CLINICAL MICROBIOLOGY

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Objectives

- Describe role of the clinical laboratory in infection prevention; emphasis on microbiology

- Describe factors that can adversely affect reliable lab results

- Discuss the importance of the gram stain

- Discuss the interpretation, use and importance of the antibiogram

- Discuss common pathogens that may contribute to HAIs

- Understand laboratory testing methods for confirming infections

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Microbiology and Infection Prevention

Microbiology has two important functions related to infections

- **Clinical**: diagnosis and management of infections

- **Epidemiological**: understand infectious microbes in patients (and populations), to find sources and routes of transmission necessary for prevention efforts

# Clinical Microbiology

Physician's perspective:

– What's growing?

– What antibiotic can be used?

  • Determined either by predictive value of the organism type (e.g. gram negative bacillus) or by complete result with sensitivities

IP or Epidemiologist's perspective:

– Surveillance for determining clusters/outbreaks and assessing trends

– Need to know organism so IP can implement proper transmission-based precautions as needed in a timely fashion

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Primary Rules on Microbiology Cultures

- Rule 1:

  No Lab Test is 100% Accurate

- Rule 2:

  Positive Cultures Do Not Make an Infection
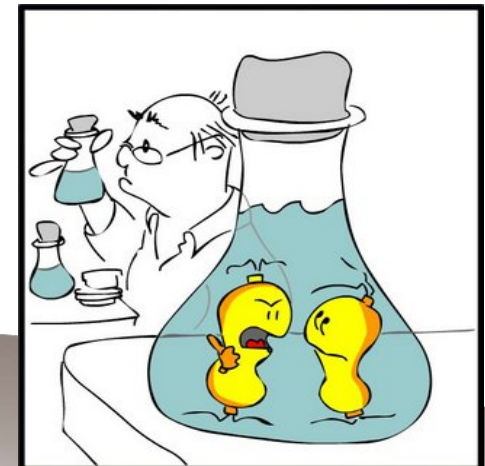
I'M FED UP WITH THIS GUY - LET'S BECOME PATHOGENIC

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Assessing Accuracy of Lab Results

Rule #1: No lab test is 100% accurate 100% of the time

Many factors can affect accuracy of laboratory tests

1. Collection Error
   - How was specimen collected, handled, transported, preserved prior to arrival in the lab?

2. Lab Error
   - Were correct agar plates used? Was the specimen incubated at correct temp? Lab protocols followed? Skill of the micro tech? Accuracy of biochemical and instrument system?

3. Reporting Error
   - Accurate result transcription in computer systems? Did results get communicated to the doctor accurately?

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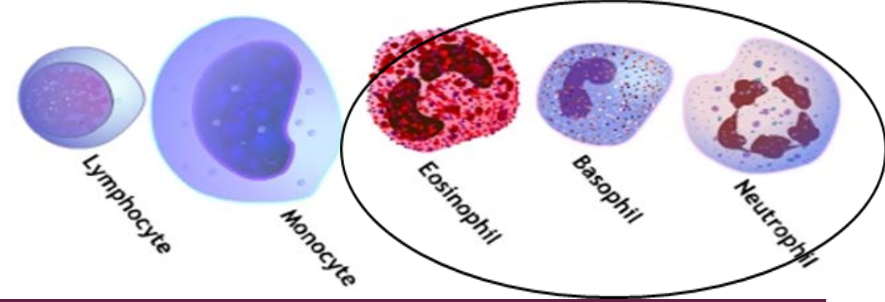## Rule #2: Positive Culture Does Not Mean Infection

Bacteria Must Invade Tissue To Cause An Infection

- For some tests such as polymerase chain reaction (PCR), because an organism is present does not mean it is viable (transmissible)

- Pseudo-outbreaks due to lab contamination of samples can occur

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What might indicate invasion into Tissue???

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White Blood Cell (WBC)

- PMNs (polymorphonuclear leukocytes) made in bone marrow; provide general response to threat
    - Neutrophils (~50-60% wbcs) are first line of response to infection; may also be called 'segs'
    - Eosinophils (1-7% wbcs); allergic reactions and parasites)
    - Basophils (<1%); allergic reactions, help mediate strength of immune response)
- Left shift: presence of immature neutrophils (called ' bands' or 'stabs') in blood count; are indicative of acute infection or inflammatory process

