YOUR INSTITUTION'S ANTIBIOGRAM – MORE THAN JUST A TABLE

September 20, 2013

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Disclosure

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September 20, 2013

No Disclosures

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OBJECTIVES

1. Define “Antibiogram”
2. Review the CDC Campaign to Prevent antimicrobial resistance
3. Demonstrate that antimicrobial resistance is local
4. Illustrate the importance of antimicrobial stewardship
5. Explain how the antibiogram is put together by our Lab.
6. Things to watch out for when making your own Antibiogram

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Antibiogram

Definition - aggregation of antimicrobial susceptibility data specific to particular location

Purpose - demonstrate the prevalence of antibiotic resistance among bacteria obtained from residents in your facility

- starting point for empiric antibiotic therapy decisions

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Using the Accumulative Antimicrobial Susceptibility Report

- Use when selecting empiric antibiotic therapy
- Not all antibiotics are included
- When patient specific cultures and susceptibilities become available, streamline antibiotic therapy appropriately
- ICU bacteria tend to more resistant than bacteria isolated from patient's on the general floors, use the ICU Accumulative Antimicrobial Susceptibility Report for ICU patients when possible
- Read the footnotes, you might be missing important information
- MIC is the lowest concentration of antibiotic which inhibits growth of bacteria *in vitro*

In March 2002, the CDC launched a campaign to reduce the prevalence of antibiotic resistance bacteria. In the 12-step prevention campaign, the 6th step recommends for practitioners to "use local data", such as that provided by your institution's accumulative antimicrobial susceptibility report.

This accumulative antimicrobial susceptibility report lists the percent susceptibility of the more common bacteria isolated in the Microbiology Laboratory at ProHealth Care Laboratories for the year 2009. The data is derived from patients admitted to the hospital and individuals seen in the ER. The ICU report is based upon bacteria isolated from patients while in the ICU. We hope this information will be helpful to physicians treating infections in patients at these locations while awaiting individual susceptibility results. Questions should be directed to Raymond P. Podzorski, Ph.D., D(ABMM), Clinical Microbiologist, ProHealth Care Laboratories, 262-928-7635, raymond. podzorski@phci.org.

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Campaign to Prevent Antimicrobial Resistance

Centers for Disease Control and Prevention
National Center for Infectious Diseases
Division of Healthcare Quality Promotion

Clinicians hold the solution!

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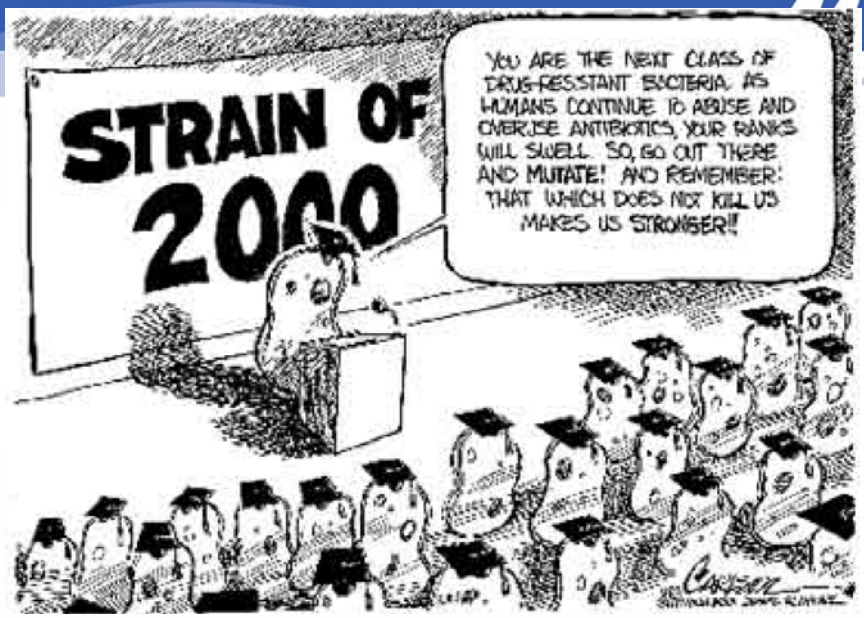

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12 Steps to Prevent Antimicrobial Resistance: Long-Term Care

