UNIVERSITY of MARYLAND
SCHOOL OF PHARMACY

UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE

Microbiology, Antibiograms and Anti-Infective Basics 101

Kimberly Claeys, PharmD

Emily Heil, PharmD

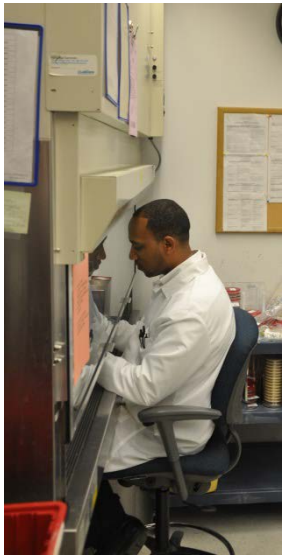
J. Kristie Johnson, PhD

Objectives

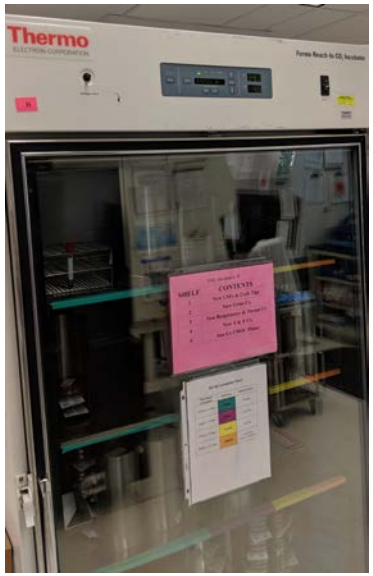
1. Describe antibiotic spectrum of activity and clinical application of agents commonly used in long-term care
2. Demonstrate an understanding of basic principles of microbiology with respect to organisms most commonly encountered in long-term care
3. Identify key elements and interpret antibiograms and microbiology lab reports

The Clinical Microbiology Laboratory: a Fundamental Resource

Urine samples are sent to the microbiology laboratory

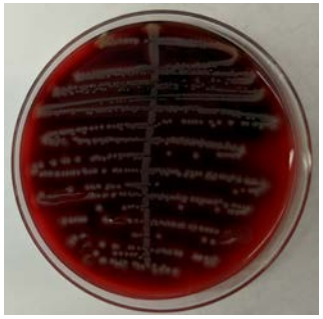


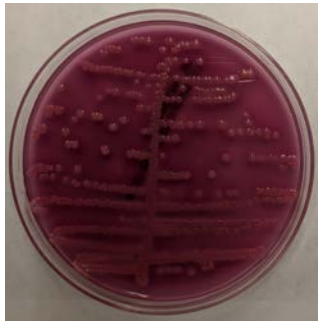
Urine samples are plated onto media for bacterial pathogens in a biological safety hood



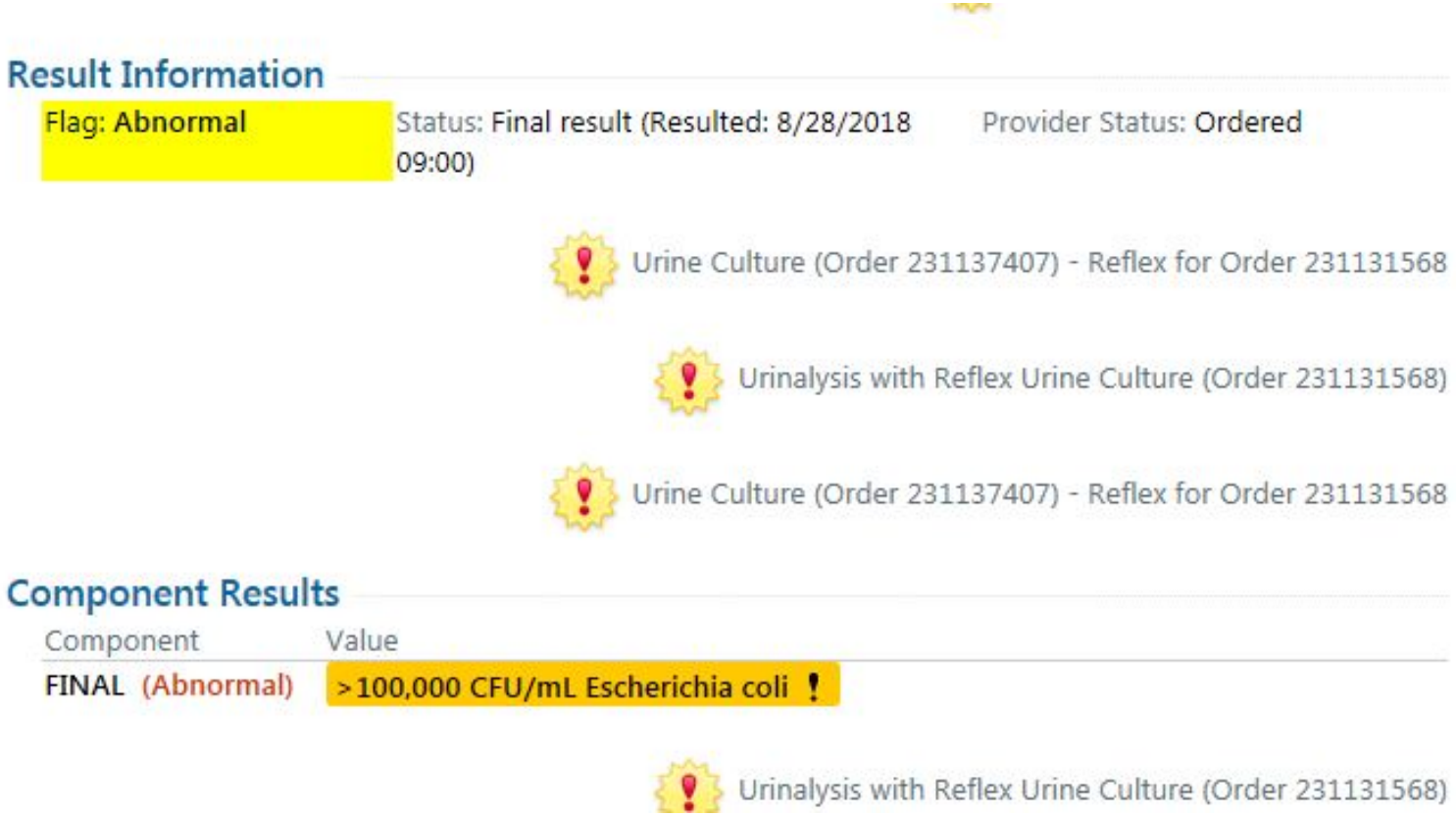
Plates are incubated overnight

After incubation, plates are examined for bacterial pathogens





Report


Result Information
Flag: Abnormal
Status: Final result (Resulted: 8/28/2018 09:00)
Provider Status: Ordered
Urine Culture (Order 231137407) - Reflex for Order 231131568
Urinalysis with Reflex Urine Culture (Order 231131568)
Urine Culture (Order 231137407) - Reflex for Order 231131568
Component Results
Component
Value
FINAL (Abnormal)
>100,000 CFU/mL Escherichia coli
Urinalysis with Reflex Urine Culture (Order 231131568)

Susceptibility Results

Escherichia coli	Results
Aztreonam	Resistant
Ceftriaxone	Resistant
Cefepime	Sensitive
Cefazolin	Resistant
Ciprofloxacin	Resistant
Nitrofurantoin	Resistant
Meropenem	Sensitive
Piperacillin-tazobactam	Resistant
Tetracycline	Resistant
Sulfamethoxazole/Trimethoprim	Resistant

Old is New Again-Fosfomycin

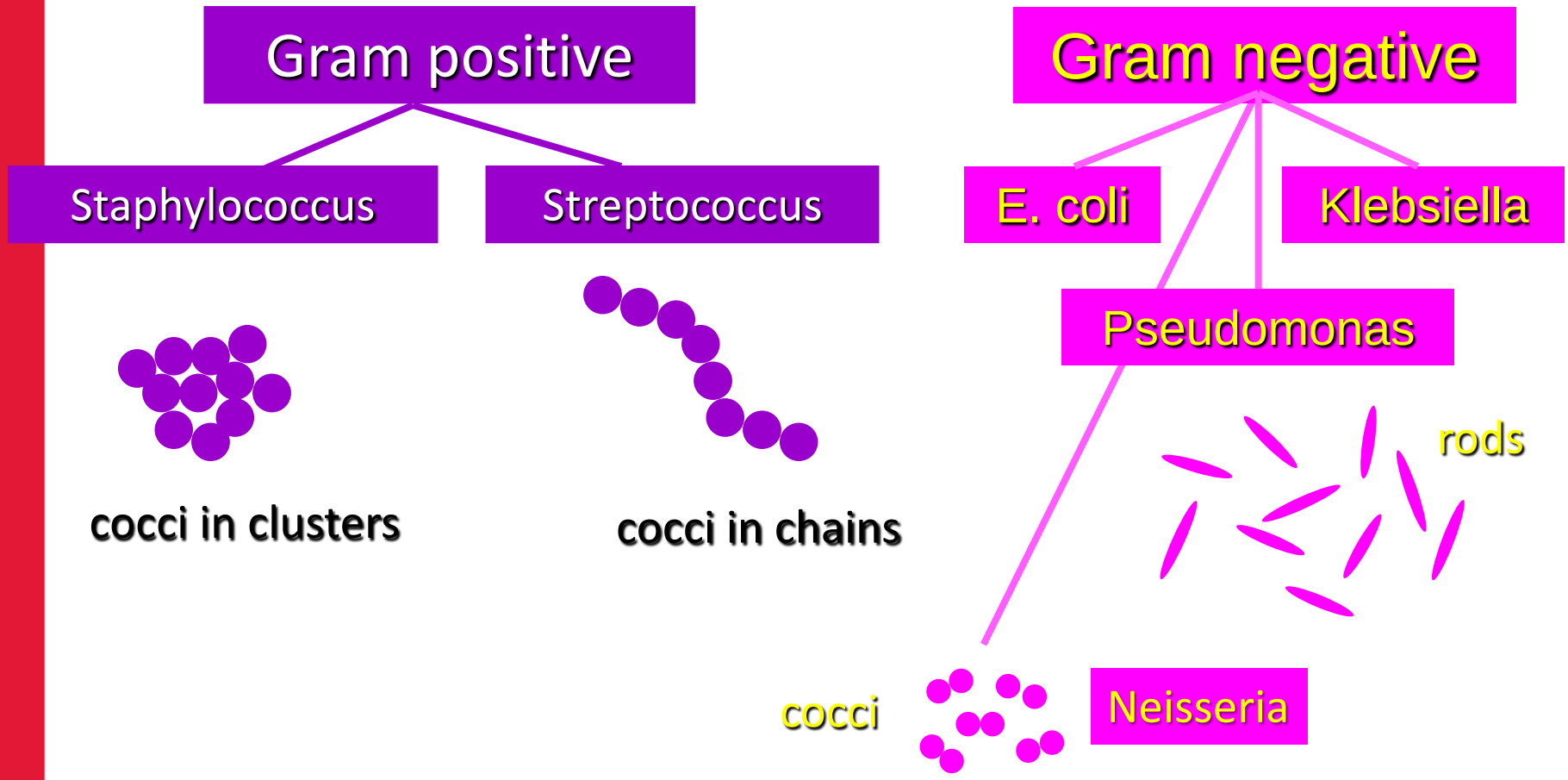
- Breakpoints for 2 organisms only
- Agar dilution or disk diffusion only
- Agar media supplemented with 25 µg/ml of glucose-6-phosphate.

