One Team, One Goal

AMS Education for Health Professions Learners

Vera P. Luther, MD, MS, FACP, FIDSA

Professor of Medicine
Section on Infectious Diseases

Wake Forest University
School of Medicine

No Disclosures

Learning Objectives

- Describe each profession's role in AMS principles and practice
- Identify educational strategies to foster stewardship behaviors
- Apply basic stewardship decision-making to clinical scenarios to effectively role model AMS for trainees

OUTLINE

- What should nursing, dental, pharmacy, and medical students learn about antimicrobial stewardship?
- How can we teach stewardship to build habits, not just knowledge?
- Given various clinical scenarios, how can we model stewardship decision-making and behaviors to shape trainee behavior?

OUTLINE

- What should nursing, dental, pharmacy, and medical students learn about antimicrobial stewardship?
- How can we teach stewardship to build habits, not just knowledge?
- Given various clinical scenarios, how can we model stewardship decision-making and behaviors to shape trainee behavior?

Why a “one team” approach?

- Resistance is a shared problem
- Most antibiotic exposure occurs outside ID consultation
- Stewardship is a shared clinical responsibility
- It’s a teachable professional skill

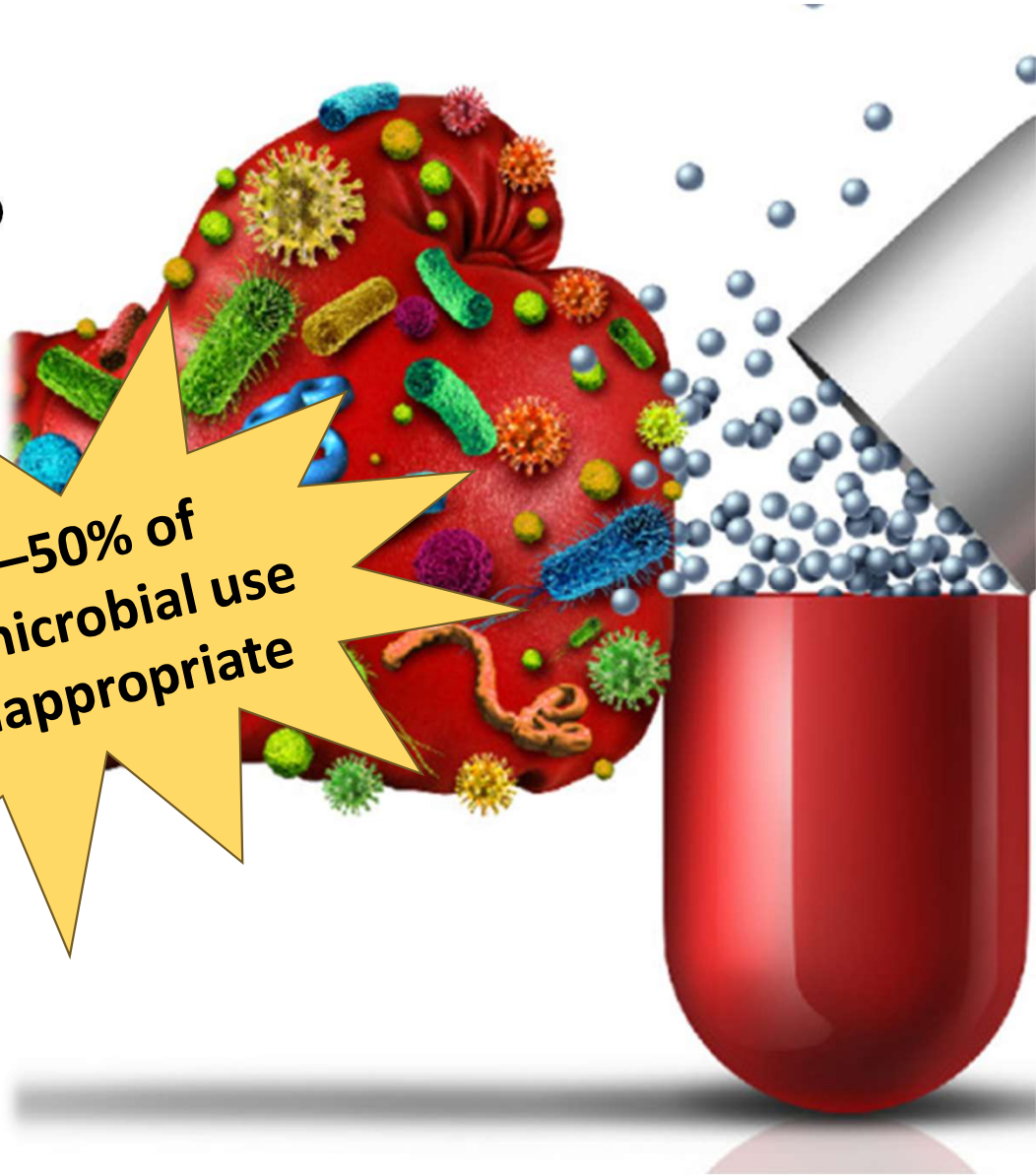
Why is antimicrobial stewardship education important for Health Professions Learners?

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

What should health professions students learn about stewardship?

