

Antimicrobial Resistance Solutions

Management. Education. Innovation.

Antibiograms Regulatory Standard - Impacting Patient Lives

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What is an Antibiogram

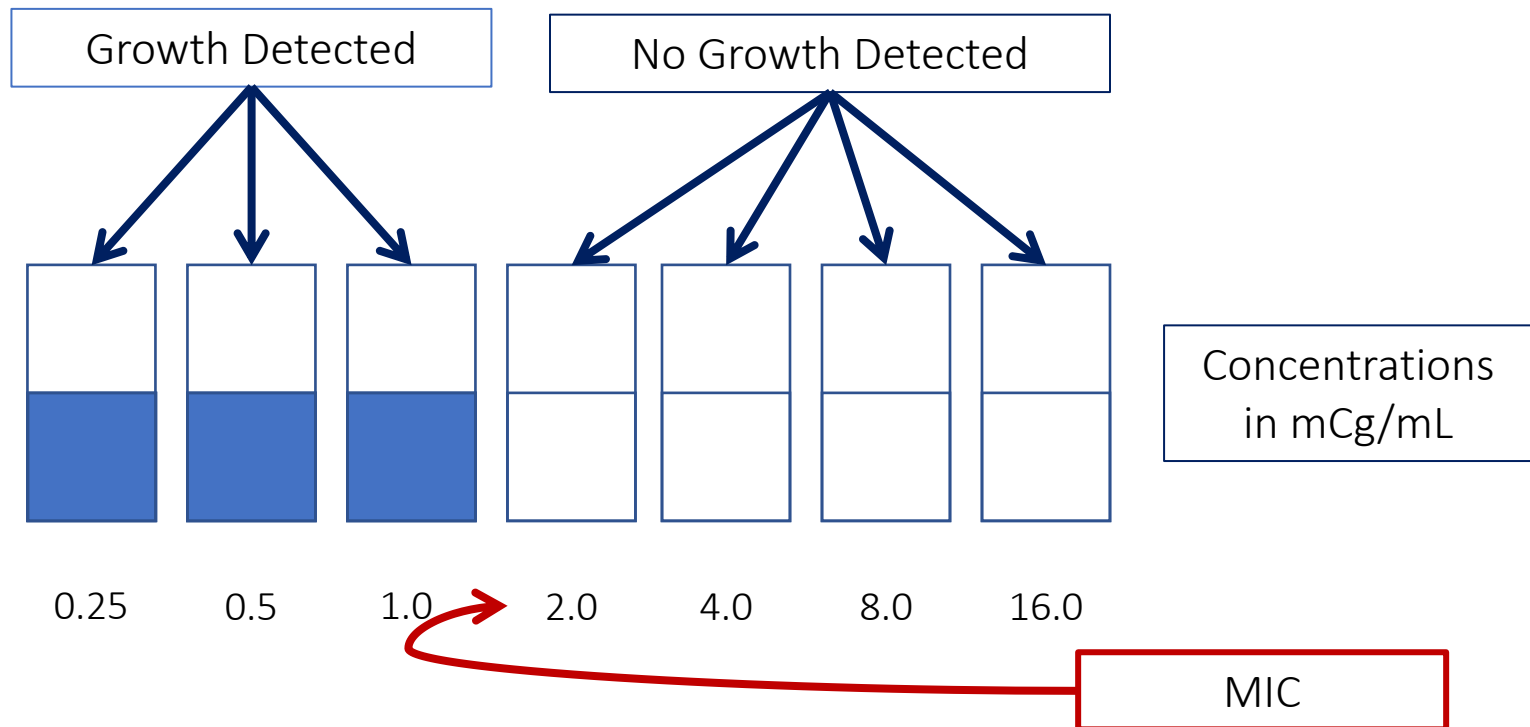
- A summary of antimicrobial susceptibility testing for a specific/unique care setting or population of patients.
- Clinically isolate micro-organisms are listed against and a panel of anti-infectives in table form summarizing the percentage of susceptible organisms to anti-infective drugs.
- Data summary period is typically one year but may vary.

What is the Intended Use

- Optimizing empiric antimicrobial therapy, thereby influencing outcomes.
- Tracking the development of resistance within and institution, patient population, clinical setting or geographic area over time, allowing for adaptations in anti-infective use to prevent or reverse antimicrobial resistance.
- Tracking resistance is limited by breakpoints, antibiogram does not track specific changes in MIC over time unless threshold for resistance is surpassed.
- Summarizing year-over-year susceptibility patterns for sentinel organisms (*Strep pneumoniae*).

Defining MIC

- MIC – minimum inhibitory concentration



What are Breakpoints?

- Breakpoints are determined by laboratory standard organizations utilizing MIC values
- Organisms can be defined as susceptible or resistant
- Susceptible organisms should respond to standard dosing regimens of antimicrobials
- Methods used to determine susceptibility breakpoints can differ
- Historically many different entities recommended breakpoints
 - Pharmaceutical companies
 - FDA
 - Laboratory oversight bodies
- Breakpoint questions
 - How are breakpoints determined?
 - Who defines susceptible?
 - Are definitions consistent in all countries?
 - Do breakpoints change over time?

