

**Pediatric
Antimicrobial
Stewardship
Fellowship
Track**



Importance of Antimicrobial Stewardship

Antimicrobials are a cornerstone of modern medicine. These drugs not only make lethal infections reliably treatable, but also enable other life-saving interventions like complex surgeries, cancer chemotherapy, and organ transplantation. However, an alarming number of antimicrobials are unnecessarily prescribed and expose patients to drug-related adverse events, antimicrobial resistant infections, and increased healthcare costs.¹⁻⁵

Significant research and quality improvement efforts have been undertaken in recent years to ensure appropriate antimicrobial use. From these efforts, antimicrobial stewardship programs (ASPs) have emerged as critical tools in reducing inappropriate antimicrobial prescribing.⁶ ASPs function to improve clinical outcomes related to antimicrobial use while minimizing toxicity, antimicrobial resistance, and adverse effects. Multi-modal interventions are employed to ensure appropriate antimicrobial drug selection, dose, duration, and route of administration.⁷ Examples of interventions include daily prospective audit with feedback reviews, development of evidence-based clinical practice guidelines, use of electronic clinical decision support tools, participation in formulary decisions related to antimicrobials, and inter-institutional collaborations to improve ASP efficacy. ASPs have been successful in reducing antimicrobial utilization, cost, and prescribing errors without compromising clinical outcomes.⁸

The Centers for Disease Control and Prevention (CDC) have developed recommendations for implementing ASPs and specifically calls for program leadership to include physicians with training in infectious diseases and/or antimicrobial stewardship. Multiple policy statements issued by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS) have also advocated for infectious diseases physician leadership of ASPs.^{7,9-11} In January 2017, The Joint Commission (TJC) issued a new requirement for hospitals to implement and maintain ASPs, specifically calling for infectious diseases physicians to be a part of the leadership team [MM.09.01.01, EP 4].¹² TJC and the Centers for Medicare & Medicaid additionally specify in their standards that ASP leaders must be, "...qualified through education, training, experience, or certification in antibiotic stewardship."¹³ Despite widespread recognition of the value of infectious diseases physicians in ASP leadership, few formal training opportunities exist.

Gap in Antimicrobial Stewardship Training

While current infectious diseases fellowship training programs include some exposure to stewardship activities, most do not address unique content areas related to the design, implementation, and leadership of ASPs. Stewardship leaders must not only be well-versed in appropriate antimicrobial use and ASP principles, but also program development and logistics, data analytics, effective communication

and leadership, engaging key stakeholders, and regulations/governance related to stewardship.¹⁴ Additionally, newer standards from The Joint Commission (TJC) and the Centers for Medicaid and Medicare (CMS) are emphasizing the importance of ASP-specific education for ASP leaders. The two-year track in antimicrobial stewardship at Children's Mercy addresses these training gaps by providing future ASP leaders with the skills, experiences, and mentorship required for their future work.

Antimicrobial Stewardship at Children's Mercy

Children's Mercy (CMH) has a comprehensive antimicrobial stewardship program (ASP), addressing both the inpatient and outpatient settings. We have a multidisciplinary team, including members from Infectious Diseases, Pharmacy, Infection Prevention and Control, the Microbiology Laboratory, and Information Systems, as well as an Outpatient Advisory Board. The stewardship team employs multiple strategies to optimize antimicrobial prescribing. In the inpatient setting, members perform prospective-audit-with-feedback review of all antibiotics (e.g., every antibiotic ordered in the hospital is reviewed at 48 hours for appropriateness and the primary care team is contacted if there is an opportunity for optimization), daily review of positive blood cultures, and restriction of certain broad-spectrum antimicrobials. In the outpatient setting, the program tracks antibiotic prescribing for 16 common pediatric diagnoses and regularly shares this data with leaders from the emergency department (ED), urgent care centers (UCC), and primary care centers (PCC). Members also work collaboratively with representatives from these areas to develop guidelines and best practices to optimize antibiotic utilization. Additionally, the ASP has established an antibiotic allergy delabeling program in our Infectious Diseases Clinic to help remove inaccurate antibiotic allergies. Our outpatient ASP is also leading a national collaborative to establish outpatient benchmarks for pediatric antibiotic utilization across care settings.