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.

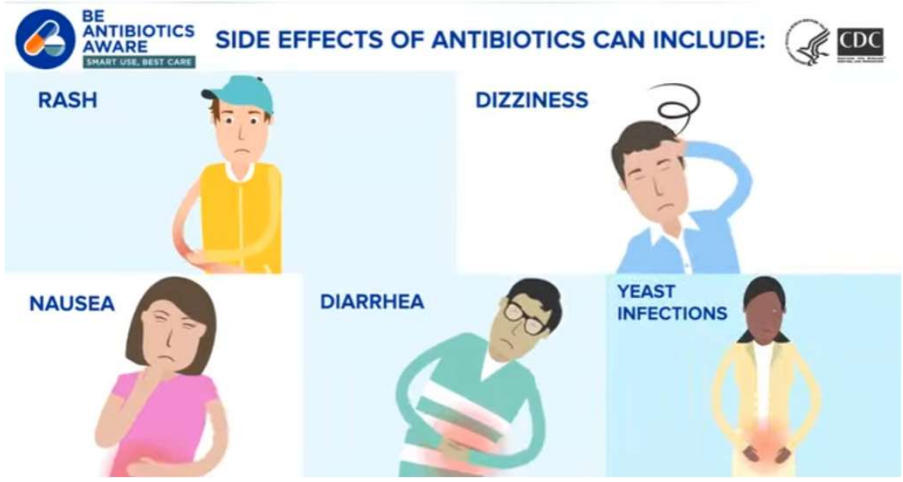


Aiesh BM, et al. Sci Rep. 2023; 13:1–9.
Fanelli U, et al. Front Pharmacol. 2020; 11:2019–2021

Antimicrobial Stewardship = Harm Reduction

Harms of unnecessary antibiotics:

- Development of resistance
- *C. difficile* infection
- Drug toxicities and AE (QT prolongation, kidney injury, cytopenias)
- Drug–drug interactions
- Microbiome disruption



Dellit TH, et al. *Clin Infect Dis*. 2007;44(2): 159-77.
Tamma PD, et al. *JAMA Intern Med*. 2017;177(9):1308-15.

Domino effect

Inappropriate testing

Colonization misread as infection

Unnecessary antibiotics

Adverse events

5Ds of Antimicrobial Prescribing

Appropriate **D**rug for the **D**iagnosis

Correct **D**ose

Right **D**elivery route

Appropriate **D**uration

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

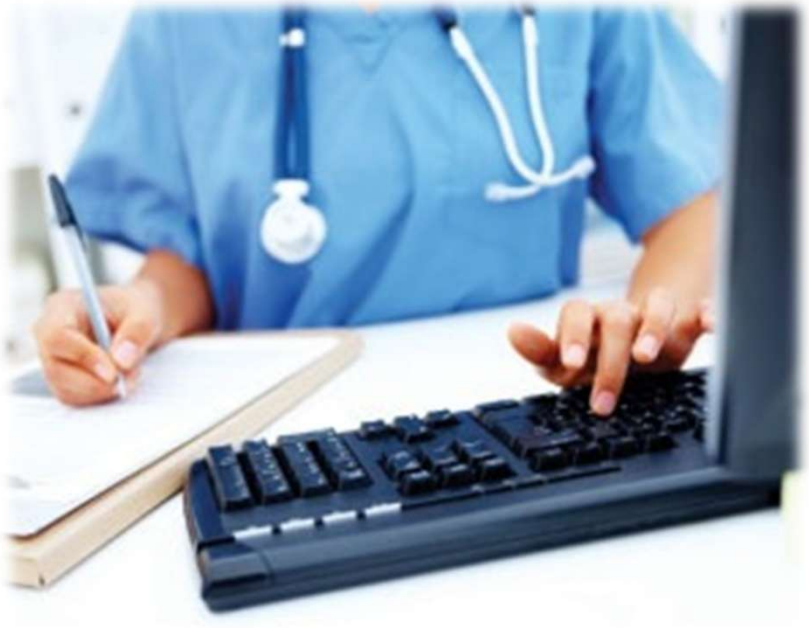
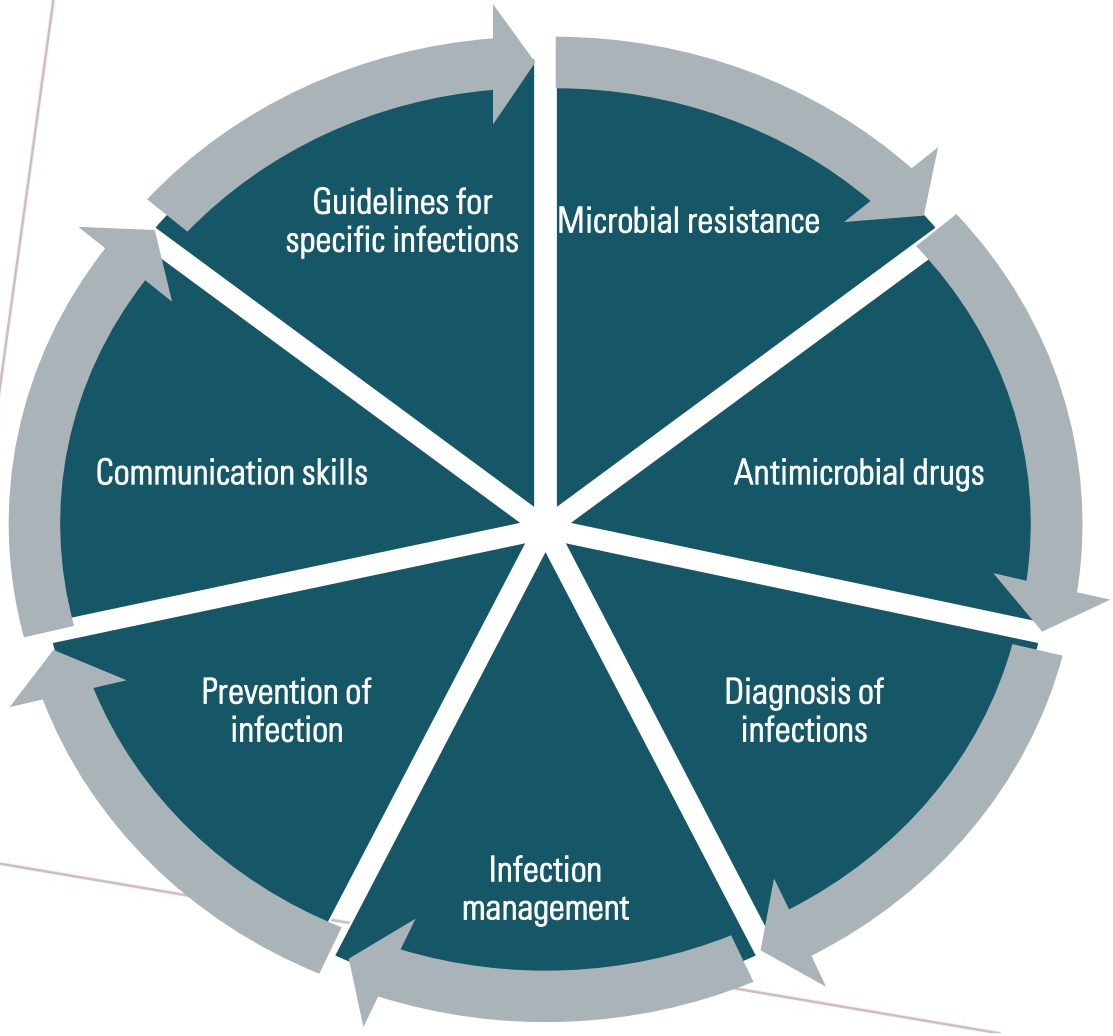


