The Clinical Microbiology Laboratory: a Fundamental Resource for Infection Preventionists!

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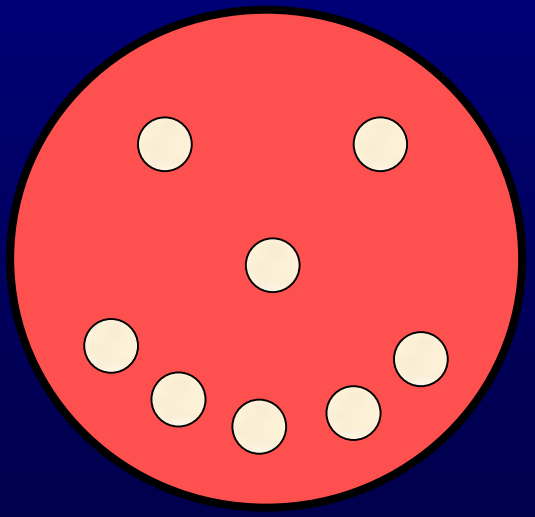


At the conclusion of this program, you will be able to:

- Describe the primary role of a clinical microbiology laboratory; focus on bacteriology.
- Explain how improperly collected specimens can contribute to misleading results.
- List examples where bacteria reported may NOT be contributing to an infection.
- Discuss tests used to determine if a bacterium is susceptible or resistant to an antimicrobial agent.
- Describe a cumulative antibiogram and how this report can be used to guide empiric therapy and monitor % of bacteria susceptible (%S) to specific antimicrobial agents.

Scenario:

Physician sends a specimen to the microbiology lab.

What does he/she want to know?

Does the specimen contain pathogens? What type? How many?

What are the antimicrobial susceptibility profiles of the pathogens in the specimen?

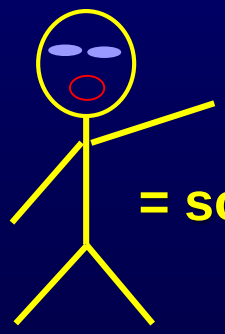
Scenario:

IP practitioner / epidemiologist reviews microbiology laboratory reports.

What does he/she want to know?

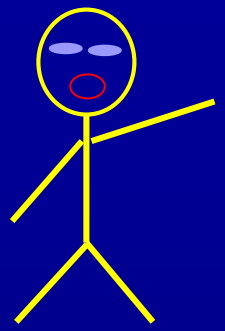
Could the pathogens isolated have been acquired while the patient was in the facility?

What can be done to prevent further spread of the pathogens?

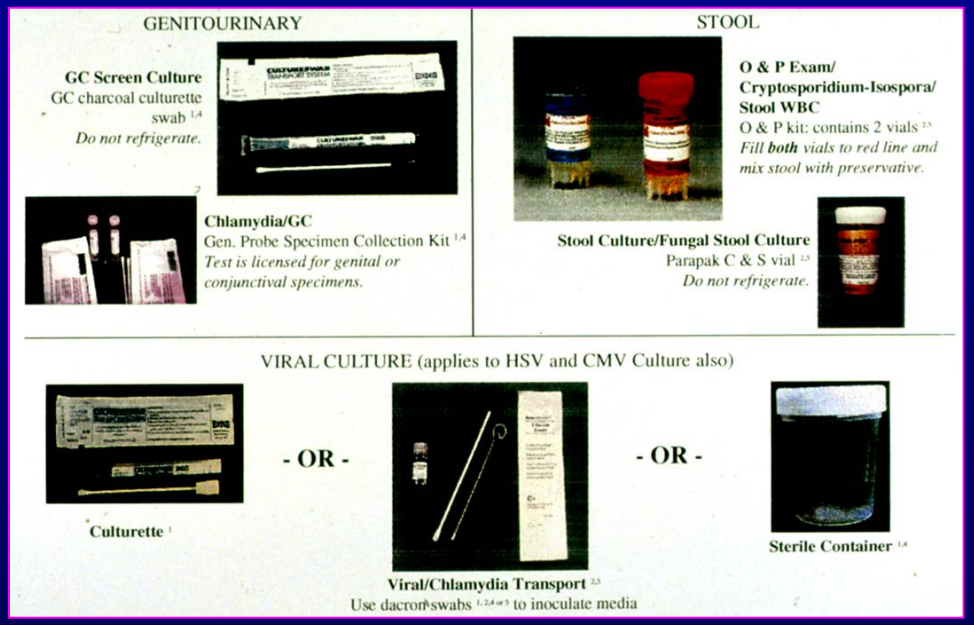


= some key messages!

Examining Patient Specimens for Microorganisms

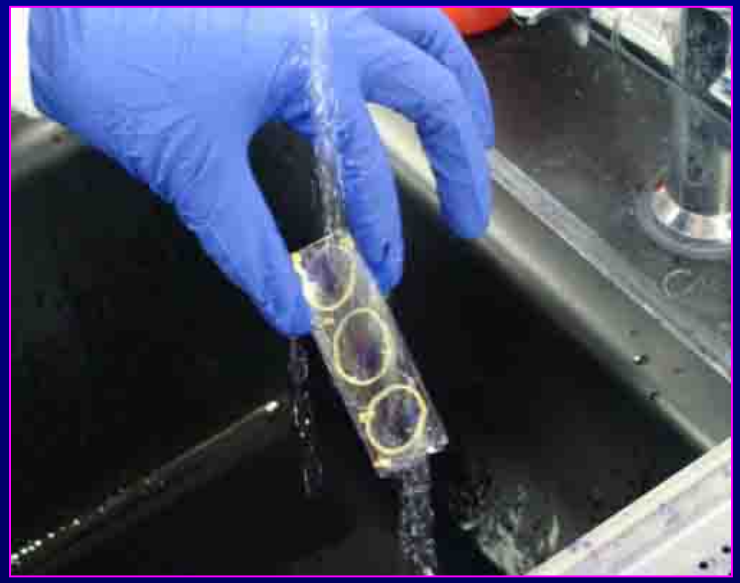


Instructions for collecting / transporting specimens for microbiology tests…



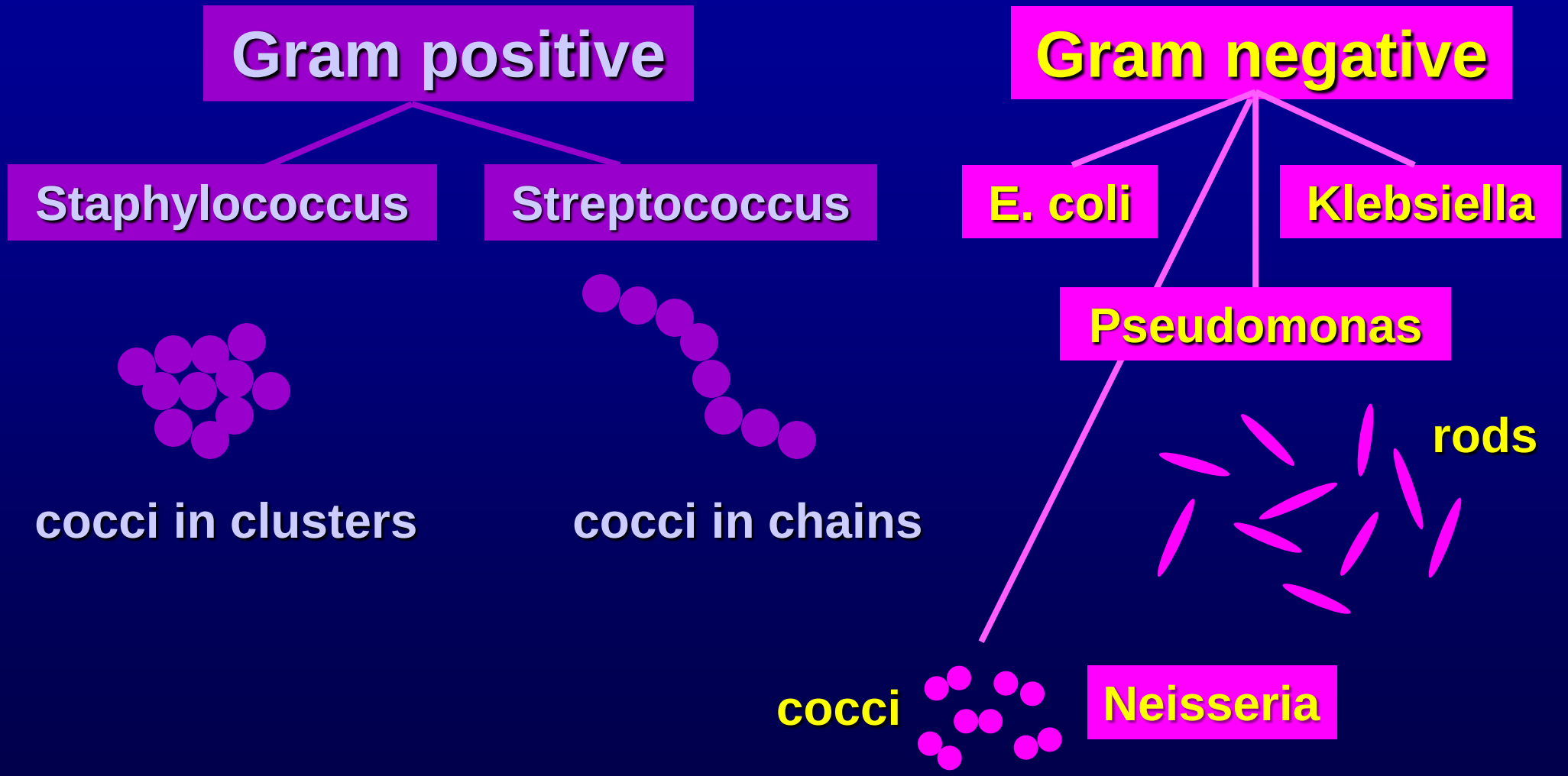
Processing specimens in a biological safety cabinet

