IDENTIFICATION OF INFECTIOUS DISEASE PROCESS

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INFECTION PREVENTION CERTIFICATION COURSE, 2023

Duke University School of Medicine

dcasip.medicine.duke.edu

Duke Center for Antimicrobial Stewardship and Infection Prevention

Disclosures

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Objectives

Infectious disease process (aka. Pathogenesis)

Clinical signs/symptoms of infection (aka. Immune process)

Diagnostics and laboratory reports including specimen handling

Infection vs. colonization vs. contamination

Antimicrobial Use

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Disclosures (2)

I cannot teach you all of infectious diseases and microbiology in 90 minutes.

I will address each core principle broadly and add context.

To illustrate the core principles I'll add a specific scenario.

Try to hit key pathogens from each of the (38!) chapters I'm supposed to cover

- Average 2.4 minutes per chapter

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INFECTIOUS DISEASE PROCESS (PATHOGENESIS)

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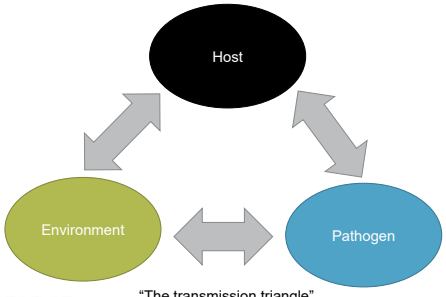
What is the process that leads to infection?



"The transmission triangle"

"The infectious disease process refers to the interaction between the pathogenic microorganism, the environment, and the host"

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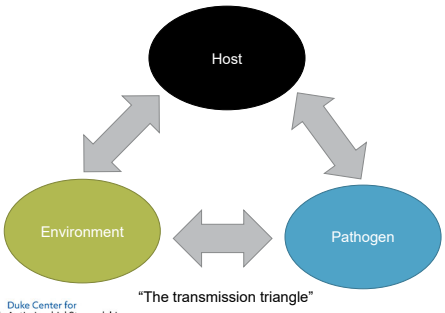
What is the process that leads to infection?



"The transmission triangle"

Key factors for infection to occur:

- Host is susceptible to infection
- Pathogen is virulent (can invade tissues and evade immunity of the host)
- Exposure from the environment is significant enough to allow pathogen entry into the host

Environmental risk factors

Environment

People, places/physical structure/space, time

Healthcare environments (e.g. Hospitals, OR, Clinic, ED, SNF/ALF) or community settings

Each setting and practice/procedure has it's own unique environmental risks to consider

- Examples:
  - Likelihood of needle sticks?
  - Likelihood of significant contamination events?
  - Likelihood of an encounter with a returning traveler presenting with fever?
  - What infections are circulating at this time of year?

Transmission: linear in time, multi-dimensional in space

TIME

E. coli lives happily in Patient #1's gut

Patient #1's feces (*E. coli*) contaminate the bed

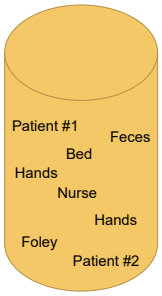
Nurse touches the bed, but doesn't effectively clean hands

Patient #2 is elderly with impaired immunity and poor functional status

Nurse does peri care on Patient #2's foley catheter

E. coli contaminates the foley catheter

Patient #2 develops a CAUTI



Reservoirs and intermediaries

Environment

The Environmental component may include multiple intermediate steps for transmission to occur:

Reservoir

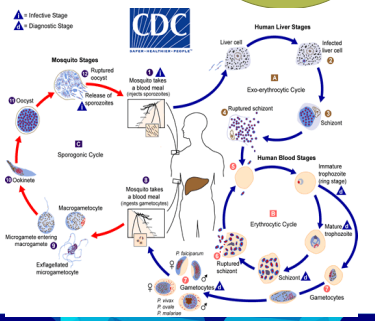
Portal of Exit (from the reservoir)