12 ID residents with MDROs
11 Perform hand hygiene
10 Break the chain of contagion
9 Isolate the pathogen
8 Stop antimicrobial treatment
7 Treat infection, not col./contamination
6 Know when to say "no"
5 Use local resources
4 Use established criteria for diag. of infection
3 Get the unnecessary devices out
2 Prevent conditions that lead to infection
1 Vaccinate

Prevent Transmission

Use Antimicrobials Wisely

Diagnose & Treat Effectively

Prevent Infections

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Diagnose and Treat Infection Effectively

Step 4: Use established criteria for diagnosis of infection

Fact: Using established diagnostic criteria breaks the chain of infection.

Actions:

- ✓ target empiric therapy to likely pathogens and use **local antibiogram**
- ✓ obtain culture and interpret results with care
- ✓ target definitive therapy to known pathogens and antimicrobial susceptibility test results
- ✓ consider *C. difficile* in patients with diarrhea and antibiotic exposure

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Diagnose and Treat Infection Effectively

Step 5: Use local resources

Fact: Antibiotic resistance is local. Common antibiotic-resistant bacteria in one location are often different than those in another location.

Actions:

- ✓ **Contact your lab. and request an antibiogram**
- ✓ **Correlate this information to your facility**

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WI Cumulative Statewide Antibiogram for 2008

Indicates a ≥10% *decrease* in susceptibility as compared to 2006

Indicates a ≥10% *increase* in susceptibility as compared to 2006

		Percent Susceptible (%S)																	
		Aminoglycoside			Cephalosporins					Penicillins			Other						
Gram-Negative Organisms	Number of isolates*	Amikacin	Gentamicin	Tobramycin	Cefazolin (1st generation)	Cefuroxime (2nd generation)	Ceftriaxone (3rd generation)	Ceftazidime (3rd generation)	Cefepime (4th generation)	Ampicillin	Ampicillin/Sulbactam	Piperacillin/Tazobactam	Ciprofloxacin	Levofloxacin	Ertapenem	Imipenem	Nitrofurantoin**	Trimethoprim/Sulfamethoxazole
*Acinetobacter baumanii complex****	237	68	54	68	—	—	6	60[a]	21	—	87	91[a]	18	21	—	54	—	35
Acinetobacter spp.	51	87[a]	84	86	—	—	37[a]	68	78	—	78	88[a]	76	80	—	93	—	85
Citrobacter freundii	895	100	97	97	—	79	88	88	100	—	33	89	88	90	99	100	90	84
Citrobacter koseri	223	100	99	99	94	83	100	100	99	—	91	88	99	97	100	100	81	98
Enterobacter aerogenes	695	100	98	97	—	82	90	89	99	—	24	90	96	98	100	99	22	97
Enterobacter cloacae	2,232	99	97	97	—	37	84	87	98	—	20	88	94	96	93	100	29	91
Escherichia coli	57,886	100	94	95	93	92	98	98	98	64	71	99	85	85	100	100	96	84
Klebsiella oxytoca	1,610	100	99	99	85	93	98	98	99	—	79	96	98	98	99	100	76	97
Klebsiella pneumoniae	9,865	100	99	99	97	93	99	99	99	—	91	99	98	98	100	100	40	95
Morganella morganii	298	100	90	98	—	0	93	89	100	—	6	82	78	83	100	99	—	77
Proteus mirabilis	5,174	100	91	93	93	98	99	99	98	87	95	100	80	86	100	92	—	84
Pseudomonas aeruginosa	8,594	94	87	95	—	—	—	90	86	—	—	96	71	71	—	88	—	—
Serratia marcescens	777	100	100	94	0	0	99	99	98	2	4	98	92	94	100	99	0	98
Stenotrophomonas maltophilia	247	—	—	—	—	—	—	—	—	—	—	—	—	84	—	—	—	93

Note: Not all isolates tested against all antibiotics listed. All sources are included unless indicated.
* Maximum number of isolates tested. % susceptible for each organism/antimicrobial combination may include more than one isolate per patient
** Urine isolates only
*** Includes *A. baumannii* and *A. calcoaceticus*
[a] Less than 30 isolates tested. Percent susceptibility may have less statistical validity
[b] Based on isolates from one institution only.
(—) Drug not tested or drug not indicated