Perform / Report Direct Gram Stain for Bacteria

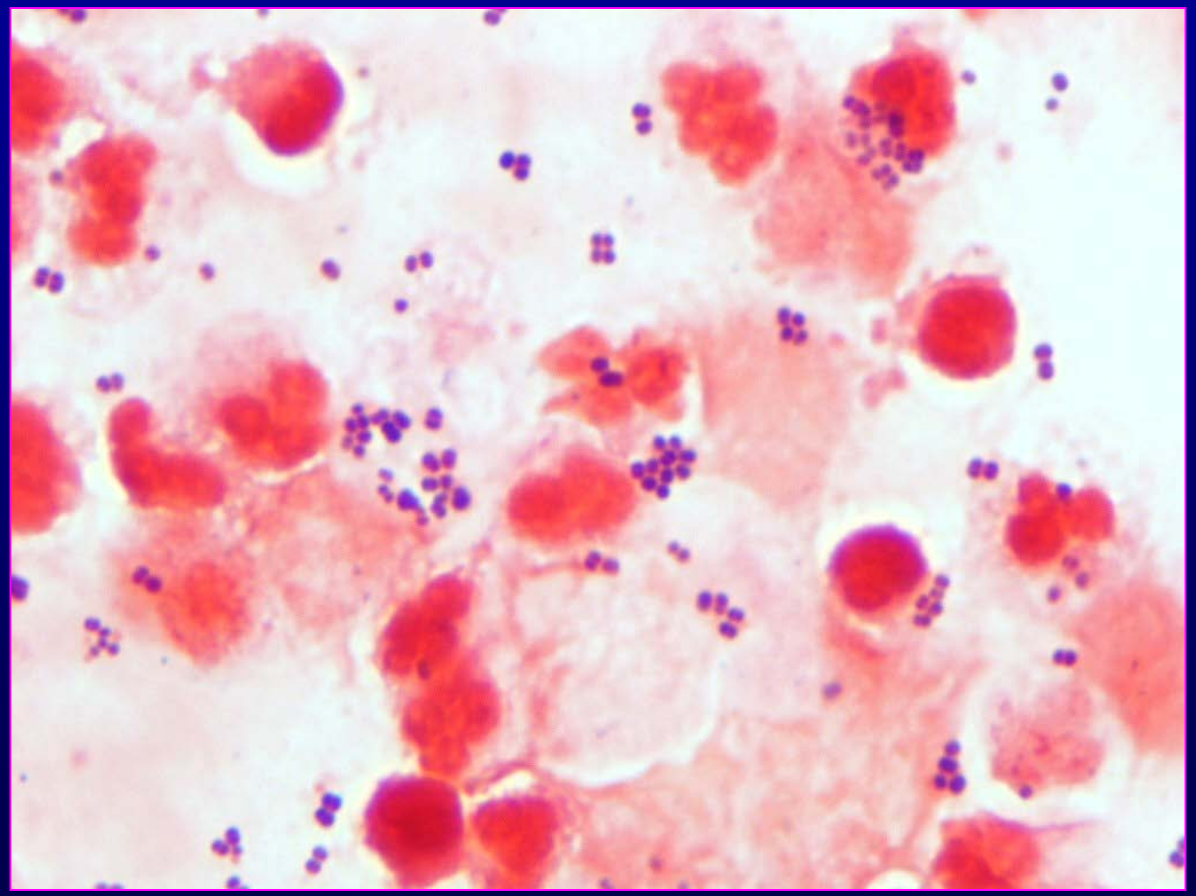


- Report results within a few hours
- Quick insight into possible cause of an infection

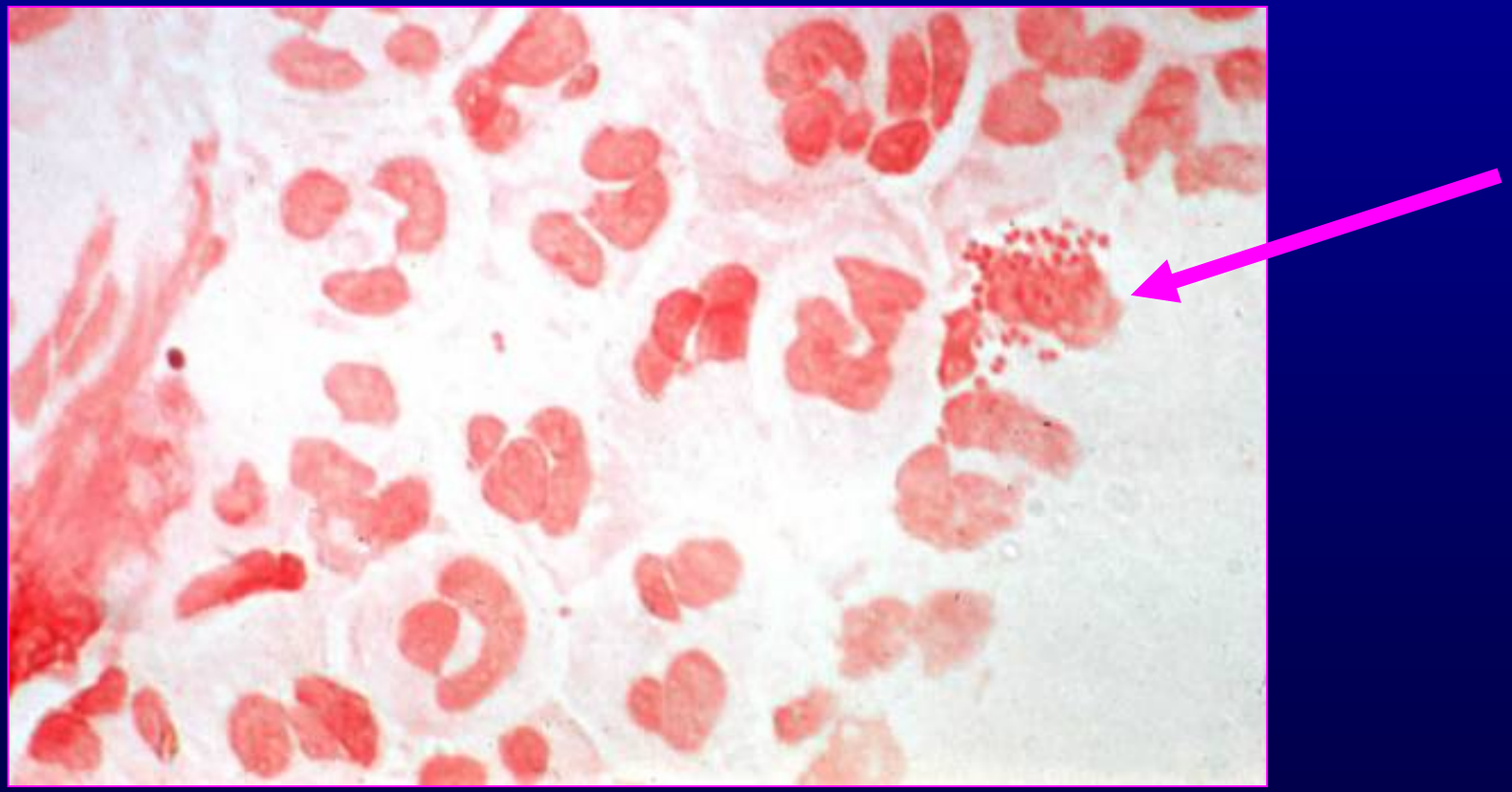
Gram Reactions for Select Bacteria



Direct Gram stain (pus from wound): Gram-positive cocci in clusters + white blood cells



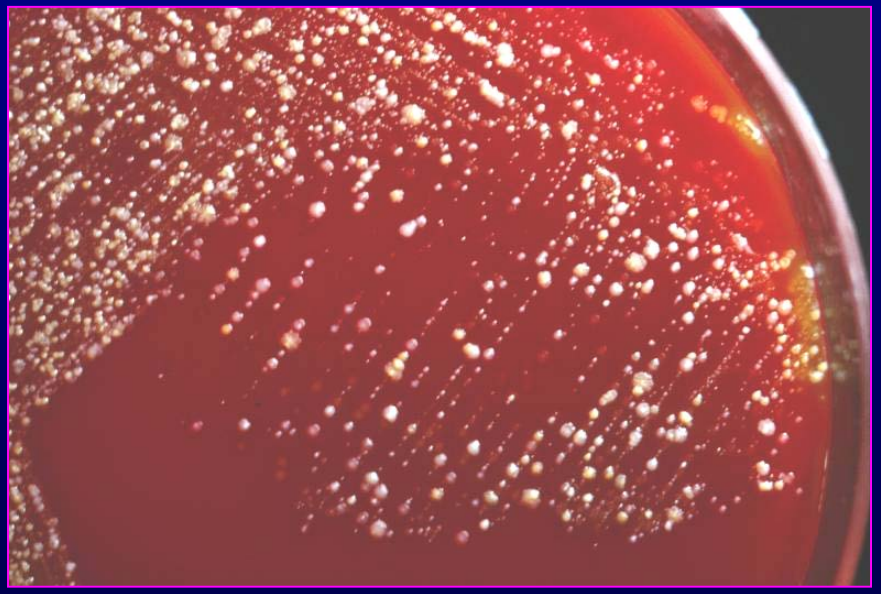
Direct Gram stain (urethral discharge): Gram-negative diplococci (gonorrhoeae) within white blood cells



Place inoculated plates in incubator…

Should I identify these bacteria? Should I perform antimicrobial susceptibility tests on them?

next day



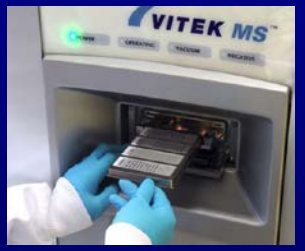
Criteria Used to Identify Bacteria

Traditional methods:

- Gram stain and microscopic exam
- Growth rate and colony appearance on various types of agar media
- Reactivity with various chemicals / reagents

Modern (molecular) methods:

- DNA / RNA content of microorganisms
- Protein profile (MALDI-TOF) of microorganisms



MALDI-TOF = Matrix-assisted laser desorption ionization – time of flight mass spectrometry

Sick Patient!

