

A Nationwide Survey of Antimicrobial Stewardship Practices

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ABSTRACT

Objective: The goal of this study was to characterize hospital antimicrobial stewardship practices nationwide and to identify factors associated with the presence of these programs.

Methods: The first web-based survey was sent in 2009 to members of the Yankee Alliance and the Premier Healthcare Alliance, nationwide organizations of health-care providers. The second survey, a slightly modified version of the first, was sent in 2010 to a commercially purchased list of hospital pharmacy director e-mail addresses.

Results: A total of 406 responses were received from ~5890 providers targeted, for an overall response rate of ~7%. More than one half (206 of 406) of the respondents reported having what they considered to be a formal antimicrobial stewardship program (ASP). Among all respondents regardless of presence or absence of an ASP, 96.4% (351 of 364) were using some form of antimicrobial stewardship technique. Of those respondents working in hospitals without an ASP, 63.3% (114 of 180) had considered implementing one. After controlling for all significant variables, those that remained which were significantly associated with having an ASP were survey (Premier vs commercial), having an infectious disease consultation service, and having an infectious disease pharmacist.

Conclusions: In this survey of 406 respondents from across the country, we found that just more than one half of hospitals had what they considered to be formal ASPs; however, the vast majority were using stewardship techniques to optimize the use of antibiotics. Common barriers to implementation of ASPs included staffing constraints and insufficient funding. (*Clin Ther.* 2013;35:758–765) © 2013 Elsevier HS Journals, Inc. All rights reserved.

Key words: antimicrobial resistance, antimicrobial stewardship, antimicrobials.

INTRODUCTION

The idea that hospitals should have antimicrobial stewardship programs (ASPs) is not new. In fact, the concept of stewardship was first introduced in the 1970s.^{1,2} Today, with rising antimicrobial resistance rates reaching a crisis, and the scarcity of new antimicrobial agents in the drug development pipeline, hospital ASPs are being recognized as essential to the efforts to preserve the utility of antimicrobials for infected patients. The link between antimicrobial use and resistance is well accepted,^{3–5} and the fact that antimicrobials are overused and misused is known.⁶

Hospitals use antimicrobial stewardship activities to ensure “the optimal selection, dose, and duration of an antimicrobial that results in the best clinical outcome for the treatment or prevention of infection, with minimal toxicity to the patient and minimal impact on subsequent resistance.”⁷ In 2007, the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America⁶ published guidelines on the development of ASPs. In the wake of this publication, we conducted a survey to determine what percentage of hospitals nationwide are engaging in stewardship activities, either through formal programs or informally, and to elucidate the types of strategies being used nationwide. The goal of the survey was to identify factors associated with the

Accepted for publication May 13, 2013.

<http://dx.doi.org/10.1016/j.clinthera.2013.05.013>
0149-2918/\$ - see front matter

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presence of programs as well as barriers to their successful implementation.

METHODS

A web-based survey (SurveyMonkey) was sent by e-mail. This survey had 29 questions for respondents from hospitals with an ASP and 26 questions for respondents from hospitals without an ASP. It was first sent in July 2009 to the e-mail addresses of the hospital pharmacists from the 42 hospitals in the Yankee Alliance, a nationwide organization of health care providers. A reminder e-mail was sent to non-respondents in September 2009. The introductory message asked that the recipient forward the survey to the pharmacy director or infectious disease (ID) pharmacist. In November 2009, a link to this same survey was included in a Premier Healthcare Alliance newsletter and was included every week for 4 consecutive weeks. The Premier Healthcare Alliance includes 2500 acute care hospital members and 19 rehabilitation hospitals. The Yankee Alliance is a subset of the Premier Healthcare Alliance.

A slightly modified survey was then sent in June 2010 to a commercially purchased list of 3391 hospital pharmacy director e-mail addresses. A reminder e-mail was sent to nonrespondents in July 2010; because the commercial list is continuously updated, this e-mail was sent to 5745 addresses. This version of the survey had 5 additional questions for respondents from hospitals with an ASP and 2 additional questions for respondents from hospitals without an ASP compared with the first survey but was otherwise identical. The results were combined with the results from the first survey for analytical purposes. The second survey is included in the **Supplemental Appendix** in the online version at <http://10.1016/j.clinthera.2013.05.013>.

The surveys asked respondents to describe their role and the hospital setting in which they practice. The presence or absence of an ID consultation service, ID fellowship program, and pharmacist specializing in ID was ascertained. Respondents stating that their hospital had an ASP were given 1 set of questions, whereas respondents stating their hospital had no ASP were given another set. No definition of ASP was provided in the survey, as the investigators incorrectly assumed none was needed. Respondents who stated that their hospital had an ASP were asked about the characteristics of that program such as its year of

implementation, techniques used, role of ID fellows, classes of antibiotics restricted, and perceived level of clinician satisfaction with the program. These respondents were asked to specify how success of the program was measured. Respondents without an ASP were asked about the use of specific stewardship techniques and educational programs related to antibiotic use. They were also asked to describe barriers to formal program implementation.

