Evidence on the Effectiveness of GPS Monitoring for Mental Health Forensic Rehabilitation Patients

October 2014

*Literature Scan*

Nova Scotia Health Research Foundation
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Key Points

- Due to the contemporary nature of GPS monitoring, there is limited evidence available in the published literature about the use and effectiveness of electronic monitoring among mental health forensic rehabilitation patients.

- GPS monitoring was implemented among mental health forensic rehabilitation patients in the United Kingdom in 2010 and in Queensland, Australia in 2012.

- The longest operating example of the use of GPS monitoring among mental health forensic rehabilitation patients is the Buddi system in the United Kingdom. In this case, there is a correlation between the use of electronic monitoring and an increase in unescorted leave and decreased violations during leave.

- Preliminary research findings from the United Kingdom suggest that GPS monitoring deters patients from absconding and can help patients view leave as part of their treatment and progress, as well as an incentive.

- Concerns about the use of GPS monitoring among mental health forensic rehabilitation patients include the potential for increased stigmatization which may negatively impact a patient's mental health, treatment and recovery process.
Executive Summary

The purpose of this literature scan is to consider the effectiveness and appropriateness of electronic monitoring for mental health forensic rehabilitation patients who are accessing the community as part of their treatment, and the potential impact of this monitoring approach on public safety. Specifically, the literature scan sought to address three questions which were identified by the Nova Scotia Department of Health and Wellness including:

i) The available evidence that assesses the effectiveness of GPS or other electronic tracking systems for mental health forensic rehabilitation patients;

ii) The factors that impact the successful use of these tools for mental health forensic rehabilitation patients; and

iii) The unintended consequences of using GPS or other electronic tracking systems for mental health forensic rehabilitation patients.

As a reflection of the contemporary nature of GPS monitoring, there is limited evidence available in the published literature about its use and effectiveness among mental health forensic rehabilitation patients. The act of leave among mental health forensic rehabilitation patients can be an important component of treatment and recovery. Subsequently, abscondment or breaches in leave can result in negative impacts on patients' treatment and harms to the public.

Evidence on the use and effectiveness of GPS or other electronic monitoring systems among mental health forensic rehabilitation patients is found in two primary case studies. It was first implemented in the United Kingdom in 2010, and more recently in Australia in 2012. GPS monitoring was implemented in these locations after several high profile abscondments -- it was suggested that the safety of both patients and the public could be enhanced by the use of this technology.

A patient's decision to abscond during leave is often impulsive and is influenced by socio-environmental factors. The use of electronic monitoring can increase access to leave, manage risk and help prevent patients from making impulsive decisions. The longest operating example of the use of GPS monitoring among medium- and high-risk mental health forensic rehabilitation patients is the Buddi system in the United Kingdom. The Buddi system includes a steel-reinforced leather ankle bracelet which allows for patients to be electronically monitored in real time when they are on leave as part of their treatment including accessing hospital grounds, other hospitals and the community.

The use of the Buddi system in this case relies on a partnership between the patients and numerous organizations including the London hospital trust which is responsible for the
implementation and evaluation of the electronic monitoring system; the product provider who supplies the device, support and information; the alarm receiving centre which provides the tracking service; and the police who work with all the different parties in order to safely locate and return absconded patients to the hospital.

A forthcoming publication by Tully et al. will be the first research to formally examine the effects of the implementation of electronic monitoring in any psychiatric setting. Data from the first two years of the program in London indicate that there is a correlation between the use of the Buddi system and an increase in unescorted leave, as well as decreased violations during leave. It was found that GPS monitoring deters patients from absconding and can help patients view leave as part of their treatment and progress, as well as an incentive. The Buddi system has recently been approved to continue for the next five years as a result of its positive impact on patient leave and safety.

GPS monitoring among mental health patients was implemented in Queensland, Australia after amendments to the Mental Health Act. The amendments allow for electronic monitoring of forensic and classified patients during limited community treatment which isapproved by the Mental Health Review Tribunal and includes escorted or unescorted absences from the grounds of the mental health facility, or receiving treatment as an outpatient. Electronic monitoring is not used on all forensic or classified mental health patients, each case must be formally approved by the Director of Mental Health. While there were only six electronic monitoring devices shared between the 16 mental health facilities in December 2013, dozens more have been ordered so that all facilities will have at least five devices.

The legislative amendments in Queensland received criticism from stakeholders and healthcare professionals. A group of local forensic psychologists raised concerns about the potential for increased stigmatization of mental health issues, a negative impact on treatment, and the risk of breaching patient confidentiality with data collection and storage. Legal Aid Queensland suggested that people who suffer from paranoia often have a fear of electronic or mechanical surveillance and that their well-being may be affected by the use of electronic monitoring. The organization recommended specific criteria to be considered before using electronic monitoring including the patient’s mental state and treatment needs; the patient’s history of compliance with treatment and conditions of release; the offences leading to the forensic designation; previous episodes of absence without permission; the patient’s risk assessment and management plan; and concerns from victims and members of the community. Similarly, it was recommended that electronic monitoring devices not be used unless i) it is necessary to avoid another incident of the patient absconding, in circumstances where a patient has previously absconded; ii) there is a high risk of the patient absconding, and of harm to the patient or another person if the patient is not promptly located; or iii) the fitting of a GPS tracking device is preferable to requiring escorted leave.

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Factors that impact the successful use of GPS monitoring for mental health forensic rehabilitation patients include ethical concerns, stigmatization, rehabilitative issues, technical issues, increased workload, and cost effectiveness.

There are concerns about the potential for increased stigmatization associated with the use of electronic monitoring among mental health forensic rehabilitation patients. Stigmatization has the potential to negatively impact a patient’s mental health, treatment and recovery process.

Technical malfunctions of the monitoring devices include alerts which are the result of a lost signal or low battery, the time and duration for battery charges, and the accuracy of the signal. The use of GPS monitoring produces a substantial amount of data which may be viewed as difficult to manage or interpret. However, this perception may be the result of unfamiliarity with the technology and its operating systems.

The costs of the Buddi system among mental health forensic rehabilitation patients in the United Kingdom are covered by the National Health Service. The costs associated with abscondment have decreased, particularly reducing the use of police helicopters. The cost per leave using the Buddi system is £61 ($113CAD) compared to £73 ($133CAD) per leave episode without. The costs associated with leave violations were not calculated and imply that the cost benefits are even more substantial. For a summary of the cost-effectiveness data related to mental health forensic rehabilitation patients found in the literature scan, refer to Appendix A.