www.rnceus.com/cbc/cbcdiff.htm

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Lymphocytes & Monocytes
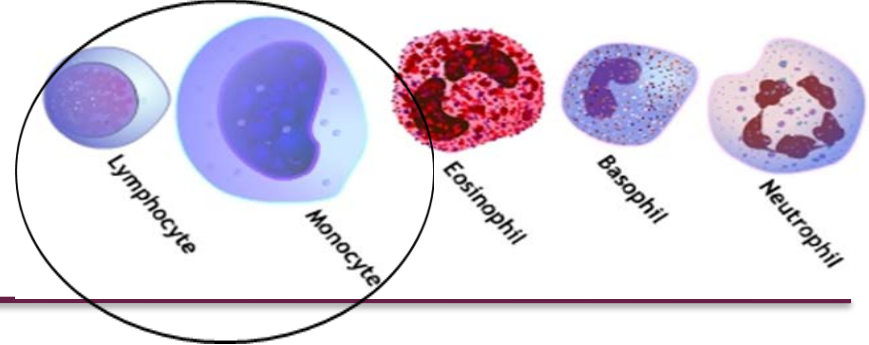
- Lymphocytes (lymphs) mature in the lymphatic portion of the immune system
    - Include pathogen-specific immune response (B cells, T cells)
    - Increase may be indicative of viral infection
- Monocytes (or macrophages) phagocyte function (or eat) cellular debris and foreign pathogens from the immune system
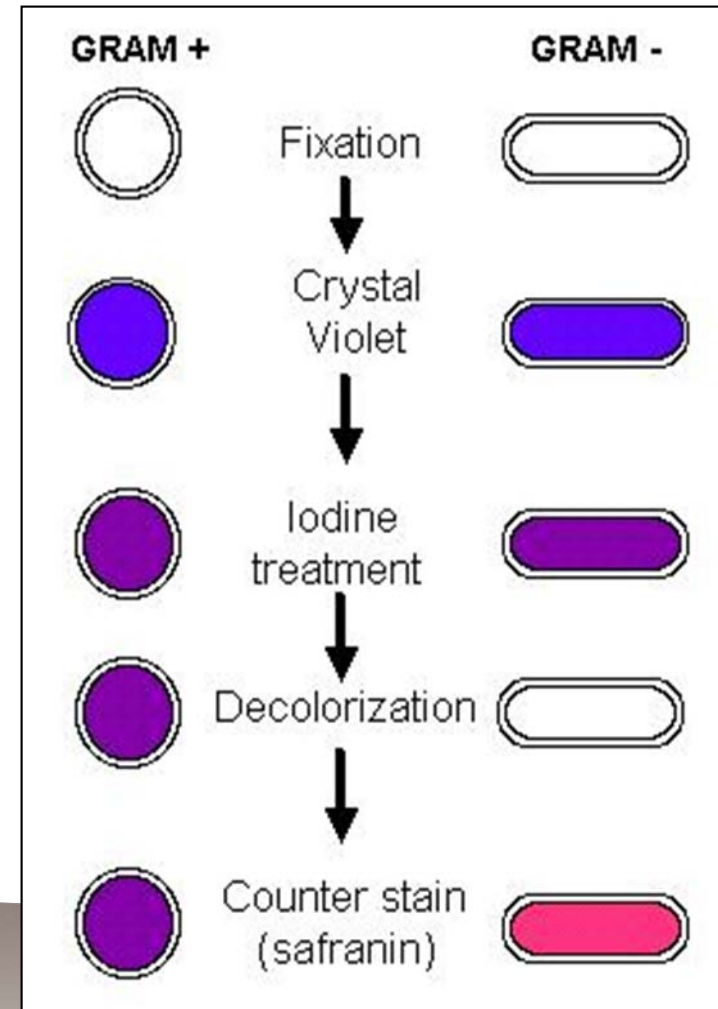
www.rnceus.com/cbc/cbcdiff.htm

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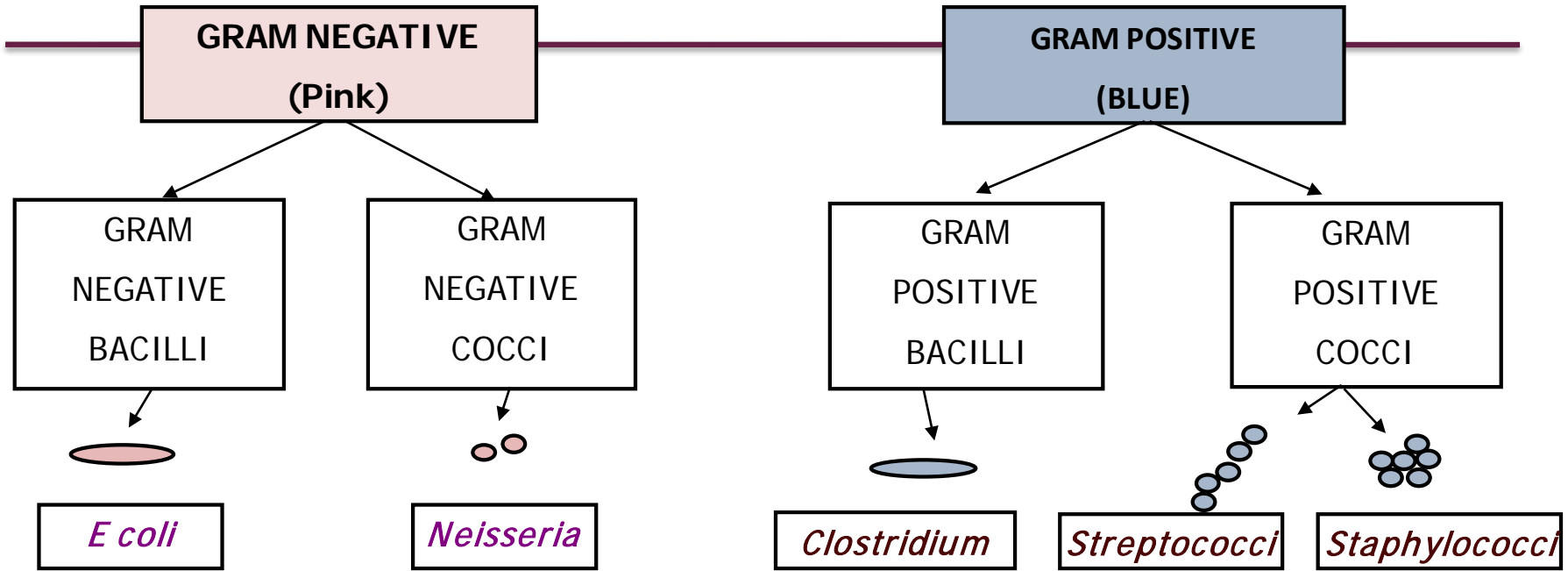*Expert care with a personal touch*

Immunoglobulins

- Immunoglobulins (antibodies) are proteins that bind to viruses and bacteria
  - IgM – produced immediately after exposure
  - IgG – most abundant, is long term response to disease
  - IgA – secretory, present in mucosal linings
  - IgE – plays a role in hypersensitivity reactions

What is Gram Stain?

