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Brief Report

Central line infections in United States hospitals: An exploration of variation in central line device days and infection rates across hospitals that serve highly complex patient populations

Jennifer L. Hefner PhD, MPH [a,b,c,*], Naleef Fareed PhD, MBA [c,d], Daniel M. Walker PhD, MPH [b,c], Timothy R. Huerta PhD [a,b,c,d], Ann Scheck McAlearney ScD, MS [a,b,c,d]

[a] Division of Health Services Management and Policy, The College of Public Health, The Ohio State University, Columbus, OH
[b] Department of Family Medicine, College of Medicine, The Ohio State University, Columbus, OH
[c] Center for the Advancement of Team Science, Analytics, and Systems Thinking, College of Medicine, The Ohio State University, Columbus, OH
[d] Department of Biomedical Informatics, College of Medicine, The Ohio State University, Columbus, OH

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Our descriptive analyses show a wide distribution in rates of central line device days and central line–associated bloodstream infections for a given standardized infection ratio—the measure linked to federal payment penalties—among 215 US hospitals serving highly complex patient populations. We established that the standardized infection ratio masks hospital-level variation in device use and associated patient safety.

US hospitals have made great strides in reducing the incidence of central line–associated bloodstream infections (CLABSIs). Between 2008 and 2015, there was a 50% reduction in the national CLABSI rate,[1] which can be linked to the Centers for Medicare and Medicaid Services (CMS) reimbursement penalties that spurred routine hospital-wide surveillance and standardized clinical processes.[2] Despite this success, the Centers for Disease Control and Prevention (CDC) has noted that there is a need for further improvement, and they have set a goal to reduce the national CLABSI rate by an additional 50% by 2020.[1]

The CMS penalties that have driven CLABSI reductions are calculated based on the standardized infection ratio (SIR)—defined as the number of observed infections for the hospital divided by the number of predicted infections—and adjusted for both the number of central line device days that a hospital reports and the hospital's structural characteristics (eg, bed size, number of intensive care unit [ICU] beds, and status as a teaching hospital).[3] However, using central line days to adjust risk, the SIR can mask success for hospitals that are able to reduce both the use of central lines as well as the number of CLABSIs.[4,5] Based on current SIR calculation methods, a hospital that reports a higher number of central line device days and CLABSIs can have the same SIR as a hospital reporting fewer device days and infections,[4–6] but this relationship has yet to be empirically studied using a national dataset. The goal of this study was to describe the relationship between the SIR and the variation in device days and CLABSI rates among US hospitals with similar characteristics; specifically, a subgroup of hospitals that treat highly complex patients while serving as a safety net in their community.[7,8]

METHODS

Data, variables, and study sample

This study used the CMS Hospital Compare 2016 infection data from US hospitals, including CLABSI SIRs, predicted and actual numbers of CLABSIs, and the number of central line device days. Using Medicare identification numbers, this primary data set was merged with the FY2016 CMS Impact File and the FY2015 CMS Healthcare Cost Report Information System File in order to obtain hospital characteristics.

To identify our analytical sample, we operationalized a variable for hospitals serving highly complex patient populations (i.e., *highly complex hospitals)* as those with both hospital patient case-mix index and percent share of Medicaid Disproportionate Share Hospital payments in the top quartile of US hospitals.[8]

* Address correspondence to Jennifer L. Hefner, PhD, MPH, Division of Health Services Management and Policy, The College of Public Health, The Ohio State University, 1841 Neil Ave, Columbus, OH 43210.
E-mail address: Jennifer.Hefner@osumc.edu (J.L. Hefner).
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Analysis

Descriptive statistics were calculated for the analytical sample. We generated scatter plots to visualize the distribution of hospitals across the central line use and infection rate variables. Additionally, we verified that the hospitals in the analytical sample were similar in regard to the characteristics included in the SIR predictive model.

RESULTS

Table 1 presents descriptive statistics for the infection rate and central line day variables for the 215 highly complex hospitals. The number of CLABSIs ranged from 0-138, and the number of central line days ranged from 1,770-122,679. The number of ICU beds ranged from 6-323, with a median of 57.

