

A Deeper Dive Into Antibiotic Stewardship Needs: A Multihospital Survey

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In a 2016 survey of 46 Michigan hospitals, we identified four key needs for antibiotic stewardship: clinically-relevant antibiotic data, monitoring compliance, syndrome-specific interventions, and discharge stewardship. A stewardship initiative now addresses these needs within the Michigan Hospital Medicine Safety Consortium.

Keywords. antibiotic stewardship; infection prevention; survey.

Antibiotic stewardship programs improve outcomes by reducing adverse events, such as *Clostridioides difficile* infection and antibiotic resistance. Thus, The Joint Commission (TJC) began requiring that US hospitals have stewardship programs for accreditation in 2017 [1]. Because TJC focused on the Centers for Disease Control and Prevention's (CDC) core elements for antibiotic stewardship, the requirement resulted in a substantial increase in their use [2]. Because multiple aspects of stewardship can improve care, the core elements allow flexibility in how hospitals implement stewardship [3]. This flexibility has allowed most hospitals to meet core elements and TJC requirements [3]. Regardless, many small, nonacademic hospitals have

limited ability to execute the more resource-intensive strategies that may be more impactful elements of stewardship [2, 3].

One way for hospitals to overcome barriers to stewardship implementation is by joining or establishing regional collaborative quality initiatives. These regional organizations allow hospitals to pool resources, benchmark data, and share successful strategies [4–7]. The Michigan Hospital Medicine Safety Consortium (HMS) is one such statewide initiative. Previously, HMS has improved care related to venous thromboembolism and peripherally inserted central catheters [8, 9]. However, it was unclear what gaps in hospital-based stewardship could be fulfilled through such a statewide collaborative given the diversity of hospitals (eg, multiple payers, owners, etc) and existing stewardship interventions. Furthermore, HMS offered an ideal platform to assess statewide variation in antibiotic stewardship practices given this history of collaboration and engagement in patient safety. Thus, we surveyed the 46 hospitals participating in HMS immediately before the start of TJC's stewardship requirement to assess current practices and needs related to antibiotic stewardship.

METHODS

Data Collection

Between September 30, 2016 and November 7, 2016, surveys were e-mailed to 46 hospitals voluntarily participating in HMS, which includes 50% of the noncritical access, nonfederal hospitals in Michigan. The data abstractor (typically a nurse in quality) at each hospital completed the survey and was responsible for working with local individuals to ensure accuracy.

Survey Measures and Data Analysis

The survey assessed antibiotic stewardship program characteristics including those related to the 2014 CDC core elements of “Action,” “Tracking,” “Reporting,” and “Education” (survey in Appendix) [10]. Descriptive statistics are reported for responses. Because small hospitals may have limited capacity to individualize interventions, we compared presence of facility-specific treatment recommendations and syndrome-specific interventions between hospitals with ≤ 200 vs >200 beds, using 2-sided Fisher's exact, χ^2 , or t tests, as appropriate (StataSE version 14).

RESULTS

Survey response rate was 100% (46 of 46 hospitals). With the exception of 2 small community hospitals, all hospitals reported having an antibiotic stewardship program (96%, 44 of 46). Most stewardship programs reported collaborating with CDC-defined “key support” groups, although partnering with

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Table 1. Antibiotic Stewardship Program Interventions and Policies in the Michigan Hospital Medicine Safety Consortium (N = 46 Hospitals)

