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Antimicrobial Stewardship in the Emergency Department and Guidelines for Development

Larissa May, MD, MSPH,

Department of Emergency Medicine, The George Washington University, Washington, D.C

Sara Cosgrove, MD,

Department of Infectious Diseases, The Johns Hopkins University, Baltimore, Maryland

Michelle L'Archeveque,

The George Washington University School of Public Health, Washington, D.C

David A. Talan, MD,

David Geffen School of Medicine at University of California Los Angeles, Los Angeles, CA

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Corresponding Author: Larissa May, MD, Department of Emergency Medicine, 2150 Pennsylvania Avenue, NW, Suite 2B, Washington, DC 20037, Phone 202-741-2911, Fax 202-741-2921, larissa@gwu.edu.

Address for reprints: Larissa May, MD, MSPH, Department of Emergency Medicine, 2150 Pennsylvania Avenue, NW, Suite 2B, Washington, DC 20037, Phone 202-741-2920, Fax 202-741-2921, larissa@gwu.edu

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Additional Resources:

ED clinicians can play an active role in translating successful antimicrobial stewardship strategies to their patient care. While strategies will vary by site and existing resources from each institution's hospital based antimicrobial stewardship program may be tailored to the ED setting, there are some useful resources available which may help guide efforts.

1. The Centers for Disease Control and Prevention Get Smart for Healthcare Program maintains a list of resources that provides guidance for implementation of antimicrobial stewardship programs. This campaign for inpatient stewardship has useful resources for ED clinicians, including patient educational brochures on antimicrobial resistance and guidelines to change clinician behavior which can be downloaded freely at <http://www.cdc.gov/getsmart/>. The CDC viral prescription pad is a simple, useful tool for patient education and discharge instruction: <http://www.cdc.gov/getsmart/campaign-materials/print-materials/ViralRxPad.html>
2. Local antimicrobial recommendations based on national guidelines and institution specific data can be created. Examples include the Johns Hopkins Hospital Antibiotic Guidelines (www.hopkinsmedicine.org/amp) and the University of Pennsylvania Medical Center Guidelines for Antimicrobial Therapy (<http://www.uphs.upenn.edu/bugdrug/antibioticmanual/table%20of%20contents.htm>)
3. While most antimicrobial order forms are restrictive forms geared at inpatients, there are some examples that may be tailored to the ED setting (see Appendix 1): <http://hfh-formslibrary.org/forms/HFH-78-7049MR-0409%20antimicrobial.pdf>
4. Additional tools are available from the Society for Healthcare Epidemiology of America at <http://www.shea-online.org/GuidelinesResources/FeaturedTopicsinHAIPrevention/AntimicrobialStewardship/ImplementationToolsResources.aspx>. A stewardship toolkit is available at <http://www.gnyha.org/6763/Default.aspx>

Templates for the treatment of uncomplicated infections available in pdf format can be viewed electronically, printed, or directly integrated into an Electronic Health Record. Appendices 2 and 3 serve as examples.

Perry Payne, MD, JD, MPP, and

Department of Health Policy, The George Washington University, Washington, D.C

Richard E. Rothman, MD, PhD

Department of Emergency Medicine, The Johns Hopkins University, Baltimore, Maryland

Abstract

Antimicrobial resistance is a mounting public health concern. Emergency departments (EDs) represent a particularly important setting for addressing inappropriate antimicrobial prescribing practices, given the frequent use of antibiotics in this setting that sits at the interface of the community and the hospital. This article outlines the importance of antimicrobial stewardship in the ED setting and provides practical recommendations drawn from existing evidence for the application of various strategies and tools that could be implemented in the ED including advancement of clinical guidelines, clinical decision support systems, rapid diagnostics, and expansion of ED pharmacist programs.

Background

Antimicrobial resistance is a mounting public health concern. Antibiotic-resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) and extended spectrum beta lactamase – producing organisms (ESBL) have emerged and expanded their presence from healthcare settings to the community.^{1,2,3} Inappropriate antimicrobial use has been described as the most important preventable cause of drug resistance in both hospital and community settings.^{4,5,6,7} Estimated rates of inappropriate and unnecessary antibiotic use among office-based practitioners range from 25 to 63%.⁸ Infections with resistant pathogens are associated with increased morbidity, mortality, and rising health care costs.¹ In addition, inappropriate antibiotic use is an important patient safety issue. An estimated 142,500 ED visits each year are for adverse events associated with systemic antibiotics, with nearly 80% due to allergic reactions.⁹

