CONCISE COMMUNICATION

Differences in Hospital-Associated Multidrug-Resistant Organisms and *Clostridium difficile* Rates Using 2-Day versus 3-Day Definitions

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We surveyed infection prevention programs in 16 hospitals for hospital-associated methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci, extended-spectrum β-lactamase, and multidrug-resistant *Acinetobacter* acquisition, as well as hospital-associated MRSA bacteremia and *Clostridium difficile* infection based on defining events as occurring >2 days versus >3 days after admission. The former resulted in significantly higher median rates, ranging from 6.76% to 45.07% higher.

Infect Control Hosp Epidemiol 2014;35(11):1417-1420

The Centers for Disease Control and Prevention (CDC) has long-standing guidance that hospital-associated infections (HAIs) usually become evident 48 hours after admission.[1] Based on this guidance, hospitals had built differing definitions to indicate HAIs. We previously reported that an approximately equal proportion of hospitals defined HAIs as (1) onset after 48 hours from admission, (2) onset >2 calendar days after admission, and (3) onset >3 calendar days after admission.[2]

While choice of definition is less important for intrafacility comparisons over time, the national movement toward interfacility benchmarking (eg, state public reporting laws, Centers for Medicare and Medicaid Services Hospital Inpatient Quality Reporting) can make comparisons problematic when data are collected in different ways. Furthermore, since hospital lengths of stay are, on average, 4.8 days, the inclusion of an additional day for hospital-associated event surveillance can substantially affects rates.[3]

In January 2013, CDC redefined hospital-associated events as having an onset of >2 calendar days from admission for all HAI modules (except the multidrug-resistant organisms [MDROs] laboratory module, which adds to the confusion by using a more conservative definition of >3 calendar days since it relies solely on microbiology data).[4] It would be valuable to understand the magnitude of effect that this change in surveillance may have on hospital rates. We therefore performed a multicenter evaluation to quantify the impact of using a >2-calendar-day versus a >3-calendar-day rule to define MDRO acquisition and MDRO and *Clostridium difficile* infection.

METHODS

A prospective survey of hospital-associated acquisition of MDRO carriage, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), extended-spectrum β-lactamase (ESBL) *Klebsiella* and *Escherichiacoli*, and multidrug-resistant (MDR) *Acinetobacter*, as well as hospital-associated MRSA bacteremia and *C. difficile* infection (CDI) events was completed by infection prevention programs at Orange County, California, hospitals. Respondents provided 2 sets of monthly numbers of acquisition and infection events from January to December 2010, one using a >2-calendar-day case-finding rule and the other using a >3-calendar-day case-finding rule. MDRO acquisition events were any clinical or screening test that occurred >2 days or >3 days from admission and represented the first isolation of the MDRO known to that hospital. Bacteremia or CDI events were events that began >2 days or >3 days from admission but did not have to be the first event known to that hospital. These rates were calculated based on total patient-day denominators and compared using the paired sample Wilcoxon signed-rank test for nonparametric data.

In addition, because accurate incidence rates should use at-risk patient-day denominators rather than total patient-day denominators, rates were also calculated using at-risk days. For example, for each event requiring a >2-calendar-day definition, the first 2 patient-days of each admission were removed from the denominator when calculating at-risk days. All denominators were derived from the 2010 mandatory state discharge data set.[5] Differences in median rates when using total versus at-risk patient-days were also assessed using Wilcoxon signed-rank tests.

RESULTS

Sixteen of 31 countywide hospitals participated, representing a total of 1,062,242 patient-days. Across acquisition and infection events, we found that the >2-day hospital-associated definition resulted in rates significantly higher (median 15.33%, range 6.76%–45.07%) than rates using a >3-day definition (Table 1).

When comparing total to at-risk patient-day denominators for acquisition and infection outcomes, rates using at-risk denominators were significantly higher (Figure 1). When defining hospital-associated events based on a >2-day definition, we found that median rates using at-risk denominators were significantly higher by 78.94% for hospital-associated MRSA

https://doi.org/10.1086/678423 Published online by Cambridge University Press

TABLE 1. Impact of Using >2-Day versus >3-Day Case Finding Definitions for Hospital-Associated Acquisition and Infection Events

Pathogen	Median hospital-associated rate using >2-day definition (events/10,000 total patient-days)	Median hospital-associated rate using >3-day definition (events/10,000 total patient-days)	Wilcoxon signed-rank test *P* value	Increase in median rate when using >2-day versus >3-day definition, %
Acquisition				
MRSA	7.16	5.21	.001	27.21
VRE[a]	2.24	2.01	.016	10.53
ESBL[b]	0.54	0.50	.001	6.76
MDR *Acinetobacter*	0.87	0.80	.078	8.96
Infection				
MRSA bacteremia	0.30	0.17	.031	45.07
Clostridium difficile infection	6.00	4.79	.001	20.14

NOTE. ESBL, extended-spectrum β-lactamase; MDR, multidrug resistant; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

[a] Data from 15 hospitals; other data from 16 hospitals.

