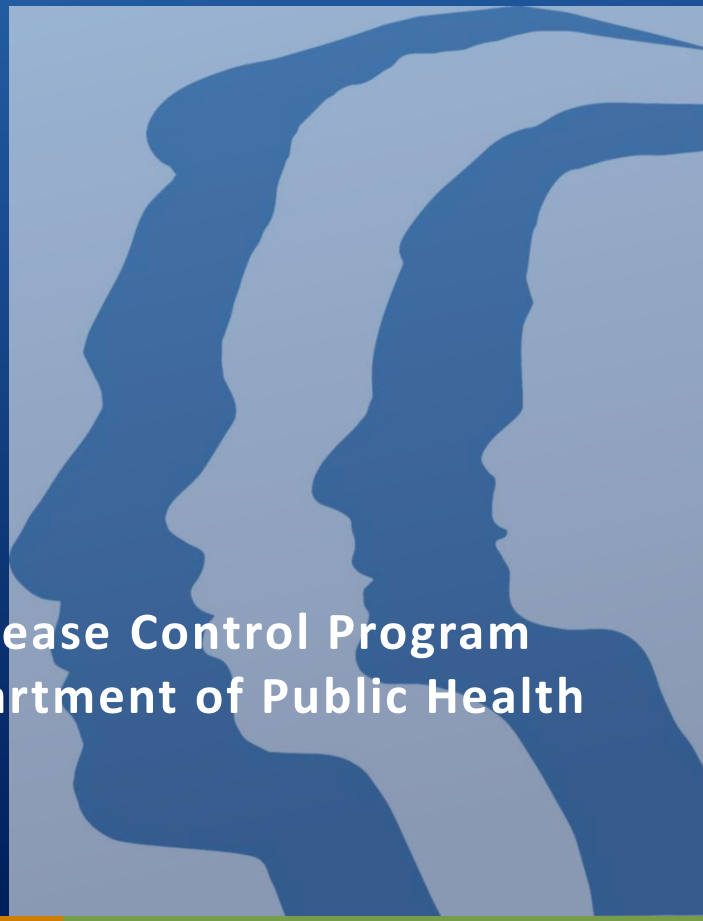
Ask an IP
Learning and Communication Series

Week 5 – Microbiology

Wednesday, April 6, 2022



County of Los Angeles Public Health

Acute Communicable Disease Control Program
Los Angeles County Department of Public Health

Disclosures

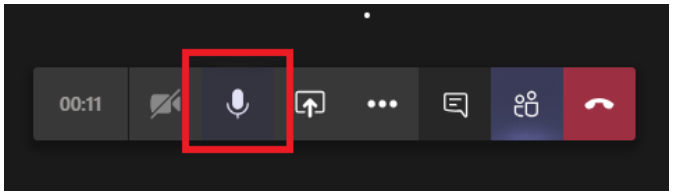
There is no commercial support for today's call

Neither the speakers nor planners for today's call have disclosed any financial interests related to the content of the meeting

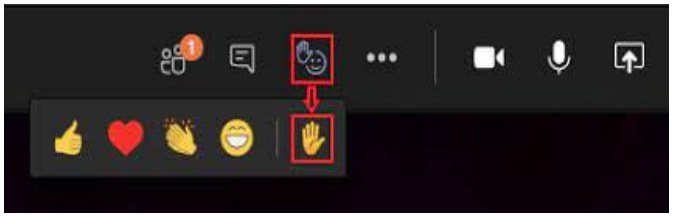
This call is meant for healthcare facilities and is off the record and reporters should log off now