Image: ecamonline.org

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

HOW CAN WE TRAIN THE NEXT GENERATION IN ANTIMICROBIAL STEWARDSHIP?



Hospitalized patients

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

Outpatients

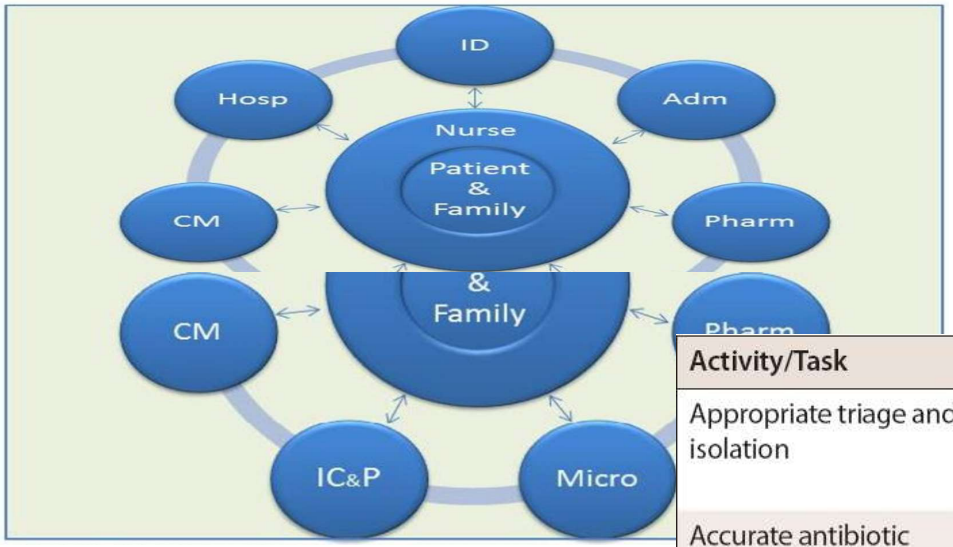
- Sinusitis
- Acute bronchitis
- Pharyngitis
- Otitis media

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

Stewardship is a team sport

Teaching gap:
Learners often see stewardship as **prescribing only**, rather than a **system of decisions**

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)

Nursing Students: Surveillance, safety, and stops

- ✓Ensuring cultures are obtained early and appropriately
- ✓Ensuring optimal antibiotic administration
- ✓Monitoring clinical response (fever curve, O_2 needs, hemodynamics)
- ✓Obtaining and documenting accurate penicillin allergy histories
- ✓Prompting an antibiotic time out “What is the stop date?”
- ✓Identifying antibiotic adverse effects early (rash, diarrhea, AKI signs)

