

## Original Article

# Antimicrobial Stewardship Knowledge, Attitudes, and Practices Among Health Care Professionals at Small Community Hospitals

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### ABSTRACT

**Background:** Very little is known about antimicrobial stewardship knowledge, attitudes, and practices (KAP) among health care practitioners in small, community hospitals (SCHs) compared to large community hospitals (LCHs).

**Objective:** To compare infectious diseases (ID) clinical resources and describe KAP pertaining to antimicrobial stewardship among prescribers, pharmacists, and administrators from a large hospital network including a comparison between SCHs and LCHs.

**Methods:** An anonymous 48-item antimicrobial stewardship KAP survey was administered to pharmacists, prescribers, and administrators at 15 SCH (<200 beds) and 5 LCHs (>200 beds) within an integrated health care network.

**Results:** In total, 588 (14%) completed the survey: 198 from SCHs and 390 from LCHs. Most respondents were familiar or very familiar with the term *antimicrobial stewardship* and felt that antimicrobial stewardship was necessary. Most pharmacists and prescribers agreed that antimicrobials were overused at their hospital. However, SCH pharmacists and prescribers were more likely to disagree that antibiotic resistance is a significant problem locally. Pharmacists saw restrictions as a reasonable method of controlling antibiotic use more than prescribers. SCH practitioners were less familiar with IDSA guidelines and less likely to rely on ID specialists to a greater extent than LCH practitioners. Most respondents strongly agreed they would like more antimicrobial education.

**Conclusion:** SCH and LCH pharmacists, prescribers, and administrators are aware of antimicrobial resistance and overuse and agree that antimicrobial stewardship programs are necessary. SCHs are less likely to contact ID for information. These results support the development of antimicrobial stewardship programs at SCHs, while recognizing the significant differences in availability and utilization of resources.

**Key Words**—antimicrobial stewardship, community hospital, survey

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National societies and accrediting bodies advocate for antimicrobial stewardship programs in all hospitals.<sup>1</sup> Although the percentage of institutions with antimicrobial stewardship programs has increased over the last decade, small community hospitals (SCHs) are least likely to have these programs.<sup>2</sup> Most surveys about antimicrobial stewardship programs have been conducted in large academic medical centers, even though most US hospitals have fewer than 200 beds (72%).<sup>3</sup> Furthermore, recent data demonstrate that the rate of antibiotic use in SCHs is similar to large community hospitals (LCHs), and SCHs may therefore benefit from antimicrobial stewardship programs.<sup>4</sup> However, very little is known about the implementation and clinical practice of antimicrobial stewardship, as well as knowledge and attitudes pertaining to antimicrobial stewardship among prescribers, pharmacists, and administrators in SCHs.

Our objective was to compare infectious diseases (ID) clinical resources and describe knowledge, attitudes, and practices (KAP) pertaining to antimicrobial stewardship among prescribers, pharmacists, and administrators from a large hospital network, including a comparison between SCHs and LCHs.

## METHODS

An anonymous, 48-item, web-based antimicrobial stewardship KAP survey<sup>5</sup> was administered to prescribers, pharmacists, and administrators at 15 SCH (<200 beds) and 5 LCHs (≥200 beds) within an integrated health care network (eAppendix). Prescribers were defined as physicians, physician assistants, and nurse practitioners. Administrators were hospital chief executive officers. This integrated health care system consists of 22 hospitals, including a pediatric and an orthopedic hospital. These 2 specialty hospitals were excluded. Fifteen of the 20 facilities have fewer than 200 beds, and the facilities range from critical access hospitals with 14 beds to a Level 1 Trauma Center with over 450 beds. Three of the 5 LCHs had antimicrobial stewardship programs in place at the time of the survey, with active prospective audit with intervention and feedback (PAWIF). The SCHs did not have active antimicrobial stewardship programs; however, they were each recently enrolled in a cluster-randomized trial of antimicrobial stewardship programs as a part of the Stewardship in Community Hospitals – Optimizing Outcomes and Resources (SCORE) study.<sup>4</sup> All 5 LCHs and only 1 SCH had on-site ID consultation at the time of this survey. All sites had active Pharmacy & Therapeutics Committees that had approved some

antimicrobial stewardship-related initiatives, including a vancomycin dosing per pharmacists collaborative practice agreement and clinical practice guideline for community-acquired pneumonia. Sixty-seven items on the survey were generated after reviewing the literature and contacting authors of previously published antimicrobial stewardship KAP surveys.<sup>6,7</sup> The survey was reviewed by a professional survey developer (A.O.S.) and pilot tested for clarity and length prior to distribution; redundant and confusing items were eliminated. Survey items assessed antimicrobial stewardship program knowledge, attitudes, and resource-related practices, but did not assess clinical knowledge or current prescribing practices. The survey used Likert scales to assess knowledge and attitudes about current antimicrobial stewardship programs and the need for antimicrobial stewardship in general, as well as current clinical practices regarding resource use, such as ID consultation and references.