- Method of classifying bacteria into 2 large groups: positive (+) and negative (-)

- Differentiates bacteria by the chemical and physical properties of their cell walls

- Helpful in guiding initial empiric therapy
  - results should get to physician ASAP

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Bacterial Groups

GRAM NEGATIVE (Pink)
- GRAM NEGATIVE BACILLI → *E coli*
- GRAM NEGATIVE COCCI → *Neisseria*

GRAM POSITIVE (BLUE)
- GRAM POSITIVE BACILLI → *Clostridium*
- GRAM POSITIVE COCCI → *Streptococci*, *Staphylococci*

**Gram stain identifies four basic groups of bacteria:**

1. Gram positive cocci (*Staphylococcus, Streptococcus, Enterococcus*)
2. Gram negative cocci (*Neisseria, Moraxella*)
3. Gram positive bacilli (*Clostridium, Listeria, Corynebacterium*)
4. Gram negative bacilli (*Pseudomonas, Escherichia coli, Haemophilus, Bacteroides*)

Gram positive cocci in pairs and chains Streptococcus

Some Gram stains to remember! Visit the Gram stain Tutorial for more organisms!

Gram negative rod – Fusiform Shaped – Fusobacterium species
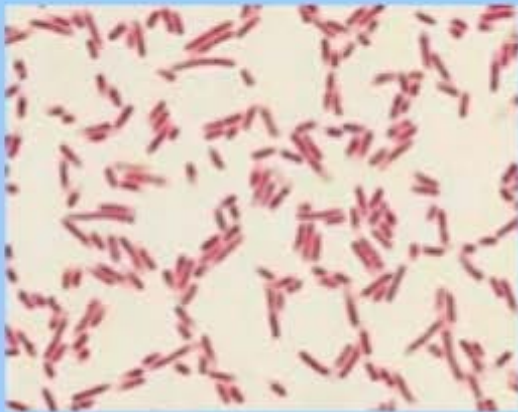
Gram negative bacillus Resembling an Enteric

Gram positive cocci in clusters, Staphylococcus

Gram positive rod most likely a Bacillus species
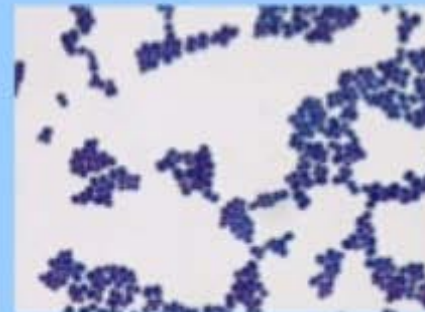
Sputum Gram Stain
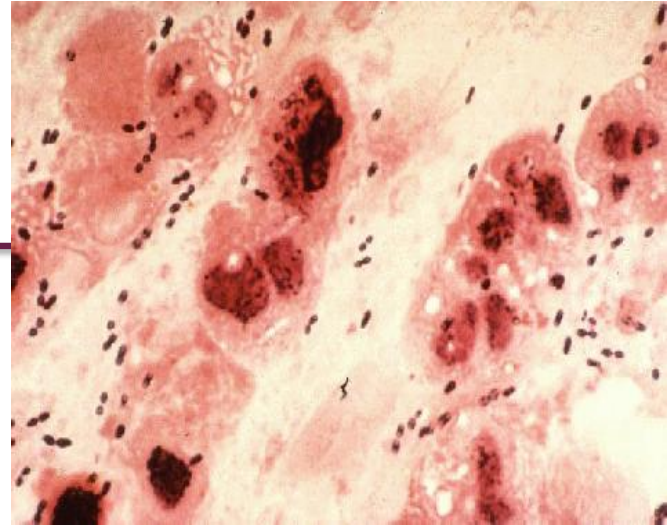
Quality of sputum specimen:

- Squamous epithelial cells (SEC)
  - <10 excellent, no appreciable
  - 10-25 equivocal but acceptable
  - >25 reject due to unacceptable levels of oral contamination
- WBC
  - <10 no infection (or poor immune response)
  - 10-25 equivocal
  - >25 purulence indicates presence of infection
- Bacteria

Common Lower Respiratory Tract Pathogens
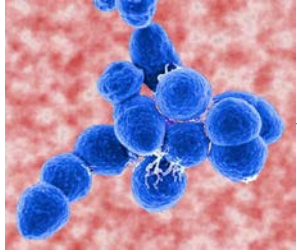
- Community-acquired pneumonia (CAP)
  - *S. pneumoniae*
  - *H. influenzae*
  - *Mycoplasma*

- Hospital-acquired, most often ICU or ventilator-associated
  - *Pseudomonas aeruginosa*
  - *Stenotrophomonas maltophilia*

- Either CAP or hospital-acquired pneumonia
  - ***Staphylococcus aureus*** (MRSA or MSSA)
    ⇑ mortality; must be recognized quickly
  - *Moraxella catarhallis* (most often CAP)
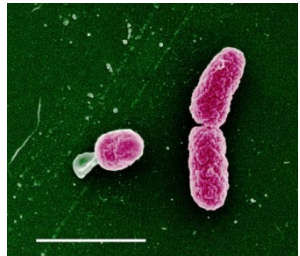
Note: Yeast is NOT usually an infecting organism for pneumonia or other lower respiratory tract infections unless it constitutes >90% of organisms in a specimen and specimen is not contaminated with oral flora

