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SHEA

Concise Communication

Using Centers for Medicare and Medicaid Services care compare data to create hospital-acquired infection count thresholds: a SAS program and analysis

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Abstract

Using the Statistical Analysis System (SAS) program shared here, all US hospitals can calculate hospital-specific hospital-acquired infection threshold counts for achieving a pre-specified benchmarked Standardized Infection Ratio performance percentile.

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Introduction

Hospital quality leaders are challenged with finding ways to educate clinicians and department chairs regarding how to interpret and contextualize publicly reported quality benchmarks. The statistical methodologies used to create benchmarks are not typically part of core medical school competencies nor used daily in patient care. For example, the methodologies used in the Hospital-Acquired Conditions Reduction Program involve mathematically complex hierarchical risk-adjustment models with terms such as "Standardized Infection Ratio" (SIR) falling on hospital quality leaders to translate for the practice. Generally, a hospital's risk-adjusted SIR in a given reporting period is used as the basis for comparing its performance to a national benchmark. However, there is a glaring disconnect between the SIRs used for Hospital-Acquired Infections (HAIs) and the practical, frontline-oriented data needed by clinicians for embarking on quality improvement efforts: a count-based HAI threshold.

For example, the 2024 Value-Based Purchasing SIR achievement threshold for Catheter Associated Urinary Tract Infections (CAUTIs) is 0.650.[1] Those providing hospital care, however, cannot design a practice such that each patient achieves 0.64 CAUTIs, but instead must strive to provide each individual patient with care that results in 0 CAUTIs for that patient. This distinction can be a hindrance to setting hospital-specific achievement threshold counts of HAIs.

Here, we discuss and share our approach to creating count-based HAI thresholds across the hospitals in our large, integrated health system by developing and providing a simple Statistical Analysis System (SAS) program that can be used to create calculations for hospital-specific HAI count thresholds at any US hospital, for any percentile benchmark, for any of the six HAIs reported by the Centers for Medicare and Medicaid Services (CMS) Care Compare site. We also provide descriptive statistics regarding the percentage of hospitals that must achieve zero HAIs in a given year to achieve top-quartile performance.

Methods

We downloaded the April 2024 "Healthcare_Associated_Infections-Hospital.csv" (https://data.cms.gov/provider-data/dataset/77hc-ibv8) from CMS Care Compare, which included all US hospitals' scores for six HAIs from July 1, 2022-June 30, 2023:

1) Central Line Associated Bloodstream Infections (CLABSI)
2) Catheter Associated Urinary Tract Infections (CAUTI)
3) Surgical Site Infections – Colon Surgery (SSI-Colon)
4) Surgical Site Infections – Abdominal hysterectomy (SSI-Hyst)
5) Methicillin-Resistant Staphylococcus Aureus Bacteremia
6) Clostridium Difficile (CDIFF)

We wrote a SAS program (Supplement 1) that calculates user-customizable national threshold percentiles (default = 75th percentile/top quartile) for each of the six HAIs. The SAS program then combines these thresholds with hospital-specific denominators (termed eligible cases) for each HAI to create a threshold count for each of the six HAIs that cannot be exceeded at each hospital in order to perform at (or better) than the user-customized percentile threshold SIR.

We tabulated national summary statistics for threshold counts, including the mean, median, IQR, 5th percentile, 95th percentile, minimum, and maximum threshold counts for achieving 75th percentile (top quartile) or better performance for each HAI. We also calculated the percentage of hospitals with a threshold count of zero in order to be in the top quartile of performance for each HAI.