The study was determined to qualify for exempt status from the Tufts Medical Center institutional review board, and a waiver of documentation of informed consent was granted.

Statistical Analysis

Hospital and respondent characteristics were summarized by using descriptive statistics. Univariate analysis of the association between hospital and respondent characteristics and presence of an ASP were performed by using a χ^2 test and Fisher's exact test. Factors that were significant with a P value <0.1 in the univariate analyses were included in the multivariable model, which was performed by using logistic regression.⁸ Survey number (first vs second) was forced into the model. We checked model fit via a Hosmer-Lemeshow goodness-of-fit test. We checked for influential points by examining df-beta values as well as leverage and deviance residuals for each model.

RESULTS

Survey responses are described in the following sections. Denominators differ for each survey question and in each case represent the number of respondents who answered that question.

Characteristics of Respondents

A total of 406 responses were received from ~5890 providers targeted (127 responses from the first survey and 279 from the second survey), for an overall response rate of ~7%. Responses came from all 50 states and Puerto Rico, with the exception of North and South Dakota. The largest proportion of responses (40%) came from the Northeast region of the country, with the South, Midwest, and West making up 25%, 20%, and 16% of the responses, respectively. The hospital demographic characteristics of respondents in the first survey are representative of Premier hospitals. Whereas 42% of all Premier

hospitals are nonteaching, 39% of respondents were from nonteaching hospitals; similarly, 45% of Premier hospitals have bed sizes between 100 and 300, whereas 35% of respondents were from hospitals that size. Characteristics of nonrespondents in the second survey are not available because the company providing the e-mail list does not maintain such information. The practice areas of the respondents and characteristics of the hospitals in which they work are presented in **Table I**.

Characteristics of Antimicrobial Stewardship Activities

More than one half (206 of 406) of respondents reported having what they considered to be a formal ASP. Of those programs that responded to more specific questions about their characteristics, 54.3% (100 of 184) had existed for at least 1 year. Approximately 38% (52 of 136) of programs were being used for both adult and pediatric patients, whereas 58.8% (80 of 136) were being used just for adults and 2.9% (4 of 136) just for pediatric patients. ASP teams were comprised of a variety of provider types, including ID physicians (70.7% [130 of 184]), ID pharmacists (59.2% [109 of 184]), infection control professionals (51.1% [94 of 184]), and clinical microbiologists (38.6% [71 of 184]). Among hospitals that had an ID fellowship program and responded to the question about the role of fellows in stewardship, in 34.5% (10 of 29) of these hospitals, fellows were not involved in the approval of antibiotics, whereas fellows approved antibiotics all the time in 34.5% (10 of 29) and some of the time in 20.7% (6 of 29); 10.3% (3 of 29) reported that they did not fall into any of these categories.

The survey assessed the utilization of 8 stewardship techniques: antimicrobial restriction (further categorized as “front-end” approach or preauthorization required, “back-end” or postprescriptive review, verbal approval required, ID consultation required, and automatic stop orders [these categories not being mutually exclusive]), guidelines/clinical pathways, parenteral to oral conversion programs, dose optimization, streamlining/de-escalation protocols, closed formulary, antimicrobial cycling, and antimicrobial order forms. Among all respondents regardless of presence or absence of an ASP, 96.4% (351 of 364) were using some form of antimicrobial stewardship technique. Approximately 93% (168 of 180) of

Table I. Characteristics of survey participants.

Characteristic	No. (%) [*]
Practice area of respondent	
Pharmacy director	201 (50)
Clinical pharmacist/coordinator/other	135 (33)
ID pharmacist/physician	69 (17)
Licensed beds	
< 100	117 (29)
101–300	154 (38)
301–500	83 (20)
> 500	51 (13)
Annual admissions	
< 2500	83 (20)
2501–5000	51 (13)
5001– 10,000	65 (16)
> 10,000	105 (26)
Unknown	101 (25)
Health care system type	
Not a teaching hospital	146 (36)
Rural/critical access	81 (20)
Acute/rehabilitation	27 (7)
University (affiliated) hospital	83 (20)
Nonuniversity teaching hospital	68 (17)
Hospital has ID consultation service	
Yes	303 (75)
No	102 (25)
Hospital has ID pharmacist	
Yes	141 (35)
No	258 (64)
Unknown	6 (1)
Hospital has ID fellowship	
Yes	40 (11)
No	364 (89)
Hospital has a published antibiogram	
Yes	368 (91)
No	27 (7)
Unknown	10 (2)
Antimicrobial % of total pharmacy drug budget	
< 10	34 (8)
10–15	108 (27)
16–25	107 (26)
> 26	39 (10)
Unknown	117 (29)

ID = infectious disease.