Standards Organizations

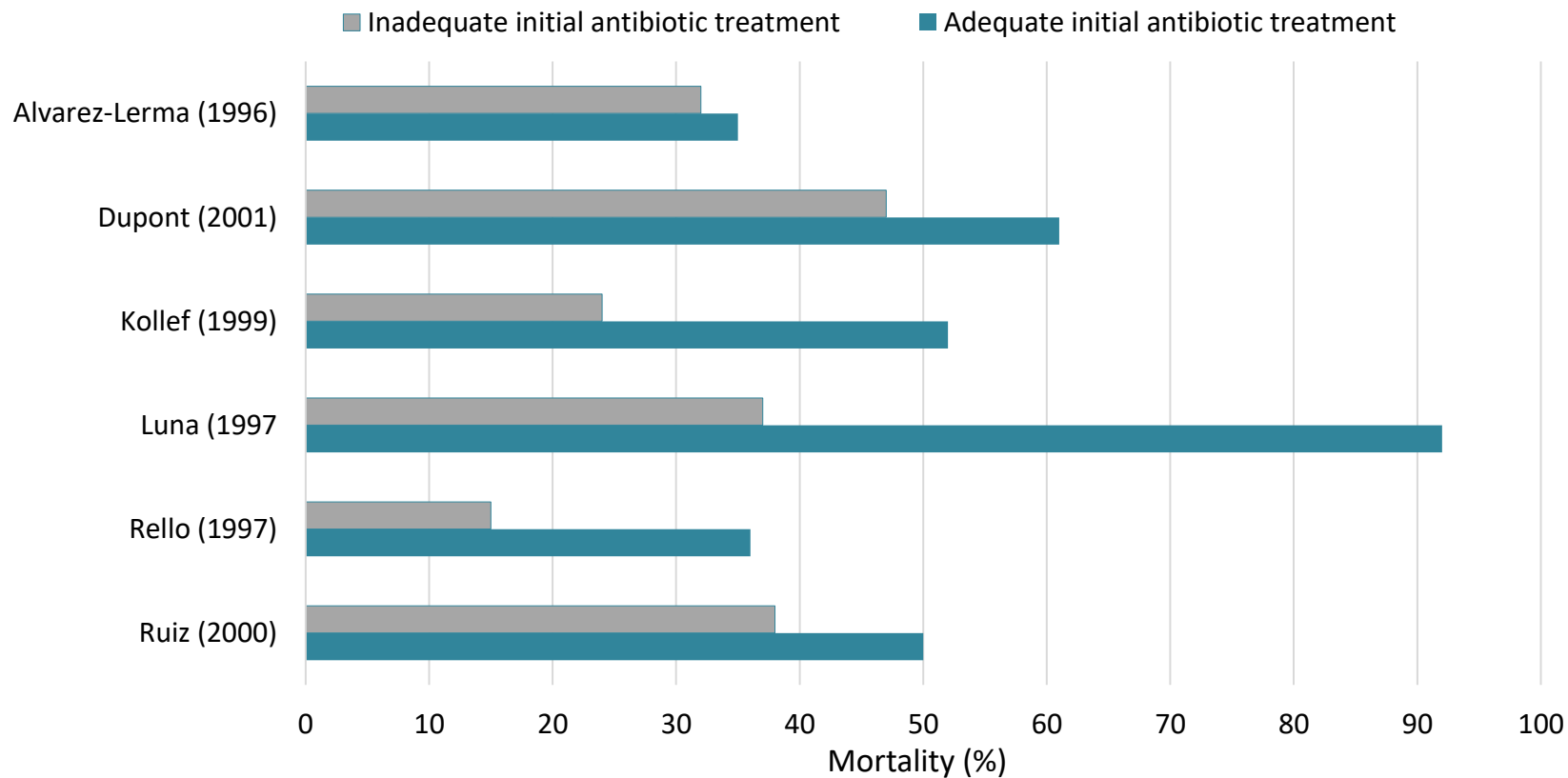
- FDA
- CLSI
- EUCAST (formed 1997, harmonized breakpoints in Europe, ongoing)
- USCAST (formed 2014, liaison to CLSI and EUCAST)

Breakpoint Questions

How are breakpoints determined?

- Cumulative MIC distributions
- Historically breakpoints viewed as static and necessary for less industry and clinical disruption
 - Pharma wants favorable susceptibilities to drugs to drive use
 - Microbiology testing companies do not want to change assays frequently
 - Desire for concrete answers
- May not reflect ability
 - achieve antimicrobial concentrations necessary for adequate microbiological or clinical response
 - Prevent emergence of resistance

Importance of Initial Empiric Antibiotic Selection



Alvarez-Lerma F. *Intensive Care Med.* 1996;22:387-394.
Dupont H, et al. *Intensive Care Med.* 2001;27:355-362.
Kollef MH, et al. *Chest.* 1999;115:462-474.

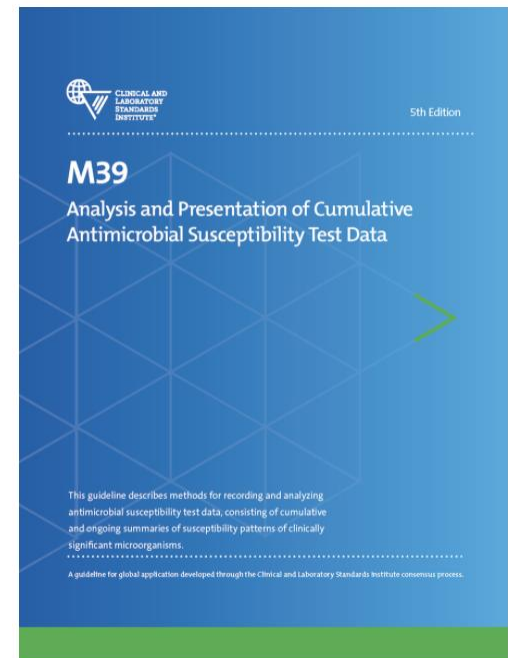
Luna CM, et al. *Chest.* 1997;111:676-685.
Rello J, et al. *Am J Respir Crit Care Med.* 1997;156:196-200.
Ruiz M, et al. *Am J Respir Crit Care Med.* 2000;162:119-125.