Cerebrospinal Fluid (CSF) Bacteria

- Meningitis due to gram negative rods or *Staphylococcus* usually associated with predisposing factors such as trauma

- Adult, most common: *Strep pneumo* (gram positive cocci in pairs)
  - generates increased WBC response

- Meningococcemia: gram stain showing gram-negative diplococci is diagnostic

  - a single case is a true infection emergency
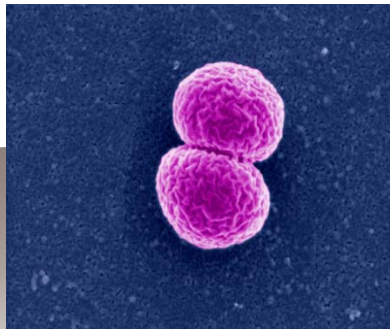
Meningitis

Onset of Symptoms

↓

Patient presents for medical evaluation
Lumbar Puncture (LP)
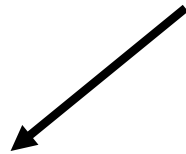
Bacterial

CSF cloudy
elevated protein
decreased glucose
WBC; positive neutrophils
organisms on gram stain
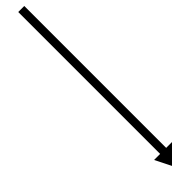
Viral (aseptic)

CSF clear
normal or elevated protein
normal glucose
no organisms on gram stain

Blood Cultures

- A single blood culture consists of two bottles
  - Bottles designed to recover aerobes and anaerobes
  - Irrelevant which bottle has growth or
     if both or only one bottle has growth

- Adults: low numbers of bacteria in blood ($\leq$30/mL)
  - Can lead to negative gram stain and false negative
  - Volume is important; usual 4 bottles/40cc blood
  - Less blood needed for children due to larger number of bacteria per cc of blood/don't normally have anaerobes

Blood Culture Common Commensals

Partial list of common commensals

- Coag neg staphylococci
- Diphtheroids
- Bacillus
- Proprionibacteria
- Viridans strep
- Aerococcus
- Micrococcus

For these bacteria to be interpreted as causing infection, two sets of blood cultures are required PLUS specific signs and symptoms such as fever; refer to your NHSN definitions and for a more comprehensive list

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Common Pathogens of Deep and Organ Space SSI

- Anaerobic (does not require O_2 for growth)
    - *B. fragilis*
    - Clostridium
    - *Peptostreptococcus*
    - *Propionibacterium* (septic arthritis, endocarditis, suture sites for craniotomy)
- Aerobic examples
    - Staphylococcus
    - Streptococcus
    - Gram negative rods (GNR)

Common UTI Pathogens

- Gram negatives
  - *E. coli:* Causes 80% of all UTI
  - Proteus, Klebsiella, Enterobacter, Pseudomonas, Gardnerella cause 5-10%
- Gram positives
  - Staph, Enterococcus, *Staph saprophyticus,* 10-20%
- Positive leukocyte esterase and/or nitrite found on a UA can be helpful in determining infection status.
- Increased WBC in urine w/ negative cultures may indicate infection w/ chlamydia or gonorrhea.

Presence of yeast are not part of the NHSN definition for a urinary tract infection

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Common Bowel Flora

- Normal mix of bacterial flora keeps numbers of yeast,*C. difficile*, and other potential pathogens in the gut in check

- With altered flora, yeast, *C. difficile,* pseudomonas species, VRE, and others can proliferate

Of note: Stool samples contain digestive enzymes; enzymes continue to work after collection, necessitating addition of a preservative and/or prompt processing of specimens

Antibiotics Resistance

- Emerges when some or all of a species/subspecies of bacteria survive exposure to an antibiotic

  - Can be intrinsic or transferred

  - Multi-drug resistance organisms (MDRO) - resistant to multiple antibiotic agents; defined by organism type/specific agents

Kirby-Bauer Disk Diffusion Susceptibility Plate

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Sensitivity Testing: Dilution in liquid broth

- Tubes containing increasing antibiotic concentrations
- Incubation during 18 hr at 37°C