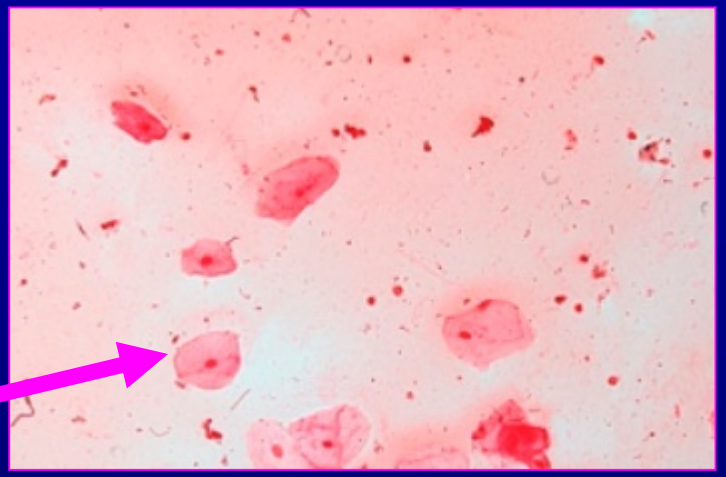
Case

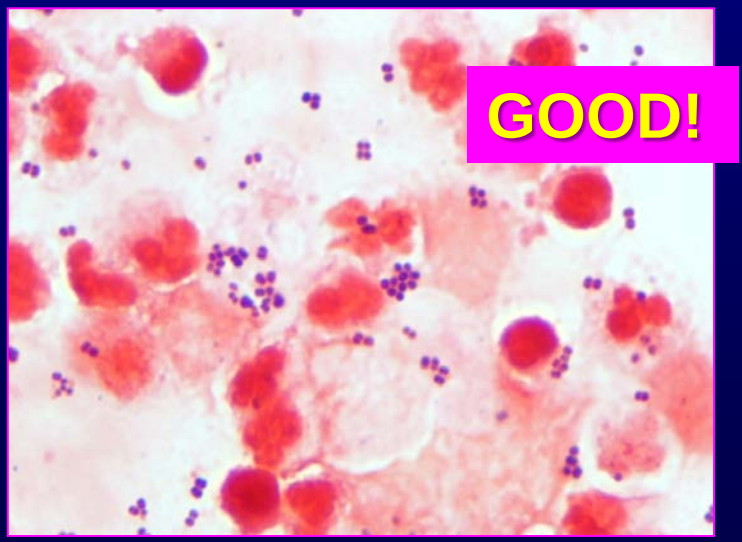
- 85 year old
- Sick for 3 days; getting progressively worse
  - Shortness of breath
  - Fever, chills, sweats, productive cough
- Temperature of 102°F
  - Sputum cultures
  - Blood cultures

Send sputum NOT saliva; send 2 blood cultures; appropriate volumes!

Direct Gram Stain
Assess Sputum Specimen Quality

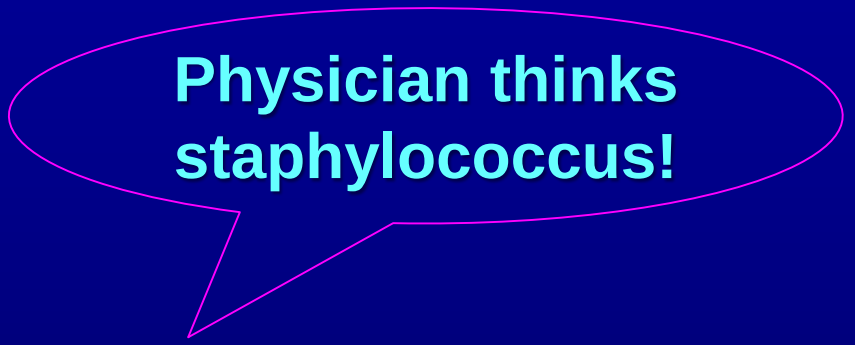
- If saliva vs. sputum collected, may NOT recover "pathogens"
- Prepare direct Gram stain (put specimen on slide)
- Count number of squamous epithelial cells (SEC)





# SEC / low power field	Interpretation
<10	No significant "mouth" contamination
≥10	Indicates poorly collected specimen

Direct Gram Stain Results



- Many WBCs
- Many Gram-positive cocci in clusters
- Moderate normal oral flora

When *Staphylococcus suspected*…

- **Questions:**
  - **Is this *Staphylococcus aureus*?**
    - **If yes, is this methicillin-resistant *S. aureus* (MRSA) or methicillin-susceptible *S. aureus* (MSSA)?**
  - **Is this another species of *Staphylococcus*, typically lumped into "coagulase-negative staphylococci" (CoNS) group?**
    - **Often contaminant; less clinically significant than MRSA or MSSA**

For serious infections….

MSSA

MRSA

Usual Therapy

Oxacillin* or Nafcillin*

Vancomycin

***Methicillin very similar but no longer available**

Common Lower Respiratory Tract Pathogens

- **Community-acquired pneumonia (CAP)**
  - ***Streptococcus pneumoniae***
  - ***Haemophilus influenzae***
  - ***Moraxella catarrhalis***
  - **"Atypicals" – *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, and *Legionella pneumophila***
    - **Often more difficult to recover / identify**
- **Hospital-acquired pneumonia (HAP); most often ICU or ventilator-associated**
  - ***Klebsiella pneumoniae***
  - ***Pseudomonas aeruginosa***
- **Either CAP or HAP**
  - ***Staphylococcus aureus*** **(MRSA or MSSA)**

Yeast uncommon cause of pneumonia or other respiratory tract infection unless present in large quantities and/or immunosuppressed.

Case

Blood specimen for bacterial culture: blood is injected directly into bottle of broth at bedside and sent to the lab.

Timing – collect before antibiotics given
Volume – check instructions; 2 sets!

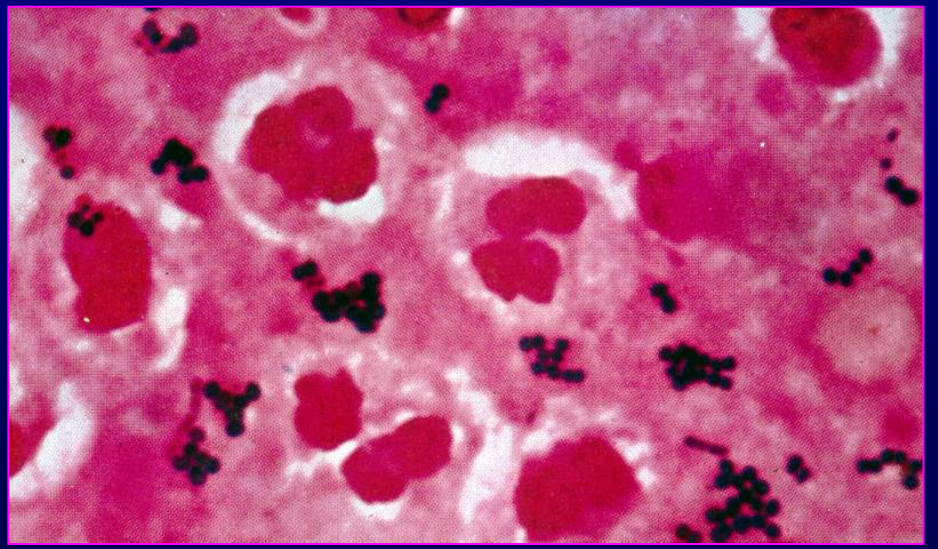
Bottles are placed in blood culture instrument and continuously monitored. If bacteria are present, they multiply, react with "indicator" and sound an alarm when a threshold is reached.

"Positive" blood cultures are Gram stained, subcultured and subjected to other "tests"!

