







Original Article

Developing a curriculum on antimicrobial stewardship for pediatric residents: a needs assessment

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Abstract

Objective: Identify essential components of a curriculum on antimicrobial stewardship (AS) for pediatric residents.

Design: Survey.

Setting: Academic tertiary care children's hospital.

Participants: Pediatric residents and infectious diseases (ID)/AS content experts (CE), including pediatric ID faculty, fellows, nurse practitioners, and pharmacists.

Methods: Residents were surveyed to assess prior AS experiences and usefulness of education in different AS domains (e.g., antimicrobial resistance [AMR]). CE was surveyed to identify content to include in an AS curriculum. A specific topic (e.g., resistance in *Staphylococcus aureus*) achieved consensus if $\geq 80\%$ of CE identified the topic as “very” or “extremely” important.

Results: Thirty-three of 110 pediatric residents responded to the resident survey (response rate 30%). Spectrum of activity (97%), empiric therapy (94%), and duration of therapy (94%) were the domains identified by the most residents as “very” or “extremely” useful. All CE responded to the CE survey (n=26). Thirty-nine of 105 topics (37%) met the consensus threshold. The domains with most topics achieving consensus were empiric therapy (11/13 topics, 85%) and duration of therapy (5/8 topics, 63%). Only one topic was identified within the domains of antibiotic allergies, diagnostics, and AMR, reflecting 18%, 14%, and 6% of the potential topics within each domain, respectively.

Conclusions: A pediatric AS curriculum focused on empiric therapy and duration of therapy is likely to meet the needs of both learners and CEs.

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Introduction

The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have identified antimicrobial resistance (AMR) as an urgent public health threat.^{1,2} Antimicrobial stewardship programs (ASPs) play a critical role in combating the rising rates of AMR by taking steps to identify and decrease the inappropriate use of antibiotics. The CDC identifies education as one of the core elements of both inpatient and outpatient ASPs, and the WHO explicitly recommends that medical trainees receive targeted education on antimicrobial stewardship (AS).^{3–5}

Children are frequent recipients of antibiotics, with roughly 20% of pediatric ambulatory and emergency room visits resulting in an antibiotic prescription, and an estimated 35–70% of hospitalized children receive at least one dose of an antibiotic.^{6–8} Furthermore, up to 30% of antibiotic prescriptions provided to children in both the inpatient and outpatient settings are thought to be inappropriate.^{9–11} Despite the clear importance of AS in the pediatric population, most published reports describing AS educational interventions targeting trainees have focused on medical students,^{12–15} internal medicine residents, family medicine residents, and infectious diseases fellows,¹⁶ with limited available data that is specific to the needs of pediatric residents.^{17–19} The specific needs of pediatric residents are likely to differ from the needs of trainees providing care to adults given substantial differences in the types of infectious diseases (ID) in pediatric patients. There are also likely differences in both the quantity and quality of data

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informing recommendations on AS topics for pediatric patients, such as empiric therapy, duration of therapy, and antibiotic dosing.

Pediatric residents at Washington University in St. Louis School of Medicine (WUSM) have the opportunity to participate in an elective rotation with the St. Louis Children's Hospital (SLCH) ASP. Residents on this rotation review a subset of patients with a new order for antimicrobial therapy as part of prospective audit and feedback, present these patients and any suggested optimizations to the ASP team (ID pharmacist and physician), and then shadow the ASP team during "handshake stewardship" rounds. Internal evaluations of this rotation indicate that this is an excellent educational experience. However, educational content is variable during the course of the two-week rotation, based on the personnel present and specific patient cases. Therefore, a standardized curriculum for resident learners to supplement education linked to patient care is desirable and has been effectively implemented at other institutions on rotations such as complex care pediatrics, pediatric pulmonology, and pediatric rheumatology.^{20–22} Given the limited literature on the knowledge and skills that graduating pediatric residents should have related to AS, we conducted a needs assessment to identify the key components of an AS curriculum.

Methods

This study was approved by the WUSM institutional review board (IRB ID 202308151). The requirement for written consent was waived. Study data were collected and managed using REDCap® electronic data capture tools hosted at WUSM.^{23,24} Both surveys were conducted at WUSM/SLCH, an urban 455-bed academic children's hospital, which includes 110 pediatrics residents and a division of pediatric ID with 19 faculty members. This needs assessment was conducted to inform AS curriculum development, aligned with Kern and colleagues' framework for curriculum development.²⁵

Resident survey

The primary purpose of the resident survey was to identify AS domains in which pediatric residents thought additional education would be useful. Secondary aims were to identify resident attitudes toward AS, satisfaction with prior education on AS, and resources utilized by residents when treating suspected or confirmed infections.

