Next-Gen Stewardship: Training Responsible Users of Antibiotics

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No Disclosures

OUTLINE

- Why is antimicrobial stewardship education important?
- How can we train the next generation?
- What are some challenges and potential solutions?

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WHY IS ANTIMICROBIAL STEWARDSHIP EDUCATION IMPORTANT FOR HEALTH PROFESSIONS LEARNERS?

- Critically important topic
- Building a foundation
- Developing a toolkit
- Shaping attitudes and beliefs
- Establishing habits

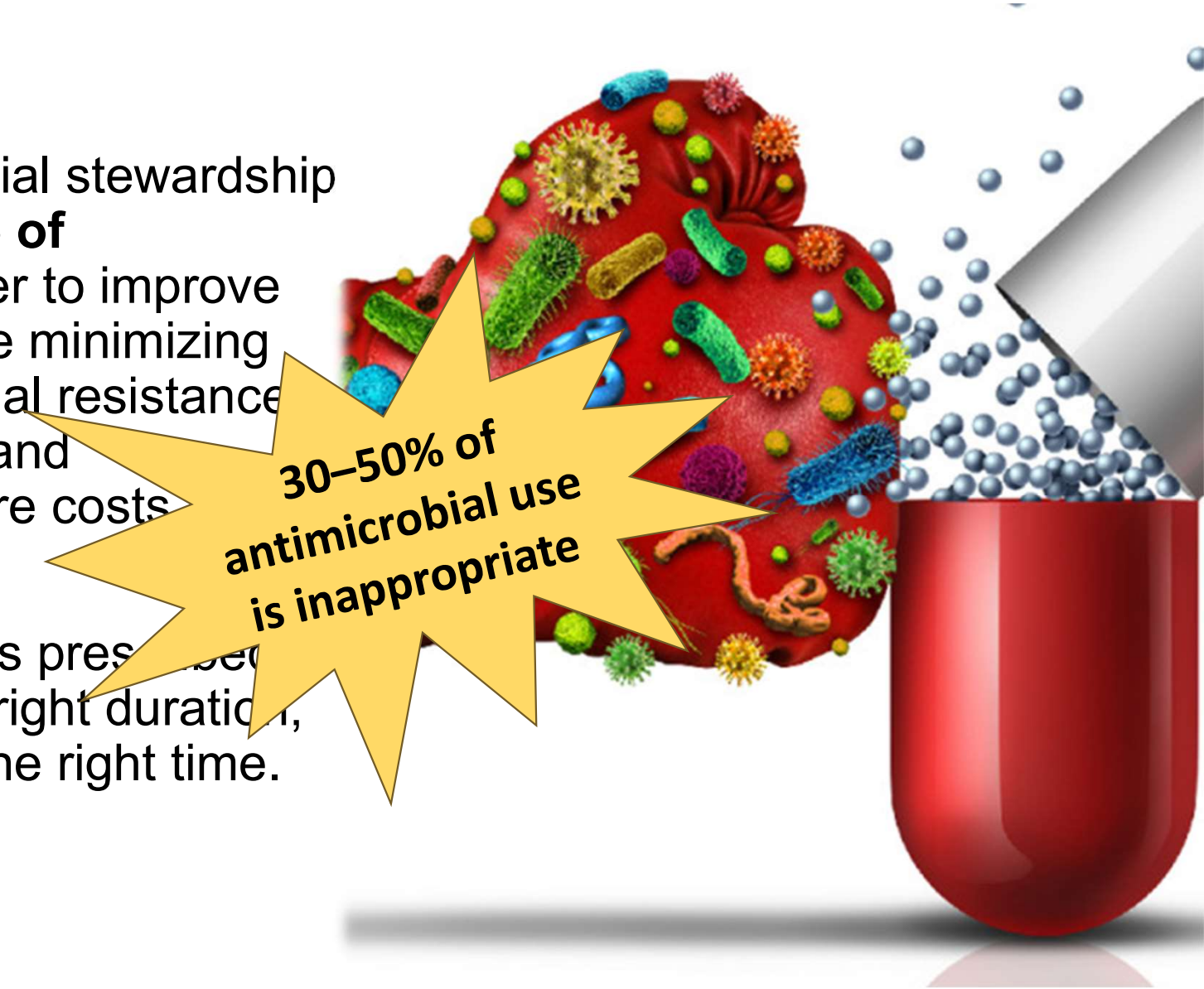
CRITICALLY IMPORTANT

Customizing each antimicrobial consideration

Combating antimicrobial resistance

The goal of antimicrobial stewardship is to **optimize the use of antimicrobials** in order to improve patient outcomes while minimizing the risks of antimicrobial resistance, adverse drug events, and unnecessary healthcare costs.

Ensure the right drug is prescribed, the right dose, for the right duration, in the right patient at the right time.

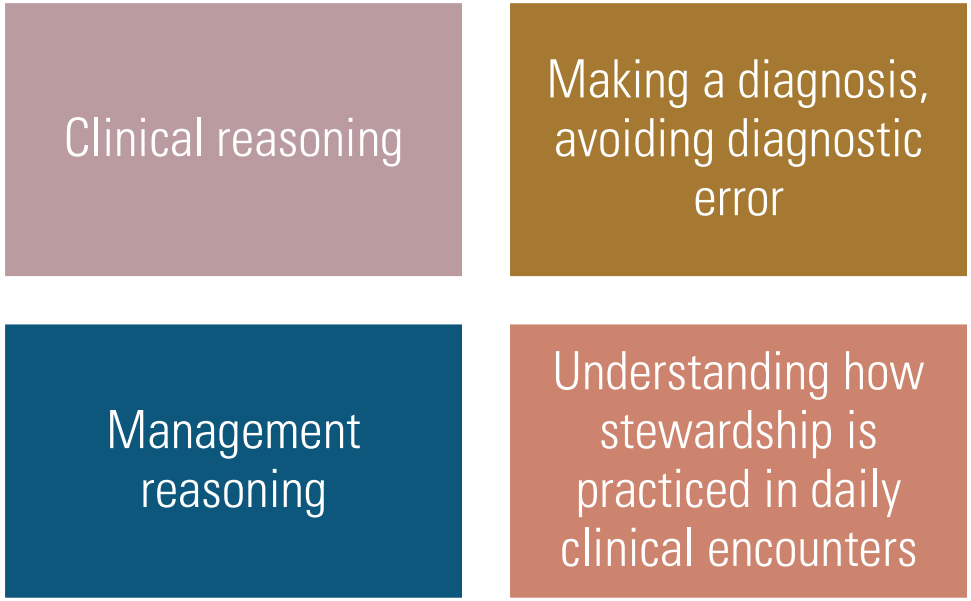


Aiesh BM, et al. Sci Rep. 2023; 13:1–9.
Fanelli U, et al. Front Pharmacol. 2020; 11:2019–2021

BUILDING A FOUNDATION OF KNOWLEDGE

- Understanding the "why"
- Deep understanding of stewardship principles
  - Resistance mechanisms
  - How antimicrobials work
  - Appropriate use of antimicrobials
  - Potential harms of inappropriate prescribing
  - How to make an accurate diagnosis
  - Benefits of stewardship
  - Behavioral psychology
  - Communication

DEVELOPING SKILLS IN THE HEALTH PROFESSIONS TOOLKIT



SHAPING ATTITUDES AND BELIEFS

Students are future healthcare professionals

Stewardship practitioner

Stewardship ally

STUDENTS ARE ESTABLISHING HABITS

SHAPING VERSUS CHANGING BEHAVIOR

HABITS CAN LAST THROUGHOUT A CAREER

EDUCATION CAN BENEFIT ANTIMICROBIAL STEWARDSHIP PROGRAMS & PROFESSIONALS

Increased AMS reach and uptake of recommendations

- Workforce is seeded with students empowered to act as stewards
- AMS team gains allies to enhance the success of interventions
- AMS team gains insight from learning the gaps in knowledge/common trainee misperceptions
- Opportunity to influence future educators and “train the trainer”

STUDENT PREFERENCES AND PERCEPTIONS

2010: >75% of students would like more education on antibiotic selection, and 83% wanted this education to be during the third year of medical school.

2013: 92% of respondents agreed that strong knowledge of antimicrobials is important in their careers, 90% wanted more education on appropriate use of antimicrobials, 33% perceived their preparedness to be adequate in some fundamental principles of antimicrobial use, and the mean knowledge score was 51% correct.