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Antibiotic Resistance is Local

LTC-A

Gram Negatives % Susceptible (all sources)	*Escherichia coli* (83)	*Klebsiella pneumoniae* (20)	*Pseudomonas aeruginosa* (21)	*Proteus mirabilis* (21)
Ampicillin	51	•	•	76
Amoxicillin/Clavulanate	83	88	•	•
Ampicillin/Sulbactam	59	82	•	•
Aztreonam	100	100	•	•
Cefazolin	93	89	•	•
Cefepime	•	100	81	•
Ceftazidime	•	100	90	•
Ceftriaxone	99	100	•	100
Cefuroxime	88	94	•	94
Ciprofloxacin	50	89	67	62
Gentamicin	•	88	81	94
Imipenem	100	100	•	•
Nitrofurantoin*	93	74	•	•
Piperacillin/Tazobactam	•	•	•	•
Ticarcillin/Clavulanate	•	88	•	•
Tobramycin	•	88	100	•
Trimethoprim/ sulfamethoxazole	79	95	•	67

* urine isolates only; (number of isolates)

LTC-B

Gram Negatives % Susceptible (all sources)	*Enterobacter cloacae* (79)	*Escherichia coli* (1,486)	*Klebsiella pneumoniae* (311)	*Pseudomonas aeruginosa* (226)	*Proteus mirabilis* (127)
Ampicillin	•	60	•	•	89
Amoxicillin/Clavulanate	•	87	96	•	•
Ampicillin/Sulbactam	•	65	85	•	•
Aztreonam	•	98	99	77	•
Cefazolin	•	89	97	•	100
Cefepime	100	•	100	86	•
Ceftazidime	82	•	100	90	•
Ceftriaxone	•	97	99	•	100
Cefuroxime	•	91	92	•	100
Ciprofloxacin	93	76	95	67	72
Gentamicin	100	•	98	83	89
Meropenem	100	100	100	86	•
Nitrofurantoin*	35	98	61	•	•
Piperacillin/Tazobactam	91	97	95	93	100
Ticarcillin/Clavulanate	73	•	97	89	•
Tobramycin	98	•	98	96	•
Trimethoprim/ sulfamethoxazole	89	82	91	•	83

* urine isolates only; (number of isolates)

LTC - C

Gram Negatives % Susceptible (all sources)	*Acinetobacter baumanhae* (31)	*Escherichia coli* (81)	*Providencia stuartii* (57)	*Pseudomonas aeruginosa* (87)	*Proteus mirabilis* (81)
Ampicillin	•	25	•	•	67
Amoxicillin/Clavulanate	•	50	•	•	•
Ampicillin/Sulbactam	62	29	50	•	•
Aztreonam	•	52	77	50	•
Cefazolin	•	47	0	•	67
Cefepime	7	•	57	44	•
Ceftazidime	29	•	29	51	•
Ceftriaxone	•	51	71	•	77
Cefuroxime	•	47	29	•	74
Ciprofloxacin	0	19	7	31	34
Gentamicin	20	•	43	35	77
Imipenem	•	100	88	49	•
Meropenem	57	100	93	52	100
Nitrofurantoin*	•	85	•	•	•
Piperacillin/Tazobactam	•	57	75	76	73
Ticarcillin/Clavulanate	7	•	93	53	•
Tobramycin	13	•	43	74	•
Trimethoprim/ sulfamethoxazole	17	44	36	•	55

* urine isolates only; (number of isolates)

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Use Antimicrobials Wisely

Step 6, 7 and 8

Fact: In LTC facilities up to 50% of systemic and topical courses of antibiotics are unnecessary.

