Development and Assessment of a Physician-Specific Antimicrobial Usage and Spectrum Feedback Tool

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Individualized data are required but difficult to obtain for effective antimicrobial stewardship audit and feedback. We developed a summative tool to evaluate consumption (days of therapy per 100 patient-days) and spectrum of antimicrobials that was also acceptable to individual clinicians.

Keywords. antimicrobial stewardship; feedback; peer comparison; spectrum score

Measuring antimicrobial consumption data is a foundation of antimicrobial stewardship programs [1, 2]. Although relatively easily obtained, consumption data from the hospital or service level do not offer prescribers information about their individual antimicrobial prescribing habits. More specific data via spot audit are resource intensive to collect [3] and may not reflect true practice over time. Additionally, although clinicians may prescribe antimicrobials with differing frequency, there may also be variability in the clinical spectrum of antimicrobials prescribed [4]. We sought to develop a scalable, summative tool to describe the spectrum of prescribed antimicrobials as well as total consumption by individual prescribers and to feed this information back to physicians.

METHODS

Setting
Development was conducted in a 442-bed academic acute care hospital in the division of General Internal Medicine (GIM) in Toronto, Canada. There are 17 licensed physicians who frequently admit to this service with approximately 3500 admissions per year. At any one time, there are 4 attending staff physicians leading 4 teams. Each team consists of a staff physician, medical residents, medical students, and a pharmacist. The institution’s Research Ethics Board waived approval due to its quality improvement nature.

Tool Development
Physician-specific antimicrobial consumption data were obtained by a prospective census report run daily between February 15 and August 24, 2016 capturing all GIM in-patients by medical record number and most responsible physician (MRP).

This database was matched to dispensed doses of antimicrobials. From this data set, the antimicrobial-specific days of therapy (DOTs) were calculated for each clinician [1, 5]. The attributed physician was defined as the one listed on service for the specific patient only for the duration of their service block. Once the physician handed over to a colleague, all attribution of antimicrobial therapy was transferred.

Days of therapy were standardized to 100 patient-days by individual physician census data. To ensure adequate sample sizes, a minimum of 500 patient-days of service were required for inclusion in the assessment.

To address the breadth of prescribing (ie, how broad-spectrum were a physician’s choices of antimicrobials), we used a modified antibiotic spectrum score based on Madaras-Kelly et al [6]. This was initially developed through a modified Delphi process using data and cases from the Veterans Administration health system and assigns a value to a class of antibacterial agents reflecting the relative number of clinically relevant pathogens covered by each class. The score ranges from 4 (metronidazole) to 49.75 (tigecycline) with a theoretical maximum score of 60. Of note, antifungals, antivirals, and antibiotics used exclusively for prophylaxis in our institution (eg, acyclovir, atovaquone) were excluded.

To calculate the breadth of antibacterial usage, the following equation was used:

$$SS_{physician} = \sum_{drug}^{\text{DOTs}} \frac{\text{DOT}_{drug}}{\text{DOT}_{physician}} \times SS_{drug},$$

where \(SS_{physician}\) is the summed spectrum score for the prescriber and \(SS_{drug}\) is the individual value for the drug. \(\text{DOT}_{physician}\) denoted the total DOTs attributed to the physician in question.

Clinician feedback reports comprised a scatter plot of antimicrobial consumption (y axis) and spectrum score (x axis) along with total patient-days and mean DOTs/100 patient-days and spectrum score ± SD (Supplementary Figure 1). Only the individual receiving the report is identified on the scatter plot;
all other data points representing other physicians are deidentified but still presented.

Assessment

Initial discussion of concepts and orientation to the feedback tool occurred both in person and electronically before circulation of individual results. After distribution of the individualized feedback form, an email was sent to individuals to elicit response and to request an interview. Semistructured qualitative interviews were developed and used to assess the acceptability, comprehension, and interpretation of the tool. The following questions were asked:

1. Did you understand the description and utility of the feedback report, specifically the spectrum score?
2. Would this change your prescribing practices were we to enact this on a regular basis to feedback relative prescribing rates and spectrum? If so, how?
3. What additional information would you wish to have before changing your practice based on this feedback?

