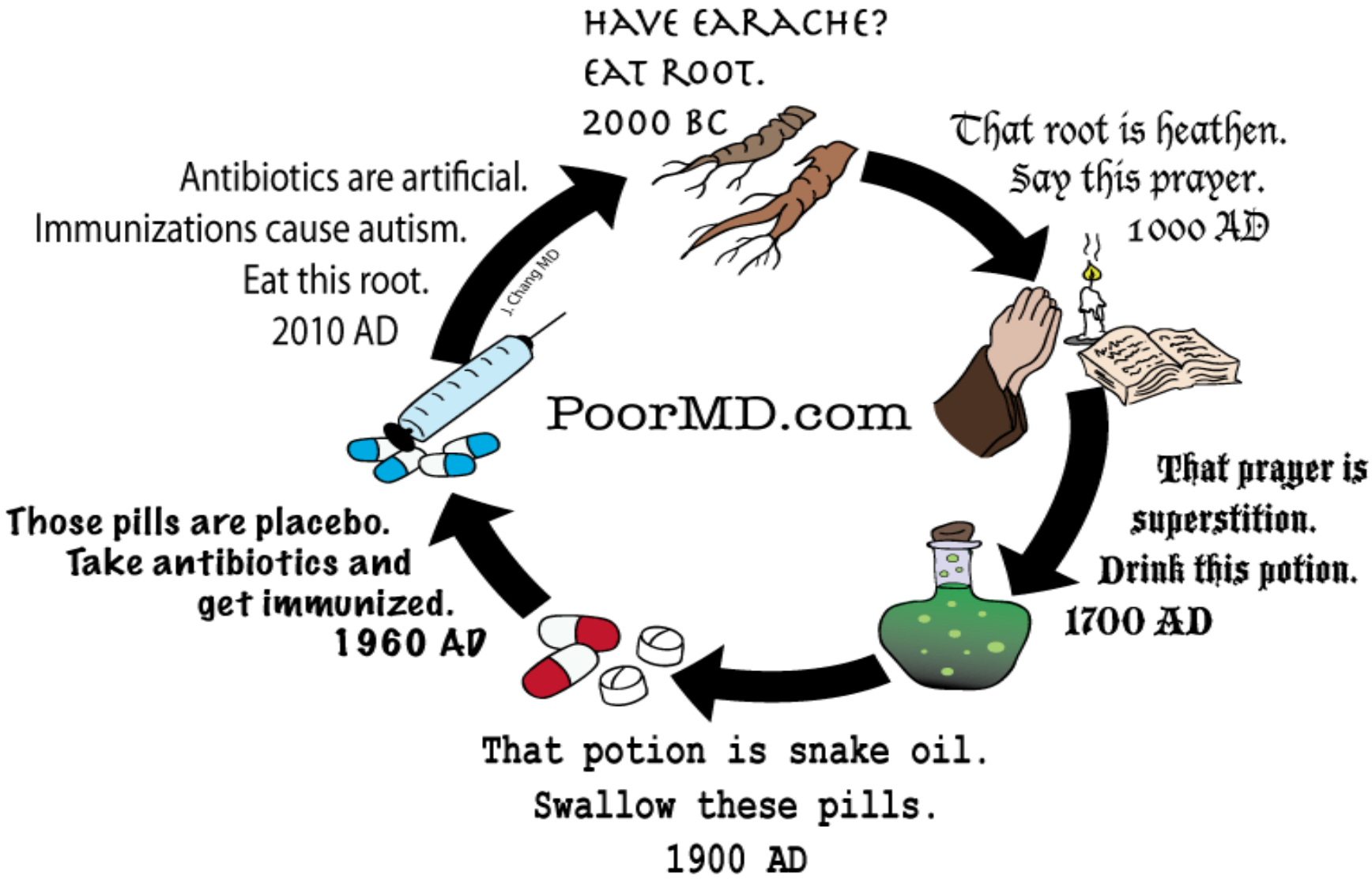
Utilization of Antibiograms

Joe Sartor, Pharm D

The History of Medicine



Is There A Need for Antibiogram?

Antimicrobial resistance

- New antibiotics to cover Gram+ organisms , MRSA, VRE
  - telavancin (Vibativ)
  - oritavancin (Orbactiv)
  - dalbavancin (Dalvance)
  - ceftaroline (Teflaro)
  - daptomycin (Cubicin)
  - tigecycline (Tygacil)
  - tedizolid (Sivextro)

Is There A Need for Antibiogram?

New antibiotics to cover gram- organisms'

- ceftazidime/avibactam (Avycaz)
- Ceftolozane/tazobactam (Zerbaxa)

Is There A Need for Antibiogram?