Case

Preliminary Report

Gram stain: gram-positive cocci in clusters



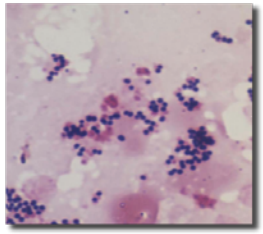
Blood "Traditional" Culture Workup (1)

Pos Blood Culture

Pos

15 Min.

Gram Stain

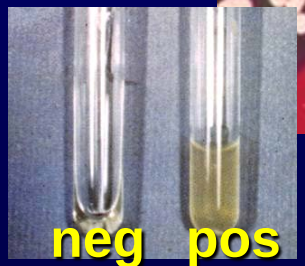


GPCC+

Sheep's Blood Agar Medium

Colonies show:
***Staphylococcus* spp.**
Perform coagulase test to determine if *S. aureus*

16-20 hours



neg pos
coagulase

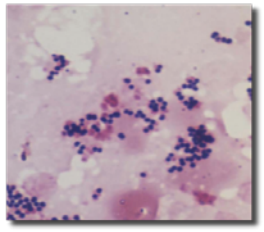
Blood "Molecular" Culture Workup (2)

Pos Blood Culture

Pos

15 Min.

Gram Stain



GPCC+

1-2 hours

Molecular Assay Results:
MSSA or MRSA or CoNS

www.bd.com/geneohm

Sick Patient (Blood Culture)

Final Report with Optional Comment

Gram Stain:

Gram-positive cocci in clusters

Culture:

Staphylococcus aureus (MRSA)

Clindamycin	R
Daptomycin	S
Linezolid	S
Oxacillin	R
Vancomycin	S

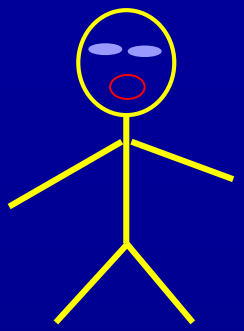
"MRSA isolated. Please check infection control policies."

Blood Culture Contaminants

- Coagulase-negative staphylococci (CoNS)
- Diphtheroids
- *Bacillus* spp.
- *Propionibacterium* spp.
- Viridans streptococcus
- *Micrococcus* spp.

Usually, for these bacteria to be considered as causing infection, two sets of blood cultures must be positive PLUS patient must show specific signs and symptoms of bloodstream infection.

Urine Collection / Transport

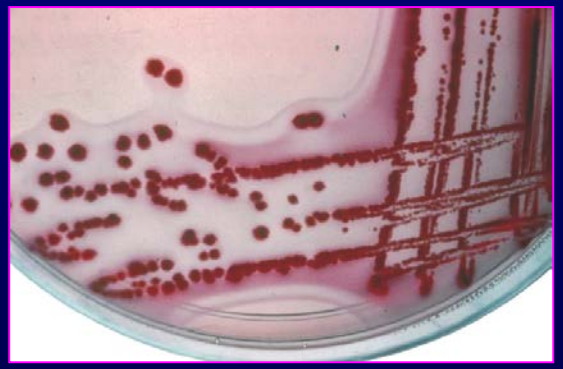


- Must test within 2 hours of collection if stored at room temp
- Must test within 24 hours if refrigerated
- Must test within 2 days if in boric acid preservative

- If UTI symptoms – send for culture!
- Best if culture performed ONLY on specimens with significant pyuria (auto-reflex to culture); e.g., IF positive for leukocyte esterase and/or nitrite tests which suggest infection, THEN culture.

Most Common Pathogens Urinary Tract Infections

- **Community acquired**
  - *E. coli* most common
  - *Klebsiella,* other Enterobacteriaceae
  - *Staphylococcus saprophyticus*
- **Hospital acquired**
  - *E. coli, Klebsiella,* other *Enterobacteriaceae*
  - *Pseudomonas aeruginosa*
  - Enterococci; staphylococci



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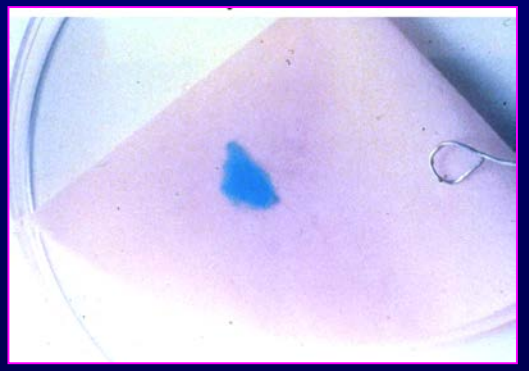


= ***E. coli***

Spot indole test (positive)

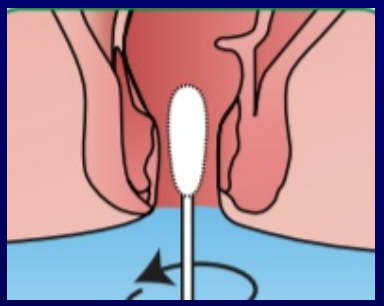
Surveillance Cultures (vs. Diagnostic Cultures)

- Lab processes differently
- Must order as "surveillance culture"
- Must send appropriate specimen
- Only tested for "targeted" pathogen (e.g. MRSA)

Nares Swab

MRSA

Rectal Swab



CRE

CRE = carbapenem-resistant Enterobacteriaceae

Tests to Detect Antimicrobial Susceptibility

When do we do antimicrobial susceptibility tests (ASTs)?

- If 1 or 2 potential pathogens isolated from culture
- If it is likely that the bacteria are causing an infection
- If bacteria have a susceptibility pattern that is unpredictable

Urine Culture

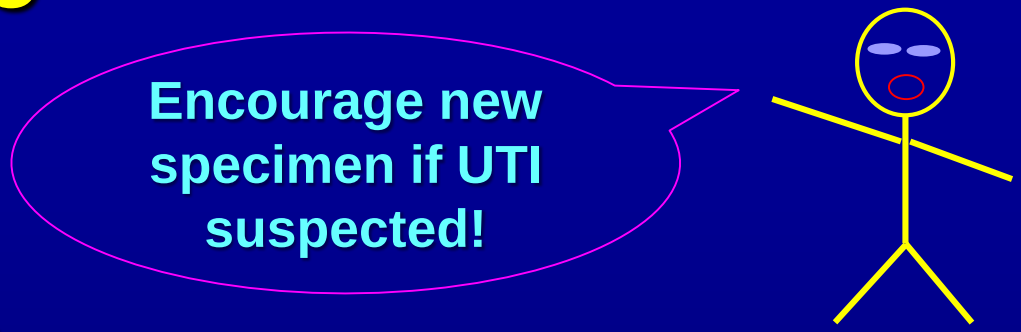
Report:

> 10^5 CFU/ml *E. coli*

Significant quantity of potential pathogen.
***E. coli* common pathogen in urinary tract infections.**
No contaminants.

Perform AST!

Urine Culture



Report:

>10^5 CFU/ml *Corynebacterium spp.*

40,000 CFU/ml *E. coli*

10,000 CFU/ml Yeast

10,000 CFU/ml *Lactobacillus spp.*

Likely contaminated culture. (high numbers of species that are unlikely pathogens).
Do NOT perform AST!

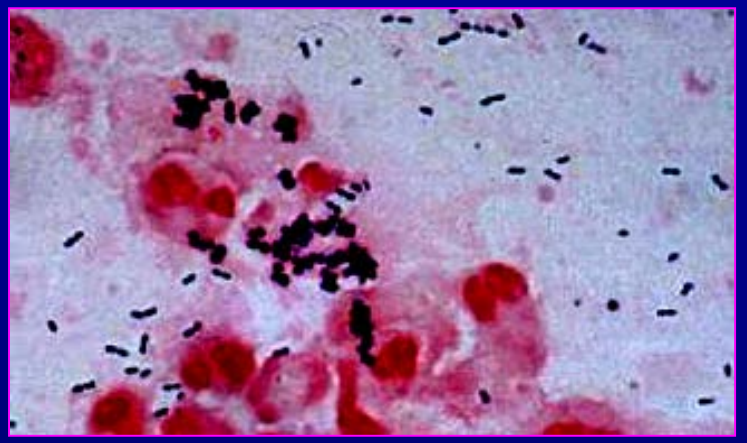
Sputum Culture

Gram Stain:

- Many oral flora
- Many Gram positive diplococci
- Many WBCs

Culture:

- Many Normal Flora
- Many *Streptococcus pneumoniae*



Good correlation of Gram stain with culture.
Significant quantity of potential pathogen.
***S. pneumoniae* relatively common pathogen in respiratory tract infections.**

Perform AST!

Foot Wound Culture

Gram Stain:

- Many Gram positive cocci in clusters
- Many pleomorphic Gram positive rods
- No WBCs

Culture:

- Many coagulase-neg staphylococci
- Many diphtheroids
- Few *E. coli*-like colonies
- Few *Proteus*-like colonies

Poor correlation of Gram stain with culture.
Small quantity of potential pathogens.
"Skin flora" suggests likely contaminated culture.
Do NOT perform AST!

Throat Culture

Many Group A Streptococcus

“Group A Streptococcus is always susceptible to penicillin.”

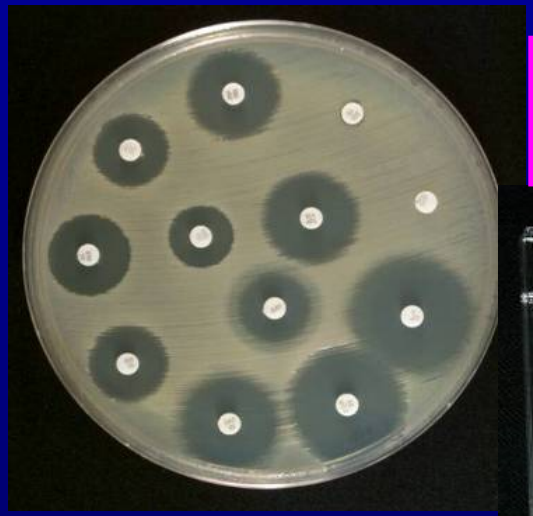
Not necessary to perform AST on bacteria that are always (predictably) susceptible to the antimicrobial agents typically prescribed.