GPS monitoring in and of itself cannot prevent a mental health forensic rehabilitation patient from absconding or a crime from being committed. However, electronic monitoring can be used as a tool in risk management processes. Due to the evolving nature of electronic monitoring technology and the few cases where it has been used in mental health forensic rehabilitation patient populations, there is a lack of discussion of the potential unintended consequences. The Schizophrenia Society of Nova Scotia is opposed to the use of electronic monitoring and does not believe that there is any therapeutic value in its use for mental health patients. With a specific focus on mental health forensic rehabilitation patients, they recommend risk assessment processes and community supports while noting that electronic monitoring devices can only locate individuals, but cannot change behaviours or guarantee outcomes. Concerns raised by Legal Aid Queensland speak to the potential for negatively impacting a patient’s well-being with the possibility of increased paranoia and stigmatization. A lack of consultation with patients may result in feelings of anger or alienation which could negatively impact treatment.

There are concerns raised by various stakeholders about the risks associated with the use of GPS monitoring including increased stigma, issues of consent and privacy, and unintended consequences such as increased paranoia. However, research findings from the United Kingdom on the use of GPS monitoring among mental health forensic rehabilitation patients found that it has helped to manage risk and increase patient access to leave which
can play an important role in a patient’s treatment and recovery. GPS monitoring has reduced the number of abscondments, decreased violations, and the devices provide an efficient and effective way to locate patients who may go missing as GPS technology provides the ability to locate individuals in real time.
Introduction

The Nova Scotia Department of Health and Wellness has asked for the assistance of the Nova Scotia Health Research Foundation (NSHRF) in developing a literature scan to identify, analyze and summarize a range of existing information, evidence and knowledge on the use of GPS tracking tools and other electronic monitoring devices. The purpose of the literature scan is to consider the effectiveness and appropriateness of electronic monitoring for mental health forensic rehabilitation patients who are accessing the community as part of their treatment, and the potential impact of this monitoring approach on public safety.

Broadly, the literature scan considered the following:

- The effectiveness of GPS tracking tools and other monitoring approaches for police to locate mental health forensic rehabilitation patients when a patient is AWOL, for improved ability to track patients who have deviated from the conditions of their community access, and the impact on public safety in terms of the effectiveness for deterring offenses;

- The evidence and description of the appropriate conditions for the use of GPS tracking tools and other monitoring approaches to safely locate and return mental health forensic rehabilitation patients in jurisdictions that have successfully implemented these tools;

- The effectiveness of this approach for and impact on patient treatment; and

- Contexts when these tools are recommended and not recommended.

The literature scan specifically sought to address three questions which were identified by the Department of Health and Wellness, including:

i) The available evidence that assesses the effectiveness of GPS or other electronic tracking systems for mental health forensic rehabilitation patients;

ii) The factors that impact the successful use of these tools for mental health forensic rehabilitation patients; and

iii) The unintended consequences of using GPS or other electronic tracking systems for mental health forensic rehabilitation patients.

Mental health forensic rehabilitation patients have “been found to have committed a criminal act, or have a prima facie case of having done so, but they have either been found not criminally responsible for that act because of mental disorder, or unfit to stand trial in
relation to the index charge(s)” (Simpson, 2012: 70; Wayward Centre for Mental Health Care, n/d). The act of leave among mental health forensic rehabilitation patients can be an important component of treatment and recovery. Subsequently, abscondment or breaches in leave can have negative impacts on treatment and increase the risk of suicide. There are also related harms to the public, and other health, economic and social issues (Hearn et al., 2012: 281). The use of electronic monitoring is becoming increasingly prevalent and GPS monitoring was introduced to mental health forensic rehabilitation patients for the first time in the United Kingdom in 2010, and most recently in Queensland, Australia after legislative changes in 2012 (Tully et al., In Press, n/da; Queensland Government, n/d).

There are a number of digitally-based tracking methods that have the capability of gathering data and monitoring an individual's location.

- **GPS-based tracking systems** utilize data from a minimum of four satellites in order to triangulate the data and produce information which will locate the position of the device.

- **Land-based tracking systems** utilize radio frequency detectors which are based on a number of antenna stations in a specific geographical region.

- **Hybrid tracking systems** combine components from both the GPS-based tracking systems and land-based tracking systems in order to provide accurate readings, even in enclosed spaces. Hybrid tracking systems include a GPS receiver, a Global System for Mobile Communications modem, a radio frequency transmitter located in a wrist watch worn by the individual, and a monitoring unit (Landau and Werner, 2012: 359).

In the table below, Tully et al. (In Press, n/da) compare the use of radiofrequency and GPS technology:

### Table 1: Radiofrequency vs. Global Positioning System

<table>
<thead>
<tr>
<th>Technology</th>
<th>How it works</th>
<th>First Operational</th>
<th>Key Advantages</th>
<th>Disadvantages</th>
<th>Examples of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio frequency</td>
<td>Uses radio frequency electromagnetic fields to transfer data from a “tag” attached to an object for the purposes of automatic identification.</td>
<td>1983</td>
<td>Strong signals for providing information on a small scale.</td>
<td>Does not allow for “tracking.” Requires specialized scanners to read and transmit data. Systems may be dangerous to users.</td>
<td>Motorway/toll systems for cars. Identification of animals. “Home detention” systems. Identification of humans by...</td>
</tr>
</tbody>
</table>
Radio frequency tagging does not allow for tracking, instead it is primarily used as part of curfew management in home detention scenarios. GPS technology is suitable for monitoring around the world, and can be used as part of treatment in monitoring an individual on leave (Council of Europe, 2013; Hearn, 2013; Tully et al., In Press, n/da, n/db).