^{*}Denominators differ for each survey question and in each case represent the number of respondents who answered that question.

respondents who did not consider their hospital to have an ASP reported that their hospital used at least 1 type of stewardship technique. The most common techniques being used by hospitals without formal ASPs were guidelines/clinical pathways (65.6% [118 of 180]) and parenteral to oral conversion programs (63.9% [115 of 180]). All of the antimicrobial stewardship techniques asked about in the survey, with the exception of antibiotic cycling and having a closed formulary, were statistically more likely to be used by institutions reporting a formal ASP. Having an ASP and being a larger hospital were significantly associated with the practice of restricting antibiotics. Of institutions with an ASP, 64.1% (118 of 184) used >1 technique, compared with 46.7% (84 of 180) of institutions without an ASP. Teaching hospitals and larger (>300 beds) hospitals were significantly more likely to use guidelines and clinical pathways ($P = 0.01$ and $P = 0.006$, respectively), streamlining and de-escalation protocols ($P = 0.02$ and $P < 0.0001$), and front-end (preauthorization required) type restriction approaches ($P < 0.0001$ and $P < 0.0001$). Larger hospitals were also significantly more likely to use dose optimization protocols ($P = 0.0003$) and have parenteral to oral conversion programs ($P < 0.0001$). Teaching hospitals were significantly less likely to use automatic stop orders ($P = 0.04$).

In the second survey, respondents additionally reported on the antibiotic classes restricted at their hospitals. More than one half of respondents reported restrictions on the use of antifungals (59.6%), carbapenems (58.8%), linezolid (57.7%), daptomycin (56.3%), and tigecycline (51.1%). Only 5.2% reported having no antimicrobial restrictions.

Of those respondents with an ASP, success of the program was most frequently measured by using changes in annual expenditures (60.3% [111 of 184]). Other methods used to measure success were antimicrobial resistance patterns (58.7% [108 of 184]) and frequency of recommendation acceptance (44.6% [82 of 184]). Almost 40% (73 of 184) of hospitals with an ASP were using some type of software program to facilitate their stewardship activities.

Barriers to Implementation of an ASP

Of those respondents working in hospitals that they claimed did not have an ASP, 63.3% (114 of 180) had considered implementing such a program. The most

common barriers to implementation were staffing constraints (69.4% [125 of 180]), funding (50.6% [91 of 180]), insufficient medical staff buy-in (32.8% [59 of 180]), not high on the list of priorities (22.2% [40 of 180]), and too many other things on the table (42.8% [77 of 180]). Respondents from nonteaching hospitals were significantly more likely to report staffing constraints as a barrier to implementation of an ASP ($P = 0.02$). Respondents from smaller hospitals were more likely to report that there was insufficient medical staff buy-in at their hospital to support an ASP ($P = 0.02$), that implementing an ASP was not high on their hospital's list of priorities ($P = 0.009$), and that there were too many other things on the table ($P = 0.02$). Respondents from nonteaching and smaller hospitals were more likely to report that an organized program had not been proposed ($P = 0.02$ and $P = 0.01$, respectively). Of those respondents from hospitals without an ASP, only 26.2% (28 of 107) reported being satisfied with the degree to which clinicians streamline or de-escalate therapy based on culture results, which was similar to the 27.2% (37 of 136) reported by respondents from hospitals with an ASP. Only 41.1% (44 of 107) of respondents from hospitals without an ASP reported that they perceived that a majority of clinicians at their institution approve of the idea of restrictions on antimicrobials compared with 66.9% (91 of 136) of respondents from hospitals with an ASP.

Factors Associated With Having an ASP

Using US census bureau divisions, there was no association between the geographic region in which the respondent practiced and the presence of an ASP (Figure). There was no greater likelihood of having an ASP in California, where monitoring and evaluating the utilization of antibiotics is mandated by law ($P = 0.15$), than anywhere else in the country.

In univariate analysis (Table II), having an ASP was associated with having an ID consultation service, an ID fellowship program, an ID pharmacist, a higher number of beds, >10,000 annual admissions, and a published antibiogram; and being a teaching hospital. Respondents in the Premier (first) survey were more likely to report having an ASP than respondents in the commercial (second) survey. Significant variables on univariate analysis were included in the multivariate model, but because of the large amount of missing data about number of admissions, only number of