Question	Hospitals, N (%)
Stewardship Collaboration (“Key Support” Groups Under “Accountability” CDC Core Element)	
Infection Prevention and Healthcare Epidemiology	41 (89%)
Microbiology (Laboratory)	39 (85%)
Infectious Diseases Physician	37 (80%)
Noninfectious Diseases Physician	36 (78%)
Quality Improvement	35 (76%)
Information Technology	31 (67%)
Nursing	17 (37%)
Stewardship Interventions (“Action” CDC Core Element)	46 (100%)
Policies that Support Optimal Antibiotic Use	
Any Policy Related to Antibiotic Documentation	37 (80%)
Require Documentation of Antibiotic Dose	36 (78%)
Require Documentation of Antibiotic Indication	21 (46%)
Require Documentation of Intended Antibiotic Duration	8 (17%)
Broad Stewardship Interventions	
Restricted Formulary for Some Antibiotics ^a	42 (91%)
Prospective Audit and Feedback for Some Antibiotics	41 (89%)
Preprescription Approval (Prior Authorization) for Some Antibiotics	36 (78%)
“Antibiotic Timeout” to Review Antibiotics at 48–72 hours	6 (13%)
Pharmacy (or Electronic Medical Record) Interventions	
Antibiotic Dose Adjustments for Organ Dysfunction	45 (98%)
Automatic Changes from Intravenous to Oral in Certain Situations	37 (80%)
Antibiotic Dose Optimization for Organisms with Reduced Susceptibility	34 (74%)
Alerts for Unnecessarily Duplicative Therapy	31 (67%)
Time-Sensitive Automatic Stop Orders	24 (52%)
Facility-Specific Treatment Recommendation for Any Infection	45 (98%)
Any Syndrome-Specific Intervention	32 (70%)
Other Stewardship Interventions^a	
Order Sets that Incorporate Facility-Specific Treatment Recommendations	42 (91%)
Order Sets Contain Decision-Support	28 (61%)
Review of Outpatient Antibiotic Orders Before Discharge	8 (17%)
Antibiotic Monitoring (“Tracking” CDC Core Element)	46 (100%)
Monitor Facility-Wide Antibiotic Prescribing	
By Direct Expenditure (purchasing costs)	30 (65%)
By Count of Antibiotic Administered (day of therapy)	19 (41%)
By Individual Antibiotics	16 (35%)
By Unit Level	6 (13%)
By Service level (eg, hospitalists, surgeons)	7 (15%)
By Diagnosis (eg, diagnosis code)	3 (6%)
By Grams of Antibiotics Used (defined daily dose)	12 (26%)
Submit to CDC’s National Healthcare Safety Network Antimicrobial Use and Resistance Module	8 (17%)
Antibiotic Use Process Measures	
Monitor Compliance with their Antibiotic Documentation Policy	24 (52%)
Monitor Adherence to Facility-Specific Treatment Recommendations	18 (39%)
Outcome Measures	
Produce a Hospital-Specific Antibigram	43 (94%)
Unit-Specific Antibigram	18 (40%)
Antibiotic Feedback (“Reporting” CDC Core Element)	44 (96%)

Table 1. Continued

Question	Hospitals, N (%)
Distribute Antibigram to Prescribers	40 (87%)
Share Facility-Specific Reports on Antibiotic Use With Providers	31 (67%)
Provide Providers Personalized Communication on Improving Antibiotic Use	23 (50%)
“Education” CDC Core Element	34 (74%)
Provide Education to Clinicians on Antibiotic Prescribing	34 (74%)
Microbiology/Laboratory Interventions^a	
Review of (Any) Cultures to Ensure Optimal Antibiotic Use	41 (89%)
Blood Cultures	41 (89%)
Urine Cultures	34 (74%)
Wound Cultures	33 (72%)
Sputum Cultures	32 (70%)
Microbiology Results Provide Comments to Guide Therapy	36 (78%)
Microbiology Lab Uses Rapid Diagnostic Tests	31 (67%)
MALDI-TOF	17 (37%)
Verigene or BioFire	9 (20%)
PNA FISH	8 (17%)
Other	7 (15%)
Review of Rapid Diagnostic Tests to Ensure Optimal Antibiotic Use	16 (35%)

Abbreviations: CDC, Centers for Disease Control and Prevention; MALDI-TOF, matrix-assisted laser desorption ionization time-of-flight mass spectrometry; PNA-FISH, peptide nucleic acid fluorescence in situ hybridization.

^aNot specifically delineated as a “core element” in 2014 CDC Core Elements.

information technology (67%, 31 of 46) and nursing (37%, 17 of 46) was less common (Table 1). All programs used 1 or more CDC-recommended Action elements, including most broad stewardship interventions; antibiotic timeouts were an exception with only 13% (6 of 46) of hospitals reporting their use. Although 80% of hospitals reported having a policy related to antibiotic documentation, only 17% (8 of 46) required documentation of intended duration and only half (52%, 24 of 46) reported monitoring compliance with documentation. It is interesting to note that only 17% (8 of 46) of hospitals had a process to review outpatient antibiotic orders before discharge.

Although most hospitals monitored facility-wide antibiotic use (83%, 38 of 46), few were able to do so by individual antibiotic, unit, service, or diagnosis, and sharing of data with prescribers was limited (Table 1). Two thirds (67%, 31 of 46) of hospitals used rapid diagnostic tests, but only 35% (16 of 46) reviewed test results to optimize antibiotic use.

Although 98% of hospitals reported facility-specific recommendations to treat specific syndromes, only 39% monitored adherence with those recommendations. Although most hospitals (70%) had at least 1 syndrome-specific intervention to optimize antibiotic use, syndromes targeted varied with the most common syndrome (pneumonia) targeted in only 54% of hospitals (eTable 1). Compared with larger hospitals (>200 beds), smaller hospitals (≤200 beds) were less likely to have

facility-specific treatment recommendations for urinary tract infection or skin and soft tissue infection (eTable 1).