Antimicrobial stewardship is a collection of strategies – including policies, guidelines, surveillance, data transparency, education, and evaluation – that collectively results in optimization of antibiotic prescribing practices.^{1,10,11} When implemented and monitored effectively, antimicrobial stewardship programs (ASPs) have been demonstrated to deliver a measurable impact in multiple clinical settings.^{12,13} Antimicrobial stewardship has been found to reduce overall and inappropriate antimicrobial use, lower drug costs, decrease treatment duration, decrease adverse events to antibiotics¹⁴, and reduce resistance locally.¹⁵ However, to date, ASPs have been targeted primarily to the inpatient setting, and there is a paucity of literature regarding ED antimicrobial stewardship strategies.

The 2010 United States' Patient Protection and Affordable Care Act (PPACA) provides an important opportunity to focus on the quality of emergency care, given the expected increase in the population who will seek care in the ED.¹⁶ Judicious use of antimicrobial agents in both the inpatient and ED settings will likely receive increased emphasis given recent PPACA provisions to eliminate payments for hospital-acquired infections.¹⁷ According to the Surviving Sepsis campaign, the initial choice of antibiotic in the ED is arguably the most important dose the patient receives for patients who are admitted with serious infections and should be based not only on the suspected infection but also host factors and prior antibiotic exposure.^{18,19} The antibiotic choice made by the ED also has a significant influence on what therapy is continued in the inpatient setting, thus representing an important opportunity for antimicrobial stewardship and collaboration with other specialties. This principle applies to both admitted patients and ED outpatients. In addition to making the decision regarding first antibiotic dose for inpatients, ED clinicians play a vital role in obtaining relevant cultures

prior to administration of antibiotics that allows for tailoring or stopping of antibiotic therapy during hospitalization.

Importance

Emergency Departments (EDs) represent a critical setting for initiating interventions that could reduce inappropriate antibiotic prescribing. As ED clinicians, we routinely prescribe antimicrobials to patients for a variety of conditions, including skin and soft-tissue infections (SSTIs), urinary tract infections (UTIs), blood-stream infections (BSIs), and upper and lower respiratory tract infections (URI, LRI). Since EDs sit at the interface of the inpatient and outpatient settings, ED practitioners have the unique opportunity to impact antimicrobial stewardship in both locations with important downstream implications. As an example, two recent ED observational studies report significant rates of overprescribing for acute bronchitis, with more than 75% of prescriptions being for broad spectrum antibiotics.^{20,21} While pilot ED based interventional studies have been implemented,²² challenges remain with substantial antibiotic overuse despite improvements after the intervention.

Reducing unnecessary antimicrobial use is imperative not only for decreasing rates of antimicrobial resistance in the community but also for individual patient safety, given the high rate of adverse events to antibiotics, including allergic reactions and development of secondary antibiotic associated infections such as *C.difficile* infection.²³ While EDs may not be included in all hospital antimicrobial stewardship programs, strategies, some of which can be extrapolated from successes in other settings, may help reduce unnecessary antimicrobial prescribing in the ED.

Challenges to Antimicrobial Stewardship in the ED setting

There are a set of distinct challenges associated with providing systematic education and oversight for antimicrobial stewardship in the ED setting. These include high rates of ED overcrowding²⁴, rapid rate of patient turnover, the need for quick decision making usually without consultation, and importantly the large and varied mix of providers who work in a shift based scheduling format, with relatively high rates of staff turnover versus other clinical settings.²⁵

Specific barriers to implementing other public health measures in the ED have been previously described and include perceived lack of efficacy, concerns regarding reimbursement and resource availability, and potential interference with ED operational efficiency.^{26,27} Further, medical liability concerns, including the failure to diagnose and treat²⁸ and requirements to satisfy local or national externally monitored quality measures have been shown to be associated with overuse of antibiotics and other medications, due to insufficient time to hone in on a definitive diagnosis.²⁹ Further, clinicians' desire to maintain patient satisfaction has been demonstrated to be an important factor in antibiotic prescribing practice in the ED setting;³⁰ previous studies have shown that provision of antibiotic prescriptions is associated with increased satisfaction for ED visits for acute respiratory tract infection,³¹ and physicians are more likely to prescribe antibiotics if they perceive patients want them.³² Despite these challenges, potential strategies described in this paper provide an important starting point for tackling this significant public health challenge.