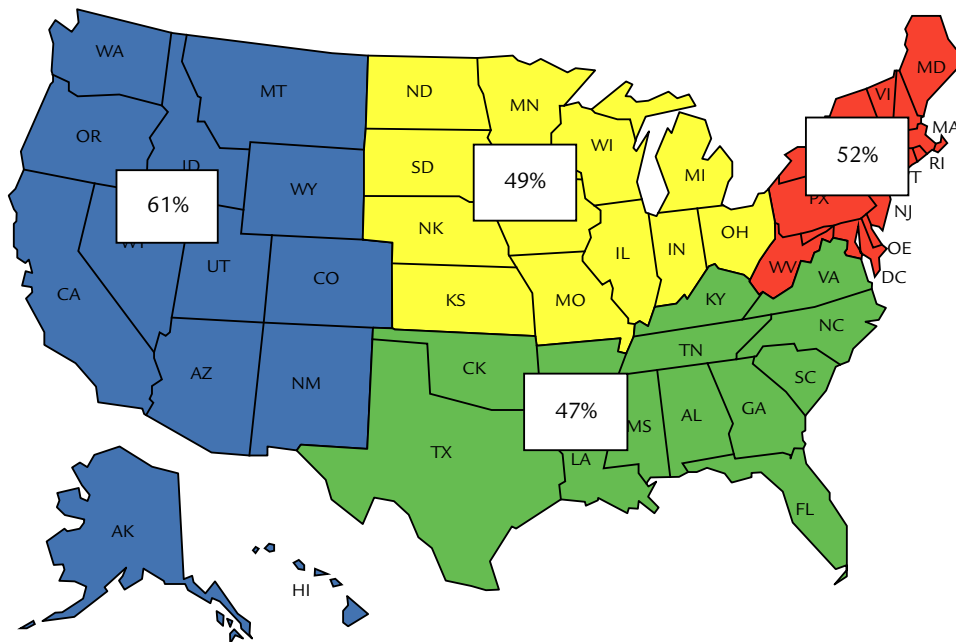


Figure. Percentage of antimicrobial stewardship programs by region.

beds was included in the model. After controlling for all significant variables, the variables that remained significantly associated with having an ASP were survey (Premier vs commercial), having an ID consultation service, and having an ID pharmacist.

DISCUSSION

In this survey with 406 respondents from across the country, we found that although only just over one half of hospitals had what they considered to be formal ASPs, 96.4% were using stewardship techniques to optimize the use of antibiotics. This finding is consistent with results from a survey done by Pope et al⁹ targeting the membership lists of the Society for Healthcare Epidemiology of America and Premier, which demonstrated that although only 48% of hospitals reported having an ASP, there was little difference between hospitals with and without an ASP in the proportion using various supplemental stewardship strategies. This finding highlights an important omission from this and previous survey studies on the prevalence of ASPs: the provision of a definition for the phrase “antimicrobial stewardship program.” Although nearly all of the hospitals in our survey were engaged in stewardship activities, a much smaller proportion identified these activities

as being consistent with having a “program,” and it is likely that each respondent defines this term differently. Given our finding that nearly all hospitals have embraced the importance of stewardship strategies and are using them, the distinction between having a formal stewardship program and not having one is becoming blurred. This finding may explain the differences in findings between the various survey studies that have been conducted.^{10–13} Indeed, authors of a 2008 survey of 68 Canadian hospitals reported an ASP prevalence of 74%,¹¹ but the unusual definition of an ASP in that survey (translated from the French: “a qualitative antibiotic utilization surveillance program”) is likely the reason for that high number.

Our survey found a prevalence of formal ASPs that was lower than that reported in 2011 by the Infectious Diseases Society of America Emerging Infections Network (EIN), which found a prevalence of active ASPs of 61%.¹⁰ This difference can easily be explained by the fact that all of the respondents in that survey were members of the EIN, which means that they must be ID specialists and members of the Infectious Diseases Society of America. These requirements for membership limit the applicability of the results from the EIN survey to the general population of US

Table II. Factors associated with having an antimicrobial stewardship program (ASP).

Hospital Characteristic			Univariate		Multivariable	
	ASP No. (%) [†]	Non-ASP No. (%) [†]	Odds Ratio	<i>P</i>	Odds Ratio	<i>P</i>
Has ID consultation service	177 (86%)	125 (63%)	3.79	<0.0001	3.54	0.0005
ID consultation service private*	73 (42%)	44 (36%)	1.29	0.30		
Has ID pharmacist	109 (53%)	32 (16%)	5.84	<0.0001	3.86	<0.0001
Has ID fellowship	27 (15%)	13 (7%)	2.22	0.02	0.80	0.63
Teaching hospital	94 (46%)	57 (29%)	2.13	0.0003	1.07	0.83
No. of beds				<0.0001		0.36
< 100	42 (21%)	75 (38%)	Reference		Reference	
101–300	74 (36%)	80 (40%)	1.65	0.05	0.78	
301–500	50 (24%)	33 (17%)	2.71	0.0008	1.14	
> 500	39 (19%)	12 (5%)	5.80	<0.0001	0.63	
Has a published antibiogram	193 (97%)	175 (90%)	3.15	0.01	1.59	0.39
No. of admissions				<0.0001		
< 1000	16 (10%)	20 (13%)	Reference			
1001–2500	16 (10%)	30 (20%)	0.67	0.37		
2501–5000	19 (13%)	33 (22%)	0.72	0.46		
5001–10,000	25 (17%)	40 (26%)	0.78	0.56		
> 10,000	76 (50%)	29 (19%)	3.28	0.003		
Antimicrobial percentage of budget				0.17		
< 10	16 (11%)	18 (13%)	Reference			
10–15	63 (42%)	45 (32%)	1.58			
16–25	47 (32%)	60 (43%)	0.88			
> 25	22 (15%)	17 (12%)	1.46			
Survey (Premier vs commercial)	156 (76%)	123 (62%)	1.99	0.002	2.26	0.002

*Only for those with an infectious disease (ID) consultation service.

