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**Title: A cost comparison study of using Global Positioning System Technology (Electronic Monitoring) in a medium secure forensic psychiatric service.**

Corresponding author: Dr Paula Murphy; St Andrew's, Cliftonville, Northampton, NN1 5DG; [paulamurphy2@nhs.net](mailto:paulamurphy2@nhs.net); tel 01604 608697

Dr Lucy Potter, Maudsley Hospital, Denmark Hill, London SE5 8AZ,

Dr John Tully, Institute of Psychiatry, Denmark Hill, London SE5 8AZ

Dave Hearn, Security Team Leader, BCD CAG, South London and Maudsley NHS Foundation Trust

Prof Thomas Fahy, Institute of Psychiatry, King's College London, De Crespigny Park, London SE5 8AF

Prof Paul McCrone, P024 Institute of Psychiatry, Psychology & Neuroscience King's College London, De Crespigny Park, London SE5 8AF

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Declaration of interest: None

## Abstract

### Background

'Electronic Monitoring' (EM) is the use of the electronic devices to monitor the whereabouts of individuals. In 2010, following a series of high-profile incidents related to absconding, EM using GPS-assisted technology was introduced in the medium secure forensic psychiatry service of the South London and Maudsley Foundation Trust in order to monitor individuals on leave. An analysis of use in the first two years revealed that EM was associated with increased unescorted leave and reduced leave violation within the service. However to date the comparative costs of using EM have not been established.

### Aims

To compare the costs of using GPS Electronic Monitoring (EM) in forensic psychiatric patients on leave from a medium secure service by comparing the average total cost per patient with EM and without EM.

### Methods

Costs were compared before and after the implementation of EM and an average total cost per patient was calculated. The total cost of leave for each study group was calculated. The cost of EM was added only to the group using the device. The total cost for each group was divided by the number of patients to generate an average total cost per patient for each group.

### Results

The average total cost per patient without EM was £1702 compared to the average total cost per patient with EM which was £1617. Although the average total cost per patient decreased following introduction of EM, this was not statistically significant.

### Conclusions

The results showed no significant difference between average total costs per patient before and after introduction of EM. The finding of EM being cost neutral is ~~highly encouragingcautiously optimistic.~~ ~~Of note, the costs of leave violations were not included in the figures, suggesting the benefits could be more substantial than stated, which has wider implications on emergency resources and cost to the public purse.~~ The results represent provisional findings only and we recommend that a further economic evaluation is carried out under rigorous trial conditions.

## Introduction

Forensic psychiatry deals with the assessment and treatment of mentally disordered offenders, many of whom are detained in secure units. In the UK, secure units are classified as low, medium or high secure, the majority of which are medium. There are around 70 medium secure units in the UK housing around 5000 patients.<sup>1</sup> The numbers of patients being detained in secure units has risen dramatically in the last two decades. The Sainsbury Centre for Mental Health reported that between 1996 and 2007, the population of high- and medium-secure units rose by 45% with the majority of expansion occurring in medium-security.<sup>2</sup> The cost of treating a patient in a medium secure unit is estimated at £450 per day.<sup>1</sup> One study conducted in 2009 found that average length of stays in medium secure units was 720 days or 2.7 years.<sup>3</sup> The total cost per patient per admission is therefore significant and it has been estimated that the national annual cost of patients detained in medium security is £1.2bn.<sup>1</sup>