Mode of Transmission

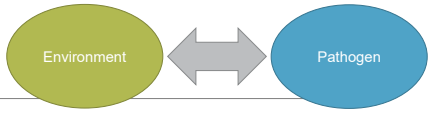
- E.g. surface/skin contact, airborne, fecal-oral, large droplet, sex, vector-borne

Portal of Entry (to the host)

https://www.cdc.gov/malaria/about/biology/index.html



Transmissibility

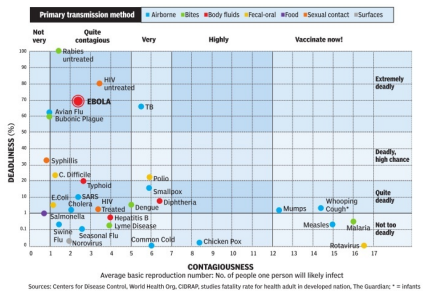


Inoculum: number of organisms needed to cause disease during an exposure

Ability of the pathogen to survive in the environment

Method of transmission (move from a reservoir to other hosts)

Reproductive number (R0) measure of infectivity: average number of people that one sick person will infect



Sources: Centers for Disease Control, World Health Org, CIDRAP, studies fatality rate for health adult in developed nation, The Guardianc, * = infants

https://www.quora.com/Whats-the-most-vicious-human-virus-in-the-world

Practice Question

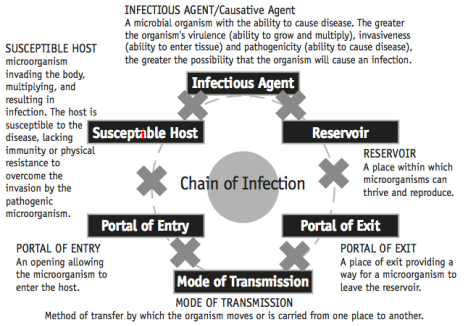
Which of the following statements about influenza is **FALSE**?

A. Influenza is primarily spread between individuals via respiratory secretions (droplets)

B. Viral shedding starts 48-72 hours after infection and typically 48 hours before the onset of symptoms

C. Viral shedding normally persists for less than 5 days but can be longer in children and in immunocompromised persons

D. The typical influenza symptomology is not always predictive of influenza in elderly or immunocompromised persons.



APIC text Figure 21-1. Components of the infectious disease process. Modified source: Centers for Disease Control and Prevention. *Principles of epidemiology*, 2nd ed. Atlanta: U.S. Department of Health and Human Services, 1992. Available at: http://www.cdc.gov/osels/scientific edu/ss1978/lesson1/Section10.html.

Mitigation of transmission risks

There are MANY things we can do to reduce transmission (examples):

- Environmental engineering, cleaning/disinfection
- Occupational health, avoidance of presenteeism
- Appropriate use of transmission based precautions
- Hand hygiene!
- Cohorting; staffing ratios

Some things are NOT modifiable with facility-level IP (examples):

- Host factors, complexity of patient population
- External factors, e.g. geographic and regional epidemiology
- Cannot wholly avoid risky things like surgery, chemotherapy, and central lines (aka competing risks)

Practice Question

An IP is conducting an educational session to help the nursing staff understand infectious disease transmission. She explains that an initial element in transmission is the ability of an organism to survive in the external environment during transit between hosts. What is the second element?

A. Secretion of enzymes that enhance spread through tissues

B. A mechanism for transmission to a new host

C. Invasion and dissemination in the host

D. Avoidance of host resistance

Host Defenses

Host

Non-specific defenses against invading pathogens

- Physiologic barriers: Secretions, Fever, normal flora
- Mechanical barriers: Mucosa or skin

Immune system

- Non-specific "Innate" immunity: Phagocytic cells (neutrophils, monocytes), hormones, fibronectin
- Complement system: protein pathways that poke holes and ramp up inflammatory response
- Pathogen-specific "Adaptive" immunity: Cellular immunity (T cells), Humoral immunity (B cells, antibodies)

Practice Question

The IP is teaching nurses how to assess infection risks in patients. Depletion of what cell type provides the best indication of susceptibility to most bacterial infections?

