the primary care teams in their clinical decision making and in building the resources that patients will need to support their insulin use.

Limitations

This review has a number of limitations. The principle one is the reliance on the quality of the data from the primary studies, as most of the studies were

not exclusive to T2DM patients, and not all based only in primary care. The latter was addressed by only including data from participants with T2DM in primary care. Another limitation was that many of the studies were biased toward the perspectives of primary care physicians, and identifying more accounts from other team members would have enhanced the review findings. From a UK perspective, more accounts of the contribution from PNs would have been desirable. It was also noted that while it was possible to elicit barriers to effective insulin utilisation, there were few studies that identified potential facilitators of insulin management, although the review was able to theorise these based on the nature of the identified barriers. Another potential source of bias was that some of the surveys were supported by insulin-related companies, although no evidence of such bias and the nature of the surveys were not related to product evaluation. The inclusion of both qualitative and quantitative designed studies is a further weakness, particularly with the variety of qualitative approaches, incorporating interpretive and descriptive approaches. However, this integration could also be viewed as a strength as identifying common themes in the different data sources adds to the likely generalisability of the findings. Finally, the literature search was completed in March 2015 and further studies have since been identified. These include a patient survey of frequency of self-treated hypoglycaemia [76], a focus group study of insulin treated T2DM patients to identify fear of hypoglycaemia [77], interviews and focus groups of patients and HCPs to ascertain their perspectives on psychological insulin resistance [78], semi-structured interviews of patients to establish barriers to and enablers of insulin self-titration [79], and finally interviews of patients with insulin treated T2DM to detect their reasons for poor glycaemic control [80].

Despite these limitations, the synthesis has provided some novel insights into the collective factors impacting on insulin treated patients in primary care. These will be a helpful reference for further exploratory studies in developing new interventions.

Conclusions

Insulin use is often poor in people with T2DM, and associated with sub-optimal long-glycaemic control, with risk of complications and increased mortality [10–12, 81, 82]. This review reveals the burden experienced by T2DM patients receiving insulin and the skills needed to equip primary care HCPs to support them. Integrated healthcare systems with appropriate resources could help facilitate this but patient-centred care by appropriately skilled GPs and PNs is also required.

Additional files

Additional file 1: Literature Search Strategy (DOCX 54 kb)
Additional file 2: Appraisal scores for the included studies. (DOCX 23 kb)
Additional file 3: Findings of the Surveys. (DOCX 29 kb)

Abbreviations

CASP: Critical appraisal skills programme; DSN: Diabetes Specialist Nurse; GP: General Practitioner; HCP: Healthcare professional; OHAs: Oral hypoglycaemic agents; PCP: Primary Care Physician; PN: Practice Nurse; QOL: Quality of life; RR: Response-rate; SMBG: Self-monitoring of blood glucose; T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus

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Availability of data and materials

All the data analysed during this study are from previously published reports. The details of the reports are included in Tables 2, 3, 4. and in the reference section.

Authors' contributions

KE conducted and wrote up the synthesis. HM Reviewed and edited the manuscript. AF made a significant contribution to the design and write up of the report. All the authors have read and approved the manuscript.

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Ethics approval and consent to participate

This was not required as the data analysed were extracted from reports of previously published studies.

Competing interests

The authors declare that they have no competing interests.

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