	MIC			DISK		
	S	I	R	S	I	R
E. coli	≤64	128	≥256	≥16	13-15	≤12
Enterococcus faecalis	≤64	128	≥256	≥16	13-15	≤12

CLSI approved adding that *Enterobacteriaceae* other than *E. coli* should not be tested because the test is unreliable.

FosA degradation of fosfomycin

Gram Reactions for Select Bacteria



ESKAPE Bugs

***E*nterococcus faecium (VRE)**
***S*taphylococcus aureus (MRSA)**
***K*lebsiella pneumoniae**
***A*cinetobacter baumannii**
***P*seudomonas aeruginosa**
***E*nterobacter spp.**

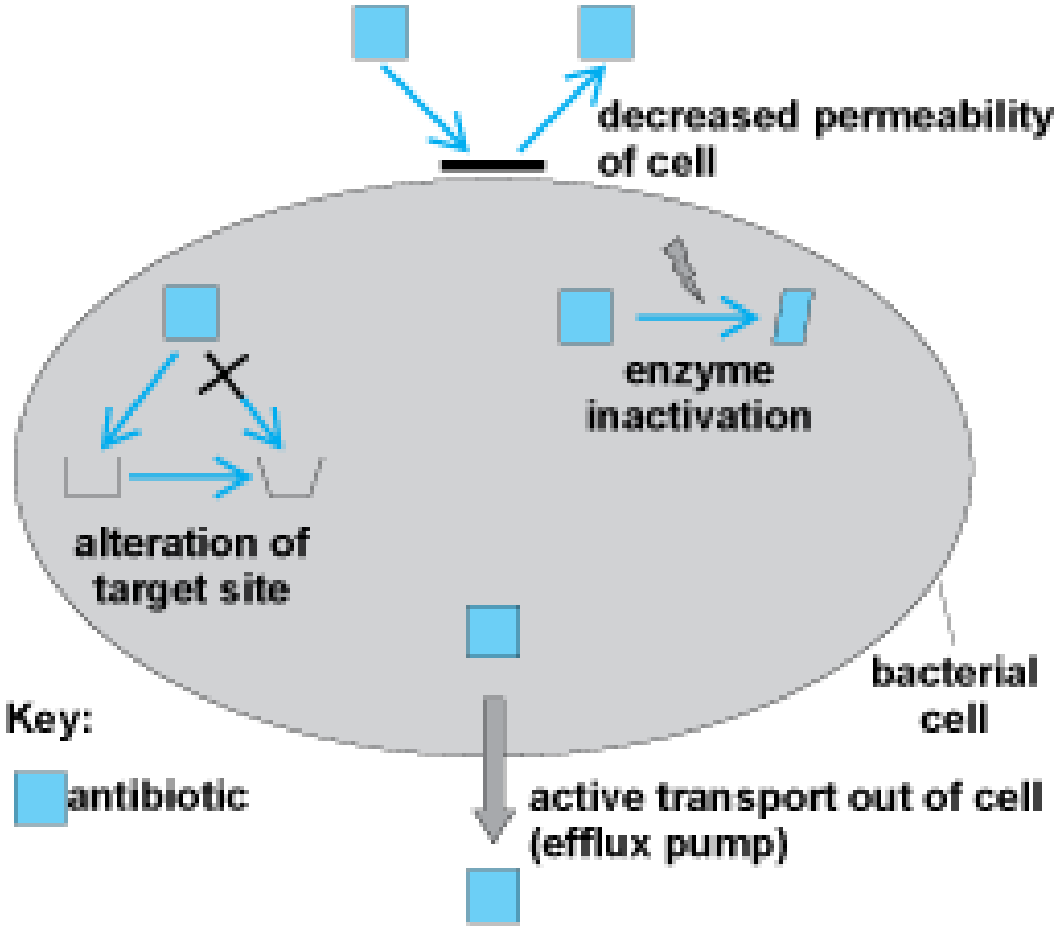
"…extraordinarily important, not only because they cause the lion's share of nosocomial infections but also because they represent paradigms of pathogenesis, transmission and resistance."

Cause majority of hospital infections
Escape the effects of antibiotics
Increase morbidity and mortality
Increase LOS

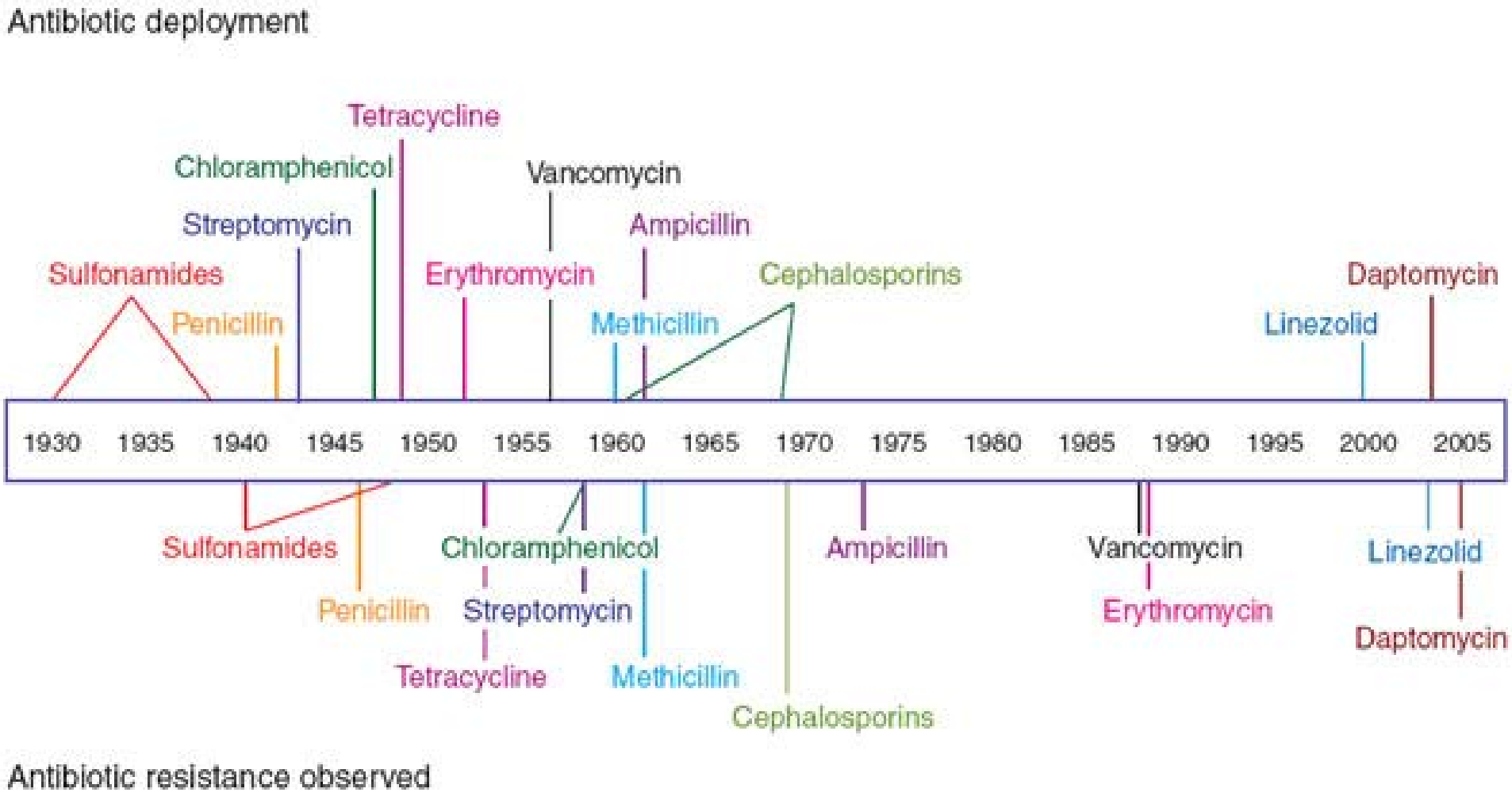
Rice, JID 2009

Mechanisms of Resistance
How I like to think about it!