A. monocyte

B. Eosinophil

C. neutrophil

D. lymphocyte

Immunity

Terms and numbers to know:

- Normal WBC : 4,000 – 10,000 cells/mm^3
- Leukocytosis: WBC >10,000 cells/mm3
- Leukopenia: WBC <4,000 cells/mm3
- Neutropenia: PMN or band forms <500 cells/mm3 or absolute neutrophil count less than 1000 cells/mm3
- Absolute count = total WBC count x % of PMN leukocytes
- Polys: PMNs: mature or segmented neutrophils
- Bands: Immature or nonsegmented neutrophils
- Infection risk is high when absolute neutrophil count is <500 cells/mm

Immunity = Defense

Host

Active

- Acquired through prior exposure (+/- resolved infection) or vaccination
- Memory of prior antigens and previously produced humoral reaction (antibodies)

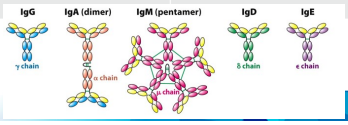
Passive

- Antibodies acquired through other means than a patient's own immune system
  - Maternal (first 6mo of life)
  - IVIG (all types of immune globulin)
  - Can be specific: e.g. rabies Ig, VZIg

Immunoglobulins/Antibodies

Host

	Relevant Facts	Where?
IgM	Appears FIRST in adaptive response, goes away by ~6mo after exposure, pentamer	Circulating free in blood plasma; too big to go into tissues
IgG	MAJOR antibody, 4 subclasses	Circulating free in blood plasma; moves easily into tissues
IgA	SECRETORY, histamine release, allergic reactions, dimer	Mucous membranes and secretions
IgD		On lymphocytes, small amt circulating in plasma
IgE	ALLERGY-inducing, "reagin", increased with parasites	Mucous membranes, incr in seasonal allergies



Practice Question

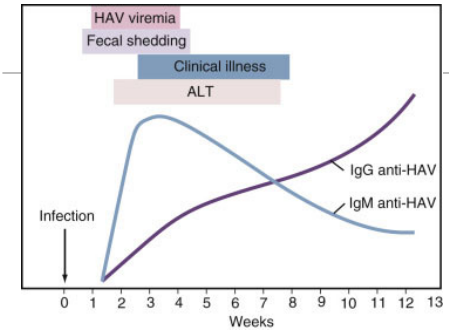
The first immoglobulin response after exposure to a communicable disease pathogen or vaccine is production of:

A. Immunoglobulin G (IgG)

B. Immunoglobulin M (IgM)

C. Immunoglobulin A (IgA)

D. Immunoglobulin C (IgC)



IgG = PRIOR exposure

IgM = RECENT exposure

BOOK CHAPTER
Viral Hepatitis
Jules L. Dienstag and Andrew S. Delemos
Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, Updated Edition, 119, 1439-1468.e9

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TABLE 119-2
Simplified Diagnostic Approach in Patients Presenting with Acute Hepatitis

DIAGNOSTIC INTERPRETATION	SEROLOGIC TESTS OF PATIENT'S SERUM			
	HBsAg	IgM Anti-HAV	IgM Anti-HBc	Anti-HCV
Acute hepatitis B	+	–	+	–
Chronic hepatitis B	+	–	–	–
Acute hepatitis A superimposed on chronic hepatitis B	+	+	–	–
Acute hepatitis A and B	+	+	+	–
Acute hepatitis A	–	+	–	–
Acute hepatitis A and B (HBsAg below detection threshold)	–	+	+	–
Acute hepatitis B (HBsAg below detection threshold)	–	–	+	–
Acute hepatitis C	–	–	–	+

HAV, hepatitis A virus; HBc, hepatitis B core; HBsAg, hepatitis B surface antigen; HCV, hepatitis C virus.
Modified from Longo D, Fauci A, Kasper D, et al. *Harrison's Principles of Internal Medicine* . 18th ed. New York: McGraw Hill; 2011.