[b] ESBL is *Klebsiella* and *Escherichia coli* combined.

($P < .001$), 73.01% for hospital-associated VRE ($P < .001$), 69.12% for hospital-associated ESBL ($P < .001$), 75.08% for hospital-associated MDR *Acinetobacter* ($P < .001$), 69.21% for hospital-associated MRSA bacteremia ($P = .002$), and 61.90% for CDI ($P < .001$). Similarly, when defining hospital-associated events based on a >3-day definition, we found that rates using at-risk denominators were significantly higher by 134.80% for hospital-associated MRSA ($P < .001$), 149.00% for hospital-associated VRE ($P < .001$), 135.79% for hospital-associated ESBL ($P < .001$), 133.23% for hospital-associated MDR *Acinetobacter* ($P < .001$), 133.87% for hospital-associated MRSA bacteremia ($P = .008$), and 124.78% for CDI ($P < .001$).

Although case finding (numerators) were greater when >2-day versus >3-day definitions were used, median rates were significantly higher for some outcomes with the >2-day versus >3-day definition when using at-risk denominators for VRE (28.78%, $P < .001$), ESBL (30.00%, $P < .001$), MDR *Acinetobacter* (21.27%, $P = .013$), and CDI (10.87%, $P = .009$). MRSA acquisition and MRSA bacteremia rates were found to be lower but not statistically significant.

Although hospitals provided case findings using both >2-day and >3-day definitions, when asked which definition they routinely employed in their infection prevention program, 4 (22%) reported using the >48-hour definition, 10 (56%) used the >2-day definition, and the remaining 4 (22%) used the >3-day definition for identifying HAIs. The number of hospitals that used the >2-day definition increased from 30% reported in 2007–2008[2] to 56%.

DISCUSSION

The CDC's new explicit definition in 2013 to use a >2-day rule for identifying hospital-associated events is a positive step toward standardization. It will shift surveillance rates for many hospitals that were using other definitions based on CDC's prior guidance that most hospital-associated events occur after 48 hours. For hospitals that were defining hospital-associated events as >48 hours, or >3 calendar days from admission, we show this new definition will result in potentially large changes to their surveillance rates.

We found that the impact of changing from a >3-day rule to a >2-day rule was substantial, resulting in significant increases in MDRO acquisition and infection, including increases as high as 45% for hospital-associated MRSA bacteremia when using total patient-days as a denominator. Given the sizeable proportion of hospitals that were not previously using the >2-day rule (45% in this 2010 cohort), verification of adoption may be necessary for valid interhospital comparisons. In addition, the magnitude of difference suggests that comparisons made prior to the uniform implementation of this definition may unfairly disadvantage hospitals that were using the >2-day definition. It is notable that many US hospitals have a mean length of stay of only 3 days, meaning that using an event definition of >3 days excludes capture of any HAI events in the majority of patients.

Although not currently used for national surveillance, we evaluated the impact on acquisition and infection rates of using the more accurate but more time-consuming at-risk patient-day denominators.[6] We identified two important findings. First, use of at-risk versus total patient-day denominators for the >2-day case finding rule would uniformly increase rates by approximately 70%, suggesting that the proxy measure of total patient-days may be misleading. Second, when using at-risk days, use of the >2-day case finding rule often led to significantly lower rates compared to the >3-day case finding rule, suggesting a substantial effect related to the removal of an additional hospital-day from the denominator and evidence that risk of infection increases as hospitalization continues for certain outcomes. The substantial impact of using at-risk denominators versus total denominators has