Rehabilitation is a key component of treatment for patients detained for lengthy periods, with the aim being eventual discharge back into the community. Central to rehabilitation and reintegration into society is leave from the secure unit. For patients detained under the Mental Health Act, leave is granted by the Responsible Clinician under the auspices of Section 17 of the Mental Health Act 1983 (amended 2007). Some mentally disordered offenders are subject to additional restrictions placed on them by the Courts, under Sections 41 or 49 of the Mental Health Act 1983 (amended 2007). In such cases Section 17 leave must also be agreed by the Secretary of State. The Secretary of State recognises leave as having *'an important part to play in treating and rehabilitating restricted patients. It also provides valuable information to help responsible clinicians, and the Secretary of State, in managing the patient in hospital, and to all parties, including the Tribunal, when considering discharge into the community.'*<sup>4</sup> Leave allows the testing out of the patient's willingness to comply with stipulated conditions such as length of absence or destination of leave, thus acting as an indicator of the likelihood of compliance with treatment and follow up in the community following discharge. In cases where patients do not comply with the conditions of their leave, it is usually because they have absconded whilst on escorted leave with staff, do not return from unescorted leave or return later than agreed. This is recorded as a leave violation, and its occurrence requires certain procedures to be followed in line with local policy, which often involves informing the police and the Secretary of State if the patient is restricted.

A literature review on absconding from psychiatric hospitals in 2010 by Stewart and Bowers, which included 75 empirical papers, found that a minority of patients who had absconded committed an offence whilst on unauthorised leave, the proportion of which ranged from 2% to 11%.<sup>5</sup> Around half of offences committed were serious, though homicides were noted to be extremely rare. Risk to the patient was also considerable, with 25% of suicides by patients with 'inpatient' status carried out by individuals who had absconded. Other consequences included self-harm, physical health problems or missing medication. In addition to this, it was noted that absconding placed *'a burden upon staff who worry about the safety of absconding patients and upon the police who are often involved in returning patients to hospital'*<sup>5</sup>

Mental health services have a duty to provide high quality patient care while at the same time promoting public safety. The Secretary of State states that leave programmes should be *'designed and conducted in such a way as to preserve public safety and, where appropriate, respect the feelings and fears of victims and others who may have been affected by the offences.'*<sup>4</sup>

A series of high-profile incidents<sup>6</sup> related to absconding from River House, a medium secure unit in South London and Maudsley NHS Foundation Trust, led to the introduction of electronic monitoring (EM) of patients on leave in 2010.

EM uses global positioning system technology to monitor the whereabouts of individuals and is worn around the ankle of the individual. Wearing the device is voluntary and used only in capacitous patients who agree to its use whilst on leave, except for high-risk patients who require urgent hospital or court transfer<sup>6</sup>.

The use of EM when patients are on leave has evoked much legal and ethical debate and a consensus on it has not yet been reached. Whilst it is important that these issues continue to be debated, the cost benefit of such an intervention also needs consideration. Analysis of its use in the first two years following its introduction in River House revealed positive associations, namely that it was associated with increased unescorted leave and a reduction in leave violations within the service<sup>7</sup> (~~unpublished data~~). However, to date, the comparative costs of using EM in the UK have not been established. It is essential that this information is available for those responsible for the planning and commissioning of mental health services, particularly in times of austerity and health cut backs. Given the financial burden of secure care, it is vital that the cost effectiveness of any new intervention be determined, particularly if it has potential to improve public safety.

## **Aims**

To compare the costs of using GPS Electronic Monitoring (EM) in forensic psychiatric patients on leave from a medium secure service by comparing the average total cost per patient with EM against the average total cost per patient without EM.

## **Methods**

### Patients and study design

This was an observational retrospective study in a medium secure unit. (Total number of beds: 107 male beds and 15 female beds.) Data on patients who had used leave during a three-month period in 2010 and in the corresponding period in 2011 were collected. Ethical approval was received prior to starting data collection from the Trust Audit Committee. Ward data were used to obtain information on the type of leave taken (escorted or unescorted), the number of staff needed to facilitate the leave, and the ward from which the patients originated. Electronic patient records were then consulted to ascertain the patients' demographic details including age, sex and diagnosis. 'Datix', the trust's incident reporting system, was used to identify episodes of leave violation during the stated time periods.

### Comparators

Episodes of leave over the baseline period (1<sup>st</sup> January 2010 – 31<sup>st</sup> March 2010), prior to the introduction of Electronic Monitoring (EM), were compared with episodes of leave using EM in a corresponding period one year later (1<sup>st</sup> January 2011 – 31<sup>st</sup> March 2011). The average total cost per patient was ascertained for each period and included leave violations, staff costs and EM overheads.