- Increasing resistance is often associated with inappropriate therapy, esp. empiric therapy
  - Inappropriate therapy – Increased mortality, increased LOS
  - Clinical outcomes – increased morbidity, increased mortality

Kumar Chest 2009 136;1237-1248

The Antibiogram

- Antibiogram can be utilized to aid in appropriate selection of empiric therapy
- Provides susceptibility rates to optimize empiric therapy – increases probability of initiating appropriate empiric therapy
- Aids the making of clinical decisions, infection control interventions, resistance control

The Antibiogram

- Susceptibility of pathogens to commonly used antimicrobials
- Data from individual susceptibility reports of individual pathogens
- CLSI Guidelines are critical to standardized isolate selections and susceptibility testing and reporting
- Generated by clinical microbiology laboratory
- Can be used by any health care professional involved in prevention and treatment of infectious disease

Data analysis for generating antibiogram – CLSI Guidelines

- N = 30
- Once yearly required
- Multiple institutions , may include clinics, other institutions using lab services - **not recommended**
- Can include all specimen types, but may segregate (urine/non-urine)
- May include variety of patient types and settings, data stratification, infection site and type
- Report % susceptible only
- Report in a format easily accessible to clinicians

Data analysis for generating antibiogram

Frequency once a year more frequent if

- Large number of isolates
- New antimicrobial agents
- Clinically important changes have occurred or are perceived
- Seasonal variations in resistance
- Small sample of isolates

  Isolates include first isolate of a given species/patient analysis period, organism with > 30 isolates, isolates collected for diagnosis purposes should be included
- Do not include duplicate isolates from the same patient or isolates from surveillance cultures, environmental cultures or other non-patient sources

Generalities from Antibiogram

High Nosocomial MRSA=poor infection control
High VRE rates may indicate over-utilization of Vancomycin particularly oral dosing
ESBL rates might indicate over-utilization of cephalosporins/penicillins
High KPC rates = over use of cephalosporins/carbapenems

Pitfalls of antibiogram

- Small Sample = 30 isolates minimum
- Multiple institutions = ????????????
- Updated at least annually, with large number of isolates more frequently, if more frequent are things changing
- May include variety of patient types and settings, data stratification, infection site and type
- Is break point for susceptible organisms optimal
  Vancomycin, Piperacillin/tazobactam
- Selection of combination therapy to cover resistance