Bacterial growth

MIC

Inhibition

| 0 (Control) | 0,25 | 0,50 | 1 | 2 | 4 | 8 | mg/l |

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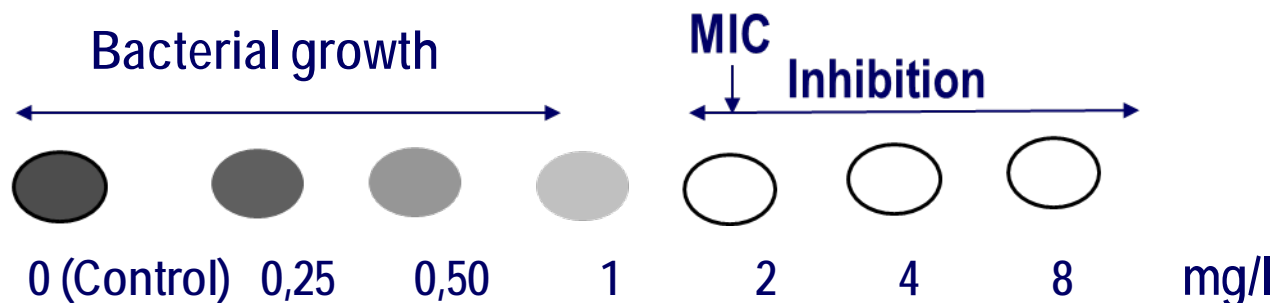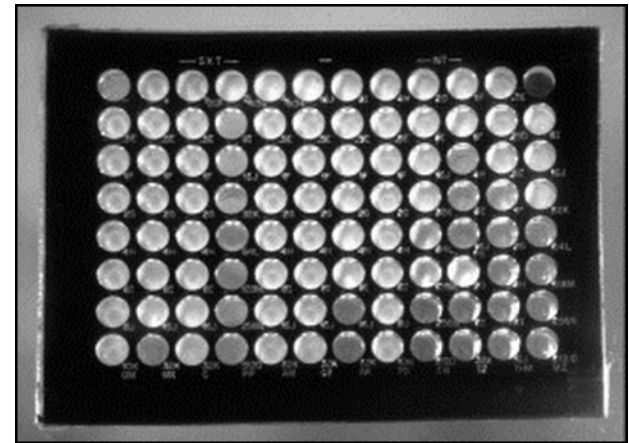
```
URINE CULTURE WITH MIC
   * SOURCE:                  URINE-CYSTO
   STATUS:                    FINAL
   COMPLETED CULTURE RESULTS
     ESCHERICHIA COLI - GREATER THAN 100,000 ORGANISMS PER ML

SUSCEPTIBILITY RESULTS:
          S = Susceptibility   I = Intermediate   R = Resistant
          Minimum Inhibitory Concentration (MIC) expressed in ug/mL

ORGANISM(S):               ECOLI

AMIKACIN                   *S  <=2
AMPICILLIN                 *R  >=32
AUGMENTIN                  *R  >=32
CARBENICILLIN              *R  >=512
CEFOTAXIME                  S  <=4
CEFTAZIDIME                *S  <=8
CEFTIOFUR                  *S  <=1
CEFTRIAXONE                 S  <=8
CEPHALOTHIN                *R  >=32
CHLORAMPHENICOL            *S  4
CIPROFLOXACIN             *R  >=4
DOXYCYLINE                  R  >=16
ENROFLOXACIN              *R  >=2
GENTAMICIN               *R  >=16
IMIPENEM                    S  <=4
NITROFURANTOIN            *S  <=32
OFLOXACIN                   R  >=8
PIPERACILLIN              *R  >=256
TETRACYCLINE             *R  >=16
TICARCILLEN              *R  >=256
TOBRAMYCIN                *S  2
TRIBRISSEN               *R  >=320
```

Focus on the interpretation <u>not</u> the number
S = Sensitive
I = Less sensitive
R = Resistant

Name: Test Patient
Admission Date: 3/19/14
Med. Record No. 0000
Visit No. 00000000
Attending Physician: Dr. Doctor
Allergies: NKDA

DOB: 1/1/1906
Age: 107
Gender: Female
Location: OP
Room/bed: N/A

MICROBIOLOGY
Collected: 03/19/14 @ 17:43

```
.           Source              Urine
Cult Urine
.           Preliminary 1
.
3/20/2014: >100,000 col/mL gram negative rods.
Identification and MIC to fo
.           Organism 1      Escherichia coli
.           Final Results
.                               3/21/14: Urine colony count: >100,000 cfu/mL. Please refer to
.                               ID and MIC tests for results.
```

```
.               Organism 1
.               E. coli
Antibiotics     SYS     MIC
Amox/K Clav     <=8/4       S
Amp/Sub         16/8        I
Ampicillin      >16         R
Cefazolin       <=8         S
Cefepime        <=8         S
Ceftriaxone     <=8         S (IB)
Cefuroxime      <=4         S
Ciprofloxacin   <=1         S
ESBL A          >4          EBL?
ESBL B          >1          EBL?
Gentamicin      <=1         S
Imipenem        <=4         S
Levofloxacin    <=2         S
Nitrofurantoin  <=32        S
Piper/Taz       <=16        S
Tetracycline    <=4         S
Trimeth/Sulfa   <=2/38      S
```

Focus on the interpretation <u>not</u> the number

S = Sensitive

I = Less sensitive

R = Resistant

S	= Susceptible	N/R = Not Reported	Blank = Data not available, or drug not advisable or tested	S* = Predicted susceptible interpretation
I	= Intermediate	-- = Not tested	ESBL = Extended spectrum beta-lactamase	R* = Predicted resistant interpretation
R	= Resistant	Pos = Positive	Blac = Beta-lactamase positive	^ = Reported Interpretation changed
MIC = mcg/ml (mg/L)		Neg = Negative	TFG = Thymidine-dependent strain	

EBL? = Suspected ESBL. Confirmatory test needed to differentiate ESBL from other beta-lactamases.
IB = Inducible Beta-lactamase. Appears in place of Susceptible with species known to possess inducible beta-lactamases; potentially they may become resistant to all beta-lactam drugs. Monitoring of patients during/after therapy is recommended. Avoid other/combined beta lactam drugs.
For blood and CSF isolates, a beta-lactamase test is recommended for Enterococcus species.

What is Antibiogram ?

