Antibiotic Stewardship in the Long-Term Care Setting

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Activity type: knowledge-based

Credits: 2 hours (0.2 CEU)

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Learning Objectives

- Interpret antibiogram information for use in patient-specific situations
- Evaluate current antibiotic use policies within a practice setting
- Identify appropriate treatment plans for respiratory infections in older adults
- Identify appropriate treatment plans for skin and soft tissue infections in older adults
- Identify appropriate treatment plans for urinary tract infections in older adults
- Identify appropriate treatment plans for Clostridium difficile infections in older adults

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Review of common bacterial infections

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Pneumonia

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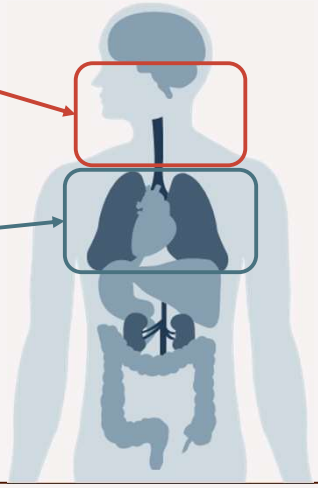
Upper & Lower Respiratory Infections

Upper Respiratory Infections
- Involves sinuses and throat
  - Sinusitis
  - Tonsillitis
  - Laryngitis

Lower Respiratory Infections
- Involves airways and lungs
  - Bronchitis
  - Bronchiolitis
  - **Pneumonia**



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Pneumonia

- Common bacterial pathogens include:
  - Streptococcus pneumonia (majority of cases)
  - Haemophilus influenzae
  - Staphylococcus aureus
  - Atypicals
  - Pseudomonas aeruginosa
- Presentation
  - Respiratory symptoms (SOB, cough, rales, etc.)
  - Systemic symptoms (Hypoxemia, Fever, chills, Leukocytosis, Sepsis)

You won't always know the causative agent due to low reliability of sputum cultures!

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Types of Pneumonia

Community Acquired Pneumonia (CAP) - PNA with onset in the community setting

- Includes PNA that occurs within < 48 hr of hospitalization

Hospital Associated Pneumonia (HAP) - PNA occurring during hospitalization

- Symptom onset must be > 48 hr after admission

Ventilator Associated Pneumonia (VAP) - PNA occurring as a result of ventilation

- Symptom onset must be > 48 hr after intubation

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CAP - IDSA Treatment Guidelines

Determining severity

- Determine based on PSI (preferred) or CURB-65
  - IDSA criteria for severe CAP will help determine level of inpatient care
    - Non-severe CAP - general medical floor
    - Severe CAP - ICU

Criteria for Severe CAP	
Major criteria (1)	**Minor criteria (≥ 3)**
- Respiratory failure requiring mechanical ventilation - Severe shock requiring vasopressors	- BUN ≥ 20 mg/dL - Confusion - Temperature < 96.8 F - Hypotension requiring aggressive IVF - Multilobar infiltrates - PLT < 100k - RR ≥ 30 bpm - WBC < 4k

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CAP - IDSA Treatment Guidelines

Empiric Treatment of CAP in Outpatient Setting		
No comorbidities No risk factors for MRSA or Pseudomonas	**Amoxicillin (preferred)**	**x 5 - 7 days**
	Doxycycline	
	Macrolide (azithromycin or clarithromycin) (only if local resistance < 25%)	
Comorbidities present	Amoxicillin/clavulanate or Cephalosporin + Macrolide or doxycycline	
	Respiratory fluoroquinolone	

Comorbidities - chronic heart, lung, liver, or hepatic disease; diabetes mellitus; alcoholism; malignancy; asplenia
MRSA/Pseudomonas risk factors - prior respiratory isolation of MRSA or Pseudomonas, recent hospitalization AND receipt of IV antibiotics in past 90 days

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CAP - IDSA Treatment Guidelines

Empiric Treatment of Non-Severe CAP in the Inpatient Setting		
Standard Regimen	Beta-lactam + macrolide	**x 5 - 7 days** x 7 days if MRSA or Pseudomonas
	Respiratory fluoroquinolone	
History of respiratory isolation of MRSA or Pseudomonas	Add MRSA or Pseudomonas coverage Obtain cultures/nasal PCR and de-escalate as able	
Recent hospitalization with IV antibiotics	Obtain cultures/nasal PCR and only initiate converge if positive results	

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CAP - IDSA Treatment Guidelines

Empiric Treatment of Severe CAP in the Inpatient Setting		
Standard Regimen	Beta-lactam + macrolide	**x 5 - 7 days** x 7 days if MRSA or Pseudomonas
	Beta-lactam + fluoroquinolone	
History of respiratory isolation of MRSA or Pseudomonas	Add MRSA or Pseudomonas coverage Obtain cultures/nasal PCR and de-escalate as able	
Recent hospitalization with IV antibiotics		

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HAP - IDSA Treatment Guidelines

Empiric Treatment of HAP		
Standard Regimen (MSSA + Pseudomonas coverage)	Piperacillin-tazobactam Cefepime, Ceftazidime Levofloxacin, Moxifloxacin Meropenem, Imipenem	x 7 days
MRSA risk factor(s) present	Add MRSA coverage	
Pseudomonas risk factors	Double Pseudomonas coverage (of different drug classes)	
Presence of structural lung disease		
MRSA risk factors - prior IV abx use within 90 days, recent hospitalization in unit in which > 20% S aureus isolates are MRSA (or MRSA prevalence unknown), high mortality risk **Pseudomonas risk factors** - prior abx use within 90 days, high mortality risk **High risk for mortality** - ventilator support needed for HAP, septic shock		

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VAP - IDSA Treatment Guidelines

