Horizon Scanning Technology
Prioritising Summary

Scalable Medical Alert Response Technology (SMART) for monitoring emergency department patients

February 2008
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PRIORITISING SUMMARY

REGISTER ID: 000353

NAME OF TECHNOLOGY: SCALABLE MEDICAL ALERT RESPONSE TECHNOLOGY (SMART) FOR MONITORING PATIENTS IN A HOSPITAL EMERGENCY DEPARTMENT

PURPOSE AND TARGET GROUP: PATIENTS WAITING IN HOSPITAL EMERGENCY DEPARTMENTS WOULD WEAR THE SMART DEVICE ALLOWING THEIR VITAL SIGNS TO BE MONITORED FOR DETERIORATION.

STAGE OF DEVELOPMENT (IN AUSTRALIA):

☑ Yet to emerge ☐ Established
☐ Experimental ☐ Established but changed indication or modification of technique
☐ Investigational ☐ Should be taken out of use
☐ Nearly established

AUSTRALIAN THERAPEUTIC GOODS ADMINISTRATION APPROVAL

☐ Yes ARTG number
☑ No
☐ Not applicable

INTERNATIONAL UTILISATION:

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>LEVEL OF USE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trials Underway or Completed</td>
</tr>
<tr>
<td>USA</td>
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IMPACT SUMMARY:

The SMART device is designed to be used as a patient monitoring and management device that remotely and wirelessly gathers vital health information from patients waiting for treatment at a hospital emergency department (ED). If adverse events are detected hospital staffs are notified allowing prompt, directed action to be taken for the deteriorating patient.

BACKGROUND

The advent of powerful, yet small and light, electronic devices will allow advanced patient monitoring and servicing. Medical devices tailored for specific needs can be
assembled from off-the-shelf, modular parts reducing the time to develop, and the end cost of integrated patient management devices.

The SMART system was designed in concordance with concepts of modularity and scalability. With the exception of the ECG, all other components of the SMART system were selected from devices available off the shelf. By using already developed and mature technologies, systems such as SMART have reduced development time and reduced end cost.

The SMART system provides an integrated package including wireless patient monitoring (Electrocardiogram, blood oxygen saturation (SpO₂), and positioning within the ED), a stationary terminal for staff to access patient parameters, a targeted warning function, and a wireless interface for mobile staff (a pocket PC with patient data displayed). In addition to hospital based monitoring, the SMART system aims to be scalable to suit large scale disasters. This is facilitated by the systems portability and wireless capability. The system is designed to effectively allow the same patient management systems to operate both at a disaster site and within the relevant receiving hospitals adjacent to the disaster area.

**CLINICAL NEED AND BURDEN OF DISEASE**

Emergency departments in hospitals provide a critical service for the Australian community and are often working to, or beyond, capacity. In 2005-2006, 6.3 million accident and emergency services were provided in all hospitals in Australia. Of these, 4.8 million occurred in larger hospitals where good patient management data are recorded. These gross figures translate to a rate of 223 hospital ED presentations per 1000 population in 2005-2006, although these data do not adjust for the repeat visits to hospital EDs by patients. In an ED, patients are triaged into categories based on their estimated need for treatment. Within this system, in 2005-06, 69 per cent of ED patients were seen within the time recommended for their triage category (DOHA 2007). In hospital EDs which are working at maximum capacity, correct patient triage is not always successfully performed. This may lead to instances of morbidity and mortality (Braitberg 2007). There is a critical need for systems, programs and technologies to reduce the potential for human error that is inevitable in such high pressure working conditions.

**DIFFUSION**

No evidence for the diffusion of this technology into Australia was found during summary preparation.

**COMPAREDORS**

The obvious comparator for the SMART system is normal ED patient management. This comparison is not possible as few data are available describing the effectiveness of ED patient management systems. Hospital ED effectiveness is currently measured
against benchmarks set by experts and/or against prior performance. This allows the quantification of service degradation or improvement from year to year, or hospital to hospital, but lacks the power to inform on whether a particular patient was treated most effectively. As systems such as SMART become part of patient management, a more objective level of evidence will be generated. For example the effectiveness of triage categories could be assessed as the SMART system has the potential to detect patient condition changes which may require re-triaging. As there is no current comparator for the SMART system, future trials should assess the effectiveness of the SMART system by RCTs in which patients are randomised to SMART monitored and not monitored categories. The outcomes of the patient management could then provide a measure of the effectiveness of the SMART system.