GPS monitoring can involve either a passive monitoring system or an active monitoring system. The primary difference between passive and active monitoring involves the timing of when the data is accessed and how quickly the data can be responded to and acted upon. While both passive and active monitoring systems allow for the data to be stored, passive monitoring involves the capture and storage of data in order to allow for an individual’s movements to be monitored at a later date – usually 24-36 hours later. However, an active approach allows for an individual to be monitored in real time and provides alerts which can be responded to in an appropriate manner depending on the situation (Payne and DeMichele, 2011: 181-82; The Scottish Government, 2013: 19). The differences between passive and active approaches should be considered before implementing GPS monitoring because the “different reporting methods have different financial costs, require different amounts of officer time, and have different abilities” in determining the location of individuals who are being monitored (Payne and DeMichele, 2011: 181).

| Global Positioning System (GPS) | A worldwide satellite-based navigation system that can calculate in three dimensions. Radio waves sent out from satellites transmit data to receivers, which can then triangulate their position relative to the satellites, and thus on the Earth’s surface. | 1994 | Individual devices may be more expensive than RF. Signal may be weaker than RF, depending on the device. Some models are not as accurate in certain situations, e.g., underground in thick-walled buildings. | “Satnav” devices. Mobile phone technology – Google maps. Modern “tracking” devices in criminal justice and healthcare systems. |
The Scottish Government (2013) notes a number of advantages associated with the use of GPS technology in electronic monitoring.

- GPS monitoring can provide immediate access to real time data which can result in a rapid response to the situation;
- GPS monitoring may result in operational savings for supervisory organizations;
- GPS monitoring can help officials to better understand an individual’s habits and lifestyle, and early indicators of possible recidivism;
- GPS monitoring can allow police to quickly eliminate suspects based on their location;
- GPS monitoring can create conditions of orders that were previously difficult to monitor, such as leave, which can be more effectively monitored and enforced;
- GPS monitoring can provide a deterrent for individuals from engaging in offending behaviours; and
- GPS monitoring can help to protect the public and known victims (who can also be monitored) (The Scottish Government, 2013: 16).

A forthcoming publication from Tully et al. will be the first research which formally examines the effects of the implementation of electronic monitoring in any psychiatric setting. It focuses on mental health forensic rehabilitation patients and finds an increase in overall leave and a significant increase in unescorted leave compared to escorted leave (Tully et al., In Press, n/db).\(^1\)

**Limitations**

While the primary cases of GPS monitoring among mental health forensic rehabilitation patients are in the United Kingdom and Australia, it should be noted that these programs are being implemented in different healthcare systems and legislative contexts than Nova Scotia.

In a reflection of the contemporary nature of GPS monitoring, there is limited evidence available in the published literature about the use and effectiveness of electronic monitoring among mental health forensic rehabilitation patients. The majority of the information on this topic is found in grey literature and media coverage.

\(^1\) The Tully et al. papers (In Press, n/da, n/db) were provided to the research team directly by the lead author. As these papers are in press and not yet published, we have permission to use the overall findings, but do not have permission to cite any specific data. The lead author can be contacted at john.tully@slam.nhs.uk.
Methodology

This literature scan provides a synthesis of evidence found both within and outside Canada that addresses electronic monitoring for mental health forensic rehabilitation patients. It considers works published in peer-reviewed journals, media coverage, and grey literature from 2006-2014.²

Peer-reviewed literature is evaluated by experts in a field in order to determine the quality of articles submitted for publication in a scholarly journal. Articles are evaluated for their validity and contribution to the field. The peer review process seeks to maintain standards of quality and provide credibility.

Grey literature is published material which contributes to the evidence base but is not peer-reviewed, and can include articles, reports, brochures, newsletters, theses, dissertations, conference proceedings, working papers, patents, databases, websites, legislation, and policy documents. These materials can be produced by government, non-profit organizations, health research institutes, professional organizations, universities, international organizations, media, and others. Grey literature can be very useful in informing decision making as it is helpful for understanding new and emerging opinions and issues, for understanding processes of individual programs and approaches, and for planning purposes. The inclusion of grey literature can help to broaden the scope of and provide a more comprehensive review by including evidence from a wider variety of sources and reducing publication bias. However, grey literature has not been exposed to a rigorous systematic review process to assess its quality, reliability and validity which means that the quality of grey literature can be quite varied. Grey literature and media coverage play a particularly important role in providing evidence on topics which are contemporary, continually evolving and where there is limited evidence available in the peer-reviewed literature.

The current literature scan consisted of the following phases:

1) Definition and Refinement of the Topic – Key search terms were developed in order to conduct the literature scan. The focus of the search centered on the current evidence surrounding the electronic monitoring of mental health forensic rehabilitation patients.

2) Searching of all Relevant Sources - The initial literature scan was conducted from April to May 2014. Detailed and extensive searches were conducted to find relevant peer-reviewed literature, grey literature and media coverage both in Canada and internationally. Searches were conducted through Dalhousie University’s Library catalogue and to a lesser extent and if a resource was not available through Dalhousie, York University’s Library catalogue. When search terms were entered all databases were searched, thus providing as many potentially relevant articles as possible. Additional searches for peer-reviewed literature

² These parameters were determined by the Department of Health and Wellness as there were significant changes in the technology after 2006.
included Google Scholar and hand searching bibliographies of other related journal articles. Extensive online searches were conducted for relevant material in the grey literature and media coverage. Key search terms included but were not limited to “GPS,” “global positioning system,” “electronic monitoring,” “tagging,” “mental health,” “mental health patients,” “mental health forensic rehabilitation patients,” “personalized ambient monitoring,” “PAM,” “ambient assisted living,” “AAL,” “electronic bracelet,” “electronic tracking,” and “tracking.”

3) Evaluation and Management of the Information - The peer reviewed literature, grey literature and media coverage was reviewed and added to the bibliography for consideration if the material was published in English and reported on topics relevant to the search term criteria. Titles, abstracts and, if necessary, full texts, were screened to ensure that each text met the inclusion criteria. The literature was then categorized according to theme. Texts that captured a variety of relevant themes were added separately to each category.

4) Collating, Summarizing and Reporting the Results - After each text was categorized according to theme, useful quotes or excerpts were selected to include in the literature scan. Major trends or patterns were especially noted, and relationships among studies were identified. The review was written with the objective of creating a clear and cohesive document that integrates the key details of the literature while addressing the three key research questions identified by the Department of Health and Wellness.

Although presented as a series of stages, the process was not linear but iterative. Each stage was moved through flexibly, with steps being repeated when needed to ensure the literature was covered in a comprehensive way.
1) Evidence of the Use and Effectiveness of GPS or other Electronic Tracking Systems among Mental Health Forensic Rehabilitation Patients

This section explores evidence on the use and effectiveness of GPS and other electronic tracking systems. The use of electronic monitoring among mental health forensic rehabilitation patients is a relatively new practice and the two case studies in the United Kingdom and Australia are explored in-depth.