### Outcome measures

The outcome measure for each group was average total cost per patient. Costs were compared for each cohort. They were divided into capital costs and recurrent costs. Capital costs included the EM overheads. Recurrent costs included direct costs (i.e.

the expense of escorting staff, which was calculated by multiplying the number of staff required by the number of escorting hours, and the cost of leave violations).

#### Resource use and costs

The economic comparison included healthcare expenses for the trust as well as wider costs involving the criminal justice system. Information on the resources used for each episode of leave was meticulously recorded and focused on the following areas:

- Staff costs

The Personal Social Services Research Unit (PSSRU) document entitled 'Unit Costs of Health & Social Care 2011'<sup>7,8</sup> was used to calculate the cost of escorting staff. The original data did not specify whether a qualified nurse or a support worker facilitated the leave. As each nursing shift comprised of a combination of both qualified and unqualified staff, the average cost for a qualified nurse per hour with patient contact (£97) and the cost of a health support worker per hour (£20), was calculated. This gave an average cost of £59. This figure was then multiplied by the number of escorting staff facilitating each episode. The figure used accounted for salary, salary on-costs, National Insurance, pensions, qualifications, management and administrative overheads, and capital overheads such as build and land requirements of NHS facilities.

- Electronic Monitoring (EM) costs

The EM costs were calculated per patient for the 2011 patient group. The cost was calculated by quartering the cost of the annual contract, to account for the three-month period in the study. The contract cost included the first 70 devices used and thereafter an extra fee was charged for each additional device used.

- Leave violation costs

Leave violations included episodes of 'absconding', defined as breaking free from escorting staff while on leave, and 'failure to return', defined as not returning from unescorted leave or returning late. In order to cost these incidents, 'Datix' was used to identify leave violations in the stated time periods in order to produce a breakdown of the likely costs. This was to take several factors into consideration, including the length of violation, whether police were contacted or involved, whether the Ministry of Justice (MOJ) was contacted, any media reports in local or national news, whether drugs/alcohol were used, or any offences committed during the leave. Additional costs required to facilitate the patient's return were to also be considered. As the costs in each group were mainly limited to basic police services, it was felt that producing a total leave violation cost was of minimal benefit. Instead a detailed description of each incident was provided in the results.

#### Analysis

Chi-squared analyses were performed to determine whether the 2010 and 2011 groups were matched for demographic details including age, sex and diagnosis. As some patients appeared in both cohorts, we compared costs using a regression model clustering on the patient ID number. This allowed robust standard errors to be produced. All statistical analyses were carried out using SPSS version 21.0 (IBM, SPSS).

## Results

### Participants

There were 175 patients included in this study. Of these, 42 (24%) patients were included in both the 2010 and 2011 groups. The 2010 group (without EM) included 96 patients (n = 96) who used a total of 2228 episodes of leave. Of these 96 patients, demographic details could not be identified for 5 (5.2%) patients. This was due to an absence of adequate patient identifiers for these individuals in the original ward data. The 2011 group (with EM) included 121 patients (n = 121) who used 3113 episodes of leave. Similarly, of these 121 patients, 29 (24.0%) could not be identified, again due to absence of patient identifiers. The majority of participants were male (n = 78, 85.7% in the 2010 group and n = 77, 83.7% in the 2011 group) and the mean age was 40.2 years (s.d. = 11.6) in the 2010 group and 38.0 years (s.d. = 11.8) in the 2011 group. Chi-squared analyses confirmed that the 2010 and 2011 groups were matched for age, sex and diagnosis. Detailed demographic information is displayed in Table 1.