[†]Denominators differ for each survey question and in each case represent the number of respondents who answered that question.

hospitals, many of which do not have ID specialists on staff.

In our survey, of hospitals without a formal ASP program, 63% had considered implementing one. This reflects appreciation by providers of the importance of stewardship activities in general, and formal stewardship programs in particular, in this era of worsening antimicrobial resistance. Nevertheless, the more difficult task of overcoming barriers to implementation remains. Staffing constraints and funding issues were, not surprisingly, the most common barriers to implementation of programs. Institutional commitment to stewardship is clearly not universal, despite the ubiquitous problem of antimicrobial resistance, and will be

essential to more widespread implementation of stewardship programs.

There was no association between the presence of a formal ASP and geography, in contrast to the EIN study,¹⁰ which used the same US census bureau regions and found a lower prevalence of ASPs in the East North Central region. In California, a 2006 state Senate bill, now part of the state's health and safety code,¹² mandated that by 2008 general acute care hospitals monitor and evaluate the utilization of antibiotics and establish a quality improvement committee to do so. The California Department of Public Health has established a formal assistance program for this purpose. In our survey, California had an ASP prevalence of 66.7%, which was not

statistically significantly greater than that of the rest of the country. In a similar survey to ours conducted within the state of California overlapping in time frame but continuing for another year, a 50% ASP prevalence was found.¹²

After controlling for confounders, factors associated with having a formal ASP in the current study included having an ID consultation service and having a pharmacist specializing in ID. In contrast to the EIN survey,¹⁰ being a larger hospital and being a teaching hospital were not associated with having an ASP nor was having an ID fellowship program. These findings should provide some reassurance to smaller and nonteaching hospitals (ie, that similar hospitals are achieving the goal of implementing stewardship programs with the same success rate as their larger and academically affiliated counterparts).

A major limitation of the current study is the response rate of ~7%. We were unable to quantify the precise response rate because requests to participate in the survey were included in the Premier Healthcare Alliance Pharmacy News Update, and we cannot know how many people read those newsletters. Furthermore, duplicate responses from the same institution may have occurred. The low response rate is most certainly associated with response bias, possibly resulting in individuals from hospitals with ASPs being more likely to respond because it is a topic of interest to them. Nevertheless, our study reports on a large number of hospitals that are varied in their characteristics and distributed across the entire country. With 406 responses, it is, to our knowledge, the largest published study on antimicrobial stewardship with the exception of the EIN survey mentioned earlier,¹⁰ which had 471 evaluable responses.

CONCLUSIONS

Our survey found widespread implementation of antimicrobial stewardship techniques, with the vast majority of responding hospitals engaging in stewardship activities even in the absence of a formal ASP. Identifying these activities as stewardship in individual institutions may serve to garner administrative support and potential funding. Indeed, the 2012 Policy Statement on Antimicrobial Stewardship by the Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America, and the Pediatric Infectious Diseases Society calls on the Centers for Medicare & Medicaid Services to require health care institutions

to develop stewardship programs. Their definition of a “program” is intentionally vague and leaves room for institutions to use the various approaches to stewardship commensurate with their available resources.¹³ However, barriers to implementation of stewardship programs are common. Resources from internal hospital as well as state or regional sources need to be allocated to this important public health initiative.

ACKNOWLEDGMENTS

This study was supported in part by a research grant from the Investigator-Initiated Studies Program of Merck Sharp & Dohme Corp. The opinions expressed in this article are those of the authors and do not necessarily represent those of Merck. Shira Doron obtained the grant funding, oversaw the study conduct, and wrote and revised the manuscript. Lauren Nadkarni managed the day to day aspects of the study, created the database, maintained and analyzed the data, and substantially contributed to the writing of the manuscript.

Lori Lyn Price conducted the statistical analysis and contributed to the writing and editing of the manuscript.

Kenneth Lawrence assisted with the development of the survey and analysis of the data. Lisa Davidson assisted with the development of the survey and analysis of the data. Jack Evans facilitated the communication with the Yankee Alliance and Premier providers, provided demographic data, contributed to the development of the survey, and assisted in the analysis of the data.