Survey data were collected and managed using REDCap electronic data capture tools hosted at University of Utah (Research Electronic Data Capture, Vanderbilt University, Nashville, TN).<sup>8</sup> The survey was e-mailed to potential respondents via the medical staff coordinators at each hospital. The survey was distributed in the spring and summer of 2014 with one reminder. Paper surveys were also distributed during medical staff meetings.

All data were entered into an online REDCap database and analyzed using Microsoft Excel 2010 (Microsoft Inc., Seattle, WA) and R (version 3.1.2; R Core Team, Vienna, Austria). Descriptive statistics were used to report demographics and survey responses. A chi-square statistic was used to compare survey responses between physicians and pharmacists and between large and small hospitals.  $P < .05$  was considered statistically significant. This survey was approved by the Inter-mountain Central Region institutional review board.

## RESULTS

The overall response rate was 14 % (588/4,140). The SCHs response rate was 13% (198/1,489): 79% (11/14) of administrators, 61% (33/54) of pharmacists, and 11% (154/1420) of prescribers. The overall response rate at LCHs was 15% (390/2,652): 100% (5/5) of administrators, 64% (138/214) of pharmacists, and 10% (247/2,433) of prescribers. All administrators at LCHs had been in health care administration for over 10 years, compared to only 4 (36%) of SCH administrators. Demographics of prescribers and pharmacists are provided in Table 1. The top 3 specialties of participants at

**Table 1.** Demographics of prescribers and pharmacists who completed an antimicrobial stewardship KAP survey in an integrated health care network: Small versus large community hospitals

| Demographics                                              | Prescribers                      |                                  | Pharmacists                      |                                  |
|-----------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
|                                                           | SCH <sup>a</sup>                 | LCH <sup>b</sup>                 | SCH <sup>a</sup>                 | LCH <sup>b</sup>                 |
| Response, <i>n</i> (%)                                    | 154 (11)                         | 247 (10)                         | 33 (61)                          | 138 (64)                         |
| Graduate school graduation year, median (IQR)             | 1995 <sup>c</sup><br>(1985-2003) | 1994 <sup>c</sup><br>(1985-2003) | 1998 <sup>d</sup><br>(1990-2008) | 2005 <sup>e</sup><br>(1995-2010) |
| Care location in which majority of clinical time is spent |                                  |                                  |                                  |                                  |
| Inpatient                                                 | 17 (11)                          | 73 (29)                          | 30 (91)                          | 111 (80)                         |
| Outpatient                                                | 98 (64)                          | 99 (40)                          | 0                                | 5 (4)                            |
| Both                                                      | 23 (15)                          | 38 (15)                          | 2 (6)                            | 6 (4)                            |
| Emergency                                                 | 13 (8)                           | 34 (14)                          | 0                                | 9 (7)                            |
| Other                                                     | 3 (2)                            | 3 (1)                            | 1 (3)                            | 7 (5)                            |

Note: KAP = knowledge, attitudes, and practices; LCH = large community hospital; SCH = small community hospital.

<sup>a</sup><200 beds.

<sup>b</sup>≥200 beds.

<sup>c</sup>Only 1 prescriber graduated after 2010.

<sup>d</sup>Only 1 pharmacist graduated in 2013.

<sup>e</sup>Thirteen pharmacists graduated in 2013, many of whom were likely to be residents.

the SCHs were family practice (*n* = 53), surgery/surgical subspecialty (*n* = 25), and internal medicine/internal medicine subspecialty (*n* = 23). The top 3 specialties of participants at the LCHs were internal medicine/internal medicine subspecialty (*n* = 67), surgery/surgical subspecialty (*n* = 44), and emergency medicine (*n* = 36).

## Knowledge Regarding Antimicrobial Stewardship

### Administrators

All administrators were familiar or very familiar with the term *antimicrobial stewardship*. Only 3 administrators (all at SCHs) had previously worked at a hospital with an antimicrobial stewardship program in place. Administrators were asked to describe in their own words the meaning of antimicrobial stewardship. High-quality responses were provided, including references to appropriate/evidence-based prescribing (*n* = 11), resource utilization (*n* = 4), reducing antibiotic resistance (*n* = 3), and patient safety (*n* = 2). When asked the primary goal of an antimicrobial stewardship program, most administrators mentioned preventing resistance (*n* = 9), appropriate antibiotic use (*n* = 7), improving patient care/quality (*n* = 5), and cost savings (*n* = 4). One response was particularly insightful, “On the micro level, the goal of antimicrobial stewardship is to use the optimum antimicrobial to achieve the highest value outcome for the patient – an antibiotic that treats the clinical condition while having the lowest adverse effects at the most reasonable cost. On a more macro level, antimicrobial stewardship saves healthcare

dollars and decreases overall antimicrobial resistance.” All administrators felt it was necessary to conduct antimicrobial stewardship at their hospital.