Why do we NOT do susceptibility tests on every potential pathogen isolated?

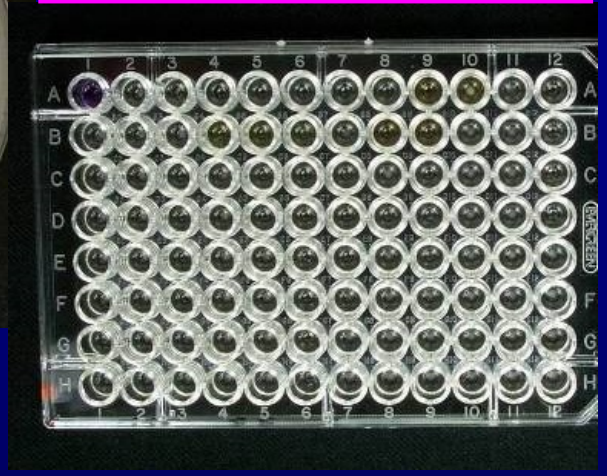
- **AST results on a report suggest that bacteria are causing an infection**
- **Reporting results when NOT needed may lead to:**
  - **Unnecessary or inappropriate therapy**
    - **Selection of resistant bacteria**
    - **Put patient at risk for *Clostridium difficile***
  - **Failure to look further to identify true cause of the patient's problem**

Antimicrobial Susceptibility Tests

Disk diffusion (Kirby Bauer)



Broth microdilution MIC



MIC = minimal inhibitory concentration (lowest concentration of drug that inhibits growth of the test bacteria)

Reported results:

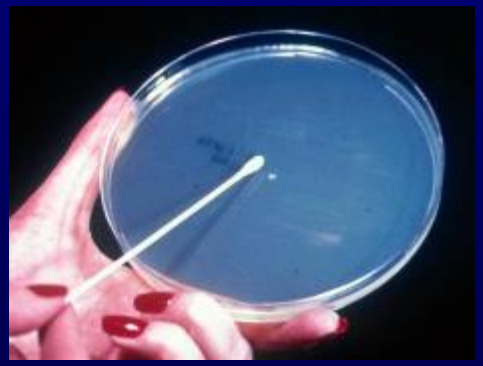
- **Susceptible (S)** – drug likely to work providing it can get to the infection site
- **Resistant (R)** – drug won't work
- **Intermediate (I)** – drug may or may not work depending on site of infection and patient's status

Disk Diffusion Testing

Pick colonies

Prepare inoculum suspension

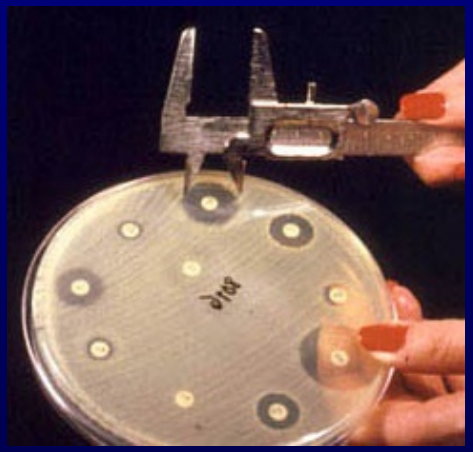
Remove sample



Swab plate

Add disks

Incubate overnight



Measure zones

Zone Diameter "Breakpoints" (mm) Enterobacteriaceae

Drug	S	I	R
Ciprofloxacin	≥21	16-20	≤15
Gentamicin	≥15	13-14	≤12

CLSI, Clinical and Laboratory Standards Institute

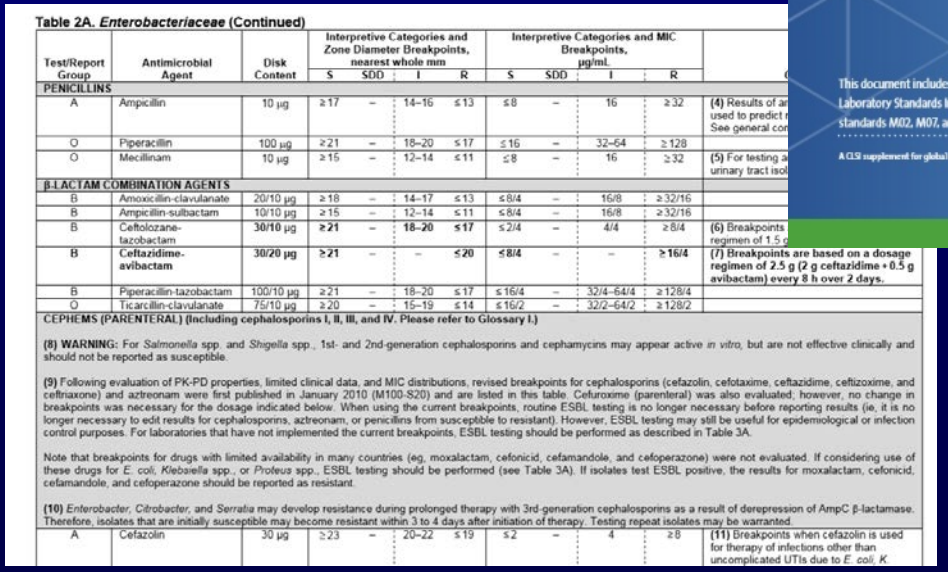


Table 2A. *Enterobacteriaceae* (Continued)

Test/Report Group	Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm S	SDD	I	R	Interpretive Categories and MIC Breakpoints, µg/mL S	SDD	I	R	
PENICILLINS											
A	Ampicillin	10 µg	≥17	–	14–16	≤13	≤8	–	16	≥32	(4) Results of ar… used to predict … See general con…
O	Piperacillin	100 µg	≥21	–	18–20	≤17	≤16	–	32–64	≥128	
O	Mecillinam	10 µg	≥15	–	12–14	≤11	≤8	–	16	≥32	(5) For testing a… urinary tract isol…
β-LACTAM COMBINATION AGENTS											
B	Amoxicillin-clavulanate	20/10 µg	≥18	–	14–17	≤13	≤8/4	–	16/8	≥32/16	
B	Ampicillin-sulbactam	10/10 µg	≥15	–	12–14	≤11	≤8/4	–	16/8	≥32/16	
B	Ceftolozane-tazobactam	**30/10 µg**	**≥21**	–	**18–20**	**≤17**	≤2/4	–	4/4	≥8/4	(6) Breakpoints … regimen of 1.5 g…
B	**Ceftazidime-avibactam**	**30/20 µg**	**≥21**	–	–	**≤20**	**≤8/4**	–	–	**≥16/4**	**(7) Breakpoints are based on a dosage regimen of 2.5 g (2 g ceftazidime + 0.5 g avibactam) every 8 h over 2 days.**
B	Piperacillin-tazobactam	100/10 µg	≥21	–	18–20	≤17	≤16/4	–	32/4–64/4	≥128/4	
O	Ticarcillin-clavulanate	75/10 µg	≥20	–	15–19	≤14	≤16/2	–	32/2–64/2	≥128/2	
CEPHEMS (PARENTERAL) (including cephalosporins I, II, III, and IV. Please refer to Glossary I.)											
A	Cefazolin	30 µg	≥23	–	20–22	≤19	≤2	–	4	≥8	(11) Breakpoints when cefazolin is used for therapy of infections other than uncomplicated UTIs due to *E. coli*, *K.*