ED Approaches to Antimicrobial Stewardship

In this concept paper, we review antimicrobial stewardship strategies, lessons learned from the literature in other settings, and existing clinical practice guidelines. The discussion includes critical interpretation of the findings or recommendations in relation to ED practice

and is followed by a general set of recommendations for decreasing unnecessary antibiotic use in ED settings. The factors important in translating antimicrobial stewardship interventions to the ED are drawn both from critical evaluation of the literature, and the authorship team's collective experience with infectious disease research in emergency settings and antimicrobial stewardship efforts in both inpatient and ED settings.

Broadly speaking support for the importance of antimicrobial stewardship programs in the ED is driven by recognition of the responsibility of front line practitioners in addressing the public health epidemic of rising rates of antimicrobial resistance. Antimicrobial stewardship in the ED, however, is nuanced by the fact that broad spectrum antibiotic use is often the most appropriate initial regimen for life-threatening infections, and ensuring the most appropriate empiric treatment is thus a major focus of stewardship interventions in that setting.

Many hospitals have existing antimicrobial stewardship programs, which are most often organized by leaders in hospital epidemiology and infection control. The simplest mechanism for EDs to engage in an antimicrobial stewardship program is to have an ED clinician volunteer to sit on the antimicrobial stewardship committee, which will provide opportunity for engaging with other professionals. Collaborative efforts between ED clinicians, pharmacists, microbiologists, and primary care and infectious disease colleagues are likely to be the most fruitful in yielding long-term successes, including reduced use of inappropriate empiric antimicrobial therapy.³³ The most effective strategies include measurement of processes and specific outcomes; interventions optimally include a comprehensive multidisciplinary antibiotic management strategy, and outcome measures to carefully track antimicrobial utilization and resistance patterns.³⁴ Various antimicrobial stewardship strategies are described below and summarized in Table 1.

Education of ED clinicians

Antimicrobial stewardship programs that have been shown to be the most effective are those that include active educational programs, such as seminars or roundtable discussions,³⁵ as they promote dialogue and increase likelihood of clinician engagement which is fundamental to practice change. Clinical practice guidelines promulgated by the Infectious Disease Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) recommend education as an essential element of a stewardship program, which should be incorporated with other strategies to increase acceptance of other stewardship activities.¹ It is noted however that these programs alone are unlikely to lead to enduring practice changes, as they require coupling with complementary strategies to reinforce practice change. For example, while a cluster randomized study of 16 EDs showed that multifaceted interventions could successfully reduce antibiotic use for the treatment of upper respiratory tract infections, substantial overuse remained even after the intervention, suggesting that education alone is insufficient for sustained practice change.²⁰ Use of educational messaging for the ED should be tailored to existing practice patterns and the particular challenges of the ED environment. Inclusion of infectious disease topics in departmental grand rounds and inter-specialty conferences and meetings may facilitate improved antibiotic use in the ED but engagement of thought leaders from the ED is essential to tailor the content of the message and ensure optimal engagement of all members of the practice group.

Development of ED-specific guidelines

Clinical practice guidelines, typically developed by professional societies, provide an opportunity to improve evidence based practice, including appropriate empiric antibiotic therapy. While guidelines for infectious diseases are typically promulgated from a broader

scope, definitions for appropriate and inappropriate antimicrobial use and guidelines for meeting ED standards may not be explicitly defined. Guidelines can be developed at the state or local level, but ideally should be adapted to the individual facility ED; optimally, they should be based on local susceptibilities and formulary.³⁶ For example, guideline committee recommendations for use of trimethoprim-sulfamethoxazole (TMP-SMX) for treatment of uncomplicated cystitis have been based on local patterns showing < 20% resistance.³⁷ Consideration should also be given to provide guidance that helps clinicians decide when NOT to treat with an antibiotic; this is particularly relevant for non-antibiotic responsive upper respiratory tract infections such as bronchitis and sinusitis which are known to be overtreated in the ED.^{20,21} The IDSA/SHEA guidelines recommend multidisciplinary development of guidelines that incorporate local susceptibilities and facilitating these guidelines through provider education and feedback on antibiotic use.³⁴ Recognizing that guidelines are affected by a variety of issues that impact uptake and sustained use, deliberate development using a team of invested partners and experts followed by systematic dissemination, implementation, and evaluation can help maximize clinical impact and address barriers to implementation in order to be most effective.^{38,39,40} Critical pathways may help address appropriate antibiotic use and decrease admission in low risk patients.⁴¹ Ultimately, a well thought out process for implementation will be most likely to foster the development of ED-specific recommendations alongside nationally developed measures for evaluating outcomes of antimicrobial stewardship.

