Case Report

Information Resources Used in Antimicrobial Prescribing

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Abstract To describe resources clinicians use when they prescribe antimicrobials, the authors surveyed prescribers by telephone within hours (median 2.9) after they ordered one or more antimicrobials for a patient. Among 157 prescribers, 87 (55%) used one or more external resources to aid in decisions about their order. The other 70 (45%) used only their own knowledge and experience. Fifty-nine (38%) consulted another person. Fifty-four (34%) used a print, computer, or Internet resource. In multivariate analysis, use of an external resource was associated with the clinician being on the medical service (odds ratio [OR] 2.99, 95% confidence interval [CI] 1.41–6.3) or being an intern (OR 13.65, 95% CI 1.44–128). Eighty percent of providers said information about antimicrobial prescribing at the point of electronic order entry would be helpful. It was concluded that decision support at the point of electronic order entry is likely to be used and might improve antimicrobial prescribing.


Improved antimicrobial prescribing is urgently needed for several reasons. Clinicians often prescribe antimicrobials that are not active against diseases or pathogens likely in their patients.1–3 Second, excessive use of antimicrobials is widespread. As many as 50% of outpatient4,5 and 40% of inpatient6 antimicrobial prescriptions are unneeded or too broad, and excessive usage contributes to relentless increases in antimicrobial resistance.7 Third, antimicrobials are a common cause of adverse drug effects (ADEs).8

When they prescribe antimicrobials, clinicians are influenced by knowledge, attitudes, and beliefs about suspected or documented infectious diseases and risks and benefits of the many antimicrobials available in a typical practice.9–11 Infectious diseases occur in most practices, but most clinicians are not experts and are unable to keep abreast of current knowledge and recommended treatments for the many possible infectious diseases they might treat. Physicians are aware of increasing microbial resistance nationally or globally, but they underestimate the magnitude of microbial resistance in their locales.10,12 In contrast, they overestimate the likelihood of antimicrobial resistance in their infected patients and then select antimicrobials with unnecessarily broad activities.9 When generalists and infectious disease specialists were asked to rank seven factors important in selection of a drug to treat community-acquired pneumonia, avoidance of resistance ranked last.10

Convenient information about appropriate prescribing is frequently not available in practice. Physicians process hundreds of pieces of information and make hundreds of decisions in a typical day,13 and they frequently have questions that go unanswered. When questions arise in practice, physicians obtain answers to only about one in three.14,15 Questions about drug treatment are among the most common.14–17 When physicians do seek answers, they usually use sources that are immediately available and provide an answer in only 1 or 2 minutes.14 Several strategies to improve prescribing behavior have been tried, but most have had little effect. One promising strategy is to offer recommendations to clinicians at the point of electronic order entry (EOE).18–25 For example, a structured intervention during EOE to improve vancomycin usage led to fewer vancomycin orders, and the duration of vancomycin therapy was shorter.24 EOE systems incorporating decision support have reduced medication error rates in some cases by more than half.26,27 Despite success in some settings, EOE can reduce physician efficiency, and unintended effects of EOE and decision support can adversely affect decisions or outcomes.28 We conducted a case study to know the extent to which clinicians use information resources when they prescribe antimicrobials in the absence of computer decision support, what those resources are, and whether they feel additional resources conveniently available at the point of EOE would improve prescribing.

Case Description

The study was done at the Minneapolis Veterans Affairs Medical Center (MVAMC), a 280-bed university-affiliated tertiary care hospital. Veterans Health Administration (VHA) hospitals use the VHA Computerized Patient Record System (CPRS), which includes EOE and is amenable to some forms of decision support.29 Providers enter most orders with a hierarchical system of menus. Basic menus are intrinsic to CPRS, but...
like most VHA hospitals, MVAMC has additional locally created menus that reflect local organization, practice patterns, and culture. Micromedex (Thomson Micromedex, Greenwood Village, CO), UpToDate Online (UpToDate, Wellesley, MA), and the Internet are available online, but many clinicians find them difficult to use for common clinical problems.

Methods

Subjects were clinicians who wrote antimicrobial prescriptions at MVAMC between September 19 and December 21, 2001. The study was declared exempt under federal guidelines 45 CFR Part 46.101(b) by the institutional review boards of the MVAMC and the University of Minnesota. Pharmacists notified study personnel by telephone or voice mail immediately after processing any inpatient or outpatient antimicrobial prescriptions. Personnel reviewed patient medical records to gather specified clinical details and attempted to contact prescribers by telephone when they could do so within 24 hours of the time the order was written. We were able to attempt to contact prescribers within this time frame in slightly more than half of all cases. Each prescriber was asked, “Did you use any resource aside from your own knowledge and experience to prescribe the antimicrobial(s)?” For example, other possible resources would include another physician or pharmacist, books, or a computer resource.” When providers answered “yes,” we asked them to specify whether resources were used for antimicrobial selection, dosing, or treatment duration, or to learn about ADEs. Finally, prescribers were asked, “Would it be helpful if information about antimicrobial prescribing were available in CPRS?”

The study was designed to be brief and unobtrusive. The interview consisted of six or seven brief questions and lasted only 2 minutes. Recall was likely to be accurate since all interviews were completed within 25 hours of the time orders were made. A disadvantage of this brief, unobtrusive survey was that it was not possible to determine the completeness or accuracy of prescribers’ knowledge about the conditions they treated or the antimicrobials they prescribed. Undoubtedly, some prescribers who did not consult external resources had adequate knowledge and prescribed antimicrobials appropriate for their cases.