### Pharmacists

All pharmacists surveyed had heard of the term *antimicrobial stewardship*. At SCHs, 76% (25/33) of pharmacists were engaged in the practice of antimicrobial stewardship, likely related to the SCORE study. At LCHs, 65% (90/138) of pharmacists were engaged in antimicrobial stewardship. All SCH pharmacists and 96% (133/138) of LCH pharmacists felt it is necessary to conduct antimicrobial stewardship at their hospital. About one-fifth of pharmacists had previously worked at a hospital with an antimicrobial stewardship program (SCHs, 6 [18%]; LCHs, 30 [22%]; *P* > .05).

### Prescribers

Of prescribers surveyed at SCHs, 10 (7%) had never heard the term *antimicrobial stewardship*, 22 (14%) had heard the term but were not sure what it was, 86 (56%) were familiar with the term, and 35 (23%) stated they were very familiar with antimicrobial stewardship (ie, engaged in the practice of antimicrobial stewardship). Family medicine, internal medicine, and general surgery were more often familiar or very familiar with the term (>75%), compared to pediatrics, obstetrics-gynecology, and anesthesiology (53%-67%). Prescribers at LCHs were similarly familiar with the term *antimicrobial stewardship*, with 37 (15%) stating they were not at

all familiar with the term, 40 (16%) not familiar, 100 (40%) familiar, and 69 (28%) very familiar. At LCHs, those in internal medicine, pediatrics, and their respective subspecialties, as well as family and emergency medicine, were most likely to have heard of the term ( $\geq 75\%$  familiar or very familiar), whereas surgery and its subspecialties, obstetrics-gynecology, anesthesiology, and other disciplines were less likely (39%-67%). Of SCH prescribers surveyed, 125 (82%) felt it necessary to conduct antimicrobial stewardship at their hospital compared to 193 (78%) of LCH prescribers. Approximately one-fifth of prescribers had

previously worked in a health care setting with an antimicrobial stewardship program (SCH, 28/153 [18%]; LCH, 56/247 [23%];  $P = .30$ ).

**Attitudes Regarding Antimicrobial Use and Resistance and Barriers to Antimicrobial Stewardship Program Implementation**

Prescriber and pharmacist responses to questions regarding the extent of agreement with a series of questions regarding antibiotic use and resistance are provided in Table 2. Administrators at SCHs felt that opposition from prescribers was an important or very important (9

**Table 2.** Antimicrobial use and resistance attitudes among survey respondents who were asked about the extent of their agreement with the following statements

| Agree or strongly agree, <i>n</i> (%)                                                                                                         | Prescriber<br>( <i>n</i> =401) | Pharmacist<br>( <i>n</i> =171) | Role,<br><i>P</i> value | SCH <sup>a</sup><br>( <i>n</i> =187) | LCH <sup>b</sup><br>( <i>n</i> =385) | Size,<br><i>P</i> value |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|
| Inappropriate use of antimicrobials causes antibiotic resistance.                                                                             | 394 (98)                       | 169 (99)                       | .49                     | 185 (99)                             | 378 (98)                             | .93                     |
| Prescribing broad-spectrum antimicrobials when equally effective narrower spectrum antibiotics are available increases antibiotic resistance. | 390 (97)                       | 170 (99)                       | .06                     | 184 (98)                             | 376 (98)                             | .95                     |
| Antimicrobial use can harm patients.                                                                                                          | 390 (97)                       | 160 (94)                       | .11                     | 182 (97)                             | 368 (96)                             | .51                     |
| Antimicrobials are overused nationally.                                                                                                       | 388 (97)                       | 163 (95)                       | .79                     | 184 (98)                             | 367 (95)                             | .14                     |
| The incidence of antimicrobial resistant organisms can be reduced by changing antimicrobial prescribing patterns.                             | 386 (96)                       | 168 (98)                       | .17                     | 179 (96)                             | 375 (97)                             | .31                     |
| Strong knowledge of antimicrobials is important in my career.                                                                                 | 382 (95)                       | 170 (99)                       | .01                     | 181 (97)                             | 371 (96)                             | 1.00                    |
| I am interested in the current status of antimicrobial use and resistance at my hospital.                                                     | 381 (95)                       | 167 (98)                       | .12                     | 178 (95)                             | 370 (96)                             | .66                     |
| Antimicrobial resistance is a significant problem nationally.                                                                                 | 375 (94)                       | 163 (95)                       | .42                     | 176 (94)                             | 362 (94)                             | 1.00                    |
| Spread of antimicrobial resistance can be reduced by changing infection control practices by health care professionals.                       | 375 (94)                       | 164 (96)                       | .27                     | 176 (94)                             | 363 (94)                             | .90                     |
| It is my responsibility to ensure appropriate antimicrobial use at my hospital.                                                               | 357 (89)                       | 159 (93)                       | .13                     | 170 (91)                             | 346 (90)                             | .88                     |
| I would like more education on the appropriate use of antimicrobials.                                                                         | 346 (86)                       | 167 (98)                       | .01                     | 166 (89)                             | 347 (90)                             | .59                     |
| Appropriate use of antimicrobials can cause antimicrobial resistance.                                                                         | 344 (86)                       | 124 (73)                       | .01                     | 160 (86)                             | 308 (80)                             | .15                     |
| Restriction on antimicrobial prescribing is a reasonable method for controlling antibiotic use.                                               | 243 (61)                       | 142 (83)                       | .01                     | 120 (64)                             | 265 (69)                             | .29                     |
| Antimicrobials are overused at my hospital.                                                                                                   | 236 (59)                       | 112 (66)                       | .14                     | 107 (57)                             | 241 (63)                             | .24                     |
| Antimicrobial resistance is a significant problem at my hospital.                                                                             | 238 (59)                       | 84 (49)                        | .04                     | 93 (50)                              | 229 (59)                             | .03                     |
| New antimicrobial development will keep up with our current resistance trends.                                                                | 56 (14)                        | 31 (18)                        | .25                     | 26 (14)                              | 61 (16)                              | .61                     |

