Teaching Antimicrobial Stewardship to Infectious Disease Fellows Through Simulated Interdisciplinary Scenarios

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Abstract

Introduction: While several approaches have been described to teach antimicrobial stewardship (AS) practices, fewer have been aimed at infectious disease physicians. We developed a series of simulated AS meetings to train infectious disease fellows in the synthesis of AS interventions. Methods: Three simulated AS committee scenarios were developed. Background lectures were given 1 week prior to the simulation during which multidisciplinary roles were assigned. Precourse work included review of primary literature pertinent to the scenario. Simulations were conducted over 1.5 hours. Individual and team performances were evaluated. Pre- and postsurveys were collected from fellows and faculty members to assess the format. Results: Six infectious disease fellows participated in the series. Fellows demonstrated information synthesis and improvements in individual and team performance. Eighty-three percent of fellows before the simulation series and 100% postseries reported educating others on AS principles in the previous month. Fellows were satisfied with the series and requested more scenarios. Eight faculty members completed surveys. Thirty-eight percent of faculty before the series and 63% after completion reported that fellows viewed antimicrobial preauthorization as useful or necessary. Faculty supported the format, found it useful in evaluation of learners, and perceived that fellows benefited from the approach. Discussion: Simulation is an effective and enjoyable way to train infectious disease fellows in AS and team utilization. Fellows demonstrated improvement in AS knowledge, skills, and attitudes and developed evidence-based interdisciplinary plans to solve AS challenges. Faculty also viewed this strategy as effective and sustainable.

Keywords
Antimicrobial Stewardship, Infectious Disease Fellows

Educational Objectives

By the end of this series, learners will be able to:
1. Describe the roles and responsibilities of antimicrobial stewardship team members.
2. Identify the evidence-based antimicrobial stewardship interventions used to improve antibiotic prescribing pertinent to a structured scenario.
3. Design a multidisciplinary solution to a structured antimicrobial stewardship scenario.

Introduction

The development of formal antimicrobial stewardship programs within health care systems has increasingly become a national priority. Antimicrobial stewardship programs have been shown to improve patient care, decrease antibiotic use, and decrease cost. The Infectious Diseases Society of America has advocated that infectious disease (ID) physicians are uniquely capable to lead antimicrobial stewardship programs due to their training in diagnosis and management of serious infections.

Education of physicians in stewardship has mainly centered on initiatives for medical students, residents, and practicing physicians. Strategies for education of these groups include lecture series, case-based learning sessions, and educational content delivered in conjunction with prescribing feedback. However, there is little published on education strategies specifically targeting ID physicians and fellows. A search of MedEdPORTAL did not reveal any materials on antimicrobial stewardship. Some strategies described for ID physician education include case-based discussions moderated by an expert panel and education on delivering antibiotic recommendations to primary teams. Half of ID fellowship programs reported that they did not have an antimicrobial stewardship curriculum and identified barriers to ID fellow education including lack of curricular materials, lack of faculty time, and lack of training time.

Graduate surveys from the ID fellowship program at the San Antonio Uniformed Services Health Education Consortium in San Antonio, Texas, revealed a desire for additional training in antimicrobial stewardship. We sought to focus our educational efforts on development of an activity concentrating on the quality-improvement and population-based strategies useful to leading and participating in an antimicrobial stewardship program. Herein, we describe a novel

Appendices
A. Flow Diagram of Approach to Each Learning Activity.docx
B. Simulation 1 Presentation Slides.pptx
C. Simulation 2 Presentation Slides.pptx
D. Simulation 3 Presentation Slides.pptx
E. Simulation 1 Scenario.docx
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N. Fellow Multiple-Choice Quiz Self-Assessment.docx
O. Faculty Assessment of Fellows.docx

All appendices are peer reviewed as integral parts of the Original Publication.
approach to training ID fellows in antimicrobial stewardship team dynamics and leadership through simulated multidisciplinary team exercises, a strategy not previously described for this topic.