2017: 40% students felt comfortable prescribing antibiotics for a known infection[1], 34% were able to describe the role of each profession in appropriate antibiotic use[2]

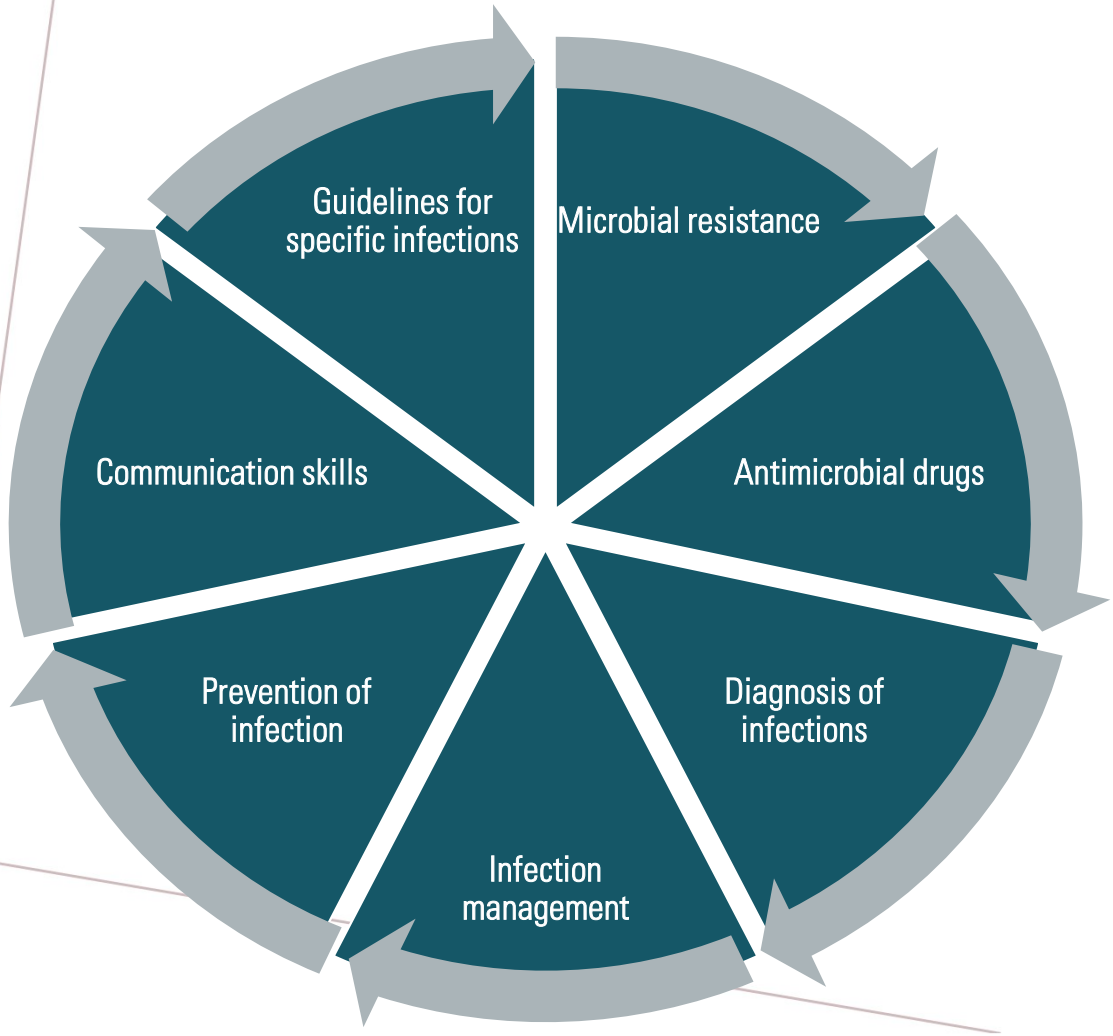
2021: 70.7% nursing students believed they had very little or no knowledge of antibiotic stewardship principles

Minen, Duquaine, Marx et al. Microbial Drug Resist. 2010:16(4)
Abbo, Cosgrove, Pottinger, et al. Clin Infect Dis. 2013: 57(5)
Nori, Madaline, Munjal, et al. Open Forum Infect Dis. 2017;4(3)[1]
MacDougall, Schwartz, Kim, et al. Open Forum Infect Dis. 2017;4(1)[2]
Bouchoucha, Kilpatrick, Phillips, et al. Nurse Educ Pract. 2021;52

OUTLINE

- Why is antimicrobial stewardship education important?
- How can we train the next generation?
- What are some challenges and potential solutions?

HOW CAN WE TRAIN THE NEXT GENERATION IN ANTIMICROBIAL STEWARDSHIP?



Hospitalized patients

- UTI & ASB
- CAP
- HAP/VAP
- SSTI

Outpatients

- Sinusitis
- Acute bronchitis
- Pharyngitis
- Otitis media

www.cdc.gov/antibiotic-use/healthcare
Ohl & Luther Inf Dis Clinics N Am 2014;28:177-93
Pulcini & Gyssens Virulence 2013; 4(2):192-202

Right drug, right patient, right indication, right dose, right route given at the right time for the right duration

Right drug, right patient, right indication, right dose, right route given at the right time for the right duration

Unnecessary

- Non-infectious diagnosis
- Viral diagnosis
- Treating colonization

Inappropriate

- Mismatch (drug doesn't cover pathogen)
- Too broad (or too narrow)
- Duration too long
- Wrong dose
- Delayed administration in critically ill patients

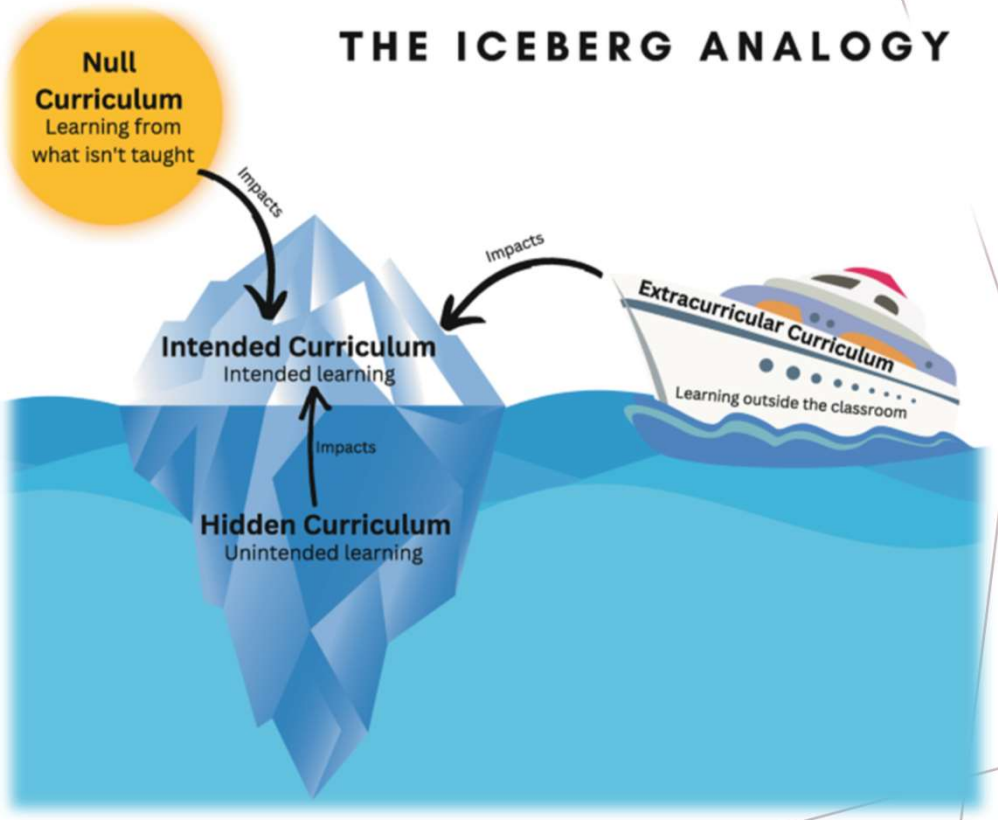
Right drug, right patient, right indication, right dose, right route given at the right time for the right duration