➢ An **antibiogram** is an overall profile of antimicrobial susceptibility testing results of a specific microorganism to a battery of antimicrobial drugs. … Only results for antimicrobial drugs that are routinely tested and clinically useful should be presented to clinician

➢ Used for Clinical decision making

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ANTIBIOTIC — Results as Percent Susceptible (ID Restriction and Relative Cost noted below)		Acinetobacter baumanii	Enterobacter cloacae	E. coli (All Isolates)	E. coli (Urine only)	Klebsiella pneumoniae	Klebsiella oxytoca	Citrobacter freundii	Proteus mirabilis	Providentia stuartii	Pseudomonas aeruginosa	Serratia marcescens	Staphylococcus aureus	Staphylococcus epidermidis	Enterococcus faecalis	Enterococcus faecium	Streptococcus pneumoniae	Haemophilus influenzae
Total-1st isolate only reported		84	126	2589	2035	648	79	60	443	74	582	61	934	169	213	62	39	34
Penicillins																		
Nafcillin	*$$												51	30				
Penicillin	$$												11	4	97	21	100-NONMEN / 77-MENINGITIS	76
Ampicillin	$												NT	NT	97	21	NT	76
Ampicillin/sulbactam	$	27	NR	50	52	73	58	NR	80	NI	IR	NR						
Piperacillin/Tazobactam	*$	NT	79	93	93	85	91	75	100	68	77	NT						
Cephalosporins																		
Cefazolin	$	IR	NI	74	80	74	48	0	71	NI	IR	NI						
Cefoxitin	$	NI	NI	86	86	88	97	0	88	82	IR	34						
Ceftriaxone	$	NI	84	84	84	84	88	72	93	53	NI	79					100-NONMEN / 95-MENINGITIS	
Ceftazidime [ID restricted]	$	NI	75	89	89	85	96	72	98	53	83	72						
Cefepime [ID restricted]	$	23	94	92	92	91	100	98	95	66	86	75						
Carbapenems																		
Meropenem [ID restricted]	$$	30	95	100	100	93	99	93	38	64	75	100						
Fluoroquinolones																		
Ciprofloxacin	$	18	96	66	66	86	95	93	53	23	67	69	NI	NI				
Levofloxacin	$	18	98	66	65	87	95	93	58	21	65	69	NI	NI			91	
Aminoglycosides																		
Gentamicin	$	16	96	86	86	93	91	100	79	54	88	97	89	68				
Tobramycin	$	17	93	83	83	86	91	100	80	32	88	66						
Amikacin	$	NR	100	97	94	84	97	100	95	100	98	100						
Miscellaneous Antibiotics																		
Nitrofurantoin	$	NI	34	96	95	24	86	93	NI	NI	NI	NI	100	97	99	15		
Clindamycin	*$												67	57			76	
Erythromycin	*$												42	22			67	

Page 1

HOSPITAL ANTIBIOGRAM FROM 01/01/2007 TO 01/12/2007
RESULT SHOWS PERCENT ORGANISMS SUSCEPTIBLE TO ANTIBIOTIC TESTED
GRAM POSITIVE COCCI

Organism	Number of Isolates Tested	Ampicillin	Penicillin	Oxacillin	Erythromycin	Clindamycin	Ciprofloxacin	Gentamicin	Vancomycin	Trimethoprim/Sulfamethoxazole	Tetracycline	Rifampin	Nitrofurantoin (Only Urines Tested)	Percent of isolates from urine
Staph. aureus, methicillin susceptible (OP)	8	0	14.29	50	87.5	87.5	100	100	100	50	100	100	100	0
Staph. aureus, methicillin susceptible (IP+ICU)	3	0	0	50	75	100	75	100	100	75	100	100	100	0
Staph. aureus, methicillin resistant (OP)	2	0	0	0	50	50	--	--	100	100	--	--	--	0
Staph. aureus, methicillin resistant (IP+ICU)	3	0	0	0	100	50	100	100	100	100	100	100	100	0
Staph epidermidis (IP+ICU)	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Staph. epidermidis OP	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Enterococcus faecalis (TOTAL)	1	100							100					
Enterococcus faecium (TOTAL)	0	--							--					
Enterococcus faecalis (IP+ICU)	0	--							--					
Enterococcus faecium (IP+ICU)	0	--							--					
Enterococcus faecalis (OP)	1	100							100					
Enterococcus faecium (OP)	0	--							--					

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Medical Center Adult Empiric Infection Therapy Pocket Guide

Antibiotic doses may require adjustment for renal dysfunction. For further information, see Antimicrobial Stewardship website on PVHMC Intranet