United Kingdom

The primary example of the use of a GPS monitoring device being used to track mental health forensic rehabilitation patients is the Buddi system which has been used in the United Kingdom since 2010. In addition to grey literature and media coverage, there are a number of peer-reviewed publications on this case which have been recently published or are currently in press. However, because the implementation of this system is relatively recent, there has not yet been a comprehensive evaluation on its impact.

Electronic monitoring was implemented in the United Kingdom after several high-profile abscondments from mental health facilities. In particular, a convicted rapist escaped from the care of a secure mental health unit in London and then strangled an elderly man to death in his home during a robbery. The patient had been taken to an emergency room after faking chest pains and then escaped where he was missing for nine weeks (BBC News, 2009; Booth, 2009; The Telegraph, 2009; Tully et al., n/da). As a result of the abscondments, Tully et al. (n/da) suggested that

public protection could be enhanced by introducing a facility that would notify clinical staff immediately should any patient violate their leave conditions or if patients were not returning from leave at the agreed time. The device also provided the facility to identify the patient’s location if they failed to return from leave or if they absconded from escorting staff. No patient was obliged to wear the device without consent, with the exception of those high-risk patients requiring emergency hospital or court transfer.

Buddi, Ltd. acquired a contract with the South London and Maudsley (SLaM) National Health Service Trust to monitor the temporary release and home leave of patients undergoing psychiatric treatment in a secure hospital. Before the Buddi system was implemented, those working at the forensic psychiatry service wanted to ensure that legal and ethical aspects of electronic monitoring among mental health forensic rehabilitation patients were considered. The use of electronic monitoring was found to be legal in the United Kingdom and not to be a violation of patients’ human rights (Tully et al., n/da). While the ethical issues are complex, it is suggested that there is also a need to account for the potential benefits associated with the implementation of electronic monitoring in the United Kingdom including “increases in users’ autonomy, acceleration of clinical
progression through secure services and back to the community[,] as well as cost effectiveness of treatment programs” (Tully et al., n/da).

The Buddi system uses three types of technology in order to determine a patient’s location including GPS, radio frequency and a global system for mobile communication (Shaw, 2010). A pilot system began in 2010 under a trial by the London hospital trust. During the trial, a group of medium- and high- risk patients at Bethlem Royal Hospital in south London were fitted with steel-reinforced leather ankle bracelets to discourage them from absconding and reoffending.³ The patients were electronically monitored when on leave as part of their rehabilitation process including walking around hospital grounds, visiting other hospitals for treatment, and leave in the community (Booth, 2009; Edwards, 2009). The active monitoring device can be set with specific geographical parameters for each patient, and “geo-fences” allow for the creation of inclusion and exclusion zones (Hearn, 2013; Tully et al., n/da). A buzzer or vibrator alerts the patient when they need to return to the hospital. An alarm is issued if patients break curfew, or if they enter prohibited areas, such as school zones or other areas from which they have been banned by the courts (Booth, 2009; Nellis and Torres Rosell, 2011).

There were 26 uses of the Buddi system in the first month of the pilot project in London, with an increase to 70 the following month. Approximately 20-30 episodes were tracked each day between April 2010 and March 2012. The introduction of electronic monitoring has reduced the number of abscondments, and when patients have gone missing or been late returning, the bracelets have proved to be an efficient and effective way of finding them (Hearn, 2013). The GPS system has the ability to track patients in real-time. For instance, the diagram below demonstrates the route taken by a patient who had absconded, with the green circles representing his or her location at 30-second intervals.

³ The more traditional tagging systems used in the United Kingdom rely on cuttable plastic tags compared to the leather and steel materials that are used in the GPS-based Buddi system (Nellis and Torres Rosell, 2011).
In this case, the diagram demonstrates the patient i) running away; ii) doubling back; iii) being stopped by the police; and iv) being returned to the hospital. This incident lasted 30 minutes from the time of abscondment to the time when police returned the patient to the hospital (Hearn, 2013: 20).

Data from the first two years of the program indicate that there is a correlation between the use of the Buddi system and an increase in unescorted leave and decreased violations during leave (Murphy et al., 2012; Tully et al., n/db). The costs associated with abscondments have decreased, particularly reducing the use of police helicopters (Nellis and Torres Rosell, 2011). The National Health Service (NHS) is responsible for the costs of the program which are approximately £600 ($1000CAD) for each patient, including £250 ($450CAD) for an ankle bracelet which contains a mobile phone chip and GPS locator (Health Service Journal, 2010).

A forthcoming paper by Murphy et al. examines the existing data on the Buddi system in order to compare the costs associated with patients’ leave using GPS-based electronic monitoring and without. The study considered the staff cost of escorting patients and the cost of the Buddi device, and determined that the use of electronic monitoring did reduce costs. The cost per leave episode without using the Buddi system was approximately £73 ($133CAD) per episode, and £61 ($113CAD) per episode with the Buddi system (Murphy et al., n/db).

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4 The green circles are numbered chronologically to map the patient’s abscondment route. If the circles are placed on top of each other, the patient is standing still; if they are close together, the patient is moving slowly; and, if they are further apart, the patient is moving more quickly.

5 The Murphy et al. paper has not yet been formally published. The lead author can be contacted at pmmurphy@standrew.co.uk.
al., 2012). It should also be noted that this study did not consider the costs associated with leave violations which implies that the cost benefits are “even more substantial than stated which has wider implications on emergency resources and cost to the public purse” (Murphy et al., 2012).

Hearn (2013: 19) contends that the success of the electronic monitoring program in the United Kingdom is due to an effective working partnership between the patients and other organizations. This partnership involves the patients who consent to wearing the electronic monitoring device; the London hospital trust which is responsible for the implementation and evaluation of the electronic monitoring system; the product provider who supplies the electronic monitoring device, support and information; the alarm receiving centre which provides the tracking service; and the police who work with all of the different parties in order to return patients who have absconded to the hospital. The Deputy Head of Communications and Media for the South London and Maudsley NHS Foundation Trust depicts the Buddi system as being a great success. Lorcan O’Neill stated that “[w]e have deployed around 100 Buddi tracker devices for use with patients having leave or being transferred from our forensic secure units. Breaches of leave - patients absconding while under escort, or failing to return from pre-arranged leave on time, have greatly reduced” (DuBreuil, 2012a). O’Neill also pointed to other advantages associated with the GPS devices.