CONFLICTS OF INTEREST

The authors have indicated that they have no conflicts of interest regarding the content of this article.

SUPPLEMENTAL MATERIAL

Supplemental appendix accompanying this article can be found in the online version at doi: <http://10.1016/j.clinthera.2013.05.013>.

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Survey of ASPs

1. Section 1: Demographics

In an effort to characterize antimicrobial stewardship practices in healthcare systems, the Division of Infectious Diseases at Tufts Medical Center is conducting this important survey to assess the antimicrobial stewardship methods at individual hospitals. Our goal is to characterize current antimicrobial practices and to better understand the efficacy and success of these programs.

Please take ~10 minutes to complete this national survey, the largest of its kind to date.

Note: this survey is best completed by ONE ID pharmacist, pharmacy director, or ID physician per institution. The responding institutions will be de-identified and results from this survey will be returned to each participant for use in the continual development or initiation of a stewardship program.

*** 1. How would you best describe your position at your facility?**

- ID pharmacist
- Pharmacy Director
- ID Physician
- Other (please specify)

*** 2. How would you classify your healthcare system?**

- University teaching hospital.
- University -affiliated teaching hospital.
- Non - university teaching hospital.
- Not a teaching hospital.
- Rural or critical access
- Acute/Rehab

*** 3. What is the number of licensed beds in your facility?**

- Fewer than 100
- Between 101 and 300
- Between 301 and 500
- More than 500

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*** 4. What is the average annual number of admissions for your healthcare facility?**

- Less than 1,000
- Between 1,001 and 2,500
- Between 2,501 and 5,000
- Between 5,001 and 10,000
- More than 10,000
- I do not know.

5. What state is your institution located in?

State:

6. If you know the average monthly case mix index for your healthcare system, please enter it here.

*** 7. Does your facility produce a cumulative susceptibility guide (i.e. antibiogram)?**

- Yes
- No
- I don't know

8. If the answer to question 6 is yes, how frequently is your cumulative susceptibility guide (antibiogram) produced?

- Every six months
- Yearly
- Less than yearly
- Other (please specify)

9. If the answer to question 6 is yes, what is the publication date of your current cumulative susceptibility guide (antibiogram)?

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*** 10. Would you be willing to share specific antimicrobial purchase information in the future for additional analysis?**

- Yes
- No

11. What is the total yearly antimicrobial expenditure (antibacterials and antifungals only) at your institution?

*** 12. What percent of the total inpatient pharmacy drug budget is represented by antimicrobials (antibacterials and antifungals only)?**

- Less than 10%
- Between 10% and 15%
- Between 16% and 25%
- Greater than 26%
- I do not know.

*** 13. Does your institution have an Infectious Disease consult service?**

- Yes, full -time.
- Yes, part -time.
- No.

14. If your institution has an Infectious Disease consult service, are your consultants any of the following?

- Private
- Hospital -based
- Combination of private and hospital based
- Other (please specify)

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*** 15. Does your institution have a pharmacist dedicated to the management of antimicrobials?**

- Yes
- No
- I don't know

*** 16. Does your institution have an antimicrobial stewardship program?**

- Yes
- No

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2. Section 2: Institutions with an Antimicrobial Stewardship Program

*** 1. If you have an antimicrobial stewardship team at your facility, who comprises it? Check all that apply.**

- Infectious Disease Physician(s)
- Infectious Disease Pharmacist(s)
- Clinical Microbiologist
- Information system specialist
- Infection control professional
- Hospital Epidemiologist
- We have no formal "team"
- Other (please specify)

*** 2. How long ago was the stewardship program put in place?**

- It is in development
- It is just starting
- Less than 1 year ago
- 1-3 years ago
- Greater than 3 years ago

*** 3. Is your program utilized for adults, pediatrics, or both?**

- Adults only
- Pediatrics only
- Both adults and pediatrics

Please explain, if necessary

Survey of ASPs

*** 4. Which of the following educational techniques are used to educate prescribers about appropriate prescription of antimicrobials? Check all that apply.**

- Newsletter
- Email
- Grand Rounds
- Conferences
- None
- Other (please specify)

*** 5. Does your institution have an ID fellowship program?**

- Yes
- No

6. If the answer to question 4 is yes, what is the level of involvement of the ID fellow in the antimicrobial stewardship program?

- The ID fellow approves restricted antimicrobials
- The ID fellow approves restricted antimicrobials at certain times only, e.g. nights or weekends
- The ID fellow does not approve restricted antimicrobials
- Other (please specify)

*** 7. Does your institution utilize any of the following restriction methods? Check all that apply.**

- A "front end" approach in which specific antimicrobials are only dispensed after approval is obtained.
- A "back end" approach in which antimicrobials are prescribed but are subject to prospective audit.
- Automatic stop orders
- ID Consult required
- Verbal approval required (telephone or face to face)
- Other (please specify)

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8. If a "front end" approach is used, who is responsible for providing the approval for restricted antibiotics? Check all that apply.

