

# PATIENT SURVEILLANCE ON THE GENERAL CARE FLOOR

## EXECUTIVE SUMMARY

Changes in patient populations, along with economic and practical considerations, have led to an overall increase in patient acuity on the general care floor (GCF).

Unfortunately, this rise in patient acuity on the GCF has not necessarily been met with an equal increase in patient surveillance capabilities.

Recent advances in patient surveillance technology that are directly applicable to the GCF patient population include tools for detecting respiratory compromise, cardiac compromise, sepsis prevention, and patient movement/activity for the prevention of pressure ulcers and falls.

- The implementation of a comprehensive patient surveillance strategy encompassing these tools on the GCF:
  - Is increasingly important given rising patient acuity
  - Has the potential to prevent common, costly, and deadly inpatient complications

## INTRODUCTION

The GCF, also referred to as medical-surgical or med-surg, typically refers to a hospital unit in which patients receive 24-hour inpatient general medicine services and/or postsurgical services. Historically, GCF units have included patients who require less care than is available in intensive care units (ICUs), step-down units, or specialty care units. However, a combination of economic pressures, ICU staffing and bed shortages, and an aging population has led to:

An increased number of patients being moved earlier from critical care units to general care units

An overall increase in patient acuity on the GCF

While GCF units are less expensive they are also less well equipped to provide the continuous patient surveillance often required by higher acuity patients. More specifically, general care units typically have higher patient to nurse ratios, reduced access to continuous surveillance technology, and reduced patient visibility due to factors such as private patient rooms and extended hallways. Together, these considerations along with the potential misconception that patients in the general care unit are "less sick," can increase the likelihood that

unexpected patient deterioration goes unnoticed, resulting in otherwise avoidable adverse outcomes, including death. Given the persistent prevalence of these unfortunate outcomes, reducing the incidence of preventable harm remains a major patient safety concern and the focus of much discussion within the healthcare community.

## ECONOMIC FACTORS

Critical care medicine is increasingly expensive.

Between 2000 and 2005, annual critical care medicine costs increased from \$56.6 to \$81.7 billion, representing 13.4% of hospital costs, 4.1% of national health expenditures, and 0.66% of gross domestic product.<sup>1</sup> In a 2005 study by Dasta et al., the mean intensive care unit cost and length of stay were \$31,574 ± 42,570 and 14.4 days ± 15.8 for patients requiring mechanical ventilation and \$12,931 ± 20,569 and 8.5 days ± 10.5 for those not requiring mechanical ventilation. Daily costs were greatest on intensive care unit day 1 (mechanical ventilation, \$10,794; no mechanical ventilation, \$6,667), decreased on day 2 (mechanical ventilation, \$4,796; no mechanical ventilation, \$3,496), and became stable after day 3 (mechanical ventilation, \$3,968; no mechanical ventilation, \$3,184).<sup>2</sup> In contrast, the daily costs of non-ICU care have been estimated to be 6 to 7 times less than those of ICU care, with average cost savings of \$1,200 per day for surviving patients who are moved from ICU care to non-ICU care.<sup>3</sup> Along these lines, the published daily room and board charges for OhioHealth MedCentral Hospital include \$2,632 for coronary care ICU, \$1,955 for standard ICU, \$1,120 for med/surg with cardiac monitoring, and \$705 for routine med/surg.<sup>4</sup>

Given these cost of care differences, there is increasing economic pressure to move patients out of the ICU as quickly as possible, such that patients who may have previously been in the ICU for a week following major surgery might now be discharged to the GCF after only a couple of days in the ICU.<sup>5</sup> These economic factors are further compounded by shortages in ICU beds and difficulties in maintaining acceptable ICU work force availability.<sup>5,6</sup> Together, these trends have resulted in a rising patient acuity on the GCF. Unfortunately, the increased movement of patients at

increased risk for clinical decompensation to general care has not necessarily been met with an equal increase in surveillance capabilities on the GCF.

