CONCISE COMMUNICATION

From VAP to VAE: Implications of the New CDC Definitions on a Burn Intensive Care Unit Population

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Ventilator-associated pneumonia (VAP) is a frequent complication of severe burn injury. Comparing the current ventilator-associated event-possible VAP definition to the pre-2013 VAP definition, we identified considerably fewer VAP cases in our burn ICU. The new definition does not capture many VAP cases that would have been reported using the pre-2013 definition.

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Ventilator-associated pneumonia (VAP) is a frequent complication among acute burn patients. In 2013, the National Health and Safety Network (NHSN) implemented a new adult surveillance algorithm to capture a variety of ventilator-associated events (VAE), including possible VAP cases.[1] This algorithm was intended to enhance the reliability and credibility of the surveillance definition within the critical care and infection prevention communities by capturing more general, objective measures of conditions and complications occurring in patients on mechanical ventilation.[2]

The most notable changes are that (1) radiographic evidence of pneumonia is no longer a criterion for possible VAP cases and (2) that VAE are further defined as ventilator-associated conditions (VAC), infection-related ventilator-associated complications (IVAC), and possible VAP cases. In contrast to the pre-2013 VAP algorithm,[3] a possible VAP case in the new 2013 VAE algorithm must also meet unique VAC and IVAC criteria, such as worsening oxygenation and need for new antibiotic therapy.[1]

Our burn intensive care unit (BICU) patients are often maintained on stable ventilator settings without aggressive weaning until surgeries are completed. Therefore, we hypothesized that VAP incidence would be lower using the new VAE-possible VAP surveillance definitions, and we assessed the effect of the changed definition on our BICU VAP rates.

METHODS

Our institution is an 850-bed tertiary-care facility including a 21-bed ICU for severely ill adult and pediatric patients with burns or extensive exfoliating skin conditions. Surveillance for hospital-associated respiratory infections was prospectively collected over a 4.5-year period (July 2011–December 2015) in accordance with NHSN criteria, and these data were entered into an electronic database. Positive microbiological cultures or nursing notification prompted infection preventionist review of potential cases according to the pre-2013 VAP algorithm, starting with physician-confirmed imaging review or according to the VAE algorithm starting with VAC criteria. From July 2011 to December 2012, the pre-2013 NHSN definition was used to identify VAP cases. From January 2013 to June 2014, the new VAE algorithm was used to identify VAE-possible VAP cases. From July 2014 to December 2015 both definitions were used simultaneously to identify cases. The results are displayed as median and interquartile range (IQR) for continuous variables and counts and percentages for categorical variables. Incidence was calculated as infections/1,000 ventilator days. Denominator data were collected following Centers for Disease Control and Prevention criteria.[4] Using Stata release 13 (StataCorp LP, College Station, Texas), univariate analyses were performed using the Wilcoxon rank sum and Fisher exact tests, and a 2-sided P value $< .05$ was considered significant.

RESULTS

Comparing the new NHSN definition for VAE–possible VAP to the pre-2013 VAP definition, we identified substantially fewer VAP cases with a lower VAP incidence over 2 different time periods (Table 1). Compared to the incidence of 4.47 VAP/1,000 ventilator days during July 2011–December 2012, the incidences of VAE-possible VAP were 1.03 during January 2013–June 2014 and 0.55 during July 2014–December 2015.

Among cases screened from July 2014 to December 2015 that failed to meet the VAE-possible VAP definition by any aspect of the VAE algorithm, our BICU infection preventionist identified 18 VAP cases meeting the pre-2013 criteria resulting in an incidence of 4.96 VAP/1,000 ventilator days. Neither VAE-possible VAP case from this period met the pre-2013 VAP definition. Two patients contributed 2 events during this period.

We did not identify any statistically significant differences between pre-2013 VAP and VAE-possible VAP cases by median age, sex, inhalational injury, days from admission to event, days of hospitalization, or hospital mortality.

DISCUSSION

In 2012, the NHSN reported a pooled mean VAP incidence in BICUs of 4.4 infections/1,000 ventilator days, which was similar to our BICU rate during the same time period.[5] Although VAE reporting is not mandated, 36 BICUs reported data to the NHSN in 2014 with a pooled mean incidence of 6.55 VAE/1,000 ventilator days and a pooled mean incidence of IVACs

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TABLE 1. Impact of the Change in National Health and Safety Network Surveillance Definitions on Burn Intensive Care Unit Ventilator-Associated Pneumonia Events