Practice question

Higher morbidity rates in chronic hepatitis B virus carriers are associated with a co-infection of which of the following:

A. Hepatitis A

B. Hepatitis D

C. Hepatitis C

D. Hepatitis E

Practice Question

All of the following are descriptions of patients with immunocompromised status EXCEPT:

A. HIV with CD4 count <200

B. Leukemia or lymphoma

C. Neutropenia (absolute neutrophil count <500/mm3)

D. 1 year post bone-marrow transplant

"Susceptible" Host

Host

Can include a large variety of factors:

No prior exposures and thus no adaptive immunity

Invasive procedures (breaking through mechanical defenses)

Immunocompromise (partial list)

- Medications (e.g. high dose steroids, chemotherapy, transplant meds)
- Malignancy (e.g. real or functional neutropenia)
- Metabolic (e.g. diabetes, ESRD, ESLD)
- HIV/AIDS
- Asplenia (e.g. s/p MVA + splenectomy, sickle cell disease)
- Inherited immune deficiency

Pathogen Virulence

Pathogen

Factors about the pathogen that can contribute to its ability to invade the host, evade host immunity, or survive:

Advantage	Example virulence factor	Pathogen/syndrome
Enzymes to increase local tissue damage/spread	Toxin production	*S. pyogenes* and necrotizing fasciitis
Invade, disseminate	Motility	E. coli swimming up a ureter
Evade host defenses	Biofilms Attach or adhere to surfaces Alter cell wall or membrane Capsule prevents phagocytosis	Coag-neg Staph on IV line *S. aureus* on a prosthetic knee HIV *S. pneumoniae*
Survive in harsh conditions	Spore-formation Lipid coat	*C. difficile, Bacillus spp.* *M. tuberculosis*

Pathogen-specific features you must know

Type of microorganism: bacteria, virus, fungus, parasite

Clinical features of infection

Laboratory diagnosis (e.g. culture, serology, PCR)

Precautions recommended in healthcare setting (e.g. contact, airborne, droplet, standard)

Key transmission data:

- Mode of transmission
- Timing: incubation period and "shedding"/contagious period (key for droplet, airborne, and some contact/viruses), typical duration of symptoms
- Vectors

List of pathogens/syndromes to know

Bordetella pertussis
C. difficile and pseudomembranous colitis
Creutzfeldt-Jakob Disease and other prions
Central Nervous System Infections
Enterobacteriaceae
Enterococci
Environmental Gram-negative bacilli
Fungi
Diarrheal diseases – Viral
Diarrheal diseases – Bacterial
Diarrheal diseases – Parasitic
Herpes Viruses
Influenza
Foodborne Illnesses
Legionella pneumophila

HIV/AIDS
Lyme Disease (Borrelia burgdorferi)
Measles, Mumps, Rubella
Neisseria meningitides
Parvovirus
Rabies
RSV
STDs
Skin and soft tissue infections
Staphylococci
Streptococci
Tuberculosis and other mycobacteria
Viral Hemorrhagic Fevers
Viral Hepatitis
West Nile Virus
Parasites

Quick and Dirty Micro Classification

Gram positive – skin, lung, guts, devices

Gram negative – guts, urine, some lung

Atypicals – lung, STIs, ticks

Anaerobes –gas- and abscess-forming, bad odors, guts

Less commonly encountered: Mycobacterium (lung), spirochetes (Syphilis and Borrelia)

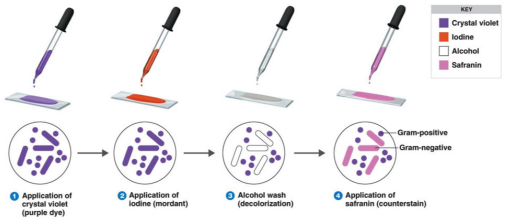
Fungal – guts, devices, really bad in immunosuppressed hosts

DIAGNOSIS: Stains and direct visualization

Gram stain
- Often provide clues to etiology (may allow presumptive diagnosis in some cases)
- Gram Positive
- Gram Negative
- Non-staining

Shape
- Coccus
- Rod
- Spiral
- Square

www.laboratoryinfo.com



Significance of the Gram Stain

By knowing the shape and gram staining reaction of the organisms, along with the body site involved; clinicians can make a reasonable guess as to the causative agent.