The ASP at Children's Mercy has been a leader in the field since its inception. Children's Mercy was one of the first tertiary care pediatric hospitals to establish a prospective audit with feedback (PAF) ASP in 2008. We were also one of the first pediatric institutions to expand our program to the outpatient setting in 2018. We are a leader in research, with members regularly presenting work at international conferences and publishing in the top ASP and infectious diseases journals. The Children's Mercy ASP has become a model for other programs and helped advance the stewardship field, which places us in a unique position to provide exceptional educational and research opportunities for fellows participating in our track.

Objectives and Structure of the Antimicrobial Stewardship Track

The overarching goal of this track is to prepare fellows for a career in pediatric antimicrobial stewardship. Graduates of the program will have the core competencies needed to assume a leadership position in a stewardship program. Specific objectives of the track are to:

- 1) Develop the skills to independently perform inpatient prospective audit with feedback antimicrobial reviews.
- 2) Understand the mission and goals of antimicrobial stewardship, strategies employed to fulfill their mission/goals, and management of a program.
- 3) Participate in the governance of antimicrobials at an institutional level (e.g., policy development and implementation, adding new drugs to formulary, managing non-formulary antimicrobials, restricting the use of antimicrobials, managing drug shortages, etc).
- 4) Explain the current and evolving regulatory landscape for ASPs from bodies such as the Centers for Disease Control and Prevention (CDC), The Joint Commission (TJC), the Centers for Medicaid and Medicare (CMS), and Food & Drug Administration (FDA) and actively participate in reviews/site visits from such bodies.
- 5) Summarize key metrics used for antimicrobial stewardship and how these data are collected, analyzed, and disseminated (both internally and externally); generate and present antimicrobial utilization and program activity data to key stakeholders.
- 6) Demonstrate effective collaboration with interdisciplinary ASP members (e.g., pharmacists, advanced practice practitioners, nurses, trainees, etc.) and ASP partners outside the ASP/ID division (e.g., Infection Prevention, Microbiology, Critical Care, Surgery, Hospitalists, outpatient clinics, hospital administration, etc.)
- 7) Identify and complete a mentored quality improvement or research project related to antimicrobial stewardship and present the work externally (may be the fellow's main infectious diseases scholarly work or a separate project).

Program Type: Non-ACGME accredited training track for active pediatric infectious diseases fellows

Duration: Two years (during the fellow's 2nd and 3rd years of pediatric infectious diseases fellowship)

Number of Fellows in Track: one per year (maximum two participating at a time)

Fellowship Track Director: Joshua Herigon, MD, MPH, MBI, Medical Director, Antimicrobial Stewardship Program

ASP Faculty

ASP Co-Directors: Joshua Herigon*; Annie Wirtz

Outpatient ASP Director: Rana El Feghaly*

ASP Physicians: Chris Day; Jennifer Goldman*

ASP Clinical Pharmacist: Alaina Burns

IP&C Medical Director: Christelle Ilboudo*

Clinical Microbiology Lab Director: Raj Selvarangan

**Core faculty members in the pediatric infectious diseases fellowship program*

Training Oversight, Evaluation, and Certification

Fellows entering the track must (1) pass their categorical board examination(s), (2) obtain approval of the Fellowship Program Director and Clinical Competency Committee (CCC) for the Infectious Diseases Fellowship, and (3) remain in good standing as defined by the Fellowship Program Director and CCC. Approval for entrance in the track will occur in the fellows first year, likely at their May/June CCC meeting. Fellows will be primarily supervised by one or more core physician faculty members in the ASP as designated by the ASP medical director. When participating in prospective-audit-with-feedback rounds, supervision will come from a physician faculty member. The ASP pharmacists—as experts in the day-to-day conduct of prospective-audit-with-feedback rounds—will assist in the training of fellows along with physician faculty members. The fellow's quality improvement or research project should have a primary or secondary mentor from the ASP faculty. If the fellow's quality improvement or research project is their main academic project for their ID fellowship, the ASP faculty member should also serve on the fellow's scholarship oversight committee. Fellows will receive verbal and written feedback for their clinical activities as is standard for pediatric infectious diseases fellows. Fellows will meet semi-annually with the Fellowship Program Director to review evaluations and training progress, review individualized learning goals, and ensure that the fellow is meeting educational milestones. Fellows will also meet with the Fellowship Track Director on a semi-annual basis to review their training progress and attainment of track goals. Fellows who complete the pediatric antimicrobial stewardship fellowship track will receive a certificate of completion with a detailed curriculum outline, scholarship portfolio, and letter of support from the program.