Example Antibioqram

Example Annual Antibioqram	Total Isolates	Antibiotics																							
		Amikacin	Amox/K Clav	Ampicillin	Ampicillin/sulbactam	Aztreonam	Cefazolin	Cefepime	Ceftazidime	Cefuroxime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Linezolid	Nitrofurantoin	Oxacillin	Penicillin	Piperacillin-Tazobactam	Tetracycline	Tobramycin	Trimethoprim/Sulfa	Vancomycin
Gram Negatives																									
Acinetobacter baumannii	*0																								
Citrobacter freundii	*3	100	0	0	0	0	100	0	33	100	100	100		100		100				67	67	100	67		
Enterobacter aerogenes	*2	100	0	0	0	0	100	0	100	100	100	100		100		0				100	100	100	100		
Enterobacter cloacae	*3	100	0	0	0	0	100	0	67	100	100	100		100		67				100	100	100	100		
Escherichia coli	46	100	78	0	52	84	100	89	100	59	100	98		75		91				100	76	91	78		
Escherichia coli ESBL	*9	100	67	0	44	0	0	0	0	0	100	100	100	0		100				100	11	78	67		
Klebsiella pneumoniae	*9	100	78	0	56	67	89	78	89	78	100	89		78		33				78	89	78	67		
Klebsiella pneumoniae ESBL	*6	100	17	0	0	0	0	0	0	0	100	17	100	80		17				83	50	17	0		
Morganella morganii	*5	100	0	0	20	0	100	0	60	80	100	80		80		0				100	60	100	80		
Pseudomonas aeruginosa	*14	100			100		100	100		77		79	100	77						100		100			
Proteus mirabilis	31	100	97	0	97	87	100		100	100	35	100	94		38		0			100	0	97	48		
Proteus mirabilis ESBL	*5	100	80	0	60	0	0	0	0	0	100	40		0		0				100	0	60	40		
Providencia stuartii	*8	100	0	0	25	0	100		38	88	25	100	0		25		0			100	0	0	100		
Serratia marcescens	*2	100	0	0	0	0	0	0	0	0	0	100		0		0				0	0	100	0		
Gram Positives																									
Coagulase Negative Staph	*0																								
Enterococcus faecalis	*18			0							67					100	100		100		11			100	
Enterococcus faecalis VRE	*4			0							0					100	100		100		0			0	
Enterococcus faecium	*0																								
Enterococcus faecium VRE	*7			0							0					100	57		0		14			0	
Methicillin Resistant S aureus MRSA	*0																								
Staphylococcus aureus	*1		0								100		100			100	0	100	0		100		100	100	

Antibiogram Requirements

- Accreditation/regulatory requirements
- Specific recommendations guidance: CLSI M-39
 - Current 5th edition, published Jan 24, 2022
- EMR Pitfalls
 - Screening for quality assurance if utilizing data from surveillance software (WHONET, TheraDoc) or EMR (EPIC)



Creating an Antibigram

- Who makes an antibiogram
 - Laboratory
 - Microbiologist
 - Pharmacist
 - Physician
 - Infection prevention practitioner
- Optimal collaboration
 - **Microbiologist**
 - **Pharmacist / ID Pharmacist**
 - **ID Physician**

Antibiogram Distribution and Education

- Individuals
 - Clinician
 - Microbiologist
 - Pharmacist
 - Infection prevention practitioner
- Care Environments
 - Acute Care (Inpatient, Units, ED, etc)
 - Post-acute (LTAC, LTC, etc)
 - Outpatient Practices (Dialysis, Physician offices, immediate care)
 - Patient type vs community specific
 - Community or region

Influences on Antibiogram Validity

Internal	External
Formulary	CLSI (M-39 or version of M-100) EUCAST, USCAST, AGAR
Electronic Medical Record	AST Panels Available/Utilized
Micro Reporting (e.g. cascade, suppression)	Third Party Lab – reporting of data
Antimicrobial Dosing Protocols	
Facility Size/Numbers	

Example Antibiogram

Example Annual Antibiogram	Total Isolates	Gram Negatives																								
		Amikacin	Amox/K Clav	Ampicillin	Ampicillin/subactam	Aztreonam	Cefazolin	Cefepime	Ceftazidime	Cefuroxime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Linezolid	Nitrofurantoin	Oxacillin	Penicillin	Piperacillin-Tazobactam	Tetracycline	Tobramycin	Trimethoprim/Sulfa	Vancomycin	
Acinetobacter baumannii	*0																									
Citrobacter freundii	*3	100	0	0	0	0	100	0	33	100	100	100		100		100				67	67	100	67			
Enterobacter aerogenes	*2	100	0	0	0	0	100	0	100	100	100	100		100		0				100	100	100	100			
Enterobacter cloacae	*3	100	0	0	0	0	100	0	67	100	100	100		100		67				100	100	100	100			
Escherichia coli	46	100	78	0	52	84	100	89	100	59	100	98		75		91				100	76	91	78			
Escherichia coli ESBL	*9	100	67	0	44	0	0	0	0	0	100	100	100	0		100				100	11	78	67			
Klebsiella pneumoniae	*9	100	78	0	56	67	89	78	89	78	100	89		78		33				78	89	78	67			
Klebsiella pneumoniae ESBL	*6	100	17	0	0	0	0	0	0	0	100	17	100	80		17				83	50	17	0			
Morganella morganii	*5	100	0	0	20	0	100	0	60	80	100	80		80		0				100	60	100	80			
Pseudomonas aeruginosa	*14	100			100		100	100		77		79	100	77						100		100				
Proteus mirabilis	31	100	97	0	97	87	100		100	100	35	100	94		38		0			100	0	97	48			
Proteus mirabilis ESBL	*5	100	80	0	60	0	0	0	0	0	100	40		0		0				100	0	60	40			
Providencia stuartii	*8	100	0	0	25	0	100		38	88	25	100	0		25		0			100	0	0	100			
Serratia marcescens	*2	100	0	0	0	0	0	0	0	0	0	100		0		0				0	0	100	0			
Gram Positives																										
Coagulase Negative Staph	*0																									
Enterococcus faecalis	*18			0							67					100	100		100		11				100	
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Enterococcus faecium	*0																									
Enterococcus faecium VRE	*7			0							0					100	57		0		14				0	
Methicillin Resistant S aureus MRSA	*0																									
Staphylococcus aureus	*1		0								100		100			100	0	100	0		100		100		100	

