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RE: Preventability of hospital onset bacteremia and fungemia: A pilot study of potential healthcare-associated infection outcome measure, by Dantes et al (2019)

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To the Editor—We read with great interest the article by Dantes et al¹ on the preventability of hospital-onset bacteremias (HOBs) and the use of this metric as a quality outcome measure. In 2017, we also reported a retrospective analysis of the impact of quality improvement efforts on overall intensive care unit (ICU) HOBs over the course of 10 years at an academic medical center, during a period when the institution developed a virtual critical care department that utilized telemedicine technology and concurrently developed, implemented, and iteratively adapted multiple clinical practice guidelines across the ICUs of an academic medical center.^{2–4}

In our study, which examined a total of 835 bacteremias across 7 ICUs, we observed a progressive and sustained 82.8% decrease in total annual bloodstream infections (BSIs), including an 85.0% decrease in primary BSIs and 81.4% decrease in secondary BSIs.² Our analysis by pathogen also detected significant decreases in BSI rates for all pathogens, particularly highest for non-*S. aureus* staphylococci (0.300-fold per year) and *Staphylococcus aureus* (0.191-fold). Decreases in BSI rates were significant across all ICUs, with the exception of the cardiac surgery and coronary care unit. Potential confounders of decreased number of blood cultures drawn, length of ICU stay, APACHE IV scores, glucose levels, vital status, and number of stays were controlled for during regression analysis, and our results remained highly significant following this adjustment.

Thus, our findings indicate that institutions can prevent and markedly reduce the incidence of HOBs, at least in the ICU setting. Moreover, BSIs represent a relatively objective end point where the primary identified limitations have been concerns with appropriate identification of blood culture contaminants and infections that arise from mucosal barrier injury.^{5,6} This focus

contrasts with other hospital-acquired infection metrics such as catheter associated urinary tract infections, ventilator associated events, *Clostridioides difficile* infection, and central-line associated bloodstream infections, where multiple definition issues have been identified that can lead to both inaccurate estimations of infection rates and can potentially promote efforts to “game the system.”^{7,8}

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Innovative methods to summarize nursing home antibiotic data

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To the Editor—Kabbani *et al*¹ published an interesting report on the utility of pharmacy dispensing data to measure antibiotic days of therapy (DOT) and antibiotic starts in nursing homes. Their data analysis was limited by a lack of resident identifiers, which led to a reliance on the number of antibiotic transactions as a proxy for starts. The authors state that this is likely an overestimate because antibiotic courses in nursing homes are often dispensed incrementally. As part of a 5-year, quality improvement study conducted in several nursing homes in Rochester, New York, we developed a methodology for calculating antibiotic starts, inferring missing data and providing data feedback to help nursing homes monitor their antibiotic use over time. The primary goals of the project were to reduce *C. difficile* infections (CDI) and to implement antibiotic stewardship programs (ASPs) via a hospital–nursing home partnership.

We worked with pharmacists at 7 in-house and commercial dispensing pharmacies to obtain antibiotic data that included (1) drug name (2) date and quantity dispensed (3) directions for use (4) duration (5) resident location and unique identifier, and (6) ordering provider. In some cases, obtaining the data required sending the pharmacy a template spreadsheet to illustrate the data needed and/or having a conversation with the pharmacist to discuss the importance of the requested data elements. Data were often received on paper or in a format that was not conducive to manipulation so extensive manual data entry was conducted. We also performed substantial data cleaning to remove topical, ophthalmic, and otic agents; antivirals and antifungals; antibiotics given for noninfectious reasons (eg, gastroparesis); and prescriptions for emergency-box replacement. Drug names were standardized using their generic equivalents; indications were categorized into common syndromes including urinary tract and lower respiratory infections. Time variables (year, quarter, and month) were added to track data over time. If not included in the original data, DOT, defined as the aggregated days a resident received an antibiotic, was calculated manually using the quantity dispensed and directions for use. Using SAS version 9.3 software (SAS Institute, Cary NC), we collapsed observations of the same antibiotic prescribed to the same resident within 4 days of the preceding prescription to calculate antibiotic starts and

duration and to infer the indication if it had not been carried over from the original observation.

From these data, we generated several measures of antibiotic use including (1) total DOT rate; (2) DOT rate by the most common antibiotics and indications; (3) DOT rate by the number of residents and unit; (4) antibiotic starts; and (5) length of treatment. Each metric has several pros and cons.^{1,2} The specific summary measures we found useful are summarized in Table 1. In our experience, nursing homes are most familiar with antibiotic starts and number of residents treated. Although the DOT rate is useful to monitor the facility-wide antibiotic burden, it is a less tangible measure and can be easily skewed by residents on chronic, prophylactic antibiotics.² Other metrics that we found to be especially valuable to nursing homes are usage by unit to account for differences in resident populations and comparative DOT rates from long-term care units across several nursing homes to encourage friendly competition. We created a data dashboard to summarize these metrics and shared the dashboard with nursing home ASP teams at face-to-face, quarterly meetings. During these meetings, we also provided coaching on how to interpret the data and make it actionable. Examples of nursing home interventions based on the summarized antibiotic data include (1) determining where documentation breakdowns occurred in a nursing home with a large number of prescriptions missing indication; (2) monitoring drug selection, specifically fluoroquinolone use to reduce CDI risk^{3,4} for common infections such as urinary tract infections; and (3) comparing length of treatment to treatment durations suggested by established guidelines.⁵

The main limitation of our analysis was the inability to verify that dispensed antibiotics were actually administered. However, in our experience, dispensing data are sufficient to guide nursing homes in the development of ASP interventions. Unlike the limitations faced by Kabbani *et al*,¹ collaboration with dispensing pharmacists allowed us to obtain data that included fields like resident identifier and location as well as antibiotic indication, allowing for more robust analyses. The in-depth evaluation of nursing home antibiotic data that we conducted was made possible by our hospital-based team's expertise in stewardship and infectious diseases and our dedicated time to clean and summarize the data. We believe that it is important to share the lessons we have learned from this process because visualizing trends in a nursing home's antibiotic data is the best way to identify areas for improvement and monitor progress over time. However, our methodology may not be possible for nursing home staff that have competing priorities and fewer resources. Therefore, we created a tool in collaboration with the Atlantic Quality Innovation Network/IPRO to help nursing homes monitor their antibiotic use. The tool requires manual data entry but automatically summarizes data by

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