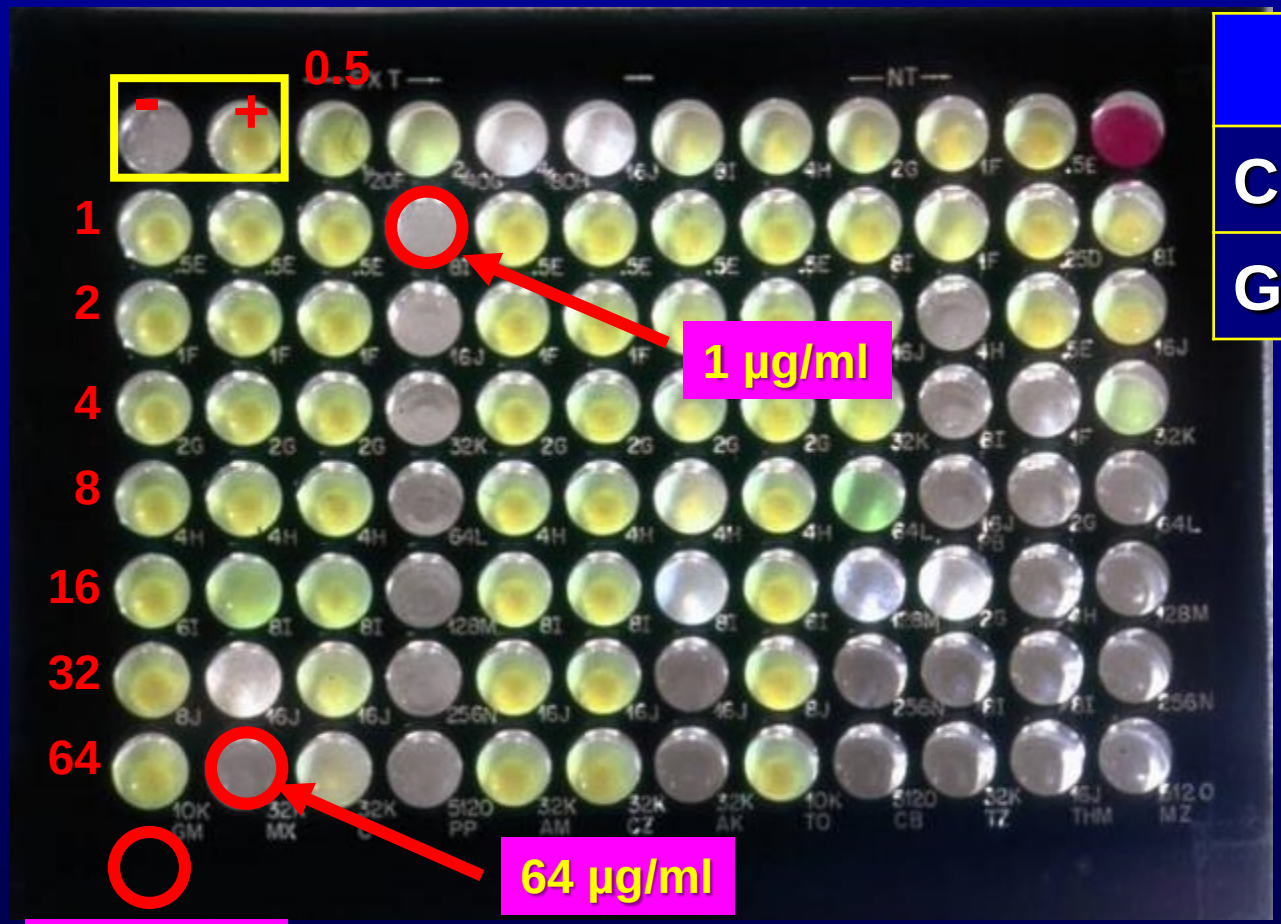
(8) WARNING: For *Salmonella* spp. and *Shigella* spp., 1st- and 2nd-generation cephalosporins and cephamycins may appear active *in vitro*, but are not effective clinically and should not be reported as susceptible.

(9) Following evaluation of PK-PD properties, limited clinical data, and MIC distributions, revised breakpoints for cephalosporins (cefazolin, cefotaxime, ceftazidime, ceftizoxime, and ceftriaxone) and aztreonam were first published in January 2010 (M100-S20) and are listed in this table. Cefuroxime (parenteral) was also evaluated; however, no change in breakpoints was necessary for the dosage indicated below. When using the current breakpoints, routine ESBL testing is no longer necessary before reporting results (ie, it is no longer necessary to edit results for cephalosporins, aztreonam, or penicillins from susceptible to resistant). However, ESBL testing may still be useful for epidemiological or infection control purposes. For laboratories that have not implemented the current breakpoints, ESBL testing should be performed as described in Table 3A.

Note that breakpoints for drugs with limited availability in many countries (eg, moxalactam, cefonicid, cefamandole, and cefoperazone) were not evaluated. If considering use of these drugs for *E. coli*, *Klebsiella* spp., or *Proteus* spp., ESBL testing should be performed (see Table 3A). If isolates test ESBL positive, the results for moxalactam, cefonicid, cefamandole, and cefoperazone should be reported as resistant.

(10) *Enterobacter*, *Citrobacter*, and *Serratia* may develop resistance during prolonged therapy with 3rd-generation cephalosporins as a result of derepression of AmpC β-lactamase. Therefore, isolates that are initially susceptible may become resistant within 3 to 4 days after initiation of therapy. Testing repeat isolates may be warranted.

MIC Testing

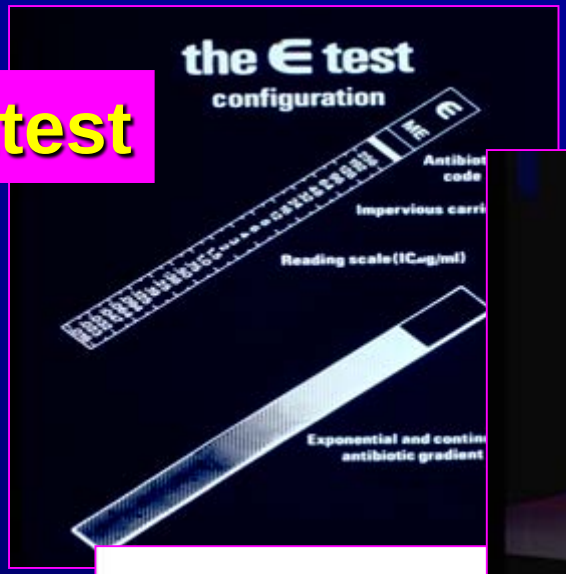


MIC "Breakpoints" (µg/ml) Enterobacteriaceae

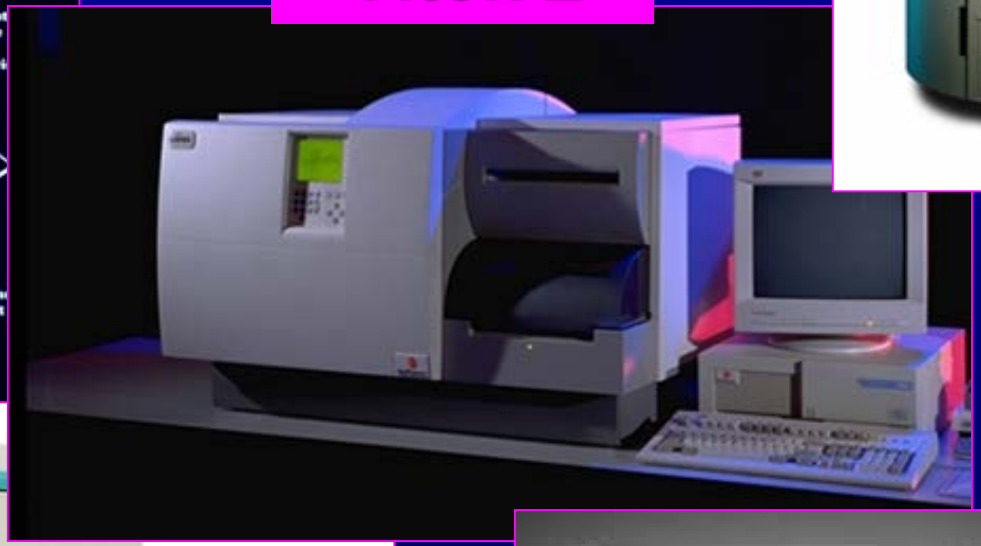
Drug	S	I	R
Ciprofloxacin	≤1	2	≥4
Gentamicin	≤4	8	≥16

Commercial Antimicrobial Susceptibility Test Systems

Etest



Vitek 2



MicroScan

Phoenix

Sensititre

Lab Report

Susceptibility

	Morganella morganii Iso1	
	MIC (MCG/ML)	
Amikacin		
Ampicillin	R	R
Azithromycin		
Cefepime	<=1	S
Ceftazidime		
Ceftazidime/Avibactam		
Ceftolozane/Tazobactam		
Ceftriaxone		
Ciprofloxacin	>=4	R
Colistin		
Ertapenem	<=0.5	S
Fosfomycin		I [2]
Gentamicin	<=1	S
Imipenem		
Levofloxacin		
Meropenem		
Minocycline		
Moxifloxacin		
Nitrofurantoin	64	I
Oral Cephalosporins		
Piperacillin + Tazobactam	<=4	S
Tobramycin		
Trimethoprim/Sulfamethoxazole	>=320	R

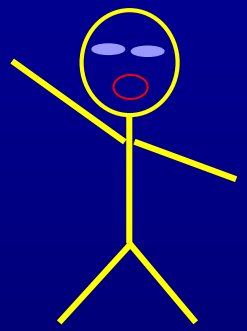
Review of S, I, R most important for IP

For MIC tests, must report S, I, R with or without MIC value.

"Typical" *E. coli* - NO "R"!

Agent	#1	#2
Ampicillin	S	R
Cefazolin	S	R
Cefepime		R
Ceftriaxone		R
Ciprofloxacin	S	R
Ertapenem		S
Gentamicin	S	S
Meropenem		
Nitrofurantoin	S	R
Piper-tazo		S
Trimeth-sulfa	S	R

Acquired "R" to all PO agents. Request fosfomycin – usually not tested routinely!



2 urine *E. coli* isolates

Broad Spectrum drug results suppressed when "S" to narrow spectrum drugs!

Potential outbreak?

Agent	#1	#2	#3	#4	#5
Ampicillin	S	R	R	R	R
Cefazolin	S	R	R	R	R
Cefepime		R	R	R	R
Ceftriaxone		R	R	R	R
Ciprofloxacin	S	R	R	R	R
Ertapenem		S	R	R	R
Gentamicin	S	S	S	S	S
Meropenem			R	R	R
Nitrofurantoin	S	R	R	R	R
Piper-tazo		S	R	R	R
Trimeth-sulfa	S	R	R	R	R

3 more *E. coli* isolates ALL CRE!