Note: LCH = large community hospitals; SCH = small community hospitals.

<sup>a</sup><200 beds.

<sup>b</sup>≥200 beds.

[82%]) barrier to antimicrobial stewardship program implementation, followed by “other clinical initiatives have higher priority” (8 [73%]). LCH administrators also felt prescriber opposition and other clinical initiatives were very important or important barriers (3 [60%] each). Financial considerations were an important barrier for administrators at 45% of SCHs (5/11) and 80% of LCHs (4/5). The statement “insufficient evidence my hospital would benefit” was thought to be important or very important for 6 SCH administrators and important for 2 LCH administrators.

### Utilization of ID Resources

Responses to questions regarding familiarity with ID-related content resources and use of ID personnel resources for information about the treatment of ID are provided in Tables 3 and 4. Germwatch is an intranet site with ID epidemiology updates and facility- and region-specific antibiograms. The HELP1 Antibiotic Assistant is a menu-driven decision support tool developed in the late 1990s.<sup>9</sup>

### Prescriber Practices in Consulting ID

At SCHs, of those prescribers who answered the question, “Apart from the SCORE study, does your hospital have ID consultation?”, 14% (20/145) responded that he or she had on-site consultation and 42% (61/145) responded that ID consultation was available by phone only. Of the 64 prescribers who answered that no ID consultation was available at their facility, 51 (80%) agreed or strongly agreed that telephone ID consultation would improve care and 49 (77%) agreed or strongly agreed that on-site ID consultation would improve care. Of all SCH prescribers, 64% (98/154) had not contacted an ID

specialist in the past month. A very small percentage (2 [1%]) had contacted an ID specialist more than 5 times. If there were a more reliable mechanism in place to contact an ID specialist, 127 (82%) stated they would contact ID at least 1 or 2 times per month.

All LCHs have on-site ID consultation, which was confirmed by 191 (77%) of the responses. However, 34 (14%) LCH prescribers surveyed felt only phone consultation was available. One site had only recently rehired an ID physician. In the past month, 131 (53%) prescribers had not contacted ID regarding a patient, 79 (32%) had contacted ID 1 to 2 times, 24 (10%) 3 to 5 times, and 11 (4%) 6 or more times.

### DISCUSSION

The results described herein are from one of the largest stewardship surveys that has been conducted with frontline pharmacists and prescribers, with nearly 600 responses, including over 200 responses from health care workers from SCHs with less than 200 beds. The 20 facilities in this survey represent a broad range of community hospitals in urban and rural locations. Although SCHs are less likely to have formal antimicrobial stewardship programs compared to large hospitals,<sup>10</sup> our results confirm that frontline health care professionals at SCHs feel antimicrobial stewardship programs, and additional education on antimicrobial use, resistance, and stewardship are necessary. Further assisting frontline practitioners in becoming more aware of and having greater access to ID resources, including ID pharmacists and physicians, is important to improving care for patients.

Although antimicrobial stewardship has received national attention recently,<sup>1</sup> it is not a new concept.<sup>11</sup> Surprisingly, a significant number of prescribers in

**Table 3.** Respondents' familiarity with Infectious Diseases content resources demonstrated by their response to the question “To what extent are you familiar with the following resources?”

| Familiar or very familiar, n (%)         | Prescribers              |                          | Pharmacists             |                          |
|------------------------------------------|--------------------------|--------------------------|-------------------------|--------------------------|
|                                          | SCH <sup>a</sup> (n=153) | LCH <sup>b</sup> (n=247) | SCH <sup>a</sup> (n=33) | LCH <sup>b</sup> (n=137) |
| Antibiogram <sup>c</sup>                 | 71 (46)                  | 118 (48)                 | 30 (91)                 | 119 (87)                 |
| Germwatch                                | 57 (37)                  | 108 (44)                 | 17 (52)                 | 52 (38)                  |
| HELP Antibiotic Assistant <sup>c,d</sup> | 22 (14)                  | 95 (38)                  | 18 (55)                 | 97 (71)                  |
| IDSA Guidelines <sup>c,d</sup>           | 37 (24)                  | 104 (42)                 | 22 (67)                 | 111 (81)                 |

Note: IDSA = Infectious Diseases Society of America; LCH = large community hospital; SCH = small community hospital.