Empiric Treatment of VAP		
Standard Regimen (MSSA + Pseudomonas coverage)	Piperacillin-tazobactam Cefepime, Ceftazidime Levofloxacin, Moxifloxacin Meropenem, Imipenem	x 7 days
Antibiotic resistance risk factors present: - IV abx use within 90 days - Septic shock at time of VAP - ARDS preceding VAP - ≥ 5 days hospitalization before VAP - Acute RRT prior to VAP	Add MRSA coverage and double Pseudomonas coverage	
MRSA isolates > 10-20% in unit	Add MRSA coverage	
Structural lung disease present	Double Pseudomonas coverage	

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Antibiotic Review - Penicillins

Common agents:

- Natural penicillins: penicillin G, penicillin VK
- Antistaphylococcal: nafcillin, oxacillin
- Extended-spectrum penicillins:
  - Aminopenicillins: amoxicillin, ampicillin
  - Aminopenicillins + BLI: amoxicillin/clavulanate, ampicillin/sulbactam
  - Antipseudomonal penicillins: piperacillin/tazobactam

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Antibiotic Review - Penicillins

MOA - inhibit cell wall synthesis by inhibiting peptidoglycan synthesis

Abx	Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
Natural pens	+++					
Anti-staph pens	+++					
	* No activity against enterococci					
Aminopenicillins	+++	+				
	* Poor activity against Staphylococcus					
Aminopen + BLI	+++	++	+++			
Extended spectrum	+++	+++	+++		+++	

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Antibiotic Review - Penicillins

ADRs
- Diarrhea
- Seizures (high doses)
- AST/ALT elevations (anti-Staph penicillins)

Notes
- Frequently used as first line
- Only ~10% of penicillin allergies are true allergies
- Majority of penicillins will need renal adjustment

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Antibiotic Review - Cephalosporins

Common agents:
- 1st generation: cephalexin, cefazolin
- 2nd generation: cefoxitin, cefuroxime, cefaclor
- 3rd generation: ceftriaxone, ceftazidime, cefdinir, cefotaxime
- 4th generation: cefepime
- 5th generation: ceftaroline

MOA - Inhibits cell wall synthesis by inhibiting peptidoglycan synthesis

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Antibiotic Review - Cephalosporins

Abx	Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
1st gen	+++	+				
2nd gen	++	++	++			
	* Cefoxitin & cefotetan have anaerobic coverage					
3rd gen	++	+++				
	* Ceftazidime has Pseudomonal coverage					
4th gen	++	+++			+++	
5th gen	+++	+++				+++

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Antibiotic Review - Cephalosporins

ADRs (similar for all beta-lactams)

- Diarrhea
- Seizures (at high doses)
- Neurotoxicity (cefepime)

Notes

- Majority of cephalosporins will need renal dose adjustments

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Antibiotic Review - Carbapenems

Common agents: Meropenem, ertapenem, imipenem

MOA - Inhibits cell wall synthesis by inhibiting peptidoglycan synthesis .

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
+++	+++	+++		+++	
* Ertapenem does not have Pseudomonal coverage					

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Antibiotic Review - Carbapenems

ADRs
- Diarrhea
- Nausea/vomiting
- Seizures (at high doses)

Notes
- Reserved for ESBL and drug-resistant organisms

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Antibiotic Review - Fluoroquinolones

Common agents: levofloxacin, ciprofloxacin, moxifloxacin

MOA - Directly inhibit bacterial DNA synthesis by inhibiting DNA gyrase and DNA topoisomerase IV.

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
++	+++	+	+++	+++	

* Ciprofloxacin has very poor gram (+) coverage
* Moxifloxacin does not cover Pseudomonas

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Antibiotic Review - Fluoroquinolones

ADRs
- GI upset
- Headache
- Dizziness
- Transient mood / sleep changes
- QT_c prolongation

Rare:
- Hepatic failure
- Psychosis
- Seizures
- Aortic aneurysm / dissection
- Hyperglycemia / hypoglycemia
- Phototoxicity

Black Box Warning

Tendonitis
Peripheral neuropathy
CNS effects
Myasthenia gravis exacerbation

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Antibiotic Review - Fluoroquinolones

Notes

- Respiratory fluoroquinolones: levofloxacin, moxifloxacin
  - Based on S pneumoniae activity
- Fluoroquinolones have activity against mycobacterium and are considered second line for TB and first line for many non-tuberculous mycobacterium
- Require renal adjustments
  - Start higher than most (CrCl < 50 mL/min)

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Antibiotic Review - Macrolides

Common agents: azithromycin, clarithromycin

MOA - bind to 50S subunit of bacterial ribosomes, leading to inhibition of protein synthesis.

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
++	+		+++		
* Also have coverage against mycobacterium					

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Antibiotic Review - Macrolides

ADRs

- GI upset
  - Clarithromycin > azithromycin
- Dysgeusia (clarithromycin)
- QT_c prolongation
- Increased risk cardiovascular mortality (rare)

Notes:

- Macrolides have an FDA-issued warning for increased risk of cardiovascular events, but causality has not been determined
- Renally adjust clarithromycin when CrCl < 30 mL/min

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Antibiotic Review - Tetracyclines

Common agents: doxycycline

MOA - inhibits protein synthesis by binding the 30S subunit
Spectrum of activity

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
+++	++		+++		++

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Tetracyclines

ADRs
- Diarrhea
- Esophagitis
- Photosensitivity

Notes
- Avoid antacids, dairy, and multivitamins 2 hours before and after administration.
  - Tetracyclines interact and chelate with divalent and trivalent cations, making them inert.
- Patients should remain upright 30 minutes after taking doxycycline to prevent esophageal irritation.

