

Quality Improvement Organizations Sharing Knowledge. Improving Health Care. CENTERS FOR MEDICARE & MEDICAID SERVICES



Antibiograms: What Are They and How Can They Help You?

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Empiric Therapy = Best Guess Therapy





How Do Clinicians Approach Suspected Infection?





Think of it





Consider Local Resistance Patterns



Prescribe Empiric Antibiotic Rx



Change to Definitive Antibiotic Rx

Done immediately before any culture data available

Done 48-72 hrs later after culture and sensitivity data available

How Do Clinicians Approach Suspected Infection?



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Susceptibility Testing The Macrodilution Method

Broth: 10⁴-10⁵ CFU/ml (pathogen)



- Mix pathogen with serial dilutions of antibiotic
- Incubate overnight
- 1st clear tube = MIC



Susceptibility Testing: The Microdulution Method

• Automated: Serial dilutions of several antibiotics are incubated in a 96-well microtiter plate

12 Different Concentrations

8 Different Antibiotics





Susceptibility Testing: The Kirby-Bauer Method

• Paper discs impregnated with various abxs are placed on agar plates, seeded with a lawn of bacteria (pts. pathogen). Zone of inhibition is related to MIC.



Susceptibility Testing: The E-test (epsilometer)





Interpreting the Susceptibilities

- Lab reports back "S", "I," or "R"
- Based on the MIC and pharmacokinetic properties of the drug in the general population and clinical trials showing success

(i.e., does the drug reach and maintain high enough concentrations in blood or tissue to expect it to kill the bacteria based on the MIC)



Common Definitions

- Susceptible (S) = MIC is below S breakpoint; concentrations represented by MIC are easily achieved using standard doses of the antibiotic and clinical trial experience shows high probability of clinical success
- Intermediate (I) = MICs above S breakpoint and approach R breakpoint; higher doses of antibiotic are needed or antibiotic needs to concentrate at infection site; response rates lower than S isolates
- Resistant (R) = MICs are above R breakpoint; concentrations represented by the MIC are not achieved with maximal doses of antibiotic and/or MIC falls in the range where resistance mechanisms are probable; treatment will likely fail

Individual Isolate Antibiogram (e.g., K. pneumonia)

Minimum inhibitory

Antimicrobials	concentration (µg/mL)	Interpretation*
Cefoxitin	8	susceptible
Ceftazidime	≥ 64	resistant
Cefepime	8	susceptible
Meropenem	1	susceptible
Ertapenem	4	resistant
Ciprofloxacin	4	resistant
Levofloxacin	≥ 8	resistant

Example Klebsiella Pneumonia Sensitivity Report

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Empiric Therapy = Best Guess Therapy





Cumulative Antibiogram

- Collect bacterial isolates over the prior year and calculate the percent that are susceptible to key antibiotics
- Can be broken down for better accuracy
 - Facility overall
 - By location (floor, ICU, outpatient)
 - List of gram positives, list of gram negatives
 - By culture source (urine, blood, other)
- Can give the provider a sense of the frequency of the pathogen and frequency of resistance, and thereby help make an empiric choice of abx



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Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline—Fourth Edition

This document describes methods for recording and analysis of antimicrobial susceptibility test data, consisting of cumulative and ongoing summaries of susceptibility patterns of clinically significant microorganisms.

A guidefine for global application developed through the Clinical and Laboratory Standards Institute consensus process

CLSI publishes regular guidance on how to develop and report an antibiogram

Some General Cumulative Antibiogram Guidelines

- Compile and update data at least annually
- Include only final, verified results
- Include only diagnostic results (not surveillance cultures)
- Include only the first isolate per patient per reporting period
- Should have at least 30 isolates per species before reporting cumulative sensitivity rates
- Only report the % sensitive (not intermediate isolates)

	too low to analyze	< 30 isolates	< 30 isolates			
Organism	Acinetobacter baumanii	Citrobacter freundii	Enterobacter gerogenes	Enterobacter cloacae	E. coli	Klebsiella oxytoca
		,				
Total Isolates	1	21	25	56	905	32
	Susceptibility					
Amoxicillin/Clavulanic acid	-	-	-	-	85%	78% (11)
Ampicillin	-	-	-	-	54%	-
Amp/Sulbactam	-	-	-	-	-	-
Piperacillin/Tazobactam	-	90%	92%	67% (↓)	96%	88%
Cefazolin	-	-	-	-	86%	50% (_{↓)}
Cefepime	-	100%	100%	88%	95%	88% (4)
Cefoxitin	-	-	-	-	89%	91%
Ceftazidime	-	86%	92%	73% (↓)	93%	94%
Ceftriaxone	-	90%	92%	71% (↓)	94%	84% (↓)
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Levofloxacin	-	95%	100%	85%	83%	100%
TMP/SMX	-	95% (↑)	100%	81%	78%	91% _(↓)
Nitrofurantoin	-	95%	13%	45%	96%	75%

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Total isolates	182	70	73	71	30
	Susceptibility				
Benzylpenicillin	99%	-	22%	6% (↑)	100%
Ampicillin	100%	-	-	-	-
Oxacillin	-	-	<mark>63%</mark> (↑)	35%	-
Cefazolin	-	-	-	-	-
Ceftriaxone	-	-	-	-	100%
Gentamicin	-	-	99%	96% (↑)	-
Ciprofloxacin	72% (↑)	4%	59%	46%	-
Levofloxacin	7 3% (↑)	4%	59%	46%	100%
Linezolid	-	-	100%	100%	-
Rifampicin	-	-	100%	100%	-
Tetracycline	22%	2%	97%	<mark>87%</mark> (↑↑)	-
TMP/SMX	-	-	96%	48% (↑)	-
Vancomycin	100%	26%	100%	100%	-

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Linezolid	-	-	100%	100%	-

Best to avoid empiric antibiotics where antibiogram shows < 80% susceptibility rate

What to Do About the > 30 Rule

- Most CAHs and many NHs will not have 30 or more isolates on many species
- Look at larger regional hospital's antibiogram
- Look at health department data if available for the state
- NDDH/ND QIN partnership for NH and CAH infection and antibiotic use tracking tool (Redcap). Hopefully will allow QIN to develop local/regional antibiograms by pooling facility data. Participate!

Other Advantages to Developing Antibiograms: Follow Resistance Trends (E. coli resistance in U.S.)



MRSA at MeritCare/Sanford

Staph aureus Resistance to Oxacillin MeritCare Medical Center



Noting These Trends May Be Invaluable for Setting Targets for Your ASP Program: **Quinolone Resistant Pseudomonas at Sanford**



Quinolone DDD/1000 Patient Days

Year

Limitations of Antibiograms

- MIC concentrations are not included; as a result, subtle trends below the resistance threshold (MIC creep) are not reflected
- Data do not take into account patient factors, such as history of infection or past antimicrobial use
- May not take into account specific populations within a health facility (ICU, oncology, burn, or transplant units may have very different types of infections than the rest of the facility)
- Antibiogram cannot take into account individuals likely response to an antibiotic based on age or disease nor factors like synergistic combinations of antibiotics