Housekeeping

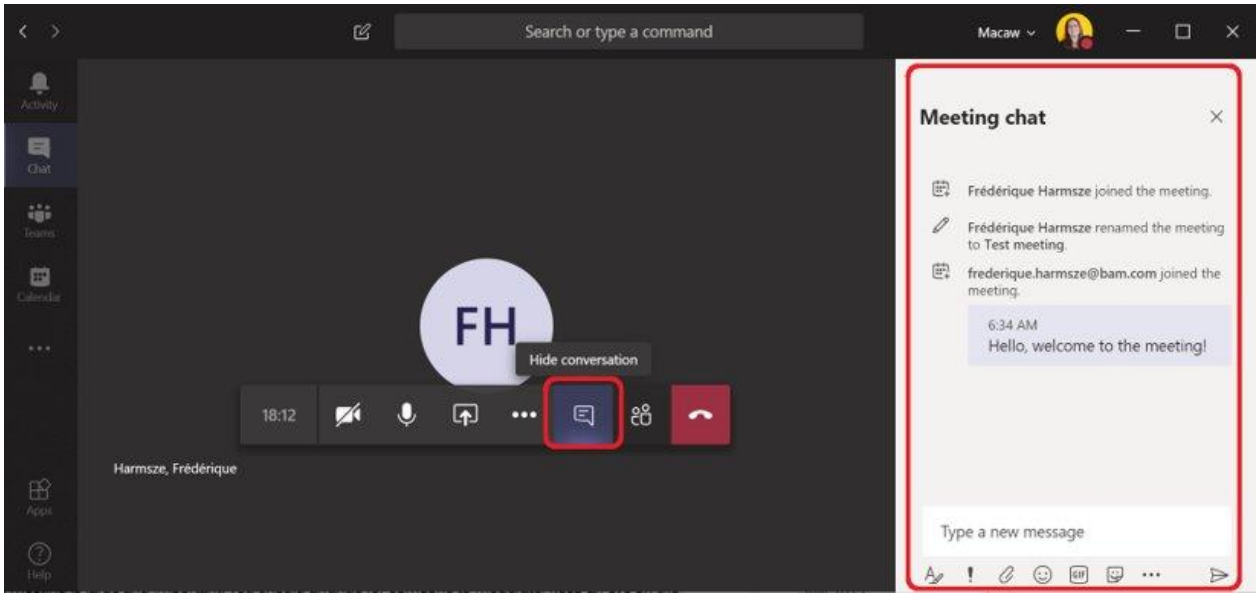
- How to Mute/Unmute (Crtl+ Shift+ M):
  - Press the Mute button on your phone if dialing in



- How to Raise Hand:



- How to use Chat:



Reminder

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We would like to remind everyone that the LAC DPH SNF COVID-19 Guidance has been updated as of 03/31/2022. Please take time to review this updated information. We will not be reviewing COVID-19 guidelines (including CDPH AFLs) during these sessions.

Link to Guidelines:
http://publichealth.lacounty.gov/acd/ncorona2019/healthfacilities/snf/prevention/

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Slides & recordings:

http://publichealth.lacounty.gov/acd/infectionpreventionseries.htm

Objectives

- Describe the **role of the laboratory** in Infection Prevention
- Describe **essential laboratory tests** for the identification of infectious pathogens
- Examine **common HAI** pathogens
- Foster discussion among LA County Skilled Nursing Facilities about infection control practices

Microbiology and Infection Prevention

- Microbiology has two vital functions associated with infection prevention and control

Clinical: Identification of pathogens and their susceptible treatment

Epidemiological: Identification of pathogens causing disease or outbreak in a population of people and potential sources of the pathogen

Laboratory Result Accuracy

- There is no such thing as a lab test that is 100% accurate 100% of the time
- Factors affecting accuracy of lab tests:

Pre-testing: specimen collection, handling, transportation, preservation prior to lab arrival

During testing: specimen processing, lab technician skill and behaviors, biochemical accuracy, instrument system

Post-testing: transcription accuracy, communication of results accuracy

Interpreting Microbiology Test Results

- The presence of an organism does not always mean that it is causing disease
  - Sterile sites- bacterial growth may confirm an infection
- All cultures should be interpreted in the context of what pathogens are typically found in that body site
- Sample contamination may result in inaccurate results & pseudo-outbreaks
- To interpret microbiological test results, use in conjunction with blood cell counts

1.chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.cdph.ca.gov%2FPrograms%2FCHCQ%2FHAI%2FCDPH%2520Document%2520Library%2F2019_11_Intro.Micro_Approved02.22.19.pdf

Complete Blood Count (CBC)

- Provides a quick snapshot of someone's overall health
  - Including absence or presence of infection
  - Measures blood components
    - White Blood Cells (WBC) included
      - If elevated, could indicate infection
      - A normal white blood cell count is in the range of 4,000 to 11,000 cells per liter of blood

Types of White Blood Cells (WBC)