Track Activities

Starred () activities are activities currently required of pediatric infectious diseases fellows, independent of participation in this track.*

A) Clinical activities

1. Participate in and lead prospective-audit-with-feedback rounds
2. Complete clinical rotations in Infectious Diseases*
3. Participate in joint initiatives with Infection Prevention and Control (IPC) and Microbiology
4. Analyze monthly outpatient antimicrobial use reports

B) Institutional leadership activities

1. Attend ASP-wide and ASP leadership meetings (including the outpatient ASP advisory board)
2. Attend meetings with ASP Executive Champion
3. Participate in program updates given to Pharmacy & Therapeutics Committee, Infection Control & Prevention, Quality & Safety Council, Microbiology, Medication Management Continuous Readiness Team, Outpatient Cookie Rounds and frontline clinicians at CMH
4. Participate in meetings with extramural collaborations (e.g., Sharing Antimicrobial Reports for Pediatric Stewardship (SHARPS), Sharing Antimicrobial Reports for Pediatric Stewardship—Outpatient (SHARPS-OP), ASP Impact Score Collaborative, etc.)
5. Participate in the preparation for and conduct of site visits from regulatory bodies such as The Joint Commission (TJC) and the Centers for Medicaid and Medicare (CMS)
6. Develop a business case to support ongoing ASP activities and/or a new ASP initiative

C) Scholarly activities

1. Develop an independent stewardship-related project, with a subsequent work product.* Examples of a work product include, but are not limited to, an abstract presented at a national conference, a manuscript published in a peer-reviewed journal, local presentation of a quality improvement (QI) project, or creation of a guideline. The same project and work product may satisfy scholarly activity requirements of both Infectious Diseases fellowship and the Antimicrobial Stewardship fellowship track.

D) Didactic activities

1. Weekly Infectious Diseases clinical case conference*
2. Microbiology laboratory plate rounds*
3. Infectious Diseases journal club*
4. Infectious Diseases research conference*
5. Infectious Diseases fellows' didactics*
6. Quarterly ASP journal club
7. Local and national guideline review (in the course of completing PAF)
8. Review key literature in antimicrobial stewardship (in the course of completing PAF)

9. Online-antimicrobial stewardship coursework, for example:
 - i) [Infectious Diseases Society of America \(IDSA\) Academy Core Antimicrobial Stewardship Curriculum for Fellows](#)
 - ii) [The Society for Healthcare Epidemiology of America \(SHEA\) Primer on Healthcare Epidemiology, Infection Control & Antimicrobial Stewardship](#)
 - iii) [PIDS Pediatric ASP Toolkit](#)
 - iv) [Stanford Antimicrobial Stewardship Online CME Courses](#)
 - v) [World Health Organization's Antimicrobial Stewardship Course](#)
10. Quality improvement methodology training (e.g., CMH QI curriculum, Institute for Health care Improvement (IHI) learning modules)
11. Research ethics, compliance, and safety training (e.g., Collaborative Institutional Training Initiative (CITI Program), institutional research training)
12. Annual International Pediatric Antimicrobial Stewardship Conference
13. Optionally, additional national infectious diseases conferences and meetings with significant antimicrobial stewardship content, including the SHEA Annual Conference and/or IDWeek