Pneumonia	Community-Acquired (CAP) **Pseudomonal risk factors:** bronchiectasis, severe COPD, chronic oral steroids, frequent recent antibiotics	Mild-Moderate **without** risk for Pseudomonas	**Ceftriaxone** 1 g IV q24H *PLUS* **Azithromycin** 500 mg IV q24H *Severe β-lactam allergy:* **Levofloxacin** 750 mg IV q24H *If known/suspected MRSA: ADD* **Vancomycin** per pharmacy and obtain culture	**Procalcitonin** on admit and every 2-3 days **BNP** if concomitant heart failure or fluid overload Suction for **sputum** or **BAL** for gram stain & culture if Pseudomonas risk **Influenza PCR** during influenza season or with clinical suspicion
		Severe (ICU) **without** risk for Pseudomonas	**Ceftriaxone** 1 g IV q24H *PLUS* **Levofloxacin** 750 mg IV q24H *Severe β-lactam allergy:* **Aztreonam** 2 g IV q8H *PLUS* **Levofloxacin** 750 mg IV q24H *If known/suspected MRSA: ADD* **Vancomycin** per pharmacy	
		Any severity **with risk** for Pseudomonas (Obtain culture for all patients)	**Piperacillin-Tazobactam** per pharmacy *PLUS* **Levofloxacin** 750 mg IV q24H *Severe β-lactam allergy:* **Aztreonam** 2 g IV q8H *PLUS* **Levofloxacin** 750 mg IV q24H *If known/suspected MRSA: ADD* **Vancomycin** per pharmacy	
	Healthcare-Associated/Hospital-Acquired (HCAP/HAP) (Obtain culture for all patients)	Standard risk (Concern for Pseudomonas, MRSA)	**Piperacillin-Tazobactam** per pharmacy *PLUS* **Tobramycin** per pharmacy *PLUS EITHER* **Vancomycin** per pharmacy *OR* **Linezolid*** 600 mg IV q12H *Severe β-lactam allergy:* **Aztreonam** 2 g IV q8H *PLUS* **Tobramycin** per pharmacy *PLUS EITHER* **Vancomycin** per pharmacy *OR* **Linezolid*** 600 mg IV q12H	**Procalcitonin** on admit and every 2-3 days. **BNP** if concomitant heart failure or fluid overload Suction for **sputum** or **BAL** for gram stain & culture required **Influenza PCR** during influenza season or with clinical suspicion
		Expanded risk (Concern for multi-drug resistant orgs, strongly consider **ID consult**)	**Vancomycin** per pharmacy *OR* **Linezolid*** 600 mg IV q12H *PLUS AGENTS BELOW:* For ESBL/AmpC: **Meropenem*** 1 g IV q8H For CRE/KPC: **Ceftazidime-Avibactam*** 2.5 g IV q8H *MDR Acinetobacter:* **Ampicillin-Sulbactam*** 3 g IV q6H *PLUS* **Minocycline*** 200 mg IV x 1 dose then 100 mg IV q12H *PLUS EITHER* **Colistin*** or **Polymixin B***	
Urinary Tract Infection	Asymptomatic bacteriuria		**Antibiotic contraindicated** unless pregnant or GU surgery in next 4 days	
	Cystitis (symptomatic)		**Ceftriaxone** 1 g IV q24H *or* **Fosfomycin*** 3 g PO x1 dose	Confirm UA & urine culture collected **before** antibiotics given If foley >2 wks, collect UA & urine culture **after** changing foley
	Pyelonephritis	Uncomplicated	**Ceftriaxone** 1 g IV q24H *(if Severe β-lactam allergy:* **Aztreonam** 1 g IV q8H*)* *Uncomplicated = No recent antibiotics, instrumentation, healthcare-association, obstruction, immunosuppression, prolonged symptoms, pregnancy*	
		Complicated	**Piperacillin-Tazobactam** per pharmacy *(if Severe β-lactam allergy:* **Aztreonam** 1 g IV q8H*)* *Suspected ESBL/AmpC/Pseudo:* **Meropenem*** 1 g IV q8H +/- **Tobramycin** per pharmacy *Suspected VRE: ADD* **Daptomycin*** 6 mg /kg IV q24H *OR* **Linezolid*** 600 mg IV q12H	
SSTI	Nonpurulent Cellulitis	Mild (no SIRS)	**Cephalexin** 500 mg PO q6H *(if β-lactam allergy:* **Clindamycin** 300 mg PO QID*)*	Gram stain/culture of purulent drainage or abscess
		Moderate (SIRS)	**Cefazolin** 1 g IV q8H	
		Severe/Complicated	**Piperacillin-Tazobactam** per pharmacy *PLUS* **Vancomycin** per pharmacy	
	Purulent cellulitis/abscess	Abscess Only (no SIRS)	**I&D** and consider **TMP/SMX** 1-2 DS tab PO BID (dose adjusted for renal function) *OR* **Doxycycline** 100 mg PO q12H	
		Abscess with cellulitis	*Outpatient, ED discharge:* **TMP/SMX** 1-2 DS tab PO BID (dose adjusted for renal function) *OR* **Doxycycline** 100 mg PO q12H *Inpatient, Severe:* **Vancomycin** per pharmacy *OR* **Linezolid*** 600 mg IV q12H	

Extended Spectrum Beta-lactamase (ESBL)-producing Gram-negative Bacteria

- Cephalosporins: class of antibiotics developed to combat emergence of β-Lactamase producing GNR

- Resistance to cephalosporins began in ~1990s

- ESBLs now resistant to 3rd generation Cephalosporins (eg: cefotaxime, ceftazidime, ceftriaxone) and monobactams (e.g.: aztreonam)

- ESBL remain susceptible to cephamycins (cefoxitin, cefotetan, cefmetazole) and carbenapenems (meropenem, imipenem)

ESBL (continued)

- Carbapenems are the last β-Lactam antibiotic class for treatment of ESBL infections
  - e.g. imipenem, meropenem, doripenem, ertapenem
- New Delhi metallo-beta-lactamase 1 (ndm-1) CRE detected in 2008; susceptible only to polymyxins and tigecycline
- Carbapenemase-resistant Enterobacteriaceae (CRE) beginning to emerge, leaving few treatment options
  - Seen in 47 states by Feb 2014

See 2013 CDC guidance for management of CRE infected patients at
www.cdc.gov/hai/organisms/cre

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CRE – Reportable to LA PHD

LAC DPH Health Information:
New Health Officer Order – Health Facilities
to Report Carbapenem-Resistant
***Enterobacteriaceae* and Antimicrobial**
Resistance

January 19, 2017

This notification is to inform Los Angeles health care providers of a new Health Officer order. All affected health care facilities will receive detailed communications and guidance regarding this mandate and its implementation.

The Los Angeles County Department of Public Health (LACDPH) Interim Health Officer has mandated that all Los Angeles County acute care hospitals and skilled nursing facilities report all clinical laboratory carbapenem-resistant *Enterobacteriaceae* (CRE) positive tests from any specimen. The order also requires that acute care hospitals, and skilled nursing facilities that generate an annual antibiogram, submit it to LACDPH each year.