Monsees EA, et al. Infect Control Hosp Epidemiol. 2019 Feb 21:1-6.
https://www.cdc.gov/antibiotic-use/media/pdfs/ANA-CDC-whitepaper-508.pdf

Nursing stewardship skills to teach

- Skills in obtaining cultures with proper technique
- Allergy history accuracy (true allergy vs intolerance)
- Clarifying indication: “What infection are we treating?”
- Prompting antibiotic time-outs (24-48 hours)
- Line necessity: identifying readiness for PO conversion
- Transitions of care: discharge antibiotics and duration clarity

Dental Students:
Prescribe less, prescribe better

Key AMS roles:

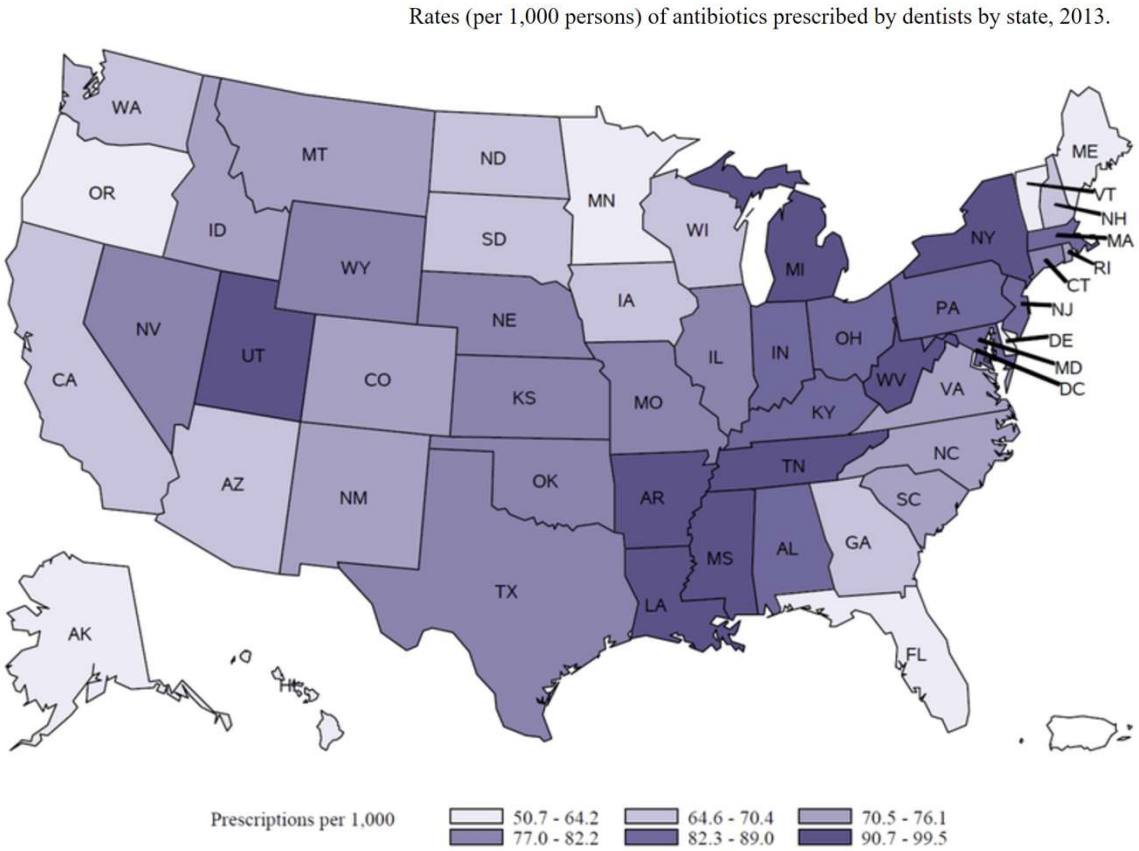
- ✓Avoid antibiotics for uncomplicated dental pain without systemic infection
- ✓Educate patients: “antibiotics don’t fix tooth pain without infection”
- ✓Use local source control (drainage/extraction) rather than antibiotics alone
- ✓Apply prophylaxis guidance appropriately (avoid reflexive prophylaxis)
- ✓Use narrow-spectrum therapy and short courses when indicated

Lockhart PB, et al. *J Am Dent Assoc*. 2019 Nov;150(11) :906-21
J Am Dent Assoc. 2017;148(2):57-59
Wilson WR, et al. Circulation 2021;143(20):e963-e78

Dental antibiotic prescribing

Dentists prescribe about 10% of all outpatient antibiotics

Considerable geographic variation



Roberts, et al. J Am Dent Assoc. 2017 Mar;148(3):172-178

Dental antibiotic prescribing

80% of antibiotics prescribed before dental procedures are unnecessary

30-50% of antibiotic prescriptions for endodontic infections are unnecessary

Suda et al. *JAMA Netw Open.* 2019;2(5)
Roberts, et al. J Am Dent Assoc. 2017 Mar;148(3):172-178
https://www.ada.org/en/publications/ada-news/2019-archive/april/ace-panel-report-focuses-on-antibiotic-use