Diagnostic problem

Treatment problem

CLINICAL TEACHING

Imparting **knowledge, attitudes, skills** both explicitly and implicitly



Evans et al. Leveraging Pedagogy: Enhancing Biomedical Education. 2025

MAP FRAMEWORK TO DEFINE AN INFECTION

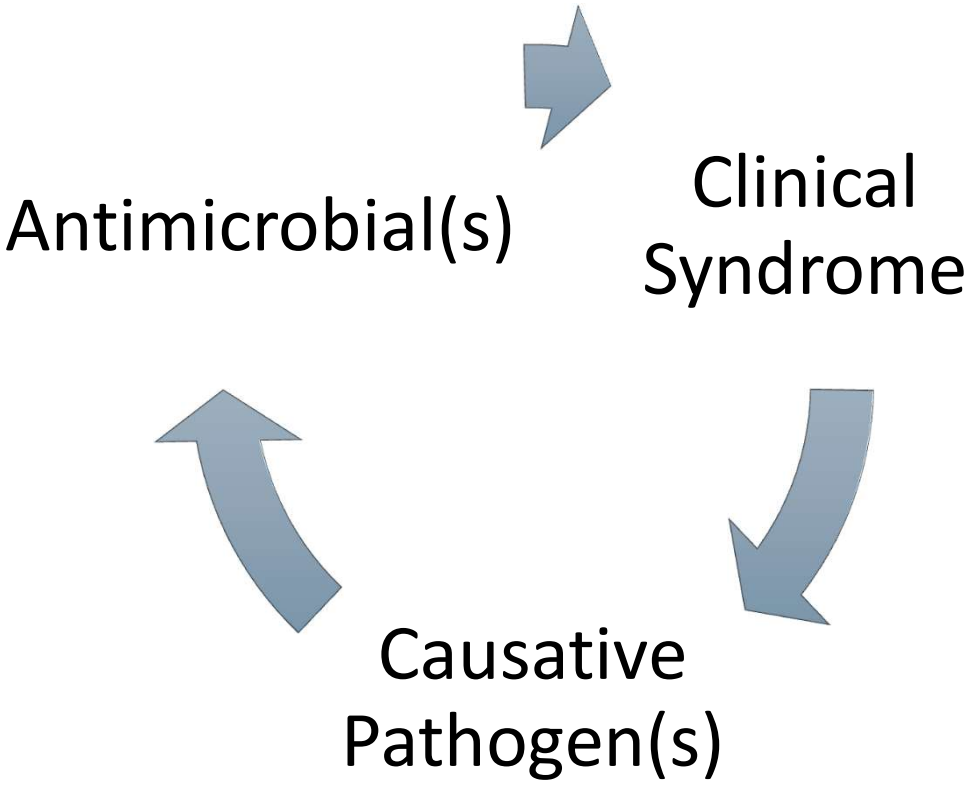
Microbiologically

Anatomically

Pathophysiologically

Ohl, Luther. *Infect Dis Clin North Am*. 2014

Framework for choosing an antimicrobial



Case

52-year-old woman admitted fever, chills, and severe right flank pain for the past 2 days. She reports frequent, painful urination and nausea. Her medical history is remarkable for type 2 diabetes mellitus and hypertension.

Physical Examination
T 102.6°F, HR 110 bpm, bp 115/62 mmHg
Gen: appears ill
Lungs: Clear to auscultation bilaterally
CV: RRR
Abd: mild ttp over suprapubic region
Back: + R sided costovertebral angle tenderness

Labs
WBC: 18,000/µL with left shift
CMP: within normal limits
Urinalysis: positive for leukocyte esterase and nitrites, numerous WBCs and bacteria
Blood glucose: 210 mg/dL

MAP FRAMEWORK

Microbiologically: *E. coli*

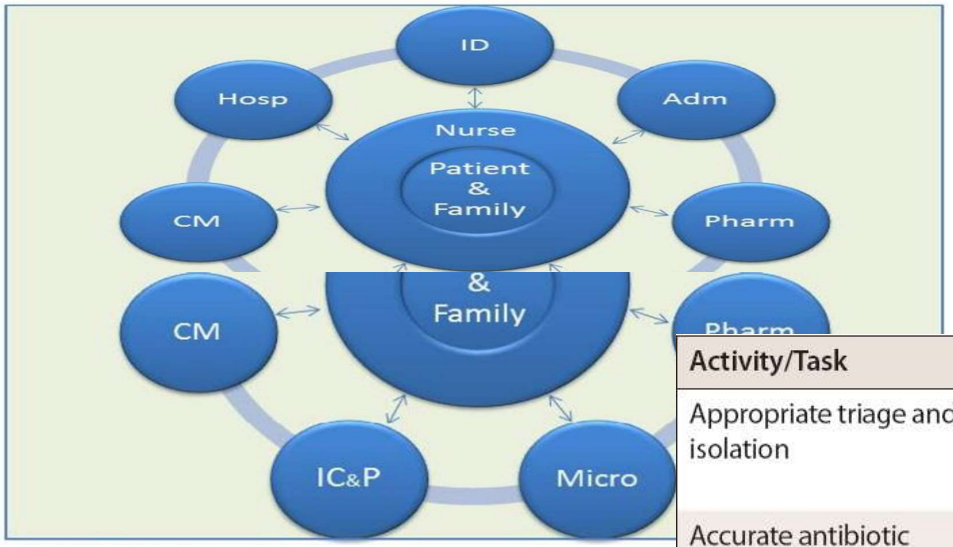
Anatomically: bladder, kidneys, bloodstream

Pathophysiologically:

E. coli colonizes the periurethral area→ attaches to urethral epithelium, travel to bladder → overcome host defenses, ascension to ureters, then kidneys → proliferates in renal parenchyma → bacteremia

Ohl, Luther. *Infect Dis Clin North Am*. 2014

AMS TASKS AND FUNCTIONS PERFORMED BY NURSES



Activity/Task	Person Responsible	Functions the Nurse Performs
Appropriate triage and isolation	Infection preventionist	Assesses the source of infection and appropriate precautions. An infection preventionist may subsequently be called for a consultation.
Accurate antibiotic allergy history	Pharmacist	Gathers information about the patient's allergy history, performs medication reconciliation, and records this in the medical record.
Early and appropriate cultures	Hospitalist, microbiologist	Obtains cultures before starting antibiotics and sends these to the microbiology laboratory. Monitors culture results and reports these to the physician.
Timely antibiotic initiation	Hospitalist, infectious disease specialist, pharmacist	Receives the orders, reviews the dose and timing of dose schedule for accuracy, checks for history of allergy, and administers antibiotics and documents administration.

Olans RD, Olans RN, Witt DJ. Am J Nurs. 2017;117(8)
ANA/CDC JAC Antimicrob Resist. 2019;1(2)

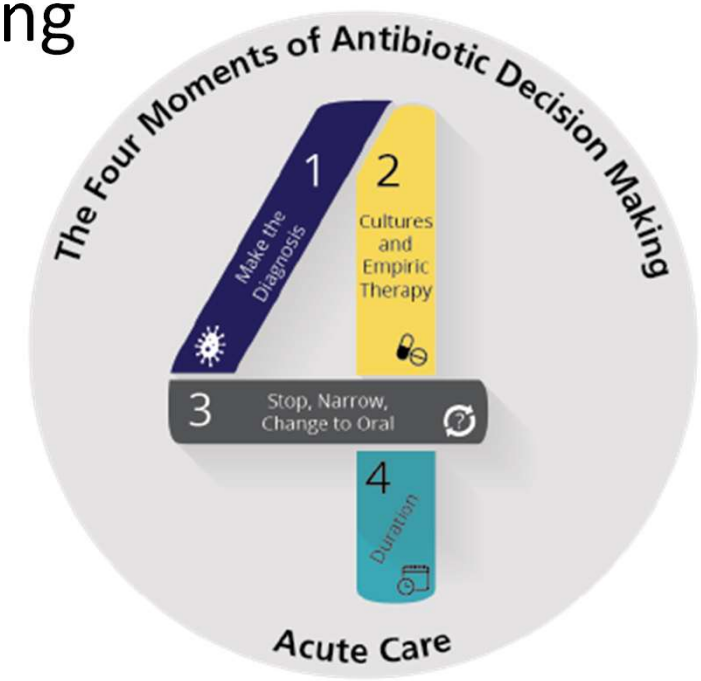
4 Moments of Antibiotic Decision Making

Moment 1: Does my patient have an infection that requires antibiotics?

Moment 2: Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?

Moment 3: A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy? These questions should be asked every day that a patient is on antibiotics.

Moment 4: What duration of antibiotic therapy is needed for my patient's diagnosis?



https://www.ahrq.gov/antibiotic-use/acute-care/four-moments/index.html

5Ds of Antimicrobial Prescribing

Appropriate **D**rug

Correct **D**ose

Right **D**rug-route

Appropriate **D**uration

Timely **D**e-escalation or **D**iscontinuation

Image: ecamonline.org

Dyar OJ, et al. *Clin Microbiol Infect*. 2017;23(11):793-798.

STEP-WISE PATIENT ASSESSMENT

Mnemonic	Corresponding term	Term details
Infections	Indication (for antibiotics)	Choose indication based on clinical scenario
Scare	Source (of infection)	Identify the source of the infection (lung, skin, brain, etc)
People	Pathogen (empiric or targeted)	List common organisms that cause the infection in question (or list specific organism(s) already isolated)
So	Spectrum (of activity)	List 2-3 drug therapy options for each pathogen listed above
Really	Resistance rates	Consult local antibiogram for resistance rates to help narrow drug therapy options
Practice	PK/PD considerations	Consider any limitations for drug therapy options listed above based on PK/PD parameters that would make the drug less desirable (or useless) in the disease state in question
Memorizing	Monitoring (allergies, etc)	List important monitoring parameters for each recommended drug; identify allergies
Drugs	Duration of therapy	Choose duration based on disease state in question (realizing that duration may change based on clinical status)

Abbreviations: PD, pharmacodynamics; PK, pharmacokinetics.

Gauthier, Cady, Liu, et al. Am J Health System Pharm. 2025;82(4)

Clinical Reasoning

Diagnostic Reasoning	Management Reasoning
Primarily classification task	Primarily shared decision-making and monitoring task
Yields one diagnosis that is objectively correct or incorrect	Multiple reasonable/defensible solutions – no single correct plan
Operates independently of patient preferences and contextual constraints	Requires prioritization of patient, provider, system preferences, constraints, and values
Assigns a specific diagnosis at a given point in time (within the limits of available information)	Requires ongoing monitoring and adjustment – the plan is dynamic and not completely specific at one point in time

Adapted from: Cook et al. *Acad Med*. 2019;94(9):1310-1316.