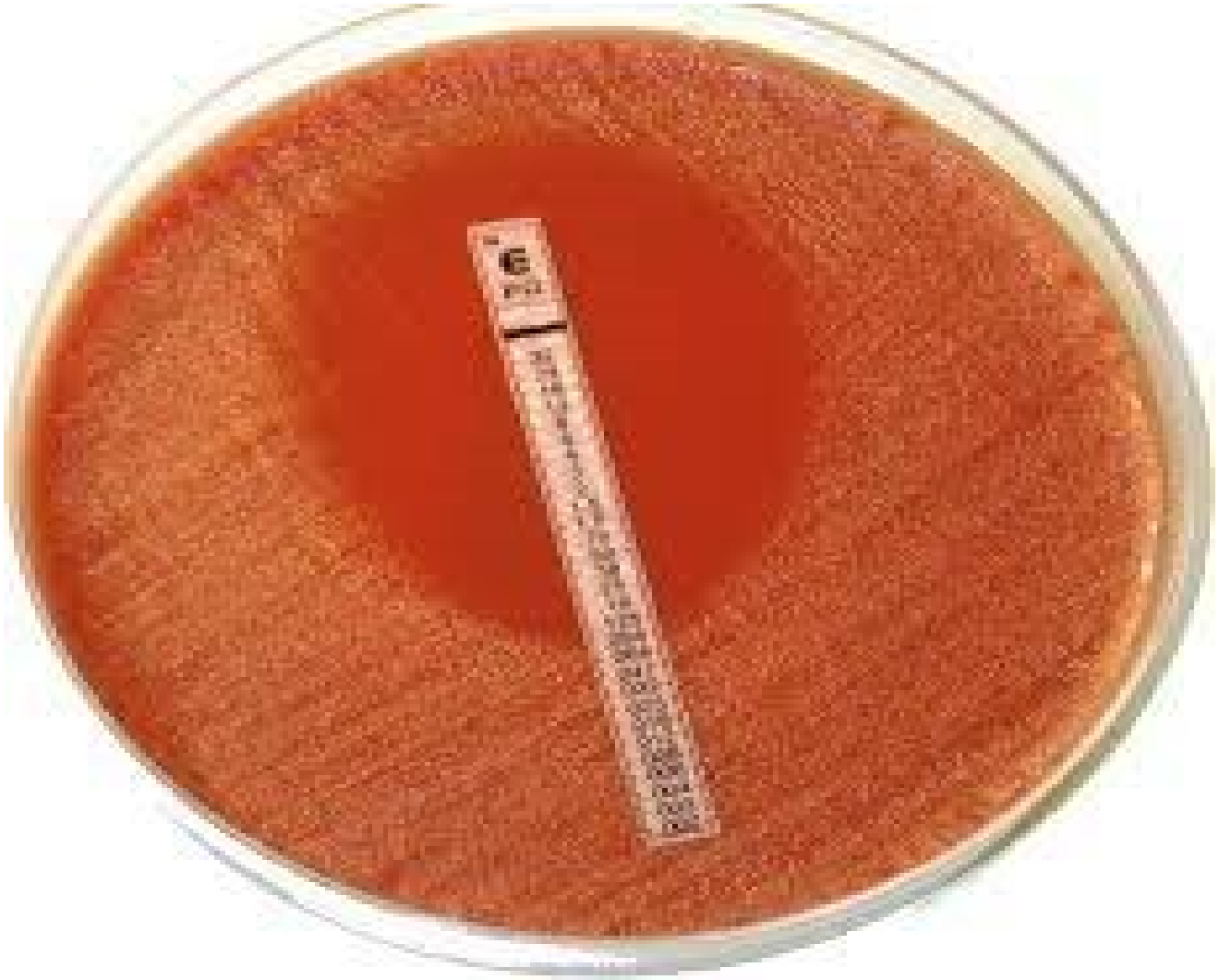
Reading the antibiogram

- n= standards recommend including only the first isolate/patient for analysis = number of patients with pathogen.
- Repeat admissions of same patient might dilute results
- Which pathogens are most common >n
- Pseudomonas doesn't usually have one antibiotic with excellent activity
- ESBL - cefepime is good marker for ESBL gram-pathogens
- KPC – resistant to carbapenems and all other b-lactams approximation looking at imipenem.
- MRSA %
- VANCOMYCIN usually 100% but MIC is important 2mcg/ml
- Enterrococcus faecium vs faecalis

Etest


VA
256
192
128
96
64
48
32
24
16
12
8
6
4
3
2
1.5
1.0
.75
.50
.38
.25
.19
.125
.094
.064
.047
.032
.023
.016

Etest, Epsilometer test



Etest

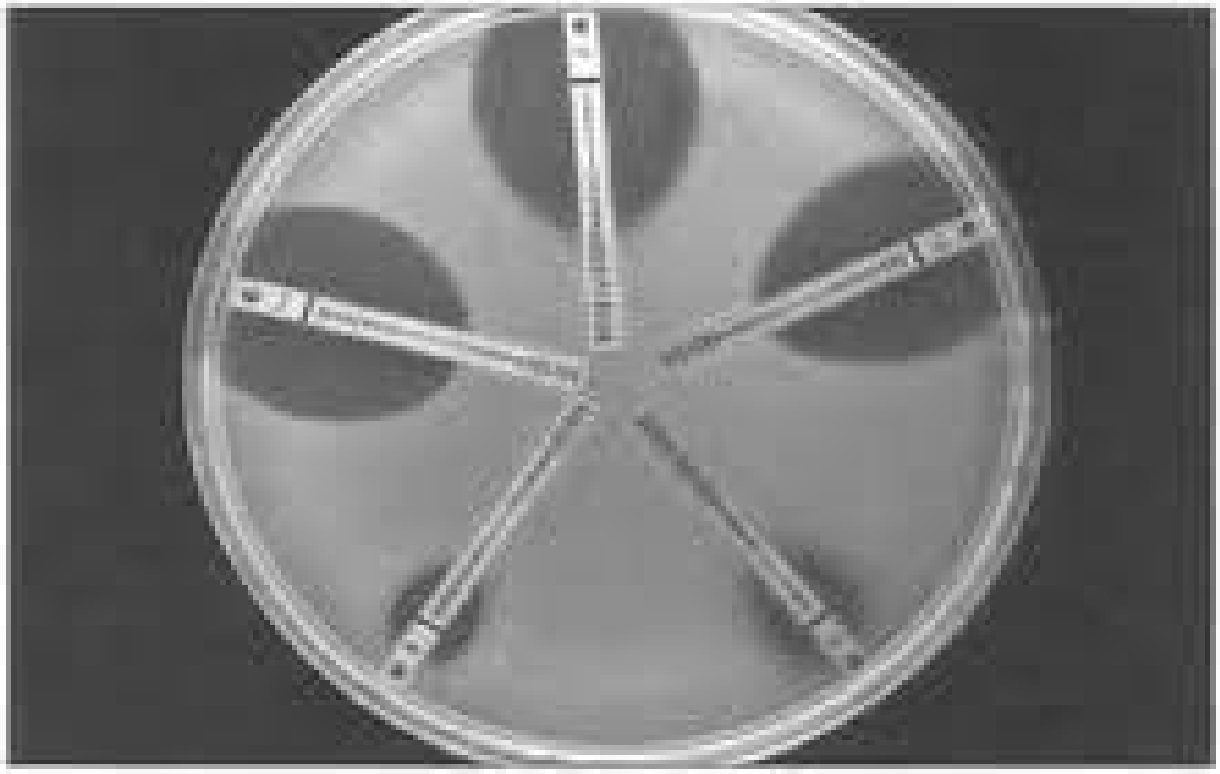


Figure 1-Photograph of a 15 centimeter long Mueller-Hinton plate with five E tests strips (ciprofloxacin, ceftazidime, piperacillin, tircacillin/clavulanic acid and trimethroprim/sulfamethoxazole. The microrganism being tested was *Xanthoma maltophilia*.