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Other Antibiotics - Vancomycin

- Glycopeptide - Binds to d-alanyl-d-alanine, preventing cross-linking of the peptidoglycan layer of the cell wall

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
+++					+++

ADRs
- Nephrotoxicity
- Ototoxicity (high doses)
- Neutropenia/pancytopenia

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Other Antibiotics - Vancomycin

Notes

- Dosed based on pharmacokinetic monitoring due to narrow therapeutic index
- Infuse slowly to avoid infusion reaction
  - Characterized by rash, flushing, pruritus, and less commonly hypotension, chest pain, and dyspnea
- Has poor systemic absorption when ingested, must give IV (unless treating C diff)

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Other Antibiotics - Linezolid

Oxazolidinone - Binds to 50S subunit blocking protein synthesis.

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
+++					+++

ADRs

- Diarrhea
- Myelosuppression
- Peripheral and optic neuropathy
- Serotonin syndrome

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Other Antibiotics - Linezolid

Notes

- Not preferred for infections requiring prolonged treatment
  - Risk of hematologic and neurologic toxicity increases after > 2 weeks of use
- Linezolid is a weak, non-selective MAOI, resulting in inhibition of serotonin metabolism

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Other Antibiotics - Aztreonam

Monobactam - inhibit cell wall synthesis by inhibiting peptidoglycan synthesis.

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
	+++			+++	

ADRs

- Neutropenia
- Elevated LFTs

Notes

- Typically reserved for Pseudomonas infections
- Renally adjust when CrCl < 30 mL/min

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Antibiotics Review - Special Coverage

MRSA	Pseudomonas
SMX/TMP Doxycycline Clindamycin Linezolid Vancomycin Daptomycin Ceftaroline	Ciprofloxacin Levofloxacin Piperacillin-tazobactam Ceftazidime Cefepime Meropenem Aztreonam

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COPD considerations

- COPD exacerbations and CAP infections may look similar. Imaging will be useful in determining if the patient has a PNA.
- COPD exacerbation should also be treated in conjunction with PNA.
  - Depending on AECOPD severity, may be treated inpatient or outpatient.
  - General pharmacological treatment includes:
    - Increased dose/frequency of short-acting bronchodilators
    - Systemic steroids - short course
    - Antibiotics course (based on CAP work-up)

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Prevention - Vaccines

- Annual flu vaccinations
  - Indicated in all patients
- Pneumococcal vaccinations
  - Indicated for all patients > 65 years and patients > 18 years with immunocompromising conditions
  - **PCV20 x 1 dose (preferred)**
  - PCV15 x 1 dose followed by PPSV23 x 1 dose a year later

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Clinical Pearls for the Older Adult

- Suspected aspiration PNA - do not add anaerobic coverage unless there is suspicion for lung abscess or empyema
- Corticosteroids should be used sparingly for CAP
  - Only routinely use if CAP is causing sepsis, then follow sepsis guidelines
- Nursing home associated PNA - no longer a PNA category per the IDSA guidelines
  - The CAP guidelines have been updated to include assessment for risk of MDROs so that healthcare associated PNA is no longer a clinically distinct category

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Case intro

A 79 year old female patient presents with coughing for 4 days and worsening shortness of breath. Her temperature is 101.2° F. Her PMH includes asthma.

1. **What organism causes the majority of CAP cases?**
2. **What antibiotic(s) should be started empirically if local resistance rates are low?**
3. **What is the appropriate treatment duration for this patient?**

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Case answers

1. Streptococcus pneumoniae causes the majority of CAP cases.
2. A good empiric option would be amoxicillin/clavulanate + azithromycin.
   a. Local resistance for azithromycin should be less than 25% per guidelines.

1. The treatment duration should be 5-7 days.

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Skin and Soft Tissue Infections

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Skin and Soft Tissue Infections

Skin and soft tissue infections (SSTIs) - caused by microbial invasion of the skin and its supporting structures.

- Purulent
  - Purulent cellulitis/abscess
  - Folliculitis/furuncle/carbuncle
- Non-purulent
  - Non-purulent cellulitis
  - Erysipelas
- Diabetic foot infection
- Pressure injury/ulcer

Typical skin flora:
- Staphylococcus spp.
- Micrococcus spp.

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Purulent Cellulitis / Abscess

Collections of pus within the dermis and deeper skin tissues

Clinical presentation

- Lesion erythematous and painful
- Swelling present with poorly defined margins and non-raised borders
- Purulent drainage and/or abscess present
- Systemic symptoms are common

Causative agent:
S aureus

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Purulent Cellulitis / Abscess

Classification of Severity

- Mild - Local symptoms only (no systemic signs/symptoms)
- Moderate -
  - Systemic symptoms
  - Multiple sites of infection
  - Lesions on hands, face, or genitalia
- Severe -
  - Failed I&D + antibiotics
  - Systemic symptoms + hypotension
  - Immunocompromised patients

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Purulent Cellulitis / Abscess

Treatment:

- Mild - I&D only
- Moderate - I&D + PO antibiotics
- Severe - I&D + IV antibiotics
  - Must cover MRSA empirically
  - Transition to PO based on clinical improvement

- Duration:
  - Moderate: 5 days
  - Severe: 7 - 14 days

Culture of pus recommended

Treatment without cultures is reasonable in typical cases

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Folliculitis / Furuncle / Carbuncle

Infections of the hair follicle:

- Folliculitis - infection limited to the epidermis
- Furuncle - infection extends through the dermis into the subcutaneous tissue
- Carbuncle - furuncle involving several adjacent hair follicles; typically larger and deeper than furuncle
  - Lesion(s) broad, swollen, and erythematous
  - Common to spread to other tissues, resulting in purulent cellulitis

Causative agent:
S aureus

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Folliculitis / Furuncle / Carbuncle

