LETTERS TO THE EDITOR

Targeting Hospitals for Antimicrobial Stewardship

To the Editor—We are writing to commend Gerber et al[1] on their recent article, "Identifying Targets for Antimicrobial Stewardship in Children's Hospitals" and their description of variation in antibiotic use in 32 children's hospitals. In our article, recently published in PLoS ONE, we reported variation in the use of a single antibiotic, vancomycin, across 421 hospitals.[2] Our conclusion, "Presently, the message to reduce vancomycin use is broadcast to the entire healthcare community. General principles of judicious antibiotic use are applicable to all hospitals and providers for all antibiotics, and these data may be used to channel intensive stewardship activities and intervention research data to hospitals with the highest volume and prevalence of vancomycin use,"[2(p6)] is in accord with that of Gerber et al[1(p1252)] regarding "high-impact targets for future antimicrobial stewardship intervention."

This avenue of data analysis has great public health potential, but several methodological issues need to be fine tuned to develop sensitive and specific indicators of excessive variation. Three issues immediately come to mind. The first issue is that of selecting samples of hospitals that best permit inferences to the widest number of hospitals in the United States. The results reported by Gerber et al[1] were derived from analysis of data from 32 children's hospitals, in contrast to our study, which analyzed data from 421 hospitals, including both children's hospitals and nonchildren's hospitals. Until we have greater understanding of the causes of variation in antibiotic use, it is prudent to include as many hospitals as possible. Our study did not find hospital characteristics, such as bed size or teaching status, to be correlated with vancomycin use, and it is thus not possible, at this time, to exclude any group of hospitals from this type of analysis. Researchers at children's hospitals may share a somewhat more homogeneous treatment philosophy compared with that of researchers at nonchildren's hospitals (although this has not been documented), and this might make the focus on those hospitals valuable for their purposes, whereas characterizing a wider net of hospitals that treat pediatric patients, as we did, may have different utility. Depending on the desired generalizability of the results and the targeted audience, both approaches may have merit.

The second issue is that of evaluating and understanding measures of medication use. Although it is well accepted to use measures of days of use, our analysis explored measurement of proportions of patients ever receiving vancomycin. Gerber et al[1] conducted 3 analyses using 3 measures of antibiotic use. They categorized patients dichotomously (ever vs never receiving antibiotics during their hospital stay), length of therapy (total number of days of any antibiotic therapy), and days of therapy (aggregate sum of length of therapy for each antibiotic therapy). It is not clear from their analysis which metric or combination of metrics is best suited to target institutions for increased stewardship efforts. Additional statistical analyses are needed to evaluate the insights resulting from each measure and their validity in identifying hospitals in need of targeted antimicrobial stewardship. It is also important to distinguish between metrics of excessive use (use not justified by the medical condition of the patient) and use that increases the probability that resistance will develop. Although there is considerable overlap between them, they are not the same thing. Gerber et al[1] explored the metric of days of therapy, because they believe that it represents "the absolute volume of antibiotic pressure," but the pharmacokinetic and pharmacodynamic evidence points to the need for additional research to establish the dosing features that will optimally minimize selection of antibiotic resistance.[3,4] With the growing availability of large databases and the increasing sophistication of analytic techniques, it should be possible to develop indicators that are valid and useful for hospitals throughout the United States. This requires funding and dedicated resources to map out methodologic challenges and a strategy for addressing these challenges.

The third issue is the great value of stratifying hospital populations by disease groups, procedures, and other factors. Gerber et al[1] identified 4 conditions associated with high levels of antibiotic use, pneumonia, appendicitis, cystic fibrosis, and skin and soft-tissue infections, and they reported wide treatment variability in 3 of the 4 conditions. This is an intriguing finding and would need to be considered in any metric used to target antimicrobial stewardship programs. A hospital may need to increase its stewardship for one group of patients but not need to increase its stewardship for a different group of patients. In our study, we stratified patients by disease groups and by ages (under 1 year of age vs 1 year of age and older). Again, this requires systematic and careful statistical modeling to produce the most useful metrics.

The key finding, that variation exists and that antimicrobial stewardship efforts need to be tailored accordingly, is fundamental to a wise and effective use of resources. We applaud the efforts by Gerber et al[1] and welcome increased efforts in this direction.

ACKNOWLEDGMENTS

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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Infect Control Hosp Epidemiol 2014;35(5):595-596

 0899-823X/2014/3505-0023$15.00. DOI: 10.1086/675841

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Factors Associated with Head-of-Bed Elevation Compliance for Prevention of Ventilator-Associated Pneumonia

To the Editor—Ventilator-associated pneumonia (VAP), a complication that is associated with significant morbidity and mortality, can develop in patients undergoing prolonged mechanical ventilation.[1-3] To avoid this complication among mechanically ventilated patients, the Institute for Healthcare Improvement developed a bundle care document for the prevention of VAP in 2004.[4] Elevation of the head of the bed (HOB) is one of the major components of the ventilator bundles.[4] However, the study about the factors associated with HOB elevation compliance is limited,[5] so this study was conducted to investigate the factors associated with HOB elevation compliance among critical care nurses.

This study was carried out at a regional teaching hospital that has 63 adult intensive care unit (ICU) beds and 20 subacute respiratory care center (RCC) beds.[6] Compliance was defined as the frequency of the number of performed actions compared to the number of HOB elevation opportunities. Observation of HOB elevation compliance was carried out by trained critical care nurses, and observers were required to reach 85% concordance with researchers before performing practice observation. Between October 1 and October 14, 2013, compliance with HOB elevation among critical care nurses was observed. Ethics approval was obtained from the Institution Review Board of Chi Mei Medical Center.

Categorical variables were compared using the χ^2 test. All significant variables with a P value of $\leq .05$ in the univariate analysis were considered for inclusion in the logistic regression model for the multivariate analysis. All statistical analyses were conducted using the statistical package SPSS for Windows (ver 19.0), and a P value of $<.05$ was considered to show statistical significance.

During the study period, 759 HOB elevation opportunities were observed, with overall compliance of 19.2%. The factors that may impact the HOB elevation compliance are shown in Table 1. Subgroups involving age 30 years and older, senior registered nurse (RN), and RCC stay had significantly higher HOB elevation compliance than those with age less than 30 years, junior RN, and ICU stay, respectively (all $P < .05$). Further multivariate analysis showed that ranking of RN and location were independently significantly associated with HOB elevation compliance.

Among this 2-week observational study of 759 HOB elevation opportunities, the overall HOB elevation compliance was as low as 19.2% among critical care nurses, while performance was lower than 27.8% in the previous study.[5] A recent investigation by Liu et al[5] showed that nursing workload and lack of knowledge of VAP were the most important factors for nonadherence with the HOB goal, by questionnaire survey. We found that the adherence to HOB elevation varied substantially according to individual nurses' characteristics and the site of clinical service by this observation study. This finding demonstrates that HOB elevation compliance is higher among critical care nurses with higher ability.

In conclusion, despite elevation of HOB being a relatively simple procedure while caring for the patient with a mechanical ventilator, the variability of HOB compliance can be observed among individual nurses. A plan to effectively enhance overall performance in HOB compliance should be based on the surveillance study to find the specific groups with lower compliance and then to target these groups to improve.

ACKNOWLEDGMENTS

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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