CRE, defined as *Enterobacteriaceae* (*Klebsiella sp., E. coli,* and *Enterobacter sp.*) resistant to carbapenem antibiotics or that produce carbapenemases, are a persistent and growing public health threat. These healthcare-associated pathogens are difficult to treat, have a high mortality rate, and are easily spread between patients in health care facilities. The mandate is a necessary step to control the spread of this healthcare-associated infection.

Hepatitis **A** Viral Markers

- Hepatitis A Virus (HAV)

  - HAV, total – current or past HAV

  - HAV, IgM – definitive diagnosis of active HAV infection

All Hepatitis (acute and chronic) are reportable communicable diseases via local public health

Acute hepatitis A requires immediate notification

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Hep A – Outbreak CA

State of California—Health and Human Services Agency

California Department of Public Health

KAREN L. SMITH, MD, MPH
Director and State Public Health Officer

EDMUND G. BROWN JR.
Governor

October 17, 2017

AFL 17-21

TO: Hospital Emergency Departments, Hospital Infection Preventionists, and Hospital Administrators

SUBJECT: California Hepatitis A Outbreak and Use of Hepatitis A Vaccine for At-risk Health Care Personnel including Health Care-based Environmental Services Staff

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All Facilities Letter (AFL) Summary

The purpose of this AFL is to provide updated California Department of Public Health (CDPH) vaccination recommendations to health care facilities in light of constrained hepatitis A virus (HAV) vaccine supplies and review infection control recommendations for preventing HAV transmission. Other recommendations related to hepatitis A that are provided in AFL 17-13 remain in effect.

Currently, there is an ongoing HAV outbreak in California. Homeless populations and persons using injection or non-injection illicit drugs are considered at risk of exposure to HAV, particularly those in settings of limited sanitation. Use of adult hepatitis A vaccine to help control recent outbreaks has resulted in concerns that the supplies for adult immunization for the last quarter of 2017 could become limited. Therefore, CDPH recommends:

Interpretation of the Hepatitis B Panel

Tests	Results	Interpretation
HBsAg	negative	Susceptible
anti-HBc	negative	
anti-HBs	negative	
HBsAg	negative	Immune due to natural infection
anti-HBc	positive	
anti-HBs	positive	
HBsAg	negative	Immune due to hepatitis B vaccination**
anti-HBc	negative	
anti-HBs	positive	
HBsAg	positive	Acutely infected
anti-HBc	positive	
IgM anti-HBc	positive	
anti-HBs	negative	
HBsAg	positive	Chronically infected
anti-HBc	positive	
IgM anti-HBc	negative	
anti-HBs	negative	
HbeAG	positive	Highly infectious

Ag = antigen   c = core
Ab = antibody s = surface

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Hepatitis **C** Viral Markers

- Hepatitis C Virus (HCV)

- Anti-HCV

  - Presence of antibodies to the virus, indicating exposure to HCV

  - Active vs. chronic vs. resolved

- HCV RIBA (recombinant immunoblot assay)

  - Confirmatory test of antibodies to the virus

  - Demonstrates if HCV was true positive (present or past is unanswered)

All Hepatitis (acute and chronic) are reportable communicable diseases via local public health

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Laboratory Tests of Interest to IP

- ***Acid Fast Bacillus (AFB) test of sputum for diagnosis of TB***
  - First morning specimen or bronch lavage are best
  - Rarely negative smear, positive culture (must follow up exposures)
  - Specimens must be at least 8hrs apart from each other
- ***Direct fluorescent antibody (DFA) tests*** for identification of respiratory viruses such as legionella
- ***Rapid diagnostic testing:*** provides quick diagnosis
  - HIV: detects antibiodies, has high sensitivity/specificity but because of false positives, confirmatory testing should be done
  - Influenza: very fast antigen detection; false positives 51-82% of time, so should not be used alone
  - Strep: antigen detection w/ 95% sensitivity; will also detect carriers

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Nucleic Acid Amplification Tests (NAAT)

- Molecular technique that detects viruses or bacterium
  - Polymerase chain reaction (PCR) assays amplify gene segments specific to organism of interest; available for a number of bacterial and viral pathogens
    - Uses alternating step and temperature cycle process to detect molecules
    - Highly sensitive; may not indicate viability of organism
    - Expensive but getting cheaper, more rapid
  - Ligase chain reaction (LCR) uses DNA polymerase (enzymes that build DNA and an enzyme that helps repair DNA. Because two targets are used, the test has greater specificity
  - Newer, faster, expensive, less versatile, best for use with a single target

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Laboratory Tests of Interest to IP - continued

- Serology testing to look for   that demonstrate exposure/infection
  - Indicates patient immunity
  - Testing can also look for antigens
- Antibiotic susceptibility testing performed on bacterial cultures to test the susceptibility or resistance to specific antimicrobial agents (see Kirby Bauer, Slide 22)
- Viral load testing for HIV, HCV
- Microscopic evaluation for fungal infections such as wet mounts for vaginal organisms, CSF, skin
- Antigen tests for   cryptococcal meningitis

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Role of Microbiology in HAI Prevention

Microbiology support is critical to

- Outbreak management
- Performing additional tests for epidemiologic analyses
- Infection surveillance
- Knowledge of new microbes or unusual resistance
- Design of antibiotic formulary (antibiogram)
- Interpretation of microbiological results
- Education of health care staff

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The Infection
Preventionist's

Guide to the Lab

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