**SAFETY AND EFFECTIVENESS ISSUES**

The SMART system components and interfaces are shown in figure 1.

![Diagram of SMART system components](image)

*Figure 1 SMART components: Caregiver PDAs, location sensors and patient PDAs with ECG and SpO2 sensors are wirelessly connected to SMART Central where all data are processed (Curtis et al 2008).*

The SMART system was tested in a functioning hospital ED for a 9-month period. A SMART operator coordinated the trial. This paramedic was responsible for monitoring the data presented at SMART central and, if necessary, sending notification to caregivers who would then attend to patients as required. There is
scope for the SMART system to work without the SMART operator but the hospital board demanded this operator to guarantee patient care standards. Patients were triaged as usual and those deemed of lower than Category 1 (most severe category) were eligible for the trial. These patients were recruited as opportunity arose. Only patients presenting with respiratory or cardiovascular symptoms were accepted into the trial. After admission to the trial each patient was fitted with the patient portion of the SMART system consisting of an ECG, SpO₂ monitor, and location tag. Of 189 eligible patients 151 were entered into the trial and of these six were subsequently withdrawn for various reasons including one who found the SMART device irritating. Of the patients fitted with a SMART device 93 per cent said they would wear one again if required, and 65 per cent reported feeling safer with the device on.

The tracking system used to locate the patient within the ED worked well with some minor problems where the patient’s location was lost temporarily. This was in all cases corrected when patients moved into a new zone.

The SMART system determined the re-triage of three patients during the trial. One patient was initially triaged into category 3 and, after a SMART alert for premature ventricular contractions, was re-triaged and admitted to the ED. A second case was admitted to the ED and, subsequently, to the hospital after a SMART alert for bradycardia was sent. With the third case, the SMART system alerted staff to the discrepancy between the ECG and SpO₂ heart rates; this patient had junctional tachycardia.

Additionally the SMART device was trialled in a mock disaster area response. There were 150 patient actors in the mock disaster, seven of whom were monitored by the SMART system. The SMART system took five minutes to be set-up and the medical staff on site were freed to attend to other duties as the seven patients were being monitored. This showed that the SMART system functioned as a mobile monitoring device performing a critical on-site role during a mock emergency (Curtis et al 2008)(Intervention evidence level IV).

Apart from the minor patient tracking issues and the one patient complaint, no adverse safety or other concerns were reported to have occurred with the SMART system.

Further trials of the SMART system are required, preferably larger scale with patients randomised to monitored or not-monitored groups and their eventual outcomes compared. The SMART device successfully alerted hospital staff to the clinical deterioration of several patients that otherwise may have gone unnoticed.

**Cost Impact**

No cost information was given about the SMART system although the majority of components were readily available off the shelf and the system was designed to be low cost.
ETHICAL, CULTURAL OR RELIGIOUS CONSIDERATIONS
No issues were identified/raised in the sources examined.

OTHER ISSUES
No issues were identified/raised in the sources examined.

SUMMARY OF FINDINGS
The preliminary evidence shows the SMART system had a positive effect on patient monitoring in a hospital ED. Further larger high quality trials are required to establish the effectiveness of the SMART system and its cost-effectiveness. Despite this the SMART system has the potential to have a significant impact of hospital EDs, allowing staff to be freed for other duties and giving a potentially higher standard of patient care.

RECOMMENDATION:
Based on the early state of development in this technology and its potential for a large impact on hospital ED patient care HealthPACT have recommended that this technology be monitored for further information in 12-months.

HEALTHPACT ACTION:

NUMBER OF INCLUDED STUDIES
Total number of studies
Intervention evidence level IV 1

REFERENCES:

SEARCH CRITERIA TO BE USED:
Emergency Service, Hospital
Monitoring, Ambulatory
Telemetry
Triage