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Smart Bed Solutions for **PATIENT DETERIORATION**

INTRODUCTION

Once seen as little more than essential furniture, hospital beds have morphed into high-tech medical devices and communication platforms that protect patients from preventable adverse events and improve clinical and economic outcomes. The advanced technology in today's Smart Beds offer 24/7 real-time tools to monitor patients, detect signs of potential health and safety risks, and alert caregivers to intervene before a patient's condition or situation gets worse. Much like the evolution of smartphones, Smart Beds are becoming robust, open and interoperable platforms for a growing number of patient care and safety applications that minimize preventable complications, improve workflow efficiency and help patients recover faster and better.

Hillrom's Smart Bed Solutions series of white papers examine how hospitals can take advantage of the various technologies integrated into patient beds to successfully address some of today's most common and urgent threats to patient health and safety. This paper covers the clinical challenges and consequences associated with patient deterioration. It shows how Smart Beds that continuously monitor patients' respiratory and heart rates and track their trending data can help hospitals detect and quickly respond to early signs of patient deterioration – the critical first step in preventing conditions such as sepsis and respiratory depression from getting worse.[1,2]

Changes in vital signs prior to clinical deterioration are well documented and early detection of preventable outcomes is key to timely intervention.[4]

EARLY INTERVENTION KEY TO SEPSIS PREVENTION

Sepsis is a significant cause of mortality in hospitals, and one of the most expensive conditions to treat[3,4]. The clinical consequences of sepsis can be reduced by early identification and intervention.

- The risk of mortality from sepsis increases 4-9% every hour treatment is delayed[3]
- One of the most common signs and symptoms of sepsis is difficult or labored breathing (35%)[5]
- As many as 80% of septic shock patients can be saved with rapid diagnosis and treatment[3]

A CLEAR AND PRESENT DANGER

OLDER AND SICKER PATIENTS, FEWER NURSES WITH LESS TIME TO CARE FOR THEM

Broadly defined, patient deterioration (also called clinical deterioration) refers to the sudden worsening of a hospital patient's physiological condition.[6] If the detection and intervention of patient deterioration is delayed, it may culminate in serious harm, including unplanned admissions to the ICU, prolonged hospital stays and unexpected deaths. Three of the most serious and costly outcomes associated with deterioration include sepsis, cardiac arrest and respiratory depression.[7]

For the estimated 6.2 million high-risk patients in U.S. hospital med-surg units,[8] patient deterioration represents a clear and present danger. If countermeasures are not taken, two trends make it more likely patient deterioration events could rise precipitously.

- Hospital patients are older, sicker and have more comorbidities. In 2010, more than two-thirds of Medicare beneficiaries had at least two or more chronic conditions[9]
- Nurses (who are primarily responsible for detecting patient deterioration) have more patients and less time to monitor and care for them. One study found that a medical center's nurses were spending only 16% of their time on patient interaction and care[10]

The failure to identify patient deterioration events as they occur can result in missed or delayed diagnoses, which the ECRI Institute ranked as its #1 patient safety concern in 2020.[11]

PREEMPTING DETERIORATION WITH EARLY DETECTION AND INTERVENTIONS

The aging population, nursing workload, nursing mental and physical fatigue and the increasing complexity of patient conditions may further increase the incidence of patient deterioration. Hospitals however can reduce the frequency of such events, and most importantly, their most harmful and catastrophic consequences. This outcome can only happen if hospital staff is empowered to be more vigilant in detecting changes in patients' vital signs and quickly respond to them with appropriate interventions.

Numerous studies have reported that:

- Vital signs can accurately predict patient deterioration several hours before a serious adverse event.[12]
- Recognizing even subtle changes in basic vital signs might allow patient deterioration to be identified well before serious adverse events occur.[6]
- 60% of patients have a documented physiological indication before a cardiac arrest, unplanned ICU admission and/or death.[13]
- 70 – 80% of patients have elevated vitals scores six hours before an adverse event.[8]
- Abnormal vital signs during the four hours preceding an in-hospital cardiac arrest (IHCA) occurred in nearly 60% of patients.[14]

> If vital signs were more accurately and frequently measured, and acted on promptly and appropriately, hospital care would be safer, better and cheaper.[15]

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RESPIRATORY RATE

THE MOST IMPORTANT, ACCURATE AND NEGLECTED PREDICTOR OF PATIENT DETERIORATION[7]

