Real-Time Automated Surveillance for Ventilator Associated Events Using Streaming Electronic Health Data

The Harvard community has made this article openly available. Please share how this access benefits you. Your story matters

Citation

Published Version
doi:10.1093/ofid/ofx163.1681

Citable link
http://nrs.harvard.edu/urn-3:HUL.InstRepos:34493170

Terms of Use
This article was downloaded from Harvard University’s DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA
With multiple VAP episodes >7 days apart with a different causative organism were counted separately.

**Results.** Fifty-six patients (67 episodes) with VAP in 992 admissions were identified. Ten had ≥2 episodes. In 11 episodes, ≥2 isolates were found from a respiratory sample; 78 isolates were identified in total. The cohort median age was 61 (interquartile range [IQR]: 48–70) years, with 43 (76.8%) males. Fourteen (24.6%) patients had diabetes, 10 (17.5%) had chronic kidney diseases, 17 (29.9%) had congestive heart disease, 9 (15.8%) had COPD, and 5 (8.8%) had malignancy. Among isolated bacteria, Acinetobacter baumannii (ACB) was highly resistant to meropenem, levofloxacin, and amikacin (Table). The 7-day mortality was 13% (n = 7) and 31-day mortality was 43.8% (n = 21). ACB cases had higher 31-day mortality (18 [56.2%] vs. 4 [25%]; P = 0.041) and longer ICU stay (16 [IQR: 10–27] vs. 9 [3–15]; P = 0.024; deceased excluded) than non-ACB. Colistin was used in 23 (41.1%) cases as empiric therapy and 25 (44.6%) as definitive therapy.

**Conclusion.** High resistance rates and worse clinical outcomes were found in VAP cases due to ACB in ICU in Vietnam. Further study is warranted for appropriate treatment and infection control measures.

<table>
<thead>
<tr>
<th>Acinetobacter baumannii</th>
<th>Klebsiella pneumoniae</th>
<th>Pseudomonas aeruginosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meropenem</td>
<td>37 (100)</td>
<td>7 (83.3)</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>37 (100)</td>
<td>11 (100)</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>37 (100)</td>
<td>11 (100)</td>
</tr>
<tr>
<td>Amikacin</td>
<td>35 (84.6)</td>
<td>3 (27.3)</td>
</tr>
<tr>
<td>Colistin</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Approximately 50% of our NB-BAL specimens had evidence of oropharyngeal contamination on quality assessment, including one specimen that failed by standard criteria, but one failed by strict criteria.

PV APs were diagnosed on the basis of NB-BAL specimens. Of these, all were accepted (82%) were purulent (>25 WBC/lpf). Overall, 56 (48%) of samples resulted in significant growth regardless of quality assessment results, which were not revealed to ordering clinicians.

**Conclusion.** Criteria defining Ventilator Associated Events (VAEs) are objective and often available in the electronic health record (EHR) data. The use of ventilation data extracted directly from the patient's bedside monitor to allow for real-time surveillance, however, has not been previously incorporated into electronic surveillance approaches. Here we describe validation of a system that can detect and report on VAEs hospital-wide autonomously and in real-time.

**Methods.** We developed a secure informatics hardware and software platform to identify VAEs autonomously using streaming data. The automated process included 1) archiving and analysis of bedside physiologic monitor data to detect increases in positive end-expiratory pressure (PEEP) or FiO2 settings; 2) real-time querying of EHR data for leukopenia or leukocytosis and concurrent antibiotic initiation; and 3) retrieval and interpretation of microbiology reports for the presence of respiratory pathogens. The algorithm was validated on two 3-month periods in 2015 and 2016 as follows: 1) autonomous surveillance (AS) generated detections of three VAE sub-classes: VAC, IV AC, and PV AP; 2) manual surveillance (MS) by Infection Control (IC) staff independently performed standard surveillance based on chart review, 3) senior IC staff independently performed standard surveillance for cases of AS-MS discordance. The sensitivity (Se), specificity (Sp), and positive predictive value (PPV) of the algorithm are reported.