Functional Antibiogram

Inpatient
Gram-negative Bacilli
% Susceptible
(Suscept #/Total #)

	Amikacin	Gentamicin	Tobramycin	Cefazolin	Cefoxitin	Cefuroxime	Cefepodoxime	Ceftriaxone	Cefepime	Ampicillin	Ampicillin / Sulbactam	Amoxicillin / Clavulanate	Piperacillin / Tazobactam	Imipenem ‡	Meropenem	Ciprofloxacin	Nitrofurantoin, Urine only	Fosfomycin, Urine only	Sulfamethoxazole / Trimethoprim	Tetracycline
<i>Enterobacter cloacae</i>	100 (21/21)*	97 (41/42)	97 (41/42)						90 (37/41)						100 (22/22)	95 (40/42)	52 (11/21) *		92 (39/42)	85 (18/21) *
<i>Escherichia coli</i>	100 (92/92)	93 (560/597)	91 (549/597)	91 (463/506)	91 (78/85)	88 (75/85)	95 (81/85)	99 (539/544)	92 (544/586)	61 (334/544)	69 (378/544)	85 (502/588)	97 (571/587)	100 (132/132)	100 (95/95)	76 (458/596)	95 (478/502)	92 (39/42)	78 (470/596)	77 (73/94)
<i>Klebsiella oxytoca</i>	100 (16/16)*	96 (31/32)	96 (31/32)		93 (15/16) *	93 (15/16) *	93 (15/16) *	96 (30/31)	93 (30/32)		64 (20/31)	90 (29/32)			93 (14/15)	93 (30/32)	81 (13/16) *		96 (31/32)	93 (15/16) *
<i>Klebsiella pneumoniae</i>	100 (69/69)	96 (194/200)	96 (193/200)	97 (130/134)	92 (62/67)	92 (62/67)	100 (67/67)	100 (190/190)	96 (190/197)		85 (163/190)	94 (186/197)	94 (186/197)	100 (41/41)	98 (69/70)	93 (186/200)	26 (35/131)		90 (181/200)	84 (59/70)
<i>Klebsiella variicola</i>		100 (22/22)*	100 (22/22) *					100 (22/22) *	100 (22/22) *		100 (22/22) *	100 (22/22) *		100 (8/8) *		100 (22/22) *	57 (11/19) *		95 (21/22) *	
<i>Proteus mirabilis</i>	100 (29/29)*	90 (84/93)	94 (88/93)	92 (64/69)	100 (29/29) *	100 (29/29) *	100 (29/29) *	100 (91/91)	98 (91/92)	83 (78/93)	90 (84/93)	100 (89/89)	100 (93/93)		100 (29/29)	75 (70/93)			83 (78/93)	
<i>Pseudomonas aeruginosa</i>	95 (67/70)	92 (97/105)	98 (102/104)						86 (91/105)				86 (90/104)		88 (61/69)	85 (90/105)				
<i>Stenotrophomonas maltophilia</i>																37 (6/16) *			100 (25/25) *	95 (24/25) *

‡ Imipenem susceptibility predicts Meropenem susceptibility

Green = greater than or equal to 85% of isolates susceptible

Yellow = 75% to 84% of isolates susceptible

Red = less than 75% of isolates susceptible

* less than 30 isolates, interpret with caution, as small numbers may bias the group susceptibilities

Gram Positive

Percent Susceptible, Number Susceptible/Number Tested	Gentamicin	Rifampin	Cefazolin	Oxacillin	Clindamycin	Erythromycin	TMP/Sulfa	Tetracycline	Moxifloxacin	Ceftriaxone	Penicillin G	Ampicillin	Vancomycin	Linezolid	Nitrofurantoin (Urine Only)
Enterococcus faecalis											98 (76/77)	98 (83/84)	95 (80/84)		97 (47/48)
Enterococcus faecium											42 (8/19)*	36 (8/22)*	50 (11/22)	100 (12/12)*	46 (6/13)*
Enterococcus species (all - faecalis, faecium, other)											88 (89/101)	86 (99/114)	85 (97/114)	100 (16/16)*	86 (53/61)
Staphylococcus aureus	99 (201/203)	100 (201/201)	63 (134/212)	63 (135/213)	72 (134/185)	54 (111/202)	95 (205/215)	91 (182/200)					100 (214/214)	100 (30/30)	
Staphylococcus aureus - MRSA	97 (71/73)	100 (73/73)			61 (43/70)	27 (20/73)	92 (72/78)	86 (62/72)					100 (77/77)	100 (30/30)	
Staphylococcus aureus - MSSA	100 (128/128)	100 (128/128)	99 (134/135)	100 (135/135)	80 (91/113)	71 (91/128)	97 (131/135)	93 (120/128)					100 (135/135)		
Staphylococcus coagulase negative - ALL	87 (49/56)	96 (53/55)	35 (24/67)	36 (25/69)	57 (11/19)*	25 (14/56)	57 (40/70)	75 (52/69)					100 (70/70)		100 (15/15)*
Streptococcus agalactiae (Group B)†					39 (14/36)					100 (36/36)	100 (36/36)		100 (36/36)		
Streptococcus pneumoniae†					80 (20/25)*		77 (28/36)	80 (28/35)	100 (36/36)	94 (34/36)	94 (34/36)				

* Small sample size, interpret with caution.