The reasonable guess can guide early empiric antibiotic choices.

Practice Question

When reviewing the Gram stain of a person with a wound infection, the IP sees Gram-positive organisms in clusters. Which organism would this most likely represent?

A. *Streptococcus*

B. Enterococcus

C. Corynebacterium

D. Staphylococcus

Microbiology

Physical requirements for growth of bacteria
- Nutrition (media)
- Temperature – 35° for most bacteria
- Atmospheric conditions
  - Aerobic (needs oxygen to survive)
  - Anaerobic (needs absence of oxygen to survive)
  - Facultative anaerobes (with or without oxygen)
  - Microaerophilic

Microbiology: Key words

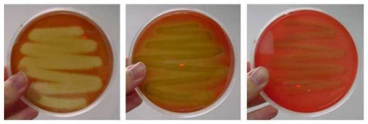
Growth media
- Blood agar = Multiple organisms
- Chocolate = Haemophilus, Neisseria
- Charcoal = Yeast, legionella
- MacConkey = Gram Negative
- Bile esculin = group D Strep
- Thayer-Martin = N. gonorrhoeae
- Lowenstein Jensen = Mycobacterium

Biochemical tests
- Catalase: Strep (-) Staph (+)
- Coagulase: Staph aureus (+)

https://microbeonline.com/types-of-bacteriological-culture-medium/

Microbiology: Key words

Hemolysis on Blood Agar
- Alpha = green
- Beta = clear
- Gamma = no hemolysis

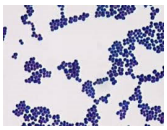


https://microbiologyinfo.com/haemolysis-of-streptococci-and-its-types-with-examples/

Lancefield grouping = Strep A to O
Bile esculin = black pigment
Optochin inhibition: S. pneumoniae (+)

GRAM POSITIVE ORGANISMS

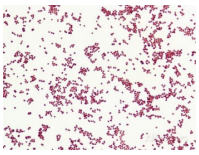
Gram positive cocci
- *Staphylococcus aureus*
- Coagulase negative staphylococcus
- *Streptococcus pneumoniae*
- *Streptococcus* sp.
- *Enterococcus* sp.



Gram positive rods
- *Bacillus* sp. (aerobes)
  - B. antracis
- *Clostridium* sp. (anaerobes)
- Listeria

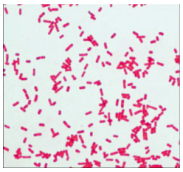
GRAM NEGATIVE ORGANISMS

Gram negative cocci
- *Neisseria meningitidis*
- *Neisseria gonorrhoeae*



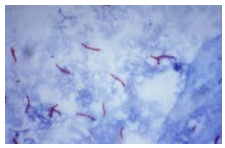
Gram negative rods (non-enteric)
- *Pseudomonas aeruginosa*
- *Stenotrophomonas maltophilia*
- *Acinetobacter* sp.

Gram negative rods (Enterobacteriaceae)
- *E. coli*
- *Klebsiella* sp.
- *Enterobacter* sp.
- *Proteus* sp.
- *Serratia* sp.



NON-STAINING/Special stain PATHOGENS

- Not stained by Gram's method
  - *Legionella* sp.
  - *Chlamydia*
  - *Rickettsia*
  - Mycobacteria
    - *M. tuberculosis*
    - Non-tuberculous mycobacteria



Ziehl-Neelsen Stain of TB

Aka. Acid Fast

Organism Diagnosis

Fungal
- Morphology
- Presence of hyphae
- Size of yeast
- Presence of capsule

Virology
- Direct- electron microscopy
- Antigen detection
- Virus isolation from culture
- Antibody detection/serology
- PCR testing

Parasitology
- Direct exam
- Microscopy (oocytes)
- Antigen detection/serology

Choice of Empiric Antimicrobials

What class of pathogen am I likely to be treating?
- (Bacterial? Viral? Fungal? Other?)