High-yield dental stewardship targets

Acute pulpitis (pain ≠ infection)

Periapical abscess w/wo systemic sx

Antibiotic prophylaxis misconceptions

Overuse of clindamycin despite risk

ADA Treatment Recommendations[1]

Pulpal/Periapical Condition	DCDT Immediately Available		DCDT Not Immediately Available	
	Prescribe Antibiotics	Perform DCDT	Prescribe Antibiotics	Refer to DCDT
Symptomatic irreversible pulpitis with or without symptomatic apical periodontitis	X	✓	X	✓ Interim monitoring
Pulp necrosis and symptomatic apical periodontitis	X	✓	X*	✓ Interim monitoring
Pulp necrosis and localized acute apical abscess without systemic involvement	X	✓	✓	✓ Urgent referral
Pulp necrosis and localized acute apical abscess with systemic involvement	✓	✓	✓	✓ Urgent referral

*If DCDT is not feasible, provide a delayed antibiotic prescription to be filled after a predetermined period if symptoms worsen or do not improve

Lockhart PB, et al. *J Am Dent Assoc*. 2019 Nov;150(11) :906-21
J Am Dent Assoc. 2017;148(2):57-59
Wilson WR, et al. Circulation 2021;143(20):e963-e78

DCDT: definitive, conservative dental treatment

Pharmacy Students:
Optimization, safety, systems thinking

- ✓Dose optimization (renal dosing, weight-adjusted dosing)
- ✓PK/PD and therapeutic drug monitoring (vancomycin, aminoglycosides)
- ✓Drug interactions (warfarin, QT prolongers)
- ✓IV-to-PO conversion
- ✓Antibiotic allergy delabeling support
- ✓Antibiotic formulary restrictions and prospective audit/feedback
- ✓Patient counseling and adherence

https://sidp.org/Stewardship-Certificate
https://www.idsociety.org/education--training/training-and-curriculum/fellows-in-training-resources/idsa-antimicrobial-stewardship-curriculum-for-id-fellows/

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)

Pharmacy student emphasis areas

Antimicrobial spectrum awareness

Guideline interpretation

De-escalation and duration coaching

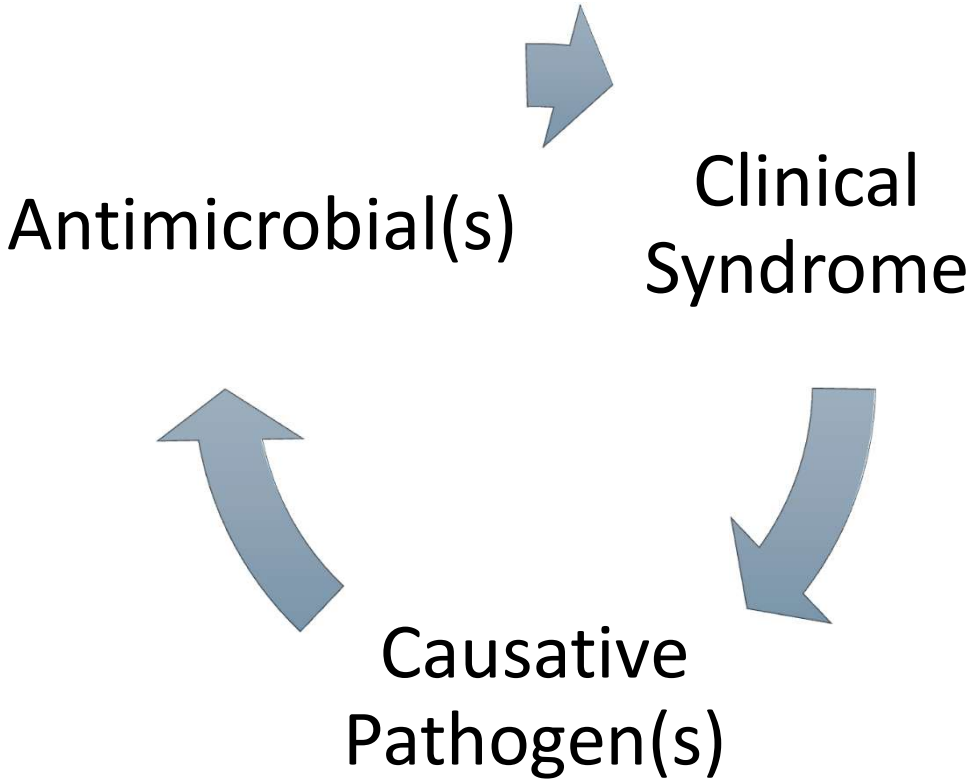
Clinical documentation of stewardship recommendations

Medical Students:
Diagnosis and prescribing accountability

- ✓Differentiate bacterial vs viral syndromes
- ✓Use diagnostic tests appropriately (avoid reflex cultures)
- ✓Start empiric antibiotics when indicated, but reassess at 24-48 hrs
- ✓Narrow therapy based on cultures
- ✓Define duration explicitly
- ✓Document indication and stop date
- ✓Communicate plan across transitions of care