<sup>a</sup><200 beds.

<sup>b</sup>≥200 beds.

<sup>c</sup>P value <.05 comparing all prescribers to all pharmacists.

<sup>d</sup>P value <.05 comparing all SCH to all LCH respondents.

**Table 4.** Respondent's use of Infectious Diseases personnel resources as demonstrated by their response to the question: "To what extent do you rely on the following sources for information about the treatment of infectious diseases?"

| To a great extent, <i>n</i> (%)                | Prescribers                       |                                   | Pharmacists                      |                                   |
|------------------------------------------------|-----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
|                                                | SCH <sup>a</sup> ( <i>n</i> =153) | LCH <sup>b</sup> ( <i>n</i> =246) | SCH <sup>a</sup> ( <i>n</i> =33) | LCH <sup>b</sup> ( <i>n</i> =137) |
| Clinical textbooks <sup>c,d</sup>              | 19 (12)                           | 14 (6)                            | 7 (21)                           | 17 (12)                           |
| Colleague <sup>c</sup>                         | 24 (16)                           | 43 (17)                           | 18 (55)                          | 52 (38)                           |
| ID specialist <sup>c,d</sup>                   | 23 (15)                           | 58 (24)                           | 8 (24)                           | 56 (41)                           |
| Personal clinical experience                   | 79 (52)                           | 123 (50)                          | 15 (45)                          | 60 (44)                           |
| PubMed                                         | 19 (12)                           | 24 (10)                           | 4 (12)                           | 24 (18)                           |
| Up-to-Date                                     | 64 (42)                           | 97 (39)                           | 16 (48)                          | 47 (34)                           |
| <b>Very little or not at all, <i>n</i> (%)</b> |                                   |                                   |                                  |                                   |
| Clinical textbooks <sup>c</sup>                | 89 (58)                           | 161 (65)                          | 13 (39)                          | 71 (52)                           |
| Colleague <sup>c,d</sup>                       | 63 (41)                           | 62 (25)                           | 1 (3)                            | 10 (7)                            |
| ID specialist <sup>c,d</sup>                   | 77 (50)                           | 88 (36)                           | 13 (39)                          | 31 (23)                           |
| Personal clinical experience                   | 15 (10)                           | 17 (7)                            | 0                                | 15 (11)                           |
| PubMed <sup>c,d</sup>                          | 108 (71)                          | 135 (55)                          | 16 (48)                          | 47 (34)                           |
| Up-to-Date <sup>c</sup>                        | 45 (29)                           | 62 (25)                           | 1 (3)                            | 22 (16)                           |

Note: ID = infectious diseases; LCH = large community hospital; SCH = small community hospital.

<sup>a</sup><200 beds.

<sup>b</sup>≥200 beds.

<sup>c</sup>*P* value <.05 comparing all prescribers to all pharmacists.

<sup>d</sup>*P* value <.05 comparing all SCH to LCH respondents.

our survey were unfamiliar with the term *antimicrobial stewardship* (20% SCHs, 31% LCHs). This may be related to prescriber specialty, with familiarity decreasing with increasing specialization. However, a focused effort to educate the approximately 20% of prescribers who did not feel antimicrobial stewardship was necessary may be helpful.

Nonetheless, most prescribers and all pharmacists were familiar or very familiar with the term *antimicrobial stewardship*, and the majority supports the need for antimicrobial stewardship, regardless of hospital size. Although limited guidance is presently available for initiating antimicrobial stewardship programs in SCHs, they have been successfully implemented using PAWIF and/or formulary restriction, resulting in significant reductions in antibiotic use and cost.<sup>12-14</sup>

Many SCH and LCH practitioners within the Intermountain Healthcare system are practicing antimicrobial stewardship in an informal way, even when formal antimicrobial stewardship programs are not in place. A recent nationwide survey of 406 pharmacists and ID specialists by Doron et al found 96.4% of respondents had components of an antimicrobial stewardship program at their hospital but only

half of hospitals had formal antimicrobial stewardship programs.<sup>15</sup> Smaller hospitals (≤300 beds; 271 [67%]) were less likely to use formalized guidelines and clinical pathways, streamlining and de-escalation protocols, formulary restriction, dose optimization protocols, and intravenous to oral conversion programs.<sup>15</sup> A focus on formalizing stewardship efforts in SCHs will be necessary as formal national stewardship regulations are likely forthcoming.<sup>1</sup>

Pharmacists were more likely to support antimicrobial restrictions as a method of stewardship. Loss of autonomy may be one reason that prescribers do not endorse prior authorization as a primary stewardship strategy. Perhaps because of this, prior authorization as a primary strategy is used less frequently in newly established or planned antimicrobial stewardship programs.<sup>2</sup> However, Doron et al reported that hospitals with established antimicrobial stewardship programs were more likely to agree with the use of antimicrobial restrictions compared to those without antimicrobial stewardship programs.<sup>15</sup> This may be one of the most effective and efficient methods of controlling antibiotic use in both large and small facilities.<sup>16,17</sup>