- Polymorphonuclear leukocytes (PMN): generalized response to threat
  - Neutrophils – make up 50-60% of WBC, 1st line response to infection; infection fighters that increase during bacterial infections - AKA “segs”
  - Eosinophils – present with parasites and allergic reactions
  - Basophils – present with allergic reaction, mediate strength of immune response

Types of White Blood Cells (WBC) (2)

- Lymphocytes – mature in the lymphatic portion of the immune system
  - Include pathogen-specific immune response (B cells and T cells)
  - An increase in lymphocytes may be indicative of viral infection
- Monocytes – (AKA macrophages) have phagocytic functions meaning they eat cellular debris and foreign pathogens in the immune system

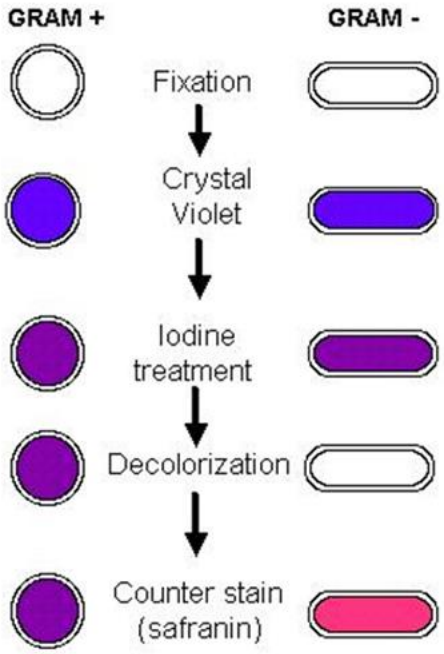
Serology

- Diagnostic test that identifies immunoglobulins (AKA antibodies) in serum blood
- Immunoglobulins (Ig) proteins that bind to viruses and bacteria
  - Types:
    - IgM- produced immediately following exposure (acute phase of disease)
    - IgG- most abundant; long term response to disease (chronic disease)
    - IgA- secretory, present in mucosal linings
    - IgE- plays role in hypersensitivity reactions

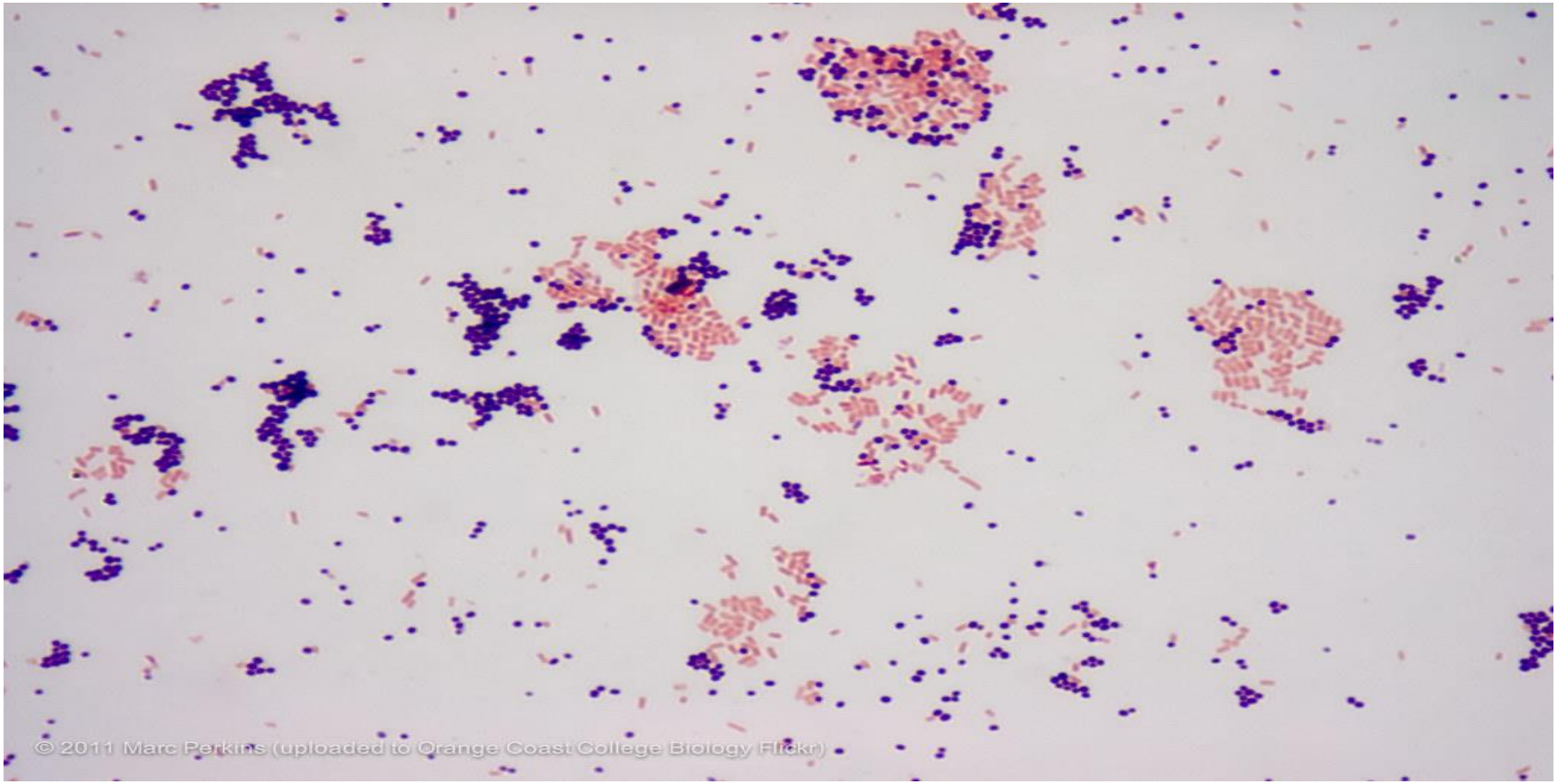
1.https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/2019_11_Intro.Micro_Approved02.22.19.pdf

