

# Surveillance Monitoring to Improve Patient Safety in Acute Hospital Care Units

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## Introduction

When a patient is deteriorating in a hospital bed, it is critical that the clinicians on the unit recognize it as quickly as possible and respond rapidly and effectively to rescue the patient. [Failure to rescue](#) is a serious patient safety issue in the inpatient setting; research estimates between 10% and 13% of patient hospital deaths could be attributed to inaction or the lack of recognition of deterioration.<sup>1,2</sup> In response to this problem, researchers have developed and implemented many strategies in the last few decades aimed at preventing failure at [three critical points](#): (1) failure to recognize the complications; (2) failure to relay information to the care team, and (3) failure to react in a timely and appropriate manner.

Surveillance monitoring is an emerging strategy addressing the first two points, recognition and relay of information about deterioration, specifically in general care hospital units. Although it is only one part of a larger approach to addressing failure to rescue, this strategy has the potential to reduce preventable patient harm.

## Surveillance Monitoring

Surveillance Monitoring is an electronic system for continuously monitoring patient vital signs and alerting staff when a serious and sustained change in vital signs occurs, indicating that the patient is deteriorating and needs immediate attention. Surveillance monitoring compliments other tools used to identify patients who may experience deterioration, like risk prediction scores and [early warning scores](#). These scores are calculated using vital signs and other clinical predictors to determine a patient's current physiologic state and risk of deterioration. But the vital signs are static or intermittent rather than dynamic measures of patient status. Even with these scores in place, clinicians often cannot identify which patients may experience an unwitnessed cardiac arrest or other presentations of acute deterioration. The real-time nature of continuous surveillance monitoring enables clinicians to respond to a deteriorating patient early, when intervention is more likely to be successful.

As a novel approach to patient monitoring on general hospital care units, surveillance monitoring dramatically increases the frequency with which vital signs are available and thus improves clinician response time to acute events. On a typical general care unit, patient vital signs are assessed intermittently every 4–8 hours. While this may be the current standard of care in most hospitals, it is rare that staff are monitoring vital signs or are standing at the bedside when a patient experiences an event in this setting. Every minute counts when responding to an event such as a cardiac arrest, so anything that reduces the time to recognition improves a patient's chance of survival.<sup>3,4</sup> Adding surveillance monitoring to general care units provides earlier recognition of serious and sustained deterioration and reduces response times to prevent patient harm.

Surveillance monitoring differs from clinically indicated continuous monitoring in higher-acuity settings in several important ways. Vital signs are assessed in both settings, but continuous monitoring used in critical and intermediate care units has different indications for use and objectives. Patients in these areas are higher acuity with expected or known risk for deterioration. These clinical conditions warrant closer observation of vital signs. In such higher-acuity units, staffing ratios (often one nurse for every one or two patients) allow for more frequent observation and intensive assessment of patients. In contrast, patients on a general care unit are considered lower acuity. Fewer severe episodes of deterioration are expected; consequently, nurses are often assigned to care for four or five patients. For these patients, the goal of a surveillance monitoring system is to capture serious and sustained changes in patient state. To accomplish this goal, surveillance monitoring systems are adapted to their setting and patient population in two important ways. First, because patients are more mobile in this setting, highly reliable and well-tolerated physiologic sensors are used to increase the likelihood the monitors are worn and that accurate information can be conveyed to staff. Pulse oximetry is a good choice for this application because a single sensor can provide timely indication of changes in patient state (e.g., via oxygen saturation, pulse rate, and other indicators) and is well-tolerated by patients. The second key difference is the communication system used to direct staff attention to a specific patient in distress. Specific alarm thresholds, annunciation delays (i.e., a delay in activation of an alarm after trigger criteria are met), and directed notifications to only the responsible clinicians minimize nuisance alarms while still providing ample time for life-saving response.

Recent evaluations of surveillance monitoring implementation in hospitals have shown promising results. Surveillance monitoring systems decreased average vital sign collection time and improved accuracy of patient information, such as first name, last name, and bed number.<sup>5</sup> A qualitative study on clinicians who implemented a surveillance monitoring program found that it was generally positively received.<sup>6</sup> Finally, one study found that it reduced the death rate from opioid-induced respiratory depression from 0.02% without monitoring to 0.0009% with monitoring ( $p=0.03$ ).<sup>7,8</sup> In addition to these process and outcome measures, the systems can be cost-effective for hospitals, through a reduction in inappropriate cardio-telemetry orders and reduced transfers and shorter lengths of stay at higher level of care.<sup>9,10</sup> Overall, surveillance monitoring improves patient outcomes, enhances process of care by increasing accuracy of documented information, and is cost-effective.