- Avoid it
- Inactivate it
- Change it



Rates of Antibiotic Resistance



Nature Chemical Biology 3:541, 2007

Resistant Gram-negative Bacteria: Importance of Long-term care facilities

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY DECEMBER 2012, VOL. 33, NO. 12

ORIGINAL ARTICLE

Transfer from High-Acuity Long-Term Care Facilities Is Associated with Carriage of *Klebsiella pneumoniae* Carbapenemase–Producing *Enterobacteriaceae*: A Multihospital Study

Kavitha Prabaker, MD;[1,2] Michael Y. Lin, MD, MPH;[1] Margaret McNally, RN, BSN, PCCN;[3] Kartikeya Cherabuddi, MD;[4] Sana Ahmed, MD;[5] Andrea Norris, DO;[5] Karen Lolans, BS;[1] Ruba Odeh, DO;[5] Vishnu Chundi, MD;[6] Robert A. Weinstein, MD;[1,2] Mary K. Hayden, MD[1] for the Centers for Disease Control and Prevention (CDC) Prevention Epicenters Program

MAJOR ARTICLE

The Importance of Long-term Acute Care Hospitals in the Regional Epidemiology of *Klebsiella pneumoniae* Carbapenemase–Producing Enterobacteriaceae

Michael Y. Lin,[1] Rosie D. Lyles-Banks,[2] Karen Lolans,[3] David W. Hines,[4] Joel B. Spear,[5] Russell Petrak,[4] William E. Trick,[1,2] Robert A. Weinstein,[1,2] and Mary K. Hayden;[1,3] for the Centers for Disease Control and Prevention Epicenters Program

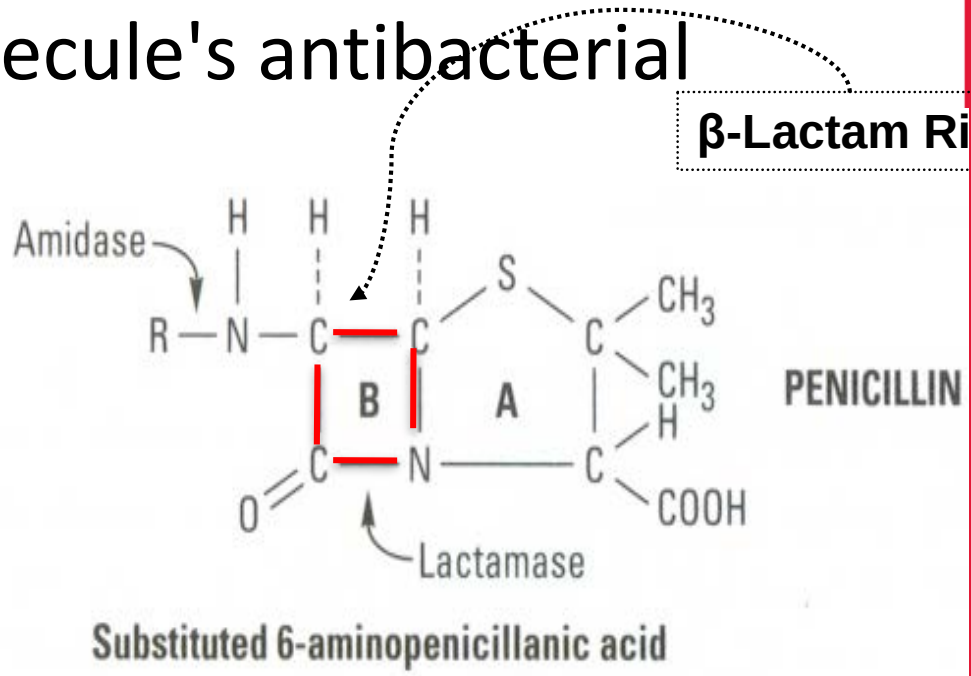
[1]Department of Medicine, Rush University Medical Center, [2]Department of Medicine, Cook County Health and Hospitals System, and [3]Department of Pathology, Rush University Medical Center, Chicago; [4]Metro Infectious Diseases Consultants, LLC, Burr Ridge; and [5]Department of Medicine, St Joseph Hospital, Chicago, Illinois

Mechanisms of β-lactam Resistance for Gram-Negative Bacteria

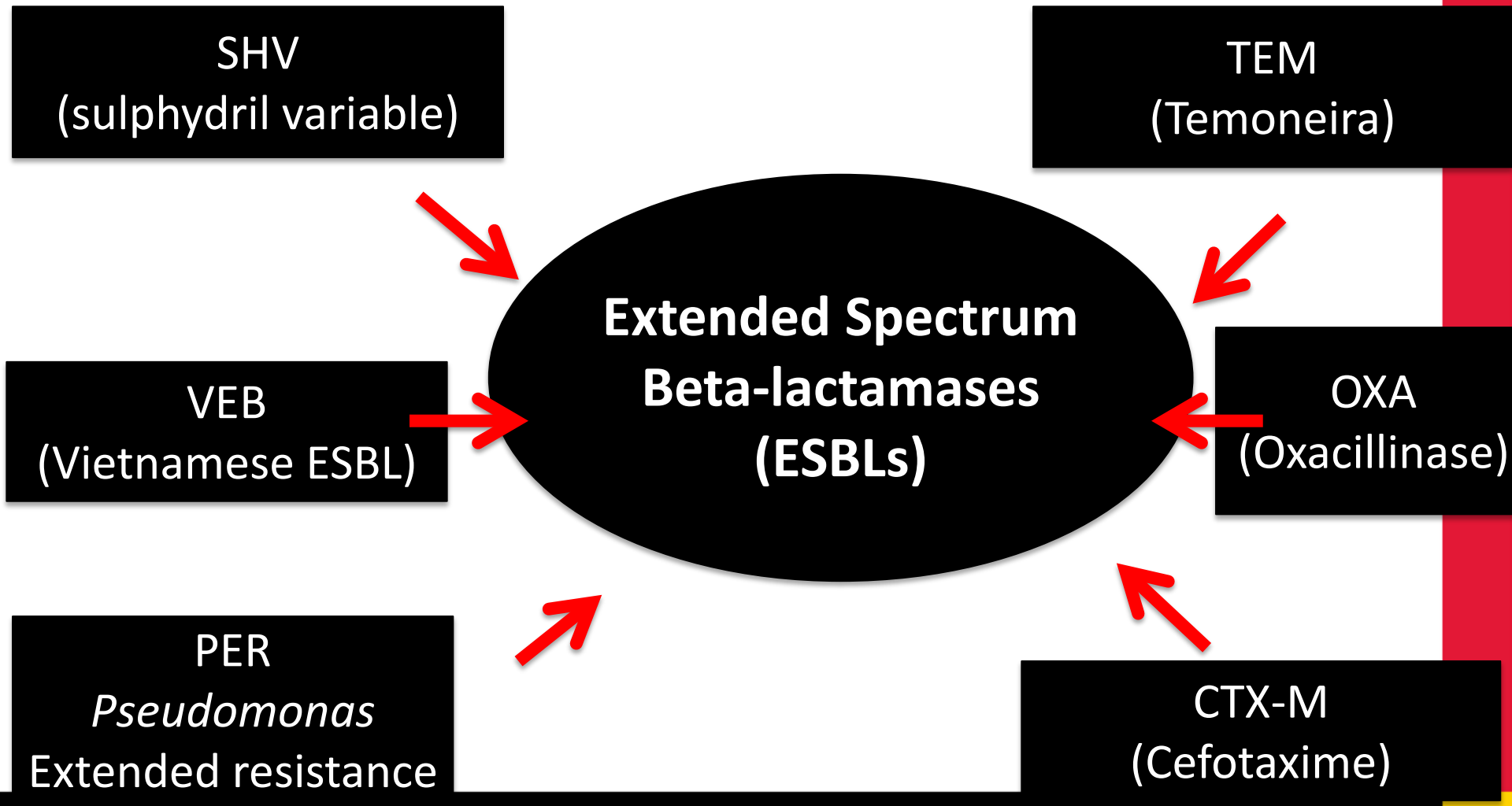
- **β-lactamases**
  - **Extended spectrum β-lactamases**
  - **Plasmid-mediated AmpC**
  - **Carbapenemases**
- Efflux
- Porin

β-lactamase

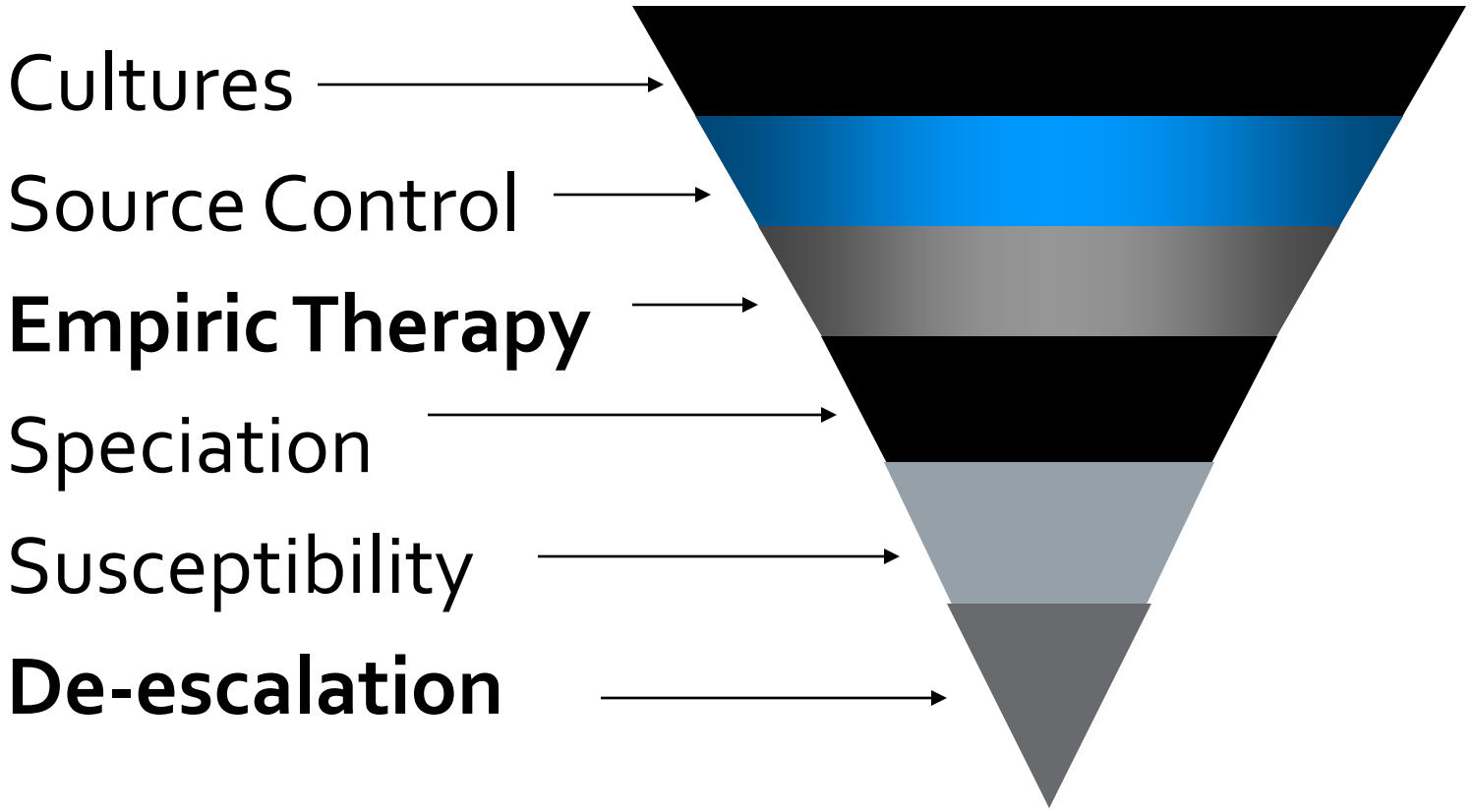
- Enzyme produced that hydrolyzes the ß-lactam ring
- Enzyme breaks the β-lactam ring open, deactivating the molecule's antibacterial properties.
- Differ based on antibiotic