All interviews were conducted by M. T. M. and discussed with C. M. B. and A. M. M.

RESULTS

Fifteen physicians met criteria for inclusion. A total of 15×281 patient-days occurred during the study period representing 1700 distinct patients. The mean number of patient-days per physician was 1011 ± 461 days. The mean antibiotic consumption was 38.5 ± 8.4 DOTs/100 patient-days. There was consumption variability between the lowest and highest prescribers (2.2-fold difference DOTs/100 patient days). The mean antibacterial spectrum score was 23.7 ± 1.8, which approximates the spectrum of cefuroxime. Variability was also pronounced in this group with the minimum prescriber being 19.5 (equivalent to cefazolin) and maximum being 26.7 (broader than ceftriaxone). The scatter plot presented to physicians (Figure 1) demonstrates no relationship between antimicrobial consumption and spectrum score ($R^2 = 0.053$). Additionally, no interaction could be seen between both measures and total patient volume as determined by patient-days.

Assessment

Results were sent to 15 physicians, and 13 responded with feedback and request for individualized data. The nonresponders were in the 1st and 2nd quartile, respectively, of both consumption and spectrum score. Overall, responding physicians understood what the tool was measuring and the tool’s inherent elements. The physicians found the tool and the measurement concept acceptable for further use in an investigational quality improvement context and were amenable to further feedback.

Four responding clinicians also provided voluntary detailed semistructured interviews. The feedback received based on the semistructure interview questions was that the tool was generally understood from both a consumption and spectrum perspective. Physicians stated that they would be unlikely to change practice based on the limited data but were open to further discussion once more information was available. Additionally, clinicians generally wanted more data (>1 year) with trending over time to assess variability before drawing conclusions and implementing this feedback on a regular basis. Concern was raised by 1 physician about the perceived implicit drive toward lower antibiotic usage without balancing measures.

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Figure 1. Depiction of individual clinician by total antimicrobial consumption (y axis) and modified spectrum score (x axis). Abbreviations: DOTs, days of therapy; IQR, interquartile range.
DISCUSSION

We developed a novel feedback tool combining aggregate consumption and summative spectrum of activity to report and compare physician-level antimicrobial prescribing. The metric and tool was understandable and generally acceptable to clinicians and showed considerable variability in both consumption and spectrum between physicians over the trial period.

Current quality metrics observe long-term effects of antimicrobial stewardship activities [7]. These aggregate consumption metrics, such as DOTs, defined daily doses, and antibiotic-free days, do not adequately inform clinicians of prescribing behavior or individual actions that can affect the metric and thus use of antibiotics [8]. In the absence of valid and reliable appropriateness measures, reflection on consumption and spectrum of use compared with peers may provide important normative information to prescribers [9]. The addition of the spectrum score adds another prescribing dimension—choice of antimicrobial therapy—that has been mainly ignored.

Providing individual feedback in a multidisciplinary care environment requires the ability to accurately attribute responsibility of care [10]. We attributed antimicrobial decision-making to the MRP on the GIM team, not the physician placing the order. The benefit of this approach is that the MRP has ultimate responsibility and ability to influence their team’s practice. This may be more impactful than aggregate feedback to a mixed group of MRPs, trainees, and nonresponsible clinicians.

This study has several limitations. Because this study was a proof of concept, we did not determine the cause of variability in both consumption and spectrum score. The a priori assumption was—as patient-days per clinician increase—variability among physician prescribing practices will be the cardinal driver of difference between clinicians. We plan on investigating the cause of this variability in the future using a larger data set and more granular patient information. Additionally, we assumed that physicians who continue antibiotics prescribed by the previous attending physician behaved similarly to those who initiated treatment. This assumption requires discussion about accountability and attribution with clinicians but also increases the onus on attending physicians to fully understand antibiotics being prescribed, regardless of who initiates therapy.

Future directions for this project include incorporating more data to further validate the tool and its metrics in GIM and other settings. We will also describe individual prescriber consistency by examining other areas of interest, including differential time to de-escalation and indication-specific prescribing while incorporating more patient variables into the feedback tool.

Supplementary Data

Supplementary materials are available at Open Forum Infectious Diseases online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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