DISCUSSION

In a survey of 46 Michigan hospitals immediately before TJC stewardship requirement, we identified 4 areas of need for antibiotic stewardship, including the following: (1) clinically relevant antibiotic use data, (2) tracking and monitoring compliance, (3) syndrome-specific interventions, and (4) discharge stewardship.

Consistent with prior studies, we found that most hospitals monitored facility-wide antibiotic use [11]. However, few hospitals were able to monitor use by antibiotic type, service, unit, or diagnosis. Nationally, the CDC is attempting to provide antibiotic use data through the National Healthcare Safety Network's (NHSN) antimicrobial use and resistance module. However, we found fewer than 1 in 5 hospitals were contributing data to NHSN, lower than in other studies [4, 11]. Although NHSN provides unit-specific data, there remains a missing gap related to service and syndrome-specific data, which we found most hospitals were unable to obtain on their own. Syndrome-specific data can be quite powerful—for example, a statewide collaborative in Colorado improved antibiotic use by providing hospitals with data on their treatment of urinary tract infection and skin and soft tissue infection [7]. A second need involved monitoring process measures related to stewardship. Although almost all hospitals met the CDC's 2014 Action core element (ie, "implementing at least one recommended [stewardship] action"), a deeper dive found that adherence to interventions, policies, and recommendations were rarely monitored. Limited resources and the noted lack of collaboration with information technology may contribute. Because both process and outcome data are necessary to improve outcomes, limited data could severely impact the ability of programs to change prescribing.

Third, hospitals had limited use of syndrome-specific interventions, despite evidence that they are more effective at engaging prescribers, and more sustainable, than broad stewardship interventions [12]. Pneumonia and urinary tract infection account for approximately half of all inpatient antibiotic use; however, only approximately half of the hospitals had interventions in place for these conditions. It is notable that hospitals with ≤ 200 beds were less likely to report having recommendations for treating urinary tract infection or skin and soft tissue infection.

Finally, we found that few hospitals reviewed antibiotics before discharge. Likewise, in 2015, the Veterans Health Administration (VHA) found that 24% of VHA hospitals reported "never" reviewing antibiotics at discharge and only 5% evaluated appropriate antibiotic duration at discharge [13]. Although medication reconciliation at discharge has long been an established element of hospital care, antibiotic stewardship at discharge is a relatively novel area—one that is now

recommended in both the CDC's recently updated 2019 core elements (within Action and Tracking) [14] and by TJC [3]. Because antibiotics prescribed at discharge account for up to half of antibiotic use related to hospitalization for common infections, interventions at discharge (or lack thereof) could have broad implications for stewardship and patient outcomes.

Our study has limitations. We relied on self-reporting and were limited to a single state. However, HMS represents a group of diverse hospitals across multiple payers, sizes, and locations. We were also limited by survey methodology on program details, including additional information on program infrastructure (eg, full time equivalent [FTE] support). Although the survey took place immediately before TJC requirements took effect, hospitals may have subsequently increased stewardship efforts—the CDC has found increased use of their core elements over time [2]. Finally, further research is needed to understand whether addressing the 4 needs we identified may improve antibiotic use and outcomes. Study strengths include an outstanding response rate with no missing data. Also, we provide additional detail related to adherence monitoring, microbiology, and discharge interventions that builds on prior national surveys.

The results from our study already have implications in Michigan that may be applicable to hospitals—especially those with limited resources—nationwide. Specifically, the results of this survey helped inform an antimicrobial stewardship initiative across HMS hospitals beginning in 2017. First, through HMS, we collect clinically relevant data on a sample of patients hospitalized at member hospitals with the 2 most frequent drivers of inpatient antibiotic use, pneumonia, or urinary tract infection. Data collection includes process (antibiotic) and outcome data. Second, data are used to help hospitals track and monitor compliance with guidelines related to antibiotic use. With this detailed data collection process, we are able to assess antibiotic appropriateness and provide clinically relevant metrics not previously available to HMS hospitals. This, for example, has enabled feedback to individual providers. Third, because approximately half of hospitals lacked syndrome-specific interventions, we provide syndrome-specific guidelines and suggest syndrome-specific interventions via quarterly in-person meetings and an online toolkit (<https://mi-hms.org/resources/hms-quality-initiative-toolkits/hms-antimicrobial-toolkit>). Finally, we provide a mechanism for monitoring, tracking, and improving antibiotic use at discharge. The results of this multiyear effort are underway, but preliminary results are promising [15] and may inform similar stewardship initiatives elsewhere. Specifically, other initiatives should focus on providing concrete, actionable, and benchmarked hospital data.