Classification of severity: Carbuncle > furuncle > folliculitis

Treatment

Folliculitis	Furuncle	Carbuncle
- Can rupture & drain spontaneously - Moist heat compress - I&D not necessary	- Can rupture & drain spontaneously - Moist heat compress - I&D not *usually* necessary	- I&D only

- Only initiate antibiotics if patient has systemic symptoms
  - Duration: 5 - 10 days
  - Cultures can be considered but are not usually necessary

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Non-Purulent Cellulitis

Skin infection spreading from epidermis to dermis with no purulence

Causative agent:
S pyogenes

Clinical presentation

- Lesion is erythematous, painful, and swollen
- Poorly defined margins and non-raised borders
- No purulent drainage or abscess
- Systemic symptoms common

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Non-Purulent Cellulitis

Classification of severity

- Mild - No systemic symptoms
- Moderate - Systemic symptoms
- Severe -
  - Failed oral antibiotics
  - Presence of SIRS
  - Immunocompromised patient
  - Lesion associated with penetrating trauma
  - Evidence MRSA infection elsewhere or MRSA colonization
  - Presence of skin sloughing or bullae
  - Presence of hypotension or sepsis

Systemic Inflammatory Response Syndrome (≥ 2)
Temp > 38 C or < 36 C
RR > 24 bpm
HR > 90 bpm
WBC > 12k or < 4k

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Non-Purulent Cellulitis

Treatment

- Mild - I&D only
- Moderate - I&D + PO antibiotics
- Severe - I&D + IV antibiotics
  - Must cover MRSA empirically
  - Transition to PO based on clinical improvement

Culture of pus recommended

Treatment without cultures is reasonable in typical cases

Duration:

- Moderate: 5 days
- Severe: 7 - 14 days

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Erysipelas

- Lesion intensely red and edematous, with a raised border
  - Burning sensation
  - Systemic symptoms common

Causative agent:
S pyogenes

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Erysipelas

Classification of severity

- Mild - no systemic symptoms
- Moderate - systemic symptoms present
- Severe -
  - Failed oral antibiotics
  - Presence of SIRS/sepsis
  - Immunocompromised patient
  - Large surface area involvement
  - Facial involvement

Treatment

- Mild - Moderate - oral antibiotics
- Severe - IV antibiotics (non-broad spectrum)
- Duration - 7 - 10 days

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Antibiotics - Purulent / Non-Purulent SSTIs

S pyogenes	MSSA	MRSA
Penicillin VK Amoxicillin-clavulanate Oxacillin/nafcillin Piperacillin-tazobactam Cefazolin Cephalexin Ceftriaxone Clindamycin	Amoxicillin-clavulanate Oxacillin/nafcillin Piperacillin-tazobactam Cefazolin Cephalexin Ceftriaxone Ceftaroline Clindamycin Doxycycline TMP-SMX Vancomycin Daptomycin Linezolid	Ceftaroline Clindamycin Doxycycline TMP-SMX Vancomycin Daptomycin Linezolid

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Diabetic Foot Infections

Acute or chronic infection in diabetic patients due to peripheral neuropathy, impaired wound healing, and impaired blood flow

Clinical presentation -

- Purulent or non-purulent cellulitis
- Swelling
- Foul odor

Causative organisms: Polymicrobial

- Gram (-) more common in chronic infection

Causative agents:
Staphylococcus
Streptococcus
Pseudomonas
Anaerobes
Variety of Gram (-)

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Diabetic Foot Infections

Classification of Severity

Grade 1	Grade 2	Grade 3	Grade 4
No local or systemic signs of infection	≥ 2 of the following: - Local swelling or induration - Erythema 0.5 - 2.0 cm around the wound - Local tenderness or pain - Local increased warmth - Purulent drainage	No systemic symptoms and involving: - Erythema > 2.0 cm from the wound margin and/or - Skin involvement deeper than subcutaneous tissue (e.g. tendon, muscle, joint, bone)	Presence of systemic symptoms/SIRS, with ≥ 2: - Temperature > 38 C or < 35 C - HR > 90 bpm - RR > 20 bpm - WBC > 12k or < 4k or bands > 10%

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Diabetic Foot Infections

Severity	Additional factors	Target pathogens	Potential empiric regimens
Mild	None	GPC	Penicillins
			1st gen cephalosporins
	Recent abx exposure	GPC + GNR	Beta-lactam + BLI
			Fluoroquinolone
			TMP/SMX
	High MRSA risk*	MRSA	Linezolid
			TMP/SMX
			Clindamycin
			Doxycycline

*High risk MRSA - previous MRSA infection or colonization

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Diabetic Foot Infections

Severity	Additional factors	Target pathogens	Potential empiric regimens
Moderate / Severe	None	GPC + GNR	Beta-lactam +BLI
	Recent abx exposure		2nd or 3rd gen cephalosporin
	Wound maceration**	GNR Pseudomonas spp.	Piperacillin-tazobactam
			Carbapenem
	Ischemic limb/ necrosis/ gas forming	GPC + GNR + anaerobes	Penicillin + BLI
			Carbapenem
			2nd/3rd gen ceph + clindamycin/ metronidazole

** Wound maceration - prolonged/excessive moisture
*** MRSA risk factors - recent or history prolonged hospitalization, recent antibiotic use, invasive procedures, HIV infection, **nursing home admission**, open wounds, hemodialysis, long term central access

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Diabetic Foot Infections

Severity	Additional factors	Target pathogens	Potential empiric regimens
Moderate/ Severe	MRSA risk factors***	MRSA	**Add** MRSA coverage: - Vancomycin / Linezolid / Daptomycin / TMP-SMX / Doxycycline
	Concern for resistant GNR	ESBL	Carbapenem
			Fluoroquinolone
			Aminoglycoside