Actions:

- ✓ **Develop an antibiotic usage policy - antibiogram**
- ✓ **Collect cultures correctly**
- ✓ **Do not treat asymptomatic bacteriuria**

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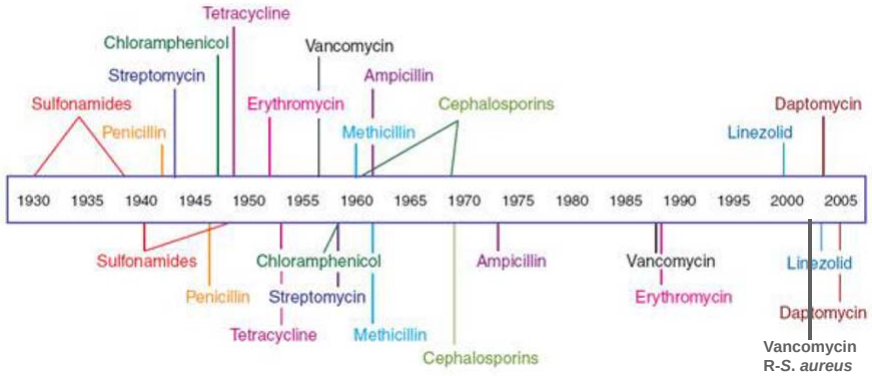
Growing Threat of Antibiotic Resistance

Timeline of Antibiotic Resistance

Introduction of antibiotic



Antibiotic resistance observed

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Antibiotic Pipeline is Drying Up

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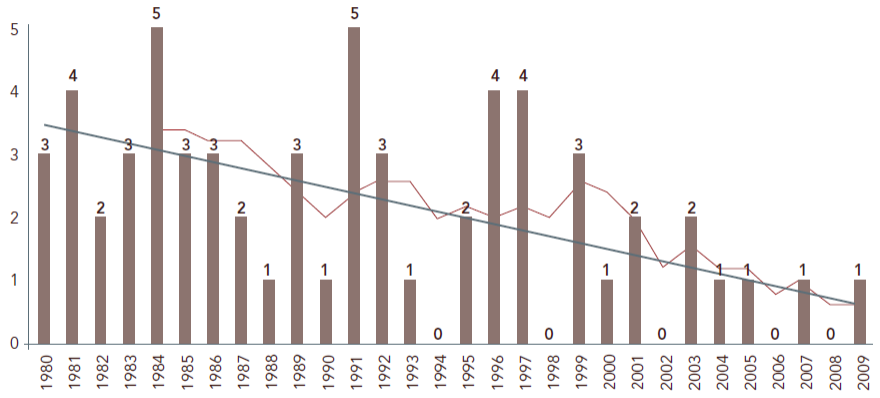
Antibiotic Pipeline is Drying Up

Figure 1. Systemic Antibiotics Approved by FDA (1980–2009)

Total Approvals, Linear Trend, and Five-Year Moving Average



FDA approved 29 systemic antibiotics (those that fight infection throughout the body) in the 1980s, 23 in the 1990s, and only nine in the 2000s.

Source: Adapted from presentation by John Powers

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Antibiotic Pipeline is Drying Up

"Don't forget to take a handful of our complimentary antibiotics on your way out."

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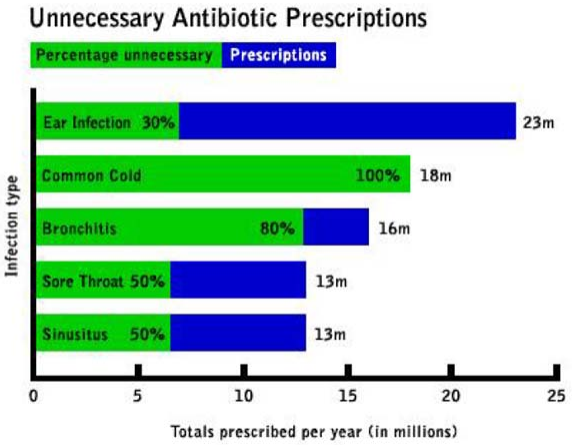
LTC and Antibiotics



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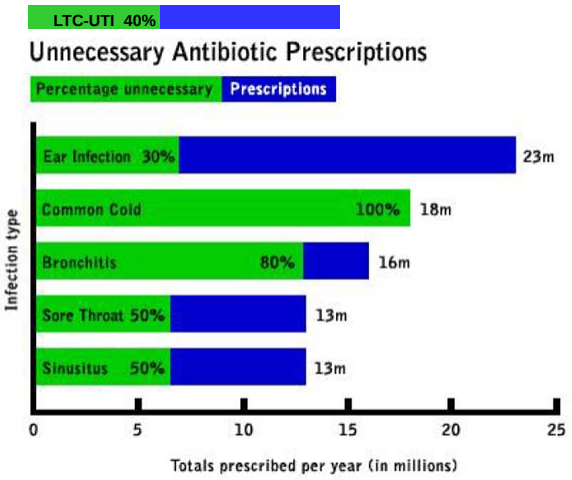
LTC and Antibiotics