- ID Physician on the Antimicrobial Stewardship team
- ID Pharmacist
- ID Fellow
- Other (please specify)

*** 9. Does your institution have a specific group that approves formulary restrictions?**

- No
- I do not know.
- Yes (please specify)

*** 10. Which of the following antimicrobial stewardship techniques are utilized by your institution? Check all that apply.**

- Guidelines and Clinical Pathways
- Antimicrobial cycling
- Antimicrobial order forms
- Streamlining or de-escalation of therapy
- Dose optimization
- Parenteral to oral conversion
- Closed Formulary
- None
- Other (please specify)

Survey of ASPs

* 11. Are you satisfied with the degree to which clinicians at your institution streamline or de - escalate therapy based on culture data?

Yes

No

Please explain:

* 12. Are any of the following medications or medication classes on formulary at your institution? Check all that apply.

Piperacillin - Tazobactam

Gatifloxacin

Amphotericin B Products

Ticarcillin - Clavulanate

Cefepime

Daptomycin

Ampicillin - Sulbactam

Ceftazidime

Linezolid

Ertapenem

Ceftriaxone

Fluconazole

Meropenem

Cefotaxime

Voriconazole

Imipenem

Cefoxitin

Posaconazole

Doripenem

Cefazolin

Micafungin

Moxifloxacin

Tigecycline

Caspofungin

Levofloxacin

Vancomycin

Anidulafungin

Ciprofloxacin

Polymyxin E (Colistin)

Other (please specify)

Survey of ASPs

*** 13. Are there any restrictions on the following medications or medication classes? Check all that apply.**

Other	Restricted by time	Restricted by provider	ID consult required	Other restrictions
Piperacillin - Tazobactam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin - Clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin - Sulbactam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ertapenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meropenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doripenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moxifloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Levofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gatifloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefepime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftriaxone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefotaxime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tigecycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin E (Colistin)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amphotericin B Products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Daptomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Linezolid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fluconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voriconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Posaconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Micafungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Caspofungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anidulafungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please describe other restriction methods or agents that are not on this list

Survey of ASPs

*** 14. What is your perception of the extent to which physicians at your institution agree with the restrictions on antimicrobials?**

- The vast majority agree.
- A small majority agree.
- The physicians are neutral.
- A small majority disagree.
- The vast majority disagree.
- I do not know.

*** 15. How does your institution measure the effectiveness of the antimicrobial stewardship program? Check all that apply.**

- Total antimicrobial expenditures
- Antimicrobial resistance
- Frequency of physicians' acceptance of the antimicrobial stewardship team's recommendations
- We do not measure the effect of the antimicrobial stewardship program
- Other (please specify)

*** 16. What is your perception of the percent of the total number of requests for restricted antimicrobials that is denied?**

- Less than 10%
- Between 10% and 25%
- Between 26% and 50%
- More than 50%
- I do not know.

Survey of ASPs

*** 17. Does your institution use proprietary or self developed software to facilitate your antimicrobial stewardship program?**

- No
- Self Developed
- I don't know
- Proprietary (please specify name of program).

18. Comments/concerns/challenges.

Survey of ASPs

3. Section 3: Institutions without Antimicrobial Stewardship Program

*** 1. Has your institution ever considered having an antimicrobial stewardship program? If your answer is "yes", jump to question 3. If your answer is "no", continue on to question 2. If your answer is "I don't know" jump to question 4.**

- Yes
- No
- I don't know

2. If your institution has not ever considered having an antimicrobial stewardship program, why not? Check all that apply. If this question applies to you, jump to question 4 after you complete this question.

- Funding
- Staffing constraints
- Insufficient medical staff buy-in
- Not high on the list of priorities
- Too many other things on the table
- Organized program has not been proposed
- Other (please specify)

3. If your institution has considered having an antimicrobial stewardship program, why has it not been implemented? Check all that apply.

- Funding
- Staffing constraints
- Insufficient medical staff buy-in
- Not high on the list of priorities
- Too many other things on the table
- Organized program has not been proposed
- Other (please specify)

Survey of ASPs

* 4. If your institution implemented an antimicrobial stewardship program, would it be utilized for adults, pediatrics, or both?

- Adults only
- Pediatrics only
- Both adults and pediatrics

Please explain, if necessary

* 5. Does a formal education program exist to educate prescribers about the appropriate prescription of antimicrobials?

- Yes
- No
- I do not know

6. If the answer to question 4 is yes, which of the following educational techniques is utilized? Check all that apply.

- Newsletter
- Email
- Grand Rounds
- Conferences
- Other (please specify)

* 7. Does your institution have an ID fellowship program?

- Yes
- No

Survey of ASPs

*** 8. Does your institution utilize any of the following restriction methods?**

Check all that apply.