[T]he Buddi tracker device enables the location identity and tracking of anyone wearing them to within metres. Monitoring is available 24/7 and all year round. High risk patients may be monitored in real time. The system records and time logs movements so it is possible to track someone’s journey and timescale, at any point in their leave. The devices are tamper proof and alert the monitoring system of any attempt at removal (DuBreuil, 2012a).

Hearn (2013) notes that it is possible to achieve fewer abscondments without the use of GPS technology by reducing the amount of leave patients have access to or by revising existing policies and procedures. However, he proposes that “restricted or overly cautious access to leave will hinder patients’ progress and is likely to have an impact on length of stay” (Hearn, 2013: 21). In London, there was an unexpected increase in the amount of leave granted to patients with the implementation of GPS tracking. It was found that GPS monitoring deters patients from absconding and can also help patients view leave as part of their treatment and progress, as well as an incentive. Leave is a valuable part of promoting recovery for mental health forensic rehabilitation patients and can ultimately impact the length of stay (Hearn, 2013). A patient’s abscondment is usually made based on a spur of the moment decision and is influenced by socio-environmental factors. Thus, the use of electronic monitoring can help to prevent patients from making impulsive decisions, particularly in early stages of treatment when they may be especially vulnerable. In this

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For a summary of the cost-effectiveness data found in the literature on GPS monitoring among mental health forensic rehabilitation patients, refer to Appendix A.
case, GPS monitoring has helped to “manage risk and at the same time has significantly increased access to leave, which is important for recovery” (Hearn, 2013: 21).

The table below demonstrates the number of leave incidents each year before and after the Buddi system was implemented.

**Table 2: Number of Leave Incidents for Each Year Before and After GPS Tracking**

<table>
<thead>
<tr>
<th>Year</th>
<th>Abscondments</th>
<th>Failures to Return</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-tracking</td>
<td>11</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>April 1, 2009 – March 31, 2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>3</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>April 1, 2010 – March 31, 2011</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>April 1, 2011 – March 31, 2012</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Heare, 2013: 21).\(^7\)

There was discussion at the European Electronic Monitoring Conference in Portugal in 2011 about the unremovable strap on the Buddi device. The straps can be cut, but only by a heavy duty bolt cutter. Since this time, there has been an understanding in England and Wales that the straps should be able to be removed in the event of an emergency, such as being caught on machinery at work, or on motorbike engines (Nellis and Torres Rosell, 2011).

The Buddi system has recently been approved to continue for the next five years because of its positive impact on patient leave and safety (Hearn, 2013). Dr. Tom Fahy, Clinical Director of Forensic Services at the South London and Maudsley NHS Foundation Trust, said the device adds an extra element of safety when patients are allowed out on leave in order to prepare them for re-integrating into life in the community. The BBC News quotes Fahy as saying that the primary advantage of GPS monitoring is that “it gives us confidence, about the patient's whereabouts, that they're complying with their leave conditions” (Shaw, 2010).

\(^7\) In the case of this table, abscondments are considered to occur during escorted leaves, while a failure to return occurs during an unescorted leave (Hearn, 2013). However, abscondment is used throughout the literature and in this report to encompass both scenarios. It should be noted that the increase in failure to return in the first year was as a result of the tracking system identifying a “late return from leave” as an incident which previously would not have been categorized in that way (Hearn, 2013: 21).
Queensland, Australia

The use of electronic monitoring among mental health forensic rehabilitation patients in Queensland, Australia is even more recent than the use of the Buddi system in the United Kingdom. The primary sources of information about the use of electronic monitoring among this population in Australia are found within grey literature and media coverage.

Queensland was the first state in Australia to use electronic monitoring for mental health forensic rehabilitation patients (Viellaris, 2012). The move to revise legislation to allow for the implementation of electronic monitoring occurred as a result of two abscondment incidents from the Park Centre for Mental Health in Wacol. Police ultimately located both patients, but concerns were raised about the safety and well-being of the patients, the public, and the length of time before public alerts were released (ABC News, 2012; Banks, 2012; Baskin, 2012; Hurst and Jbour, 2012; Jbour, 2012; Kyriacou, 2012; Viellaris, 2012; Vonow, 2012). Queensland’s Health Minister Lawrence Springborg stated in the Queensland Times that there were 33 incidents of patient absence without permission at the Park Centre for Mental Health involving 18 different patients. The missing patients were most often found and returned to the mental health facility within three days. However, in one instance, it took a week for the patient to be located (Korner, 2013).

The Queensland Mental Health Commission Bill 2012 included amendments to the Mental Health Act 2000. Part 9, section 131A allows the Director of Mental Health to require monitoring for mental health patients. This includes forensic patients who are on a forensic order determined by the Mental Health Court when the individual is found to be of unsound mind, not criminally responsible, or unfit to stand trial (Queensland Government, n/d). It also includes classified patients who are before a court or detained in custody as a result of being charged with an offence or serving a sentence of imprisonment. Classified patients may be detained in a mental health service facility for assessment and treatment, but this process does not include involuntary treatment (Queensland Government, 2009).

The Bill provides examples of the circumstances under which a mental health patient’s treatment plan would include monitoring, such as i) a forensic patient who is undertaking limited community treatment for the first time; ii) a classified patient who has previously attempted abscondment while on limited community treatment; and iii) a forensic patient who is transitioning from escorted to unescorted limited community treatment (Queensland Mental Health Commission, 2012: 32). Limited community treatment is designed to support a transition into the community and includes any treatment or rehabilitation which takes place outside of the mental health facility. Limited community treatment is approved by a Mental Health Review Tribunal and may include escorted or unescorted absences from the grounds of the mental health facility, absences from the mental health facility for short periods of time during the day or overnight, or living in the community and receiving treatment as an outpatient (Queensland Government, 2008).

The Bill also provides examples of potential monitoring conditions that may be included as part of a mental health patient’s treatment plan. These examples include i) the patient
calling the treating mental health facility before moving from one location to another; ii) the patient providing a plan while on limited community treatment detailing where they will be, and who they will be with; and iii) the patient wearing an electronic monitoring device while on limited community treatment which can determine his or her location (Queensland Mental Health Commission, 2012: 32). It should be noted that electronic monitoring devices will not be used for all forensic or classified mental health patients; rather, each case must be formally approved by the Director of Mental Health (Viellaris, 2012).