*** MRSA risk factors - recent or history prolonged hospitalization, recent antibiotic use, invasive procedures, HIV infection, **nursing home admission**, open wounds, hemodialysis, long term central access

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Pressure Injury / Ulcer

Tissue ischemia caused by prolonged external pressure

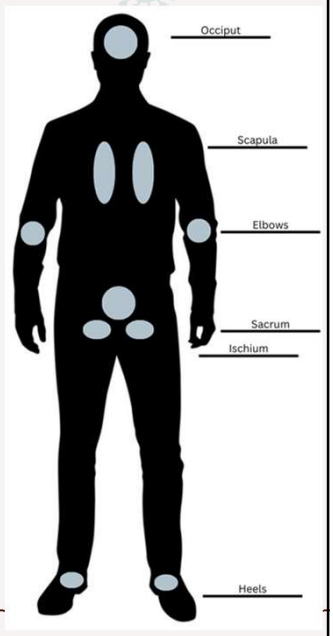
- Typically occur over bony protuberances
- Commonly seen in patients with immobility, decreased sensation, and malnutrition

Clinical presentation

- Common locations - back of head, scapula, elbow, sacrum, heel

Causative organisms - skin flora

- Ulcers typically form aseptically and will acquire infection due to skin structure changes.



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Pressure Injury / Ulcer

Classification of severity

- Range from simple erythema (Stage I) to full-thickness skin loss and deep structure exposure (Stage IV/Unstageable)

Treatment

- Offloading offending pressure source
- Debridement of necrotic tissue
- Treatment of any cellulitis (if present)
- Regular wound care to support healing

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SSTI Risk Factors/Clinical pearls

- Immobility
- Nutritional deficiency
- Incontinence
- Steroid use
- Chronic disease
  - Diabetes
  - Peripheral neuropathy
  - Peripheral artery disease
- Soaking feet
- Skin differences (thinning, loss of moistures)

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Preventative measures

- Avoid skin tears
- Clean daily
- Emollients
- Gentle soap
- Glycemic control
- Combatting immobility - turning, foam, suspend, low air mattress
- Incontinence - hygiene, keep area dry, protective barrier

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Sulfamethoxazole - Trimethoprim

Sulfamethoxazole (SMX) - Inhibits dihydrofolic acid reduction to tetrahydrofolate furthering the inhibition of the folic acid pathway

Trimethoprim (TMP) - Interferes with bacterial folic acid synthesis and growth via dihydrofolic acid inhibition

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
+++	++				+++

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Sulfamethoxazole - Trimethoprim

ADRs

- Electrolyte disturbances
  - Hyperkalemia
  - Hypocalcemia
  - Hyponatremia
- Myelosuppression
- Hypoglycemia
- Dermatologic hypersensitivity
  - Rash, TENS, SJS, DRESS

Notes

- Increased risk of ADRs in geriatric population
- Renal dose adjustments
- Use with caution in patients with folate deficiency
  - Malnutrition
  - Crohn's disease
  - Pregnancy

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Case intro

A 72 year old male with a sulfonamide allergy presents with a diabetic foot ulcer and infection. There is some local swelling, erythema, and pain. Purulent drainage is coming from the ulcer. His PMH includes HTN and T2DM (admitted to ED with diabetic foot infection 6 months ago, tested positive for MRSA). His most recent HbA1c is 11.2%.

1. **What are the likely causative organisms?**

2. **What are some appropriate oral antibiotic options for empiric treatment?**

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Case answers

1. Likely causative organisms: Staphylococcus, Streptococcus, Pseudomonas, anaerobes, variety of Gram (-)

2. Doxycycline, minocycline, clindamycin, linezolid.

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Urinary Tract Infection

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Urinary Tract Infection

Urinary tract infection (UTI) is infection involving any part of the urinary tract system.

- This includes the bladder, kidneys, urethra, and ureters.

Most common pathogens:

E coli (75 - 95%)
Proteus mirabilis
Klebsiella pneumoniae
Staphylococcus saprophyticus
Pseudomonas (rare)

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UTI Categorization

- **Uncomplicated** - Cystitis in healthy, non-pregnant women
- **Complicated** - Cystitis associated with factors that increase the risk of poor outcomes or decreased treatment efficacy
  - Recent urinary instrumentation
  - Urinary tract anatomy abnormality
  - Male sex
  - Pregnancy
  - Renal transplant or immunocompromised
- **Pyelonephritis** - Infection extending to the kidneys
- **CAUTI** - UTI in the presence of a urinary catheter
- **Asymptomatic bacteriuria** - Asymptomatic presence of bacteria in the urine

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Presentation

Cystitis:

- Dysuria
- Urinary frequency
- Urinary urgency
- Hematuria
- Suprapubic pain

Pyelonephritis:

- Fever
- Chills, rigors
- Fatigue
- Nausea/vomiting
- Flank pain
- Pelvic or perineal pain (in males)

Geriatric Specific Presentation: Confusion, delirium, lethargy, new incontinence, decreased appetite

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IDSA Treatment Guidelines

Diagnosis	First-line treatment	Second-line treatment	Notes
Uncomplicated cystitis	Nitrofurantoin x 5 days	TMP/SMX x 3 days	Treatment duration depends on agent used Beta-lactams have lower efficacy compared to other UTI agents Avoid moxifloxacin due to low urinary concentrations Recommend giving ceftriaxone 1 g IM x 1 dose when using fluoroquinolone regimen
		Fosfomycin x 1 dose	
		Cephalexin x 3 - 7 days	
Complicated cystitis	Nitrofurantoin x 7 days	TMP/SMX x 7 days	
		Fosfomycin x 6 days	
		Cephalexin x 7 days	
Pyelonephritis	TMP/SMX x 7-14 days	Ciprofloxacin x 7 days	
		Levofloxacin x 5 days	
		Amoxicillin/clavulanate x 10-14 days	
Asymptomatic bacteriuria	Do not treat unless patient is pregnant or has had prior to urologic procedures.		