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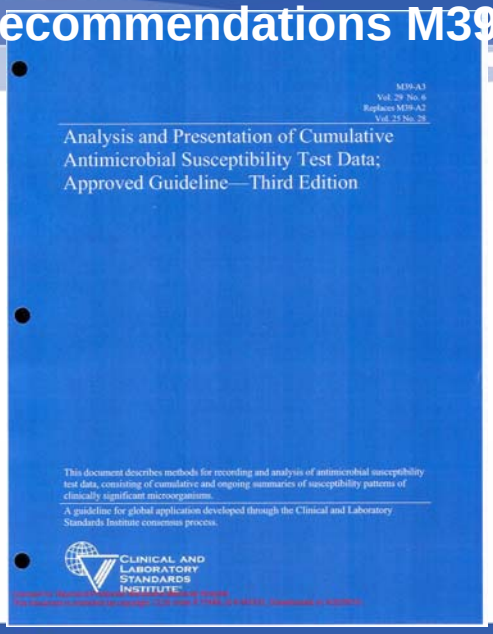
Recommendations M39-A3


M39-A3
Vol. 29 No. 6
Replaces M39-A2
Vol. 25 No. 28

Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline—Third 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 guideline for global application developed through the Clinical and Laboratory Standards Institute consensus process.

CLINICAL AND LABORATORY STANDARDS INSTITUTE

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CLSI Recommendations M39-A3

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WHICH ANTIBIOTICS/BACTERIA TO REPORT IN ANTIBIOGRAM?

- Only Antibiotics Routinely Tested
- When Using Surrogates Report The Agent Represented by the Surrogate
- Include Selective Report and Supplemental Report Antibiotics, Not Just the Primary Reports (Cascade)
- Do Not Include The Results of Agents Tested Selectively Against Isolates with significant resistance
- Report only species with > 30 isolates
- Include only the first isolate/species per patient

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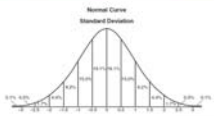
How Many of Each Isolate Are Needed?

95% Confidence (CI) Table



Susceptible or Resistant Rate

Sample Size	10%		20%		30%		40%		50%		60%		70%		80%		90%	
10	0	45	1	56	6	65	12	74	19	81	26	88	35	94	44	99	55	100
20	0	33	6	44	12	54	19	64	27	73	36	81	46	88	56	94	67	100
30	2	27	8	39	15	50	23	59	31	69	41	77	50	85	61	92	73	98
40	3	24	9	36	17	47	25	57	34	66	43	75	53	83	64	91	76	97
50	3	22	10	34	18	45	27	55	36	64	45	73	55	82	66	90	78	97
60	4	21	11	33	19	43	28	53	37	63	47	72	57	81	67	89	79	96
70	4	20	12	32	20	42	29	52	38	62	48	71	58	80	68	88	80	96
80	5	19	12	31	20	41	29	52	39	61	48	71	59	80	69	88	81	95
90	5	18	12	30	21	41	30	51	39	61	49	70	59	79	70	88	82	95
100	5	18	13	29	21	40	30	50	40	60	50	70	60	79	71	87	82	95
200	6	15	15	26	24	37	33	47	43	57	53	67	63	76	74	85	85	94
400	7	13	16	24	26	35	35	45	45	55	55	65	65	74	76	84	87	93
600	8	13	17	23	26	34	36	44	46	54	56	64	66	74	77	83	87	92
1000	8	12	18	23	27	33	37	43	47	53	57	63	67	73	77	82	88	92

CLIS M39-A3

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Do you recognize this man?

Benjamin Disraeli
British Prime Minister
from 1874-1880

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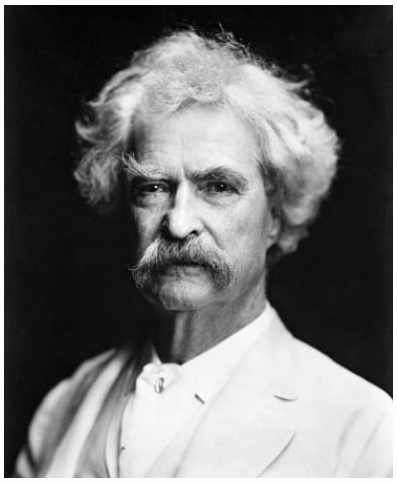
Do you recognize this man?