The amendments to the Bill received criticism from stakeholders and healthcare professionals (Magarey, 2013; Queensland Advocacy Incorporated, n/d). In a submission to the Health and Community Services Committee, Anthony Reilly, Chief Executive Officer of Legal Aid Queensland raised several concerns about the implementation of electronic monitoring for mental health patients. Legal Aid Queensland suggested that people who suffer from paranoia often have a fear of electronic or mechanical surveillance and that their well-being may be affected by the use of electronic monitoring. They also proposed that the lack of consultation with patients may result in anger or alienation which could negatively impact their risk and treatment (Reilly, 2013: 2).

Legal Aid Queensland recommended specific criteria to be considered before electronic monitoring should be used including

- the patient’s mental state;
- the patient’s treatment needs;
- the patient’s history of compliance with treatment and conditions of release;
- the offences leading to the forensic designation;
- previous episodes of absence without permission;
- current risks from the patient’s risk assessment and risk management plans; and
- concerns from victims and/or members of the community (Reilly, 2013: 4).

Similarly, Legal Aid Queensland also recommended that electronic monitoring devices should not be used unless i) it is necessary to avoid another incident of the patient absconding, in circumstances where a patient has previously absconded; ii) there is a high risk of the patient absconding, and of harm to the patient or another person if the patient is not promptly located; or iii) the fitting of a GPS tracking device is preferable to requiring escorted leave (Reilly, 2013: 3-4).

A group of forensic psychologists practicing in Queensland also raised concerns with the amendments to the Mental Health Commission Bill 2012. Their concerns about the implementation of electronic monitoring include an increased stigmatization of mental health, as well as adverse consequences to a patient’s mental health and recovery as a result of risk management interventions such as electronic monitoring. There were also questions raised about the risk of breaching patient confidentiality and a request for specific details about how the information would be collected, stored, communicated, or
used for evaluation purposes (Doley et al., 2013). Doley et al. (2013) point to a lack of evidence on the use of electronic monitoring among forensic mental health populations by citing the *Joint Review of the East Coast Forensic Hospital’s Community Access Privileges* which was commissioned by the Nova Scotia Department of Health and Wellness, Department of Justice, and the Capital District Health Authority.

There were 9984 cases of mental health patients absconding from 2010-2013. In December 2013, Queensland Health also ordered the 16 mental health inpatient facilities to implement a locked door policy in order to reduce patients from absconding. Michael Cleary, Deputy Director General of Queensland Health, attributed this decision to concerns about the risks associated with abscondment and the costs incurred to locate patients and return them to the mental health facility.\(^8\) Cleary stated that “[t]he absences pose a risk for patients and places a burden on the Queensland Police Service who are required to locate the patients and return them to hospital” (Wardill, 2013). As of December 2013, there were only six electronic monitoring devices shared between the 16 mental health facilities in Queensland, despite more than 2000 cases of patients absconding in 2012-2013. Health Minister, Lawrence Springborg suggested that the mental health facilities are designed to provide safe environments, and that improved security was needed to protect the public, police, mental health staff, and patients (Wardill, 2013). Dozens of electronic monitoring devices have since been ordered to allow each of the Queensland mental health facilities to have at least five devices. In a statement provided to the *Courier-Mail*, Springborg said that monitoring conditions for high-risk patients, or patients with an identified risk of absconding, offers the best mechanism to quickly locate the patient if they are absent without permission. Monitoring devices will not be used indiscriminately for all forensic or classified patients. A monitoring condition will only be applied if the Director of Mental Health considers there is a real and identified need to ensure the patient’s location is monitored while they are on limited community treatment (Viellaris, 2012).

**2) Factors that Impact the Successful Use of Electronic Monitoring for Mental Health Forensic Rehabilitation Patients**

This section explores the factors that impact the successful use of electronic monitoring among mental health forensic rehabilitation patients which include ethical concerns, stigmatization, rehabilitative issues, technical issues, increased workload, and cost effectiveness. Similar to the evidence on the use and effectiveness of GPS monitoring

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\(^8\) In 2010-2011, forensic mental health services accounted for 5.4% of the state and territory government mental health expenditures in Australia. General adult mental health services accounted for 61.4% of expenditures; older persons mental health services accounted for 10.6%; child and adolescent mental health services accounted for 9.9%; grants to NGOs accounted for 7.2%; and other indirect expenditures accounted for 5.4% (Department of Health and Ageing, 2013: 37).
explored above, the academic and grey literature is limited due to the relatively recent implementation of the technology.

**Ethical Concerns**

There is currently little evidence on the ethical concerns of the use of GPS monitoring technology specific to mental health forensic rehabilitation patients.

Michael et al. (2006) raise a number of issues about the emerging ethics of “human-centric GPS tracking and monitoring.” Questions which may be asked include:

- Is the monitoring of a patient’s location information ethical?
- Does a government or the police have the right to location information when an illegal activity is suspected?
- What rights does a mentally ill individual have over his or her location data, and who has the right to impose inclusion and exclusion zones?
- Who owns the location data (e.g., the individual, service provider, or a third party that stores the information)?

**Stigmatization**

Forensic psychologists practicing in Queensland, Australia expressed concerns about the potential for increased stigmatization associated with the use of electronic monitoring among mental health forensic rehabilitation patients. They suggest that there is a risk of further stigmatizing patients with mental health concerns and that stigmatization can negatively impact mental health, treatment and recovery processes (Doley et al., 2013).

**Rehabilitative Issues**

There is a lack of consensus about the potential impact of GPS monitoring on rehabilitation among this population. In the United Kingdom, Hearn (2013) found that the use of GPS monitoring deterred mental health forensic rehabilitation patients from absconding. It can help patients view leave as part of their treatment process, and can also help to prevent patients from making impulsive decisions while on leave, especially in the early stages of treatment when they may be particularly vulnerable.

However, in a letter addressed to *CBC News*, the Schizophrenia Society of Nova Scotia stated that they do not believe there is any therapeutic value in the use of electronic monitoring for mental health patients. With a specific focus on mental health forensic rehabilitation patients, they recommend risk assessment processes and community supports while noting that electronic monitoring devices can only locate individuals, but cannot change behaviours or guarantee outcomes (DuBreuil, 2012b; Legere, 2012).
An opinion piece in a Canadian Mental Health Association Newsletter proposes that a risk assessment should be conducted in order to carefully consider a patient’s psychological state before leave is granted, rather than using GPS monitoring devices (Legere, 2012). “The hospital should also be supporting patients to help them successfully move from hospital into the community and the necessary supports should be set up to continue their mental health treatment and help them successfully live in the community...GPS tracking devices risk making the patient feel like a criminal instead of a mental health consumer” (Legere, 2012).

