NHSN SAAR Assessment Using Visual Analytics: CREATE Tools to Improve Population Antibiotic Use

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Abstract (amended)

Introduction:
The National Healthcare Safety Network (NHSN) recently began reporting Standardized Antibiotic Administration Ratio (SAAR). The SAAR uses antibiotic use (AU) data transmitted to NHSN to generate an observed-to-expected ratio of Days of Therapy (DOT) using risk adjustment for facility characteristics. Currently, 60 VA Medical Centers participate. While the SAAR provides a high-level overview for benchmarking AU, it lacks granularity. Antibiotic stewardship (AS) decision-making nodes can be further characterized using a cognitive framework of Choice (initial selection, i.e., hospital days 0-2), Change (de-escalation, i.e., hospital days 3-4), and Completion (duration of therapy, i.e., hospital days 5-6) (CCC). Adding this framework to SAARs can improve granularity for targeting AS opportunities.

Methods:
As part of the CREATE study, we developed visual analytics tools (i.e., a dashboard) based on data extracted from the VA Corporate Data Warehouse that combines antibiotic days, SAAR, CCC, and Spectrum Score [a measure to quantify antibiotic spectrum of activity, (BMC Infectious Diseases, 2015 Apr 25;15:197-208)] for three common infectious disease conditions: pneumonia, UTI, and SSTI. Stewards can use the dashboard to identify AU patterns and potential areas for improvement. Data benchmarked to other NHSN-participating VA facilities can be categorized by condition, decision-making node (CCC), antibiotic class or agent, administration route, and ward. Results can be expressed visually using graphs, tables, and charts.

Results:
The dashboard is currently being pilot tested by stewards in 8 VA facilities. The tools have identified areas for improvement in measures for SAARs > 1 and with SAARs not different than 1. Figure 1 shows how the dashboard is able to refine analysis of piperacillin/tazobactam (P-T) in one facility with an MDRO Gram negative SAAR not different than 1 [ICU 0.957 (95% CI), Ward 0.979 (95% CI)] to uncover increased empiric P-T use for pneumonia patients admitted to medical-surgical wards. This data led the stewards to update pneumonia order menus and algorithms. Figure 2 shows how an outlier SAAR > 1 for ICU anti-MRSA antibiotic usage [1.599 (95% CI 1.477-1.729)] at another facility can be further investigated by a) comparing the SAAR to other VAs sharing data within NHSN; b) trending the SAAR over time; and c) demonstrating patterns of vancomycin use across disease syndrome and timeframe of antibiotic prescription. This data assisted stewards in providing feedback to ICU physicians on their patterns of antimicrobial use.

Discussion:
The visual analytics tools provide additional granularity in evaluation of AU data beyond SAARs, and have the ability to identify AU improvement opportunities in an efficient manner.

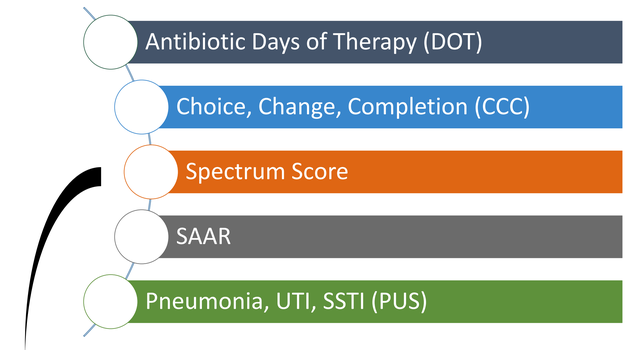
Background

- SAARs measure antibiotic consumption compared to other facilities reporting data to NHSN
- SAARs are observed-to-expected ratios risk adjusted based on ICU status, hospital teaching status, facility bed size, facility ICU bed size, location bed size, ward type: medical, medical/surgical, and surgical wards
- SAARs are calculated in 5 different categories based on specific antibiotic agents and stratified by ICU and/or ward location: all antibiotic use, broad spectrum agents for hospital-onset/multi-drug resistant bacteria, broad spectrum agents for community-acquired infections, anti-MRSA agents, and agents for surgical site infection prophylaxis

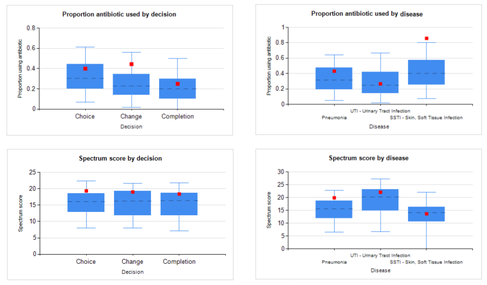
Objective

To develop tools to support antibiotic stewards in interpreting reported metrics including SAARs, identifying areas for quality improvement, and evaluating impact of interventions developed and implemented to improve population antibiotic use locally