Mark Twain
Samuel Clemens
American Author
1835-1910

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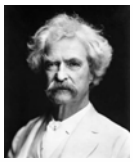
What's the point?

There are three kinds of lies:
"Lies, Damn Lies, and Statistics"

"**Lies, damned lies, and statistics**" is a phrase describing the persuasive power of numbers, particularly the use of statistics to bolster weak arguments. It is also sometimes colloquially used to doubt statistics used to prove an opponent's point.

The term was popularized in the United States by Mark Twain (among others), who attributed it to the 19th-century British Prime Minister Benjamin Disraeli (1804–1881)



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Shady Rest

Gram Negatives % Susceptible (all sources)	*Escherichia coli* (11)	*Klebsiella pneumoniae* (10)	*Pseudomonas aeruginosa* (8)	*Proteus mirabilis* (7)
Ampicillin	64	•	•	33
Amoxicillin/Clavulanate	91	85	•	•
Ampicillin/Sulbactam	64	85	•	•
Aztreonam	100	90	•	•
Cefazolin	91	90	•	•
Ceftazidime	•	90	90	•
Ceftriaxone	99	90	•	100
Cefuroxime	88	90	•	94
Ciprofloxacin	50	80	67	62
Gentamicin	•	88	81	94
Imipenem	100	90	•	•
Nitrofurantoin*	93	74	•	•
Piperacillin/Tazobactam	•	•	•	•
Ticarcillin/Clavulanate	•	88	•	•
Tobramycin	•	88	100	•
Trimethoprim/ sulfamethoxazole	79	85	•	67

* urine isolates only; (number of isolates)

Gram Positive % Susceptible (all sources)	*Enterococcus faecalis* (7)	*Enterococcus faecium* (10)	*Staphylococcus aureus* (13)
Amoxacillin/Clavulanate	•	•	53
Ampicillin	100	10	•
Ampicillin/Sulbactam	•	•	53
Cefazolin	•	•	53
Ceftriaxone	•	•	•
Ciprofloxacin	•	•	•
Clindamycin	•	•	•
Erythromycin	•	•	•
Gentamicin	•	•	•
Linezolid	100	100	100
Meropenem	•	•	•
Moxifloxacin	•	•	•
Nitrofurantoin*	100	100	100
Nafcillin	•	•	53
Penicillin	100	10	•
Tetracycline	•	•	•
Trimethoprim/ sulfamethoxazole	•	•	100
Vancomycin	100	10	100

§ For serious *Enterococcus spp.* infection combination therapy of penicillin, ampicillin, or vancomycin (for susceptible strains), plus an aminoglycoside, is usually indicated, unless high-level resistance to both gentamicin and streptomycin is documented.
* urine isolates only; (number of isolates)

ORGANISM INCIDENCE BY BODY SITE AT SHADY REST 2012

BODY SITE	PERCENT INCIDENCE
BLOOD (4 ISOLATES)	
Staphylococcus aureus	50
Escherichia coli	50
RESPIRATORY (1)	
Streptococcus pneumoniae	100
WOUND/ABSCESS/TISSUE/FLUID (20)	
Staphylococcus aureus	42
Pseudomonas aeruginosa	22
Enterococcus faecium	14
All Others	22
URINE (44)	
Escherichia coli	21
Klebsiella pneumoniae	19
Pseudomonas aeruginosa	13
Enterococcus faecalis	10
Proteus mirabilis	10
Enterococcus faecium	5
All Others	22