Extended Spectrum Cephalosporin-Resistant Gram-Negative Bacteria



Appropriate Antibiotic Management



Common Bacteria by Site of Infection

Mouth	**Skin / Soft Tissue**	**Abdomen**
Peptococcus *Peptostreptococcus* *Actinomyces*	*S aureus* *S pyogenes* *S epidermidis*	*E. coli* *Proteus* *Klebsiella* *Enterococcus* *Bacteroides*
Urinary Tract *E. coli* *Proteus* *Klebsiella* *Enterococcus* *Staph saprophyticus*	**Bone & Joint** *S. aureus* *S. epidermidis* *Streptococci* *N. gonorrhoeae* Gram negative bacilli	**Upper Respiratory** *S pneumoniae* *H influenza* *M catarrhalis* *S pyogenes*
Meningitis *S pneumoniae* *N meningitidis* *H influenza* *Group B strep* *E coli* *Listeria*	**Lower Respiratory (CAP)** *S pneumoniae* *H influenza* *K pneumoniae* *Legionella pneumophilia* *Mycoplasma* *Chlamydia*	**Lower Respiratory (HAP)** *P aeruginosa* *Enterobacter* *Serratia* *S aureus* *Acinetobacter*

Oral Antibiotics That Cover Enteric GNRs

Guideline Recommended

Cystitis Only	Pyelonephritis/Complicated UTI
• Nitrofurantoin • Fosfomycin	• Sulfamethoxazole/Trimethoprim • Fluoroquinolones (Cipro, Levo, NOT moxi)

Alternates

- Amoxicillin/Clavulanate
- 3rd Generation PO cephalosporins (e.g., cefpodoxime, cefdinir)

Clin Infect Dis. 2011;52(5):e103-e120.

Urinary antibiotics

Nitrofurantoin	Fosfomycin

• Activity: *S. saprophyticus, Enterococci, E.coli, Klebsiella, Proteus*
• Duration 5-7 days
• Adverse Drug Effects
  • GI: Take w/ food
  • Pulmonary fibrosis (rare, with prolonged use)
  • Peripheral neuropathy (rare)
• Contraindicated for use with CrCl <50 mL/min (inadequate urinary concentrations and/or increased ADRs although recently refuted)
• Beer's list avoid for long term prophylaxis use or in patients with reduced renal function
	• Activity: Enterococci (inc VRE), *E.coli, Pseudomonas, Serratia, Citrobacter, Klebsiella, Proteus*
	• 3g PO x 1 (uncomplicated), 3g PO every 3 days x3 doses (complicated)
	• Adverse Drug Effects
	  • Headache
	  • Diarrhea (Take w/ food)
	  • Hypokalemia
	• Last choice of first line options
	• $$$ compared to other first line options

Fluoroquinolones

Agents	Spectrum of Activity	Comments
Ciprofloxacin (Cipro®) **Levofloxacin (Levaquin®)** **Moxifloxacin (Avelox®)** **Delafloxacin (Baxdela®)** **All PO and IV**	Cipro: Good enteric gram negatives, *H. influenzae*, moderate *Pseudomonas*, atypicals, poor *S. pneumoniae*, anaerobes, enterococci Levo: Good enteric gram negatives, *S. pneumoniae, H. influenzae*, atypicals Moderate *Pseudomonas* No anaerobes, enterococci, MRSA Moxi – Similar to levo but with improved anaerobic coverage, poor *Pseudomonas* coverage Dela: Similar to levo but with MRSA coverage	Good bone penetration Good bioavailability Chelate cations – bioavailability decreased when administered with calcium, iron, antacids, milk, multivitamins, magnesium **Overprescribing has led to rising resistance** CYP450 drug interactions possible (especially with cipro) Contraindicated in pregnancy Relatively contraindicated in children All renally cleared except moxifloxacin (**moxifloxacin achieves poor urinary penetration and should not be used for UTI)** Cipro is not a “respiratory fluoroquinolone”

Trimethoprim/Sulfamethoxazole

Agents	Spectrum of Activity
Trimethoprim/Sulfamethoxazole IV and PO Bactrim DS® (or Septra DS) 800 mg SMX/160 mg TMP Bactrim SS® (or Septra SS) 400 mg SMX/80 mg TMP SMX:TMP is in a 5:1 ratio in all formulations	Good: *S.aureus* including MRSA, *H.influenzae, Stenotrophomonas maltophilia, Listeria, Pneumocystis jirovecii* Moderate: enteric Gram Negatives, *S. pneumoniae, Salmonella, Shigella,* Nocardia No: *Pseudomonas*, *S. pyogenes*, enterococci, anaerobes
Adverse Effects	**Comments**
Rash Stevens-Johnson syndrome Bone marrow suppression Crystalluria – recommended to take with a full glass of water Acute interstitial nephritis Trimethoprim causes hyperkalemia, especially at higher doses, elderly on ACEs/ARBs at higher risk	Dose is based on trimethoprim component Dose adjust for renal insufficiency Interacts with warfarin “Pseudo renal failure” – trimethoprim blocks creatinine secretion and can increase the SCr without changing GFR

Oral Beta-Lactams

Agents	Spectrum of Activity
Cephalosporins (PO) • Cefdinir • Cefpodoxime Aminopenicillin/Beta-lactamase inhibitor • Amoxicillin/Clavulanate	Good: *Streptococci, Enterococci* (except the cephalosporins!), Enteric GNRs
Adverse Effects	**Comments**
Rash/Hypersensitivity Reactions GI Upset Neutropenia (rare) Interstitial nephritis (rare)	Less effective than FQs or SMX-TMP for UTIs, longer course required

Fluoroquinolones

- QT_c interval prolongation
  - Risk increases with each increasing offender
- Phototoxicity/ Photosensitivity
  - Not as common wit… FQs
- Seizures
  - Prim… …n known seizur…
- Hypoglyce… /hyperglycemia
- Arthralgia, Achilles tendon rupture

- GI u…
  …ea, …dominal …ort, ***C. difficile*** **…ciated diarrhea**
- …: headache, dizziness, insomnia, tremor, confusion, psychosis
- Hepatotoxicity
- Peripheral neuropathy
- May exacerbate weakness of myasthenia gravis
- Cation interaction

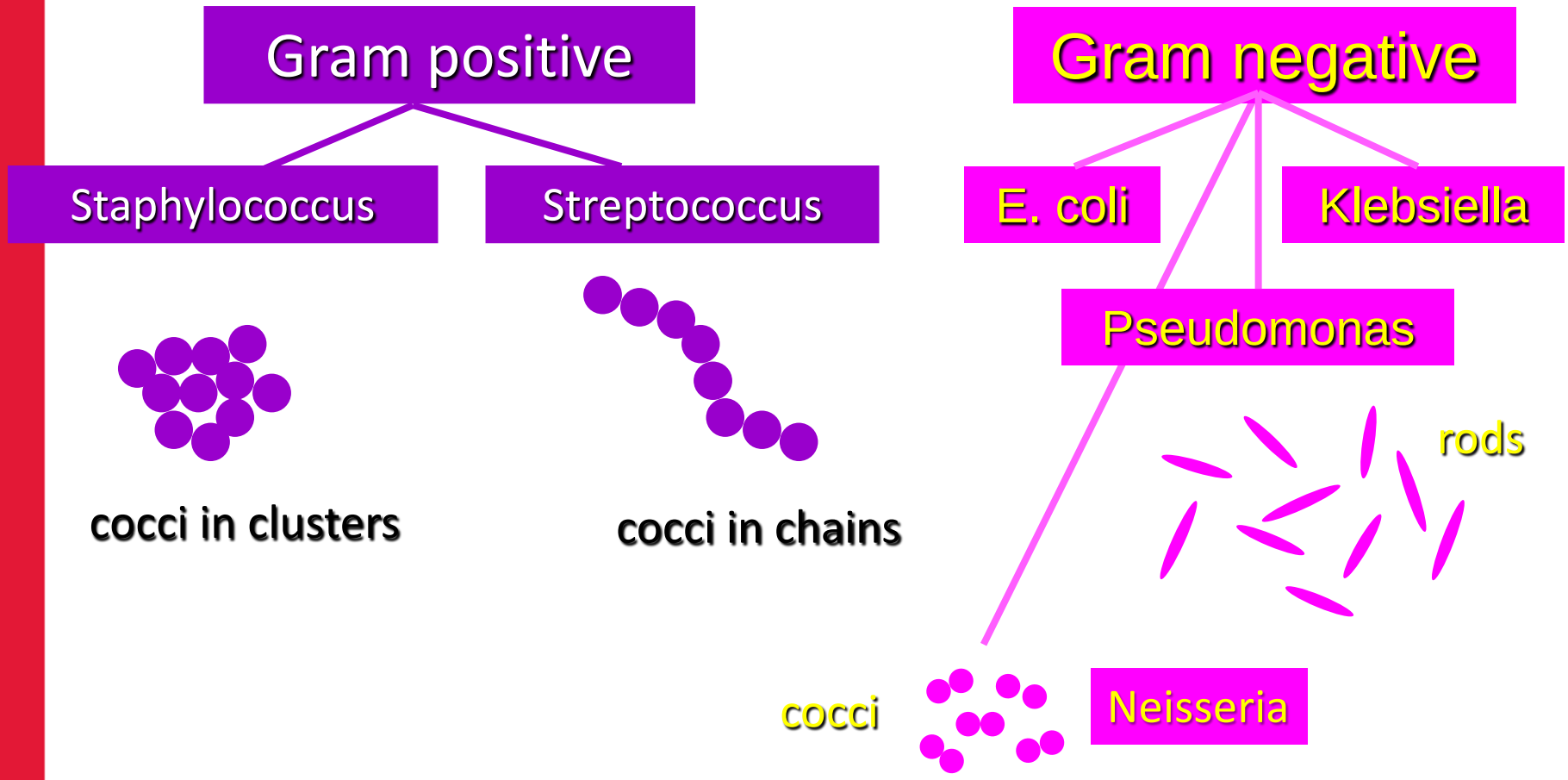
FDA: RISKS OUTWEIGH BENEFITS FOR UNCOMPLICATED UTI