## **SURVEILLANCE ON THE GENERAL CARE FLOOR: CURRENT PRACTICE**

Current GCF surveillance is often limited to isolated spot checks of core vital signs, such as heart rate, respiratory rate, blood pressure, and temperature, with such observations often limited to every 4 hours, which leaves patients unmonitored 96% of the time.<sup>7</sup> Along these lines, in a 2008 study by Hendrich et al., nurses from 36 medical-surgical units documented their time spent on various activities. The authors found that for the 767 nurses who participated, only 7.2% (31 minutes) of nursing practice time during a 10-hour shift was used for patient assessment and reading of vital signs. This value was in contrast to the 35.3% (147.5 minutes) spent on documentation. The authors also noted that the adoption of wireless devices for data entry could improve efficiencies and allow for nurses to spend more time in patient rooms and less time walking back and forth between patients and the nursing station.<sup>8</sup>

While some institutions provide continuous electronic surveillance (typically pulse oximetry [SpO<sub>2</sub>]) on the GCF, this practice is not universal, often due to cost concerns and/or equipment availability constraints.<sup>7</sup> When continuous pulse oximetry is employed, alarm fatigue is a common problem and the selection of appropriate alarm thresholds remains a highly debated topic. While an SpO<sub>2</sub> <90% remains the most commonly employed alarm threshold, the utility of this cutoff on the GCF has never been rigorously evaluated.<sup>7</sup> Furthermore, this practice has been associated with alarm fatigue, alarm neglect, continuous surveillance exclusion, and poor opioid-associated outcomes.<sup>7</sup> Of note, since 2007, Dartmouth's Hitchcock Medical Center has employed a patient surveillance system designed around an SpO<sub>2</sub> alarm threshold of 80% and heart rate alarm thresholds of <50 or >140 beats per minute.<sup>7</sup> The implementation of this system has resulted in improved patient outcomes, reduced cost of care, and reduced incidence of alarms.<sup>7</sup>

## **SURVEILLANCE ON THE GENERAL CARE FLOOR: ROOM FOR IMPROVEMENT**

### **RESPIRATORY SURVEILLANCE**

As described above, the accelerated movement of patients from ICU or step-down units to the GCF has led to a new set of patient safety concerns on the GCF. Of these, hypoxemia leading to respiratory compromise remains a likely cause of preventable harm on the GCF. In surgical patients, the risk of postoperative hypoxemia can persist throughout the first postoperative week, long after such patients are typically moved to the GCF.<sup>9</sup> Patients most at risk for life-threatening hypoxemia include<sup>7,10</sup>:

- Patients recovering from abdominal, cardiothoracic, and orthopedic surgeries
- Patients with cerebrovascular disease or cerebral ischemia
- Obese patients
- Patients with sleep apnea
- Patients receiving opioids for analgesia

Unfortunately, without adequate surveillance equipment, oxygen desaturation is extremely difficult to detect. Manual counting of respiration rate is notoriously unreliable and visual signs of hypoxia (i.e., cyanosis) are slow to manifest, often appearing long after the onset of dangerous ventilatory patterns.<sup>5</sup> Compounding these concerns, respiration rate is often the least well-documented vital sign, potentially because of lack of clinical care staff time and knowledge or equipment constraints.<sup>11,12</sup> Furthermore, respiratory compromise in general is one of the least well-identified modes of patient deterioration, often resulting in significant delays in emergency team activation.<sup>13</sup> In such patients, delayed emergency team activation is associated with an up to two-fold increase in mortality.<sup>13</sup>

An additional concern is that SpO<sub>2</sub> surveillance alone can provide a false sense of security for caregivers, especially in patients receiving supplemental oxygen. In fact, in some patients, SpO<sub>2</sub> values may be maintained >90% despite the onset of potentially deadly changes in ventilatory patterns and harmful levels of carbon dioxide.<sup>7</sup> Such changes are especially relevant in patients receiving opioids and in patients with unrecognized sleep apnea, with additional risk factors including obesity and COPD.<sup>7</sup> Given this concern, capnography or end-tidal CO<sub>2</sub> surveillance has emerged as a vital tool for combating respiratory distress, especially in the setting of procedural sedation and opioid administration.<sup>14</sup> The American Society of Anesthesiologists recommends that a comprehensive patient surveillance strategy for deeply sedated patients should include the surveillance of respiration rate, exhaled CO<sub>2</sub>, and apneic events by capnography in addition to the traditional surveillance of heart rate and SpO<sub>2</sub> by pulse oximetry.<sup>15</sup> Similarly, the Anesthesia Patient Safety Foundation has recently encouraged surveillance of patient oxygenation and ventilation in patients receiving patient-controlled analgesia or neuraxial opioids in the postoperative setting.<sup>16</sup>