In the 2016-2017 academic year, the ID fellowship developed and conducted a series of three antimicrobial stewardship program simulations. The first scenario focused on designing an antimicrobial stewardship strategy to decrease rates of *Clostridium difficile* infections at an inpatient academic medical center. The second focused on designing an antimicrobial stewardship strategy to decrease outpatient antibiotic prescriptions for acute respiratory illness in primary care clinics affiliated with an academic medical center. Finally, the third focused on designing an antimicrobial stewardship intervention to improve antibiotic use in trauma patients with some team members remotely participating via telehealth.

All fellows in the program were required to participate in the simulation series. Curricular goals included training fellows to be team leaders in antimicrobial stewardship through development of the Association of American Medical Colleges' quality-improvement competencies. Competencies targeted were working in an interprofessional team, understanding and improving systems, and risk-benefit analysis in population-based care in the context of antimicrobial stewardship. As the focus was set to train ID fellows to be team leaders, simulated antimicrobial team meetings were created to allow the fellows to demonstrate the synthesis of information and design solutions to notional problems. Learning objectives were developed. Short-term goals were to have fellows recognize the role of antimicrobial stewardship programs and team members, apply principles of stewardship in management of their patients, educate others in stewardship, and gain experience in quality improvement.

**Methods**

This series is designed for ID fellows and requires understanding of the diagnosis and management of common, as well as serious, infections. Familiarity with antimicrobial stewardship best practices and experience with antimicrobial stewardship program management is recommended for faculty facilitators.

**Equipment/Environment**

Running the series required a room with computer projection equipment, a table, enough chairs for all of the learners and faculty, and name tags.

**Personnel**

All six ID fellows in our fellowship program participated. Eight multidisciplinary roles were developed for each of three scenarios (see the Table). Roles were randomly assigned to fellows; however, four core roles were identified as required for each simulation. The faculty moderators throughout the series were ID physicians with educational background or experience in antimicrobial stewardship implementation. This level of experience or expertise was useful in the moderation of these specialized learners.

<table>
<thead>
<tr>
<th>Table. Overview of the Simulation Scenarios</th>
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<td><strong>Simulation Scenario</strong></td>
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| Decrease *Clostridium difficile* infections | ID physician  
ID pharmacist  
Infection preventionist  
Clinical microbiologist | QI representative  
Inpatient nurse  
Hospital leadership representative  
Medical informatics representative | Prospective audit  
Provider feedback  
Restrictive guidelines |
| Decrease outpatient antibiotic prescriptions | ID physician  
ID pharmacist  
Clinical microbiologist  
Primary care physician | Medical informatics representative  
Infection preventionist  
QI representative  
Clinic nurse | Antibiotic restriction  
Clinical practice guidelines  
Communication training  
Decision support  
Delayed prescribing  
Provider education  
Provider feedback  
Provider incentives |
| Improve antibiotic use | Trauma surgeon  
Infection preventionist  
Nurse  
Clinical microbiologist  
ID physician*  
ID pharmacist* | QI representative*  
Medical informatics representative* | Antibiotic timing  
Decision support  
Clinical practice guidelines  
Point-of-injury antibiotics  
Provider education  
Telehealth |

Abbreviations: ID, infectious disease; QI, quality improvement.

*Off-site roles.

**Implementation**

Three antimicrobial stewardship simulated scenarios were developed (Appendix A). The simulations were conducted as a series over a 6-month period, with 2 months between each scenario. A week prior to the simulation, the faculty conducted a 30-minute introductory lecture that presented background information and revealed the scenario to the learners (Appendices B-D). During this lecture, multidisciplinary roles were assigned to the fellows based on the scenario. After role assignment, fellows were instructed to review the literature pertinent to the scenario and to their
unique role over the next week (Appendices E-G). Fellows were required to bring to the simulation one resource that best addressed the scenario from the perspective of their role and use it in their discussion. For Simulation 1, information cards (Appendix H) were distributed to fellows based on their roles.