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

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MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
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GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	FD	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
E. coli	589		58	99	53	96	96	96	97	88	78	97	91	100	98	93	100	78	100	96	68	100	94
Klebsiella sp.	156		84	100	0	96	96	96	96	88	96	96	92	99	49	98	100	97	100	96	92	99	97
Proteus sp.	69		78	99	74	90	90	94	93	81	84	94	91	100	0	88	0	86	100	100	80	100	90
Pseudomonas sp.	43			95		77	50	98	33		84	93				81	84	81	93	100	33		95

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/sulb	Ampicillin	Augmentin	Ceftriaxone	Ciprofloxacin	Daptomycin	Nitrofurantoin	Gentamicin	Gentamicin Synergy	Levofloxacin	Linezolid	Oxacillin	Penicillin	Rifampin	Strep Synergy	Synercid	Trimeth/Sulf	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	CAX	CP	DAP	FD	GM	GMS	LVX	LZD	OX	P	RIF	STS	SYN	T/S	TE	VA
Coag Neg Staph	76		33	0	33	33	54	100	97	88		54	100	33	14	99		100	71	86	100
Enterococcus sp.	141			90			58	98	94		70	63	94		89	37	70			17	91
Strep agalactiae	13							100				100	100		100						100
MRSA	0																				
MSSA	23		23	0	100	100	83	96	100	100		87	100	100	17	100		100	100	96	100

Data collected 01/01/15 thru 12/31/15

No MRSA isolated from urine in 2015

Fluroquinolone use is associated with:

- Increased risk of *Clostridium difficile* NAP1/027 hypervirulent/epidemic strain
- Increased risk of vancomycin-resistant *Enterococcus*
- Increased risk of ESBL *Enterobacteriaceae (E coli, Klebsiella)*
- Increased *Pseudomonas* meropenem resistance
- Increased Carbapenem Resistant *Enterobacteriaceae*

1. Center for Infection Disease ANTIBIOTIC RESISTANCE THREATS in the United States, 2013

2. Hayakawa et al. January 2013 Volume 57 Number 1 Antimicrobial Agents and Chemotherapy p. 49–55

3. Rodriguez-Bano J, Navarro MD, Romero L, Muniain MA, Perea EJ, Perez-Cano R, et al Clin Infect Dis 2006;42(1):37-45.

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

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MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
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MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
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ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

MRSA = Methicillin Resistant Staph aureus

MSSA = Methicillin Susceptible Staph aureus

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

MRSA = Methicillin Resistant Staph aureus

MSSA = Methicillin Susceptible Staph aureus

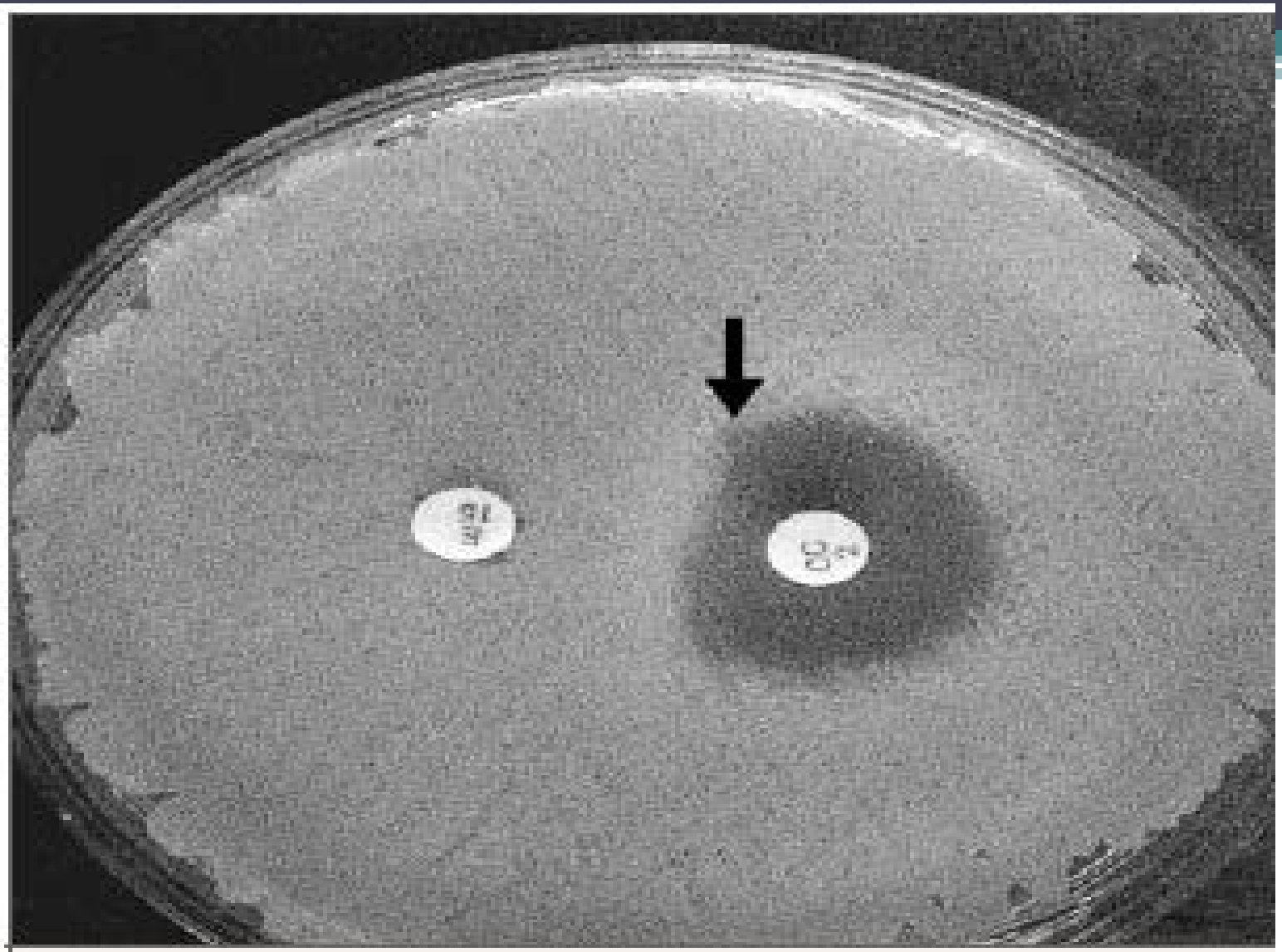

Figure 3. The D-Zone Test for Erythromycin-Resistant, Clindamycin-Susceptible Isolates.