ED pharmacist

Initial therapy decisions made in the ED are critical for ensuring positive patient outcomes. Several recent publications have reported the potential impact of inclusion of an ED pharmacist (EPH) as a key component of the clinical care team to facilitate appropriate prescribing in the ED, yet fewer than 5% of EDs have a dedicated Eph.^{42,43} While the EPH coverage recommended or supported by different programs varies, it is clear that the EPH offers added value for the ED across multiple roles, including continuous clinician education, real-time feedback and consultation regarding prescribing practices, provision of culture and susceptibility report follow-up, development of continuity of care programs, medication distribution and reconciliation, identification of drug interactions, and support for non-infectious disease programs including resuscitation management and trauma care. Studies have already demonstrated that an Eph in the ED can reduce duration of treatment and overall cost of care and plays an important role in reducing medication errors.⁴⁴

The Eph may also play another important role in defining ASP outcome measures. Although direct demonstration of decreased antimicrobial resistance as an outcome of the ASP remains challenging, common surrogate outcomes which an ED pharmacist (or a hospital pharmacist focused on infectious diseases and antimicrobial stewardship) can evaluate and document include effect of the ASP on length of stay, antibiotic use, and compliance with guidelines, via a quality assurance program.

Clinical decision support systems (CDSS)

Clinical decision support systems use health information technology to deliver information to the clinician at the point of care. The use of CDSS to assist with antimicrobial prescribing has been shown to be successful in a variety of other clinical care settings,^{45,46} and could be applied to the ED. For example, the use of handheld CDSS was found to reduce antibiotic usage and length of stay in patients in the ICU setting.⁴⁷ In the outpatient setting, CDSS has been successful in reducing unnecessary antibiotic use for upper respiratory infection in the community.⁴⁸ The IDSA/SHEA guidelines recognize that CDSS can improve prescribing practices; however, widespread implementation of CDSS has been slow, likely because many institutions lack the IT infrastructure and systems required for implementation. In

order to be practically feasible in the ED, streamlined CDSS can be designed specifically to help avoid information overload. However, it is important to recognize that CDSS may lead to over-reliance on automation.⁴⁹ An ideal CDSS system for use in the ED would incorporate patient data at the time of electronic antimicrobial prescribing, including laboratory results (e.g. culture if available, patient's renal function), patient medical history and allergies, in addition to local recommendations, then deliver "suggestions" to the ED prescriber. With a trend toward wider spread implementation of electronic health records (EHRs) nationwide, CDSS may provide important high impact opportunities to facilitate antimicrobial stewardship in the ED.

Antimicrobial order forms

One of the earliest methods developed to reduce unnecessary antibiotic use is the use of antimicrobial order forms, which can be paper or electronic based and require clinician completion of a form, with subsequent approval by pharmacy or an infectious disease physician.⁵⁰ Order forms have been advocated as a method to facilitate implementation of clinical practice guidelines³⁴. Published studies evaluating the impact of antibiotic order forms in reducing unnecessary antibiotic use report mixed results in different settings. For example, while they have been used successfully in reducing inappropriate surgical prophylaxis,⁵¹ they have not been shown to be useful in reducing vancomycin in pediatric inpatients.⁵² In the critical care setting, restrictions on antibiotic use have resulted in reducing selected antimicrobial agents, though that success has been offset in some studies by increasing use of other broad-spectrum agents.^{53,54} The most notable challenge with order forms which has been described is their practical inconvenience and undue time requirements;³³ accordingly, future evaluation of the utility and impact of antibiotic order forms in ED should attend to streamlining methods for integrating them into EDs and will require further study. An example of an antimicrobial order form may be found in Appendix 1.

Post-prescription review

A common approach to stewardship among inpatients is to perform review of antimicrobial use 48 to 72 hours after antibiotics are started with the goals of stopping or streamlining therapy based on the patient's clinical course as well as imaging and microbiology data which become available. ED providers can make significant contributions to these efforts by obtaining adequate culture specimens prior to the first dose of antibiotics so that the admitting physician will have pathogen identification and susceptibility results on which to de-escalate to targeted antibiotics.