https://doi.org/10.1086/678423 Published online by Cambridge University Press

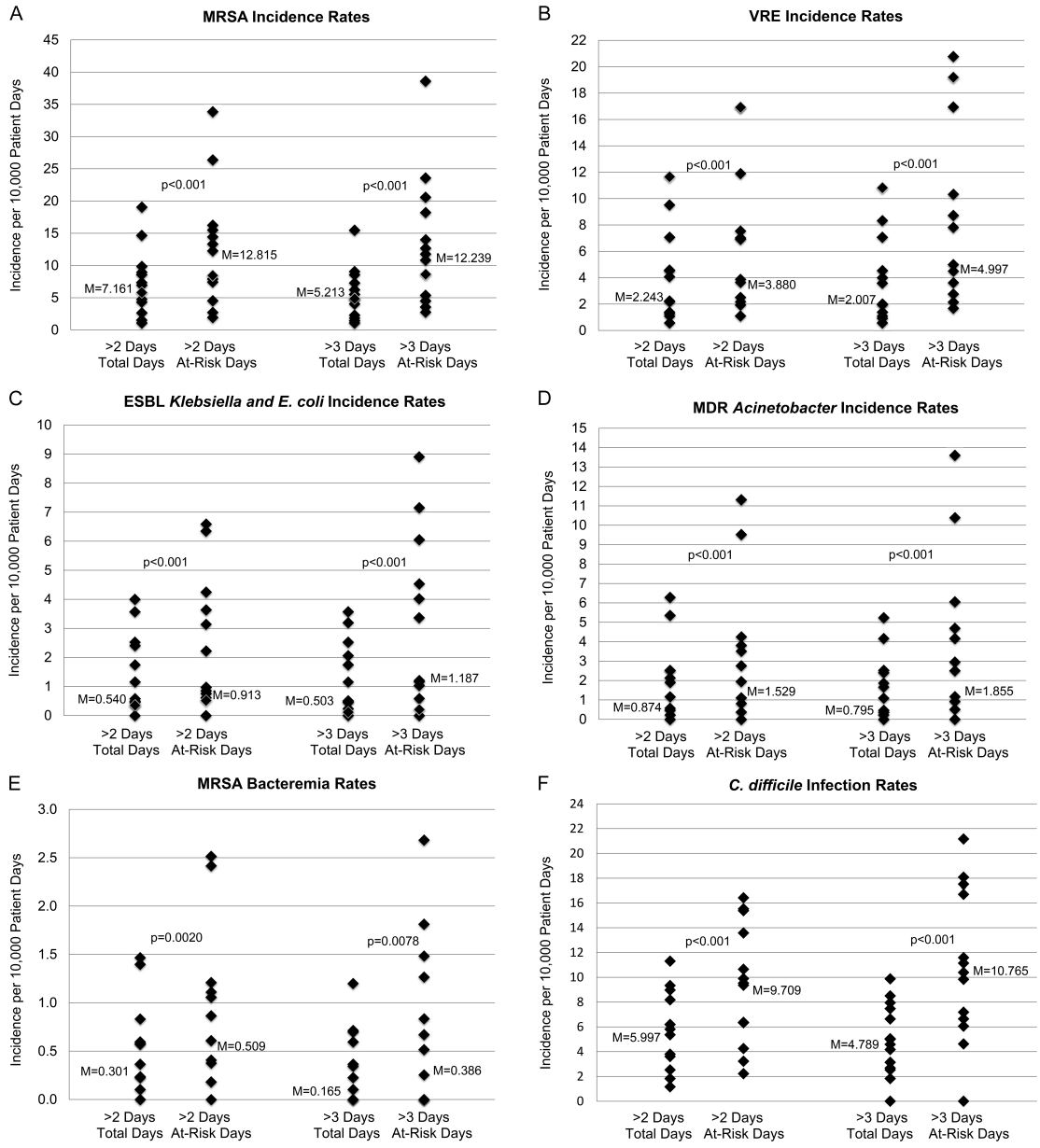


FIGURE 1. Comparison of hospital-associated incidence rates in 16 Orange County, California, hospitals when using total patient-days versus at-risk patient-days as denominators for methicillin-resistant *Staphylococcus aureus* (MRSA) acquisition (*A*), vancomycin-resistant enterococci (VRE) acquisition (*B*; data for 15 hospitals), extended-spectrum β-lactamase (ESBL) acquisition (*Escherichia coli* and *Klebsiella* sp.; *C*), multidrug-resistant (MDR) *Acinetobacter* acquisition (*D*), MRSA bacteremia (*E*), and *Clostridium difficile* infection (*F*).

been previously shown by us and others when evaluating MDROs and *C. difficile* in other contexts.[6-9]

This study is limited by the sampling of only 16 hospitals from a single metropolitan county. Additionally, all events were self-reported without additional validation, although this is consistent with current HAI reporting to CDC. Nevertheless, there is a large impact in the magnitude of infection rates when changing the definition of how long a patient must be hospitalized before being eligible to have an HAI, and interfacility comparison of HAI rates should be made with caution until uniform definition of such eligibility can be verified.

ACKNOWLEDGMENTS

We especially recognize and thank the infection control and prevention programs at all of the participating hospitals for their participation in this project: Coastal Communities Hospital, Fountain Valley Regional Hospital and Medical Center, Garden Grove Hospital Medical Center, Hoag Hospital Newport

https://doi.org/10.1086/678423 Published online by Cambridge University Press

Beach, Kaiser Orange County–Anaheim Medical Center, Kaiser Orange County–Irvine Medical Center, Los Alamitos Medical Center, La Palma Intercommunity Hospital, Mission Hospital, Orange Coast Memorial Medical Center, Placentia Linda Hospital, Saddleback Memorial Medical Center–Laguna Hills, Saddleback Memorial Medical Center–San Clemente, St. Joseph Hospital of Orange, St. Jude Medical Center, and University of California–Irvine Health.

Financial support. Financial support was provided by the Department of Medicine at the University of California–Irvine Health.

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

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Received April 16, 2014; accepted July 15, 2014; electronically published October 8, 2014.

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