Individual simulations were conducted over a period of 1 to 1.5 hours. At the simulation, a prebrief was conducted, fellows were reminded of the prompt, and the team was instructed to start its discussion to address the scenario. Faculty members were provided with tools to assist in the moderation of the exercise, assessment of the learners (Appendices I-K), and conducting of the prebrief and debrief (Appendices L & M). After up to 30 minutes of discussion, the team was interrupted and given feedback on its strategy in order to initiate new quality-improvement cycles. Notional results of the team’s chosen interventions were given to the group based on published examples at other institutions. Faculty determined the success of an intervention guided by the scenario sheets (Appendices E-G). Teams proposing successful interventions were then instructed to analyze their plans from standpoints of patient safety and sustainability, whereas teams proposing unsuccessful strategies were advised to develop a new approach. After additional team discussion, the simulation was ended, and the debrief was conducted (Appendix M).

Learner Assessment
During the simulation, individual performance and team performance were evaluated by faculty using adaptations of a previously described tool and critical action checklists pertinent to the scenario based on literature review of best practices (Appendices I & J). At the end of each exercise, simulation debriefs were conducted using accepted principles.

Medical knowledge and clinical self-assessments were performed. A short multiple-choice quiz on key antimicrobial stewardship facts, including a self-assessment of participation in stewardship practice and education, was developed and administered to the fellows at the beginning of the series (Appendix N). It was repeated at the completion of the series to monitor for any changes.

Program Evaluation
Program evaluation was conducted by surveying the fellowship program’s key clinical faculty and adjunct faculty on fellow application of antibiotic stewardship principles, fellow attitudes, and faculty satisfaction with the approach approximately 2 months after series completion to assess changes (Appendix O). Learner satisfaction was assessed during simulation debriefs, through an anonymous survey distributed at the conclusion of the series, and through comments solicited by a senior fellow. This feedback was pooled for anonymity and discussed at the fellowship’s annual program evaluation.

Debrief
At the end of each simulation scenario, faculty conducted a brief informational overview of stewardship strategies that had not been explored by the teams (Appendices B-D). Following this brief lecture, debriefs were conducted. Debriefs were discussion based and were conducted immediately at simulation end (Appendix M). Learners were also forwarded PowerPoint files used in the simulation for review.

Results
Six ID fellows participated as learners in the series. Six faculty members participated as moderators or evaluators throughout the series, with an average of four present at each simulation. Three simulations were conducted, focusing on various aspects of antimicrobial stewardship (see the Table). Six of the eight roles were disseminated based on faculty determination of appropriateness for each scenario; the ID pharmacist and the ID physician roles were assigned in all scenarios. Simulations were conducted approximately 2 months apart.

Learner Assessment
Fellows performed well on knowledge-based multiple-choice questions both before and after the series. The proportion of fellows who reported delivering education on antimicrobial stewardship increased from 83% to 100% after series completion. Despite fellows performing well on multiple-choice questions prior to the series, failure of material synthesis and application was noted by faculty during the first simulation. No failure of material synthesis was noted during subsequent simulations, and individual and team performance consistently improved throughout the series. Debriefs were able to highlight the roles of team members of differing backgrounds.

Program Assessment
Eight of 12 faculty completed pre- and postseries surveys. Faculty assessment of fellows’ clinical performance varied before and after the simulation series (Figure 1). Thirty-eight percent of faculty presimulation series and 63% of faculty postsimulation series stated that the fellows thought a restricted formulary was useful and necessary (Figure 2).
Faculty surveyed reported that the simulation series was "so fantastic" and "great" and that "the fellows take [the simulation] seriously." Additional comments from faculty indicated that the format was useful for identifying knowledge and practice gaps in fellows and that the discussions were true to actual discussions of the facility's antimicrobial stewardship committee. Faculty reported enthusiasm for continuation of the exercises in subsequent academic years.