Lai A, et al. *Pharmacy*. 2025;13(5):116
Ohl & Luther Inf Dis Clinics N Am 2014;28:177-93
Pulcini & Gyssens Virulence 2013; 4(2):192-202

Always consider likely pathogens when choosing an antimicrobial



MAP FRAMEWORK TO DEFINE AN INFECTION

Microbiologically

Anatomically

Pathophysiologically

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

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

High-yield prescribing pitfalls

Misinterpreting colonization (respiratory cultures, urine cultures)

Using broad-spectrum therapy “just in case”

Treating asymptomatic bacteriuria

Treating “atelectasis pneumonia”

Prolonged durations of therapy

OUTLINE

- What should nursing, dental, pharmacy, and medical students learn about antimicrobial stewardship?
- How can we teach stewardship to build habits, not just knowledge?
- Given various clinical scenarios, how can we model stewardship decision-making and behaviors to shape trainee behavior?

Teaching stewardship isn’t just content, it’s culture!

Stewardship education succeeds when it includes **knowledge** +

- Behaviors
- Clinical reasoning
- Role modeling
- Psychological safety

Weeks S, et al. *JAC Antimicrob Resist*. 2026;8(1):dlaf245

Educational strategies

Case-based learning

- Interprofessional small group cases
  - UTI
  - CAP
  - Dental abscess
- Ask “what would you do now?” at multiple time points

Structured 24-48 hr reassessment

Do we still think infection is present?

Can we narrow?

Can we stop?

Can we shorten duration?

Can we switch to PO?

Chetty S, et al. *JAC Antimicrob Resist*. 2024 Apr 1;6(2):dlae054
MacDougall C, et al. *Open Forum Infect Dis*. 2017;4(1):ofw225
Luther VP, et al. *Clin Infect Dis*. 2013;57(9):1366

Educational strategies

Simulation/OSCE/mini-CEX

- Communication and patient counseling
- Allergy history-taking
- “Pushback” practice when patient demands antibiotics

Self-reflection audit & feedback

- Learners review their own antibiotic decisions and practices
- Brief feedback loop: “What could we have done differently?”

Lim A, et al. *J Pharm Practice*. 2023 646-9
Barsoumian AE, et al. *MedEdPORTAL*. 2018;14:10693
Nasim J, et al. *Infect Control & Hosp Epi*. 2020;41(S1):s103-s103

Educational strategies

Embedded stewardship in clinical workflow

- Require indication and duration in note templates
- Require stop date for discharge antibiotics

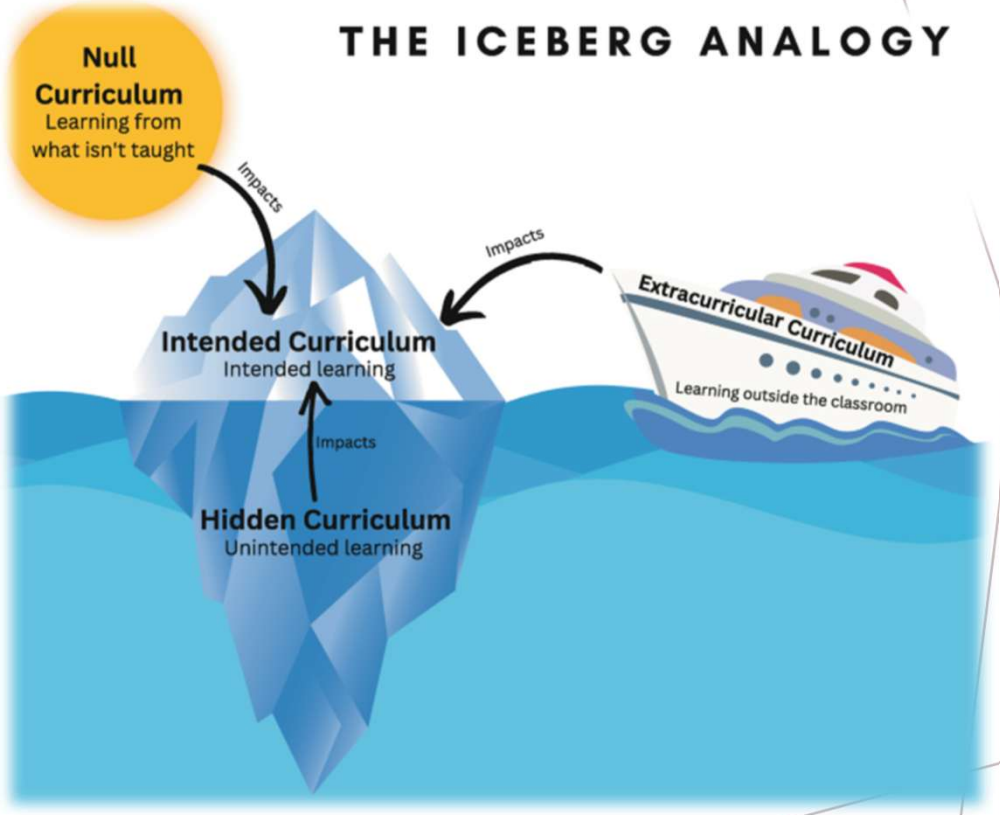
Interprofessional education

- Mixed discipline groups normalize shared accountability
- Improves attitudes about and confidence in stewardship skills