Interestingly, pulse oximetry-derived respiratory rate has recently been suggested to provide a viable method of surveillance of respiratory rate in GCF patients.<sup>17</sup> Thus, in the GCF setting, it may be possible to integrate the surveillance of respiration rate, oxygen saturation, and pulse rate into a single noninvasive sensor. Such technological advances could improve patient safety with limited patient burden and allow for high compliance even in lower acuity settings.

### **CARDIAC SURVEILLANCE**

Cardiac disease or suspected cardiac disease remains one of the most common reasons for hospital admission for adults.<sup>18,19</sup> While GCF patients are presumed to be at low risk for adverse cardiac events and thus not appropriate patients for cardiac telemetry, many of these patients may benefit from some form of cardiac surveillance. In fact, in a 2010 study by Larkin et al., 33.9% of in-hospital cardiac arrests occurred on the GCF, with a mortality rate of 58.5%.<sup>20</sup> Furthermore, the odds of dying after cardiac arrest were 53% higher on the GCF than in the ICU.<sup>20</sup> Acute cardiac compromise and ischemic stroke are often directly linked with respiratory compromise, further highlighting the need for rigorous surveillance of both respiratory and cardiac function.<sup>9</sup>

For GCF patients, recent advances in surveillance technology may allow for the comprehensive surveillance of multiple variables at once, including single-lead ECG and respiratory rate, and thus allow for the preprogramming of “smart-alerts” better designed to detect clinically significant changes in patient condition. Importantly, these integrated smart-alerts may effectively reduce false alarms and thus reduce the likelihood of alarm fatigue. In these patients, a simple, single-lead, chest-mounted ECG sensor may effectively allow for surveillance of heart rate and cardiac arrhythmias. In support of this, a single-lead ECG system has been shown to be surprisingly accurate for arrhythmia detection as compared to 3-lead Holter monitor, especially for longer (i.e., >24 hour) recording periods.<sup>21</sup> In fact, in this analysis, the single-lead sensor detected more arrhythmias than the Holter monitor and arrhythmias that were “missed” by the single-lead system in the first 24 hours were detected in the second 24 hours. Furthermore, 93.7% of patients found the adhesive surveillance patch comfortable to wear as opposed to 51.7% for the Holter monitor. Similarly, the adhesive patch monitor affected patient activities of daily living less than patients in the Holter group (10.5% vs. 76.2%). When these patients were asked whether they would prefer to wear the adhesive patch monitor or the Holter monitor, 81% chose the adhesive patch monitor.<sup>21</sup>

## SEPSIS

Along with respiratory and cardiac compromise, sepsis is one of the most common postsurgical complications. In a study of 363,897 general surgery patients, Moore et al reported that sepsis occurred in 8,350 (2.3%) patients, a rate that was significantly higher than that seen for postsurgical myocardial infarction (0.2%) or pulmonary embolism (0.3%).<sup>22</sup> Overall, sepsis remains one of the most frequent conditions in U.S. hospitals, accounting for 934,000 hospital stays in 2010, or 30 stays per 10,000 patients.<sup>23</sup> In a 2001 study, Angus et al estimated an average cost of just over \$22,000 per case, and in 2011, sepsis was the most expensive hospital condition treated, resulting in an aggregate cost of \$20.3 billion or 5.2 percent of the total aggregate cost for all hospitalizations.<sup>24,25</sup> Given the rapidity with which sepsis can develop, early identification and treatment is critical for optimizing patient outcomes. In general terms, sepsis care bundles typically focus on supporting failing organ systems and maintaining blood pressure, with interventions centered around fluid replacement, airway management, antibiotic therapy, use of vasoactive medications, and hemodialysis.<sup>26</sup> With shortened ICU stays and increased patient acuity on the GCF, adequate sepsis surveillance, including vital signs and key laboratory parameters such as lactate, is a critical component of a comprehensive GCF patient surveillance strategy. Recent advances in surveillance technology allow for the seamless integration of sepsis prevention bundles into an overall patient surveillance strategy that is especially relevant on the GCF.