CRE = carbapenem-resistant Enterobacteriaceae

CRE = R to doripenem, ertapenem, imipenem OR meropenem

Bacterial Culture Urine (Edited)

40,000 CFU/mL Morganella morganii (A)
Susceptibility Setup Date: 01/18/2018

<10,000 CFU/mL Klebsiella pneumoniae (A)
Susceptibility Setup Date: 01/20/2018

Carbapenem Resistant Enterobacteriaceae (CRE).

This organism is positive for the KPC Carbapenemase. Infectious diseases consult strongly suggested. This patient requires contact precautions, consult HSIC 002.

Susceptibility

	Morganella morganii [iso1]		Klebsiella pneumoniae [iso2]	
	MIC (MCG/ML)		MIC (MCG/ML)	
Amikacin			16	S
Ampicillin	R	R	R	R
Azithromycin			>32	%
Cefepime	<=1	S	>32	R
Ceftazidime			>32	R
Ceftazidime/Avibactam			<=2	S
Ceftolozane/Tazobactam			>32	R
Ceftriaxone			>32	R
Ciprofloxacin	>=4	R	>2	R
Colistin			<=2	WT [1]
Ertapenem	<=0.5	S	>4	R
Fosfomycin		I [2]		S
Gentamicin	<=1	S	16	R
Imipenem			16	R
Levofloxacin			>8	R
Meropenem			>16	R
Minocycline			16	R
Moxifloxacin			>8	%
Nitrofurantoin	64	I	256	R
Oral Cephalosporins			R	R
Piperacillin + Tazobactam	<=4	S	>128	R
Tobramycin			16	R
Trimethoprim/Sulfamethoxazole	>=320	R	>4/80	R

Nitrofurantoin should not be used in patients with impaired renal function (Creatinine Clearance <60 mL/min) or in patients with suspected or confirmed pyelonephritis.

This Klebsiella Pneumoniae has unusual Carbapenem results; Infectious Disease consult suggested.

Lab Report

CRE with comments

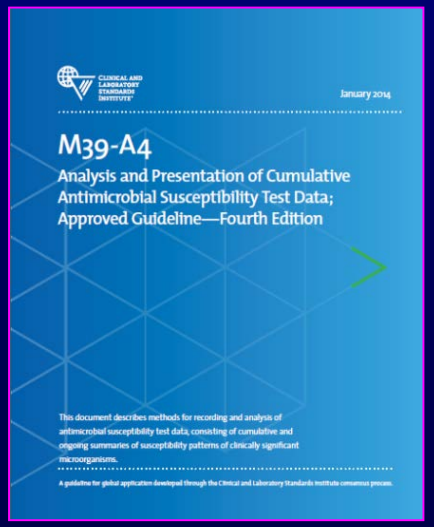
The Cumulative Antibiogram Report

Antibiogram = report that lists percent of isolates of common species susceptible (%S) to individual antimicrobial agents.

- Analyzes data from routine antimicrobial susceptibility tests performed in the clinical laboratory
- Separate report prepared for each healthcare facility
- Primarily used to guide empiric therapy
- Sometimes used to monitor resistance
  - Changes in %S from year to year
- Highly impacted by culturing practices
  - If cultures only done when patients fail therapy, antibiogram will…
    - not be representative of all isolates causing infection in a facility
    - overestimate "resistant" bacteria causing infection in a facility

Recommendations
Preparation of Cumulative Antibiogram

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



Often difficult to get 30 isolates in LTCFs

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

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

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

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

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

CLSI M39-A4.

E. coli - % Susceptible[1]

Category	N	Cip	FM	T-S	CZ
All isolates	4167	77	93	71	92
18-40 yo female outpatient urine	797	90	95	79	96
>65 yo outpatient urine	1260	70	91	68	92

[1] First isolate/pt (CLSI M39-A4)

Cip, ciprofloxacin
FM, nitrofurantoin
T-S, trimethoprim-sulfamethoxazole
CZ, cefazolin as surrogate for cephalexin (oral cephalosporins)

UCLA

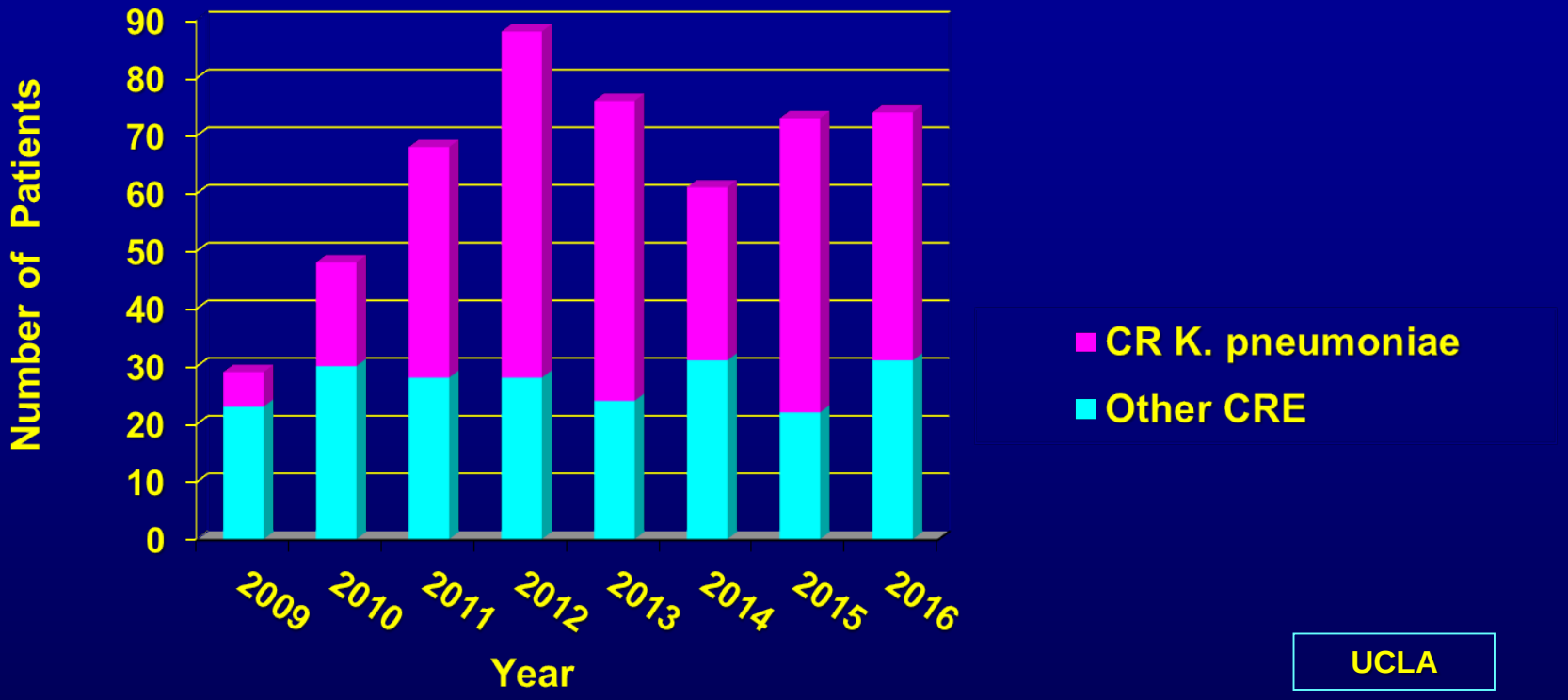
Routine Cumulative Antibiogram % Susceptible

Organism	N	Amp	P-T	Ceftriax	Erta	Mero	Amk	Gent	Cip	T-S
K. pneumoniae	450	R	88	85	95	98	98	92	88	82

- Meropenem = carbapenem
- 98% "S"
- ≈ 2% CRE

CRE = carbapenem-resistant Enterobacteriaceae

Number of CRE Patients



UCLA

Examine all isolates (not just first isolate/patient).
Number of Enterobacteriaceae/year tested = approximately 5000 isolates.

CRE = carbapenem-resistant Enterobacteriaceae

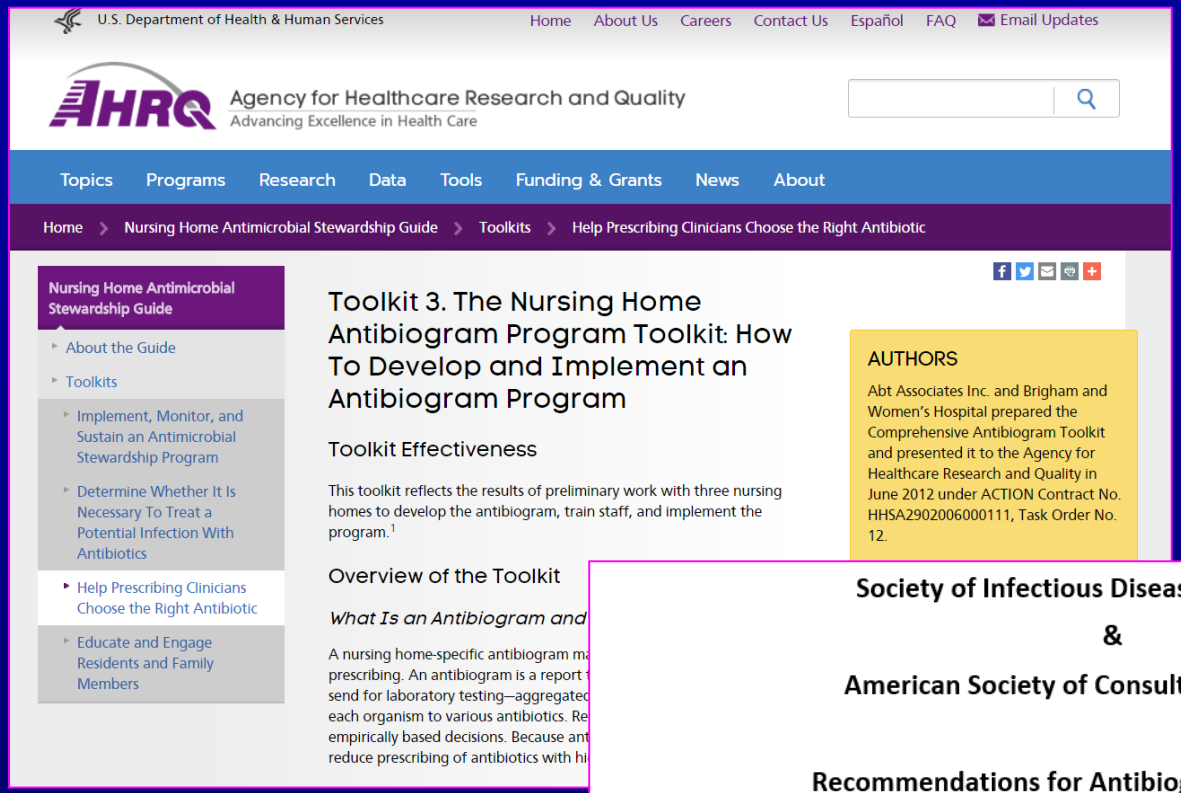
2015 LOS ANGELES COUNTY ACUTE CARE HOSPITAL ANTIBIOGRAM