Penicillin Allergies

- Approximately 1 in 10 people report a penicillin allergy, however <10% of these patients are actually allergic by penicillin skin testing
- Overall incidence of cross-reactivity with cephalosporins and carbapenems is low (<1% for later generation cephalosporins!)
- Beta-lactam ring + side chains contribute to cross-reactivity
- Beta-lactams with identical side chains should be avoided (e.g., avoid cephalexin in a patient with an amoxicillin allergy)

	Amoxicillin	Ampicillin	Cephalexin	Cefoxitin	Cefuroxime	Cefotaxime	Ceftazidime	Ceftriaxone	Cefepime
Amoxicillin		X	X						
Ampicillin	X		X						
Cephalexin	X	X							
Cefoxitin					X				
Cefuroxime				X					
Cefotaxime								X	X
Ceftazidime									
Ceftriaxone						X			X
Cefepime						X		X	

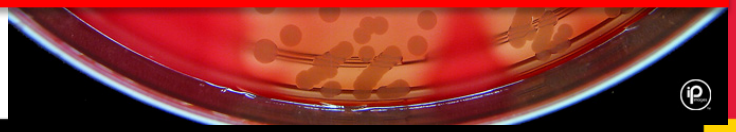
Gram Reactions for Select Bacteria



Staphylococcus aureus

-
-
-
-
-

Is it MRSA or MSSA?

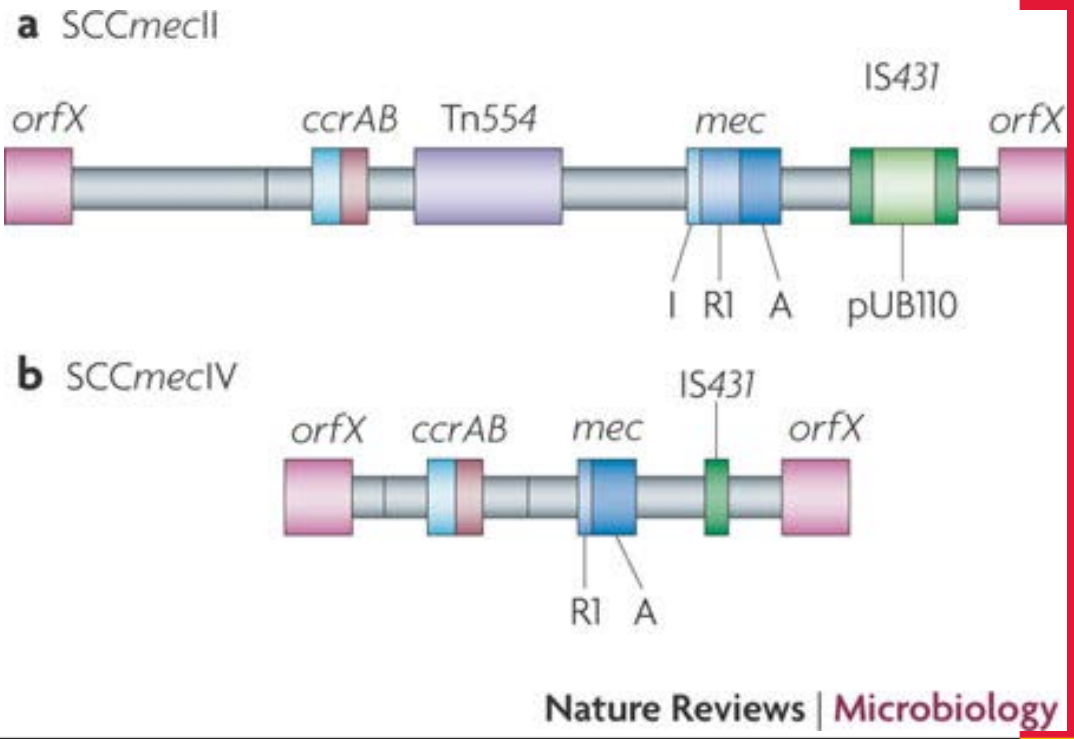


Mechanisms of MRSA

- Classic Resistance
  - mecA gene found in SCCmec
  - Chromosomally mediated
  - Altered PBP (penicillin binding protein) 2a
  - NOT due to β-lactamase inactivation

Staphylococcal Cassette Chromosomal (SCCmec)

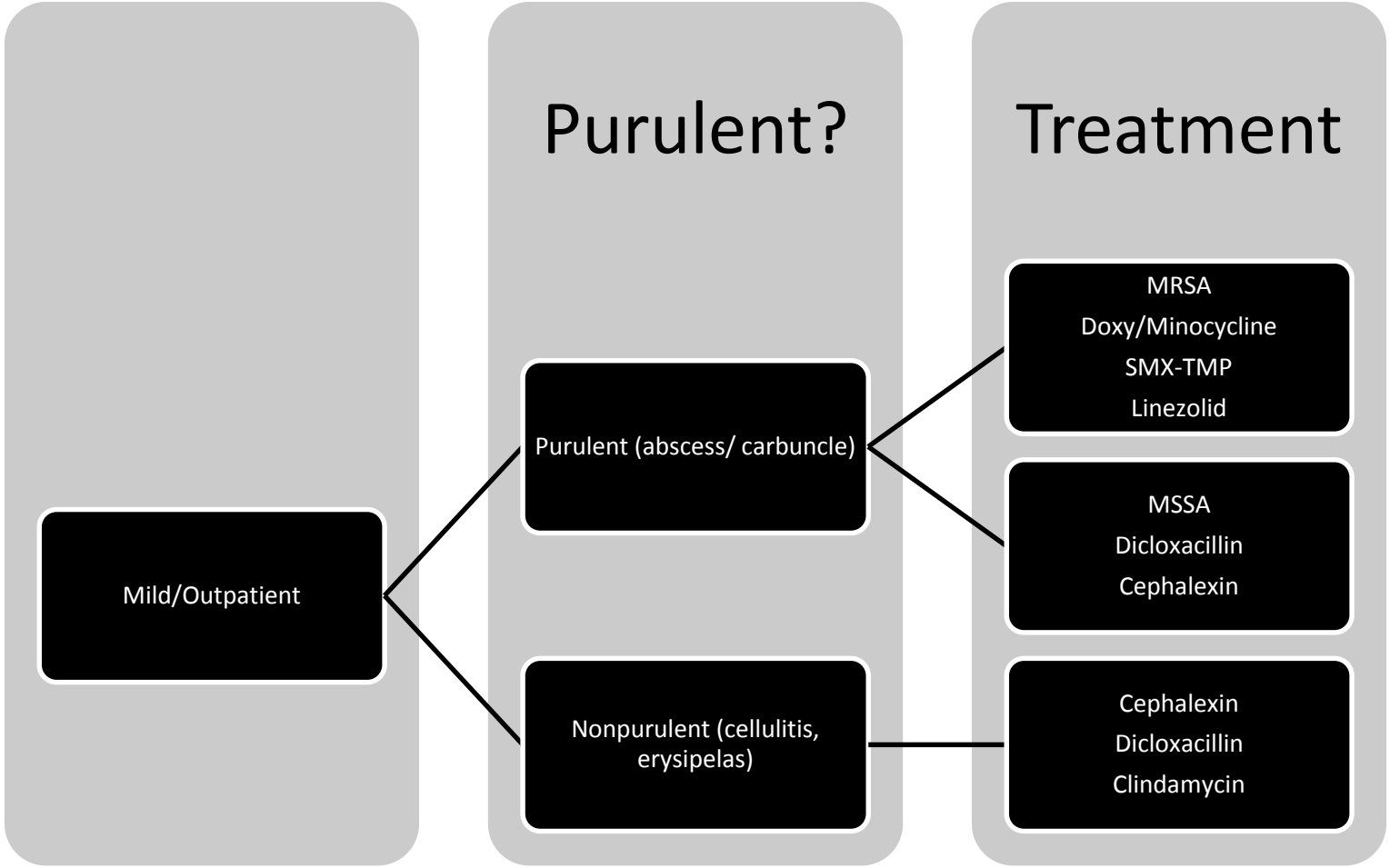
- To date there are 11
- Includes mecA
  - mecA dropouts
- SCCmec typing