### **Addressing the Alarm Problem**

One hurdle that organizations face in implementing any type of continuous monitoring on general care units is the [alarm problem](#). Alarms distract staff who are engaged in important clinical tasks and increase the risk

of errors. To justify the increased error risk, alarms should be sent only when it is important enough to warrant a distraction and change of attention from the task on hand. To address this issue, the alarming system for surveillance monitoring is notably different from other continuous monitoring approaches. The SpO<sub>2</sub> trigger threshold for surveillance monitoring is between 80% and 85%, which is lower than the typical threshold in high acuity units. In addition, there is a 15-second delay before SpO<sub>2</sub> alarms are sent to clinicians after a threshold is crossed, which eliminates alerts from brief and transient drops. These changes increase the likelihood that the alarm needs immediate attention versus being a nuisance alarm. In addition to the alarm problem, the heavily documented phenomena of [alarm fatigue](#) shows that clinicians become desensitized to alarms over time and are less likely to act on alarms that truly indicate an issue.<sup>11</sup> <sup>12</sup> The surveillance system also employs directed notification and escalation of alarms to limit alarm exposure. These three tactics, that is, wide thresholds, annunciation delays, and directed notification, mitigate both the alarm problem and alarm fatigue.

The changes to the alarm system have shown promising results for reducing alarm frequency and duration. When an 80% threshold was implemented at the general units of one hospital, the number of alarms decreased by 88%.<sup>13</sup> When they added the 15-second delay on top of that, alarms dropped by an additional 71%.<sup>13</sup> As a result, average audible alarms per 24 hours of monitoring decreased from 83 in the critical care setup to 4.2 in the surveillance setup.<sup>13</sup> In addition, the surveillance alarm thresholds did not increase risk of patient harm as this same system significantly decreased death rates from opioid-induced respiratory depression, as cited above.<sup>14</sup>

### **Implementing Surveillance Monitoring**

Researchers who have implemented surveillance monitoring systems have noted several challenges and lessons learned, the first of which is clinician pushback on surveillance alarm thresholds. Alarm thresholds, such as SpO<sub>2</sub> of 80%, can cause concern among clinicians who are accustomed to the higher monitoring thresholds in critical care. The worry is that these changes could cause patients in distress to go unnoticed for longer than necessary. When this concern is raised, organizations implementing surveillance monitoring should reiterate that the goal of this type of monitoring is to capture severe and sustained events; it is intended to run in the background and interrupt clinicians only if absolutely necessary. It may be helpful to remind clinicians that the status quo in a general unit is intermittent vital signs with no way to alert clinicians to deterioration in between assessments. In comparison, continuous monitoring provides a timely response to deterioration even with surveillance alarm configuration.

Having a multidisciplinary team engaged in designing the system, integrating reliable technology, and providing training to staff are other key aspects for successful implementation. Enlisting human factors and systems engineers to work with staff to map existing workflows and determine how the new system should be integrated will facilitate buy-in and seamless integration. These engineers have specialized skills in understanding and designing systems and their involvement throughout the process is critical to successful and sustainable implementation. In recognition of the importance of this systems-based approach to safety initiatives, AHRQ created [patient safety learning labs](#) in 2014 and continues to promote their work. These labs use cross-disciplinary teams to address the patient safety-related challenges that providers face, with an emphasis on the system-level confluence of the multiple factors that cause these challenges. Another

important element specific to this intervention is reliable and accurate signal technology, such as pulse oximetry, which allows clinicians to trust the system when it alarms. Other facilitators include providing training to clinicians before implementation, gathering daily feedback from clinicians for several weeks after implementation, and being willing to adjust the system during major disruptions such as a pandemic. By using these lessons learned, surveillance monitoring programs will be much more likely to succeed and ultimately to reduce patient harm.

### Future Directions

Surveillance monitoring is a promising and innovative approach to preventing failure to rescue in general hospital units. In addition to hospital units, this approach could be extended to other settings to prevent unmonitored patient deterioration. For example, neonates released from the neonatal intensive care unit but still in need of some monitoring could be monitored remotely at home using surveillance monitoring. [Remote monitoring](#) programs have expanded since the COVID-19 pandemic. These programs could benefit from the lessons learned in this surveillance monitoring approach.

Wider implementation of surveillance monitoring, as one aspect of a broader systems-based approach to safety, could help mitigate the complex problem of failure to rescue.

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