Table 1
Descriptive statistics of the infection and central line day variables for the 215 hospitals serving highly complex patient populations

	Central line days	CLABSI predicted	CLABSI observed	SIR	No. of ICU beds
Mean	21485	23	21	1	72
Median	16986	18	15	1	57
SD	17021	20	21	1	50
Minimum	1770	1	0	0	6
Maximum	122679	137	138	4	323

CLABSI, central line–associated bloodstream infections; *ICU*, intensive care unit; *SD*, standard deviation; *SIR*, standardized infection ratio.

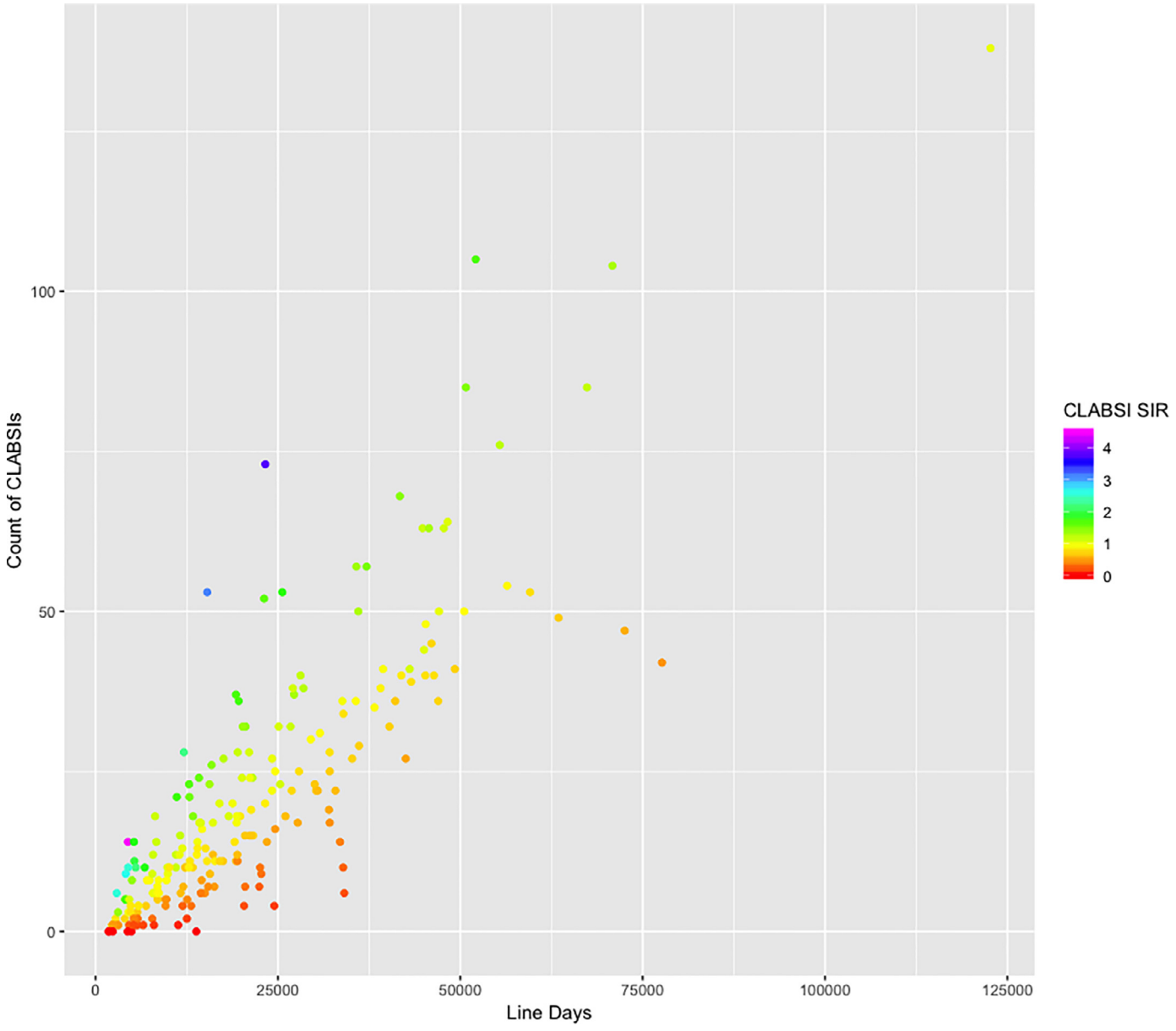

Fig 1. Visual presentation of the distribution in the number of central line–associated bloodstream infections and central line days among hospitals serving highly complex patient populations. Each standardized infection ratio is denoted by a different color dot.