Weeks S, et al. *JAC Antimicrob Resist*. 2026;8(1):dlaf245
Laake AM, et al. *Open Forum Infect Dis.* 2017;4(2):ofx060

ROLE MODEL STEWARDSHIP

Do as I say, not as a I do
Learners gain **knowledge, attitudes, skills** both explicitly and implicitly



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

How to role model stewardship

Trainees learn stewardship most powerfully by observing:

- Practices and techniques around culture collection
- How clinicians talk about uncertainty
- Whether clinicians practice “just in case” prescribing
- Whether clinicians normalize stopping antibiotics

High-impact phrases to model:

- “Antibiotics are not benign.”
- “Changes in urine color do not equal a UTI”
- “Let’s be precise with our diagnosis.”
- “If the diagnostics don’t support infection, we stop.”
- “Shorter durations are safer and just as effective.”

OUTLINE

- What should nursing, dental, pharmacy, and medical students learn about antimicrobial stewardship?
- How can we teach stewardship to build habits, not just knowledge?
- Given various clinical scenarios, how can we model stewardship decision-making and behaviors to shape trainee behavior?

Clinical Scenario

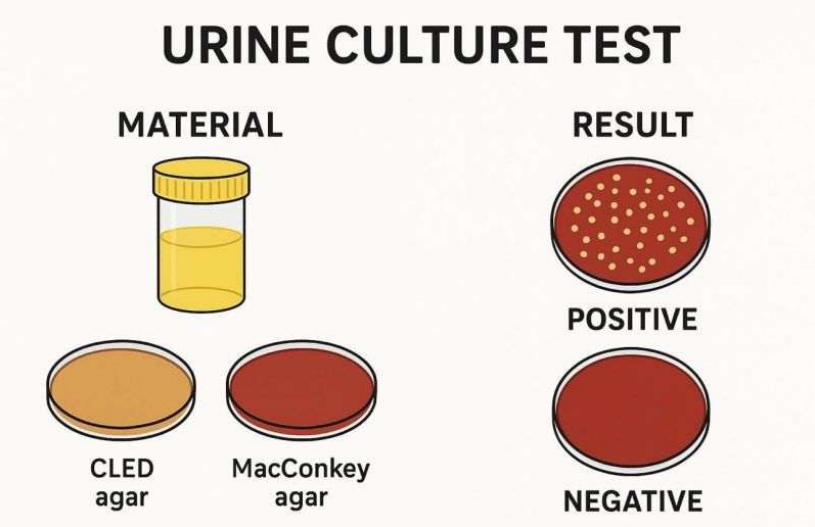
82-year-old nursing home resident is evaluated after a fall. The patient has mild cognitive impairment, which is baseline, and is able to answer questions. She denies any dysuria or urinary frequency. No abdominal or pelvic pain. No fevers.

Her urinalysis is significant for moderate leukocyte esterase, 50 wbc/hpf UA positive, and positive bacteria. The urine culture is pending.

Should antibiotics be started?

Asymptomatic bacteriuria

- No antibiotics unless clear UTI symptoms or systemic signs
- Address fall evaluation, hydration, meds, pain
- Educate team and patient/family: pyuria/bacteriuria is common and ≠ infection
- Role model and articulate: a positive test ≠ disease



Profession-specific roles

Nursing: monitor for new urinary symptoms, fever; avoid unnecessary repeat UA; counseling family

Pharmacy: education, stop unnecessary therapy, review renal dosing if started

Medicine: document rationale for not treating

Dentistry (transferable principle): colonization/pain ≠ infection

But, the patient’s urine is really dark!

The Color Does *NOT* Tell

- Many non-infectious causes may alter the appearance of the urine.
  - **Pale yellow/clear**: good hydration
  - **Bright yellow**: B vitamins
  - **Red**: blood, beets, blackberries
  - **Orange**: dehydration, carrots, rifampin
  - **Green**: phenol drugs, antidepressants, dyes in food, bile
  - **Brown**: anti-psychotics, laxatives, muscle relaxants, muscle injury
  - **Purple**: porphyria

- Isolated urine color changes ("dark", "murky", "cloudy") do not correlate well with UTI and should not prompt urine cultures in the absence of other signs and symptoms of infection.