Gram Stain

- Methodology used to classify bacteria into 2 groups:
  - Gram Positive
  - Gram Negative
- Differentiates bacteria by physical and chemical cell wall properties
- Helpful in guiding empiric therapy



Gram Stain



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Blood Cultures (cx)

- A blood culture specimen is collected in 2 bottles. Growth may occur in either or both bottles
  - 1 bottle for aerobe growth
  - 1 bottle for anaerobe growth
- In adult population, false negative results occur from low amount of bacteria presence in blood (≤ 30/mL)
- Collection of adequate blood volume is essential (40mL of blood for 4 bottles)
- Specimen collection technique is important because introduction of contaminants to specimen (common skin commensal flora)

Blood Culture (2)

Urinalysis (UA)

- Positive nitrite or leukocyte esterace can help determine presence of WBC
- WBC presence in urine with negative cultures indicative of gonorrhea or chlamydia

Common Urinary Tract Infection (UTI) Pathogens

- Gram Positive
  - Staph, Enterococcus, *Staphylococcus saprophyticus*
- Gram Negative
  - E. coli- cause of more than 80% of all UTI's
  - Proteus, Klebsiella, Enterobacter, Pseudomonas, Gardnerella

Common Pathogens for Surgical Site Infection (SSI)

- Aerobic (can survive and grow in oxygenated environment)
  - Staphylococcus
  - Streptococcus
  - Gram negative rods (GNR)
- Anaerobic (does not require oxygen for growth)
  - B. fragilis
  - Clostridium
  - Peptostreptococcus
  - Propionibacteriam

Common Bowel Flora

- Gut health is maintained by a normal mix of bacterial flora
- Altered conditions of the gut allow for C. difficile, yeast, pseudomonas species, Enterobacter, and other organisms to become dominant
- 400 species of organism can be located in the bowel

– 95-99% of those 400 species are comprised of:
  - Enterobacter
  - Enterococcus
  - Proteus
  - Morganella
  - Peptostreptococcus
  - Bacteroids
  - Clostridium
  - Bifidobacterium

https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/2019_11_Intro.Micro_Approved02.22.19.pdf

Antibiotic Resistance (AR)

- AR emerges when some or all of a species or subspecies of bacteria survive exposure to an antibiotic
  - Can be intrinsic or transferred
  - Multi-drug resistance organisms (MDRO) are resistant to multiple antibiotic agents
- An antibiogram shows the proportion of bacteria resistant to specific antibiotics in a hospital or region
  - Used for clinical decision-making