Susceptibility Results

Staphylococcus aureus	**Results**
Ampicillin	Resistant
Ciprofloxacin	Resistant
Clindamycin	Sensitive
Cefazolin	Resistant
Daptomycin	Sensitive
Doxycycline	Sensitive
Erythromycin	Sensitive
Gentamicin	Resistant
Linezolid	Sensitive
Oxacillin	Resistant
Rifampin	Resistant
Tigecycline	Sensitive
Vancomycin	Sensitive

Skin and Soft Tissue Infections



Oral Antibiotics for Gram Positives

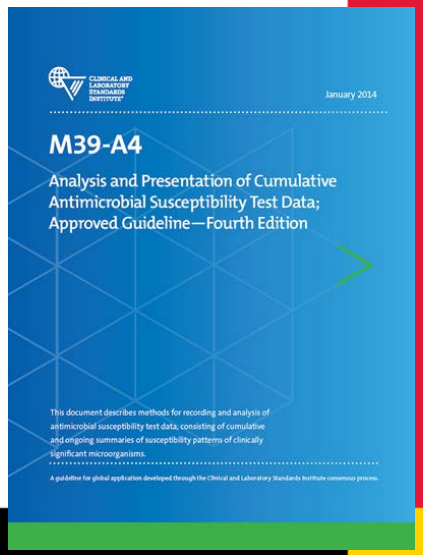
Doxycycline/Minocycline	**Cephalexin, Dicloxacillin**
• Spectrum: Staphylococci (including MRSA), moderate Streptococci (increasing resistance), atypicals, rickettsial diseases • ADEs: GI upset, photosensitivity, esophageal irritation, vertigo (mino) • Administration: Take with food, separate from cations	• Spectrum: *Streptococci,* MSSA • Generally well tolerated • ADEs: Hypersensitivity • Frequent dosing (q8h for cephalexin, q6h for dicloxacillin)
Linezolid	**Clindamycin**
• Spectrum: MRSA/MSSA, Streptococci, VRE • ADEs: bone marrow suppression, peripheral neuropathy (longer durations) • MAOi – Interactions with serotonergic agents • Generic but $$ compared to others	• Spectrum: Streptococci, Staphylococci (increasing resistance with MRSA), GP anaerobes • ADEs: Diarrhea, *C.difficile* infection • Frequent dosing (q8h)

UNIVERSITY of MARYLAND
SCHOOL OF PHARMACY

What tools are available for the selection of empiric therapy?

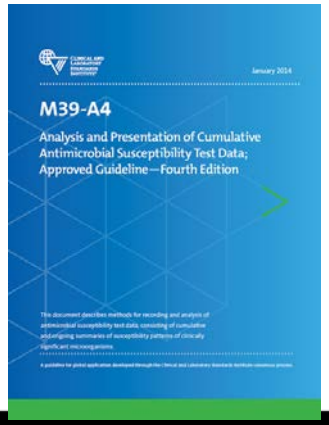
Cumulative Antimicrobial Susceptibility Test data (AKA: Antibiogram)

- A report generated by analysis of results on isolates that reflects the percentage of the first isolate per patient of a given species that is susceptible to each antimicrobial agent routinely tested
- Primary aim of guiding clinicians in the selection of initial empirical antimicrobial therapy for infections
- Guidelines for creating an antibiogram



Recommendations
Preparation of Cumulative Antibiogram

- Analyze/present data at least **annually**
- Include only species with **≥ 30** isolates of each species
- Include **diagnostic** (not surveillance) isolates
- Include the **1st isolate/patient**; no duplicate patient isolates



Often difficult to get 30 isolates in LTCFs

Antibiograms

- Who makes them?
  - Microbiologist
  - Pharmacist
  - Infection control practitioner
- Who uses them?
  - Clinician
  - Pharmacist
  - Infection control practitioner

Appendix E1. Cumulative Antimicrobial Susceptibility Report Example – Antimicrobial Agents Listed Alphabetically (Hypothetical Data)

Memorial Medical Center
1 January – 31 December 2012 Cumulative Antimicrobial Susceptibility Report*
Percent Susceptible

Gram-Negative Organisms	No. Strains	Amikacin	Ampicillin	Cefazolin	Cefotaxime	Ceftazidime	Ciprofloxacin	Nitrofurantoin†	Gentamicin	Meropenem	Piperacillin-tazobactam	Trimethoprim-sulfamethoxazole	Tobramycin
Acinetobacter baumannii	32	80	R	R	34	52	51	–‡	60	80	46	58	59
Citrobacter freundii	49	100	R	R	72	67	90	78	100	99	67	67	100
Enterobacter aerogenes	31	100	R	R	68	69	92	85	91	99	74	95	91
Enterobacter cloacae	76	99	R	R	61	62	92	81	90	99	77	84	90
Escherichia coli	1433	99	36	68	96	94	72	98	91	99	51	65	92
Klebsiella pneumoniae	543	99	R	72	91	92	84	74	94	95	86	81	94
Morganella morganii	44	100	R	R	85	81	99	R	100	99	64	75	100
Proteus mirabilis	88	100	87	80	99	99	89	R	90	100	70	73	93
Pseudomonas aeruginosa	397	97											
Salmonella spp.	32	–											
Serratia marcescens	50	10											
Shigella spp.	33	–											
Stenotrophomonas maltophilia	72	R	R	R	R	63	6	R	R	R	–	98	R

* The percent susceptible for each organism/antimicrobial combination was generated by including the first isolate of that organism encountered on a given patient.
† Nitrofurantoin data from testing urine isolates only.
‡ (–) drug not tested or drug not indicated.
Abbreviations: No., number; R, intrinsic resistance.

"Routine" Cumulative antibiogram
Generally…all isolates from a facility

CLSI M39-A4

Antibiogram Challenges in Long-Term Care

- Long-term care facilities have unique challenges when developing antibiograms
  - Facility with small number of patients
  - Limited number of diagnostic isolates
  - Working with multiple laboratories
  - Lack of electronic medical records

Antibiogram Challenges in Long-Term Care

1. Extending antibiogram beyond one year
2. Creating regional antibiogram
3. Using antibiogram from nearby hospital
4. Collapse antibiogram information

Extending Antibiogram Beyond One Year

- CLSI M39 promote approach of extending data longer than 1 year to overcome low numbers of isolates
  - Technically easiest to operationalize
- More accurate susceptibility of extended time period
- May not capture changes in resistance patterns over time

Clinical and Laboratory Standards Institute (CLSI). (Approved guideline M39–A4)4th ed. CLSI, Wayne, PA; 2014

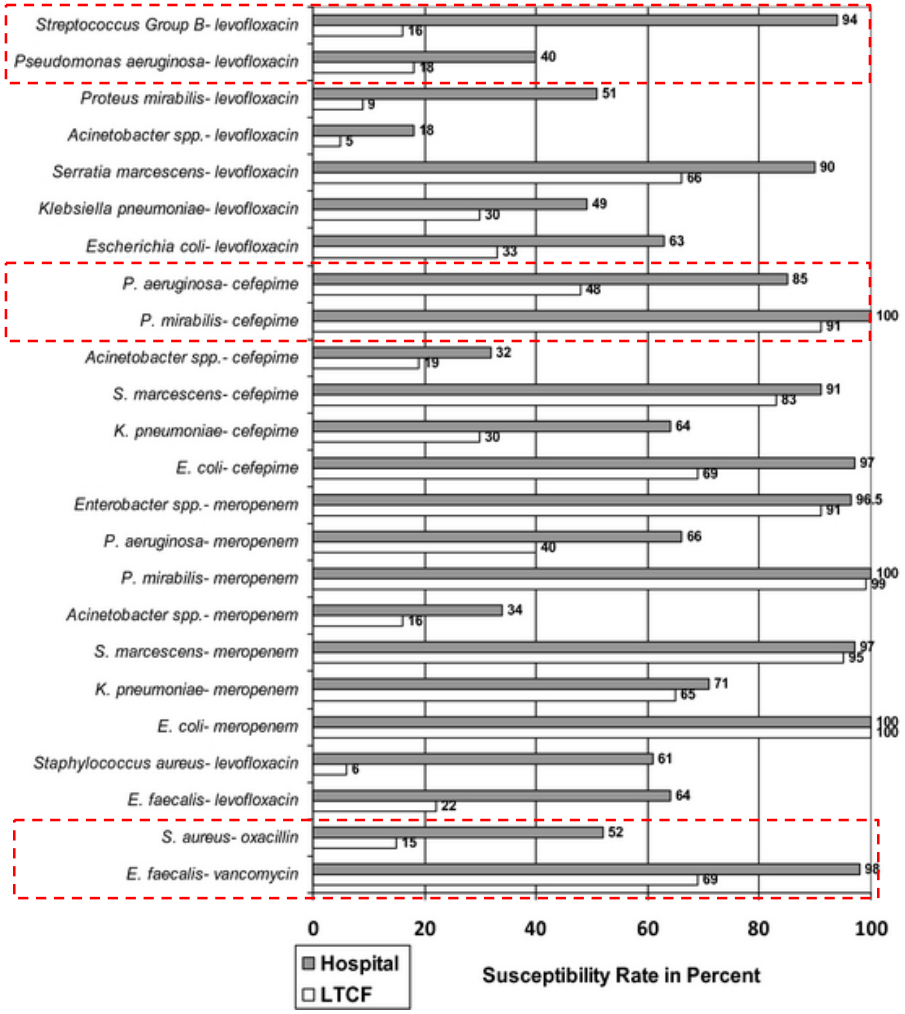
Creating Regional Antibiogram

- Antibiogram data from 13 hospitals combined
  - 12 community hospitals; 1 central tertiary care referral hospital
- Overall, similar rates of resistance among common organisms
  - Oxacillin resistant *S. aureus*: 51% to 58%
  - Vancomycin resistant *E. faecium*: 75%
  - Ampicillin/sulbactam resistant *E. coli*: 48% to 56%
- Significant differences in methodology, interpretation and antibiotic panels used by area laboratories

Var SK et al. *Ann Clin Microbiol Antimicrob*. Apr 9;14:22.