## MOVEMENT/ACTIVITY SURVEILLANCE

Depending on their clinical history and risk factors, GCF patients may be at increased risk of developing pressure ulcers (PUs). In general terms, PUs develop when compression

of the capillaries supplying the skin and subcutaneous tissue results in reduced tissue perfusion. In addition to this pressure-induced regional hypoxia, reperfusion injury, localized lymphatic system impairments, and mechanical injury are also believed to contribute to tissue necrosis and PU formation.<sup>27</sup> Unfortunately, while PUs are considered mostly preventable events, they remain a major health problem in U.S. health care facilities, affecting an estimated 3 million patients per year with approximately 60,000 patient deaths per year attributed to PU complications.<sup>28-30</sup> Perhaps not surprisingly, PUs are costly events, with an estimated charge per stay of over \$70,000 for full-thickness ulcer and an estimated \$11 billion spent annually on PU treatment in the United States.<sup>31-33</sup> Despite advances in patient surveillance and care, there has been disappointing progress in reducing the occurrence of these events. In the Eighth Annual HealthGrades Patient Safety in American Hospitals Study, which reviewed records from approximately 5,000 hospitals from 2007 to 2009, PUs were the second most common patient safety indicator, with an incidence rate of 26.6 per 1000 at-risk hospitalizations.<sup>34</sup>

Importantly, PUs can develop in as little as 2–6 hours, indicating that early and continuous surveillance of at-risk patients is of critical importance.<sup>35</sup> It is also important to note that PU development is an insidious process. The initial injury typically begins in the deeper layers of tissue and progresses toward the surface, such that by the time there is visible injury, the deeper damage is already more advanced.<sup>27</sup> With this in mind, effective PU care bundles require vigilant risk assessment combined with aggressive prevention strategies. The cornerstone of PU prevention is frequent patient turning, which is considered crucial for reducing pressure “hot spots.” However, despite the widespread adoption of patient turning protocols, these standards are often not actually achieved on the patient care floor.

Recent advances in surveillance technology can allow for the incorporation of patient turning alerts, assessment of patient movement patterns, and the direct mapping of pressure hot spots. Widespread implementation of these technologies on the GCF could aid in PU prevention and reduce the incidence of these “never events.” These technologies can also provide assistance in fall prevention, by surveillance of patient movements and bed exits. In the context of the GCF, with private patient rooms and reduced sightlines, such technology can help reduce adverse events due to delayed patient care following a fall, or even prevent falls by alerting nurses to attempted bed exits.

## CONCLUSIONS

Rising patient acuity combined with economic and practical considerations present new challenges for patient surveillance on the GCF. Current trends and practice result in the relatively rapid movement of patients from ICU and step-down units onto the GCF, where technological, staffing, and architectural limitations can hinder adequate patient surveillance. While patient surveillance capabilities on the GCF have improved in recent years, areas for continued improvement include respiratory compromise, cardiac

compromise, sepsis prevention, and patient activity and movement related to pressure ulcer formation and fall prevention. Respiratory compromise remains a common, costly, and deadly event throughout the hospital, and current patient surveillance strategies are typically insufficient for the GCF patient. Similarly, a large number of cardiac arrests on the GCF might be prevented through better surveillance. Despite best efforts, sepsis continues to be one of the most common and most expensive inpatient conditions. Pressure ulcers also remain a significant source of preventable inpatient harm, despite their recognition as never events and established prevention care bundles. In the context of the GCF, the implementation of a comprehensive patient surveillance strategy encompassing the continuous assessment of respiration rate, pulse oximetry, capnography, single-lead ECG, sepsis care bundles, and patient activity may improve patient outcomes and lower the cost of care. Improved patient surveillance in conjunction with the implementation of a medical emergency team or rapid response team intervention strategy may help reduce the incidence and severity of subsequent events.

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