Management Reasoning

Types of Interventions	Potential Management Options	Considerations	Selected Management for this Patient
Labs			
Imaging			
Procedures			
Specialists			
Medications			
Monitoring			

Adapted from: Abdoler et al. *Diagnosis*. 2022;10(1):19-23

Management Reasoning

Types of Interventions	Potential Management Options	Considerations	Selected Management for this Patient
Labs	CBC, CMP, U/A, urine culture, blood culture		CBC with diff, CMP, blood culture
Imaging	Renal Ultrasound CT abdomen (w/ or w/o contrast)		CT abdomen with contrast
Procedures	Foley catheter placement		None
Specialists	ID consultation Urology consultation IR consultation		ID consultation
Medications	Ceftriaxone (IV) Cefepime (IV) Meropenem (IV)		Ceftriaxone IV
Monitoring	OPAT candidate Symptoms Labs Follow-up appointments post-discharge		Symptoms Labs Primary Care follow-up

Adapted from: Abdoler et al. *Diagnosis*. 2022;10(1):19-23

Discuss How Errors in Management Can Occur

First, understand the “psychology” of antibiotic prescribing

Common Drivers of Antibiotic Overuse:

1. Fear of “missing an infection” > fear of antibiotic ADRs
2. Stated or perceived patient expectations
3. Emphasis on potential benefit for individual patient over societal risk of antibiotic resistance

Flanders SA, et al. *JAMA Internal Med* 2014; 174 (5): 661-662.

AMS TASKS AND FUNCTIONS PERFORMED BY NURSES

Activity/Task	Person Responsible	Functions the Nurse Performs
Progress reporting	Hospitalist, infectious disease specialist	Cares for the patient 24 hours a day, 7 days a week; monitors and communicates daily patient progress.
Antibiotic adjustment based on microbiology reports	Hospitalist, infectious disease specialist, microbiologist	Typically receives laboratory and radiology reports first; coordinates results and communicates them to the treating physicians.
Antibiotic dosing, culture and sensitivity reporting, and deescalation	Infectious disease specialist, microbiologist, pharmacist	Updates clinical and laboratory renal function results, drug levels, and preliminary and final microbiology results.
Adverse events	Hospitalist, pharmacist	Monitors and reports to the physician and pharmacist any adverse events, including diarrhea.
Antibiotic orders	Hospitalist, infectious disease specialist	Reviews patient's clinical status and changes in medications.
Antibiotic resistance	Infectious disease specialist, hospitalist, microbiologist	Reviews culture and sensitivity results and reports "bug–drug" mismatches. Time outs and antibiotic deescalation are used to reassess the patient's clinical status.
Superinfection and resistant infection	Infectious disease specialist, infection preventionist, microbiologist	Monitors patient response and initiates appropriate changes in isolation precautions.

Olans RD, Olans RN, Witt DJ. Am J Nurs. 2017;117(8)
ANA/CDC JAC Antimicrob Resist. 2019;1(2)

AMS TASKS AND FUNCTIONS PERFORMED BY NURSES: DISCHARGE PLANNING

Activity/Task	Person Responsible	Functions the Nurse Performs
Transition patients from IV to oral antibiotics and to outpatient antibiotic therapy	Case manager, infectious disease specialist, pharmacist	Monitors patient's clinical progress and capacity to take oral medications.
Length of stay: monitors patient's progress 24 hours a day, 7 days a week	Administrator, case manager, infectious disease specialist	Reviews patient's response to therapy and capacity for discharge to home and rehabilitation needs.
Patient education and medication reconciliation	Hospitalist, infectious disease specialist, pharmacist	Educates patient and family and performs discharge teaching.
Manages transition to outpatient visiting nurse service, skilled nursing facility, or long-term care facility as well as readmission to the hospital	Administrator, case manager, infection preventionist	Communicates patient's diagnosis, management, and medications to the nurse at the visiting nurse service, skilled nursing facility, or long-term care facility.

Olans RD, Olans RN, Witt DJ. Am J Nurs. 2017;117(8)
ANA/CDC JAC Antimicrob Resist. 2019;1(2)

Case

42 y/o female presents with warmth and pain on her arms. Developed over 7 days. Denies any trauma to UE. No IDU.

Started on TMP-SMX as outpatient. No improvement over 3 days. Develops fevers to 103°F. Admitted and started on cefepime + vancomycin.

T102.9°F, bp 92/68 mmHg, HR 115 bpm

Wbc 16,000/µL with left shift

Image: https://www.triage.com/health/en

Clinical Approach to Antimicrobial "Failure"

Wrong diagnosis

- Infectious mimic
- Non-treatable infection

Additional diagnosis

- Concomitant infection
- Concomitant non-infectious condition
  - Adrenal insufficiency
  - Pulmonary contusion/infarct/PE
  - Thyroiditis/hyperthyroidism
  - Malignancy
  - Rheumatologic disorder
  - Non-antimicrobial drug reaction
  - Immunosuppression

Complication of diagnosis

- Source control
  - Drain abscess
  - Relieve obstruction
  - Debride devitalized tissue
  - Identify intravascular sites
  - Remove prosthetic material
- Endovascular infection
- Protected foci
- Inflammatory complications
  - Necrotizing pneumonia
  - Hemorrhagic complications
  - Paradoxical responses
  - "point of no return"

Complication of treatment

- Drug fever/reaction
- Intravenous site infection

Wrong antimicrobial regimen

- Need additional coverage
- Resistance
- Superinfection or secondary infection
- Antibiotic not reaching site of infection
- Malabsorption
- Inadequate dose
- Drug–drug interaction

Adapted from: Schlossberg D. *Med Clin North Am*. 2006;90(6):1265-1277.

Case

Underwent skin biopsy

Neutrophilic dermatosis (Sweet's syndrome)

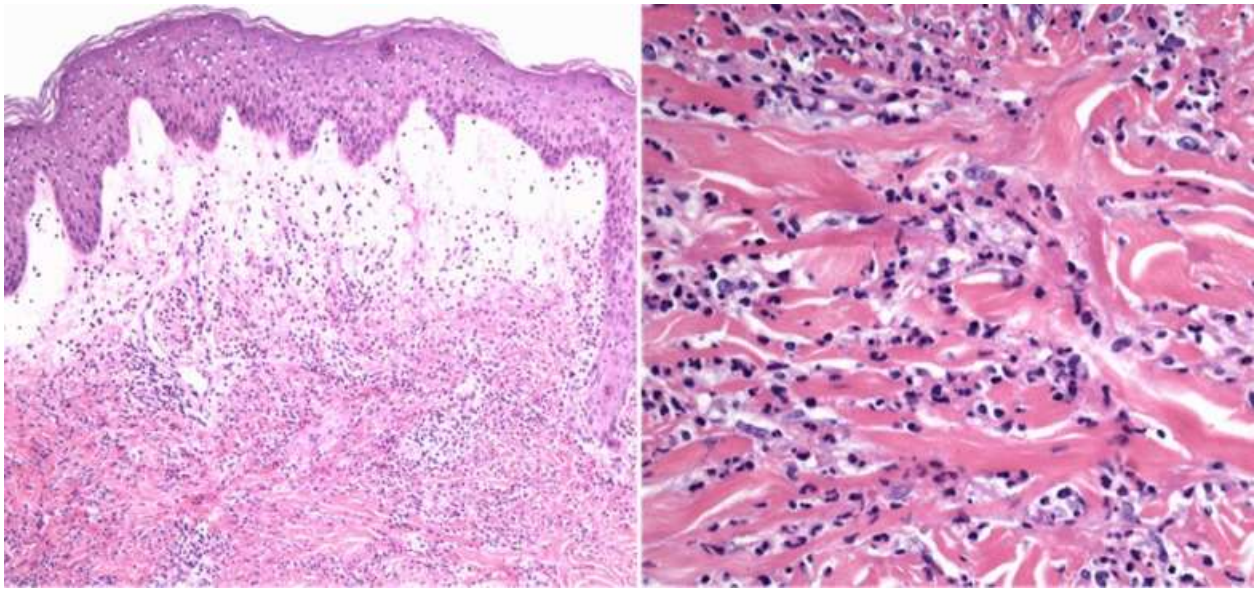
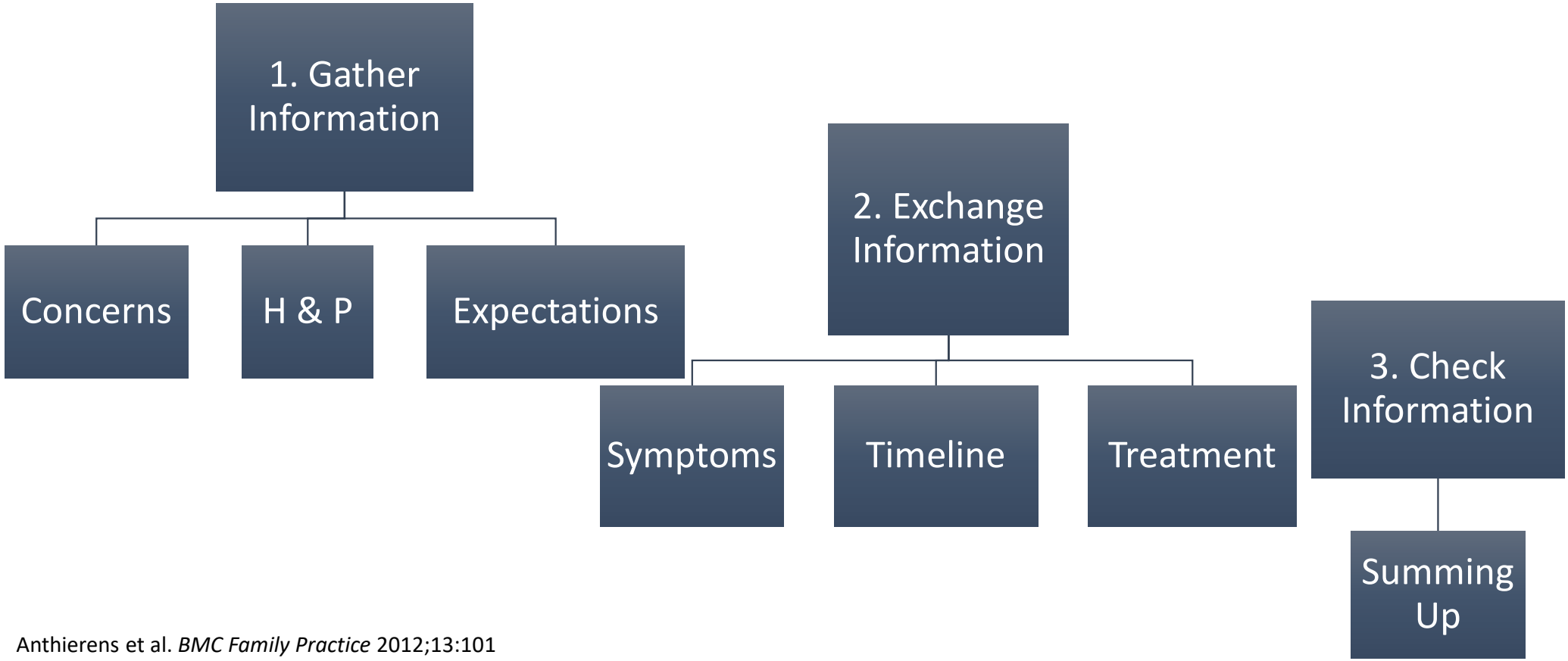