n engl j med 357;4 www.nejm.org july 26, 2007

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

MRSA = Methicillin Resistant Staph aureus

MSSA = Methicillin Susceptible Staph aureus

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

MRSA = Methicillin Resistant Staph aureus

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UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

MRSA = Methicillin Resistant Staph aureus

MSSA = Methicillin Susceptible Staph aureus

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER TYLER
DEPARTMENT OF PATHOLOGY - MICROBIOLOGY
2010 NON-URINE ANTIBIOGRAM
% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Augmentin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Cefotetan	Gentamicin	Imipenem	Levofloxacin	Meropenem	Moxifloxacin	Pip/ Tazobactam	Trim/ Sulfa	Ticar/ Clavulanate	Tobramycin						
GRAM NEGATIVE			A/S	AK	AM	AUG	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	CTN	GM	IMP	LVX	MER	MXF	P/T	T/S	TIM	TO						
Acinetobacter sp.	36		91	94				64	79	64		88	82			88		97	91			94	91	88						
Achromobacter sp.	5			80			40	40	100	60		60	80			60	100	100	100		100	100	80	60						
Enterobacter sp.	52		54	100	25		88	92	92	90	13	94	100	46	81	94	100	94	100	94	96	94	81	94						
E. coli	84		42	99	36		93	93	93	93	82	68	94	88	96	83	100	69	100	68	93	50	77	80						
Klebsiella sp.	93		84	99	0		93	97	95	97	87	98	98	93	97	92	100	99	100	99	98	96	95	92						
Proteus sp.	40		62	100	52		92	100	100	100	68	70	100	92	100	85	100	85	100	57	100	62	100	88						
Pseudomonas sp.	289			85			78	41	93	28		81	86			75	91	83	94		95	53	81	89						
Serratia sp.	51		16	96	18		92	98	86	86	2	86	98	6	96	96	96	96	98	94	86	96	98	86						
Stenotrophomonas	83								29									87				98	39							

ORGANISM	# ISOLATES		Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chroamphenicol	Ceftriaxone	Clindamycin	Cephalothin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Ertapenem	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Pip/Tazo	Rifampin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CF	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	ETP	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	P/T	RIF
Enterococcus sp.	66			92										65			100	26			80		71	98				92		58
MRSA	383		0	0	0		86	0	73	0			0	49			99	8		98		0	52	99		76	0	0		97
MSSA	245		100	13	99		96	99	79	99			99	87			99	55	100	99		99	90	100		97	100	14	99	96
Coag Neg Staph	122		54	25	54			53	69				54	73			99	45	100	94			75	100			54	25		97
Strep pneumoniae	60				78	41	100	93	78		63	95			88	69		39					98		71			54		

*17% of the MSSA were D test positive (Inducible Clindamyacin Resistance)
14% of the Coag Neg Staph were D test positive (Inducible Clindamycin Resistance)
61% of the Staph aureus isolated were MRSA
Data collected 01/01/10 thru 12/31/10

UT HEALTH NORTHEAST

DEPARTMENT OF PATHOLOGY - MICROBIOLOGY

2015 NON-URINE ANTIBIOGRAM

% SUSCEPTIBLE

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Amikacin	Ampicillin	Aztreonam	Ceftriaxone	Ceftazidime	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Pip/Tazo	Trim/Sulfa	Tigecycline	Tobramycin
GRAM NEGATIVE			A/S	AK	AM	AZT	CAX	CAZ	CFT	CFZ	CP	CPE	CRM	ETP	GM	IMP	LVX	MER	P/T	T/S	TGC	TO
Acinetobacter sp.	88		83	91			65	84	52		80	80			85		85	94		86		86
Achromobacter sp.	37			64		17	44	50	28		44	47			67	92	72	89	78	86		61
Enterobacter sp.	163		48	98	22	88	83	93	90	21	98	97	47	99	93	94	99	99	95	93	98	94
E. coli	135		45	99	40	93	93	93	94	83	64	94	91	100	84	99	64	100	97	59	100	84
Klebsiella sp.	210		81	99	<1	97	98	98	98	84	99	99	92	99	97	100	99	100	99	93	99	97
Proteus sp.	58		74	98	62	90	93	95	95	69	71	95	90	100	95	50	84	100	100	67	100	95
Pseudomonas sp.	600			87		66	50	90	29		87	85			76	86	87	92	95	62		92
Serratia sp.	162		15	99	8	69	60	65	70	<1	94	97	1	100	94	95	97	100	57	97	99	86
Stenotrophomonas sp.	244							38									91			99		