**Table 1**

	<b><u>2010</u></b> <b>(n= 96)</b> n (%)	<b><u>2011</u></b> <b>(n= 121)</b> n (%)
Demographic details unavailable	5 (5.2)	29 (24.0)
<b><u>Sex</u></b>		
Female	13 (13.5)	15 (12.4)
Male	78 (81.3)	77 (63.6)
<b><u>Diagnosis</u></b>		
Psychosis	72 (75.0)	72 (59.5)
No Psychosis	19 (19.8)	20 (16.5)
Affective disorder	5 (5.2)	8 (6.6)
No Affective disorder	86 (89.6)	84 (69.4)
Personality Disorder	19 (19.8)	23 (19.0)
No Personality Disorder	72 (75.0)	69 (57.0)
Substance use disorder	11 (11.5)	9 (7.4)
No Substance use disorder	80 (83.3)	83 (68.6)
<b><u>Other diagnoses</u></b>		
PTSD	0 (0.0)	1 (0.8)
Borderline LD	0 (0.0)	1 (0.8)
Mild LD	1 (1.0)	1 (0.8)
Moderate LD	1 (1.0)	1 (0.8)
Mental disorder NOS	1 (1.0)	0 (0.0)
No other diagnosis	88 (91.7)	88 (72.7)
<b><u>Age</u></b>		
18-29 years	20 (20.8)	23 (19.0)
30-39 years	20 (20.8)	26 (21.5)
40-49 years	36 (37.5)	31 (25.6)
50-59 years	8 (8.3)	6 (5.0)
60-69 years	5 (5.2)	5 (4.1)
70-79 years	2 (2.1)	1 (0.8)

### Resource use and costs

- Staff costs  
The hourly cost of escorting staff in each group was £59.
- Electronic Monitoring (EM) costs  
The cost of EM per patient for the 2011 group was £286. This figure was calculated from the combined costs of the annual EM contract (£114,336 for up to 70 devices) and the cost of the additional devices used (£119 per device). As this study focused on a specific three month period, the annual cost was converted into an equivalent cost per quarter (£28,584). A total of 121 patients were included in the 2011 group and therefore an additional 51 devices were required at a cost of £6,069 (51 x £119). This gave a total cost of EM over 3 months for 121 devices of £34,653, and as previously stated, a cost per patient of £286 (£34,653/121 patients).
- Leave violation costs  
Tables 2 and 3 illustrate each leave violation in the 2010 and 2011 groups. There were six separate incidents in each group. In 2010 two patients absconded from escorted leave and four failed to return on time from unescorted leave. In 2011 six patients failed to return on time and there were no episodes of absconding.

**Table2  
2010**

Patient	Abscond (hours)	Failure to return (hours)	Police contacted	MOJ contacted	Police Involvement	Media Reports	Drugs/ Alcohol on leave	Offences on leave
1	48	-	Yes	Yes	Police search. Patient surrendered to police out of area. Transported 54 miles in secure police vehicle back to hospital.	Yes (Croydon Advertiser)	Yes (UDS positive for THC/cannabis & opiates)	No
2	1	-	Yes	No	Escorted back to hospital in local police patrol car.	No	No	No
3	-	6	Yes	Yes	No	No	Yes (Alcohol)	No
4	-	1.5	Yes	No	Two police officers attended hospital to obtain information.		Yes (Alcohol; Refused UDS)	No
5	-	2	Yes	Yes	No	No	No	No
6	-	1.5	No	No	No	No	No	No
<b>Total:</b>	<b>2/6</b>	<b>4/6</b>	<b>5/6</b>	<b>3/6</b>	<b>3/6</b>	<b>1/6</b>	<b>3/6</b>	<b>0/6</b>

**Table 3  
2011**

Patient	Abscond (hours)	Failure to return (hours)	Police contacted	MOJ contacted	Police Involvement	Media Reports	Drugs/ Alcohol on leave	Offences on leave
7	-	23	Yes	Yes	Three police officers attended hospital to obtain information.	No	Yes (Alcohol, cannabis and cocaine)	No
8	-	8	Yes	Yes	Four police officers attended hospital to search room.	No	Yes (UDS positive for cannabis)	No
9	-	64	Yes	No	Two police officers attended hospital to obtain information. Two further officers searched patient's room. Patient later escorted 8 miles back to hospital by police.	No	No	No