Changes in respiratory rates often are the first signs of deterioration as the body attempts to maintain oxygen delivery to the tissues.[16] Respiratory insufficiency or failure is the most common reason for unplanned ICU transfers,[17] and abnormal respiratory rates have been associated with a 13-fold increased risk of mortality.[18]

Although early identification of these changes enables prompt interventions that reduce the risk of organ failure and death, respiratory rates have consistently been the least frequently measured and inaccurately recorded vital sign.[17] The varied causes for such serious failures in patient monitoring include:

- Respiratory rates are not consistently and/or accurately recorded. Studies show that respiratory rates were not documented in 15[19] to 37%[20] of patients. Another study found that 77% of recorded respiratory rates in hospitalized patients were recorded as 18 or 20 breaths per minute, but only 13% directly observed measurements were within that range.[21]
- The importance of accurate respiratory rates are undervalued. One survey found 46% of nurses considered respiratory rates the least important indicator of deterioration and 27% said they relied on quick estimates to determine these rates.[22]
- Nurses do not have automated measurement tools. Unlike heart rates, blood pressure and temperature, which can be easily measured with automated devices, respiratory rates have traditionally required manual measurements. One study found that vital signs were more frequently documented in patients who were automatically monitored compared to manual monitoring methods (96% compared to 74%).[23]
- Intermittent rounding delays measurements. Depending on the patient, vital signs are typically spot-checked during rounds every four to six hours, and respiratory rates are not consistently assessed. In one study, only 43% of nurses recorded vital signs every six hours.[24]
- Other tasks take precedent, which leads to neglect and errors. Nurses' workloads can be overwhelming, especially on busy med-surg units. A lack of time and competing responsibilities were likely key factors in a study that found 15% of respiratory rate records were undocumented.[14]

THE LOGICAL SOLUTION

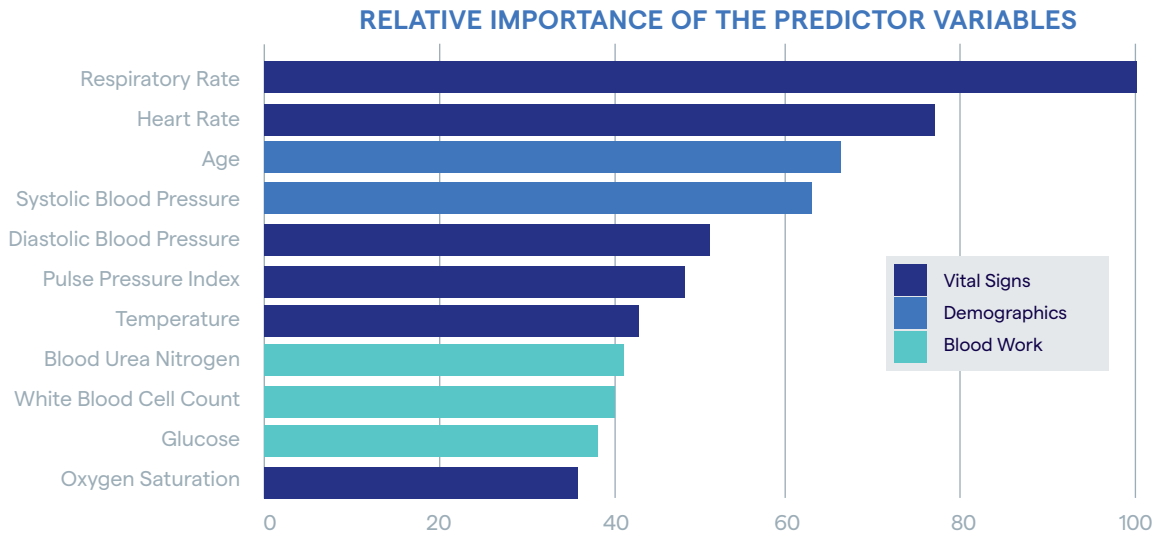
CONTINUOUS MONITORING, REAL-TIME ALERTS

As we have seen, the best line of defense against patient deterioration requires: 1) early detection of significant physiological changes – particularly respiratory rates – as soon as they occur, and 2) Near real-time communication of this information to caregivers, who can then quickly initiate clinical interventions. Ideally, clinicians will review respiratory and heart rate data trends for proper context on the current metrics, guiding their decisions while increasing the accuracy of models designed to detect critical illness.[7]

This heightened level of vigilance is now available in Smart Beds with 24/7 monitoring and alert and alarm management capabilities that seamlessly connect to hospitals' communication systems and devices, including patients' EMRs. When patients lie down on one of these beds, sensors under the surface continuously record their respiratory and heart rates and compile trending data that clinicians can use to assess how these rates have changed over the last seven days.