ORGANISM	# ISOLATES	ANTIMICROBIC	Amp/Sulbactam	Ampicillin	Augmentin	Azithromycin	Chloramphenicol	Ceftriaxone	Clindamycin	Cefaclor	Cefotaxime	Cefazolin	Ciprofloxacin	Cefepime	Cefuroxime	Daptomycin	Erythromycin	Gentamicin	Gent/Syn	Imipenem	Levofloxacin	Linezolid	Meropenem	Moxifloxacin	Oxacillin	Penicillin	Rifampin	Strep/Syn	Synercid	Trim/Sulfa	Tetracycline	Vancomycin
GRAM POSITIVE			A/S	AM	AUG	AZI	C	CAX	CD	CFR	CFT	CFZ	CP	CPE	CRM	DAP	E	GM	GMS	IMP	LVX	LZD	MER	MXF	OX	P	RIF	STS	SYN	T/S	TE	VA
Enterococcus sp.	60			95				0					70			97	12		77		75	98				95	45	70			17	95
MRSA	261		0		0		82	100	68			0	35			99	12	98		0	38	99	0	70	0	0	95		99	99	95	100
MSSA	374		99	0	100		89	54	80			100	86			99	66	99		100	89	98	100	95	100	19	96		99	99	95	100
Coag Neg Staph	155		54	0	54			98	68				65			97	38	88			66	99		78	54	17	99		98	64	82	99
Strep pneumoniae	42				98	63	95		83	71	98			95	80		63				100		93			71				76	78	100

Data collected 01/01/15 through 12/31/15

41.0% of the Staph aureus isolated were MRSA

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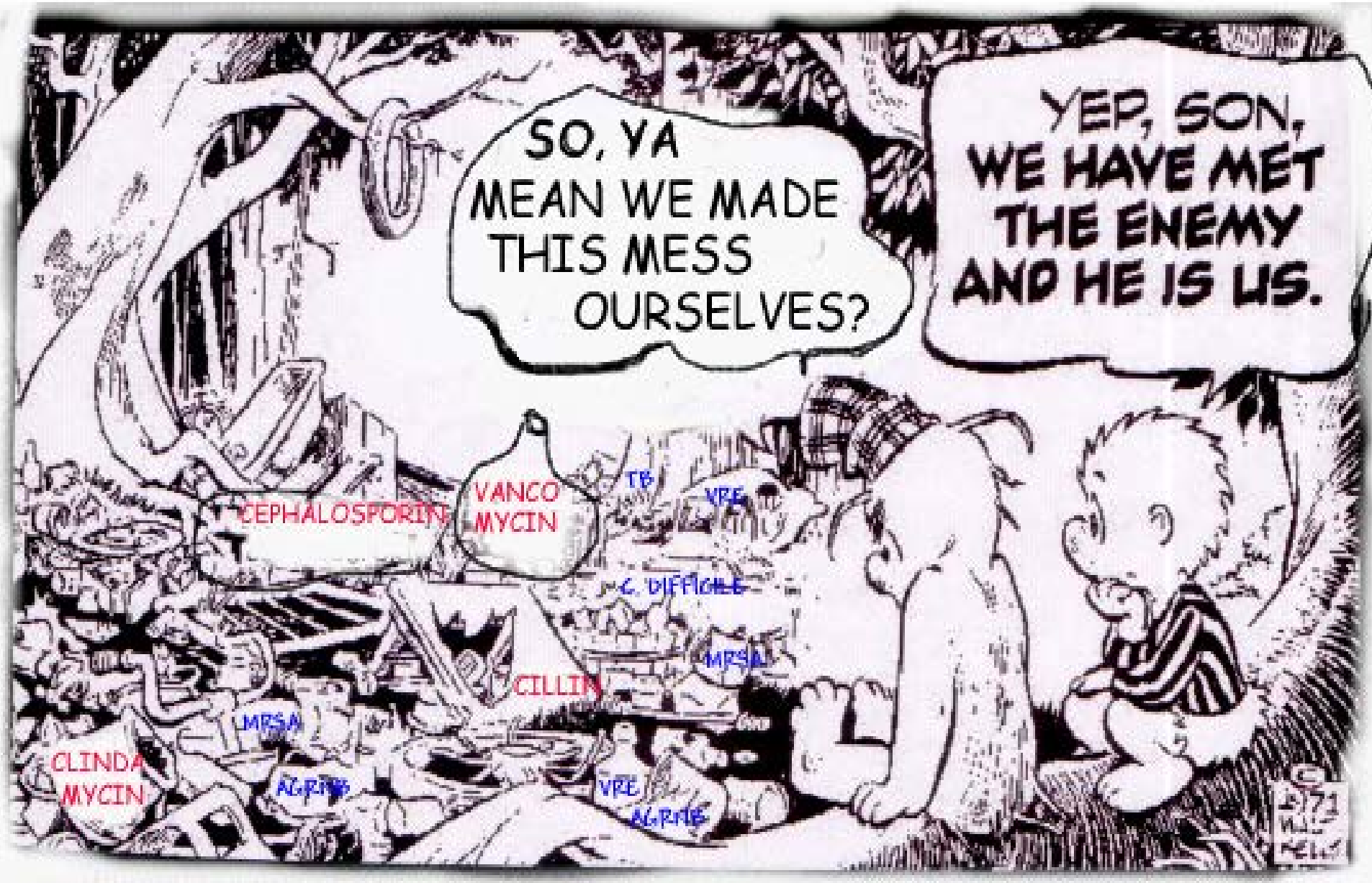
Update: Antibiotic Stewardship,

Joe Sartor, Pharm.D.