Previously published surveys assessing AS-related educational needs of medical trainees (including medical students, residents in any training program, and ID fellows) were reviewed to inform development.^{12,15,18,19,26} The survey was refined via the cognitive interviewing technique of retrospective probing, which was conducted with a total of five recent graduates or current residents in the pediatric residency program. Survey questions were modified based on that feedback to ensure that questions were interpreted and responded to as intended by the authors.²⁷

Questions related to attitudes and usefulness of additional education were assessed using a five-point Likert-type scale, with anchored response options ranging from "not at all useful" to "extremely useful." The purpose of this component of the assessment was to gauge general interest in broad domains, and no specific thresholds were established for significance or consensus. Respondents selected one or more of their preferred learning methods or formats from a pre-generated list, with the option to add additional methods via free response text. Similarly, respondents selected resources they use when treating suspected or

confirmed infections from a pre-generated list, and could add additional responses via free response text. The remainder of the survey consisted of multiple-choice questions and demographic information. The questions used in the final resident survey are included in the supplemental material (Supplement 1).

All categorical pediatric residents were eligible to complete the survey; those who had participated in cognitive interviewing were asked not to complete the survey when it was distributed. The survey was initially delivered via an email distributed by the pediatric chief residents and received responses for an 8-week period. Residents were intermittently reminded of the survey during regularly scheduled conferences and during prospective audit and feedback "handshake stewardship" rounds conducted by the ASP team. Residents also received one reminder email from the pediatric chief residents prior to closure of the survey.

Content expert (CE) survey

The primary purpose of the CE survey was to identify specific AS topics within broad domains on which ID/AS CEs consider important that graduates of a pediatric residency program be knowledgeable. For example, a domain would refer broadly to AMR, whereas a specific topic could include resistance in *Staphylococcus aureus*. This increased level of specificity compared to the resident survey was intended to ensure that critical topics were included in the curriculum, and to ensure CE buy-in on the curriculum that would ultimately be developed.

The CE survey was initially developed by reviewing Accreditation Council on Graduate Medical Education Pediatrics Milestones 2.0 and the American Board of Pediatrics (ABP) Entrustable Professional Activities (EPAs) for General Pediatrics.^{28,29} For example, the ABP EPAs identify specific essential skills for pediatricians to meet the needs of their patients and provide a scale on which these skills can be evaluated. EPA 4 in particular (entitled "Manage patients with acute common diagnoses in an ambulatory, emergency, or inpatient setting") outlines specific conditions, many of which are infectious in nature, that most pediatricians should be able to manage independently, as well as those they should be able to manage with the assistance of a consultant. These topics provided a starting point for questions on the CE survey related to patient management, and topics were added to the survey iteratively based on feedback from study team members. Respondents rated the importance of four to 18 specific topics within nine broad domains (general principles of AS, spectrum of activity, toxicities of antimicrobial therapy, antimicrobial allergies, AMR, antimicrobial prophylaxis, diagnostics, empiric antimicrobial therapy, and duration of therapy). Topic importance was assessed on a five-point Likert-type scale, with anchored response options ranging from "not at all important" to "extremely important." The CE survey is included in the supplemental material (Supplement 2).

All pediatric ID faculty, fellows, advance practice providers, and pharmacists at our institution were eligible to complete the CE survey. While it is important to note that not all individuals who received the survey would consider themselves experts specifically on AS, they are viewed by the local community as experts on ID as a whole. They engage regularly with residents as teachers and are expected to be able to teach key stewardship concepts. On the other hand, there is a finite amount of time during which broad ID topics can be taught to residents during training, and there may be a concern that teaching on AS content may come at the expense of other topics within ID which are also applicable to pediatric

residents. We therefore felt it was important to incorporate the perspective of all ID experts so that the content included in the curriculum we developed would be identified as important by all stakeholders. The survey was announced at a division meeting and subsequently delivered via email. Prospective respondents received reminder emails weekly over a four-week period until they completed the survey. Responses to the survey were de-identified.

Statistical analysis

All statistical analysis was performed using R Statistical Software (version 4.1.2; R Foundation for Statistical Computing, Vienna, Austria). Time to complete each survey was calculated by subtracting the time at which the survey was opened from the time at which the survey was submitted. The number of prior experiences each resident had was calculated by adding the number of ID/AS rotations completed in medical school to those completed in residency. Responses to Likert-type responses on the resident survey were dichotomized as either “top box” responses (4 or 5 on the Likert-type scale) or “not top box” responses (1-3 on the Likert-type scale). Topics on the CE survey achieved consensus as being important to include in an AS curriculum if at least 80% of respondents identified the topic as “very important” or “extremely important.”

Results

Resident survey

The resident survey was distributed to 110 residents, of whom 33 responded (response rate 30%). The median (IQR) time to complete the survey was 3.4 (2.4, 5.2) minutes. Demographic information and prior educational experiences are summarized in Table 1. Overall, 23 respondents (70%) reported having at least one prior clinical experience in either ID or AS.