Post-prescription review of patients discharged from the ED has not traditionally been performed by ED personnel due to lack of resources. However, with the expected increase in home health services advanced through health care reform, enhanced patient follow-up and care coordination presents a unique opportunity for culture follow-up and switching to narrow spectrum antibiotics. Telephone follow-up is already being conducted in many EDs for purposes of patient satisfaction (Press Ganey), and could be leveraged for decreasing unnecessary use of antibiotics in the ED. Patient satisfaction in the ED has been found to be related to better understanding of illness rather than receipt of antibiotics for upper respiratory infection.³² Techniques to enhance patient education include giving patients a prescription to fill in the event of a positive test (for example, for streptococcal pharyngitis), and use of the Centers for Disease Control and Prevention (CDC) viral prescription pad as an innovative patient education tool, which provides patient education on viral illness and recommendations for symptomatic treatment.⁵⁵ Furthermore, follow-up phone calls can be used to assess medication compliance and identify adverse events.⁵⁶ A systems based approach should be in place to assist with patient follow up and coordination of care, such as

a quality improvement program or staff nurse coordinator, in order to reduce the burden on ED clinicians.⁵⁷ ED outpatients with viral infections present a unique opportunity for patient education and reduction of unnecessary antibiotics; for example, clinical practice guidelines recommend a “watch and wait” approach to the treatment of most cases of otitis media.⁵⁸ Telephone follow-up for patients with these less severe infections represents an important opportunity for addressing patient or parent concerns and further education, while striving towards the goal of patient satisfaction.

Rapid diagnostics

Improving access to rapid diagnostics is one of the cornerstones of the IDSA strategy to curb resistance.⁵⁹ Expanded laboratory capacity is beginning to play an important role in antimicrobial stewardship programs and the clinical microbiology laboratory has an important role in providing patient specific culture and susceptibility data.^{34,60} The recent availability of rapid molecular diagnostic tests can provide accurate pathogen identification including resistance markers with short turn-around-times of approximately one hour. The use of rapid molecular diagnostics in the inpatient setting has already been shown to lead to more targeted use of narrow spectrum antibiotics, earlier switch in therapy, and a decrease overall antibiotic use.^{61,62} There is a growing arsenal of rapid diagnostic tests which could have potential utility in the ED setting to improve antimicrobial prescribing and patient outcomes.⁶³ Many of these tests are already or could be made available at or near the point of care, such as rapid streptococcal antigen tests and newly emerging rapid molecular tests (e.g. molecular based screening for *S. aureus* colonization and infection, *C. difficile*, and viral respiratory pathogens including influenza, RSV, and pneumococcus among others). Limitations to uptake and integration of molecular tests in the ED include false negative and positive results, challenges to simultaneous identification of multiple organisms, and logistical and regulatory constraints associated with integration of these tests in the ED.⁶⁴ Nonetheless, expansion and further development of automated molecular platforms (such as the Cepheid GeneXpert® and BD GeneOhm®) as point of care tests for the ED setting could prove to be a critical component of a strategy directed toward decreasing antimicrobial resistance.⁶⁵ Further study is required to assess performance and cost, relative to traditional testing or empiric therapy before widespread consideration is realized.

Efforts to shorten duration of therapy

Antibiotic guidelines which recommend reducing the duration of therapy have the potential to reduce selection pressure for resistant pathogens without compromising individual patient outcomes.⁶⁶ Duration of antimicrobial therapy for community acquired pneumonia is now measured by the Centers for Medicare and Medicaid Services (CMS) as a core performance measure. Antimicrobial stewardship strategies that involve provider education and prospective feedback have already been found to reduce treatment duration from 10 to 7 days in non-ED settings.⁶⁷ Similar models of educational interventions could be advanced in the ED but await ED advocates and/or formal investigation. Examples of shortened treatment regimens for various uncomplicated infections in ED patients treated as outpatients are shown in Table 2.

Dose optimization

Dose optimization relies on the principles of pharmacokinetics and pharmacodynamics and patient (age, weight, renal function) and infection specific factors (pathogen, site of infection) in antibiotic selection. Examples include prolonged beta lactam infusion and higher doses of fluoroquinolones for coverage of *S. pneumo* in patients with community-acquired pneumonia. Dose optimization is most applicable for admitted patients that have

prolonged ED length of stay awaiting admission and can be undertaken with input from pharmacist colleagues.^{33,34}