Antibiogram data intended to guide empiric choice of antibiotics. Once culture results are known, adjust antibiotic selection narrowing spectrum, if appropriate.

Greater than or equals to 85% of isolates susceptible
75% to 84% of isolates susceptible
Less than 75% of isolates susceptible

Antibiogram – Single isolates

Gram-negative Bacilli Antibiogram: First Species Isolate per Patient per Year

	# of Isolates	Gentamicin	Tobramycin	Cefazolin	Ceftriaxone	Ceftazidime	Cefepime	Ciprofloxacin	Levofloxacin	Meropenem	Ampicillin	Ampicillin / Sulbactam	Amoxicillin / Clavulanate	Piperacillin / Tazobactam	Nitrofurantoin (Urine Only)	TMP/Sulfa
MIC Breakpoints (mcg/ml)		≤4	≤4	≤4*	≤1	≤4	≤2	≤0.25	≤0.5	≤1#	≤8	≤8	≤8	≤8#	≤32	≤2/38
MIC Breakpoint - <i>P. aeruginosa</i>						≤8	≤8	≤0.5	≤1	≤2				≤16		
<i>Escherichia coli</i>	69	80	78	78	84	83	91	61	59	100	41	51	78	93	97	64
<i>Klebsiella pneumoniae</i>	19	100	84	84	84	84	84	89	89	100	-	74	84	79	21	74
<i>Proteus mirabilis</i>	30	100	97	70	93	93	93	57	57	100	73	87	97	93	0	67
<i>Pseudomonas aeruginosa</i>	12	100	100	-	-	-	67	75	-	100	-	-	-	67	-	-

MIC Breakpoints Based by Infection and Achievable Concentrations

* Cefazolin MIC ≤4 systemic infections/non-urine, MIC ≤16 cystitis Enterobacteriaceae (83% *E. coli*, 84% *Klebsiella pneumoniae*, 90% *Proteus mirabilis*),

Less than 30 isolates, interpret with caution as small numbers may bias the group susceptibilities.

Basic Antibiogram – Single isolates

Enhanced Broad Spectrum Activity in Class

Gram-negative Bacilli Antibiogram: First Species Isolate per Patient per Year

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MIC Breakpoint - <i>P. aeruginosa</i>						≤8	≤8	≤0.5	≤1	≤2				≤16		
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Basic Antibiogram – Single isolates

Peak / MIC

Time / MIC (Exposure)

Gram-negative Bacilli Antibigram: First Species Isolate per Patient per Year

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MIC Breakpoint - <i>P. aeruginosa</i>					≤8	≤8	≤0.5	≤1	≤2				≤16		
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Basic Antibiogram – Single isolates

Gram-negative Bacilli Antibiogram: First Species Isolate per Patient per Year

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<i>Pseudomonas aeruginosa</i>	12	100	100	-	-	-	67	75	-	100	-	-	-	67	-	-

Merino Trial: 3rd Gen Resistant *E.coli* or *Klebsiella spp.* BSI
 Pip/tazo 4.5g IVQ6h vs Meropenem 1g IV Q8h
 Mortality: P/T 23/187 (12.3%) vs Mero 7/191 (3.7%)

Harris PN, et al. JAMA. 2018 Sep 11;320(10):984-994.