In his review of the Capital District Health Authority’s policies and procedures for the care and supervision of mental health forensic rehabilitation patients, Simpson (2012: 89) suggests that the use of GPS monitoring may be more acceptable to offenders with personality disorders who are often transferred from prison to mental health forensic rehabilitation facilities. Other individuals with serious mental health issues may have different needs and expectations regarding their treatment. A number of questions are raised about the appropriateness of GPS monitoring as part of forensic rehabilitation processes:

- Does the use of GPS monitoring improve the patient’s long-term safety?
- Does the use of GPS monitoring improve the therapeutic alliance to help the patient make the changes necessary to recover from their illness and the effects related to offending?
- Does the use of GPS monitoring result in a physical manifestation of distrust and create distance between the patient and the hospital staff? (Simpson, 2012: 89).

**Technical Issues**

There are technical limitations associated with GPS monitoring and the Scottish Government (2013: 16) provides an overview of some of these issues:

- “GPS drift” may affect the accuracy of the signal when movement is static for long periods of time and if it is near bodies of water;
- GPS monitoring devices function in most domestic homes, but may not work inside all buildings;
- GPS monitoring devices work in moving vehicles, but may not work as well on trains; and
- The accuracy of GPS monitoring devices can be impacted by tall buildings and does not work underground. However, Location Based Services as part of a cellular network can be used when a GPS signal is unobtainable (Dialogic, n/d; The Scottish Government, 2013; Zickuhr, 2013; Zündt et al., 2005).

There are risks associated with the technology used in GPS monitoring devices which the tracking providers cannot control, such as a failure with the satellite. However, cases of satellite malfunction are reported to be “extremely rare” (The Ostrich Group, n/da).
technical malfunctions include problems with monitoring systems in rural or isolated areas, alerts which are the result of technical issues and not a violation, such as a lost signal or low battery, and the time and duration of battery charges (Correctional Service Canada, 2009; Napo, 2012; Payne and DeMichele, 2011).

**Increased Workload**

GPS monitoring does produce a large amount of data which may be perceived as difficult to manage or interpret (The Scottish Government, 2013). The Scottish Government (2013) notes that this perception may be the result of unfamiliarity with electronic monitoring systems. For instance, there is an option to have secure web-based access to the information so that officials are able to access the data remotely for immediate information about the individual's location. The electronic monitoring company is also able to provide this information in an easily accessible and interpretable format.

**Cost Effectiveness**

The costs associated with abscondment were reduced through the use of the Buddi system among mental health forensic rehabilitation patients in the United Kingdom (Nellis and Torres Rosell, 2011). Murphy et al. (2012) found that the cost per leave episode using the Buddi system was £61 ($113CAD) compared to £73 ($133CAD) per leave episode without. Additional studies may consider the costs associated with leave violations which could determine that the cost benefits associated with the Buddi system are even more substantial (Murphy et al., 2012).

**3) Unintended Treatment Consequences of Electronic Monitoring among Mental Health Forensic Rehabilitation Patients**

Due to the evolving nature of electronic monitoring technology and the few cases where it has been used in mental health forensic rehabilitation patient populations, there is a lack of discussion of potential unintended treatment consequences.

As discussed in the Queensland case study (refer to page 19), concerns were raised by Legal Aid Queensland about the implementation of electronic monitoring for mental health patients. Specifically, it is suggested that a patient’s well-being may be impacted with a potential increase in paranoia, as well as anger or alienation if the process does not include consultation with patients which may negatively impact treatment outcomes (Reilly, 2013). Forensic psychologists in Queensland raised concerns about the stigma associated with mental illness being compounded by the use of GPS monitoring among forensic and classified patients. A perceived increase in stigma may affect a patient's well-being and their recovery process as part of treatment (Doley et al., 2013).
Conclusions

The use of GPS monitoring among mental health forensic rehabilitation patients is a relatively new phenomenon which was first implemented in the United Kingdom in 2010. A patient's abscondment during leave is often the result of a spur of the moment decision and is also influenced by socio-environmental factors. Thus, research suggests that the use of GPS monitoring can influence patients’ decisions while on leave (Hearn, 2013; Hearn et al., 2012).

GPS monitoring in and of itself cannot prevent a patient from absconding or a crime from being committed. However, electronic monitoring can be used as a tool in risk management processes. GPS monitoring may be viewed in the context of other novel technological developments used in mental health. While these developments will continue to offer benefits to service users and healthcare providers, it is essential that they are seen and used as part of comprehensive care packages rather than isolated interventions (Tully et al., In Press, n/da).

There are concerns raised by various stakeholders about the potential risks associated with the use of GPS monitoring including increased stigma, issues of consent and privacy, and unintended consequences such as increased paranoia. However, research findings on the use of GPS monitoring among mental health forensic rehabilitation patients in the United Kingdom found that it has helped to manage risk and increase patient access to leave which can play an important role in a patient’s treatment and recovery. GPS monitoring among mental health forensic rehabilitation patients in London has reduced the number of abscondments, decreased violations, and the devices provide an efficient and effective way to locate patients who may go missing as GPS technology provides the ability to locate individuals in real time (Hearn, 2013; Murphy et al., 2012; Tully et al., In Press, n/da, n/db).
Appendix A

Summary of Cost Effectiveness Data

**Mental Health Forensic Rehabilitation Patients (Buddi System, United Kingdom)**

- Costs associated with abscondments have decreased, particularly reducing the use of police helicopters.

- Costs include £600 ($1000CAD) for each patient, including £250 ($450CAD) for an ankle bracelet which contains a mobile phone chip and GPS locator.

- Costs of the program are covered by the National Health Service.