E) Education

1. Create educational materials for distribution via CMH's The Link Newsletter, CMH's ASP Stewie Shares, and other media
2. Participate in the annual update of the inpatient and outpatient antibiotic handbooks
3. Participate in the conduct (e.g., education, supervision, and evaluation) of ASP rotations for trainees (medical residents, pharmacy trainees, medical fellows excluding other ID fellows)
4. Prepare and participate in didactic sessions related to antimicrobial stewardship, such as those delivered to pediatric residents, clinical fellows, nurses, advanced practice providers, pharmacists
5. Plan and participate in educational activities during CDC Antibiotic Awareness Week each November

Detailed Antimicrobial Stewardship Track Objectives

The track objectives above are mapped to specific knowledge and skills outlined in a Society for Healthcare Epidemiology of America white paper detailing core competencies required for antimicrobial stewardship professionals engaged with building and leading ASPs.¹⁴

1. Develop the skills to independently perform inpatient prospective audit with feedback (PAF) antimicrobial reviews.
 - 1.1. Understand different classes of antimicrobials, including antibiotics, antifungals, and antivirals
 - 1.2. Understand common adverse events associated with different antimicrobials, including adverse reactions that mimic infectious syndromes

- 1.3. Understand approaches to therapeutic monitoring of antimicrobials such as vancomycin and aminoglycosides
- 1.4. Understand common mechanisms of resistance for different antimicrobial/organism combinations and their impact on resistance to other antimicrobials
- 1.5. Understand antimicrobial therapy options for highly resistant organisms
- 1.6. Understand how to appropriately obtain cultures and other samples for microbiology testing and interpret results
- 1.7. Understand CLSI recommendations for constructing institutional antibiograms
- 1.8. Work with the microbiology laboratory to select appropriate panels for automated systems and adopt selective and cascade reporting when necessary
- 1.9. Assist the laboratory in decisions regarding implementation of rapid diagnostic testing and appropriately incorporate results into stewardship interventions
- 1.10. Understand the uses of inflammatory biomarkers (e.g., procalcitonin, CRP, ANC) in antimicrobial stewardship
- 1.11. Understand the strengths, weaknesses, and diagnostic accuracy of testing performed in the microbiology laboratory
- 1.12. Recognize clinical syndromes and infections where combination therapy is recommended
- 1.13. Understand presentation, diagnosis, management, and appropriate antimicrobial use, including appropriate duration of therapy associated with common infectious syndromes, including (1) upper and lower respiratory tract infection; (2) urinary tract infection; (3) intra-abdominal/pelvic infection; (4) Skin, soft-tissue, bone and joint, diabetic foot infection; (5) central nervous system infection; (6) bloodstream, catheter, and endovascular infection; (7) infections involving prosthetic materials and devices other than catheters; (8) gastrointestinal infection, including *C. difficile* infection; (9) methicillin-resistant *Staphylococcus aureus* infection; (10) sepsis; (11) febrile neutropenia; (12) fungal infection; (13) viral infection
- 1.14. Develop and maintain communication and conflict resolution skills to assist in communication with a variety of stakeholders
2. Understand the mission and goals of antimicrobial stewardship, strategies employed to fulfill their mission/goals, and management of a program.
 - 2.1. State the overall mission and goals of antimicrobial stewardship
 - 2.2. Describe the relationship between antimicrobial use and resistance, selection of pathogenic organisms, and adverse patient outcomes
 - 2.3. Understand the roles and responsibilities of stakeholders in antimicrobial stewardship, including physician, pharmacist, infection preventionist, microbiologist, hospital administrators
 - 2.4. Describe the common methods for antimicrobial stewardship and approaches for their implementation, including (1) restriction with approval required before the first dose or after a certain time period (e.g., 24 hours); (2) post prescription prospective audit and feedback,

including discontinuation of antimicrobials when unwarranted, de-escalation of antimicrobial therapy, correction of mismatch between antimicrobial therapy and microbiology results, and recommendation regarding duration of therapy; (3) formulary management (4) education; (5) algorithm/order set development; (6) guideline development; (7) IV to PO switch