CONCLUSIONS

In summary, we provide a picture of antibiotic stewardship practices in Michigan hospitals immediately before TJC

standard for stewardship. Although almost all hospitals had an antibiotic stewardship program, we identified 4 key areas of need: (1) clinically relevant antibiotic data, (2) tracking and monitoring compliance, (3) syndrome-specific interventions, and (4) antibiotic use at hospital discharge. Quality collaboratives may play a key role in helping hospitals—especially those with limited resources—address these needs to optimize antibiotic use.

Supplementary Data

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

eTable 1. Syndrome Specific Stewardship Interventions (N = 46 Hospitals).

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APPENDIX: SURVEY QUESTIONS

ANTIMICROBIAL USE SPECIFIC INFORMATION

In preparation for the launch of antimicrobial use data collection in 2017, we are seeking baseline information related to your site’s current quality-improvement efforts related to this initiative.

1. Please answer the following questions based on the activity at your hospital over the last six months (unless otherwise specified). The survey is due 11/07/16.
2. Hospital Name (select from drop down box)
3. Does your facility submit data to the CDC’s National Healthcare Safety Network (NHSN) related to any of the following?
 - Antimicrobial Use and Resistance (AUR) Module
 - Hospital Associated Infections (HAI)/Patient Safety Component
 - None of the Above
4. Does your hospital have an antimicrobial stewardship program?
 - Yes
 - No
5. Does any of the staff below work with the stewardship leaders to improve antibiotic use at your facility?

	Yes	No
Infectious Disease Clinician (without Antimicrobial Stewardship Team (AST) support)	<input type="radio"/>	<input type="radio"/>
Clinicians (NonInfectious Disease)	<input type="radio"/>	<input type="radio"/>
Infection Prevention and Healthcare Epidemiology	<input type="radio"/>	<input type="radio"/>
Quality Improvement	<input type="radio"/>	<input type="radio"/>
Microbiology (Laboratory)	<input type="radio"/>	<input type="radio"/>
Information Technology (IT)	<input type="radio"/>	<input type="radio"/>
Nursing	<input type="radio"/>	<input type="radio"/>

	Yes	No
Other	<input type="radio"/>	<input type="radio"/>

6. Does your facility have a policy that requires prescribers to document the following in the medical record or during order entry for all antibiotic prescriptions?

	Yes	No
Dose	<input type="radio"/>	<input type="radio"/>
Intended Duration of Use	<input type="radio"/>	<input type="radio"/>
Indication	<input type="radio"/>	<input type="radio"/>

7. Does your stewardship program monitor adherence to this documentation policy? (Display this question if question six is answered yes for either dose OR intended duration of use OR indication)

- Yes
- No
- Hospital does not have a stewardship program

8. Does your facility have facility-specific treatment recommendations, based on national guidelines, to assist with antibiotic selection for common infectious conditions (ie, UTI, HCAP, CAP, etc.)?

- Yes
- No

9. For which of the following infectious conditions does your facility have facility-specific treatment recommendations to assist with antibiotic selection (check all that apply)?

(Display this question if question eight is answered yes)

- Urinary Tract Infection (UTI)
- Health Care Associated Pneumonia (HCAP)
- Community Acquired Pneumonia (CAP)
- Skin and Soft Tissue Infection
- Intra-abdominal Infection
- Sepsis
- None of the Above

10. Does your stewardship program monitor adherence to the facility specific treatment recommendations?

(Display this question if question eight is answered yes)

- Yes
- No
- Hospital does not have a stewardship program

11. Does your computerized physician order entry (CPOE) contain order sets for specific infectious disease conditions which incorporate your facility-specific treatment recommendations?

(Display this question if question eight is answered yes)

- Yes
- No

12. If your computerized physician order entry (CPOE) contains order sets for specific infectious disease conditions which incorporate your facility-specific treatment recommendations, is decision support built into these order sets?

(Display this question if question 11 is answered yes)

- Yes
- No

13. Does your hospital have a formal procedure/policy for all clinicians to review the appropriateness of all antibiotics after the initial orders (eg, a “timeout” 48–72 hours after starting antibiotics)?

- Yes
- No

14. Indicate the timing of the antibiotic time out:

(Display this question if question 13 is answered yes)

- 48 hours after the initial antibiotic order
- 72 hours after the initial antibiotic order
- Other

15. Does your facility have a restricted formulary (eg, some antibiotics are not available)?

- Yes
- No

16. Do specific antibiotic agents need to be approved by a physician or a pharmacist before dispensing (ie, pre-authorization) at your facility?