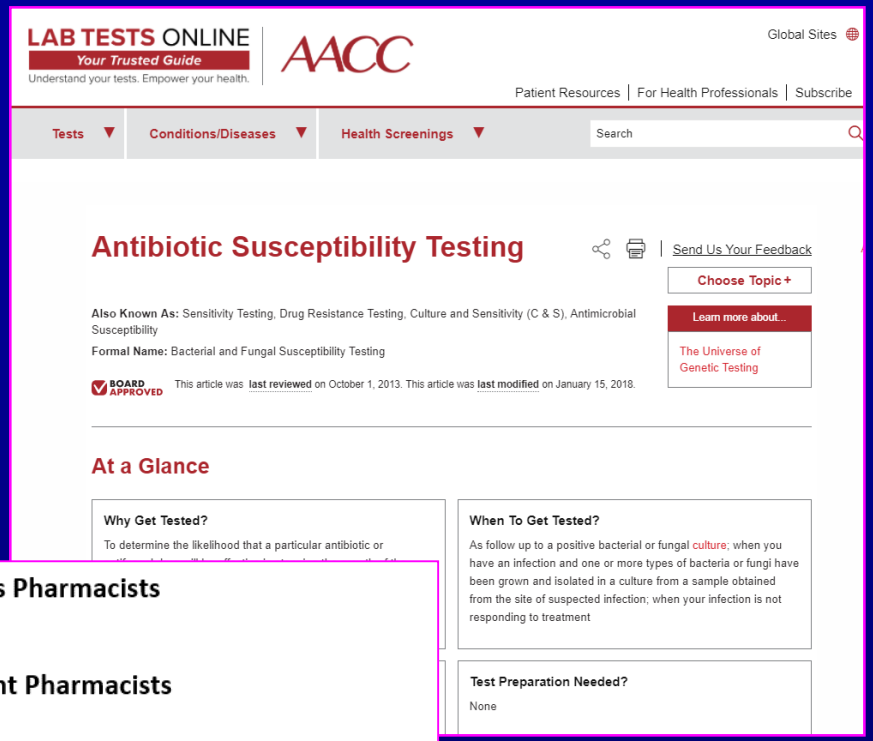
Gram-Negative Organisms

		Penicillins		Cephalosporins			Carbapenems		Aminoglycosides			Quinolone	Other
Percent Susceptible (Number of isolates tested)	**# of all isolates tested** (# of hospitals reporting)	**Ampicillin/ Sulbactam**	**Piperacillin/ Tazobactam**	**Ceftriaxone**	**Ceftazidime**	**Cefepime**	**Ertapenem**	**Meropenem**	**Amikacin**	**Gentamicin**	**Tobramycin**	**Ciprofloxacin/ Levofloxacin**	**Trimethoprim/ Sulfamethoxazole**
Acinetobacter sp.	**3189** (66)	-	**33** (1,873)	**11** (1,475)	**30** (2,184)	**34** (1,864)	R	**53** (1,561)	**43** (2,004)	**41** (2,970)	**46** (2,126)	**33** (3,024)	**49** (2,859)
Citrobacter freundii	**1975** (43)	R	**97** (1,823)	**82** (1,869)	**83** (1,503)	**98** (1,713)	**99** (1,156)	**99** (1,142)	**100** (1,536)	**92** (1,924)	**93** (1,138)	**91** (1,975)	**81** (1,939)
Citrobacter koseri	**631** (23)	-	**99** (631)	**96** (631)	**97** (427)	**100** (456)	**100** (223)	**100** (184)	**99** (389)	**99** (631)	**99** (428)	**99** (631)	**96** (601)
Enterobacter sp.	**8122** (66)	R	**82** (7,507)	**80** (7,307)	**82** (6,204)	**96** (7,040)	**96** (4,417)	**99** (4,638)	**100** (6,235)	**97** (7,972)	**96** (4,630)	**96** (8,120)	**92** (8,018)
Escherichia coli	**139212** (73)	**55** (25,534)	**93** (115,257)	**86** (105,020)	**86** (95,157)	**86** (90,175)	**100** (78,427)	**100** (84,318)	**99** (104,151)	**86** (129,487)	**81** (67,956)	**70** (129,130)	**66** (123,819)
Klebsiella sp.	**30655** (72)	-	**84** (25,586)	**86** (23,006)	**86** (19,120)	**85** (19,895)	**98** (15,578)	**97** (17,025)	**94** (22,223)	**91** (27,934)	**82** (16,128)	**86** (28,047)	**82** (26,934)
Morganella sp.	**2235** (52)	-	**96** (2,233)	**88** (2,055)	**81** (1,811)	**98** (1,921)	**100** (1,148)	**100** (1,127)	**99** (1,913)	**71** (2,234)	**86** (1,358)	**60** (2,231)	**55** (2,154)
Proteus sp.	**16908** (68)	-	**98** (15,836)	**90** (15,682)	**92** (13,067)	**92** (13,832)	**99** (9,018)	**99** (9,903)	**99** (13,470)	**83** (16,554)	**84** (10,176)	**68** (16,738)	**68** (16,491)
Providencia sp.	**1618** (36)	-	**73** (1,542)	**66** (1,404)	**55** (1,315)	**77** (1,285)	**88** (228)	**90** (553)	**91** (1,442)	**11** (1,259)	**14** (960)	**11** (1,512)	**46** (1,513)
Pseudomonas aeruginosa	**22804** (73)	R	**83** (20,040)	R	**82** (18,315)	**84** (19,015)	R	**82** (14,261)	**95** (19,491)	**83** (22,271)	**91** (19,850)	**69** (22,132)	R
Serratia sp.	**2676** (58)	R	**91** (2,098)	**90** (2,403)	**91** (2,188)	**97** (2,203)	**97** (1,414)	**98** (1,579)	**97** (2,188)	**97** (2,757)	**85** (1,677)	**88** (2,646)	**97** (2,544)
Stenotrophomonas maltophilia	**1719** (50)	R	R	R	**37** (848)	R	R	R	R	R	R	**79** (1,052)	**90** (1,548)

LA County Antibiogram 2015

Composite Data from Antibiograms from Acute Care Hospitals





Society of Infectious Diseases Pharmacists

&

American Society of Consultant Pharmacists

Recommendations for Antibiogram Development
Long-Term Care Facility (LTCF) Addendum

The ability to generate an accurate annual cumulative susceptibility report (antibiogram) according to CLSI M39 guidelines is challenging for many LTCF due to selective culturing practices, small numbers of isolates, and ambiguity with regard to who should be responsible for antibiogram development for each LTCF (e.g., the LTCF contracted lab, the LTCF medical director, the LTCF consultant pharmacist, etc). Similar to acute care hospitals, the first step in the process of antibiogram development for LTCFs is to have a multidisciplinary planning meeting with all of the stakeholders in the LTCF in order to discuss and formulate a plan to meet the needs of each individual LTCF. For LTCF antibiogram development, this multidisciplinary group should be comprised of LTCF leadership, the LTCF medical director, LTCF consultant pharmacist, the LTCF lab provider, and representatives from the LTCF Antibiotic Stewardship Committee and local hospital, if applicable. Areas that should be addressed at the planning meeting include identification of:

1) the person responsible for preparing the antibiogram

Summary

- Assessment of patient's clinical symptoms together with reliable clinical microbiology laboratory results are essential for accurate diagnosis of infections.
  - Reliable clinical microbiology laboratory results are dependent on:
    - appropriate collection and transport of specimens.
    - accurate identification and antimicrobial susceptibility testing.
    - good communication between healthcare providers and lab.
- Review of clinical microbiology laboratory results is key to identification of potential nosocomial transmission of microbes.
- Additional clinical microbiology laboratory tests may be needed for epidemiological investigations.
- A local cumulative antibiogram can help guide empiric therapy decisions and monitor "%S" for antimicrobial agents appropriate for common pathogens.

Thank You!