Intelesens Ltd.
Case Study

Improving patient care in the hospital setting with Surveillance Monitoring

Implementation of Intelesens Surveillance Monitoring with the South Eastern Health and Social Care Trust

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ABSTRACT

This case study presents feasibility testing of Intelesens Surveillance Monitoring in a general medical ward in the Ulster Hospital, Dundonald within the South Eastern Health and Social Care Trust. The testing aimed to review the wireless monitoring system in the clinical setting and review user interactions with the system, considering in particular healthcare personnel acceptance and impact on workflow.

BACKGROUND

With our aging population and rise of chronic illness, there is ever increasing pressure on our healthcare system. Nursing staff are faced with the challenge of continuing to provide a high level of care despite higher numbers of patients and reduced resources. [1, 2]

About Ulster Hospital

Ulster Hospital in Dundonald, Northern Ireland is part of the South Eastern Health and Social Care Trust.

As the major acute care hospital for the Trust, it delivers the full range of acute services to a population of 250,000 in the surrounding area.

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[1] **D.E. Bloom**, et. al, "Program on the global demography of aging." Harvard University Oct. 2009.

[2] **J.M. Corrigan**, et. al, "Crossing the quality chasm: A new health system for the 21st century," Washington, DC: National Academy Press 2001.

There is clear evidence of changing vital signs and a period of deterioration some 6-8 hours before a cardiopulmonary arrest.[3] Combined with reduced monitoring outside of the ICU environment in step-down and general wards, potentially avoidable sentinel events are frequently reported.[4] Appropriate vital signs monitoring that is accepted by patients, their families and the wider team of healthcare professionals that deliver care will help. Patient vital signs information must be accurately and consistently measured, recorded, and relayed to front-line staff frequently enough to allow the deteriorating patient to be identified and appropriate care delivered.

The Intelesens Surveillance Monitoring solution provides healthcare professionals with relevant and timely indicators of their patients' health. A comfortable and discrete body-worn monitor intelligently measures ECG and heart rate, respiration waveform and rate and skin temperature. Pulse oximetry can also be monitored using optional bedside solutions. This information is sent via Wi-Fi to an intuitive central station platform. Pulse oximetry data can be sent to the central station over a wireless bridge or a wired connection.

Clinicians can see at a glance current and previous health status, view trending information, and be alerted immediately to breaches in predefined limits for heart rate, respiration rate, skin temperature and SpO2 (that can be tailored to suit each patient). Key cardiac arrhythmia detection algorithms are also used to notify healthcare professionals of ventricular fibrillation and asystole events.

[3] **J. Kause**, *et. al,* "Intensive Care Society (UK), Australian and New Zealand Intensive Care Society Clinical Trials Group: A comparison of antecedents to cardiac arrests, deaths and emergency intensive care admissions in Australia and New Zealand, and the United Kingdom—the ACADEMIA study." *Resuscitation* 2004; 62:275– 82

[4] **A.H. Taenzer**, *et. al,* "A review of current and emerging approaches to address failure to-rescue." *Anesthesiology* 2011 Aug; 115(2):421-31

[5] **Department of Health, Social Services and Public Safety Northern Ireland**, "Health Minister Visits the Critical Care Complex at the Ulster Hospital." DHSSPSNI Website: http://www.dhsspsni.gov.uk/; October 2009 [Accessed 17th Dec 2014]

CLINICAL SETTING

The Ulster Hospital in Dundonald, just outside Belfast, is part of the South Eastern Health and Social Care Trust. It is the major acute hospital for the Trust and delivers the full range of acute services to a population of 250, 000 in the surrounding area. A £340 million refurbishment is currently underway that will see the provision of a state-of-the-art replacement hospital with single patient rooms and seven new operating theatres with expected completion in 2016. Completed redevelopment includes an upgraded A&E Department, a new maternity block, a critical care unit and a renal unit.[5]

Ward 17, a general medical ward within the SE Trust cares for patients presenting with a range of chronic and acute conditions, many with pre-existing comorbidities. The 20-bedded ward consists of two six-bedded bays and one four-bedded bay with four single bedded side rooms.

The timeliness of the feasibility testing is significant as plans progress to move to the newly built hospital with individual patient rooms instead of four or six-bedded bays. The additional level of patient safety that Intelesens Surveillance Monitoring provides will be more essential than ever when patients are not in direct view of healthcare professionals.

STUDY OBJECTIVE

Feasibility testing of Intelesens Surveillance Monitoring aimed to review the solution in a typical care setting and review user interactions with the system. Healthcare personnel acceptance, integration with workflow and potential clinical impact were of particular interest during the test.