	Jul 2011–Dec 2012 (18 mo) Pre-2013 VAP	Jan 2013–Jun 2014 (18 mo) VAE-Possible VAP	July 2014–Dec 2015 (18 mo)	
			Pre-2013 VAP	VAE-Possible VAP
Ventilator-associated events, no.	21	5	18	2
Total ventilator days	4,695	4,860	3,632	3,632
Total patient days	11,148	10,968	10,944	10,944
Device utilization ratio, device days/patient days	0.42	0.43	0.33	0.33
Incidence of (P)VAP events/1,000 ventilator days	4.47	1.03	4.96	0.55
Days from admission to event, d, median (IQR)	19 (11–43)	15 (5–36)	6 (4–21)	21.5 (5–38)
Days hospitalized, d, median (IQR)	73 (55–104)	52 (15–66)	71[a] (46–119)	131 (125–137)
Died during hospitalization, no. (%)	9 (43)	1 (20)	5[a] (29)	0 (0)
Age at event, y, median (IQR)	50 (27–60)	36 (34–77)	43[a] (30–64)	61.5 (59–64)
Male, no. (%)	13 (62)	0 (0)	11[a] (65)	2 (100)
Inhalational injury, no. (%)	8 (38)	0 (0)	7[a] (41)	0 (0)
Common organisms recovered, no. (%)[b]				
S. aureus	3 (14)	1 (20)	10 (56)	1 (50)
P. aeruginosa	13 (62)	1 (20)	3 (17)	0 (0)
Enterobacteriacae	7 (33)	1 (20)	6 (33)	1 (50)
A. baumannii	0 (0)	1 (20)	0 (0)	0 (0)

NOTE. IQR, interquartile range; VAP, ventilator-associated pneumonia; VAE, ventilator-associated event.
[a]A single patient contributed 2 events but was counted only once for these analyses.
[b]Percentages may not sum to 100 because >1 bacterial species could be collected from a single event.

(including possible VAP) of 2.93 events/1,000 ventilator days.[6] We found an incidence of VAE-possible VAP cases ranging from 0.6 to 1.0/1,000 ventilator days over a 4.5-year period, which was much lower than our pre-2013 VAP rates. Even though the BICU is our highest risk unit for VAP, we found very few events that met the current VAE-possible VAP definition. Our findings are consistent with other reports suggesting that the new VAE surveillance algorithm has low sensitivity for detecting VAP cases as previously defined and likely identifies only select VAP cases.[7,8]

Arguments supporting a change in the VAP surveillance definition include that screening ventilator settings for VAE would capture a similar set of complications as VAP but may also provide data that could be used to assess the effectiveness of prevention of noninfectious complications of mechanical ventilation.[9] VAE surveillance with automated computer algorithms may be less time-consuming and less subjective than pre-2013 VAP surveillance if the hospital has an electronic medical record system that captures ICU data. Possible and probable VAE reduction strategies have been published, such as conservative fluid management, transfusion thresholds, and minimizing sedation.[9] Theoretically, these strategies would protect patients against mild VAP that do not meet the strict VAE mechanical ventilation and oxygenation parameters as well as severe possible VAP cases, but the effectiveness of these prevention strategies for VAE is not yet clear.

Our infection control department does not yet track VAC and IVAC routinely (1) because the computerized algorithm for this objective measure has not been integrated into our electronic surveillance system, (2) because no specific VAC prevention strategies have been endorsed by the CDC, and (3) because these events are not classified as healthcare-associated infections. Therefore, we cannot comment on the characteristics of VAC or IVAC in our BICU or on what percentage of VAC are attributable to possible VAP. Additionally, we do not yet have an automatic surveillance system for detection of VAC, so we may have missed some VAE-possible VAP cases. Manual surveillance has been shown to be less sensitive than automated surveillance for detection of VAE.[10]

Because these data were collected for infection control purposes, we cannot describe what aspects of the definition change are related to the reduced rate or why the ventilator days were lower during the later period. Low events numbers may have prevented us from detecting differences between groups. The date of event protocol change (from the day all elements were present together to the day the first symptom was present) may have led to more events in 2015 being classified as present on admission rather than as healthcare-associated events; however, this change should have primarily affected pre-2013 VAP cases. Lilly et al[7] and Chang et al[8] both found that not having a period of stability followed by worsening oxygenation was the major reason that most radiographic VAP failed to meet the VAE-probable VAE definition, and we suspect this is also the case in our BICU.

Our results are strengthened by the collection of all events by a single, highly experienced infection preventionist, who strictly followed NHSN surveillance definitions of VAP and VAE-possible VAP without regard for clinical diagnosis of pneumonia. Our VAP bundle has been in effect and consistently implemented in the BICU since 2007, and no additional improvement efforts were implemented over the study periods.

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Finally, during the final 18-month period, we used both definitions simultaneously so that the rates could be directly compared.

In summary, our findings in a busy academic BICU confirm prior reports that the new VAE definition identifies only select cases of VAP and misses many VAP cases that would have been captured with the pre-2013 definition. These findings suggest that this new surveillance definition may miss potentially clinically meaningful events that are important for driving infection prevention efforts.

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