Critical Data for Antimicrobial Treatment Decisions

- Antibigram - most active agent(s) for clinical setting or pathogen

- Drugs concentrations at the infection site

- Drugs optimal dosing characteristics

- Drugs risk for selecting resistance

- Drug risk for adverse effects

- Cost

Empiric Antimicrobial Recommendations
Example Facility

Suspected Source	First Line Regimen(s) (w/ β -lactam Allergy)	Non-Severe PCN Allergy (w/ Rash, etc)	Severe β -lactam Allergy (w/ Anaphylaxis)	Recommended Total Duration of Effective Therapy**
Cystitis	Amoxicillin 500mg PO BID PLUS Gentamicin 3-5mg/kg (qd) wgt IV/IM x1 OR Gentamicin 3-5mg/kg (qd) wgt IV/IM x1	Gentamicin 3-5mg/kg (qd) wgt IV/IM x1	Gentamicin 3-5mg/kg (qd) wgt IV/IM x1	3-5 days
	No antibiotics previous 90 days or previous nitrofurantoin or TMP/SMX resistant strain: Nitrofurantoin 100mg PO BID OR TMP/SMX 1 DS PO BID	No antibiotics previous 90 days or previous nitrofurantoin or TMP/SMX resistant strain: Nitrofurantoin 100mg PO BID OR TMP/SMX 1 DS PO BID	No antibiotics previous 90 days or previous nitrofurantoin or TMP/SMX resistant strain: Nitrofurantoin 100mg PO BID OR TMP/SMX 1 DS PO BID	
UTI	Ampicillin 1gm IV q8hr PLUS Gentamicin 5mg/kg (qd) wgt IV/IM x 1*	Ceftriaxone 1gm IV/IM q8hr PLUS Gentamicin 5mg/kg (qd) wgt IV/IM x 1*	Gentamicin 5mg/kg (qd) wgt IV/IM x 1*	5-10 days
Pyelonephritis/ Systemic Infections	Limited IV access: Gentamicin 3-5mg/kg (qd) wgt IM x1* PLUS Amoxicillin 1gm PO TID	Limited IV access: Gentamicin 3-5mg/kg (qd) wgt IM x1* PLUS Ceftriaxone 1gm PO TID	ICiprofloxacin 400mg IV q12hr if septic/severe disease	
Community Acquired CAP - Low Risk	ORAL Doxycycline 200mg PO Daily (Preferred) OR Amoxicillin/clavulanate 500mg PO TID OR Cefdinir 300mg PO BID PLUS Doxycycline 200mg PO Daily OR Azithromycin 500mg PO Daily (3 days)	ORAL Doxycycline 200mg PO Daily (Preferred) OR Cefdinir 300mg PO BID PLUS Doxycycline 200mg PO Daily OR Azithromycin 500mg PO Daily (3 days)	ORAL Doxycycline 200mg PO Daily (Preferred) OR Moxifloxacin 400mg PO Daily	5-7 days
	INTRAVENOUS Ampicillin/sulbactam 3g q8hr PI OR Ceftriaxone 1gm IV/IM q24hr PLUS Doxycycline 200mg PO Daily OR Azithromycin 500mg PO Daily (3 days)	INTRAVENOUS Ceftriaxone 1gm IV/IM q24hr PLUS Doxycycline 200mg PO Daily OR Azithromycin 500mg PO Daily (3 days)	INTRAVENOUS Moxifloxacin 400mg IV/PO q24hr	
	1 MRSA Coverage if/see risk factors below - Doxycycline with MRSA activity, if not utilizing doxycycline ADD Vancomycin 20mg/kg then pharmacy to dose	1 MRSA Coverage if/see risk factors below - Doxycycline with MRSA activity, if not utilizing doxycycline ADD Vancomycin 20mg/kg then pharmacy to dose	1 MRSA Coverage if/see risk factors below - Doxycycline with MRSA activity, if not utilizing doxycycline ADD Vancomycin 20mg/kg then pharmacy to dose	
CAP At Risk Pseudomonas/MRSA*	Piperacillin/azobactam 3.375gm IV q8hr PI OR Cefepime 1gm IV q8hr PI PLUS Tobramycin 7mg/kg (qd) wgt IV/IM x 1 PLUS Doxycycline 200mg PO Daily (Preferred) OR Azithromycin 500mg PO Daily (3 days) Empiric Severe CAP w/MRSA risk factors* ADD Vancomycin 20mg/kg then pharmacy to dose	Cefepime 1gm IV q8hr PI OR Meropenem 500mg IV q8hr PLUS Tobramycin 7mg/kg (qd) wgt IV/IM x 1 PLUS Doxycycline 200mg PO Daily (Preferred) OR Azithromycin 500mg PO Daily (3 days) Empiric Severe CAP w/MRSA risk factors* ADD Vancomycin 20mg/kg then pharmacy to dose	***Penicillin allergic (anaphylaxis) call ID for recommendation***	5-7 days (if S. aureus pneumonia identified, duration of therapy may be longer)
Community Acquired Intra-abdominal Infection	ORAL Amoxicillin/clavulanate 500mg PO TID OR Cefpodoxime 400mg PO BID PLUS Metronidazole 500mg PO Daily INTRAVENOUS Ampicillin/sulbactam 3g q8hr PI PLUS Gentamicin 7mg/kg (qd) wgt IV/IM x 1*	ORAL TMP/SMX 1DS PO BID OR Cefepodoxime 400mg PO BID PLUS Metronidazole 500mg PO Daily INTRAVENOUS Ceftriaxone 1gm IV/IM q24hr PLUS Metronidazole 500mg PO/IV Daily	ORAL TMP/SMX 1DS PO BID OR Ciprofloxacin 750mg PO BID PLUS Metronidazole 500mg PO Daily INTRAVENOUS Ciprofloxacin 400mg IV q12hr PLUS Metronidazole 500mg PO/IV Daily PLUS Gentamicin 7mg/kg (qd) wgt IV/IM x 1*	5-7 days
	Healthcare/ Hospital Acquired	Cefepime 1gm IV/IM q8hr PI PLUS Metronidazole 500mg PO/IV Daily PLUS Tobramycin 7mg/kg (qd) wgt IV/IM x 1*	Ciprofloxacin 400mg IV q12hr PLUS Metronidazole 500mg PO/IV Daily PLUS Tobramycin 7mg/kg (qd) wgt IV/IM x 1*	
Skin & Soft Tissue Infection	ORAL Amoxicillin/clavulanate 500mg PO TID OR Cephalexin 500mg PO QID INTRAVENOUS Cefazolin 1gm IV/IM q8hr OR Ampicillin/sulbactam 3g IV q8hr PI 1 MRSA Coverage* - see risk factors below ADD Vancomycin pharmacy to dose. If able to take PO then doxycycline or TMP/SMX in place Vancomycin.	ORAL Cephalexin 500mg PO QID INTRAVENOUS Cefazolin 2 gm IV/IM q8hr 1 MRSA Coverage* - see risk factors below ADD Vancomycin pharmacy to dose. If able to take PO then doxycycline or TMP/SMX in place Vancomycin.	ORAL Doxycycline 200mg PO Daily OR TMP/SMX 1 DS PO BID INTRAVENOUS Vancomycin pharmacy to dose If able to take PO then doxycycline or TMP/SMX in place Vancomycin.	5-10 days
	Diabetic Foot Infection with ulcer/open wound	Piperacillin/azobactam 3.375gm IV q8hr PI PLUS Doxycycline 200mg PO Daily OR TMP/SMX 1 DS PO BID	Cefepime 1gm IV/IM q8hr PI PLUS Metronidazole 500mg IV/PO q24hr Doxycycline 200mg PO Daily OR TMP/SMX 1 DS PO BID	