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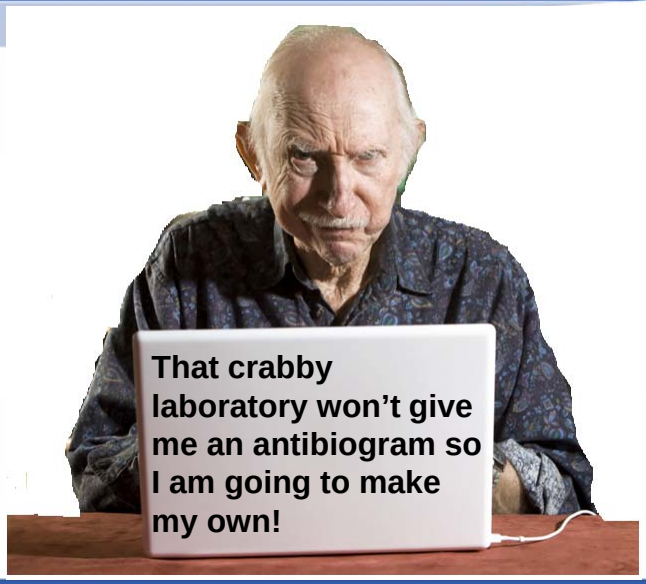
Tips When Making Your Own



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Watch Out for Antibiotic Cascades

Typically not all antibiotics tested on your isolates are reported to you.

Here is Some of What They Tested

Urine – *E. coli*
"*Primary Report*":

Many of these would be included in your Antibiogram!

AMPICILLIN - **S**
CEFAZOLIN – **S**
CEPHALEXIN **- S**
CIPROFLOXACIN - **S**
NITROFURANTOIN - **S**
TRIMETHOPRIM/SULFAMETHOXAZOLE (TMP/SMX) - **S**
CEFTRIAXONE - **S**
IMIPENEM - **S**
CEFEPIME - **S**
TICARCILLIN/CLAVULANATE -
GENTAMICIN - **S**
TOBRAMYCIN – **S**
Plus 10 more!

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Here is Your Patient's Report

Urine – *E. coli*
Primary Report:

AMPICILLIN - **S**
CEFAZOLIN – **S**
CEPHALEXIN **- S**
CIPROFLOXACIN - **S**
NITROFURANTOIN - **S**
TRIMETHOPRIM/SULFAMETHOXAZOLE (TMP/SMX) - **S**

PROHEALTH CARE

When You Have This – Report a Few More

Urine – *E. coli*
Primary Report:

AMPICILLIN - **R**
CEFAZOLIN – **R**
CEPHALEXIN **- R**
CIPROFLOXACIN - **S**
NITROFURANTOIN - **S**
TRIMETHOPRIM/SULFAMETHOXAZOLE (TMP/SMX) - **S**

PROHEALTH CARE

When You Have This – Report a Few More

Urine – *E. coli*
Cascade Report:

AMPICILLIN - **R**
CEFAZOLIN – **R**
CEPHALEXIN **- R**
CIPROFLOXACIN - **S**
NITROFURANTOIN - **S**
TRIMETHOPRIM/SULFAMETHOXAZOLE (TMP/SMX) - **S**
CEFTRIAXONE - **S**

PROHEALTH CARE

Shady Rest

Gram Negatives % Susceptible (all sources)	*Escherichia coli* (11)	*Klebsiella pneumoniae* (10)	*Pseudomonas aeruginosa* (8)	*Proteus mirabilis* (7)
Ampicillin	64	•	•	33
Amoxicillin/Clavulanate	91	85	•	•
Ampicillin/Sulbactam	64	85	•	•
Aztreonam	100	90	•	•
Cefazolin	91	90	•	•
Ceftazidime	•	90	90	•
Ceftriaxone	99	90	•	100
Cefuroxime	88	90	•	94
Ciprofloxacin	50	80	67	62
Gentamicin	•	88	81	94
Imipenem	100	90	•	•
Nitrofurantoin*	93	74	•	•
Piperacillin/Tazobactam	•	•	•	•
Ticarcillin/Clavulanate	•	88	•	•
Tobramycin	•	88	100	•
Trimethoprim/ sulfamethoxazole	79	85	•	67

* urine isolates only; (number of isolates)