Streamlining or de-escalation of therapy—The goal of de-escalation is to transition patients from empiric broad spectrum antibiotics to targeted narrow spectrum therapy as soon as possible. In de-escalation strategies, laboratory reporting of the causative agent triggers antimicrobial switch therapy to the narrowest possible spectrum. Laboratory results are reviewed by a pharmacist or infectious disease physician, and recommendations are provided to the clinician for adjusting therapy.^{1,10} This strategy, while more commonly used in inpatient settings, could be applied to ED outpatients as well, in the context of a robust program for follow up and coordination of care. Streamlining aims to minimize a patient's antibiotic exposure. For example, a pharmacy system can identify those patients on two or more antibiotics, triggering an alert for the pharmacist to contact the medical provider to determine clinical indication and provide alternatives, eliminating redundancy.⁶⁸

ED antibiogram development

An antibiogram is a comprehensive picture of the susceptibility of microbial species to a select antimicrobial agent specific for an individual facility. While antibiograms are often reported for outpatient isolates, they may be limited in that they bias high risk cases or treatment failures where cultures are sent by the ED clinician. These antibiograms therefore may overestimate antimicrobial resistance, which could lead to inappropriate use of broad spectrum antibiotics unless that bias is taken into consideration. Hospital antibiograms may not always provide susceptibilities broken down by unit or source of isolate, which would be useful for helping guide ED clinicians in their choices for empiric therapy. According to the IDSA/SHEA guidelines, local antibiograms with pathogen-specific susceptibility data should be updated no less than once yearly and consideration should be given to providing ward specific data and outpatient data to facilitate clinical decision-making in those settings.³⁴ ED-based antibiograms could be incorporated into CDSS platforms to provide ED physicians with a comprehensive resource for clinical decision-making, especially with the development of more rapid molecular based testing for drug resistance. Educational interventions would aid ED clinicians in appropriate interpretation and use. Dissemination of local antibiograms based on ED patient isolates would also be useful to establish uniform measures for tracking resistance and developing ED specific quality control initiatives.

Conclusions

Globally, clinicians practicing in ED settings must acknowledge and address the increasing problem of antimicrobial resistance stewardship, which require EDs take an active role in designing and systematically studying strategies to improve antimicrobial stewardship in these settings. Since not all antimicrobial stewardship strategies are applicable to the ED, programs must be developed through partnership between the ED and other key stakeholders, including local communities, outpatient physicians, hospital administrators, pharmacists, and infectious disease specialists. It is time to incorporate ED antimicrobial stewardship into these policies and other directives, as calls for its broad application continues to expand from leadership at the CDC, National Institutes of Health (NIH), IDSA, SHEA, and Centers for Medicare and Medicaid Services (CMS). While some have begun this process, there remains a large gap in the literature evaluating ED based antimicrobial stewardship strategies. Accordingly a strong need exists for research to define appropriate metrics for measuring ASP outcomes in EDs. In addition, research is needed to determine which of multiple ASP strategies (e.g. clinical practice guidelines, use of rapid diagnostics) are most appropriate for the ED, by assessing feasibility and relative impact for key outcome measures as well as acceptability to ED stakeholders. There is an important role for

researchers and advocates to disseminate findings for evidence based public health interventions, identify local barriers to implementation, adapt measures to local context and advocate for legislation, regulation and incentives outside of the ED to strengthen these ED based interventions.⁶⁹ Ultimately, however, it is the practicing ED clinician who has the greatest potential to impact outcomes for patients and their community through careful antimicrobial prescribing decision-making.

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Appendices: Templates for ED Antimicrobial Stewardship

**Prototypes developed by Larissa May and Sara Cosgrove. Templates are provided as examples only and are not intended to replace clinical judgment.

Appendix 1

Sample Antimicrobial Order Form for Empiric Vancomycin in the ED

Please check criteria met below in order to justify use of empiric vancomycin therapy for this patient:
◦ Serious infection suspected to be caused by beta-lactam- resistant gram-positive microorganism
◦ Infection suspected to be caused by gram-positive microorganisms in patient who has a serious allergy to beta-lactams.
◦ History of MRSA or Coagulase negative <i>S. aureus</i> positive culture + suspected infection
◦ Bacterial Meningitis (suspected <i>S. pneumo</i>)
◦ Prophylaxis for endocarditis following certain procedures in patients at high risk for endocarditis or with suspected <i>S. aureus</i> infection, per American Heart Association Guidelines. ⁸³
◦ Respiratory tract, skin or musculoskeletal procedure Y/N
◦ Patient at risk of endocarditis Y/N
◦ Prophylaxis for major surgical procedures involving implantation of prosthetic materials or devices (e.g., cardiac and vascular procedures and total hip replacement) at institutions that have a high rate of infections caused by MRSA or methicillin-resistant <i>S. epidermidis</i> . ⁸⁴
◦ Oral vancomycin: Patient with severe <i>C. difficile</i> infection or failure to respond to metronidazole therapy
• If criteria above not met, please enter alternate explanation for use and call the pharmacy for notification.
• Send clinical specimen (blood, wound, sputum, urine, body fluids) to microbiology for culture and sensitivity
• Vancomycin use should be re-evaluated by the infectious disease pharmacy team at 48 hours for consideration of discontinuation if criteria are no longer met

