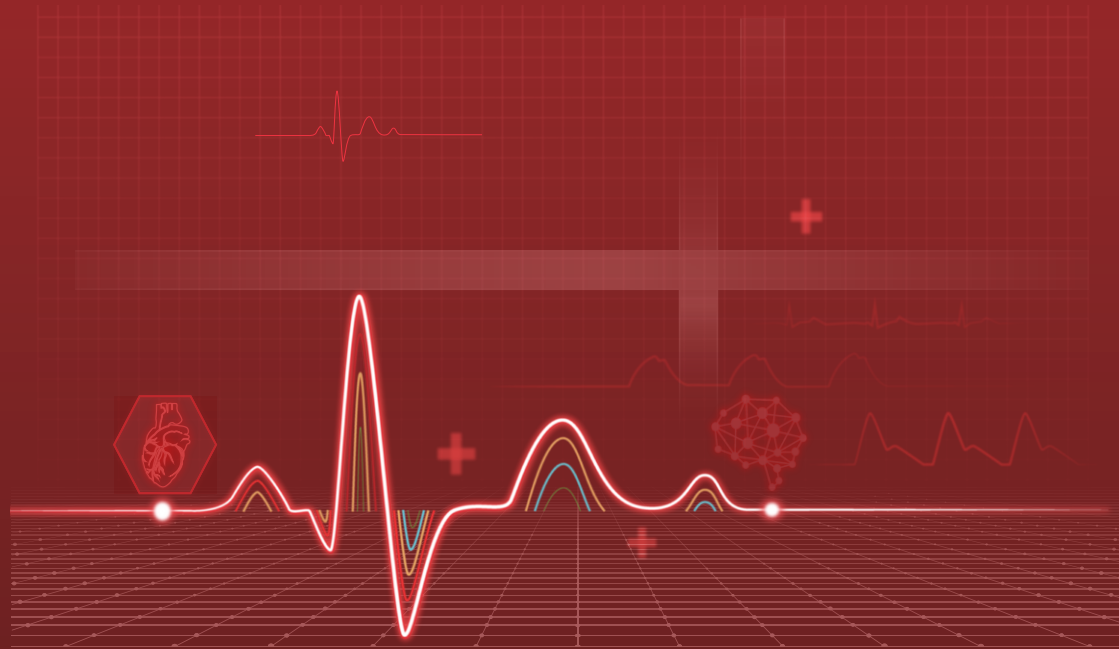


SMART DECISION SUPPORT FOR PATIENT SAFETY



Smarter ICU

Smart Decision Support for Patient Safety

The intensive care unit (ICU) is the busiest, most complex, yet essential room where care for a diverse population of critically ill patients in a hospital takes place. When clinicians are required to make decisions during a medical emergency, they are usually confronted by an unrelenting flood of information streaming out of patient monitors, ventilators and other bedside devices.

Recent studies show that the care of critically ill patients generates a median of 1348 individual data points per day and that this number has increased 26% over five years.^[1] A smart clinical decision support solution with easy-to-use interfaces and real-time data mining capabilities is essential for an ICU in order to lessen cognitive load, improve workflow and reduce medical error.

To navigate this complex array of data, Mindray developed a comprehensive ICU solution consisting of patient monitors, ventilators, infusion pumps and point-of-care ultrasound systems, all of which are integrated with various smart decision support tools. Through a range of Clinical Assistive Applications (CAAs), these devices can integrate, analyze and interpret large volumes of patient data in real-time, helping clinicians quickly identify adverse events and make accurate, informed and timely decisions that assure patient safety.



► Smarter alarm management

Clinical alarm systems provide essential warnings that alert caregivers to changes in a patient's condition. Yet excessive alarms can result in alarm fatigue, which is listed among the Top 10 Health Technology Hazards by ECRI [2]. The innovative CrozFusion™ multi-parameter technology solution from Mindray BeneVision N Series and ePM Series patient monitors uses a unique algorithm to simultaneously identify, combine and analyze ECG and SpO₂ pleth waveforms, suppressing false alarms caused by signal noise, and, by doing so, vastly mitigates risk to the patient's safety.