10	-	19.5	Yes	Yes	Two police officers attended hospital to obtain information.	No	No	No
11	-	8	Yes	Yes	No	No	No	No
12	-	72.5	Yes	No	Two police officers attended hospital to obtain information on two occasions. Police unit also attended patient's partner's house.	No	Yes (UDS positive for cocaine)	No
<b>Total:</b>	<b>0/6</b>	<b>6/6</b>	<b>6/6</b>	<b>4/6</b>	<b>5/6</b>	<b>0/6</b>	<b>3/6</b>	<b>0/6</b>

### Cost Analysis

The combination of staff costs with or without EM allows the calculation of an average total cost per patient, and enables comparison of the 2010 and 2011 groups. It is important to note that average total cost per patient was selected rather than cost per leave hour. The original data clearly recorded the number of leave hours per escorted leave episode. However, recording of leave hours for unescorted episodes was less consistent. Although this had no implication on total staff costs, it would have affected an average cost per leave hour when escorted and unescorted leave were considered together. Therefore average total cost per patient was deemed to be a more accurate measure to enable comparison between the two groups.

The staff costs in the 2010 group equalled £163,390 (the total number of escorted leave hours x £59), compared to staff costs in 2011 of £161,050. The 2011 staff costs were lower, despite an overall greater number of leave episodes, indicating a larger proportion of unescorted leave (carrying no staff cost) in this group. The 2011 group carried the additional EM costs of £34,653 giving a total expenditure of £195,703. Finally an average total cost per patient was calculated, which equated to £1702 (£163,390/96) in the 2010 group and £1617 (£195,703/121) in the 2011 group. These figures are displayed in Table 4.

<b>Table 4</b>	<b>2010</b>	<b>2011</b>
Number of patients	96	121
Number of leave episodes	2228	3113
Number of staff hours	2793	2753
Staff costs (£59/hour)	£163,390	£161,050
EM costs	NA	£34,653
Average total cost per patient	£1702	£1617
<b>Significance:</b>	<b>p-value</b>	<b>0.72</b>

### **Discussion**

Our study showed no significant difference between average total costs per patient before and after introduction of EM. The average total cost per patient decreased following introduction of EM, though this was not statistically significant. In light of the considerable costs of implementing the EM system, this is ~~an encouraging~~

cautiously optimistic finding.

EM was introduced for a number of reasons. As well as public protection concerns (addressed above), serious consideration was given to the importance of moving patients as quickly as possible through the medium secure recovery pathway, without compromising on public or patient safety. In our other work, we have shown an significant increase in escorted leave and a significant reduction in episodes of leave violation following the introduction of EM <sup>2</sup>(unpublished data). This cost comparison study suggests that such important these benefits (relevant, critical to patient progress and reduced length of stay) have arisen without any extra cost per patient.

The use of EM in the 2011 group appeared to result in more unescorted leave. At present the value of leave is poorly understood and there is no evidence to suggest that leave in itself leads to better outcomes, such as reduced recidivism. However leave is an important part of rehabilitation and recovery and presumably considered valuable by the patient. Therefore the utility of unescorted leave needs to be established and should be included in future economic evaluations.

A potential benefit of EM might include having less staff on per shift if fewer escorts are required to facilitate leave. This was not directly examined in this study and therefore the reduced cost of staff escorts in the 2011 group is a notional saving only. It would only represent economic efficiency if staffing costs were reduced, or if it could be demonstrated that deployment of staff elsewhere resulted in some other benefit.

It is also important to note that by calculating average total cost per patient, the capital EM costs have been dissipated (due to the increased number of patients in the 2011 group). If the number of patients had remained the same, the average total cost per patient would have increased in the 2011 group. Therefore we cannot conclude that money has been saved as a result of the introduction of EM. The

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Firstly, it is likely possible that the cost difference would have been greater if the cost per hour of leave had been calculated, rather than the average total cost per patient. The cost per hour of leave could not be calculated because the number of hours of unescorted leave had not been recorded for all of the data. Both groups were similar in terms of the number of escorted leave hours and therefore the main difference between the groups was in the amount of unescorted leave taken. In the 2010 group the number of hours of unescorted leave taken was well documented however in the 2011 group, this was poorly documented. The reasons for this were not known. This meant that the number of hours of leave could not be directly compared for each group and therefore the cost per hour of leave could not be calculated. For this reason the average total cost per patient was calculated instead.