Using Antibiogram from Nearby Hospital

- Antibiogram of isolates from LTCF residents generated
- Compare susceptibilities to local acute care
- Resistance more common on LTCF
- Widest disparities
  - Levofloxacin
  - Meropenem
  - Cefepime



Kindschuh W et al. *J AM Geriatr Soc* 2012 Apr;60(4):798-800.

Collapse Antibiogram Information

- Grouping similar organisms
- Consider grouping by specimen site (i.e. urine)
- Limitation that some bacteria in similar groups may have intrinsic resistance

Organism	# isolates	Amox/Clav	Cefazolin	Ceftriaxone	Ciprofloxacin	TMP/SMX	Nitrofurantoin
Urinary Gram-negatives	127	84	74	82	67	85	99

Escherichia coli, *Klebsiella pneumoniae*, and *Proteus mirabilis*

Antibiogram Challenges in Long-Term Care

Approach	Advantages/Disadvantages
Extending the antibiogram data beyond 1 year	• Technically simple/easy to crate • Resistance patterns may change from year to year
Creating a regional antibiogram	• Helpful if residents access facilities throughout the region • Requires coordination between multiple laboratories and facilities
Using antibiograms of nearby hospitals	• Antibiograms already annually made by hospitals • Bacteria that infect LTCF residents may not have similar antimicrobial susceptibilities to those of the hospital population
Collapsed antibiograms	• Help guide infection-specific antibiotic choices • Intrinsic resistance of some bacteria to specific antibiotics would not be listed

Incorporating Antibiogram Information

- Antibiograms help guide antibiotic choices before patient specific culture/susceptibility information is available
- Guide initial *empiric* therapy recommendations

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY OCTOBER 2014, VOL. 35, NO. S3

ORIGINAL ARTICLE

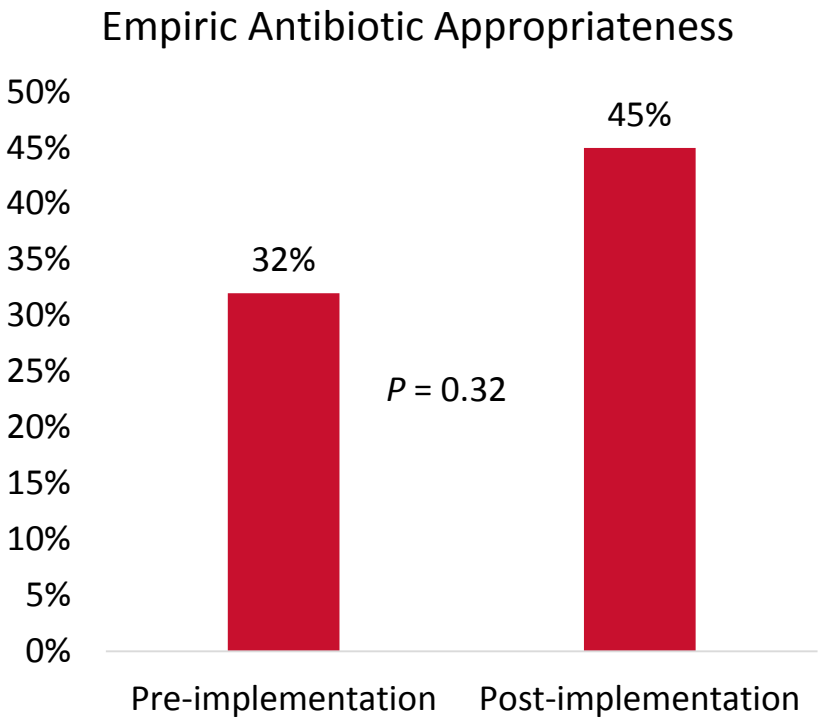
Using Antibiograms to Improve Antibiotic Prescribing in Skilled Nursing Facilities

Jon P. Furuno, PhD;[1] Angela C. Comer, MPH;[2,3] J. Kristie Johnson, PhD, D(ABMM);[2,4] Joseph H. Rosenberg, BS;[2]
Susan L. Moore, PhD, MSPH;[5] Thomas D. MacKenzie, MD, MSPH;[5] Kendall K. Hall, MD, MS;[6]
Jon Mark Hirshon, MD, MPH, PhD[2,3,7]

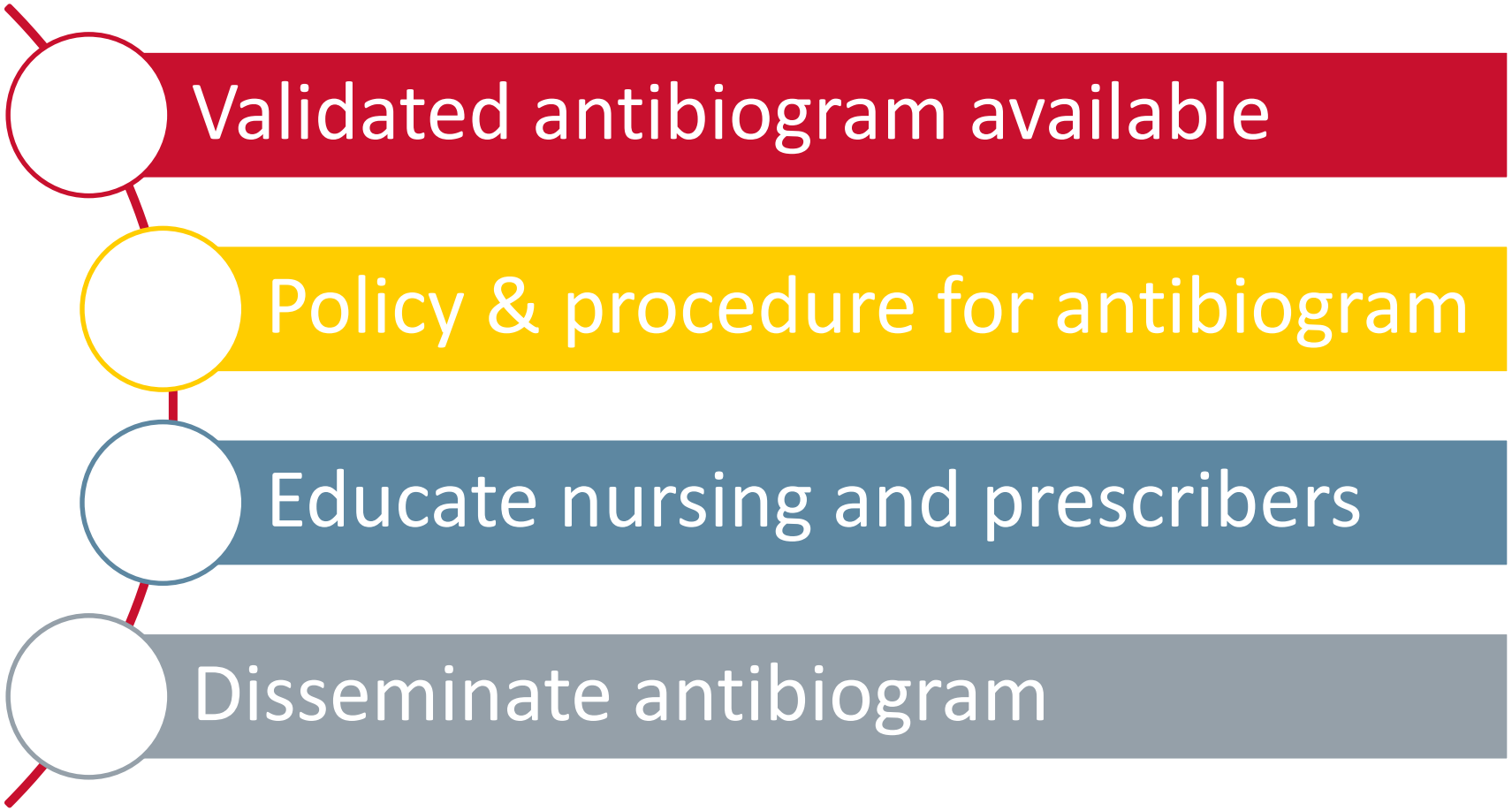
Using Antibiograms to Improve Antibiotic Prescribing in Skilled Nursing Facilities

- Quasi-experimental study of implementation of SNF-specific antibiograms at three facilities in Maryland

- Evaluate effectiveness through assessment of changes in empiric antibiotic prescribing (SNF 1, 118 beds)



Incorporating Antibiogram Information



Incorporating Antibiogram Information

- AHRQ Toolkit Phase 3: Implementation
  - Provides sample policies and procedures
  - Educational materials
  - Draft emails and communications
- https://www.ahrq.gov/nhguide/toolkits/help-clinicians-choose-the-right-antibiotic/toolkit3-develop-implement-antibiogram-program.html

Incorporating Antibiogram Information

Comprehensive Antibiogram Toolkit: Phase 3 Sample Policy

[NAME OF NURSING HOME]

RE: Antibiogram Program

[DATE]

Antibiotics are among the most commonly prescribed pharmaceuticals in long-term care settings, yet reports indicate that a high proportion of antibiotic prescriptions are inappropriate. The adverse consequences of inappropriate prescribing practices—including drug reactions/interactions, secondary complications, and the emergence of multidrug-resistant organisms—have become more common. Inappropriate prescribing practices by primary care clinicians and overuse of newer, broad-spectrum antibiotics when either no antibiotic or an older narrow-spectrum drug would suffice are believed to be the primary contributors to this problem. As a result of the above complexities, nursing homes increasingly are recognized as reservoirs of antibiotic-resistant bacteria.

Antibiograms aggregate information for an entire institution over a period of several months or a year. They display the organisms present in clinical specimens sent for laboratory testing and the susceptibility of each organism to an array of antibiotics. Use of antibiograms helps reduce reliance on broad-spectrum antibiotics as initial therapy and leads to fewer clinical failures of antibiotics that are first prescribed.

To improve appropriate antibiotic use for the residents at [NAME OF NURSING HOME], the antibiogram program will be implemented on [DATE]. A facility-specific antibiogram will be made available to all prescribing clinicians on [DATE], prior to implementation.