Image: Weiss, et al. *Curr Derm Rep*. 2022; 11, 89–102

Image: https://www.triage.com/health/en

Communication Skills

Communication skills training



Anthierens et al. *BMC Family Practice* 2012;13:101
Cals JW et al. Pat Educ Counsel 2007;68(3):270-8

Communication strategies

Online commentary during PE (prior to official dx) about the presence or absence of signs

No problem online commentary
- "Your lungs sound clear"
- "Your throat is just a little red"

vs.

Problem online commentary
- "Your tonsils are very red"
- "Your glands are very swollen"

Recommendation against antibiotic treatment

"I think we're in good shape here. I don't think you need antibiotics because they wouldn't work"

"A cough medicine may help you get more comfortable but there's no antibiotic that's going to touch it."

25% reduction in inappropriate prescriptions

Mustafa M et al. *Ann Fam Med* 2014;12(1):29-36
Heritage J et al. *Patient Educ Couns* 2010;81(1):119-125

Strategies for Counseling Patients

Communication strategy	Examples	Results
Negative treatment recommendations (Explanation for why antibiotics are not needed)	"This is a nasty cold, so antibiotics won't make you better faster." "You have a chest cold, and antibiotics won't help."	Combination of negative and positive treatment recommendations decreased inappropriate prescribing by 85% Increased likelihood of receiving highest patient satisfaction score possible by 16%
Provide treatment recommendations	"Taking ibuprofen and drinking plenty of fluids will help you feel better."	
Education	Ask-tell-ask	13% reduction in antibiotic prescriptions for ARI (39% vs 26%)

Mangione-Smith R et al. *Ann Fam Med* 2015:13(3):221-7
Cals JW et al. *Ann Fam Med* 2013;11(2):157-64

Motivational Interviewing

Principles of Motivational Interviewing

- Express empathy
- Develop discrepancy
- Avoid argumentation
- Roll with resistance
- Support self-efficacy

NARROWS

A Strategy to Positively Influence Prescribing

Name the issue

Ask for the reason

Reflect their emotion

Relate with personal experience

Orient to suggested management

Work together on a plan

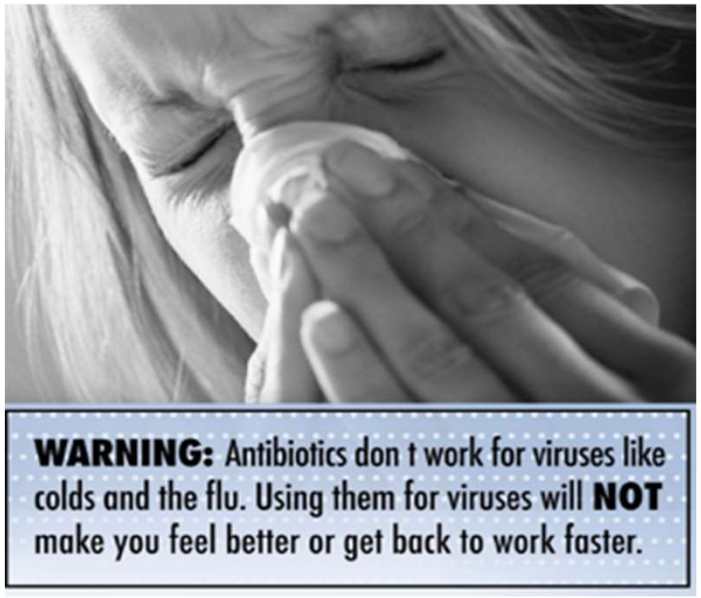
Set follow up

IDSA CORE Antimicrobial Stewardship Curriculum; Infectious Diseases Society of America; 2018.
http://idsa2.knowledgedirectweb.com/kd/idsaadmin.cfm

Communication Skills

Develop “teaching script” for common areas of abx overuse (URI, ASB, SSTI)

Coach learners on how to educate patients, address myths, and find resources for non-antibiotic approaches



Stewardship is a team sport

www.who.int

Everyone has a role to play in stewardship


Patient


Home Care RN


Hospital nursing staff


Hospitalist Physician


Primary Care Physician


ED Physician


Family


Clinical Pharmacy

- Direct role in a given encounter
  - Convey accurate information
  - Contribute to the prudent use of antibiotics
- Learners
- Educators
- Influencers of the healthcare environment, guidelines, policies, and/or procedures

Patients and Families

Patient

Family

- Direct role in a given encounter
  - Convey accurate information
  - Contribute to the prudent use of antibiotics
- Learners
- Educators

Talk to healthcare providers about

- ✓ When antibiotics will and won't help
- ✓ Ask about antibiotic resistance
- ✓ How to relieve symptoms
- ✓ Ask what infection an antibiotic is treating, how long antibiotics are needed, and what side effects might happen

Take antibiotics only when and exactly as prescribed

cdc.gov

Healthcare Providers


Home Care RN


ED Physician


Primary Care Physician


Hospital nursing staff


Hospitalist Physician


Clinical Pharmacy

- Direct role in a given encounter
  - Convey accurate information
  - Contribute to the prudent use of antibiotics
- Learners
- Educators
- Influencers of the healthcare environment, guidelines, policies, and/or procedures

Follow clinical guidelines

- ✓ Use the right antibiotic, at the right dose, for the right duration, and at the right time

Be aware of antibiotic resistance patterns

- ✓ Use the data to inform prescribing

Talk to patients and families

- ✓ When antibiotics are and are not needed
- ✓ Discuss possible harms: allergic reactions, *C. difficile*, resistant infections

cdc.gov

Integrate bedside nurses into antibiotic stewardship efforts

Hospital nursing staff

- ✓Ensuring appropriate indications prior to obtaining specimens for urine culture
- ✓Ensuring optimal antibiotic administration
- ✓Obtaining and documenting accurate penicillin allergy histories
- ✓Prompting an antibiotic time out
- ✓Ensuring appropriate *Clostridioides difficile* testing

Monsees EA, et al. Infect Control Hosp Epidemiol. 2019 Feb 21:1-6.
cdc.gov/antibiotic-use/healthcare/pdfs/ANA-CDC-whitepaper.pdf

Antibiotic Stewardship in Daily Practice

- ✓Define clinical syndromes
  - Microbiologically
  - Anatomically
  - Pathophysiologically
- ✓Don't treat viral infections or bacterial colonization with antibiotics
- ✓Accurate allergy assessment
- ✓Make de-escalation routine
- ✓Use appropriate durations

Duration of Antibiotic Therapy for Common Infections

Disease	Duration of Antibiotic Therapy (days)
Community Acquired Pneumonia	5
Nosocomial Pneumonia	7
Intra-abdominal Infection	4
Acute bronchitis	≠
Acute Exacerbation of Chronic Bronchitis and COPD	≤ 5
Acute Bacterial Sinusitis	5
Cellulitis and skin abscesses	5-6
Complicated Urinary Tract Infection (including pyelonephritis or CA-UTI)	5-7*
Cystitis	1-5
Asymptomatic Bacteriuria	0*

Antibiotic Stewardship in Daily Practice

Hospitalized patients
- UTI & ASB
- CAP
- HAP/VAP
- SSTI

Outpatients
- Sinusitis
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Cystitis	1-5
Asymptomatic Bacteriuria	0*

OUTLINE

- Why is antimicrobial stewardship education important?
- How can we train the next generation?
- What are some challenges and potential solutions?