If bacterial, what organisms are most likely?
- (Gram positive? Gram negative? Anaerobe?)

What information can I get to guide treatment?
- Microbiology data?

Do I need to order any other diagnostic tests?

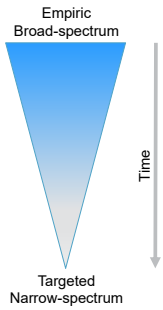
How sick is my patient? How risky would it be if I miss?

General Indications for Antibiotics

Prophylaxis: prevent infection
- EASY! Guidelines and ordersets
- E.g. surgical prophylaxis, pre-transplant protocol

Empiric: when you suspect infection but don't exactly know with what
- Not easy. Local guidelines help (based on local micro data).
- Clinical syndrome guides choice

Directed: pathogen known
- Only available for a small portion of folks treated for infection
- Moderately easy. Follow and interpret patient-specific micro data.

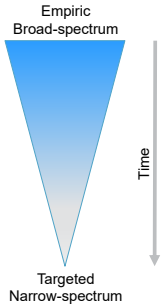


De-escalation

De-escalation is a core principle of Antimicrobial Stewardship.

Target/narrow antibiotic therapies after more clinical data returns

Stop therapy when infection has been ruled out



DIAGNOSIS: Culture

- "Gold standard" to identify the pathogen
- Requires sampling of site of infection, best if collected *prior to* therapy
- Allows determination of antimicrobial susceptibility
- Can be "banked" for future tests if needed, e.g. outbreak investigations, strain typing, PFGE

DIAGNOSIS: Culture

- There are some key limitations to traditional culture methods:
  - Time and resource intensive
    - Typically have no info other than the stain for 2-3 days
  - Highly reliant on specimen collection techniques
  - Sometimes positive in absence of infection
  - Sometimes negative when infection is present (e.g. in the setting of antibiotics) or get contaminated/mixed flora result

Practice Question

Guidelines for transporting specimens include:

1) Transport within 2 hours of collecting a specimen
2) Transport in leakproof specimen containers and sealable leakproof bags
3) Transport specimen in the syringe used to collect it
4) Refrigerate all specimens prior to transport

A. 1,4
B. 2,3
C. 1,2
D. 3,4

Culture Contamination

Inadequate specimen collection technique can lead to confusing results.

Best example: Contaminated blood cultures with skin flora – infection or not?

- Solutions: Collect blood cultures in pairs. Avoid drawing from existing lines. Hire/educate phlebotomists.

Other examples: Patients had clinical symptoms, are sick, but culture comes back "mixed flora" and pathogen remains unknown. Patient is treated with broad spectrum therapy.

- Example: urine cultures from existing foley catheter (doh!)
- Example: lower respiratory cultures

Specimen Collection: Key points

Do not contaminate sterile specimens: Aseptic technique + sterile specimen carriers; Appropriate skin prep; Get more than 1

Tissue > Fluid >>>>>>>> Swab (avoid!)

More volume is better (blood, fluids)

Send tissue from the OR to BOTH path and micro

Label appropriately and include key clinical clues for the lab, esp for pathogens that are more difficult to culture

Don't send cultures from drains/foleys that are already in place

Don't let specimens sit around (to lab within 2h preferred)

Practice Question

A patient has a nasal swab positive for methicillin-resistant Staphylococcus aureus (MRSA) in the absence of symptoms. This is an example of:

A. Normal flora

B. Colonization

C. Asymptomatic infection

D. Symptomatic infection

Infection vs. Colonization

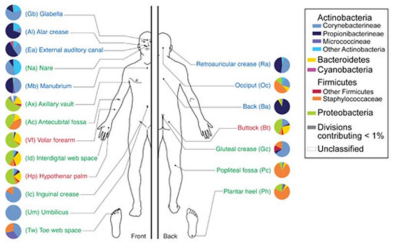
Human beings are not sterile.