Potential opposition from prescribers and competing clinical initiatives were top barriers for antimicrobial stewardship program implementation cited by hospital administrators in our survey. Other surveys report that staffing constraints, lack of personnel funding, insufficient medical staff buy-in, and competing priorities are the main barriers to antimicrobial stewardship program implementation, particularly for nonteaching hospitals.<sup>2,15</sup> In a survey of the Society of Healthcare Epidemiology of America (SHEA) member practitioners, personnel shortages were reported as a barrier by 55% of respondents, of whom 37.3% were from hospitals with fewer than 250 beds.<sup>18</sup> Antimicrobial stewardship programs may become a Condition of Participation under the Centers for Medicare & Medicaid Services, which may change antimicrobial stewardship prioritization compared to competing initiatives. A written statement of support of antimicrobial stewardship from administrators is considered a best practice from the Centers for Disease Control and Prevention and can be used to overcome prescriber resistance and increase the clinical priority of stewardship.<sup>19</sup>

Despite free access, SCHs did not report being as familiar with Infectious Diseases Society of America (IDSA) guidelines compared to LCHs (35% vs 56%;  $P < .001$ ). In addition, pharmacists were more likely than prescribers to be familiar with IDSA guidelines (78% vs 35%;  $P < .001$ ). This may relate to the difference in median graduation year or educational training, as one survey found Doctor of Pharmacy students more likely than medical students to rely on published materials for clinical recommendations (83% vs 29%, respectively), including IDSA guidelines.<sup>20</sup> There may be a role for creating a more comprehensive easy-to-access website for ID diagnosis and treatment information.

Based on this survey, SCH prescribers are less likely than LCH prescribers to contact ID specialists for information. This trend was not surprising considering that only 1 of 15 SCHs has access to inpatient ID consultation. However, if a more reliable mechanism were in place, 83% of SCH prescribers responded they would likely consult ID at least 1 to 2 times per month; this suggests a need for ID specialist input and a re-evaluation of resources for ID consultation as an adjunct to antimicrobial stewardship programs in SCHs. Numerous studies demonstrate that ID consultation improves patient outcomes.<sup>21-24</sup> However, in a 2010 survey of 568 hospitals included in the HealthTrust Purchasing Group, 80% of hos-

pitals had bed sizes 25 to 300, but only 58.8% had an on-site ID specialist.<sup>25</sup> A similar trend was found in rural hospitals in Colorado.<sup>26</sup> Financial reasons may explain the lack of ID physicians at smaller hospitals and the lack of ID physician involvement in antimicrobial stewardship programs.<sup>27</sup> There are also a decreasing number of medical residents seeking ID fellowships,<sup>28</sup> which may be a factor. Innovative strategies such as ID hotlines<sup>25</sup> or telemedicine<sup>29</sup> may help to increase access to ID physicians in SCHs.

The pivotal role of pharmacists in the development, implementation, and maintenance of antimicrobial stewardship programs is well established, and pharmacists frequently serve as the program lead.<sup>25</sup> The American Society of Health-System Pharmacists (ASHP) supports pharmacists having a prominent role in antimicrobial stewardship programs<sup>30</sup> while IDSA/SHEA recommends pharmacists with ID training.<sup>31</sup> However, in a recent survey of 47 institutions in Michigan, only 47% had ID-trained clinical pharmacists (27% of those with fewer than 150 beds).<sup>32</sup> As more SCHs develop antimicrobial stewardship programs, non-ID physician champions and non-ID-trained clinical pharmacists will be called upon to lead stewardship initiatives.<sup>33,34</sup> A recent evaluation suggests current opportunities for postgraduate specialty training are woefully inadequate to fulfill the anticipated future needs,<sup>35</sup> and pregraduate training is unlikely to meet these needs. In a cross-sectional, multicenter survey of 579 Doctor of Pharmacy students at 12 schools of pharmacy, students were concerned about antimicrobial overuse and resistance; however, based on answers to clinical vignettes, there is room for improvement in enhancing their knowledge of appropriate antimicrobial use.<sup>20</sup> Of note, only 29% of those surveyed reported completing a clinical rotation in ID during pharmacy school. Even if all students were able to participate in an ID rotation, these short-term training experiences may provide only a rudimentary introduction to ID.<sup>36</sup> Clinical pharmacists without ID training can help reduce unnecessary antibiotic use with guidance from those trained in ID.<sup>37,38</sup> Numerous programs are now available to help augment training for non-ID specialists, including Making a Difference in Infectious Diseases (MAD-ID), Society of Infectious Diseases Pharmacists (SIDP), SHEA conferences, Coursera, homegrown programs, and others. Novel techniques that put responsibility in the hands of prescribers are worth considering, so-called point-of-prescription interventions. Although in one pilot study in an intensive care

unit setting, pharmacist involvement appeared to be more effective than prescriber involvement alone.<sup>39</sup>

The primary limitation to this study is the low response rate, particularly from prescribers, although our response rate was not dissimilar from other physician-based surveys.<sup>15,18,40</sup> It is possible that some respondents completed the survey more than once, since reminders were sent to the original study population. We were also unable to determine specific responses by facilities due to the anonymous design of the survey. This survey was set out at the onset of the SCORE study, which may have biased some SCHs respondents as they had recently received information regarding stewardship, although LCHs with active stewardship programs were likely also providing ongoing stewardship education as well.