WHAT ARE SOME CHALLENGES IN TEACHING HEALTH PROFESSIONS LEARNERS ABOUT ANTIMICROBIAL STEWARDSHIP?

Time

Resources

CHALLENGES WITH IMPLEMENTING ANTIMICROBIAL STEWARDSHIP EDUCATION

Preclinical

Curriculum time is compressed

Time for microbiology, pharmacology, and stewardship concepts decreased

Topics may be taught by non-clinical faculty

More information to be learned than ever (competing priorities)

Making concepts relevant to students

Clinical years

Fewer didactics

Less structured

Hidden curriculum

Fewer ID clinicians on primary teams

Limited interactions with institutional ASP teams

Overall

Lack of standardization of expected stewardship education

Heterogeneity of existing stewardship education resources

Few specifically for given type of health professions student

Lack of rigorous evaluation for existing curricular resources

MORE CURRICULAR RESOURCES ARE NEEDED ALONG WITH A RIGOROUS EVALUATION OF EXISTING RESOURCES

Published level of evaluation for various UME antimicrobial stewardship education interventions

No Evaluation	Kirkpatrick Level 1 (Reaction)	Kirkpatrick Level 2 (Learning)	Kirkpatrick Level 3 (Behavior)	Kirkpatrick Level 4 (Results)
Didactic teaching (4) Workshop/seminar (3) Clinical case discussion (1) Guideline promotion (1)	Didactic teaching (1) Board game (1) Audit (3)	Didactic teaching (1) Web-based teaching (1) Board game (1) Intensive module (1)	Guideline promotion (2) Didactic teaching (1)	

Silverberg, Zannella, Countryman, et al. *Int J Med Educ.* 2017; 8:353-374

TEACHING STEWARDSHIP IN THE CLASSROOM

Employ layered learning
- assessment of perceptions, attitudes, knowledge
- multiple learners at various levels educate each other

Encourage interprofessional learning opportunities

Explore ways to incorporate AS principles into other coursework

Consider non-traditional classrooms/educators

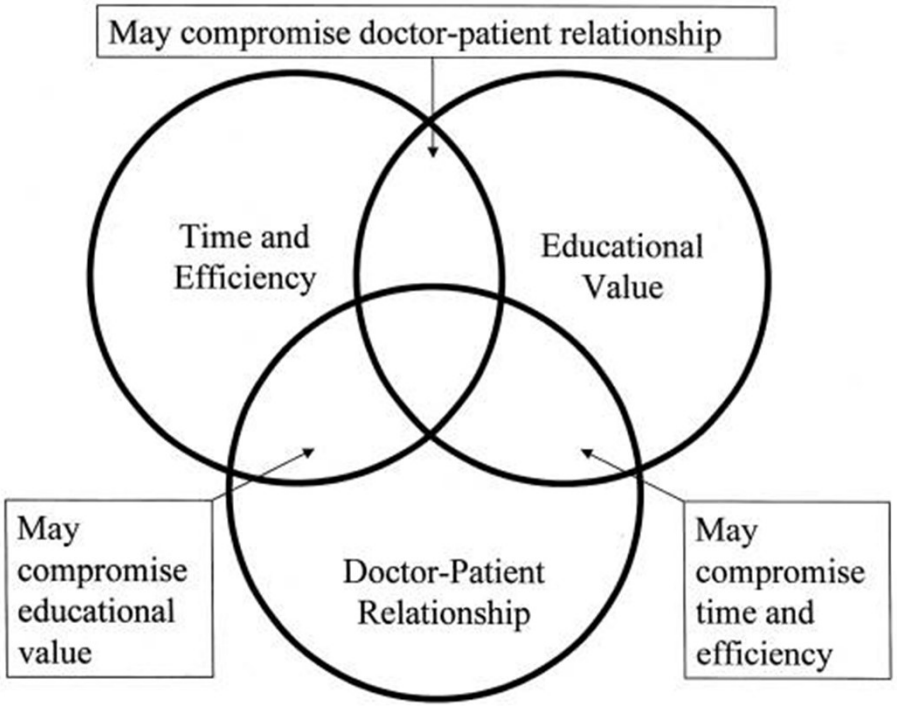
Loy BM et al *Hosp Pharm* 2017; 52(4): 266–272.

Strategies to enhance clinical teaching

During

1. Consider which patients to assign the learner
2. Teach by asking
3. Be explicit when role modeling
4. Use evidence-based techniques for teaching in clinic
   - 1-minute preceptor (*plus*)

Consider which patients to assign the learner



Teach by asking

Use graduated difficulty of questioning

- Students can be asked to suggest a differential diagnosis
- Upper level resident can be asked for preferred management

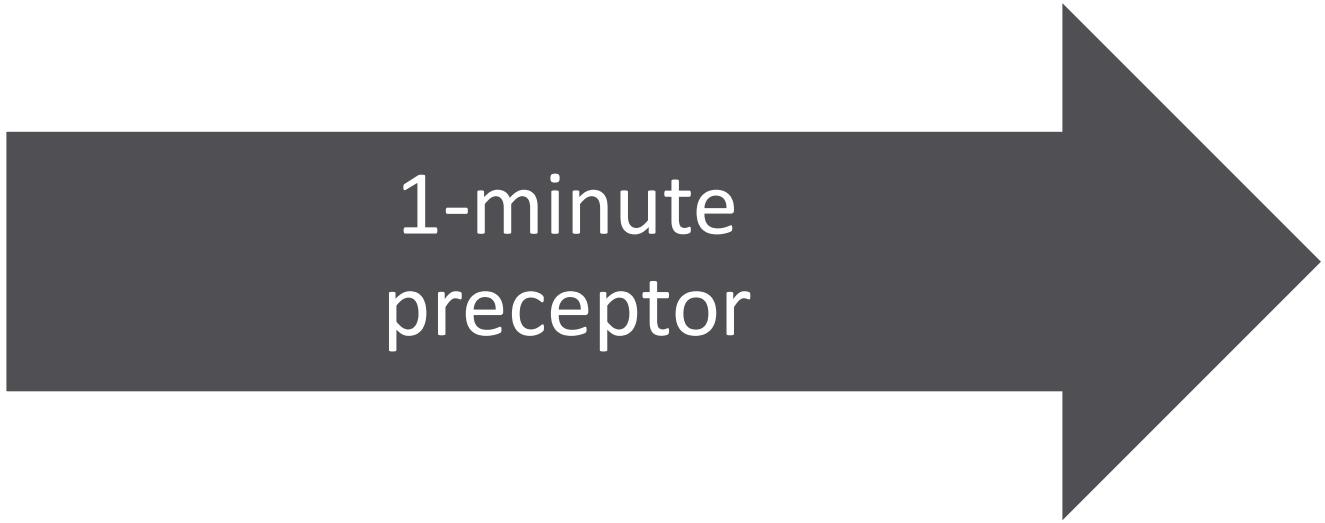
Learners can be challenged to provide an increasing number of correct answers to a particular question

- e.g. provide 2, 4, 6 examples of potential complications that can occur as a result of this disease

