

The Afferent Limb of Rapid Response Systems

Continuous Monitoring on General Care Units

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KEYWORDS

- Rapid response systems • Continuous monitoring • Alarm management
- Physiologic sensors

KEY POINTS

- Continuous monitoring is the way to solve the afferent limb problem and to improve rapid response systems.
- Implementation, education, and training are key elements in determining the success.
- Sensors are only as good as their tolerance by patients.
- Alarm management is a key consideration for surveillance monitoring.

INTRODUCTION

Patients in general care units (GCUs) often deteriorate unnoticed while under our care, leading to preventable adverse events and escalation of care.^{1,2} Many of these adverse events are preceded by changes in vital signs and hence provide opportunity for earlier intervention.^{3,4} Rapid response systems (RRSs) were introduced to intervene at an earlier stage than at cardiorespiratory arrest (code teams).⁵ Fig. 1 illustrates the deterioration process and the points of intervention for code and rapid response teams (RRTs), as well as patient surveillance. The success of RRS, however, is dependent on being activated, a process that depends on 2 key components: monitoring and notification, or the “afferent limb.”⁶

Although there have been successful implementations of surveillance and continuous monitoring systems on GCUs, to reduce inpatient adverse events, by using pulse oximetry–based surveillance for almost a decade,⁷ the understanding of surveillance monitoring and its utilization of principles of population health medicine to hospital

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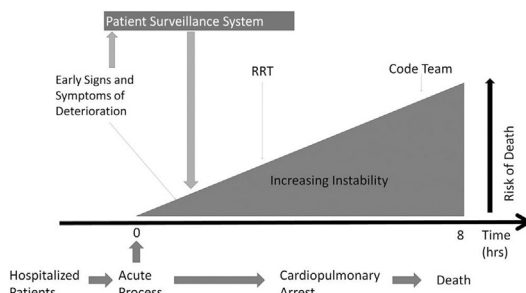


Fig. 1. Illustration of increasing physiologic deterioration over 8 hours, ultimately leading to cardiac arrest and death. Code teams intervene at the time of arrest, RRTs intervene earlier during the process and patient surveillance was introduced to halt the deterioration at an even earlier time point while being integrated in the workflow with RRTs. (From Taenzer AH, Pyke JB, McGrath SP. A review of current and emerging approaches to address failure-to-rescue. *Anesthesiology* 2011;115:421–31; with permission.)

wards is still in its infancy. The practice of risk stratifying individual patients based on comorbidities has largely failed because the risk environment that a patient is being exposed to is much more complex than just the patient's comorbidities on which the stratifications are primarily based.^{1,8}

Postoperative patients on opioids are a subset of the inpatient population at particularly high risk for preventable adverse events due to respiratory depression.⁹ Postoperative respiratory failure represents nearly 11% of all inpatient safety events and has the highest mortality rate per 100 discharges of all classified safety events.^{10,11} According to the Joint Commission's Sentinel Event database (2004–2011), 47% of respiratory depression events were wrong dosing medication errors, 29% were related to improper monitoring of the patient, and 11% were related to other factors, including excessive dosing, medication interactions, and adverse drug reactions (http://www.jointcommission.org/sentinel_event_statistics/, last accessed April 9, 2017). These data provide some insight as to why risk stratification and selective, individual monitoring has failed, as individual risk profiles do not accurately account for the entire risk environment. In the example of postoperative respiratory depression, almost half of events are related to medication administration (not ordering) error. Based on these considerations with respect to patient surveillance, the continuous monitoring of all patients (vs a selected group based on individual risk stratification) was introduced a decade ago.^{1,7,8}

CONTINUOUS MONITORING

Intermittent sampling of vital signs, the current practice, is insufficient to detect physiologic deterioration processes in a timely fashion to prompt interventions. This is often cited as the primary reason for “unexpected” adverse events in patients.¹² Episodic vital sign collection, even when sampled in 2-hour intervals, has been shown to miss adverse events in postsurgical patients.¹³ Additionally, most manually collected vital signs are inaccurate and fail to reflect the patient's true physiologic state.^{14–18} **Fig. 2** illustrates an example of patients on GCUs whose oxygen saturation averaged less than 90% for at least 15 minutes, along with a spot check of oxygen saturation during the same time.¹⁵ Although a systematic review of continuous versus intermittent vital signs monitoring has failed to demonstrate benefits of continuous

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