[NAME AND TITLE OF AUTHORIZING OFFICER] [DATE]

Comprehensive Antibiogram Toolkit: Phase 3 Sample Procedures[1]

[NURSING HOME NAME]

[DATE]

Purpose and Scope

This procedure covers the use of an antibiogram at [NURSING HOME NAME]. Antibiotics are among the most commonly prescribed pharmaceuticals in long-term-care settings, yet reports indicate that a high proportion of antibiotic prescriptions are inappropriate. The use of antibiograms can help reduce inappropriate prescribing and lead to fewer clinical failures of antibiotics that are first prescribed.

Responsibility for Implementing the Antibiogram

[IDENTIFY WHO WILL IMPLEMENT THE PROCEDURE]

Procedures [ADD DETAILS SPECFIC TO FACILITY]

1. Development of the initial and subsequent antibiograms
2. Initial and ongoing training for nurses
3. Introduction and ongoing communication with prescribers
4. Monitoring the use of the antibiogram

Documentation

[List any documents that will be used. Attach the antibiogram, training materials, and quality-improvement tracking documents.]

Records

[List any records that will be kept in conjunction with the program (for example, the infection-control log).]

[NAME AND TITLE OF AUTHORIZING OFFICER] [DATE]

https://www.ahrq.gov/nhguide/toolkits/help-clinicians-choose-the-right-antibiotic/toolkit3-develop-implement-antibiogram-program.html

Ways to Integrate Antibiogram Information

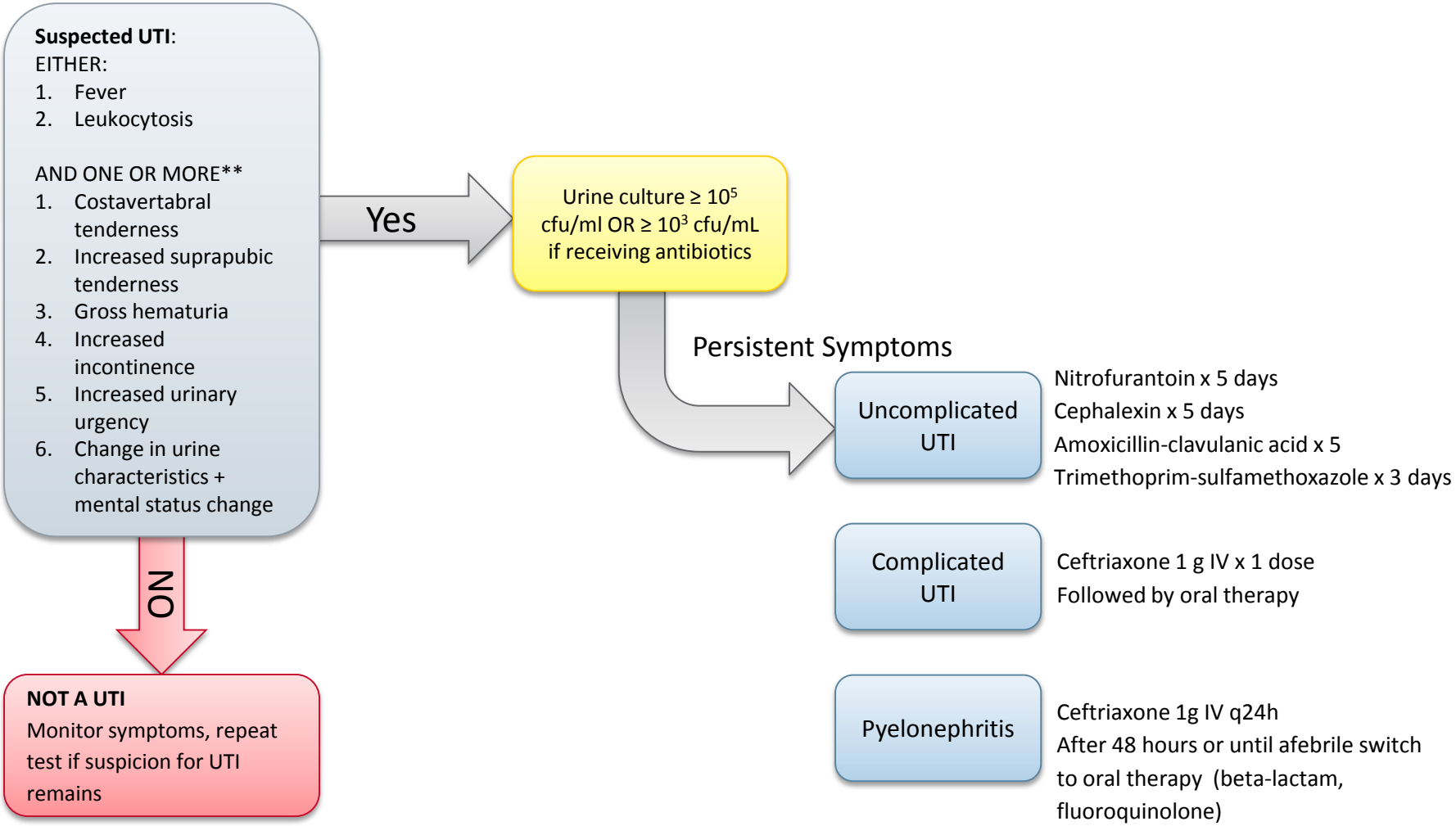
1. Development of facility-specific policies, procedures, and pathways
2. Changes in order-sets and/or clinical decision support services
3. Decisions regarding changes in formulary
4. Assessing resistance trends

Arizona Department of Health Services Antibiogram Toolkit.
https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/healthcare-associated-infection/advisory-committee/antimicrobial-stewardship/antibiogram-toolkit.pdf

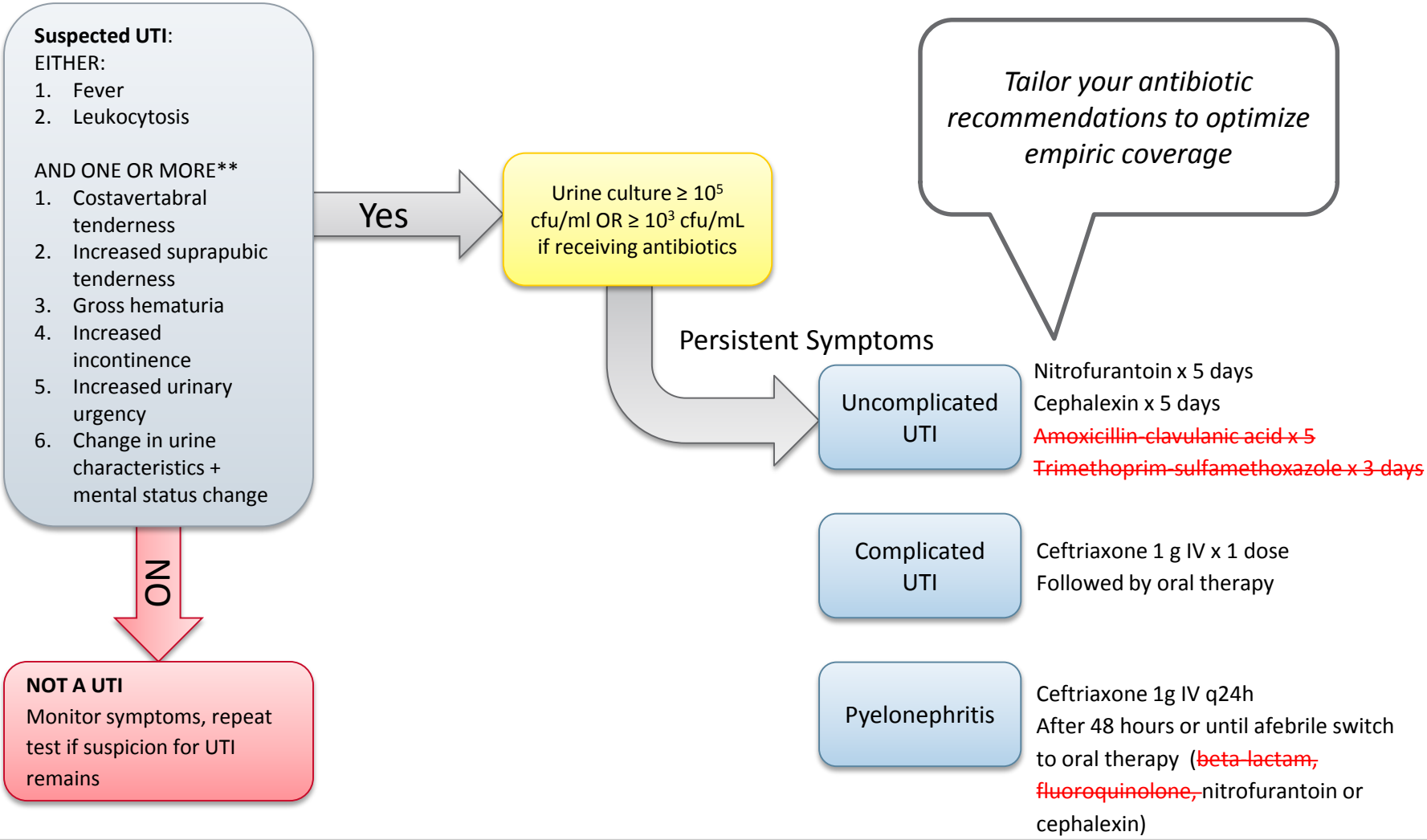
Ways to Integrate Antibiogram Information

- Important to incorporate local susceptibility information in facility policies/procedures
- Compare national guideline recs to antibiogram information
- Change recommended antibiotics in facility pathway based on antibiogram

Ways to Integrate Antibiogram Information



Ways to Integrate Antibiogram Information



Incorporating Antibiogram Information

- Once antibiogram information incorporated, continuous quality improvement important
- CMS State Operations Manual
  - Tracking of *C. difficile*, MRSA, CRE
  - Monitoring of antibiotic use
- More to come!!

UNIVERSITY of MARYLAND
SCHOOL OF PHARMACY

UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE

Microbiology, Antibiograms and Anti-Infective Basics 101

Kimberly Claeys, PharmD

Emily Heil, PharmD

J. Kristie Johnson, PhD