Appendix 2

Template for Clinician Guidance for Treatment of SSTI

Suspected Infection	Likely Pathogens	Empiric Therapy	Duration
Purulent SSTI	<i>S. aureus</i>	Cephalexin, dicloxacillin, clindamycin	5–10 days
• Cutaneous abscess, uncomplicated	<i>S. aureus</i> (MRSA, MSSA)	I and D first line	
• Cutaneous abscess, complicated (e.g. comorbidities, immune)	<i>S. aureus</i> (MRSA, MSSA)	TMP-SMX, clindamycin (outpatients) Vancomycin, linezolid, daptomycin (hospitalized patients)	7–10 days Consider admission

Suspected Infection	Likely Pathogens	Empiric Therapy	Duration
suppression, failing outpatient treatment, area difficult to drain)			
Cellulitis uncomplicated	<i>Streptococcus sp.</i> , <i>S. aureus</i>	Cephalexin, dicloxacillin, clindamycin	5–7 days
Diabetic Foot Infection (not osteomyelitis)	polymicrobial	Broad spectrum penicillin, cephalosporin, quinolone + antimicrobial coverage	14 days Hospital admission

- Where possible, base empiric therapy on prior culture results, patient medical history, local antibiograms, taking into account any serious allergies or prior adverse events. While targeted spectrum antibiotics are ideal, cost, patient compliance and duration of treatment may be factors in clinical decision-making
- Weblink to clinical practice guidelines: click here:
- SSTI: <http://cid.oxfordjournals.org/content/early/2011/01/04/cid.ciq146.full.pdf+html> DFI: http://www.idsociety.org/uploadedFiles/IDSA/Guidelines-Patient_Care/PDF_Library/Diabetic%20Foot%20Infection.pdf

Appendix 3

Template for Clinician Guidance for Empiric Treatment of Suspected UTI

Suspected infection	Laboratory Results	Recommendation	Duration
Asymptomatic Bacteriuria	Bacteria +/- pyuria	Do not treat unless pregnant. Consider telephone follow up for outpatients.	N/A
Cystitis		TMP-SMX where resistance rates < 20% Nitrofurantoin	3 days for TMP-SMX or Fluoroquinolones, 7 days for nitrofurantoin
Uncomplicated Pyelonephritis		Ciprofloxacin or other quinolone Extended spectrum penicillin or cephalosporin in children/pregnant females Send urine culture Consider telephone follow up for patients discharged home	7 days
Complicated UTI (diabetes, male, indwelling catheter)		Quinolone where resistance rates does not exceed 10% Consider Fosfomycin Send urine for culture and sensitivity	7–10 days Consider admission

- Where possible, base empiric therapy on prior culture results, patient medical history, local antibiograms, and taking into account any serious allergies or prior adverse events. While targeted spectrum antibiotics are ideal, cost, patient compliance and duration of treatment may be factors in clinical decision-making
- Links to clinical practice guidelines: click here:
- Asymptomatic bacteriuria: http://www.idsociety.org/uploadedFiles/IDSA/Guidelines-Patient_Care/PDF_Library/Asymptomatic%20Bacteriuria.pdf
- uncomplicated UTI: http://www.idsociety.org/uploadedFiles/IDSA/Guidelines-Patient_Care/PDF_Library/Uncomp%20UTI.pdf Complicated UTI: http://www.idsociety.org/uploadedFiles/IDSA/Guidelines-Patient_Care/PDF_Library/Asymptomatic%20Bacteriuria.pdf

Table 1

Summary of types of programs that may support antimicrobial stewardship in the ED