MEASURING FEASIBILITY

Taking existing ward practices into account, use of the system was discussed with ward management to establish how it could be best integrated by nursing staff. Healthcare personnel were provided with basic system training. A 20-patient feasibility test was undertaken, with eligible patients being invited to wear the monitor during their stay on the ward. Healthcare personnel added

the patient on the Surveillance Monitoring Central Station (using only an anonymised unique ID number) and set up the patient with a patch electrode and vital signs monitor. The healthcare team interacted with the system as often as possible during their shift, and when the monitor was removed during patient discharge or end of monitoring.

DATA ANALYSIS
Quantitative outputs of user acceptability were provided from the data collected. Open text boxes allowed users to provide further comment on answers provided if they wished. These comments were reviewed with main themes pinpointed and reviewed.

Anonymised vital signs data and monitoring summaries were reviewed to provide information relating to the number and type of alarms raised; whether the alarms were true or false; and how the vital signs monitor readings compared with manual observations routinely recorded by nursing staff.

Information presented by the system during the evaluation was reviewed retrospectively by the consultant in charge to consider whether the technology could benefit healthcare professionals and patients.

SAMPLE SIZE
Fifteen healthcare personnel that had interacted with the system returned questionnaires at the end of the feasibility test. Questions were based around how easy the system was to use, their impressions of the system, how useful they found the system and how well it integrated with their existing workflow.

Where possible, and once a patient's monitoring had completed, patients were provided with a questionnaire to provide feedback on device acceptance. Patients were asked about how comfortable the vital signs monitor and electrode were, what they liked most and least about it, and if they would want to wear it in the future should they have to stay in hospital again. Twelve

patients returned questionnaires during the evaluation.

Clinical performance of the system and potential clinical impact were reviewed once all patient monitoring was completed.

FINDINGS

Healthcare Personnel Acceptance
The Intelesens Surveillance Monitoring system was evaluated positively by healthcare personnel that returned questionnaires.

System Impressions
71% of healthcare professionals felt comfortable using the system, with 60% indicating that they would have liked to interact more with the system, had time allowed.

77% believed it would have a very positive or positive impact on routine care and patient safety.

77% wanted to keep the system after the evaluation.

Ease of Use
Overall healthcare professionals rated the system as being easy to use. 84% rated all system interactions as being easy or very easy.

Tasks that staff felt neutral about included viewing trend data and acknowledging alarms. Given the reduced level of training delivered to nursing staff, the positive ratings recorded are most encouraging.

Overall Ease of Use
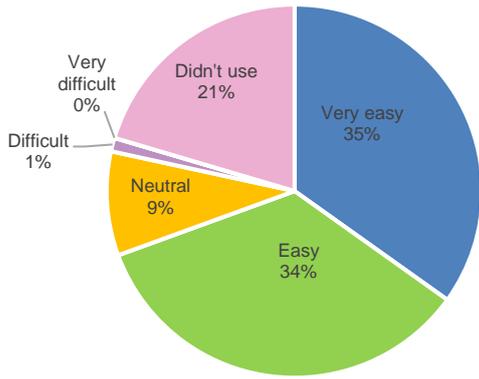
Figure 1 Average ease of use ratings from all healthcare professionals for all

Usefulness of the System

Healthcare professionals reported that they found the system to be useful. The most valued features include cardiac arrhythmia alerts, high and low heart rate alerts, leads off and low battery notifications, the patient tile view and the detailed patient view.

Utility of system features
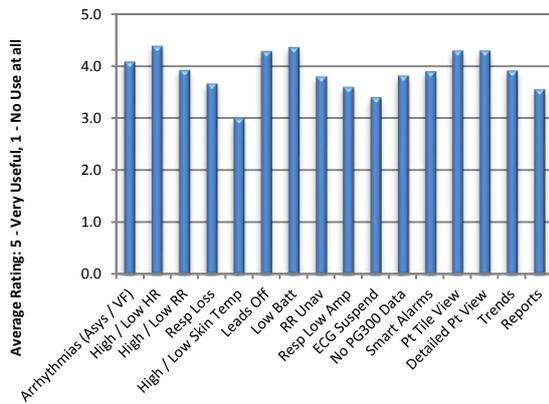
Figure 2 Average utility rating for each system feature

Utility of system features
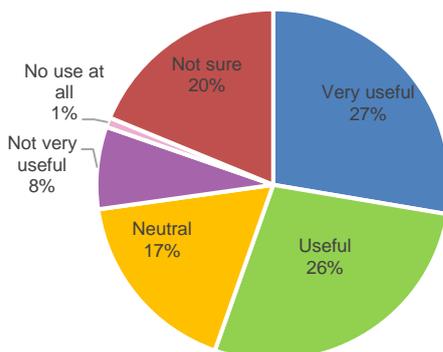
Figure 3 Average utility ratings from all healthcare professional for all

Healthcare personnel that did not find visualisation and trending useful indicated:

- That they preferred the current observation charts
- That the central station display was difficult to understand by glancing at it.