Fellows reported via survey and at the fellowship's annual program evaluation that they "enjoyed the format," that "the sims are very engaging," and that the simulation "gave [them] confidence" to be part of an antimicrobial stewardship program. All fellows offered positive comments on their anonymous surveys. Additionally, they requested more scenarios, particularly on how to establish a stewardship program from the ground up.

Discussion

Fellows were able to demonstrate information synthesis in the development of multidisciplinary solutions to antimicrobial stewardship challenges and improved in their performance throughout the series. Modest changes were noted in fellow self-assessment of teaching frequency after participation in the series. From these limited survey results, faculty described improvements in fellows' attitude toward the restricted formulary with the series. Other aspects of performance were less clearly impacted, with decreased rates of "never" discussing limiting antibiotic duration and optimizing pharmacokinetics, but also decreased rates of "often" discussing these and other features. Interestingly, rates of omitting cost from discussion were high pre- and postseries. Although cost metrics could have been discussed during each scenario, they were largely ignored in team discussion. Having the faculty moderator interject to focus the team discussions on aspects of cost or cost savings could be incorporated to improve the experience if desired.

Our fellows described high levels of satisfaction with the approach and requested the development of additional simulations. The consistent desire for additional training has been noted by ID fellows participating in other types of training and may reflect interest in the topic or awareness of future leadership responsibilities. One of our participants requested a simulation on establishing an antimicrobial stewardship committee from the ground up, similar to 68% of program directors who were interested in teaching their fellows the same skills. This pilot project is an example of a low-cost, reusable, and interactive approach useful for supplying this training and evaluation of ID fellows.

One of the barriers identified in a survey of ID program directors was limitation of faculty time in development of antimicrobial stewardship curricula. Adaptations of our approach and tools may be useful in these programs as the simulation instructional commitment is about 6 hours for the series. Only one faculty member is required to moderate each session. Additional faculty members may be utilized to evaluate participants and team performance in programs.
with greater numbers of learners, although their involvement may not be strictly necessary. In the coming academic year, we plan to have last year’s participants serve as simulation instructors and moderators to further develop their leadership skills and understanding of antimicrobial stewardship team practices. Finally, our faculty enjoyed participation with this approach and volunteered to return for multiple sessions.

Antimicrobial stewardship programs are, in essence, multidisciplinary process-improvement programs. Having multiple disciplines represented in antibiotic management programs is recommended by the Infectious Diseases Society of America. We used the role assignment to better educate ID fellows on the assets of a multidisciplinary antimicrobial stewardship team. Through their literature review, they were able to bring rich discussion topics to the table, such as data on using community pharmacists as health educators, ways to utilize informatics and diagnosis codes to monitor prescribing and safety, and limitations and benefits of rapid diagnostics. Interprofessional training of pharmacy and medical trainees together has been described as improving interprofessional relationships. Next steps could include involving learners of other disciplines in the simulation exercises.

Limitations of this study include that it was single site and conducted with only one cohort of fellows using an unvalidated evaluation tool. Additionally, low numbers of fellows and faculty make interpretation of data difficult. Learner and faculty assessments performed via questionnaire may also be inadequate to assess practice changes. Faculty surveyed included both key clinical faculty and adjunct faculty members. Key clinical faculty were required to dedicate at least 10 hours per week to the fellowship program. Adjunct faculty members had less exposure to fellows and may not have accurately assessed their performance. Finally, while there are simulated interdisciplinary roles, the exercises are not truly interdisciplinary. Modifications of this approach could include the use of interdisciplinary learners to represent the additional roles.

Simulation-based training is an effective and enjoyable way to train ID fellows in antimicrobial stewardship and stewardship team utilization. We are planning for senior fellows to assist with conducting simulations. Future studies could evaluate perceptions of the training from graduates and from surveys of graduate involvement in antimicrobial stewardship activities, as well as expansion to include interprofessional learners.

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Ethical Approval
Reported as not applicable.

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