Respondents rated their satisfaction with AS-related education in medical school and since starting residency. Four respondents (12%) identified that they were “very” or “extremely” satisfied with their education in medical school, whereas 20 (61%) respondents reported that they were “very” or “extremely” satisfied with the AS-related education they had received since starting residency training.

Residents were asked to identify resources they use when treating suspected and confirmed infections. All respondents reported knowing where to access their hospital’s empiric treatment guidelines, and 31 respondents (93%) reported using these guidelines more than half of the time when treating suspected or confirmed infections. Thirty-one respondents (93%) reported knowing how to access the hospital’s antibiogram; of these, 18 (58%) reported using the antibiogram more than half of the time when treating suspected or confirmed infections. Other resources that respondents reported using included UpToDate® (91% of respondents); the ID consult service (82%); ASP team members (79%); the American Academy of Pediatrics (AAP) Red Book (52%); Lexicomp® (40%); clinical practice guidelines published by organizations such as the AAP, Infectious Diseases Society of America, or Pediatric Infectious Diseases Society (36%); primary literature (9%); and textbooks (6%).

Respondents were asked to rate the usefulness of additional education in several different AS domains. Responses to these questions are summarized in Table 2. The percentage of respondents identifying that additional education on a topic would be “very” or “extremely” useful to them ranged from 73%

Table 1. Demographics of resident survey respondents

Demographic Information	Number of Respondents, n (percentage)
Year in training	
PGY-1	12 (36%)
PGY-2	13 (40%)
PGY-3	8 (24%)
Prior educational experiences	
ID rotation in medical school	14 (42%)
AS rotation in medical school	2 (6%)
ID rotation since starting residency	12 (36%)
AS rotation since starting residency	3 (9%)
Number of prior experiences ^a	
0	10 (30%)
1	17 (52%)
2 or more	6 (18%)

AS: antimicrobial stewardship, ID: infectious diseases, PGY: postgraduate year.

^aRefers to number of ID or AS rotations in which the resident participated prior to completing survey. For example, a resident who completed an ID rotation in medical school and an AS rotation in residency would be classified as having two prior experiences.

Table 2. Percentage of resident respondents identifying that additional education on a domain would be “very” or “extremely” useful

AS Domain	Percent of Respondents, (%)
Adverse effects of antibiotics	82
Antibiotic spectrum of activity	97
Antibiotic prophylaxis	91
Antimicrobial resistance	73
Diagnostics	82
Duration of therapy	94
Empiric therapy	94
Managing antibiotic allergies	82

(AMR) to 97% (spectrum of antibiotic activity). Other topics on which more than 90% of respondents identified that additional education would be useful were empiric antibiotic therapy (94%), duration of therapy (94%), and antibiotic prophylaxis (91%).

Respondents were asked to select methods by which they would like to learn more about AS from a list of possible learning formats. The method most frequently selected by respondents was discussion on rounds with the ASP team (79% of respondents); other methods selected by respondents included board-style questions with answer explanations (70%), handouts to reference in clinical practice (64%), in-person didactic sessions (58%), small group case-based discussions (42%), a curated list of references to read (24%), pre-recorded lectures (21%), and narrated slide decks (12%). No respondents reported that they did not want additional education on antimicrobial stewardship.

CE survey

The CE survey was distributed to 26 individuals, all of whom responded to the survey (response rate 100%). The median (IQR)

constructed the CE survey in part using tools such as the ABP EPAs and that the results of the resident and CE surveys were in general agreement, we suspect that our findings will be a useful starting point for the development of local curricula for most centers. Furthermore, we have included the survey tools we used as supplemental material, which others can readily implement as part of their own needs assessment. A second limitation is that the response rate to the resident survey was relatively low (30%), which limited statistical analysis. Furthermore, residents who were more interested in AS may have been more likely to complete the survey, which may have inflated the level of interest in learning more about AS. That being said, the concordance with the results of the CE survey, which had a 100% response rate, supports the findings seen in the resident survey.

In conclusion, this needs assessment identified that an AS curriculum that focuses on empiric therapy and duration of therapy is most likely to meet the needs of pediatric residents and CEs. These topics align with the ABP EPAs for general pediatrics. While addressing the challenge of rising rates of AMR is a key focus of ASPs, stewardship-related education that centers on AMR is less likely to be of interest to the broadest swath of pediatric residents, and would come at the expense of other topics identified by CEs as more important for residents. Framing education on essential AMR topics within the broader context of education on empiric therapy may prove a more successful strategy, especially if it is incorporated into the day-to-day teaching that most ASPs already provide. Educators at other institutions who are interested in developing AS-related educational content for pediatric residents can consider utilizing the survey material developed in this needs assessment (included in the supplemental material) as a starting point for developing formal institution-specific curricula in AS.

Supplementary material. For supplementary material accompanying this paper visit <https://doi.org/10.1017/ash.2024.492>

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Research transparency and reproducibility. The survey instruments used to create this needs assessment have been included as supplementary material. Data are available upon request; please direct inquiries to the corresponding author.

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