A few scenarios from our analytical sample illustrated the variation in central line days and CLABSI rates for hospitals with similar SIRs. Hospitals A and B have 199 and 190 ICU beds, respectively, and both have a SIR of 0.5. Hospital A reported 27 CLABSIs from 42,520 central line days, while hospital B reported 47 CLABSIs from 72,532 central line days. Both hospitals have a low SIR and were financially rewarded by CMS; however, hospital B reported almost double the number of CLABSIs, indicating a much higher infection burden in that hospital.

Notably, this variation is also present among hospitals with higher SIRs. For instance, both hospitals C and D had ~100 ICU beds (100 and 104, respectively) and SIRs of 1.7—indicating a higher infection rate than predicted for a hospital with similar characteristics. While hospital C reported 52 CLABSIs from 23,102 central line day, hospital D reported 105 CLABSIs from 52,109 central line days, again indicating a much higher infection burden for the same SIR.

Figure 1 represents a scatter plot of the findings from Table 1. The distribution of the number of reported CLABSIs and central line days across the SIRs shows a wide distribution in rates of central line use and infections for a given SIR. In the scatter plot, each SIR is denoted by a different color dot.

DISCUSSION

Our analyses demonstrate that similar hospitals can have the same SIR but very different numbers of central line days and CLABSI rates. This variation in infection burden may translate to nontrivial differences in patient safety. Our findings have important policy implications because the CMS value based purchasing program incentives should, ideally, reward both absolute reduction of central line use and relative incidence of infection.

Current federal infection prevention policies, however, are focused on infection rates. The same 2016 CDC report that set new CLABSI goals for 2020, also reported that the national central line device use rate had stayed consistent for the past 6 years. The report further noted that there is a net benefit to patients in focusing on both central line safety and reducing central line use; however, this type of success, while noted by the CDC as integral to a CLABSI-prevention strategy, is not currently rewarded by the SIR calculation.

CONCLUSIONS

An alternative publicly available metric that controls for these issues is the hospital- and unit-level standardized utilization ratio. This CDC metric is a risk-adjusted rate that compares the actual central line device days reported to what would be predicted for a hospital with similar characteristics. While CMS 2019 value based purchasing methodology will still rely on the SIR, our results suggest that incorporating the standardized utilization ratio into the methodology for calculating financial penalties may more appropriately measure infection prevention than an SIR that is adjusted for each hospitals' rate of central line use.

References

1. Centers for Disease Control and Prevention. Healthcare-associated infections in the United States, 2006-2016: a story of progress. Available from: https://www.cdc.gov/hai/surveillance/data-reports/data-summary-assessing-progress.html. Accessed November 16, 2018.
2. Krein SL, Fowler KE, Ratz D, Meddings J, Saint S. Preventing device-associated infections in US hospitals: national surveys from 2005-2013. BMJ Qual Saf 2015;24:385-92.
3. Centers for Disease Control and Prevention. The NHSN standardized infection ratio (SIR): a guide to the SIR. Available from: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf. Accessed November 16, 2018.
4. Wright MO, Kharasch M, Beaumont JL, Peterson LR, Robicsek A. Reporting catheter-associated urinary tract infections: denominator matters. Infect Control Hosp Epidemiol 2011;32:635-40.
5. Abrantes-Figueiredo JI, Ross JW, Banach DB. Device utilization ratios in infection prevention: process or outcome measure? Curr Infect Dis Rep 2018;20:8.
6. Fakih MG, Gould CV, Trautner BW, Meddings J, Olmsted RN, Krein SL, et al. Beyond infection: device utilization ratio as a performance measure for urinary catheter harm. Infect Control Hosp Epidemiol 2016;37:327-33.
7. Rajaram R, Chung JW, Kinnier CV, Barnard C, Mohanty S, Pavey ES, et al. Hospital characteristics associated with penalties in the centers for Medicare and Medicaid services hospital-acquired condition reduction program. JAMA 2015;314:375-83.
8. Bazzoli GJ, Thompson MP, Waters TM. Medicare payment penalties and safety net hospital profitability: minimal impact on these vulnerable hospitals. Health Serv Res 2018;53:3495-506.