- Yes
- No

17. Does a physician or pharmacist review targeted antimicrobials (ie, prospective audit with feedback) at your facility?

- Yes
- No

18. Are any of the following pharmacy-driven interventions implemented at your facility?

	Yes	No
Automatic changes from intravenous to oral antibiotic therapy in appropriate situations	<input type="radio"/>	<input type="radio"/>
Dose adjustments in cases of organ dysfunction	<input type="radio"/>	<input type="radio"/>
Dose optimization to optimize the treatment of organisms with reduced susceptibility	<input type="radio"/>	<input type="radio"/>
Automatic alerts in situations where therapy might be unnecessarily duplicative	<input type="radio"/>	<input type="radio"/>

	Yes	No
Time-sensitive automatic stop orders for specified prescriptions	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>

19. Does your facility or antimicrobial stewardship team (AST) have specific interventions in place to ensure optimal use of antibiotics to treat the following common infections (Check all that apply)?

- Urinary Tract Infection
- Hospital Care Associated Pneumonia (HCAP)
- Community Acquired Pneumonia (CAP)
- Skin and Soft Tissue Infection
- Intra-abdominal Infection
- Sepsis
- *Staphylococcus aureus* bacteremia
- Candidemia
- *Clostridium difficile* Infection
- None of the Above

20. Does your antimicrobial stewardship team (AST) or clinical pharmacists review cultures in an effort to ensure optimal use of antimicrobials?

- Yes
- No

21. Indicate the type of culture (check all that apply):

(Display this question if question 20 is answered yes)

- Blood Culture
- Urine Culture
- Sputum Culture
- Wound Culture
- Other Culture
- No

22. At your facility, do microbiology results provide comments to help guide therapy for specific pathogens?

- Yes
- No

23. At your facility, does the microbiology lab utilize rapid diagnostic tests?

- Yes
- No

24. If the microbiology lab utilizes rapid diagnostic tests, which types of rapid diagnostic tests are utilized by your microbiology lab? (Check all that apply)

(Display this question if question 23 is answered yes)

- PNA FISH

- Verigene or BioFire
- MALDI-TOF
- Other
- None of the Above

25. Does your antimicrobial stewardship team (AST) or clinical pharmacists review results of rapid diagnostic tests in an effort to ensure optimal use of antibiotics?

(Display this question if question 23 is answered yes)

- Yes
- No
- Hospital does not have a stewardship program

26. At your facility, is there a review of outpatient antimicrobial therapy orders before discharge?

- Yes
- No

27. Does your facility monitor antibiotic use (consumption) by any of the following metrics (Check all that apply)?

- Yes, by counts of antibiotics(s) administered to patients per day (Day of Therapy—DOT)
- Yes, by number of grams of antibiotics used (Defined Daily Dose—DDD)
- Yes, by direct expenditure for antibiotics (purchasing costs)
- Yes, by a method other than is listed above
- No, hospital does not monitor antibiotic use

28. For Days of Therapy (DOT), are you able to differentiate between the following (check all that apply): (Display this question if question 27 is answered yes, by counts of antibiotic(s) administered to patients per day [day of therapy—DOT])

- All Antimicrobials
- Individual Antimicrobials
- Unit Level
- Service Level (ie, hospitalists vs surgeons)
- For a Specific Diagnosis (ICD 10 Code)
- None of the Above

29. For Defined Daily Dose (DDD), are you able to differentiate between the following (check all that apply):

(Display this question if question 27 is answered yes, by number of grams of antibiotics used [defined daily dose—DDD])

- All Antimicrobials
- Individual Antimicrobials
- Unit Level

- Service Level (ie, hospitalists vs surgeons)
- For a Specific Diagnosis (ICD 10 Code)
- None of the Above

30. Does your facility produce an antibiogram (cumulative antibiotic susceptibility report)?

- Yes
- No

31. Is the antibiogram available by unit (ICU, medical floor, etc.)?

(Display this question if question 30 is answered yes)

- Yes
- No

32. Is this antibiogram distributed to prescribers at your facility?

(Display this question if question 30 is answered yes)

- Yes

- No

33. Does your stewardship program share facility-specific reports on antibiotic use with prescribers?

- Yes
- No
- Hospital does not have a stewardship program

34. Do prescribers ever receive direct, personalized communication about how they can improve their antibiotic prescribing?

- Yes
- No

35. Does your stewardship program provide education to clinicians and other relevant staff on improving antibiotic prescribing?

- Yes
- No
- Hospital does not have a stewardship program