Mindray is also the first company to integrate the latest National Early Warning Score (NEWS2) protocol in a patient monitor. The customized EWS feature included in Mindray patient monitors provides prompt alarm management by automatically calculating the EWS, using color-coding to highlight the patient's status and supplying recommended instructions to caregivers. The feature is especially important for patients at risk of further deterioration.

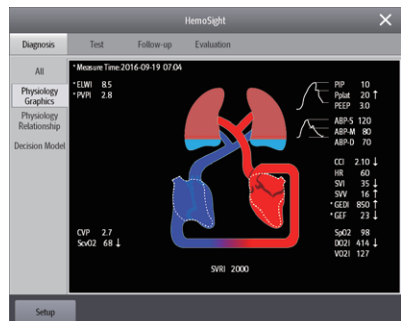


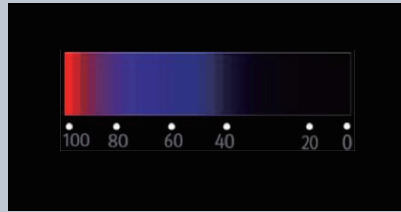
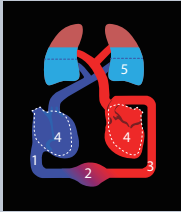
Automating the scoring process can help eliminate human errors and speed up patient deterioration detection.

EWS scoring trend review allows clinicians to quickly review changes in the patient's status.

► Visualization of complex patient data

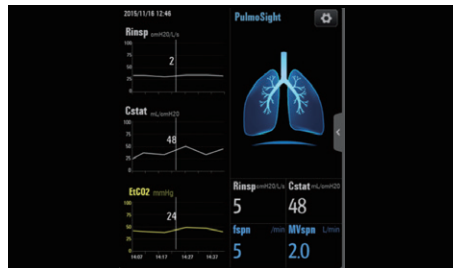
Hemodynamic management is one of the top challenges in an ICU. Mindray HemoSight™ is a suite of clinical tools that presents a comprehensive analysis of multiple hemodynamic parameters graphically. It helps clinicians make the right decision more efficiently throughout the hemodynamic monitoring workflow: from diagnosis, test to follow-up and evaluation.





When ScvO₂ or SvO₂ is available, the change in color indicates the change of ScvO₂ or SvO₂ values.

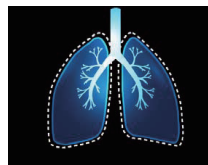
Another application in the high-end SV800 ventilator, PulmoSight™, gives real-time feedback (e.g. lung compliance, resistance, ventilation delivery) via graphic representation instead of numerical data, making interpretation of patients' pulmonary condition a much easier task.



Normal



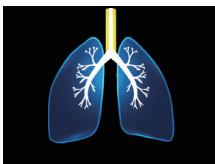
High compliance
The alveoli contour is thinned



Hyperventilation
(EtCO₂ high alarm)



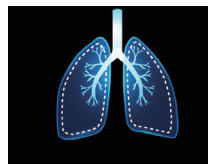
Diaphragm contract Spontaneous
Breathe – Inspiration



High resistance
The airway is obstructed



Poor compliance
The alveoli contour is thickened



Hypoventilation
(EtCO₂ low alarm)

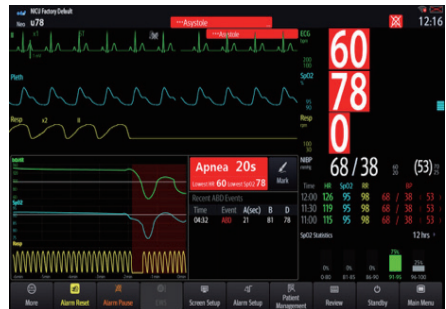


Diaphragm relax Spontaneous
Breathe – Expiration

► Smart analysis for better patient safety

Delivering early nutritional support therapy is a proactive therapeutic approach that can reduce the severity of the disease, diminish the likelihood of complications, and decrease the length of stay in the ICU ^[3]. Malnutrition can adversely affect patient outcomes. According to the recommendations of ESPEN Guidelines ^[4], Mindray adopts indirect calorimetry as the accountable method to continuously monitor energy expenditure in critically ill patients. This technology helps evaluate the nutritional balance and prevent over- and underfeeding.

