The data on respiratory depression in the hospital is alarming - increased use of patient-controlled analgesia (PCA) and increasing numbers of patients presenting with obesity and diagnosed or undiagnosed sleep apnea have significantly increased the risk of adverse or fatal events.

According to published data\(^1\), respiratory depression:
- Affects 17 out of every 1,000 patients
- Each year over 20,000 patients administered opioids experience respiratory depression arrests
- Has third-highest mortality rate of patient safety indicators (PSI)
- Accounts for nearly $2 billion dollars annually in excess U.S. healthcare costs

ECRI Institute has named undetected opioid-induced respiratory depression as one of the top 10 Health Technology Hazards for 2017\(^2\). In addition, both The Joint Commission and AAMI Foundation now recommend continuous respiratory monitoring of patients receiving sedatives to prevent adverse events\(^3, 4\).

Challenges and Limitations related to Respiratory Depression Surveillance

Until now, most efforts to mitigate the risk of respiratory depression have had limited success, due to a number of inherent challenges:

- Patients needing surveillance are often in General Care or Medical-Surgical departments that have a higher nurse-to-patient ratio and lack systems that provide for continuous measurement and surveillance of patients

- Many hospitals have moved to single-patient rooms, reducing the visual and audible oversight capability of clinicians

- Most devices, (pulse oximeters and capnographs), are susceptible to a variety of artifacts that produce a high number of false and non-clinically actionable alarms\(^5\), increasing the risk of alarm fatigue

- Devices typically lack the ability to send alarms and real-time patient data to mobile clinical communication tools (VoIP phones or Smartphone applications)
Bernoulli Respiratory Depression Safety Surveillance

Building on our leadership in vendor-neutral medical device connectivity and real-time patient safety applications, Bernoulli’s Respiratory Depression Safety Surveillance (RDSS) is a revolutionary solution that:

- Provides connectivity to the hospital’s existing fleet of pulse oximeters and capnographs from a wide range of vendors including Medtronic, Masimo and others.
- Enables remote centralized continuous monitoring of patients at risk of respiratory depression, helping clinicians to quickly recognize respiratory distress and respond to signs of patient deterioration.
- Utilizes comprehensive real-time data to provide active patient monitoring, eliminating the exclusive reliance on individual device alarms to inform clinicians regarding the patient’s condition.
- Includes Bernoulli’s exclusive RDSS analytics with multi-variable thresholds - adjustable by the hospital - to identify, clinically actionable events while significantly reducing the overall number of alarms communicated to clinicians, which can result in the risk of alarm fatigue.
- Integrates with mobile clinical communication tools to deliver the right alarms and alerts to the right nurse, respiratory therapist or care team member at the right time.

Proven Clinical Results

In a recent clinical study\(^6\) of patients diagnosed or suspected to have Obstructive or Central Sleep Apnea (to be published in the Journal of Biomedical Instrumentation & Technology), the use of Bernoulli’s RDSS analytics with multi-variable thresholds reduced 22,812 alarms generated by bedside capnographs and pulse oximeters to just 209 respiratory depression alerts delivered to clinicians’ mobile phones, a reduction of over 90%. More importantly, the RDSS analytics alerted for every patient that experienced an actual respiratory depression episode.

Many alarm management systems from other vendors utilize criteria that requires alarms from devices to be sustained for a certain period of time before sending an alert to a mobile clinician. In this same study, use of a 30-second sustained alarm criteria still resulted in over 13,000 alarms, potentially putting both patients and clinicians at risk due to alarm fatigue.

Another study has shown that early detection and clinical intervention for patients at risk of respiratory depression can result in savings of over $1 million dollars a year, through the avoidance of transfers to ICU, reduced length of stay and improved patient flow\(^7\).
Implementing Bernoulli Respiratory Depression Safety Surveillance

The Bernoulli RDSS solution is flexible, adaptable and scalable from individual departments to enterprise-wide deployments. Its vendor-neutral architecture leverages the hospital’s existing investments in IT, network, wireless and mobile infrastructure, while our FDA class II clearance includes indications for use to provide remote monitoring and alarm surveillance.

Our technical and clinical services teams manage the complete implementation process to ensure both operational success and clinical adoption, including goal setting, pre- and post-implementation assessment, integration with other systems and clinical workflow analysis.

An Expandable Platform for Real-Time Healthcare

By adopting Bernoulli Respiratory Depression Safety Surveillance, healthcare systems are creating a foundation to enable a wide range of additional applications including:

- Comprehensive Medical Devices Integration (MDI) into an EHR – not just networked devices
- Precision Alarm Notifications – using Smart Alarms and real-time patient data
- Additional Clinical Surveillance modules for at-risk patients – including patients on ventilators and Virtual ICU for multiple locations
- Potential other future real-time clinical analytics designed to improve patient safety and quality while reducing the cost of care

A recent report by healthcare industry analysts at Gartner on the role of an alarms and notifications platform noted that such a platform “can significantly reduce the number of critical alarms the nursing staff has to respond to through best-practice filtering, distribution and management — improving operation efficiency, outcomes and staff morale”.

References
3. The Joint Commission, Sentinel Event Alert, Issue 49, Aug. 8, 12
5. Patient monitoring alarms in the ICU and in the operating room. Critical Care, 2013
6. Continuous Surveillance of Sleep Apnea Patients in a Medical-Surgical Unit, BI&T, May/June 2017 (accepted for publication)
8. The Role of the Alarms and Notifications Platform in the Real-Time Health System, Gartner, Jan. 2017