Whenever the rates move outside preset parameters, the bed signals an "alert" using lighted floor projections and sounds. If Smart Beds are part of a unit's care communications network, the alerts can be sent automatically to central workstations, clinicians' mobile devices or a cloud-based ecosystem.

Smart Beds are more than a powerful tool to prevent patient deterioration. Unlike expensive telemetry monitoring systems, they do not require wired leads that can cause patient discomfort and frequently become detached, which sets off false alarms. For many patients, especially those feeling vulnerable and scared or those feeling isolated due to COVID-19 restrictions, just knowing their beds can warn nurses at the first sign of problems can help alleviate stress and anxiety.



A study of trends in weighted vital signs found respiratory rate appears to be the best predictor of patient deaths.[25]

REAL-WORLD IMPACT

Research shows that Smart Bed continuous monitoring on a medical-surgical unit is associated with significant decreases in code blue rates, ICU days for transferred patients and total lengths of hospital stays.[26]

86% reduction in code-blue events

45% reduction in ICU days for patients transferred from the unit

9% reduction in patients' lengths of stay

CASE IN POINT: ARNOT OGDEN MEDICAL CENTER

After two weeks of using 26 Centrella® Smart+ Beds with contact-free, continuous monitoring technology on a medical-surgical unit, the hospital had seven cases in which bed alerts enabled nurses to quickly intervene and resolve patient's problems, including opioid-induced respiratory depression.

"This technology is a cost-effective, patient-friendly solution that is highly sensitive and has high positive predictive value."[27]

—Arnot Ogden Medical Center, a not-for-profit, 256-bed tertiary medical facility in Elmira, New York

CASE IN POINT: COVENANT HEALTHCARE

Soon after the pandemic struck, Covenant Healthcare began using its continuous monitoring Smart Beds to care for COVID-19 patients in its 24-bed medical pulmonary unit.

"The smart beds with continuous monitoring have become an essential tool in our toolbox. They turned out to be a lifesaver in many cases where we were able to identify deteriorating cases faster using these beds."[28]

—Patient Services Manager, Covenant HealthCare, a 643-bed hospital in Saginaw, Michigan

BENEFITS SUMMARY

CONTINUOUS HEART AND RESPIRATORY RATE MONITORING WITH TRENDING DATA

- Improves patient safety by facilitating automated notification of patient deterioration and early diagnostic and therapeutic interventions at the first signs of problems
- Provides clinicians with up to seven days of trending data to help them evaluate the problem and determine appropriate interventions
- Supports patient mobilization compared to wired monitoring devices, which has been shown to improve patient recovery and reduce the risk of complications[29]
- Automatically transfers patient information directly to the EMR
- Enhances patient comfort and satisfaction by:
  - avoiding additional electrodes and/or sensing/ monitoring attachments
  - alleviating anxieties caused by prolonged response times with actionable alarms that detect deterioration earlier
  - facilitating uninterrupted, restorative sleep by eliminating the need to disturb patients to manually capture respiratory and heart rate

FINAL WORD

Patient deterioration events occur far too often in hospitals. They not only impose significant clinical and economic burdens on hospitals, patients and society, but also cause undue physical and emotional hardships for caregivers, patients and their families. For various reasons, the traditional method for detecting and responding to such events in medical-surgical units – intermittent manual monitoring of vital signs by the nursing staff – is no longer an effective approach. Retrospective reviews have suggested that as many as 38% of deterioration cases could have been avoided.[17]

Smart Bed technologies with continuous monitoring capabilities , such as the Centrella® Smart+ bed with Contact-free, Continuous Monitoring, offer an efficient, practical and patient-friendly way to prevent such harmful events by triggering early diagnostic and therapeutic interventions that potentially can save lives.

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For more information, please contact your Hillrom sales representative at 1-800-445-3730.

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