1.https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/2019_11_Intro.Micro_Approved02.22.19.pdf

Antibiogram

- Definition: Summary of antimicrobial susceptibility for selected bacterial pathogens, provide comprehensive information about local antimicrobial resistance. They are usually generated by a laboratory using aggregate data from a hospital or healthcare system.
  - Help guide the clinician and pharmacist in selecting the best empiric antimicrobial treatment
  - Detect and monitor trends in antimicrobial resistance

1. http://publichealth.lacounty.gov/acd/AntibiogramData.htm

Antibiogram (2)

Gram-Negative Organism Antibiogram

		Penicillins			Cephalosporins				Carbapenems			Aminoglycosides			Quinolones		Other			
Data presented as: **Percent Susceptible** (# of Isolates Tested)	# of all isolates tested (# of hospitals reporting)	Ampicillin	Ampicillin/ Sulbactam	Piperacillin/ Tazobactam	Ceftriaxone	Ceftazidime	Cefepime	Cefazolin	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Trimethoprim/ Sulfamethoxazole	Nitrofurantoin	Minocycline	Tigecycline
Acinetobacter baumannii	**2,723**	R	**43**	**27**	**10**	**27**	**40**	R	R	**27**	**39**	**36**	**37**	**40**	**27**	**26**	**48**	-	**79**	**79**
	75		2,084	1,776	1,320	1,894	1,139			1,120	1,436	1,925	2,661	2,084	2,030	1,985	2,287		154	424
Citrobacter freundii	**1,720**	R	R	**83**	**79**	**80**	**98**	R	**100**	**98**	**98**	**99**	**92**	**92**	**91**	**90**	**82**	**95**	-	**100**
	45			1,604	1,629	1,370	1,579		1,100	361	1,329	1,517	1,720	916	1,490	801	1,683	1,443		254
Citrobacter koseri	**561**	R	**90**	**99**	**96**	**97**	**99**	**93**	**100**	**99**	**100**	**99**	**99**	**97**	**99**	**98**	**96**	**86**	-	**100**
	19		85	549	527	383	483	498	248	161	364	450	561	427	372	450	550	542		61
Enterobacter sp.	**8,911**	R	R	**81**	**79**	**81**	**96**	R	**95**	**94**	**99**	**99.5**	**97**	**97**	**96**	**95**	**92**	**35**	-	**99**
	71			8508	7918	6816	8044		5333	2138	6770	7207	8818	5022	7331	4605	8510	5735		1650
Escherichia coli	**143,153**	**38**	**50**	**94**	**87**	**89**	**89**	**83**	**100**	**100**	**100**	**99**	**88**	**83**	**73**	**67**	**67**	**96**	-	**100**
	82	15,318	59,750	135,592	136,184	118,505	128,176	123,386	89,252	27,115	11,374	123,826	142,208	67,642	122,656	69,750	141,267	129,730		8,523
Klebsiella oxytoca	**3,248**	R	**66**	**93**	**93**	**96**	**97**	**53**	**100**	**100**	**100**	**100**	**96**	**94**	**95**	**95**	**91**	**85**	-	**100**
	49		1,693	2,844	2,842	2,448	2,772	2,604	1,890	717	2,408	2,679	2,948	1,692	2,588	1,358	2,780	2,046		479
Klebsiella pneumoniae	**30,629**	R	**71**	87	**85**	**86**	**87**	**81**	**96**	**90**	**97**	**95**	**90**	**84**	**86**	**84**	**83**	**35**	-	**93**
	80		13,763	24,936	25,145	20,712	23,744	21,631	15,606	6,529	19,382	24,501	25,802	15,356	21,942	13,646	24,970	20,500		1,948
Morganella morganii	**2,300**	R	**10**	**96**	**85**	**78**	**96**	R	**100**	**55***	**99**	**99**	**73**	**85**	**63**	**54**	**56**	R	-	R
	53		1,362	2,223	2,037	1,747	2,077		1,300	439	1,599	2,119	2,240	1,325	1,876	1,401	2,178			
Proteus mirabilis	**19,503**	**70**	**77**	**97**	**87**	**91**	**92**	**74**	**99**	**69***	**97**	**99**	**83**	**82**	**67**	**62**	**68**	R	-	R
	80	17,791	9,969	17,599	17,582	14,857	16,487	16,657	10,454	2,583	13,057	15,833	18,733	11,239	15,154	11,572	18,603			
Pseudomonas aeruginosa	**23,921**	R	R	**85**	R	**81**	**85**	R	R	**80**	**84**	**96**	**85**	**93**	**73**	**65**	R	R	-	R
	83			23,524		20,258	21,045			12,142	17,770	22,185	23,575	21,464	19,554	16,206				
Serratia marcescens	**2,668**	R	R	**94**	**90**	**92**	**95**	R	**99**	**96**	**97**	**96**	**97**	**79**	**87**	**86**	**98**	R	-	**99.6**
	58			1,876	2,376	2,047	2,401		1,462	555	1,987	2,417	2,663	1,707	2,330	1,581	2,256			550
Stenotrophomonas maltophilia	**1,970**	R	R	R	R	**46**	-	R	R	R	R	R	R	R	-	**81**	**92**	-	**98**	R
	51					1,082										1,511	1,996		42	

