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Concise Communication

Lack of correlation between standardized antimicrobial administration ratios (SAARs) and healthcare-facility–onset *Clostridioides difficile* infection rates in Veterans Affairs medical facilities

Martin E. Evans MD[1,2,3], Makoto M. Jones MD[6,7], Kelly W. Davis PharmD[2], Matthew T. Lane PharmD[2], Loretta A. Simbartl MS[1], Brian P. McCauley DPM[1], Natalie Gauldin RN[1] and Gary A. Roselle MD[1,4,5]

[1]National Infectious Diseases Service, Specialty Care Services, Veterans Health Administration, US Department of Veterans Affairs, Washington, DC, [2]Lexington Veterans Affairs Healthcare System, Lexington, Kentucky, [3]Division of Infectious Diseases, Department of Internal Medicine, University of Kentucky School of Medicine, Lexington, Kentucky, [4]Cincinnati Veterans Affairs Healthcare System, Cincinnati, Ohio, [5]Division of Infectious Diseases, Department of Internal Medicine, University of Cincinnati School of Medicine, Cincinnati, Ohio, [6]VA Salt Lake City Health Care System, Salt Lake City, Utah and [7]Division of Epidemiology, Department of Internal Medicine, University of Utah School of Medicine, Salt Lake City, Utah

Abstract

We detected no correlation between standardized antimicrobial administration ratios (SAARs) and healthcare facility-onset *Clostridioides difficile* infection (HO-CDI) rates in 102 acute-care Veterans Affairs medical centers over 16 months. SAARs may be useful for investigating trends in local antimicrobial use, but no ratio threshold demarcated HO-CDI risk.

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Judicious use of antimicrobials has been associated with decreases in the incidence of healthcare facility-onset *Clostridioides difficile* infection (HO-CDI).[1] The National Healthcare Safety Network (NHSN) developed an Antimicrobial Use and Resistance (AUR) module with an option focused on antimicrobial use (AU).[2] The primary objective of this option is to facilitate risk-adjusted inter- and intrafacility antimicrobial-use benchmarking. A secondary objective is to evaluate antimicrobial use trends at the facility and national levels.

Antimicrobials in the AU option are grouped into 7 categories, one of which is "adult antibacterial agents posing the highest risk for CDI." This category includes several third- and fourth-generation cephalosporins, fluoroquinolones, and clindamycin.

Standardized antimicrobial administration ratios (SAARs) are calculated for the AU module to help facilities monitor their use of these agents. The NHSN calculates the SAAR by dividing the number of observed antimicrobial days of therapy (DOT) by the number of predicted DOT. Predicted DOT are calculated by risk-adjusting for location- and facility-level factors that are statistically significantly associated with differences in AU rates among the SAAR referent population. The referent population comes from nationally aggregated patient-care location-level AU data reported to NHSN during the baseline period. A SAAR >1 suggests that antimicrobial use is higher than comparator facilities, whereas a ratio <1 suggests that use is lower. Keeping the ratio at ≤1 could, in theory, lead to lower drug costs and fewer HO-CDIs because there is a correlation between drug use and CDI rates.[1]

To our knowledge, however, little data exist validating whether a SAAR >1 or <1 correlates with increased or decreased HO-CDI rates, respectively. A good correlation might be useful in managing increased facility HO-CDI rates if a ratio <1 suggests that antimicrobials are not the primary driver of the increased rate and that other factors might be of more importance.

The "adult antibacterial agents posing the highest risk for CDI" may be the best of the 7 AU categories to assess the clinical value of SAARs because there is clear pathophysiological theory underlying the interplay between antimicrobial use, its effect on the normal gut microbiome, and the ascendency of *C. difficile* with toxin production and disease. This theory has been supported by studies documenting a link between increased antimicrobial use and increased HO-CDI rates.[1]

The VHA has reported nationwide facility SAARs to the NHSN AU option since 2014 and has reported HO-CDI cases to the VA Inpatient Evaluation Center (IPEC) since 2012. As of January 2019, all VA facilities have been mandated by the Department of Veterans Affairs to have an antimicrobial stewardship program.[3]

In this work, we sought to determine whether there was a correlation between SAARs for CDI-specific antimicrobials and HO-CDI rates in acute-care VA facilities. A good correlation might be of value for the prevention and control of HO-CDI.