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Catheter-Associated UTI

- Patients with urinary catheters should not be screened for UTI
  - Typically colonized with bacteria
  - Only check urinalysis if patient is experiencing symptoms
    - Absence of urinary frequency and painful urination due to presence of catheter
  - Typically present with systemic symptoms
  - Pyuria and urine presentation is not indicative of or preclude CAUTI

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Catheter-Associated UTI

- More wide-spectrum of potential infecting organisms and increased likelihood of antimicrobial resistance
  - Recommend obtaining urine culture prior to starting antimicrobials
  - Always make sure culture is retrieved from newly placed catheter
- Empiric treatment same as for complicated UTI
  - Narrow/adjust antibiotics based on urine culture

Diagnosis	First-line treatment	Second-line treatment	Treatment Duration
CAUTI	Nitrofurantoin	TMP/SMX Cephalexin Fosfomycin	Standard: 7 days Delayed Response: 14 days

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Preventative measures

- Hydration
- Good hygiene
- Avoid/limit use of anticholinergics due to urinary retention
- Avoid catheterization
  - Only use catheters when absolutely necessary
  - Remove catheter as soon as possible
  - External > internal catheters

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Nitrofurantoin & Fosfomycin

Nitrofurantoin - Inactivates bacterial ribosomal proteins, leading to inhibition of protein synthesis, energy metabolism, DNA/RNA synthesis, and cell wall synthesis

Fosfomycin - Inactivates pyruvyl transferase, inhibiting bacterial cell wall synthesis

	Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
Nitrofurantoin	+++	+++				+++
Fosfomycin	+++	+++			++	+++

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Nitrofurantoin & Fosfomycin

ADRs

- Generally well tolerated
- GI symptoms
- Pulmonary toxicity - nitrofurantoin (long-term use)

Notes

- Only concentrates in the urine
- Can only use for cystitis
- Avoid nitrofurantoin in CrCl < 60 mL/min
- Nitrofurantoin can discolor urine (dark yellow to brown)
- Fosfomycin comes as powder to be mixed with water
- Do not mix with food or hot water

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Clinical Pearls for the Older Adult

- Urine cultures should not be checked regularly
  - Only check in the presence of signs and symptoms UTI
- Majority of UTIs will have a urinalysis with (+) nitrites and (+) leukocytes
  - UTI caused by Staph saprophyticus will **not** have (+) nitrites

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Case intro

A 64 year old female presents with complaints of frequent urination and a burning sensation during urination for the past 3 days. She has not had a UTI in several years. Her CrCl is > 60 mL/min.

1. **What is the most common likely causative organism?**
2. **What antibiotic should be started empirically?**

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Case answers

1. E. coli is the most common organism that causes UTIs.
2. Nitrofurantoin is first-line treatment option for this uncomplicated cystitis patient as she has adequate renal function.

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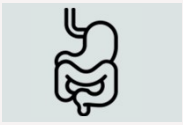

C. difficile

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Clostridioides difficile

Clostridiodes difficile (aka C diff)

- Anaerobic
- Gram +
- Spore forming rod

Clostridioides difficile infection (CDI) diagnosed with:

- Symptoms (usually diarrhea) plus stool test positive for C diff toxins/toxigenic C diff strain
- Colonoscopy or histopathologic findings revealing pseudomembranous colitis

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Presentation

Wide range of symptoms:

- **Asymptomatic** - pt colonized by C diff with no symptoms
- **Mild/moderate** - acute watery diarrhea, WBC < 15k, no renal dysfunction
- **Severe** - acute watery diarrhea, WBC > 15k, SCr > 1.5 mg/dL
- **Fulminant** - acute watery diarrhea + hypotension, shock, ileus, or megacolon

Life threatening complications of C diff include: sepsis, renal failure, toxic megacolon, and bowel perforation

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Risk Factors

- Healthcare environment exposure
- Age > 65 years
- Exposure to antibiotics
- Previous CDI
  - High risk of recurrence (25%)
- PPIs/H2RAs?
  - Mixed evidence
  - Not enough evidence to d/c PPI/H2RA for CDI prevention

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IDSA Treatment Guidelines

Initial episode:

- **Fidaxomicin standard regimen (preferred)**
- Vancomycin standard regimen

	Standard Regimen	Pulse Dose Regimen
Fidaxomicin	200 mg PO BID x 10 days	200 mg PO BID x 5 days, then 200 mg PO once every other day
Vancomycin	125 mg PO QID x 10 days	125 mg PO QID x 10-14 days, then PO BID x 7 days, then every 2 to 3 days x 2 – 8 weeks

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IDSA Treatment Guidelines

First Recurrence:

- Fidaxomicin standard or pulse dose regimen
- Vancomycin standard or pulse dose regimen

	Pulse Dose Regimen
Fidaxomicin	200 mg PO BID x 5 days, then 200 mg PO once every other day
Vancomycin	125 mg PO QID x 10-14 days, then PO BID x 7 days, then every 2 to 3 days x 2 – 8 weeks

Multiple Recurrences:

- Same as first recurrence, but with extra options:
- Vancomycin followed by rifaximin
- Bezlotoxumab 10 mg/kg x 1 dose (add-on)
- Fecal microbiota
  - For pts with ≥ 2 recurrences (treated appropriately)

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IDSA Treatment Guidelines

Fulminant colitis

- Vancomycin 500 mg PO QID + metronidazole 500 mg IV Q8H
  - Could consider adding vancomycin retention enema if ileus present
  - Fidaxomicin not recommended

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IDSA Treatment Guidelines

Suppression/Prophylaxis

- Long-term prophylaxis - vancomycin 125 mg PO daily
- Short-term prophylaxis - vancomycin 125 mg PO daily during antibiotic treatment and x 5 days after completion

Only for high risk pts with history of CDI

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Fidaxomicin

Inhibits RNA polymerase sigma subunit resulting in inhibition of protein synthesis

Spectrum - Only active against C diff

ADRs

- GI effects
- Fever

Notes

- Some cross-reactivity with macrolides
- Caution with macrolide allergies

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Metronidazole

Nitroimidazole - Causes DNA loss of helical structure and strand breakage resulting in inhibition of protein synthesis.