SO, YA MEAN WE MADE THIS MESS OURSELVES?
YEP, SON, WE HAVE MET THE ENEMY AND HE IS US.
CEPHALOSPORIN
VANCO MYCIN
TB
VRE
C. DIFFICILE
MRSA
CILLIN
MRSA
CLINDA MYCIN
AGRIE
VRE
AGRIE

Antimicrobial Stewardship

- Antimicrobial stewardship refers to coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration.
- There will be national or coordinated legislative or regulatory mandates designed to optimize use of antimicrobial therapy through antimicrobial stewardship.
- Given the societal value of antimicrobials and their diminishing effectiveness due to antimicrobial resistance, IDSA supports broad implementation of antimicrobial stewardship programs across all health care settings

http://www.idsociety.org/stewardship_policy/#sthash.ODbuCtGQ.dpuf

Goals of Antimicrobial Stewardship

- To achieve best clinical outcomes by optimizing antimicrobial use
- Minimize toxicity and other adverse events
- Limit the selective pressure on bacterial populations that drives the emergence of antimicrobial-resistant strains
- Reduce health care associated infections
- Reduce the costs of inappropriate antimicrobial use

Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America

The Joint Commission has announced a new Medication Management standard effective Jan. 1, 2017.

The elements of performance, in part, address:

- Leaders establishing antimicrobial stewardship as an organizational priority.
- Educating staff and licensed independent practitioners involved with ordering, dispensing, administering and monitoring antimicrobial resistance and stewardship practices.
- Educating patients and families on appropriate use of medications, including antibiotics.
- Creating a multidisciplinary, antimicrobial stewardship team.
- Developing an antimicrobial stewardship program.

CMS

The antibiotic stewardship requirements in the final version of the CMS infection control survey include the following: COMMENT PERIOD ENDS 8/15/2016

- The hospital has written policies and procedures whose purpose is to improve antibiotic use (antibiotic stewardship).
- Designate leaders of the infection prevention and control program and the antibiotic stewardship program respectively, who are qualified through education, training, experience, or certification. This requirement allows for flexibility in staffing in order to suit the needs of each hospital or CAH.
- The hospital's antibiotic stewardship policy and procedures requires practitioners to document in the medical record or during order entry an indication for all antibiotics, in addition to other required elements such as dose and duration.
- The hospital has a formal procedure for all practitioners to review the appropriateness of any antibiotics prescribed after 48 hours from the initial orders (e.g., antibiotic time out).
- The hospital monitors antibiotic use (consumption) at the unit and/or hospital level.

CDC Core Elements of Hospital Antibiotic Stewardship

- Leadership Commitment: Dedicating necessary human, financial and information technology resources
- Accountability: Appointing a single leader responsible for program outcomes. Experience with successful programs show that a physician leader is effective
- Drug Expertise: Appointing a single pharmacist leader responsible for working to improve antibiotic use.
- Action: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e. “antibiotic time out” after 48 hours)
- Tracking: Monitoring antibiotic prescribing and resistance patterns
- Reporting: Regular reporting information on antibiotic use and resistance to doctors, nurses and relevant staff
- Education: Educating clinicians about resistance and optimal prescribing

CDC Key Support

- **Clinicians and department heads**- As the prescribers of antibiotics, it is vital that clinicians are fully engaged in and supportive of efforts to improve antibiotic use in hospitals.
- **Infection preventionists and hospital epidemiologists** coordinate facility-wide monitoring and prevention of healthcare-associated infections and can readily bring their skills to auditing, analyzing and reporting data.
- **Quality improvement staff** can also be key partners given that optimizing antibiotic use is a medical quality and patient safety issue.
- **Laboratory staff** can guide the proper use of tests and the flow of results. They can also guide empiric therapy by creating and interpreting a facility antibiogram. .
- **Information technology staff** are critical to integrating stewardship protocols into existing workflow.
- **Nurses** can assure that cultures are performed before starting antibiotics. In addition, nurses review medications as part of their routine duties and can prompt discussions of antibiotic treatment, indication, and duration.

Interventions to improve antibiotic use

- Broad interventions
  - Antibiotic “Time outs”.
  - Prior authorization
  - Prospective audit and feedback
- Infection and syndrome specific interventions
  - Community-acquired pneumonia, Urinary tract infections (UTIs), Skin and soft tissue infections
  - Empiric coverage of methicillin-resistant *Staphylococcus aureus* (MRSA) infections
  - *Clostridium difficile* infections
  - Treatment of culture proven invasive infections

Interventions to improve antibiotic use

- Pharmacy-driven Interventions
  - Automatic changes from intravenous to oral antibiotic therapy
  - Dose adjustments
  - Dose optimization
  - Automatic alerts in situations where therapy might be unnecessarily duplicative
  - Time-sensitive automatic stop orders
  - Detection and prevention of antibiotic-related drug-drug interactions