Hospital prescribers, pharmacists, and administrators are aware of antimicrobial resistance and overuse and agree that antimicrobial stewardship programs are necessary. SCHs are less likely to have formal antimicrobial stewardship programs; therefore, care and consideration is needed to span the gap between small and large hospitals. Given that 20% to 30% of prescribers are not familiar with the term *antimicrobial stewardship* and approximately 20% do not feel antimicrobial stewardship is necessary, this survey supports the need for further education to prescribers regarding the definition of antimicrobial stewardship and its benefits for small community hospitals. Education about current available resources and better access to ID consultation in addition to antimicrobial stewardship may be the best way to improve care for patients with ID at SCHs. More evidence about the direct benefit of antimicrobial stewardship programs to patient quality and safety in the SCH setting will also be helpful. These results help support improved care for infectious diseases at SCHs, while recognizing the significant differences in resources.

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#### **REFERENCES**

1. Executive Order — Combating Antibiotic-Resistant Bacteria. White House website. <http://www.whitehouse.gov/the-press-office/2014/09/18/executive-order-combating-antibiotic-resistant-bacteria>. Published September 18, 2014. Accessed on October 1, 2014.
2. Johannsson B, Beekmann SE, Srinivasan A, Hersh AL, Laxminarayan R, Polgreen PM. Improving antimicrobial stewardship: The evolution of programmatic strategies and barriers. *Infect Control Hosp Epidemiol*. 2011;4:367-374.
3. National Center for Health Statistics. Health, United States, 2013: With special feature on prescription drugs. Centers for Disease Control and Prevention website. <http://www.cdc.gov/nchs/data/abus/abus13.pdf>. Published May 2014. Accessed on August 1, 2014.
4. Stenehjem E, Hersh AL, Greene T, Sheng X, Jones PS, Evans RS, Buckel WR, Burke J, Pavia A. Stewardship in community hospitals - optimizing outcomes and resources (SCORE): A baseline analysis of antimicrobial use utilizing CDC NHSN AU data [poster presentation]. IDWeek 2014; October 9, 2014; Philadelphia, PA.
5. Advocacy, communication and social mobilization for TB control: A guide to developing knowledge, attitude and practice surveys. World Health Organization website. [http://whqlibdoc.who.int/publications/2008/9789241596176\\_eng.pdf](http://whqlibdoc.who.int/publications/2008/9789241596176_eng.pdf). Published 2008. Accessed on November 11, 2013.
6. Abbo L, Sinkowitz-Cochran R, Smith L, et al. Faculty and resident physicians' attitudes, perceptions, and knowledge about antimicrobial use and resistance. *Infect Control Hosp Epidemiol*. 2011;7:714-718.
7. Abbo LM, Cosgrove SE, Pottinger PS, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: How are we educating our future prescribers? *Clin Infect Dis*. 2013;5:631-638.
8. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;2:377-381.
9. Evans RS, Pestotnik SL, Classen DC, et al. A computer-assisted management program for antibiotics and other anti-infective agents. *N Engl J Med*. 1998;4:232-238.
10. Pogorzelska-Maziarz M, Herzig CT, Larson EL, Furuya EY, Perencevich EN, Stone PW. Implementation of antimicrobial stewardship policies in U.S. hospitals: Findings from a national survey. *Infect Control Hosp Epidemiol*. 2015;3:261-264.
11. Kunin CM, Tupasi T, Craig WA. Use of antibiotics. A brief exposition of the problem and some tentative solutions. *Ann Intern Med*. 1973;4:555-560.