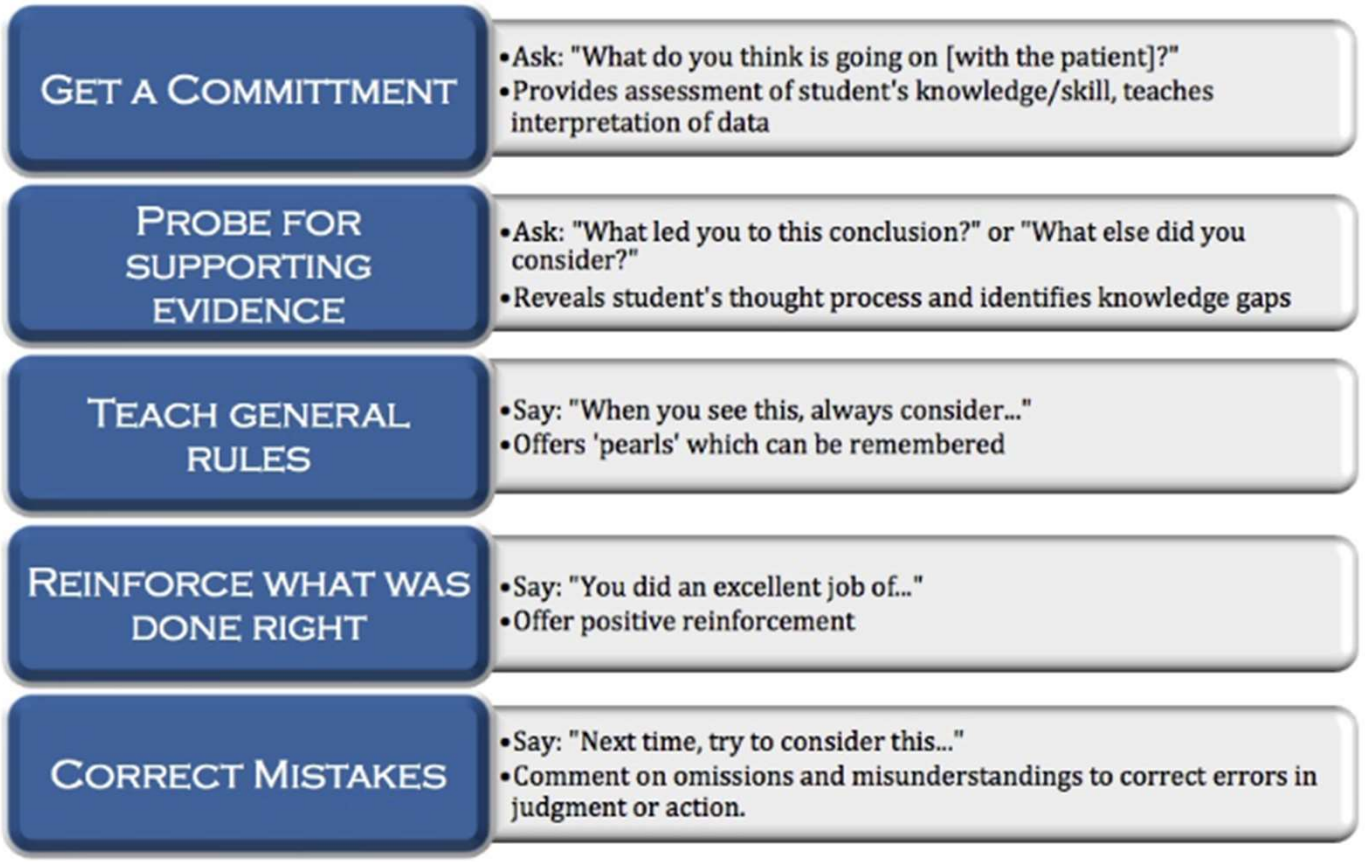
Be explicit when role modeling

Describe what, how or why you are doing something

Specific Teaching Strategies



5 Microskills for the 1-Minute Preceptor



Advantages of the One Minute Preceptor

- ✓Efficient and effective teaching tool
- ✓Teaches at the level of the learner
- ✓Delivers one key learning point
- ✓Associated with superior ratings for teaching and learning experience
- ✓Learners are more motivated to perform outside reading

Furney SL, Orsini AN, Orsetti KE, Stern DT, Gruppen LD, Irby DM. Teaching the one-minute preceptor. A randomized controlled trial. J Gen Intern Med. 2001 Sep;16(9):620-4.

Consider adding a *PLUS*

to build on previous knowledge, apply information or compare/contrast concepts

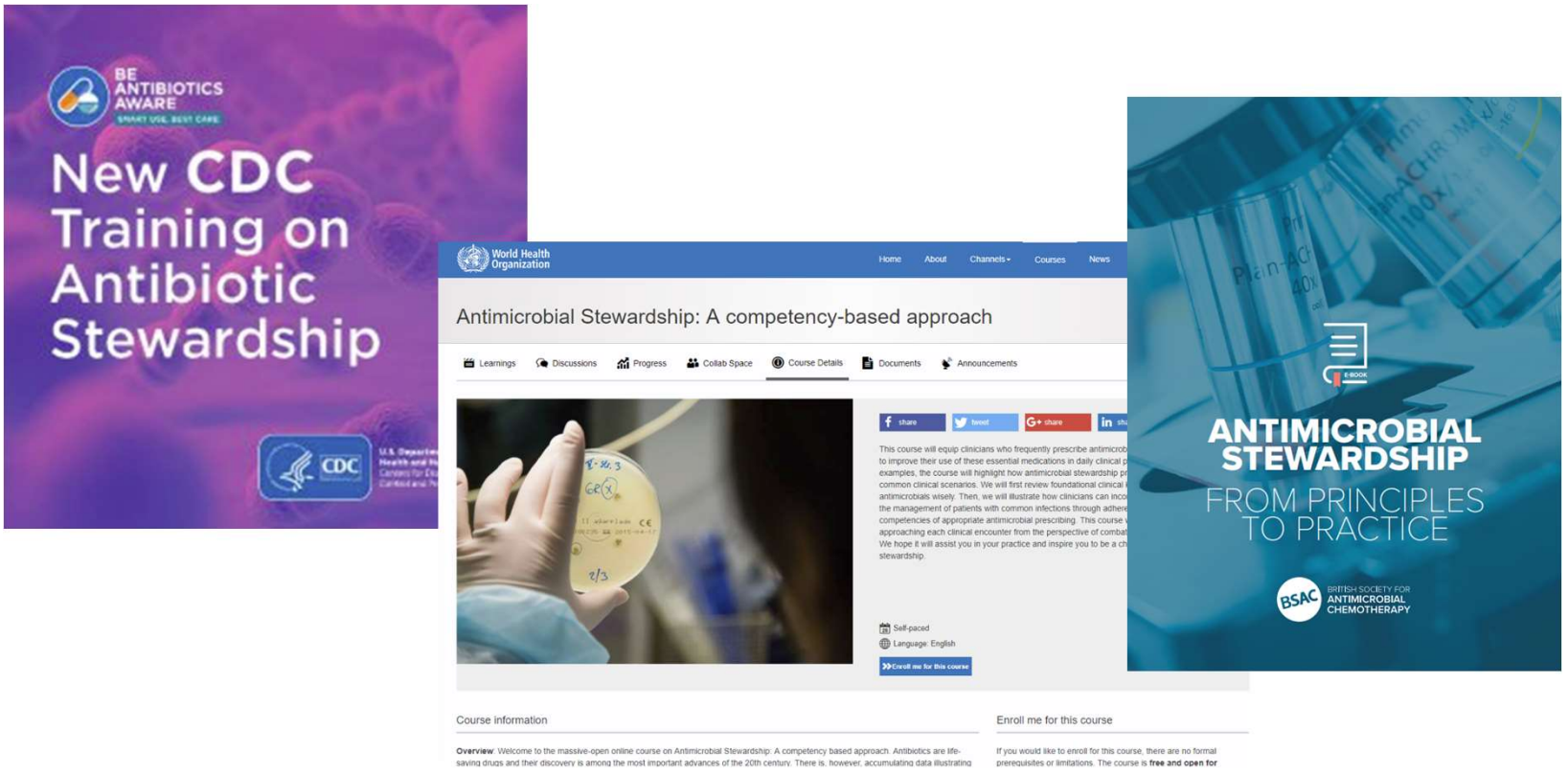
- List other conditions that can cause fever and cough
- Name another antibiotic that could be used for this patient
- What counseling should be done when prescribing this antibiotic?

EDUCATION ACTIVITIES

Activities	Shaping or Changing	Efficacy
Didactic lectures/talks	Shaping	Low
Distribution of printed material	Shaping	Low
Interactive small group sessions	Shaping	Moderate
eLearning	Shaping or Changing	Low-Moderate
Local consensus process	Changing	Low-Moderate
Educational outreach	Changing	Moderate-High
Periodic review/audit and feedback	Changing	Moderate
One-on-one patient-directed education	Changing	Moderate-High

Ohl & Luther *Inf Dis Clinics N Am* 2014;28:177–193

EXAMPLES OF ONLINE RESOURCES: CONTENT



EXAMPLES OF ONLINE RESOURCES: CURRICULAR CONTENT

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Antimicrobial Stewardship Education for Medical Students FREE

Vera P. Luther, Christopher A. Ohl, Lauri A. Hicks

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Building an Antibiotic Stewardship Program: An Interactive Teaching Module for Medical Students

Jennifer L. Hsu, MD
Published: June 26, 2018 | 10.15766/mep_2374-8265.10726

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Abstract
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Introduction
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Abstract

Introduction: Given the increasing importance of antibiotic stewardship, an understanding of the basic tenets of antibiotic prescribing is critical for all medical students. This engaged learning module focuses on terminology and foundational concepts in antibiotic stewardship while assisting learners with application in their early clinical practice. **Methods:** This module was developed for third-year internal medicine clerkship students at the University of South Dakota, Sanford School of Medicine. The students participated in an introductory discussion of the harms of antibiotic overuse in a large-group format, followed by small-group work to develop a miniature antibiotic stewardship program. Upon completion of the small-group portion, the large group reconvened to share antibiotic stewardship strategies and to complete the session with additional training regarding individual provider and system-level antibiotic stewardship strategies. **Results:** Approximately 150 students have participated in this module. Through use of the module, students have been highly engaged in identifying antibiotic stewardship interventions in their early practice and creating potential solutions.

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BRIEF REPORT

Development of a Multifaceted Antimicrobial Stewardship Curriculum for Undergraduate Medical Education: The Antibiotic Stewardship, Safety, Utilization, Resistance, and Evaluation (ASSURE) Elective

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To address the growing need for dedicated stewardship training in undergraduate medical education, we developed an antimicrobial stewardship curriculum for medical students with the objectives of increasing expertise in antimicrobial prescribing, introducing antimicrobial stewardship fundamentals, and enhancing comfort with engagement in interprofessional antimicrobial stewardship activities.