Additional doses Review and dependent on culture results may require additional doses and/or assessment of serum concentrations.
Add MRSA Coverage: Prior MRSA isolation from respiratory tract previous 12 months, hospitalization AND parenteral antibiotics previous 90 days, post-influenza. Mild to moderate pneumonia with MRSA risk factors may be covered empirically with doxycycline.
Add at risk Pseudomonas/MRSA coverage: Prior Pseudomonas/MRSA isolation from respiratory tract previous 12 months, hospitalization AND parenteral antibiotics previous 90 days, post-influenza. May consider in LTC/LTAC patient if risk < 1 day broad spectrum antibiotic(s) AND activity of drug using (AUC) score > 12.5 at baseline (moderate disinhibited patients). Mild to moderate pneumonia with MRSA risk factors may be covered empirically with doxycycline if MRSA empiric coverage. Coverage: Abscess, ulcer with purulent drainage, penetrating trauma (IV drug use), or patient with concurrent evidence of MRSA infection elsewhere or history of MRSA.
Duration of Therapy: Assess patient and stop therapy when clinically improved.
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Disease State Treatment

Urinary Tract Infection

Gram-negative Bacilli Antibigram: First Species Isolate per Patient per Year

# of Isolates	Gentamicin	Tobramycin	Cefazolin	Ceftriaxone	Cefepime	Ciprofloxacin	Aztreonam	Meropenem	Ampicillin	Ampicillin / Sulbactam	Amoxicillin/ clavulanate	Piperacillin / Tazobactam	Nitrofurantoin (Urine Only)	TMP/Sulfa	
MIC Breakpoints (mcg/ml)	≤4	≤4	≤4*	≤1	≤2	≤0.25	≤4	≤1	≤8	≤8	≤8	≤8	≤32	≤2/38	
MIC Breakpoint - <i>P.aeruginosa</i>					≤8	≤0.5		≤2				≤16			
Escherichia coli	812	88	87	84	94	95	67	94	100	50	53	78	93	97	74
Klebsiella pneumoniae	205	98	96	93	96	97	93	96	100	-	83	94	95	61	91
Proteus mirabilis	158	87	89	82	99	99	48	98	99	77	79	89	100	1	68
Pseudomonas aeruginosa	185	82	96	-	-	100	83	92	100	-	-	-	88	-	-

Cumulative Disease State Susceptibility

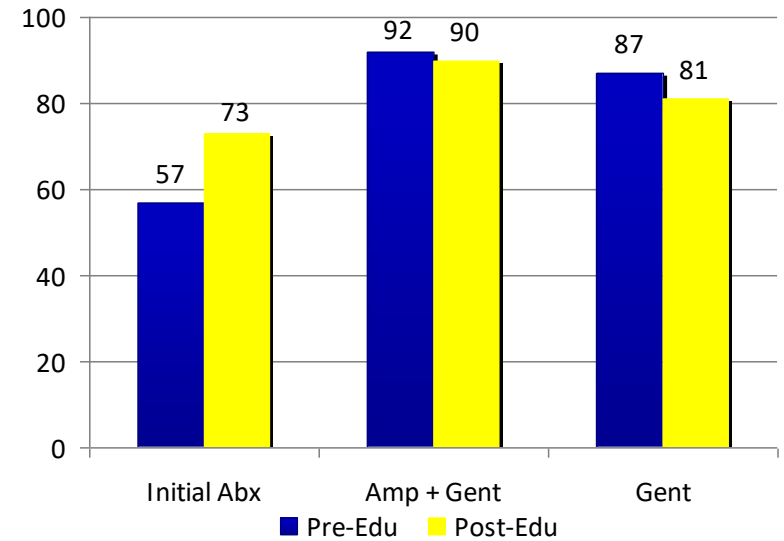
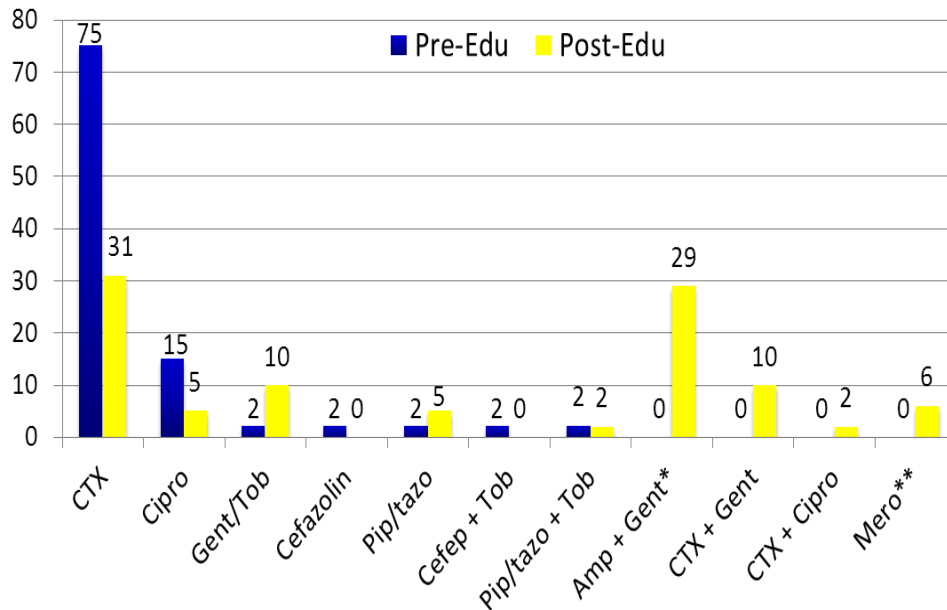
Most Prevalent Organisms Cultured from Urine