The nurse that found the central station difficult to understand when glancing at it stated that formal training would resolve this.

On the number of false alarms that would be acceptable to healthcare personnel per patient per shift, many members of staff stated that there would be no upper limit to the number of high priority alarms. Almost 60% would prefer to see an alarm and check the patient.

One third also believed there to be no upper limit for medium priority alarms.

Acceptable limits for number of FP alarms per patient per shift
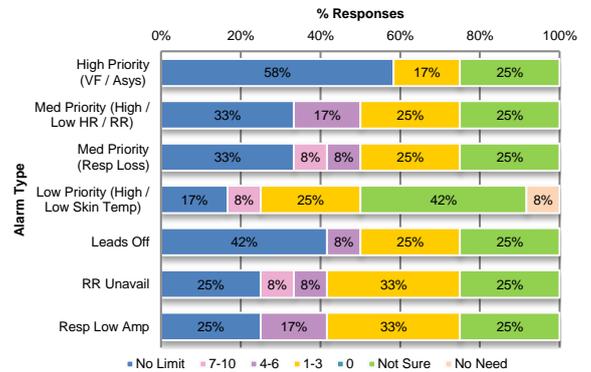
Figure 4 Acceptable false positive alarms per patient per shift

Even with this interesting response, recording good quality and accurate patient data reduces the likelihood of false alarms being raised – one of the key aspects of a successful surveillance monitoring system

Integration with Workflow

Over half of the respondents believed the system to be complementary, reasonably discrete or have a neutral impact on existing workflows. One third found that some readjustment to workflow was needed, which would be expected.

58% of staff felt it would hinder day to day activities mainly because daily battery changes were carried out only when low battery alarms were raised. If batteries were replaced on all patients at a scheduled time each day, the perceived workload associated with battery replacement would be greatly reduced.

54% felt it would not free up time, as they are still currently undertaking routine monitoring. Implementing the system to better complement routine care would provide a more realistic scenario to allow better assessment of this.

General comments about Surveillance Monitoring

I am keen to use system routinely with a view to hopefully seeing it replace nursing obs checks. (Ward Manager 1)
When the ward is short staffed, or on night duty, or if there are many "sick patients" on the ward, it is easy to see at a glance if there are any developing problems. (Ward Manager 1)
It would be beneficial to the ward staff and the patients. (Staff Nurse 11)
I think the system needs to be integrated better into the ward. (Staff Nurse 3)
Success in using the system would depend on staffing levels and workload. (Staff Nurse 7)

Patient Acceptance

Overall patients reported a high level of system acceptance.
Patients were asked to select what they found most positive and least positive about wearing the device, with opportunity to provide an alternative response to those listed.

The charts below show what patients valued most, and what they tolerated the least (if anything).

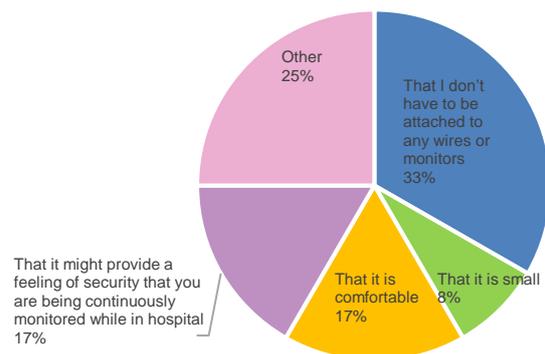### What patients valued most about Surveillance Monitoring

Figure 5 Aspects of the system valued most by patients that used Surveillance Monitoring

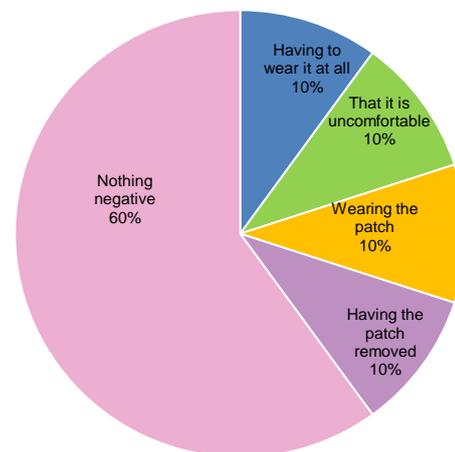### What patients liked least about Surveillance Monitoring

Figure 6 Aspects of the system valued least by patients that used Surveillance Monitoring

System Performance

Intelesens Surveillance Monitoring system performed well in the busy ward environment. Data was transmitted reliably from patient care areas to the central station for display.