Resistance - Extended Spectrum Beta-Lactamase (ESBL) Producing Gram-Negative Rods (GNR)

- Each new generation of Cephalosporins have greater activity on GNR through new forms of beta-lactam
  - Resistance develops to new beta-lactams by new forms of beta-lactamases
- GNR are now resistant to 3rd generation Cephalosporins (e.g., cefotaxime, ceftazidime, ceftriaxone) and Monobactams (e.g., aztreonam) by ESBLs
- ESBL producing GNR remain susceptible to cephamycins (e.g., cefoxitin, cefotetan, cefmetazole) and carbapenems (e.g., meropenem, imipenem)

1.https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/2019_11_Intro.Micro_Approved02.22.19.pdf

Tuberculosis

- The **Mantoux tuberculin skin test** (TST) – one method of determining whether a person is infected with *Mycobacterium tuberculosis*.

- **Interferon-Gamma Release Assays (IGRAs) – Blood Tests for TB Infection**

Interferon-Gamma Release Assays (IGRAs) are whole-blood tests that can aid in diagnosing *Mycobacterium tuberculosis* infection.

  - QuantiFERON®-TB Gold In-Tube test (QFT-GIT)
  - T-SPOT®.*TB* test (T-Spot)

1.https://www.cdc.gov/tb/publications/factsheets/testing/igra.htm

Tuberculosis (2)

- Sputum -Acid Fast Bacillus (AFB)
  - Distinguished bacteria that retains stain in the absence of an acid decolorizer
    - Present with mycobacterium species i.e., Tuberculosis, Avium, etc.
    - Few bacteria are acid-fast, making acid-fastness useful in diagnostics
  - Provider order: Sputum AFB x3
- **Negative smears do not exclude TB disease.**
  - When acid-fast bacilli are seen in a smear, they are counted.
  - According to the number of acid-fast bacilli seen at a certain magnification, the smears are classified as 4+, 3+, 2+, or 1+. The greater the number the more infectious the patient.

Rapid Lab Tests

- Antigen testing
  - Always follow positive with confirmatory test
- Polymerase Chain Reaction (PCR) Assay
  - Makes thousands of copies of a DNA segment specific to an organism so it can be detected by identifying tests
  - Available for a number of bacterial and viral pathogens
  - Highly sensitive; may not indicate viability of organism
  - Expensive, but getting less so

1.https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/2019_11_Intro.Micro_Approved02.22.19.pdf

Microbiology Resource

Programming

Session	Date (2022)	Topic
Week 1	March 9th, 2022	Personal Protective Equipment (PPE)
Week 2	March 16th, 2022	Office Hours
Week 3 (tod	March 23rd, 2022	Introduction to QAPI in SNFs
Week 4	March 30th, 2022	Office Hours
Week 5	April 6th, 2022	Introduction to Microbiology
Week 6	April 13th, 2022	Office Hours
Week 7	April 20th, 2022	Environmental Services (EVS)
Week 8	April 27th, 2022	Office Hours
Week 9	May 4th, 2022	Multi-Drug Resistant Organisms (MDRO)
Week 10	May 11th, 2022	Office Hours

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Questions