Apnea of prematurity is one of the most common clinical symptoms among premature infants. To improve their survival rate and quality of life, the new oxygen cardio-respirogram (OxyCRG) interface is designed especially for neonates to manage ABD (Apnea, Bradycardia and oxygen Desaturation) events. The relevant waveforms running in the background will be highlighted in red when an ABD event is detected, while all ABD events will be recorded and analyzed. This monitoring application can also assist clinicians in determining when intervention via medication and ventilation treatment is necessary.



The OxyCRG interface is redesigned to display 6-minute btbHR and SpO₂ trends, RESP compressed waveform, ABD parameters, and the latest ABD events, removing the needs for manual calculation and observation.

► Smart weaning tools

The Spontaneous Breathing Trial (SBT) in the SV800/600 ventilator has proved to be the most expeditious tool to determine safe discontinuation of ventilatory support. The weaning criteria can be set according to the doctor's, the hospital's or standard protocol. The continuous monitoring of the patient's SpO₂ / EtCO₂ and other parameters ensures that the patient is always protected, while, at the same time, reducing clinician workload.

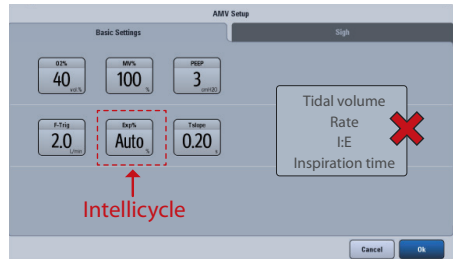
Criteria

► **Smart ventilation support tools**

As a critical component of clinical practice in an ICU, there is an urgent need for efficient ventilation support, while precise ventilation delivery remains a challenging task. The Mindray SV800 ventilator is equipped with an array of ventilation support tools and modes to meet different patients' needs, so as to assure better recovery outcomes for patients.

- The Adaptive Minute Ventilation (AMV), with the IntelliCycle automatically adjusting Expiratory Trigger Sensitivity and Cycle off, can provide real-time response to the patient's respiratory changes. The enhanced patient-ventilator synchrony simplifies the manual setting process and frees up the clinician for other tasks.

- The Esophageal Pressure Measurement is a practical approach to reflect the magnitude of the effort to breathe during spontaneous or mandatory ventilation. The feature recommends optimized settings to achieve comprehensive lung protection and early weaning during mechanical ventilation - reducing the duration of invasive mechanical ventilation.



- As an intelligent solution for precise ventilation delivery during cardiopulmonary resuscitation, the CPRV mode can effectively avoid hyper/hypoventilation, and the CO₂ monitoring allows clinicians to access the quality of CPR quickly.

[1] Pickering, B. W., Herasevich, V., Ahmed, A., & Gajic, O. (2010). Novel representation of clinical information in the ICU: developing user interfaces which reduce information overload. *Appl Clin Inform*, 1(2), 116-131. (Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3632280/>)

[2] E.C.R.I., 2019. 2019 Top 10 Health Technology Hazards Executive Brief [Online]. E.C.R.I. Institute. Available at: https://www.ecri.org/Resources/Whitepapers_and_reports/Haz_19.pdf (Accessed: 4 September 2019)

[3] Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (S.C.C.M.) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) *J.P.E.N. J Parenter Enteral Nutr* 2009 33: 277

[4] Singer, Pierre & Blaser, Annika & Berger, Mette & Alhazzani, Waleed & Calder, Philip & Casaer, Michael & Hiesmayr, Michael & Mayer, Konstantin & Carlos Montejo, Juan & Pichard, Claude & Preiser, Jean-Charles & Van Zanten, Arthur & Oczkowski, Simon & Szczeklik, Wojciech & Bischoff, Stephan. (2018). ESPEN guideline on clinical nutrition in the intensive care unit. *Clinical Nutrition*. 38. 10.1016/j.clnu.2018.08.037.

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