Results

The number of hospitals providing data on CMS Care Compare for each HAI ranged from 2,687 for SSI-Hyst to 4,096 for CDIFF. The

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Table 1. Hospital count threshold summary statistics by hospital-acquired infection (HAI) type

HAI	Number of eligible hospitals	75th percentile SIR	Mean(STD) count threshold	Min, p5, p25, p50, p75, p95, max count threshold	N(%) hospitals with a "zero count" threshold
CLABSI	n = 3,749	0.330	1.3 (3.2)	0, 0, 0, 0, 1, 7, 46	2,472 (66%)
CAUTI	n = 3,877	0.229	0.9 (2.2)	0, 0, 0, 0, 1, 5, 24	2,719 (70%)
SSI Colon	n = 2,961	0.354	0.7 (1.3)	0, 0, 0, 0, 1, 3, 13	1,957 (66%)
SSI Hyst	n = 2,687	0.302	0.1 (0.3)	0, 0, 0, 0, 0, 0, 4	2,572 (96%)
MRSA	n = 4,081	0.376	0.7 (1.8)	0, 0, 0, 0, 1, 4, 25	3,017 (74%)
CDIFF	n = 4,096	0.194	3.6 (7.1)	0, 0, 0, 1, 5, 17, 118	1,980 (48%)

75th percentile SIRs and summary statistics for hospital-level threshold counts for each HAI are shown in Table 1. The percentage of hospitals with threshold counts of zero for achieving top quartile performance (75th percentile or greater) ranged from 48% for CDIFF to 96% for SSI-Hyst.

Discussion

Using the SAS program created here (Appendix), all US hospitals can set 75th percentile HAI threshold counts, with freedom to explore alternative thresholds such as top decile or tertile SIR. Our analysis also showed that at least 2/3 of US hospitals must achieve zero HAI counts in order to perform in the top quartile SIR nationally for five of six HAIs. For example, 70% of US hospitals must have zero CAUTIs per year in order to achieve top-quartile performance on CAUTI SIR. It should be noted that this analysis is based solely on National Healthcare Safety Network (NHSN)-reported units, which does not necessarily include all HAIs occurring in a hospital (i.e. those occurring in non-NHS reportable units would not be included in threshold counts). This tool differs from existing tools such as the NHSN Targeted Assessment for Prevention Reports in that our program allows for a user-specified threshold target at any national percentile from 0 to 100 (eg: 25th percentile, 50th percentile, 66th percentile, 95th percentile, etc.) rather than having to select and interpret a meaningful SIR-based target, which can be difficult to contextualize in the absence of national percentile performance data. There was notable variability and zero-inflated distributions for mean HAI threshold counts across hospitals, which points to the need for the percentile-based threshold benchmarking offered by our SAS program versus an SIR-based approach which may not be as intuitive.

At our institution, quality leadership has found that using count-based thresholds is more practical for communicating performance goals to clinical department chairs and contextualizes that "zero harm" truly means zero infections if we wish to perform in the top quartile. The results of this analysis highlighted that top-quartile SIR performance can only be achieved by allowing zero HAIs per year for the majority of US hospitals. Also notable is the inter-hospital variation in count thresholds. Whereas 2 out of every 3 hospitals cannot allow a single CLABSI in order to perform in the top quartile, the highest volume US hospital can allow 46 CLABSIs per year and still achieve a top quartile SIR. Though this is a well-documented statistical artifact of the HAI methodologies,[2] we suspect that most hospital quality leaders have never contemplated the extent of variation through this lens. This is also a limitation of tools such as our, as they may be irrelevant for small or critical access hospitals with expected event counts of zero, however for these hospitals lower percentile thresholds such as the 26th percentile (i.e. better than worst quartile) could be explored using our tool. Our analysis highlights that "zero-count" 75th percentile goals may be implausible for both large and resource-limited hospitals, and a focus on processes for HAI prevention may be a more pragmatic focus. Alternatively, phased reduction goals such as 20th percentile performance in the first year, followed by 30th percentile the next year, may be a better aim. This analysis ultimately raises questions about the practicality of national HAI quality improvement efforts for small hospitals, and may support a national cumulative attributable difference strategy targeting larger hospitals.[3] Regardless, the program provided here is intended to be used for both practical and educational purposes at a hospital-specific level rather than nationally. With minimal edits to column and file names, our program could also be used to set percentile-based and count-based goals for any of the hospital-level data on CMS Care Compare, including patient safety indicators, patient experience, readmissions, and mortality. Using the SAS program shared here, all US hospitals can calculate hospital-specific HAI threshold counts for achieving a pre-specified benchmarked SIR performance percentile.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/ice.2024.191.

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