Gram (+)	Gram (-)	Anaerobes	Atypicals	Pseudomonas	MRSA
		+++			

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Metronidazole

ADRs
- Metallic taste
- Nausea
- CNS effects
  - Peripheral neuropathy
  - Confusion
  - Seizures
  - Dizziness

Black Box Warning:
Shown to be carcinogenic in mice and rats

Notes
- Avoid concomitant alcohol due to risk of disulfiram-like reaction
  - Severe nausea/vomiting
  - Flushing
  - Tachycardia
- Fallen out of favor for C diff treatment
  - Only used for fulminant disease

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Infection Prevention and Control

Droplet precautions:

- Mask
- Patient in single room
- Confine patient to room
  - If patient must leave room, they need a mask
- Limit equipment transport in and out of contaminated room
- **Soap and water**
  - Hand sanitizer can NOT kill C diff!

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Clinical Pearls for the Older Adult

- Collateral damage - destruction of the microbiome during antibiotic therapy
- **All** antibiotics can cause C diff
  - Antibiotics with highest C diff risk:
    - Clindamycin (highest risk)
    - 3rd generation cephalosporins
    - Fluoroquinolones (ciprofloxacin > levofloxacin)
    - Amoxicillin/clavulanate

General Rule of Thumb:

↑ spectrum of activity = ↑ collateral damage

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Antibiograms

Core Elements

Deficiencies (F-tags)

NHSN Annual Facility Survey

Quality Improvement

Improving your Antibiotic Stewardship Programs

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Antibiograms

- Using local antibiotic resistance rates to select the most appropriate empiric option.
  - Susceptibility results should always be used to establish intrinsic treatment.
  - Susceptibility results not being used is one of the biggest issues in antibiotic stewardship in our country!
- Stratified antibiograms

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Reading an antibiogram

Organism	Number of isolates	AGs		Carbapen.		Cephalosporins					Penicillins					FQs		Other							
		Amikacin	Gentamicyn	Ertapenem	Meropenem	Cefazolin	Cefoxitin	Ceftazidime	Ceftriaxone	Cefuroxime	Amox/Clav	Ampicillin	Oxacillin	Penicillin	Pip/Tazo	Ciprofloxacin	Levofloxacin	Clindamycin	Daptomycin	Erythromycin	Linezolid	Nirtofurantoin	Doxycycline	TMP/SMX	Vancomycin
Gram Positive																									100
Enterococcus sp	95											100		88		59	71			29		100	25		100
MSSA	86		98						100		100	0	100			74	78	80		12			92	97	100
MRSA	118		97						0		0	0	0			20	20	61	100		100		91	94	100
S. agalatiae group b	49													100			91								100
Gram Negative																									
E. coli	197	100	93	100	100	88	94	99	100	79		50			98	62	61					99	70	66	
Klebsiella sp	43	100	97	100	100	63	94	100	98	89		0			98	99	98					83	87	92	

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Core Elements

1. Leadership commitment

- Write public statements in support.
- Communicate expectations to all.
- Create a culture promoting stewardship.

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Core Elements

1. Leadership commitment (continued)

- Include stewardship-related duties for leaders.
  - Ensures all tasks are getting done and none are falling through the cracks.

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Core Elements

2. Accountability

- Medical director
  - Prescribing practices
- Director of nursing
  - Communication on patient changes
- Consultant pharmacist
  - Antibiotic use data
  - Advise prescribing and medication use practices
- Working with resource

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Core Elements

3. Drug expertise

- Consultant pharmacists
- Antibiotic stewardship program leads
- Infectious disease consultants

- Making a Difference in Infectious Diseases (MAD-ID)
  - https://www.mad-id.org/
- Society of Infectious Diseases Pharmacists (SIDP)
  - https://sidp.org/Stewardship-Certificate
- Board-Certified Infectious Diseases Pharmacist (BCIDP)
  - https://bpsweb.org/infectious-diseases-pharmacy/

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Core Elements

4. Taking Action through Policy and Practice Change

- Policies that support optimal antibiotic use
  - Meeting CMS requirements
- Broad interventions to improve antibiotic use
  - Communication between team members
  - Optimizing diagnostics
- Infection and syndrome specific interventions
  - Reducing unnecessary antibiotic use

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Core Elements

4. Taking Action through Policy and Practice Change (continued)

- Pharmacy interventions
  - Antibiotic time-outs
  - Dosing review
  - Culture and Sensitivity review
  - Communication

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Core Elements

5. Tracking and Reporting

- Process measures: Tracking how and why antibiotics are prescribed
  - New antibiotic start practices.
    - Prescription documentation and following antibiotic selection policies.