Total Urine Isolates (1041): E. coli (367), K. pneumoniae (118), Enterococcus faecalis (111), Proteus mirabilis (103), Pseudomonas aeruginosa (58), Enterococcus faecium (53).

Most Active Therapies	Susceptibilities
Ampicillin + Gentamicin	86%
Cefazolin + Gentamicin	75%
Gentamicin	72%
Ceftriaxone	69%
Ciprofloxacin	62%
Cefazolin	61%
Piperacillin/tazobactam	91%

Cheatham SC, et al. "Use of Conditional & Cumulative Susceptibility Reporting to Improve Antibiotic Prescribing & Rates on Initial Appropriate Antibiotic Therapy." 52nd Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, CA. September 2012.

Cumulative Disease State Susceptibility



Cheatham SC, et al. "Use of Conditional & Cumulative Susceptibility Reporting to Improve Antibiotic Prescribing & Rates on Initial Appropriate Antibiotic Therapy." 52nd Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, CA. September 2012.

Nursing Facility AntibioGrams

- Typical low number of isolates
 - Expanded time frame (rolling 2-year data)
 - Expand organism analysis to genus level
- Consider local resistance patterns to supplement data
 - Preference surrounding facilities sharing patients (e.g., local referral acute care hospital)
 - Utilize to validate resistance patterns in local area
- Consider limitations

Cumulative Disease State by Presenting Location

Presenting Location	# of Isolates	Gentamicin	Tobramycin	Cefazolin	Ceftriaxone	Cefepime	Ciprofloxacin	Meropenem	Piperacillin / Tazobactam	ESBL		Nosocomial (PA)	
										↓	↓	↑	↔
Community	425	97	97	87	97	97	74	99	97	↓	↓		
Healthcare associated	87	87	91	61	67	90	79	91	91	↓	↑		
LTCF	212	89	93	57	75	85	55	87	85	↑	↑		
Excellence SNF	38	85	88	45	55	65	58	85	75	↑↑	↑↑	↔	↔

Facility Differences in Close Proximity

Gram-negative Bacilli Antibigram: First Species Isolate per Patient per Year

	# of Isolates	Gentamicin	Cefazolin	Ceftriaxone	Ceftazidime	Ciprofloxacin	Meropenem	Ampicillin	Ampicillin / Sulbactam	Piperacillin / Tazobactam	Nitrofurantoin (Urine Only)	Tetracycline	TMP/Sulfa
MIC Breakpoints (mcg/ml)		≤4	≤4*	≤1	≤4**	≤1	≤1#	≤8	≤8	≤16	≤32	≤4	≤2/38
<i>Escherichia coli</i>	43	81	51	56	56	44	100	30	33	56	93	77	74
<i>Klebsiella pneumoniae</i>	16	94	69	75	75	75	94	-	75	75	53	75	56
<i>Proteus mirabilis</i>	17	59	88	100	100	41	100	59	100	100	0	0	53
<i>Pseudomonas aeruginosa</i>	10	60	-	-	90	90	90	-	-	90	-	-	-

	# Isolates	Gentamicin	Cefazolin	Ceftriaxone	Ciprofloxacin	Pip/tazo	TMP/Sulfa
<i>E. Coli</i>	183	93	86	90	81	97	77
<i>P. aeruginosa</i>	66	94			95	95	

	# Isolates	Gentamicin	Cefazolin	Ceftriaxone	Ciprofloxacin	Pip/tazo	TMP/Sulfa
<i>E. Coli</i>	981	91	81	90	-	90	80
<i>P. aeruginosa</i>	249	86			80	91	

Additional Information Included

- Empiric recommendations
 - Disease specific based on antibiogram
 - Alternatives due to allergy
- Optimal Dosing Guidelines
- Antimicrobial costs
- Clinical Pearls based on information presented
- Molecular testing results
 - Cumulative results
 - Recommendations

Summary Slide

- Antibigrams summarize antimicrobial susceptibility testing within care settings
- Challenges for creating accurate antibigrams include accurate data from micro lab, error-inducing interfaces between microdata collection systems and EMR, lack of microbiologic culture testing

Summary Slide

- Functional antibiograms:
 - Track and identifying organism-specific antimicrobial resistance/ resistance patterns
 - Assisting empiric therapy choices
 - Assisting in treatment order set design for unique clinical settings that are informed by prevailing resistance patterns
 - Assist in determining causes of antimicrobial resistance when combined with antimicrobial use (AU) data
 - Informing prescribers, especially when combined with education
- Use optimized when provided in various formats (pocketcard, electronic, etc) and combined with recommendations that emphasize use of appropriate antimicrobials

Antimicrobial Resistance Solutions

Management. Education. Innovation.

Antibiograms Regulatory Standard - Impacting Patient Lives

Post Education Survey

https://www.surveymonkey.com/r/IDOH_HAI_LTC_Antibiogram