https://www.hopkinsmedicine.org/antimicrobial-stewardship/nursing-toolkit/

And, it smells really bad

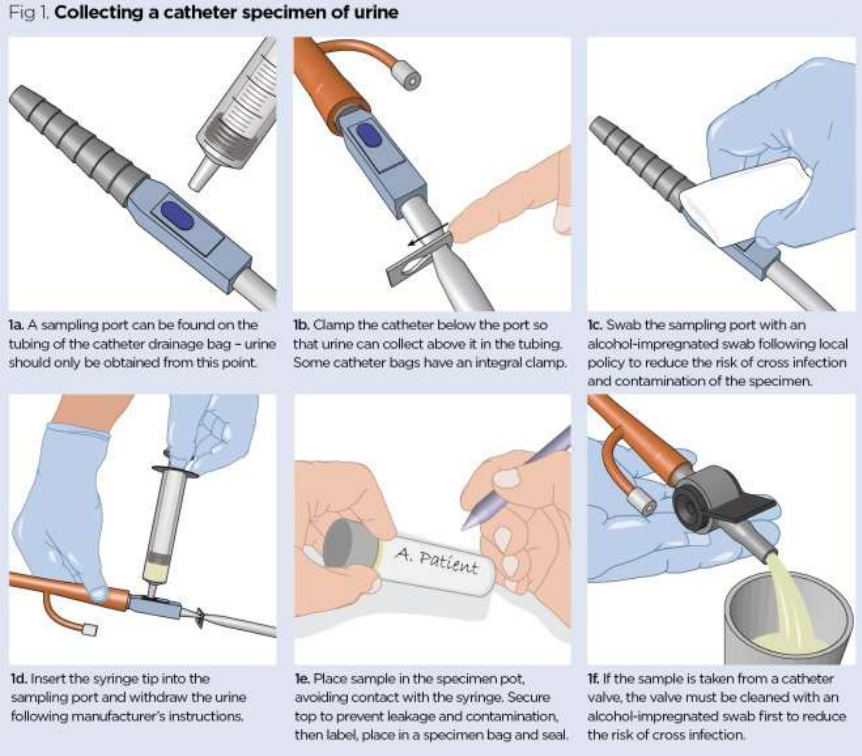
Smell does not correlate well with UTI

- Strong urine smell due to ammonia production
- Reasons for strong smell
  - Uncontrolled diabetes
  - Diet (e.g., asparagus)
  - Vitamins
  - Concentrated urine (dehydration)

- Urine odor (including foul smell) is not an accurate predictor of UTIs
- Smell of urine is often misattributed to a UTI and results in
- error

https://www.hopkinsmedicine.org/antimicrobial-stewardship/nursing-toolkit/

Urine specimen collection



Role model and articulate

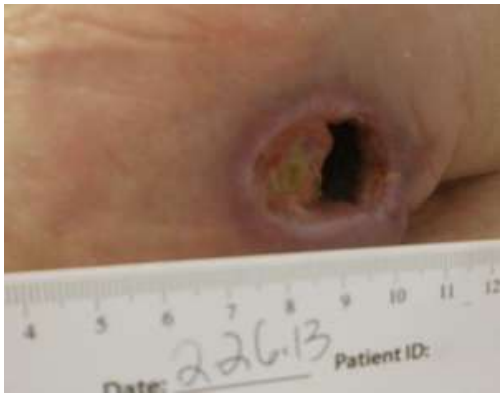
- How to properly obtain a urine specimen
- How to counsel a patient on providing a clean catch urine sample

Clinical Scenario

An 81-year-old woman with advanced dementia and limited mobility is evaluated for poor oral intake and generalized weakness. She has a **stage IV sacral pressure ulcer** with **malodorous purulent drainage** noted on exam. The wound base appears necrotic with exposed subcutaneous tissue. There is **no surrounding erythema, warmth, tenderness, or induration**, and no crepitus.

Vital signs: T 98.2°F, HR 82, BP 128/70, RR 16, SpO_2 97% on room air.
Labs: WBC 7.2, lactate normal.

What is the most appropriate next step?



Wound evaluation and management

- Manage with local wound care and assess the need for debridement
- Do not culture the wound
- Do not start systemic antibiotics
- Purulent drainage ≠ infection

Teaching Point

Purulent drainage from a chronic decubitus ulcer often represents colonization or localized infection without invasive soft tissue infection. Systemic antibiotics are not indicated unless there are signs of:

- Surrounding cellulitis
- Systemic infection (fever, leukocytosis, hemodynamic instability)

Interprofessional Roles

Nursing

- Perform and document **serial wound assessments** (size, drainage, appearance)
- **Pressure offloading**, turning schedules, moisture control
- Implement **wound care protocols** (dressings, cleansing)
- Monitor for **new signs** of cellulitis/systemic infection (fever, erythema, increasing pain)
- Coordinate wound care consult and reinforce care plan with caregivers

Physician/APP

- Avoid reflex wound cultures (often misleading) unless clinical infection suspected
- Arrange **surgical/wound care evaluation** for debridement
- Determine whether there is **true soft tissue infection vs colonization**
- **Imaging if concern for osteomyelitis**
- Communicate a clear plan: “no antibiotics unless clinical infection develops”

Pharmacy

- Reinforce stewardship: chronic wound cultures frequently grow polymicrobial flora and do not mandate antibiotics
- If antibiotics later become indicated:
  - guide **empiric selection** based on severity and risk factors
  - recommend **shortest effective** duration
  - monitor renal function and drug interactions
  - assess antibiotic-associated harms (C. difficile risk, nephrotoxicity)
- Assist with antimicrobial “time-out” reassessment at 24–48 hours if therapy is initiated

Communication Skills

Take Home Points

- Each profession has unique AMS contributions, prescribing is only one piece
- The most effective AMS education is integrated, interprofessional, and case-based
- Stewardship is a clinical behavior best learned through didactic teaching **+** role modeling and practice