- 2.5. Understand the pros and cons of restriction of antimicrobial therapy
- 2.6. Understand the pros and cons of post prescription prospective audit and feedback regarding antimicrobial therapy including specific interventions such as discontinuation of antimicrobials when unwarranted, de-escalation of antimicrobial therapy, correction of mismatch between antimicrobial therapy and microbiology results, and recommendation regarding duration of therapy
- 2.7. Understand how to develop institutional algorithms and guidelines for antimicrobial use
- 2.8. Develop a systematic approach to identify problems with antimicrobial prescribing and design interventions to address problems
- 2.9. Understand the complex interpersonal and interprofessional needs to best develop and sustain an ASP
- 2.10. Understand how to write and present a strategic plan and business case to institutional leadership for stewardship programs for initial establishment of a program and maintenance of a program
- 2.11. Understand basic theories regarding patient safety, quality science, implementation science, and organizational change
3. Participate in the governance of antimicrobials at an institutional level (e.g., policy development and implementation, adding new drugs to formulary, managing non-formulary antimicrobials, restricting the use of antimicrobials, managing drug shortages, etc).
 - 3.1. Develop recommendations for alternative therapeutic approaches when antimicrobial shortages exists
 - 3.2. Understand the medical-legal implications of a stewardship program at your institution
 - 3.3. Understand the governance structure for antimicrobials, including formulary management, at your institution
4. Explain the current and evolving regulatory landscape for ASPs from bodies such as the Centers for Disease Control and Prevention (CDC), The Joint Commission (TJC), the Centers for Medicaid and Medicare (CMS), and Food & Drug Administration (FDA) and actively participate in reviews/site visits from such bodies.
 - 4.1. Understand reporting requirements and regulatory mandates related to antimicrobial use (e.g., surgical care improvement projects, core measures, US News and World Report rankings)
 - 4.2. Understand unique challenges and strategies for implementing and managing antimicrobial stewardship across diverse clinical settings (e.g., inpatient, outpatient, long-term care facilities), multiple institutions, and in a large health system

- 4.3. Understand the differences between surveillance definitions and clinical definitions for hospital acquired infections (HAI)
5. Summarize key metrics used for antimicrobial stewardship and how these data are collected, analyzed, and disseminated (both internally and externally); generate and present antimicrobial utilization and program activity data to key stakeholders.
 - 5.1. Understand methods, data needs, and interpretation of data on antimicrobial use
 - 5.2. Understand and compare standard methods of measuring antimicrobial use, including metrics such as DDD, DOT, LOT, SAAR, outpatient ARTI rate, amoxicillin index, etc.
 - 5.3. Understand approaches to benchmarking antimicrobial use within and across institutions
 - 5.4. Discuss approaches to measure the impact of a stewardship program or stewardship intervention, including (1) reductions in antimicrobial use; (2) reductions in inappropriate antimicrobial use; (3) improved patient outcomes (e.g., decreased length of hospitalization, mortality, and readmissions); (4) changes in rates or proportions of resistant organisms; (5) decreases in rates of *C. difficile*; (6) decrease in adverse events (e.g., renal dysfunction); (7) adherence to institutional pathways and protocols; (8) decrease in time to appropriate therapy; (9) decrease in antimicrobial costs and costs of care
 - 5.5. Assess sources at an institution for data on antimicrobial use (both inpatient and outpatient)
 - 5.6. Understand how to display and report data regarding process and outcome measures in internal and external presentations and reports and manuscripts
 - 5.7. Leverage IT resources to obtain needed information regarding antimicrobial use and to develop alerts or flags for stewardship interventions (e.g., bug-drug mismatch, antimicrobial starts, antimicrobials continued after 48–72 hours, outpatient antibiotic prescribing rates)
 - 5.8. Assess external proprietary antimicrobial stewardship IT software programs
 - 5.9. Understand how the ASP intersects with the institution's strategic plan
6. Demonstrate effective collaboration with interdisciplinary ASP members (e.g., pharmacists, advanced practice practitioners, nurses, trainees, etc.) and ASP partners outside the ASP/ID division (e.g., Infection Prevention, Microbiology, Critical Care, Surgery, Hospitalists, outpatient clinics, hospital administration, etc.).
7. Identify and complete a quality improvement or research project related to antimicrobial stewardship and present the work externally (may be the fellow's main infectious diseases scholarly work or a separate project).

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