Approaches	Description
Education	Defined as an essential element of ASPs combined with implementation of active interventions to produce results. ^{1,10} The type of education provided to clinicians and patients can take a variety of forms. The Centers for Disease Control and Prevention's (CDC) Get Smart program is one prototype educational program that targets both physicians and patients. ⁵⁹
Guidelines and clinical pathways	Assists physicians in the diagnosis and treatment of diseases with the goal of producing high quality care ¹ . Treatment algorithms are also identified to assist with decision-making before culture or susceptibility data are available. ^{10,70}
ED Pharmacist	Facilitates selection of appropriate empiric antibiotic therapy and education on antimicrobial prescribing at the point of care; critical role of a dedicated pharmacist as part of a multidisciplinary team to address antibiotic use in the ED. ⁷¹
Clinical Decision Support Systems (CDSS)	Provides physicians with real-time feedback related to individual patients, including choices for antimicrobial therapy and side effects. There is a range of computer-assisted programs available in the United States, and some hospitals are actively using them with success. ^{72,73}
Antimicrobial Order Forms	Actively engages physicians, by requiring completion of antimicrobial request forms, which require clinical justification for use of individual agents. ^{1,10} Pre-written forms commonly include automatic stop orders to cease therapy after a defined period of time, and require a renewal process that includes empirical data driven decisions coupled with clinical judgment. ⁷⁴
Post Prescription Review	Involves patient follow up and transition to the outpatient care setting. Examples include: phone follow up of patients with uncomplicated pyelonephritis to ensure appropriate antibiotic treatment was prescribed based on final susceptibilities, and delayed antimicrobial prescribing for patients with cutaneous abscesses, pharyngitis, and acute otitis media. ⁷⁵
Rapid diagnostic testing	Evolving and key strategy for promoting ASPs. The capability of new rapid diagnostics to distinguish pathogens has been demonstrated to improve clinical decision-making and ensures rapid and appropriate initiation of antimicrobial therapy; this strategy helps eliminate antibiotic use in the case of viral pathogens and reduces use of broad-spectrum agents when a narrow-spectrum option is available. ^{62,76}
Shortening duration of therapy	Current guidelines are more specifically defining the duration of antimicrobial therapy recommended; shorter therapeutic duration has been shown to reduce selective pressure for resistant bacteria without compromising patient outcomes. ⁶⁷
Dose optimization	Involves defining individualized antibiotic dosing based on patient characteristics (age, weight), pathogen characteristics, site of infection, and the pharmacokinetic and pharmacodynamic properties of the medication. ^{1,10} This strategy is most applicable in the ED for patients awaiting admission to a hospital bed.
Streamlining or de-escalation of therapy	Facilitates early transition from broad to narrow spectrum antibiotics. Laboratory reporting of the causative agent triggers antimicrobial switch therapy to the narrowest possible spectrum. Laboratory results are reviewed by a pharmacist or infectious disease physician, and recommendations are provided to the clinician for adjusting therapy. ^{1,10} This strategy is most applicable to admitted patients but could be applied to ED outpatients as well, in the context of a robust program for follow up and coordination of care.
ED Antibiogram Development	Development of ED specific charts of pathogen susceptibility. In order to be representative of ED outpatients, hospital resources to facilitate sending routine cultures as a quality improvement intervention could be considered; antibiograms are most useful when broken down by inpatient versus outpatient status, by unit (ED), and by infection type and pathogen; inclusion of outpatient prescriptions (not just inpatient formulary) susceptibilities adds to fidelity of the guidelines. ^{77,78,79}

Table 2

Examples of empiric antibiotic therapy and treatment duration for uncomplicated infections in ED outpatients based on IDSA guidelines

Infection	Empiric Antibiotic	Duration
Community acquired pneumonia ⁸⁰	Macrolide Fluoroquinolone Doxycycline	5–7 days
Uncomplicated cystitis in women ³⁷	<ul style="list-style-type: none"> Nitrofurantoin Trimethoprim-sulfamethoxazole (where local resistance <20%) Ciprofloxacin or levaquin (where nitrofurantoin and TMP-SMX cannot be used) 	5 days 3 days 3 days
Uncomplicated pyelonephritis ³⁷	Ciprofloxacin Levofloxacin TMP-SMX (only if pathogen known to be susceptible) Beta lactam (less effective)	7 days 5 days 14 days 10–14 days Dose of IV ceftriaxone in ED recommended if fluoroquinolone resistance >10% or if using beta lactam or TMP-SMX empirically
Cutaneous abscess ⁸¹	Incision and Drainage +/- coverage for MRSA (clindamycin, TMP-SMX, doxycycline)	Antibiotic avoidance for uncomplicated abscesses 5 days
Uncomplicated cellulitis ⁸²	Dicloxacillin Cephalexin	5 days