Goals of Therapy Guidelines

- Use PK/PD of antimicrobials to promote the selection of the optimal antimicrobial drug regimen and minimize toxicity
- Decrease emergence of antimicrobial resistance
- Reviewed by Infectious Disease physician, Hopitalist, Intensivist, and Family Medicine physicians before presentation to PTCERC
- Promoted in Empiric Therapy order sets

Antibiotic Stewardship Team

- Clinical Pharmacists
- ID Physicians
- Clinical Microbiologist
- Infection Control Specialist
- Meets weekly to review therapies for optimal utilization of antibiotics

Antibiotic Stewardship

- Develop a formal, protocol-based, pharmacist-driven pharmacokinetic dosing program for antibiotics such as:
  - Vancomycin
  - Aminoglycosides
  - Time-dependent beta-lactam antibiotics
  - Antibiotic dosing requiring adjustments for renal/liver dysfunction

Pharmacokinetics and pharmacodynamics are interrelated such that, with respect to antimicrobials, they determine the relationship between serum drug concentrations and antimicrobial effect.

Pharmacokinetics is most important when determining dosing frequency, duration of infusion and affects on antimicrobial resistance

Different classes of antimicrobials have different pharmacodynamic properties.

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Gilbert DN, Moellering RC, Eliopoulos GM et al., eds. The Sanford guide to antimicrobial therapy. 40th ed. Sperryville, VA: Antimicrobial Therapy, Inc.; 2010-:83.

Pharmacokinetics and Pharmacodynamics

- Vancomycin has concentration dependent bactericidal activity
  - dosed renal to a targeted trough of 15mcg/ml (12mcg-17mcg/ml)
  - check trough every 4–7 doses or if significant SCr change
  - utilize MDRD6 to calculate eGFR to estimate trough
  - are looking at AUC/MIC ratios for =>85yo or poor renal function (eGFR < 20ml/minute)
- Aminoglycosides and fluoroquinolones have concentration-dependent bactericidal activity
  - higher the serum concentration, the greater the bactericidal activity of aminoglycosides Peak/MIC ratios
  - AUC/MIC ratio best estimate for fluoroquinolone activity

Rodvold KA. Pharmacodynamics of antiinfective therapy: taking what we know to the patient's bedside. *Pharmacotherapy.* 2001; 21(11, suppl):319S-330S.
Lacy MK, Nicolau DP, Nightingale CH et al. The pharmacodynamics of aminoglycosides. *Clin Infect Dis* 1998; 27:23-7.
Lode H, Borner K, Koeppe P. Pharmacodynamics of luoroquinolones. *Clin Infect Dis.* 1998; 27:33-9.

Pharmacokinetics and Pharmacodynamics

- For beta-lactams the dose–response relationship is time dependent
  - The bactericidal activity is dependent on the time (*t*) that the free drug concentration (*f*) remains above the minimum inhibitory concentration (MIC) during the dosing interval (*ft*>MIC).
- maximal efficacy occurs at a concentration four to five times higher than the MIC

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Owens RC, Shorr AF. Rational dosing of antimicrobial agents: pharmacokinetic and pharmacodynamic strategies. *Am J Health-Syst Pharm. 2*009; 66(suppl 4):S23-30.

Arnold A, Brouse SD, Pitcher WD et al. Empiric therapy for gram-negative pathogens in nosocomial and health care associated pneumonia: starting with the end in mind. *J Intensive Care Med.* 2010;25:259-70.

Kim A, Sutherland CA, Kuti JL et al. Optimal dosing of piperacillin-tazobactam for the treatment of *Pseudomonas aeruginosa* infections: prolonged or continuousinfusion? *Pharmacotherapy.* 2007;27:1490-7.

Pharmacokinetics and Pharmacodynamics

Free beta-lactam concentrations do not have to remain above the MIC for the entire dosing interval. The percentage of time required for both bacteriostatic and maximal bactericidal activity is different for the various classes of beta-lactams. **Carbapenems** require free drug concentrations to exceed the MIC 20% of the dosing interval for bacteriostatic activity and 40% of the dosing interval for maximal bactericidal activity. **Cephalosporins** require free drug concentrations to be above the MIC for 35—40% of the dosing interval for bacteriostatic activity and 60—70% of the dosing interval for bactericidal activity. **Penicillins** require free drug concentrations to exceed the MIC for 30% of the dosing interval to achieve bacteriostatic activity and 50% of the dosing interval to achieve bactericidal activity.

DeRyke CA, Lee SY, Kuti JL, et al. Optimising dosing strategies of antibacterials utilising pharmacodynamic principles: impact on the development of resistance. Drugs 2006;66:1-14.

Drusano GL. Prevention of resistance: a goal for dose selection for antimicrobial agents. Clin Infect Dis 2003;36(S1):S42-50.

Lodise TP, Lomaestro BM, Drusano GL. Application of antimicrobial pharmacodynamic concepts into clinical practice: focus on beta-lactam antibiotics. Pharmacotherapy 2006;26:1320-1332.

MIC Values

- **NOTE: MIC values vary from one drug to another and from one bacterium to another, and thus MIC values are NOT comparable between antibiotics or between organisms.**
- MIC values are used as indicators of appropriate therapies.

Future

- Nursing homes
- Ambulatory practice
- Continuous infusion

HAVE MORTAR WILL PESTLE

Joe Sartor, Pharm.D.

joe.sartor@uthct.edu

903-877-7090