Author for correspondence: Martin E. Evans, E-mail: martin.evans@va.gov
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Methods

All VA facility-wide inpatient data (NHSN location designation FacWideIN) submitted monthly from January 2021 through April 2022 to NHSN for the SAAR "adult antibacterial agents posing the highest risk for CDI" category were analyzed. Antimicrobials in this category included cefdinir, cefepime, cefixime, cefotaxime, cefpodoxime, ceftazidime, ceftriaxone, ciprofloxacin, clindamycin, gemifloxacin, levofloxacin, and moxifloxacin. The data set was curated to eliminate facility months where data were missing. Monthly facility-level acute care HO-CDI rates (cases per 10,000 patient days) were obtained from IPEC for the same facility-months where SAARs were available. During the analysis period, VA HO-CDI definitions followed those of NHSN.[4]

Trends over time were examined by linear regression and the relationship between monthly SAARs and HO-CDI rates was examined using the Spearman nonparametric rank correlation test (SAS Institute, Cary, NC) because the data were not normally distributed. The Spearman correlation coefficient (r_s) ranges from −1 to 1. A positive r_s means that one variable increases with the other variable, while a negative r_s indicates the opposite. A r_s of zero indicates that there is no tendency for one variable to change with respect to the other. $P < .05$ was considered significant.

This research was conducted under the University of Cincinnati Institutional Review Board (submission no. 2016-9502), which determined that the analysis of deidentified national VA operational data is a quality improvement–quality assurance activity and does not meet regulatory criteria for research involving human subjects.

Results

There were 1,159 HO-CDIs (range, 0–11 cases per facility per month) and 1,435 monthly SAARs from 102 unique acute-care facilities during the 16-month analysis period (Table 1). Notably, the VA HO-CDI rate was similar to that reported by the NHSN.[5] We did not find a trend in SAARs or HO-CDI rates over the analysis period ($P > .05$). The correlation between the monthly facility HO-CDI rate and the corresponding SAAR during this period was not significant ($r_s = 0.03$; $P = .21$).

Table 1. Summary Statistics for Standardized Antimicrobial Administration Ratios (SAARs) and Healthcare-Facility–Onset *Clostridioides difficile* Infections (HO-CDIs) per 10,000 Patient Days during 1,435 Facility Months in 102 Veterans Affairs Acute-Care Facilities, January 2021–April 2022.

Variable	Mean	Standard Deviation	Median	Range
SAAR	1.03	0.34	1.01	0–2.23
HO-CDI rate	3.83	6.09	0	0–72.46

Discussion

In our analysis, we did not find a significant correlation between monthly CDI SAARs and HO-CDI rates in acute-care VA medical facilities. This analysis was restricted to the NHSN CDI AU category because there is a plausible pathophysiological link between antibiotic use and *C. difficile* infection. Other AU categories such as "broad-spectrum antibacterial agents predominantly used for hospital-onset infection" or "antibacterial agents predominantly used for resistant Gram-positive infections (eg, MRSA)" were not evaluated, although links between antimicrobial use and the emergence of resistance in gram-negative and -positive pathogens have been shown.[6,7] Although positive associations between antibiotic use measured in DOT per 1,000 patient days and HO-CDI rates have been reported,[1] a significant correlation between SAARs and HO-CDI rates was not seen with VA data perhaps because of insufficient specification of the SAAR model or a lack of power. Others have shown that adding additional factors such as patient comorbidities and bacterial infection diagnoses instead of only adjusting for facility characteristics and patient care location improved the NHSN SAAR models for predicting inpatient antibiotic utilization.[8]

The incidence of HO-CDI cases in a facility is likely dependent on multiple factors in addition to antimicrobial use. These include the admission of asymptomatic carriers, promptness of isolation of patients with diarrhea, healthcare worker compliance with hand hygiene and transmission-based precautions, the type of diagnostic testing done by the laboratory, and the efficiency of cleaning by environmental management staff among others.[9] Thus, it is difficult to parse out the impact of antimicrobial use alone on HO-CDI rates.

In 2023, the Joint Commission will require all accredited hospitals to track antimicrobial use with one option being to report to the NHSN Antimicrobial Use and Resistance Module.[10] Although SAARs are designed for tracking antimicrobial use within a facility and for comparison with similar institutions, it is unclear how these data will be used. Unlike a standardized infection ratio (SIR) where the goal is zero (ie, no healthcare-associated infections), to our knowledge there is no CDI SAAR below which there are fewer or no HO-CDI cases. Having a CDI SAAR <1 does not necessarily exonerate antimicrobials as a potential driver of increased HO-CDI rates within a facility.

Rather than absolute values, CDI SAARs might be best used for monitoring local trends in antibiotic use. These data may make it easier for pharmacists and infection prevention and control professionals to assess one of the factors potentially responsible for increased HO-CDI rates.

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