Data recorded by the device matched well with nursing obs and trending information was available to healthcare professionals caring for patients.

Alarms raised during the evaluation were reviewed and classed as being true or false. Overall 3.29 false alarms were raised per patient per day, equivalent to 1.1 false alarms per patient per eight hour shift. False

alarms raised during the evaluation could be easily reduced through closer attention to best practice for electrode application. This ensures that optimum quality data is recorded by the device.

CLINICAL IMPACT

The consultant in charge of the evaluation considered the information presented by the system alongside the clinical benefits this would bring to healthcare professionals and patients. The potential impact the system could have in this environment is significant. Providing healthcare professionals with additional information relating to patient health status allows them to make more informed decisions. This in turn increases clinical confidence to make changes to current treatment plans, and provides the necessary monitoring to ensure the change resulted in the anticipated outcome.

The two main scenarios noted by the consultant were (1) that ill patients are stabilising and are responding to treatment as anticipated and (2) that very ill patients do not deteriorate further.

In the general medical ward there are patients admitted with a wide range of issues, including acute and chronic kidney conditions, diabetes, and current and previous cardiac complications. A significant number of patients admitted also have existing comorbidities that must be taken into account, further complicating their medical care.

Patients with low or elevated potassium levels or other electrolyte abnormalities are at risk of developing cardiac arrhythmias. Combined with current/previous cardiac conditions, the benefits of supportive monitoring using Aingeal are clear - alerting clinicians to changes in heart rate or respiration. These are the early warnings that are needed to instigate early intervention to help prevent further deterioration.

Patients that have experienced TLoC (Transient Loss of Consciousness) and patients on heart rate slowing medication

(such as beta blockers) are at risk of developing episodes of bradycardia. Alerting staff to these episodes and prompting early intervention has the potential to improve patient outcomes. Examples noted during the review that show how the system could help improve patient care include:

Example 1: Assisting in the detection of early signs of deterioration and early visibility of medical complications
- Patients with known cardiac disease including ischaemic heart disease are at a higher risk of experiencing complications
- Heart failure patients are at risk of fluid overload that results in elevated heart and respiratory rates
- Onset of arrhythmias due to electrolyte imbalances due to kidney problems, drug effects and other common clinical situations

Example 2: Aids by providing additional and timely information on patient response to medication changes
- Informing of good palliation (normal respiration and heart rates)
- Allowing adjustment to rate or rhythm controlling cardiac medication or avoiding ongoing use
- Ensuring adequate rate control of atrial fibrillation

Example 3: Supporting early discharge decisions
- Helping staff confirm desired response to therapeutic interventions and that there are no obvious underlying reasons for a collapse presentation

CONCLUSIONS

The results of the evaluation demonstrated that the Intelesens Surveillance Monitoring system was successfully installed and operated in the clinical environment. Healthcare professionals were provided with consistent and reliable vital signs data for traditionally unmonitored patients. The system was easy for ward staff to use and acceptable for patients to wear. Nursing staff

responded positively to the system, with most staff wanting to keep it after the evaluation. The system integrates easily with existing workflows and has the potential to make patient care pathways more efficient when used routinely. Technically, the system performed well, having a low false positive alarm rate and matching with data recorded by nursing staff. Clinically, the potential impact the system can have in this environment is extremely positive.

Training delivery should emphasize best practice for skin preparation and electrode application to guarantee that high quality data is recorded. Setting alarm limits that are appropriate to each individual patient will ensure high levels of acceptance among staff.

Healthcare personnel suggested ways that concerns with Intelesens Surveillance Monitoring could be addressed:

• Better integration with workflow
• Formalised system training
• Practice using the system

71% of staff found the visualisation of patient health status and trending on the central station useful.

86% of healthcare personnel found the system clinically useful

92% found it beneficial to patients

92% of patients found the system to be both comfortable and discrete

100% reported acceptable patch removal

92% would wear the system again

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