Sensium Whitepaper - The Deteriorating Patient

Current Standard of Care - Manual Observations

A large number of patients in hospital are at risk of deterioration in their condition – but it is often difficult to predict which patients will become worse rather than better, so a surveillance system of physiological observations (known as 'Obs') is therefore in place in all hospitals. The NICE guideline CG50 'Recognition of and response to acute illness in adults in hospital' [1], building on work from the Royal College of Physicians [2] recommends the use of a 'track and trigger' system for the frequent monitoring of vital signs (respiratory rate, heart rate, systolic blood pressure, oxygen saturation & temperature) and related observations (level of consciousness). In response, paper-based early warning systems (EWS) have been implemented in most hospitals, but these suffer from the limited frequency with which measurements can be practically and affordably measured by clinical staff, thus putting at risk rapidly deteriorating patients. Consequently, these systems continue to underperform, as highlighted by a recent systematic review of 36 clinical studies which reported unacceptably low values of sensitivity and positive prediction [3].

Patients with infection are particularly at risk of developing sepsis (when the infection spreads to have widespread effects on the body), and tackling sepsis is currently a strategic priority within the NHS. Despite medical advances and increased awareness through the 'Surviving Sepsis Campaign'[4], the incidence of sepsis and septic shock has increased over recent decades and mortality rates remain high at ~28%. An international survey has identified that patients with sepsis often receive suboptimal care, primarily due to a delayed recognition of deterioration and a failure to trigger a response from the medical team [5]. As early as 2001, Rivers demonstrated [6] that rapid identification and treatment (by haemodynamic optimisation) could significantly reduce this mortality rate – leading to the generation of the 'Surviving Sepsis' guidelines – but this effective intervention is still not being used due to a failure to recognise sepsis at an early stage. There is a general acceptance that the earlier the patient is identified and treated the better, so early identification becomes crucial in improving outcomes.

The scale of human resource dedicated to routine observations is already substantial and costly: there are ~135,000 patients in hospital in England at any time. Each of these patients will have at least 6 hourly (4 times a day) observations, so at least 540,000 sets of observations are carried out each day. Each set take approx. 10 minutes of staff time, so in NHS England about 90,000 hours per day (32.8 million hours per year) is spent in this activity. This is equal to about 21,000 members of staff doing nothing but observations. Even if employed at the lowest grade able to undertake this task (Band 2 on £15,851) the minimum cost of 'Routine Obs' each year is £330 million (the true figure is much more, as most observations are done by a staff member on a higher payscale). Adding in the costs for the 23,000 Scottish and
11,500 Welsh hospitals beds will take the minimum costs above £400 million a year. Surprisingly, despite this large amount of money that the NHS spends on ‘Observations’, little or no research has been conducted to establish the most effective methods of collecting and interpreting this data to improve patient care. There is however strong evidence that the current system is expensive and ineffective – for example up to half of patients who suffer a cardiac arrest in hospital have a pattern of deterioration in 'Observations' that is abnormal, but did not lead to preventative action [7, 8]. Further studies have shown that changes in vital signs could be noticed hours or even days in advance of cardiac or respiratory arrests, and the majority of these adverse events were observed to be preventable [9,10,11].

Technology on its own is not an answer to the failure of the current 'Observations' system – there is a 'chain of survival' that includes human factors and hospital organisation. However, an essential first step in any improved system is the detection of the earliest changes in physiology and the presentation of these changes to clinicians in an organised way. As patients’ acuity level continues to rise, hospitals are implementing new initiatives geared toward early detection of deterioration in a patient’s condition and faster intervention once a problem is recognized. Essentially what is needed is a Rapid Response System (RRS) comprising firstly a means of promptly detecting patients at risk and calling for help (‘Early Detection’), and secondly a care team that responds in a timely manner to these calls for assistance (‘Rapid Response’) [12].

The ‘Rapid Response’ part of this RRS – namely the need for faster intervention when a patient deteriorates – has been addressed in many hospitals through the development of Rapid Response (or Outreach) Teams, which deliver resources for the evaluation, stabilization, and transfer of deteriorating patients [13,14]. Although studies have demonstrated improvements in clinical outcomes after the introduction of Rapid Response Teams, they have also highlighted that delays between the onset of patient deterioration and subsequent detection by clinicians on the medical-surgical floor significantly affect patient outcomes; delayed activation of the Rapid Response Team is a strong predictor of patient mortality [15]. The question thus remains as to how best to effectively implement the ‘Early Detection’ part of the RRS – how to support the early detection and notification of patient deterioration for patients nursed in general care areas of the hospital, without relying on over-stretched staff to make more frequent observations in person, or without requiring all patients to be wired to bulky and expensive bedside monitoring systems. If it is accepted that any patient in hospital could deteriorate without prior warning then logic dictates that, if technically possible and affordable, all patients should be continuously monitored. Sensium® monitoring technology offers an exciting potential to support patient monitoring, risk assessment and event detection using affordable, miniature, wearable and wireless patches.
Sensium® (illustrated in Figure 1) is a discreet, wearable, wireless system for monitoring vital signs of patients outside of high acuity areas. By using a lightweight, comfortable sensor Patch worn on the patient’s chest, Sensium® accurately and reliably monitors and reports vital sign data every two minutes. By notifying clinicians of changes in patients’ vital signs, Sensium brings the nurse to the deteriorating patient.

The Sensium® Patch provides accurate and continuous monitoring of three key vital signs - heart-rate (HR), respiration rate (RR) and axillary temperature (T) – widely recognised as leading indicators of patient decline for conditions including sepsis [16]. Sensium® wirelessly communicates this physiological information via safe and secure low power wireless communication to the network of Sensium bridges placed through the ward area. Patches are disposable thus avoiding any risk of cross infection, with up to a 5-day battery life. The Sensium® bridges are connected into the hospital IT system, and the Sensium® Link Software installed on the hospital network allows patient data to be seamlessly conveyed to clinical staff where and when they need it most.
The Sensium® system allows patients to ambulate freely, untethered to static and expensive equipment, whilst still having the reassurance of continuous monitoring. A dashboard summary of vital signs and patient history can be viewed at nursing stations or on other web enabled devices.

Crucially, notifications can be configured to work with hospital pager systems or mobile notification devices, giving clinicians meaningful data when and where they need it. To save time and ensure accuracy, Sensium® can be easily integrated with the hospital admission, discharge, transfer systems and electronic medical records. The system is configurable to display up to 24 hours of vital signs trend data. Highly flexible, Sensium® allows clinicians to configure alert levels for each vital sign as appropriate to their clinical environment. Easy to use, Sensium® integrates into the clinical workflow with the minimum of customisation and disruption, and offers the potential for a future where avoidable adverse events due to undetected patient deterioration become an increasingly rare occurrence.

References