- Cost per leave episode without the Buddi system is approximately £73 ($133CAD) per episode, and £61 ($113CAD) per episode with the Buddi system. The costs associated with leave violations were not calculated and imply that the cost benefits are even more substantial.
Appendix B

Electronic Monitoring Devices and Service Providers

There are numerous electronic devices and service providers which include:

**Buddi** – The Buddi System was founded in United Kingdom in 2005 by Sara Murray and is promoted as incorporating world-leading technology while being durable, light and comfortable to use, performing under all conditions, and having exceptional power management and battery life (Buddi, Ltd., 2014a). The features of Buddi devices include access to a 24 hour Help Centre; an automatic fall alert where a motion detector contacts the Help Centre if a fall is detected; an emergency alarm which contacts the Help Centre and notifies contacts as necessary; and a GPS-based location finder (Buddi, Ltd., 2014b). The GPS-based technology is able to accurately determine an individual’s location via satellite navigation, and a mobile phone network to communicate between the device and the Help Centre (Buddi, Ltd., 2014a). While Buddi provides electronic monitoring devices for a number of populations, they also have a secure GPS tracker that is specifically designed for mental health forensic rehabilitation patients which monitors the patient and sounds an alarm if the individual is in breach of their conditions. The devices are small, lightweight, waterproof, and tamper-proof, and they are individually fitted with a proprietary locking system. The data provided in order to monitor mental health forensic rehabilitation patients as part of the South London and Maudsley project includes the patient’s name, hospital ID, description, risk and danger rating, inclusion and exclusion zones, leave details including places and times, escalation procedures, contact points, and the designated hospital authority (Murray and Campfield, 2011; Nellis and Torres Rosell, 2011). An overview of the use of the Buddi system in London can be found on page 14.

**G4S** – G4S Electronic Monitoring Services provides offender electronic monitoring systems sales, support and consulting services. It is one of the “world’s largest authorities” on offender electronic monitoring technologies and services (G4S, n/da). G4S provides electronic monitoring services for the corrections system and the Department of Families and Communities in South Australia. Nearly 500 offenders are monitored using a radio frequency system which includes voice verification technology (G4S, n/db). G4S also provides electronic monitoring services for the New Zealand Department of Corrections for the Home and Community Detention Programme which monitors offenders who are sentenced to remain within their house or property, as well as offenders who have access to the community as part of a gradual assimilation process back into the community. G4S monitors 3000 offenders using the radio frequency technology and providing probation officers with timely information about compliance or non-compliance of each offender (G4S, n/dc).9

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9 It should be noted that G4S and Serco are currently be investigated for overcharging for the electronic monitoring of individuals who have died, were incarcerated, or are living overseas (London Evening Standard, 2013; National Audit Office, n/d, 2013; Tadeo, 2013). With G4S and Serco not being able to compete in the bidding process, a six-year contract was awarded in August 2013 to Capita, an outsourcing company in
**The Ostrich Group** – The Ostrich Group is based in the United Kingdom and sells GPS-based personal tracking devices for clients with dementia. Geo-tracking services are offered to provide “peace of mind to anyone who may get lost” (The Ostrich Group, n/db). An emergency response call centre is managed by Torbay and Southern Devon Health and Care NHS Trust. If a caregiver reports a client missing, the location of the client can be determined from the call monitoring centre using the GPS technology. The information can be given directly to the caregiver, and emergency services can be called if necessary. Similarly, the device contains an SOS button which the client can activate if they are in distress, and the monitoring centre can proceed with an action plan which has been agreed upon in advance. If the action is not appropriate for the situation, emergency services can be contacted (Age Action Alliance, 2012; The Ostrich Group, n/da, n/db, n/dc).

**LoJack** – The Lojack Corporation promotes itself as the “premier worldwide provider of tracking and recovery systems” (Lojack, 2014a). Lojack produces SafetyNet which is a GPS-based bracelet worn by individuals who have cognitive conditions such as Alzheimer’s, dementia, autism, and Down syndrome, and experience or are at risk of wandering behaviours. If a client is reported missing, public safety agencies use the signal from the bracelet to locate the client (Lojack, 2014b, SafetyNet by Lojack, 2014).

**Ambient Assisted Living** – Ambient Assisted Living is an aged-based assistance program designed to meet the needs of older adults and cater to varying levels of (dis)abilities (Pieper et al., 2011; Hanak et al., 2007). Ambient Assisted Living seeks to extend the amount of time people can live in their own homes, support the health and well-being of older adults while enhancing security and preventing social isolation, as well as supporting caregivers and families (AAL, 2012). The Ambient Assisted Living Joint Programme involves 23 European states and uses information and communications technology including telehealth and telecare in order to monitor for fall prevention, medication adherence, and to create age-friendly environments and communities. The budget of the project for 2013 was more than 100 million euros ($148,240,000CAD). Member states invest approximately 25-35%, 20-25% comes from the European Commission, and the remaining 40-50% of the budget is from participating organizations and corporations (AAL, 2012; European Commission, 2014; ZonMw, 2014).

**Monarca** - While bipolar disorder is often treated through a combination of pharmacotherapy, psycho-education and psychotherapy, there is also an approach which attempts to predict and prevent bipolar episodes by teaching patients to recognize their early warning signs (Marcu and Bardram, 2011). The Monarca system is promoted as

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**Notes:**

- **The Ostrich Group** provided the monitoring centres, **Buddi** will provide the hardware, and **Astrium**, an aerospace company in France, and **Telefonica/02**, a Spanish company, will provide the software (Nellis and Bungert, 2013). As of March 2014, Buddi, Ltd. was no longer involved in its role in this electronic monitoring contract (Quinn, 2014).
complying with all relevant security, privacy and medical regulations (Monarca, n/d). Monarca focuses on the monitoring, treatment and prediction of bipolar disorder episodes. The European Monarca system is based on five components including a sensor enabled cell phone, an activity monitor worn on the wrist, a “sock integrated” physiological sensor which measures heart rate and galvanic skin response, a stationary EEG system, and a home gateway. The system creates a behavioural profile with GPS-based location information, physical motion information, daily activities such as nutrition habits, household activities, and the amount and quality of sleep. The combination of physiological information, voice analysis from phone conversations, and motion analysis provides an assessment of an individual’s emotional state and mood which can be used to help predict depressive or manic episodes (Bardram et al., 2012; Monarca, n/d; Marcu and Bardram, 2011).

**Personalized Ambient Monitoring** – Personalized Ambient Monitoring was a three year research project funded by the United Kingdom Engineering and Physical Sciences Research Council. Personalized ambient monitoring is used as part of managing care for individuals with bipolar disorder (PAM, 2013). The Personalized Ambient Monitoring system includes a sensor unit that is worn on the body, a cell phone and GPS unit, and sensor units in the participant’s home to detect the early signs of an acute manic or depressive episode in order to prevent “full-blown episodes” and hospital admissions. This monitoring can provide an important component in managing bipolar disorder (Amor, 2011; Magill and Blum, 2012; Mohiuddin, 2011; Mohiuddin et al., 2013; PAM, 2013, Prociow and Crowe, 2010; Prociow et al., 2012).
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