Secondly, the cost of leave violations was not included in our final figures. This was because for this particular sample, the leave violations did not incur significant costs. As the study period was only over three months, a longer study period would have better captured these relatively uncommon but highly significant and potentially costly events, such as those involving extra police involvement time and negative media coverage. It should be noted that indirect costs such as disrupting treatment/medication, loss of trust between team and patient and the added stress on staff were not determined. Further, examining 3 consecutive years of 4 month

Another measure, which would have been particularly useful in considering costs, is the length of stay (LOS). This could not be included in our study because many of

the patient's in the two groups remained in-patients at the time the study was conducted. This would have been useful because when patients violate their leave conditions the consequence is usually a delay in their progress because leave is terminated for a period of time and more precaution is applied when considering leave in future, such as using more staff escorts and granting shorter periods of leave. If EM acts as a deterrent to violating leave then this might avoid prolonged admissions ~~and —If this were to result in a reduction in length of stay, then could represent the—~~ cost benefits ~~could be substantial.~~ However further evaluations are required.

~~One of the main benefits in using EM appeared to be that it resulted in more unescorted leave. This being the case, the utility gained by patients who are granted unescorted leave needs to be established in order to fully determine the benefits and could be included in future economic evaluations. The value of leave is poorly understood and currently there is no evidence to suggest that leave in itself leads to better outcomes such as reduced recidivism. However leave is an important part of rehabilitation and recovery and presumably considered valuable by the patient.~~

#### *Limitations*

One of the main limitations was that as this was a retrospective analysis we identified only associations and not causation. In addition, the study design meant that confounders could not be controlled for and because it was a before and after study, time may have had an impact.

Demographic data could not be identified for 24% of the patients in the 2011 group. This was because the patients could not be found on the electronic system from the original data set. It should be noted however that even though demographic information could not be identified, leave details were still included in the data. It is likely that psychosis was under-estimated in the 2011 group for this reason. In addition personality disorder and substance misuse were likely under-estimated in both groups because of poor recording of co-morbid diagnoses on the electronic system.

The outcome measure applied i.e. the average total cost per patient rather than the cost per leave hour. The latter ~~would have no doubt~~ could have resulted in a greater cost difference, which might have made the results statistically significant, ~~in favour of episodes of leave with EM.~~

The short study period resulted in a small number of leave violations meaning that cost of leave violations were not necessarily representative. Our other data examining 4-month periods over 3 consecutive years suggest that EM is associated with a decrease in episodes of leave violation<sup>7</sup>.

A weighted average of the hourly cost of a qualified Nurse and a Clinical support worker was used because the data did not record the type of staff escorting the patient (i.e. qualified or unqualified). As there was a substantial difference in hourly cost of each, if either group had been used significantly more than the other, this could affect the results.

The time taken to train staff on using EM and the time taken to attach EM device to the patient and ensure a signal was not taken into account and this uses up staff time.

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## Implications

This type of study is unique to forensic psychiatry and whilst the results represent provisional findings only, it raises some important considerations for this type of intervention in the management of mentally disordered offenders and further research is required in this area. EM is a relatively new intervention for this population and as far as we are aware this is the first study to consider the costs and benefits of such an intervention. The finding of EM being cost neutral is [highly encouragingcautiously optimistic](#). A randomised controlled trial, over a longer period of time, is required to allow for a robust cost-effectiveness analysis to be carried out. A qualitative study is currently being undertaken on patient attitudes to EM however to date staff attitudes have not been sought. It is recommended that this be carried out.

Of note the Secretary of State does not consider the use of EM in their decision to grant leave when considering an application however EM does provide an extra safeguard should a patient violate leave, thereby improving public safety.

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