**Results.** The number of ventilated patients, ventilator days, and events were: 1,591 (9,407)/3,014. In cases with complete data, AS detected 66 VAE events identified by MS; AS-MS identified 66 VAE events detected by MS; no MS-identified events were missed by AS. The Se, Sp and PPV of AS and MS were: 91/100%/100%, and 61%/100%/83%, respectively. Clinical surveillance case reports generated by AS enabled visual interpretation (figure).

**Conclusion.** We developed a surveillance tool directly streaming bedside physiologic monitor and EHR data including ventilator settings, laboratory results, and microbiology reports, to apply the CDC's VAE definitions on source data. This resulted in an accurate, objective, and efficient method for real-time hospital-wide surveillance.

**Disclosures.** All authors: No reported disclosures.

**2151. Real-Time Automated Surveillance for Ventilator Associated Events Using Streaming Electronic Health Data**

Erica S. Shenoy, MD, PhD1,2,3,4; Eric S. Rosenthal, MD1,2; Siddharth Biswal, MS5; Manohar Ghanta, MS1; Erin E. Ryan, MPH, CCRP1; Yu-Ping Shao, MS1; Dolores Suslak, MSN, CIC1; Nancy Swanson, RN, CIC1; Moura Janse Valderly, MS1; MRA1; David C. Hooper, MD1; and M. Brandon Westover, MD, PhD1

Department of Medicine, Division of Infectious Diseases, Massachusetts General Hospital, Boston, Massachusetts, Medical Practice Evaluation Center, Department of Medicine, Massachusetts General Hospital, Boston, Massachusetts, Harvard Medical School, Boston, Massachusetts, Department of Neurology, Massachusetts General Hospital, Boston, Massachusetts, College of Computing, Georgia Institute of Technology, Atlanta, Georgia, Clinical Data Animation Center, Massachusetts General Hospital, Boston, Massachusetts, Division of Infectious Diseases, Massachusetts General Hospital, Boston, Massachusetts

**Session:** 241. HAI: Device-related Infections

Saturday, October 7, 2017: 12:30 PM

**Background.** Criteria defining Ventilator Associated Events (VAEs) are objective and often available in the electronic health record (EHR) data. The use of ventilation data extracted directly from the patient's bedside monitor to allow for real-time surveillance, however, has not been previously incorporated into electronic surveillance approaches. Here we describe validation of a system that can detect and report on VAEs hospital-wide autonomously and in real-time.

**Methods.** We developed a secure informatics hardware and software platform to identify VAEs autonomously using streaming data. The automated process included 1) archiving and analysis of bedside physiologic monitor data to detect increases in positive end-expiratory pressure (PEEP) or FiO2 settings; 2) real-time querying of EHR data for leukopenia or leukocytosis and concurrent antibiotic initiation; and 3) retrieval and interpretation of microbiology reports for the presence of respiratory pathogens. The algorithm was validated on two 3-month periods in 2015 and 2016 as follows: 1) autonomous surveillance (AS) generated detections of three VAE sub-classes: VAC, IV AC, and PV AP; 2) manual surveillance (MS) by Infection Control (IC) staff independently performed standard surveillance based on chart review, 3) senior IC staff independently performed standard surveillance for cases of AS-MS discordance. The sensitivity (Se), specificity (Sp), and positive predictive value (PPV) of the algorithm are reported.

**Results.** The number of ventilated patients, ventilator days, and events were: 1,591 (9,407)/3,014. In cases with complete data, AS detected 66 VAE events identified by MS; AS-MS identified 66 VAE events detected by MS; no MS-identified events were missed by AS. The Se, Sp and PPV of AS and MS were: 91/100%/100%, and 61%/100%/83%, respectively. Clinical surveillance case reports generated by AS enabled visual interpretation (figure).

**Conclusion.** We developed a surveillance tool directly streaming bedside physiologic monitor and EHR data including ventilator settings, laboratory results, and microbiology reports, to apply the CDC's VAE definitions on source data. This resulted in an accurate, objective, and efficient method for real-time hospital-wide surveillance.

**Disclosures.** All authors: No reported disclosures.