Methods



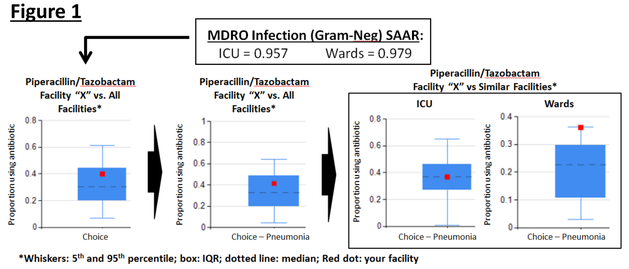
Examples of Graphs Generated Using Create Tools



Whiskers: 5th and 95th percentile; Box: IQR; Dotted Line: median; Red Dot: your facility
*Top two graphs show proportion of piperacillin/tazobactam use

Example 1 (Figure 1 from Abstract)

Figure 1



*Whiskers: 5th and 95th percentile; box: IQR; dotted line: median; Red dot: your facility

Select Facility SAARs

- 2015 SAARs: All antibiotics used in adult ICUs and wards, 1.053 (95% CI 1.026-1.081); Antibiotics used for hospital-onset/MDR bacteria in adult ICUs, 0.957 (95% CI 0.880-1.040); Antibiotics used for hospital-onset/MDR bacteria in adult wards, 0.979 (95% CI 0.912-1.049)

Conclusions Regarding Antibiotic Use

- SAAR for broad spectrum agents for hospital-onset/MDR bacteria (including piperacillin/tazobactam) for ICU and medical wards indicate slightly non-significantly reduced use compared to other facilities after risk adjustment
- Visual analytics CREATE tools allow for increased granularity dissecting the SAAR looking at only choice (empiric therapy with a specific antibiotic, e.g., piperacillin tazobactam) for pneumonia stratified by ICU and medicine wards comparing facility "X" data with other similar facilities
- While actual overall use of hospital-onset/MDR antibiotics may not be significantly different than predicted (as indicated by the SAAR), further review suggests empiric use of piperacillin/tazobactam for pneumonia on medicine wards may significantly be increased compared to similar facilities

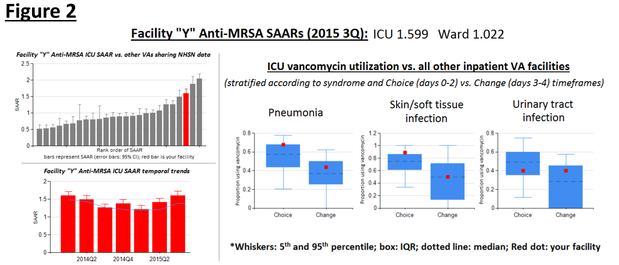
Interventions Developed & Implemented

- Pneumonia specific treatment algorithms were developed in order to risk stratify patients presenting from the community based on risk factors for MDR organisms including MRSA and *P. aeruginosa*
- Order menus within the electronic medical record were created in tandem with the pneumonia algorithms to guide prescribing behavior

Example 2 (different Facility "Y")

Figure 2

Facility "Y" Anti-MRSA SAARs (2015 3Q): ICU 1.599 Ward 1.022



*Whiskers: 5th and 95th percentile; box: IQR; dotted line: median; Red dot: your facility

Select Facility SAARs

- 3rd Quarter 2015 SAARs: All antibiotics used in adult ICUs and wards, 0.956 (95% CI 0.933-0.980); Anti-MRSA antibiotic usage in adult ICUs, 1.599 (95% CI 1.477-1.729); Anti-MRSA antibiotic usage in adult wards, 1.022 (95% CI 0.951-1.096)

Conclusions Regarding Antibiotic Use

- SAAR for anti-MRSA agents in ICU is a significantly high outlier as compared to ward anti-MRSA and overall antibiotic use.
- Visual analytics CREATE tools allow for comparison of where anti-MRSA ICU SAAR stands in relation to other VA facilities sharing NHSN data (3rd highest in cohort) as well as trends in this SAAR over time (gradual upward trend since the beginning of 2015).
- Examination of 2015 ICU vancomycin use according to disease state and Choice vs. Change shows that Choice use of vancomycin for pneumonia and skin/soft tissue infection are particular outliers. De-escalation of vancomycin in UTI may also be an opportunity for improvement.

Interventions Developed & Implemented

- Feedback was given to ICU providers on their high relative use of vancomycin as compared to other VA facilities.
- Order menus within the electronic medical record for pneumonia are being developed to de-emphasize the role of vancomycin for empiric therapy.
- Support for continuation of self-directed timeout program for reconsideration of vancomycin during Change.

Conclusion

SAARs provide standardized, risk adjusted metrics that allow for cross-institutional comparisons of AU and identify potential opportunities for improvement in antibiotic prescribing. However, without more granular data (e.g., ward location, diagnosis, antibiotic course) specific interventions are difficult to prioritize and opportunities for improvement in prescribing practices may be overlooked.

Visual analytics CREATE (Collaborative Research to Enhance and Advance Transformation and Excellence) tools provide more detail regarding patterns of antibiotic use within and across facilities that complements insights provided by SAARs. Using these tools in addition to the SAAR metrics, antibiotic stewards are able to identify variances in antibiotic use compared with other facilities and identify opportunities for improvement.

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