Keywords. antimicrobial stewardship; curriculum; medical education; medical student.

Antimicrobial stewardship programs (ASPs) improve antibiotic use, slowing the rise of antibiotic resistance while contributing to improved patient outcomes. National health care accreditation agencies, public health agencies, and professional societies have called for implementation of ASPs across the care continuum [1]. Despite the expansion and growing recognition of ASPs, most antimicrobial stewardship (AS) teaching efforts are currently directed at the postgraduate level [2, 3]. In contrast, there has been less attention devoted to AS education for medical students [4, 5]. In a survey of fourth-year students, only one-third of respondents reported feeling comfortable with the principles of antimicrobial prescribing, with 90% expressing a desire for additional instruction [5]. Incorporation of AS education into undergraduate medical educatior has enormous potential in influencing future behavior scribing practices are the most malleable early in traini In addition, given the sociobehavioral drivers of antibi scribing [7], early education regarding key AS topics co mote judicious antimicrobial use by modifying socia transmitted during training [8]. In this manuscript, w a novel, immersive curriculum focused on teaching cepts at the UME level.

METHODS

Design and Setting

To address the growing need for early AS educat Antibiotic Stewardship, Safety, Utilization, Resistar Evaluation (ASSURE) Elective was developed at the F School of Medicine at the University of Penn Participants included third- and fourth-year medical who had completed a year of clinical clerkships. The st conducted from May 2020 through December 2020 granted exempt review status by the University of Penr Institutional Review Board.

Curriculum

The 2-week course consisted of learning activities to immerse students in multiple facets of AS, with tional materials and a sample student schedule provided in Supplementary Table 1. The first objective was to increase expertise in antimicrobial prescribing by building on knowledge introduced during existing preclinical and clinical courses. Students participated in small-group didactic sessions reviewing the pharmacokinetics and spectra of activity of commonly used antibiotics. During these sessions, they were taught to utilize the "3Ps and 3Ds" AS framework, with consideration of the *place*, *pathogen*, and *patient* to inform decisions about the *drug*, *dose*, and *duration* of antimicrobial therapy (Table 1), and were provided with clinical cases to practice applying this framework.

Table 2. Survey Responses of Medical Students Before and After Completion of the Antibiotic Stewardship, Safety, Utilization, Resistance, and Evaluation (ASSURE) Elective

Question	Precourse Survey		Postcourse Survey		
	Median (IQR)	"Agree" or "Strongly Agree"	Median (IQR)	"Agree" or "Strongly Agree"	*P* Value[a]
1. How would you rate your comfort level with selecting antibiotics for bacterial infections?	3 (2–3)	19%	5 (4–5)	100%	<.001
2. How would you rate your comfort level with dosing of intravenous vancomycin?	1 (1-1)	6%	4 (4–5)	100%	<.001
3. How would you rate your comfort with evaluating the adverse effects of antibiotics when making antibiotic prescribing decisions?	3 (2–3)	19%	4 (4–5)	100%	<.001
4. How would you rate the importance of AS programs?	5 (5-5)	100%	5 (5-5)	100%	1.0
5. How would you rate your comfort with explaining the function of AS programs?	4 (3–4)	63%	5 (5-5)	100%	.03
6. How would you rate your comfort with communicating to other medical providers in reference to antibiotics?	2 (2–3)	13%	5 (4–5)	100%	<.001
7. How would you rate your comfort with explaining the ways collaboration with the microbiology department can improve antibiotic use?	3 (2–4)	38%	5 (5-5)	100%	.002
8. How would you rate your comfort in working with an interprofessional team (eg pharmacists and physicians) to improve antibiotic prescribing?	3 (3–4)	44%	5 (5-5)	100%	.004

Abbreviations: AS, antibiotic stewardship; IQR, interquartile range.

[a]Statistical analysis was conducted based on dichotomized paired survey results.

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COMMENTARY

Resources and strategies for learning infectious diseases pharmacotherapy during advanced pharmacy practice experiences and pharmacy residency

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Keywords: antibacterial agents, communicable diseases, education, health resources, internship and residency, pharmacists

This article is part of a special *AJHP* theme issue on management of infectious diseases. Contributions to this issue were coordinated by P. Brandon Bookstaver, PharmD, BCIDP, FCCP, FIDSA; and Kayla R. Stover Hielscher, PharmD, BCIDP, BCPS, FCCP, FIDSA.

infectious diseases is a critical content area to achieve proficiency in prior to finishing terminal training and to maintain when practicing pharmacy. However, this is a pharmacy content area that many trainees struggle with because it requires a significant amount of memorization as well as an awareness of what case-specific questions to ask for developing a reasonable treatment plan.

Given that most graduating pharmacists will not complete advanced training in infectious diseases, it is apparent that supplemental resources to support learning of infectious diseases pharmacotherapy are necessary. In this article we aim to identify a list of available resources for learning infectious diseases pharmacotherapy during advanced pharmacy practice experiences and pharmacy residency, including through use of textbooks, quick references, online content, games, podcasts, and more. We will additionally provide a dialogue on strategies for learners to employ using these tools throughout their academic journey as they move from

list does not indicate higher or lower quality. Guidelines are not identified here, but readers are recommended to consider major documents published by the American Society of Health-System Pharmacists (ASHP), Society of Infectious Diseases Pharmacists, Infectious Diseases Society of America, Centers for Disease Control and Prevention, National Institutes of Health, and American Association for the Study of Liver Diseases.

During experiential education and pharmacy residency, learners must develop their analysis, evaluation, and critical thinking skills to develop robust patient-specific pharmacotherapy care plans. Individuals with deficits in remembering, understanding, and applying infectious diseases pharmacotherapy are more likely to struggle when required to perform tasks that build on such foundational knowledge. If refreshing lower levels of learning is necessary, large textbooks (eg, *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*[1]), smaller

Table 1. Resources That May Be Useful for Providing Didactic and Clinical Infectious Diseases Information for Pharmacy Learners

Resource type	Title	What it teaches
E-book	Antimicrobial Stewardship: From Principles to Practice[19]	Produced by the British Society for Antimicrobial Chemotherapy, provides a global and practical primer on the wise use of antibiotics; free PDF available at https://bsac.org.uk/antimicrobial-stewardship-from-principles-to-practice-e-book/ebook-download/
Game[a]	Empiric Antibiotic Card Game[20]	Educational card game packs to teach microbiology, infectious disease states, and antibiotics to medical students, residents, and other medical professionals
Game[a]	Pharmageddon: Bugs vs Drugs[21]	Medical education card game that tests antibiotic and microbiology knowledge beyond trivia-style questions with the goal of killing the most pathogens with the fewest adverse effects
Online content	AIDS Education & Training Center Program Quick Reference Materials[22]	Slides and curricular materials for teaching/learning about HIV; available at https://aidsetc.org/resource-type/trainer-resources
Online content[a]	British Society of Antimicrobial Chemotherapy/Future Learn[23]	Expert-developed courses covering a range of infectious diseases topics; available at https://www.futurelearn.com/partners/british-society-for-antimicrobial-chemotherapy
Online content	CDC Health Topics A-Z[24]	Searchable content on a wide array of diseases and conditions; available at https://www.cdc.gov/health-topics.html

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  - Online Interactive Case B
    - Online Interactive Case B ...
  - Introductory Presentation on...
  - Workshop Instructor's Guide

Interprofessional Antimicrobial Stewardship Curriculum

A curriculum consisting of a didactic presentation on antimicrobial stewardship, interactive branched-logic case scenarios, and a small group workshop designed for interprofessional learners.

- Online Interactive Case A
- Online Case A with Explanations
  - Case A with buttons for explanations
- Online Interactive Case B
- Online Interactive Case B with Explanations
  - Case B with buttons with explanations
- Introductory Presentation on Antimicrobial Stewardship
- Workshop Instructor's Guide

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Toolkit to Enhance Nursing and Antibiotic Stewardship Partnership

Despite discussions at the national level about the need to integrate nurses into antibiotic stewardship (AS) activities, there are limited tools and resources for Antimicrobial Stewardship Programs, nursing and/or hospital leadership to facilitate implementation of nurse-based AS interventions in acute care hospitals.

This **toolkit and comprehensive user guide** aims to bridge the gap, and provides materials and resources to: (a) engage front-line nurses in AS, (b) obtain leadership support to implement nurse-driven AS activities, and (c) implement a nurse-driven diagnostic stewardship intervention to improve urine and respiratory culturing practices and a penicillin allergy algorithm to improve penicillin allergy documentation.

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http://tiny.ucsf.edu/stewardship
https://www.hopkinsmedicine.org/antimicrobial-stewardship/nursing-toolkit

KEY POINTS

- Training the next generation in antimicrobial stewardship is a critically important task
- Teach learners how they can incorporate antimicrobial stewardship in their daily practice
- Incorporate high yield clinical teaching techniques through role modeling and the one-minute preceptor
- Take advantage of existing resources