- A "front end" approach in which specific antimicrobials are only dispensed after approval is obtained.
- A "back end" approach in which antimicrobials are prescribed but are subject to prospective audit.
- Automatic stop orders
- ID consult required
- Verbal approval required (telephone or face to face)
- None
- Other (please specify)

9. If a "front end" approach is used, who is responsible for providing the approval for restricted antibiotics? Check all that apply.

- ID Physician
- ID Pharmacist
- ID Fellow
- Other (please specify)

*** 10. Does your institution have a specific group that approves formulary restrictions?**

- No
- I don't know.
- Yes (please specify)

Survey of ASPs

*** 11. Please check any techniques that your institution uses with regards to antimicrobials.**

- Guidelines and Clinical Pathways
- Antimicrobial cycling
- Antimicrobial order forms
- Streamlining or de-escalation of therapy
- Dose optimization
- Parenteral to oral conversion
- Closed Formulary
- None
- Other (please specify)

*** 12. Are you satisfied with the degree to which clinicians at your institution streamline or de-escalate therapy based on culture data?**

- Yes
- No

Please explain:

Survey of ASPs

*** 13. Are any of the following medications or medications on formulary at your institution? Check all that apply.**

- | | | |
|---|---|--|
| <input type="checkbox"/> Piperacillin -Tazobactam | <input type="checkbox"/> Gatifloxacin | <input type="checkbox"/> Amphotericin B Products |
| <input type="checkbox"/> Ticarcillin -Clavulanate | <input type="checkbox"/> Cefepime | <input type="checkbox"/> Daptomycin |
| <input type="checkbox"/> Ampicillin -Sulbactam | <input type="checkbox"/> Ceftazidime | <input type="checkbox"/> Linezolid |
| <input type="checkbox"/> Ertapenem | <input type="checkbox"/> Ceftriaxone | <input type="checkbox"/> Fluconazole |
| <input type="checkbox"/> Meropenem | <input type="checkbox"/> Cefotaxime | <input type="checkbox"/> Voriconazole |
| <input type="checkbox"/> Imipenem | <input type="checkbox"/> Cefoxitin | <input type="checkbox"/> Posaconazole |
| <input type="checkbox"/> Doripenem | <input type="checkbox"/> Cefazolin | <input type="checkbox"/> Micafungin |
| <input type="checkbox"/> Moxifloxacin | <input type="checkbox"/> Tigecycline | <input type="checkbox"/> Caspofungin |
| <input type="checkbox"/> Levofloxacin | <input type="checkbox"/> Vancomycin | <input type="checkbox"/> Anidulafungin |
| <input type="checkbox"/> Ciprofloxacin | <input type="checkbox"/> Polymyxin E (Colistin) | |
| <input type="checkbox"/> Other (please specify) | | |

Survey of ASPs

*** 14. Are there any restrictions on the following medications or medication classes? Check all that apply.**

	Restricted by time	Restricted by provider	ID consult required	Other restrictions
Piperacillin - Tazobactam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ticarcillin -Clavulanate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ampicillin -Sulbactam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ertapenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meropenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imipenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Doripenem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moxifloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Levofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ciprofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gatifloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefepime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftazidime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ceftriaxone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefotaxime	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefoxitin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cefazolin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tigecycline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vancomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polymyxin E (Colistin)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amphotericin B Products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Daptomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Linezolid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fluconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voriconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Posaconazole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Micafungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Caspofungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anidulafungin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please describe other restriction methods or agents that are not on this list

Survey of ASPs

*** 15. What is your perception of the extent to which physicians at your institution agree with the idea of restricting antimicrobials?**

- The vast majority agree.
- A small majority agree.
- The physicians are neutral.
- A small majority disagree.
- The vast majority disagree.
- I do not know.

Survey of ASPs

4. Section 4: Almost done!

1. Thank you for completing this survey!

Please provide your contact information below. This information is optional but strongly encouraged, and will be used to clarify responses, obtain additional information, and return the blinded study results.

Data will be shared with participants who provide contact information in order to help them with their practice. If you wish to receive the results of this survey and/or are willing to be contacted with any questions or clarifications to your responses, you **MUST** complete this section.

Name:

E-mail Address:

Phone Number:

Position/Title:

Associated Institution/Facility:

* 2. Would you be interested in joining a collaboration or listserv for future discussion of antimicrobial stewardship programs?

- Yes
- No

* 3. Are you receptive to filling out a similar follow-up questionnaire?

- Yes
- No

Survey of ASPs

4. Please enter any comments, concerns, or challenges that you wish to share in regards to antimicrobial stewardship initiatives. This may include any suggestions for questions to be included or excluded on a future survey.

Please be sure to click the "done" button below when you are finished. You will then be redirected to a screen confirming that you have successfully completed the survey.

Thank you once again!