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Core Elements

5. Tracking and Reporting (continued)

- Antibiotic use measures
  - Point prevalence surveys = moment in time
    - Ex. 100 antibiotic prescriptions/12 months
  - Nursing home initiated antibiotic starts = ongoing
    - Ex. 60 starts in Q1-2 > training at the end of Q2 > 40 starts in Q3-4
      - (33% reduction after antibiotic stewardship staff training)

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Core Elements

5. Tracking and Reporting (continued)

- Antibiotic use measures
  - Antibiotic days of therapy (DOT) = ongoing
    - Antibiotic utilization ratio (AUR) = DOT/patient days
      - An Antibiotic Use (AU) reporting option is available through the National Healthcare Safety Network (NHSN). This standardizes antibiotic use data and allows for national tracking of antibiotic use and resistance.

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Core Elements

5. Tracking and Reporting (continued)

- Antibiotic outcome measures
  - Adverse outcomes and costs
    - Rates of *C. difficile* and antibiotic resistance
    - Adverse drug events
    - Antibiotic use costs

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Core Elements

6. Education

- All team members.
- Everyone is responsible to antibiotic stewardship and continuous training on your facility's policies and procedures is vital.
- Incorporating feedback.

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Identify existing deficiencies (F-tags)

- F-tags refer to a particular deficiency within the Code of Federal Regulations.
- Used to identify areas of improvement in long-term care facilities.
  - 880: Infection Prevention and Control
  - 881: Antibiotic Stewardship Program
  - 882: Infection Preventionist Qualifications/Role

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F-tag 881 example (MS LTCF 2023)

- 12/20/22:
  - UA was reviewed by LPN and UTI was diagnosed by telemedicine MD. Order put in for Macobid 100 mg PO BID x 10 days.
- 12/22/22:
  - Urine culture revealed *E. coli* (ESBL). NP ordered Augmentin 500-125 mg PO BID x 7 days.
- 12/29/22:
  - Facility's revised McGeer Criteria for Infection Surveillance Checklist reviewed by facility's designated Infection Preventionist (IP).

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F-tag 881 example (continued)

- 1/11/23: Interview
  - IP revealed she was off and Director of Nursing (DON) is responsible for monitoring antibiotic use when she is off.
    - Initiated the McGeer tool upon return, thought Macrobid was discontinued.
  - DON confirmed she is responsible but failed to follow facility's antibiotic protocol while IP was off.
  - NP revealed he was not aware patient was on Macrobid when nurse called him with culture results on 12/22/22.
    - Agreed receiving both antibiotics was unnecessary and that Macrobid could have managed the infection alone.

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F-tag 881 example (continued)

- 1/11/23: Interview
  - RN confirmed she received the order for Augmentin. She did not know why she did not tell the NP about the Macrobid.
    - She stated that she normally checks the patient's medications for allergies and other medications.
  - RN confirmed that she is familiar with the facility's antibiotic stewardship protocol, and normally looks at the patient's medication and the culture for sensitivity.

881: Program deficiency, not only about antibiotic choice

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NHSN Annual Facility Survey

This yearly survey is required to be completed by Long-Term Care Facilities which report Healthcare Associated Infections (HAIs).

- Survey responses are self-reported by the facility and can be used as a guide to improve the stewardship program within the facility.
  - Questions follow the CDC's Core Elements closely and may provide ideas for how to strengthen specific parts of you stewardship program.

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NHSN Annual Facility Survey

*39. Our facility has a policy or formal procedure for other interventions to ensure optimal use of antibiotics: (Check all that apply.)

- ☐ Early administration of effective antibiotics to optimize the treatment of sepsis
- ☐ Treatment protocols for *Staphylococcus aureus* bloodstream infection
- ☐ Stopping unnecessary antibiotic(s) in new cases of *Clostridioides difficile* infection (CDI)
- ☐ Review of culture-proven invasive (for example, bloodstream) infections
- ☐ Review of planned outpatient parenteral antibiotic therapy (OPAT)
- ☐ The treating team to review antibiotics 48-72 hours after initial order (specifically, antibiotic time-out)
- ☐ Assess and clarify documented penicillin allergy
- ☐ Using the shortest effective duration of antibiotics at discharge for common clinical conditions (for example, community-acquired pneumonia, urinary tract infection, skin and soft tissue infections)
- ☐ None of the above

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NHSN Annual Facility Survey

*40. Our facility has in place the following specific 'pharmacy-based' interventions: (Check all that apply)

- ☐ Pharmacy-driven changes from intravenous to oral antibiotics without a physician's order (for example, hospital-approved protocol)
- ☐ Alerts to providers about potentially duplicative antibiotic spectra (for example, multiple antibiotics to treat anaerobes)
- ☐ Automatic antibiotic stop orders in specific situations (for example, surgical prophylaxis)
- ☐ None of the above

*42. Our stewardship program monitors: (Check all that apply.)

- ☐ Antibiotic resistance patterns (either facility- or region-specific), at least annually
- ☐ *Clostridioides difficile* infections (or *C. difficile* LabID events), at least annually
- ☐ Antibiotic use in days of therapy (DOT) per 1000 patient days or days present, at least quarterly
- ☐ Antibiotic use in defined daily doses (DDD) per 1000 patient days, at least quarterly
- ☐ Antibiotic expenditures (specifically, purchasing costs), at least quarterly
- ☐ Antibiotic use in some other way, at least annually (specify): _____
- ☐ None of the above

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Quality Improvement

CMS - "Quality improvement seeks to standardize processes and structure to reduce variation, achieve predictable results, and improve outcomes for patients, healthcare systems, and organizations."

1. **Plan**: Identify the area for improvement and its root causes. Set specific goals which will help achieve this desired improvement in services and how and when you will measure these goals.
2. **Do**: Execute your plan. Monitor the effect. Adjust as needed.
3. **Study**: Review the results. Did you achieve your goals? What did you learn from the implementation of this plan?
4. **Act**: Take what you learned during this process and apply it to practice/policies/etc.

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Mississippi

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