Associations between resource use and prescription and prescriber characteristics were quantified with odds ratios and corresponding 95% confidence intervals, and significance was determined with χ² tests. Variables that were strongly associated with resource usage in univariate analyses were included in binary logistic regression analysis along with other potential explanatory variables to identify characteristics independently associated with external resource use. First-order interactions between all potential predictor variables were included in the initial model. This overspecified model was reduced with a backward elimination selection procedure. The major criterion at each step of the model selection process was that the term with the least significant Wald χ² statistic (p-value closest to 1) was removed first, but care was taken to simplify interactions before a main effect was eligible for elimination.

Case Study Results

Pharmacy notified study personnel of 685 instances in which a prescriber ordered antimicrobials during the study period. We were able to review records, contact prescribers, and complete interviews with 157 prescribers who wrote orders on 325 occasions for 282 patients. All prescribers we were able to contact completed their initial interview, and nearly all prescribers contacted more than once completed all interviews we requested of them.

External resource use occurred unevenly among prescribers. Among 82 prescribers interviewed more than once, 50 reported external resource use for any purpose in the first interview, and these individuals reported external resource use in 64 of their subsequent 103 interviews (62%). The 32 prescribers interviewed more than once who did not report external resource use in the first interview reported external resource use in only 22 of their subsequent 65 interviews (34%, χ² = 11.7, 1df, p ≤ 0.001). Reported use of external resource use in the first interview was also predictive of use in subsequent interviews when consideration was limited to human resources (χ² = 5.7, 2df, p ≤ 0.02) or nonhuman resources (χ² = 17.1, 1df, p ≤ 0.001) or use of any external resource for antimicrobial selection (χ² = 22.6, 1df, p ≤ 0.001). These data indicated that resource use patterns for individual prescribers interviewed more than once were not independent. To simplify the analysis and make statistical inferences more straightforward, we present data only for the first interview with each prescriber. For first interviews, the median interval between the times inpatient antimicrobials were ordered and the interviews were conducted was 2.9 hours (mean, 7.0; range, 0.2 to 25). Results of data from first interviews were similar to results of data from all interviews.

The 157 prescribers were from medical (88, 56.8%), surgical (44, 28.4%), urgent care (14, 9%), or other services (9, 5.7%). Their job categories were career physician (32, 20%), physician in training (107, 68%), nurse practitioner (14, 9.6%), and other (4, 2.5%). Of all 157 prescribers, 87 (55%) used one or more external resources to decide about an antimicrobial order. Thirty-three (21% of all prescribers) used a human resource only, 28 (18%) used a nonhuman resource only, and 26 (17%) used both human and nonhuman resources. The most common reason to use an external resource was for antimicrobial selection, and for this decision prescribers usually consulted with another physician or pharmacist (57 of 81, 70%). The second most common reason was to decide on the proper dose, and for this decision, prescribers usually consulted a nonhuman resource (38 of 55, 69%). The most common nonhuman resources used for any purpose were pocket guides (e.g., The Sanford Guide to Antimicrobial Therapy30 or Tarascon Pocket Pharmacopoeia,31 computer programs (3 of 54, 5.6%), textbooks (2 of 54, 3.7%), or an Internet source (1 of 54, 1.8%).

In univariate analysis, three binary variables were associated with prescriber use of external resources: prescribing for inpatient treatment (odds ratio [OR] 2.78, 95% confidence interval [CI] 1.43–5.43), being on the medical service (OR 4.18, 95% CI 2.13–8.19), and prescription written by an intern (OR 23.35, 95% CI 3.06–178). Prescribers used resources significantly more often for some diagnoses than others. External resources were used for four of four (100%) cases of intra-abdominal infection, 13 of 14 (93%) cases of sepsis or bacteremia, six of seven (86%) cases of bone or joint infection,
Only one other study, published only as an abstract, of external resources used for antimicrobial 

22 of 41 (53%) cases of lower respiratory tract infection, 13 of 25 (52%) cases of skin or wound infection, six of 12 (50%) cases of upper respiratory tract infection, eight of 22 (36%) cases of genitourinary infection, eight of 23 (35%) cases of surgical prophylaxis, one of three (33%) cases of oral infection, and six of six (100%) cases of other or multiple diagnoses (Pearson $\chi^2$ [with small categories intra-abdominal, bone or joint, and oral infections collapsed into other] was 22.54, 6 df, $p = 0.001$).

The four variables significantly associated with prescriber use of any external resource were entered into logistic regression analysis. We sought but did not detect any first-order interactions between variables. Results showed that use of an external resource for any purpose was associated with service and job category (Table 1). If the prescriber was on the medical service, it was more likely that an external resource was used (OR 2.99, 95% CI 1.41–6.3). If an intern ordered antimicrobial therapy, it was more likely that an external resource was used (OR 13.65, 95% CI 1.44–128).

Prescribers were asked whether they would find information about antimicrobial prescribing conveniently available within CPRS helpful. Of 154 prescribers who answered the question, most 125 (80%) said yes, 15 (10%) said no, and 14 (9%) were not sure. Information within CPRS was desired most by those with less education or experience, with 94% of physician assistants or nurse practitioners answering “yes”; 85% of medical students, interns, or residents answering “yes”; and 65% of chief residents, fellows, or career physicians answering “yes” (Pearson $\chi^2 = 17.2$, 6 df, $p \leq 0.008$). The desire for information within CPRS was distributed evenly across clinical services.

Discussion

Fifty-five percent of respondents in this tertiary care medical center obtained external information when they were about to order antimicrobials. With our approach, it was not possible to know whether the external information obtained by these prescribers was accurate, complete, or helpful. Fifty-nine of the prescribers (38%) obtained some or all of their external information from another person, and we do not know whether the information provided by the other person was accurate or complete. It also was not possible to know whether the 45% of prescribers who did not consult external resources had complete and accurate information about the antimicrobials they ordered or whether they might have performed better with external information. We are aware of