12. LaRocco A, Jr. Concurrent antibiotic review programs—a role for infectious diseases specialists at small community hospitals. *Clin Infect Dis*. 2003;5:742-743.
13. Ruttimann S, Keck B, Hartmeier C, Maetzel A, Bucher HC. Long-term antibiotic cost savings from a comprehensive intervention program in a medical department of a university-affiliated teaching hospital. *Clin Infect Dis*. 2004;3:348-356.
14. Hagert B, Williams C, Wieser C, et al. Implementation and outcome assessment of an inpatient antimicrobial stewardship program. *Hosp Pharm*. 2012;12:939-945.
15. Doron S, Nadkarni L, Lyn Price L, et al. A nationwide survey of antimicrobial stewardship practices. *Clin Ther*. 2013;35:758-765.
16. Ohl CA, Dodds Ashley ES. Antimicrobial stewardship programs in community hospitals: The evidence base and case studies. *Clin Infect Dis*. 2011;52:3-28.
17. Mehta JM, Haynes K, Wileyto EP, et al. Comparison of prior authorization and prospective audit with feedback for antimicrobial stewardship. *Infect Control Hosp Epidemiol*. 2014;9:1092-1099.
18. Pope SD, Dellit TH, Owens RC, Hooton TM. Results of survey on implementation of Infectious Diseases Society of America and Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Infect Control Hosp Epidemiol*. 2009;1:97-98.
19. Gaffin N. Reflections from an Antimicrobial Stewardship Program. *Clin Infect Dis*. 2015; 60:1588-1589.
20. Justo JA, Gauthier TP, Scheetz MH, et al. Knowledge and attitudes of doctor of pharmacy students regarding the appropriate use of antimicrobials. *Clin Infect Dis*. 2014;51:162-169.
21. Schmitt S, McQuillen DP, Nahass R, et al. Infectious diseases specialty intervention is associated with decreased mortality and lower healthcare costs. *Clin Infect Dis*. 2014;1:22-28.
22. Tissot F, Calandra T, Prod'homme G, et al. Mandatory infectious diseases consultation for MRSA bacteremia is associated with reduced mortality. *J Infect*. 2014;3:226-234.
23. Weissman S, Parker RD, Siddiqui W, Dykema S, Horvath J. Vertebral osteomyelitis: Retrospective review of 11 years of experience. *Scand J Infect Dis*. 2014;3:193-199.
24. Farmakiotis D, Kyvernitakis A, Tarrand JJ, Kontoyiannis DP. Early initiation of appropriate treatment is associated with increased survival in cancer patients with *Candida glabrata* fungemia: A potential benefit from infectious disease consultation. *Clin Microbiol Infect*. 2015;1:79-86.
25. Septimus EJ, Owens RC Jr. Need and potential of antimicrobial stewardship in community hospitals. *Clin Infect Dis*. 2011;52:8-14.
26. Reese SM, Gilmartin H, Rich KL, Price CS. Infection prevention needs assessment in Colorado hospitals: Rural and urban settings. *Am J Infect Control*. 2014;6:597-601.
27. Sunenshine RH, Liedtke LA, Jernigan DB, Strausbaugh LJ. Role of infectious diseases consultants in management of antimicrobial use in hospitals. *Clin Infect Dis*. 2004;7:934-938.
28. Chandrasekar PH. Bad news to worse news: 2015 Infectious Diseases Fellowship Match results. *Clin Infect Dis*. 2015;60:1438.
29. Parmar P, Mackie D, Varghese S, Cooper C. Use of telemedicine technologies in the management of infectious diseases: A review. *Clin Infect Dis*. 2015;60:1084-1094.
30. ASHP statement on the pharmacist's role in antimicrobial stewardship and infection prevention and control. *Am J Health Syst Pharm*. 2010;7:575-577.
31. Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Clin Infect Dis*. 2007;2:159-177.
32. Collins C, Miller D, Kenney R, et al. The state of antimicrobial stewardship in Michigan: Results of a statewide survey on antimicrobial stewardship efforts in acute care hospitals. *Hosp Pharm*. 2015;3:180-184.
33. Waters CD. Pharmacist-driven antimicrobial stewardship program in an institution without infectious diseases physician support. *Am J Health Syst Pharm*. 2015;6:466-468.
34. Rohde JM, Jacobsen D, Rosenberg DJ. Role of the hospitalist in antimicrobial stewardship: A review of work completed and description of a multisite collaborative. *Clin Ther*. 2013;6:751-757.
35. Gauthier TP, Worley M, Laboy V, et al. Clinical infectious diseases pharmacists in the United States: A problem of both supply and demand. *Clin Infect Dis*. 2015;5:826-827.
36. Ernst EJ, Klepser ME, Bosso JA, et al. Recommendations for training and certification for pharmacists practicing, mentoring, and educating in infectious diseases pharmacotherapy. *Pharmacotherapy*. 2009;4:482-488.
37. DiazGranados CA, Abd TT. Participation of clinical pharmacists without specialized infectious diseases training in antimicrobial stewardship. *Am J Health Syst Pharm*. 2011;18:1691-1692.
38. Michaels K, Mahdavi M, Krug A, Kuper K. Implementation of an antimicrobial stewardship program in a community hospital: Results of a three-year analysis. *Hosp Pharm*. 2012;8:608-616.
39. Hamilton KW, Gerber JS, Moehring R, et al. Point-of-prescription interventions to improve antimicrobial stewardship. *Clin Infect Dis*. 2015;60:1252-1258.
40. Maurer D, Stephens M, Reamy B, Crownover B, Crawford P, Chang T. Family physicians' knowledge of commonly overused treatments and tests. *J Am Board Fam Med*. 2014;5:699-703. ■