Gram Positive % Susceptible (all sources)	*Enterococcus faecalis* (7)	*Enterococcus faecium* (10)	*Staphylococcus aureus* (13)
Amoxacillin/Clavulanate	•	•	53
Ampicillin	100	10	•
Ampicillin/Sulbactam	•	•	53
Cefazolin	•	•	53
Ceftriaxone	•	•	•
Ciprofloxacin	•	•	•
Clindamycin	•	•	•
Erythromycin	•	•	•
Gentamicin	•	•	•
Linezolid	100	100	100
Meropenem	•	•	•
Moxifloxacin	•	•	•
Nitrofurantoin*	100	100	100
Nafcillin	•	•	53
Penicillin	100	10	•
Tetracycline	•	•	•
Trimethoprim/ sulfamethoxazole	•	•	100
Vancomycin	100	10	100

ǂ For serious *Enterococcus spp.* infection combination therapy of penicillin, ampicillin, or vancomycin (for susceptible strains), plus an aminoglycoside, is usually indicated, unless high-level resistance to both gentamicin and streptomycin is documented.
* urine isolates only; (number of isolates)

ORGANISM INCIDENCE BY BODY SITE AT SHADY REST 2012

BODY SITE	PERCENT INCIDENCE
BLOOD (4 ISOLATES)	
Staphylococcus aureus	50
Escherichia coli	50
RESPIRATORY (1)	
Streptococcus pneumoniae	100
WOUND/ABSCESS/TISSUE/FLUID (20)	
Staphylococcus aureus	42
Pseudomonas aeruginosa	22
Enterococcus faecium	14
All Others	22
URINE (44)	
Escherichia coli	21
Klebsiella pneumoniae	19
Pseudomonas aeruginosa	13
Enterococcus faecalis	10
Proteus mirabilis	10
Enterococcus faecium	5
All Others	22

ProHealth Care

Include Only the First Isolate of a Given Species per Patient per Analysis Period (year)

Why? Including multiple isolates from an individual patient can significantly bias data in favor of that particular isolate.

ProHealth Care

Include Only the First Isolate of a Given Species per Patient per Analysis Period (year)

Ms. Reservior

7/2/13 urine > 100,000 CFU/ml *K. pneumoniae*
CFZ-R, CFX-R, CIP-R, FD-R, TMP-SMX-R, CFX-R, IMP-R, CPE-R, Gent-S
7/6/13 urine > 100,000 CFU/ml *K. pneumoniae*
CFZ-R, CFX-R, CIP-R, FD-R, TMP-SMX-R, CFX-R, IMP-R, CPE-R, Gent-S
7/6/13 Blood Culture - *K. pneumoniae*
CFZ-R, CFX-R, CIP-R, CFT, CFX-R, IMP-R, CPE-R, Gent-S, To-R, Pip/Tazo-R, AZT-R, TIG-S
7/7/13 Blood Culture - *K. pneumoniae*
CFZ-R, CFX-R, CIP-R, CFT, CFX-R, IMP-R, CPE-R, Gent-S, To-R, Pip/Tazo-R, AZT-R, TIG-S

PROHEALTH CARE

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Ampicillin	64	•	•	33
Amoxicillin/Clavulanate	91	60	•	•
Ampicillin/Sulbactam	64	60	•	•
Aztreonam	100	70	•	•
Cefazolin	91	70	•	•
Ceftazidime	•	70	90	•
Ceftriaxone	99	70	•	100
Cefuroxime	88	70	•	94
Ciprofloxacin	50	55	67	62
Gentamicin	•	88	81	94
Imipenem	100	70	•	•
Nitrofurantoin*	93	74	•	•
Piperacillin/Tazobactam	•	•	•	•
Ticarcillin/Clavulanate	•	58	•	•
Tobramycin	•	88	100	•
Trimethoprim/ sulfamethoxazole	79	65	•	67

* urine isolates only; (number of isolates)

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Ampicillin	100	10	•
Ampicillin/Sulbactam	•	•	53
Cefazolin	•	•	53
Ceftriaxone	•	•	•
Ciprofloxacin	•	•	•
Clindamycin	•	•	•
Erythromycin	•	•	•
Gentamicin	•	•	•
Linezolid	100	100	100
Meropenem	•	•	•
Moxifloxacin	•	•	•
Nitrofurantoin*	100	100	100
Nafcillin	•	•	53
Penicillin	100	10	•
Tetracycline	•	•	•
Trimethoprim/ sulfamethoxazole	•	•	100
Vancomycin	100	10	100

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Erythromycin	•	•	•
Gentamicin	•	•	•
Linezolid	100	100	100
Meropenem	•	•	•
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