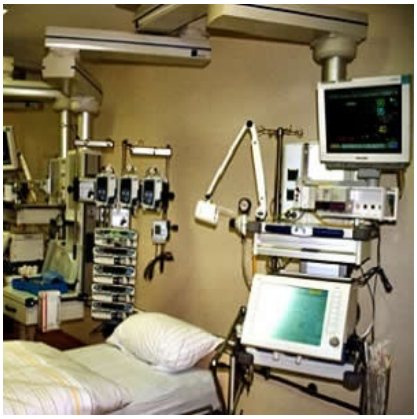
ICU
MANAGEMENT & PRACTICE

Automated system detects risk of ventilator-associated pneumonia



Researchers at Massachusetts General Hospital (MGH) have developed an automated system for identifying patients at risk for complications associated with the use of mechanical ventilators. The new system uses an algorithm that has been shown to be 100 percent accurate in identifying at-risk patients when provided with necessary data, according to a study published in the journal Infection Control & Hospital Epidemiology.

Approximately 50 percent of all patients receiving mechanical ventilator support develop ventilator-associated pneumonia. "Many patients die each year from ventilator-associated pneumonia, which can be prevented by following good patient care practices, such as keeping the head of the bed elevated and taking measures to prevent the growth of harmful bacteria in patients' airways," says Brandon Westover, MD, PhD, of the MGH Department of Neurology and co-senior author of the study.

Traditional surveillance of patients receiving mechanical ventilation involves manual recording every 12 hours, usually by a respiratory therapist, of ventilator settings – which are adjusted throughout the day to accommodate the patient's needs. Those settings, which reflect the pressure required to keep a patient's lungs open at the end of a breath and the percentage of oxygen being delivered to the patient, are reviewed by an infection control practitioner for signs that indicate possible ventilator-associated pneumonia.

"In our study, manual surveillance made many more errors than automated surveillance – including false positives, reporting cases that on review, did not meet criteria for what are called ventilator-associated events; misclassifications, reporting an event as more or less serious than it really was; and failure to detect and report cases that, on closer inspection, actually met criteria. In contrast, so long as the necessary electronic data were available, the automated method performed perfectly," explains lead author Erica Shenoy, MD, PhD, of the MGH Division of Infectious Diseases and the MGH Infection Control Unit.

Updated surveillance standards issued in 2013 by the National Health and Safety Network of the U.S. Centers for Disease Control and Prevention (CDC) specified three levels of ventilator-associated events:

• Ventilator-associated condition (VAC) - an increase in a patient's need for oxygen without evidence of infection
• Infection-related ventilator-associated complication (IVAC) - increased oxygen need accompanied by signs of infection, such as fever, elevated white blood cell count or an antibiotic prescription
• Possible ventilator-associated pneumonia (PVAP) - evidence of bacterial growth in the respiratory system, along with the factors listed above.

In the study, the MGH research team developed an algorithm to provide automated, real-time monitoring of both

ventilator settings and information from the electronic health record. Based on that data, the algorithm determined whether criteria were met for a ventilator-associated event and, if so, which level of event: VAC, IVAP, or PVAP.

Initial testing and debugging of the automated system was done from January to March 2015 in four MGH intensive care units. During that time 1,325 patients were admitted to the units, 479 of whom received ventilator support. A retrospective analysis comparing manual versus automated surveillance of data gathered from patients cared for during this development period revealed that the automated system was 100 percent accurate in detecting ventilator-associated events, distinguishing patients with such events from those without, and predicting the development of ventilator-associated pneumonia. In contrast, the accuracy of manual surveillance for each of those measures was 40 percent, 89 percent and 70 percent.

A validation study to further test the algorithm was conducted using data from a similar three-month period in the subsequent year, during which 1,234 patients were admitted to the ICUs, 431 of whom received ventilator support. During that period, manual surveillance produced accuracies of 71 percent, 98 percent and 87 percent, while results for the automated system were 85 percent, 99 percent and 100 percent accurate. The drop-off in accuracy of the automated system during the validation period reflects a temporary interruption of data availability while software was being upgraded, and the team subsequently developed a monitoring system to alert staff to any future interruptions.

"An automated surveillance system could relieve the manual effort of large-scale surveillance, freeing up more time for clinicians to focus on infection prevention," Dr. Westover notes. "Real-time, automated surveillance could help us design interventions to prevent, halt or shorten the course of an infection, something we hope to explore as we continue developing this project."

Source: Massachusetts General Hospital
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