Clinicians have trouble NOT treating when they see a positive culture.

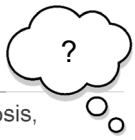
Clinical presentation is very important.

Clinical criteria for diagnosis of infection should lead to diagnostic testing (not the other way around).

The Human Microbiome



Infection vs. Colonization



Diagnostic tests used indiscriminately lead to overdiagnosis, overtreatment, and associated negative consequences.

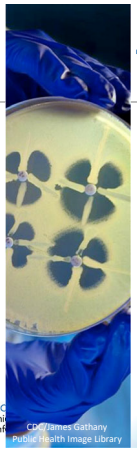
- Exhibit A: Asymptomatic bacteriuria
- Exhibit B: Patient colonized with *C. difficile* had only 1 loose BM after kayexalate = +PCR and classified as HO-CDI LabID event

Questions to ask before sending diagnostic test:

"What is the pre-test probability that this patient has infection?"

"What would I do differently if the test comes back positive? Negative?"

Establish Criteria for Testing Urine



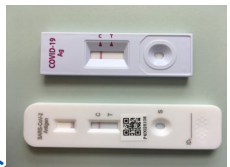
Diagnoses	Urine Culture	Clinical Symptoms
Acute, uncomplicated urinary tract infection	>100,000 bacteria, No more than 2 species of bacteria	• Dysuria OR • Fever AND 1 of the following: -Frequency -Urgency -Suprapubic pain -Incontinence* -Gross Hematuria**
Asymptomatic Bacteriuria	>100,000 bacteria, No more than 2 species of bacteria	• No signs or symptoms referable to the urinary tract

Stone *et al.* Infec Control Hosp Epi 2012;
*New or worsening of baseline incontinence
**I have never known hematuria to a sign of infection in an older adult. Rather, it seems to indicate trauma to the mucosa, which can lead to urinary tract infection or urosepsis

DIAGNOSIS: Antigen Tests

Identifies pathogen-specific proteins

- Very useful for diagnosing viral infections: HIV, HBV, COVID
- Occasionally useful for others: Cryptococcus antigen (CSF, blood), *S. pneumoniae* (urine), legionella (urine)



DIAGNOSIS: Serologic testing

- Detects immune response to a pathogen, or prior exposure to a pathogen
- For bacterial infections, generally not useful in early diagnosis (may require acute and convalescent tests)
- For viral infections, IgM indicates early diagnosis or recent exposure (e.g., Hep A)
- Important for screening for prior exposure, documenting immunity, and ensuring vaccination
  - e.g. Occupational health titers for varicella, HBV
- Once serology is positive, it is typically life-long

DIAGNOSIS: Molecular tests

PCR and other "molecular" tests

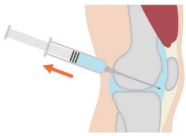
- Increasingly used allows diagnosis of non-culturable pathogens (e.g., norovirus) and faster identification(e.g., pertussis, MRSA in blood);
- Subject to false positives due to sensitivity (e.g. *C. difficile*)

DIAGNOSIS: Sterile fluid studies

Evidence of infection due to inflammatory, chemical, and cellular changes in body fluids

Examples: synovial fluid, CSF, pleural, and peritoneal fluid

Typically combined with GS/culture (which takes a while)



Practice Question

An IP is reviewing the cerebrospinal fluid (CSF) result from a patient admitted the previous night. The CSF is cloudy and has an elevated White Blood Cell count (WBC), markedly elevated neutrophils, low glucose, and elevated protein. What type of meningitis should she suspect?

A. Bacterial

B. Viral

C. Fungal

D. Aseptic

Table 74-1 APIC text

	Opening Pressure	Glucose (Ratio of CSF to Serum)	WBC count	WBC type	Total protein	Stain
Bacteria, "Septic"	Elevated	Normal to decreased	≥1,000/mm^3	Neutrophils (early or partially treated may have lymphocyte predominance)	Elevated (mild to very)	Gram* stain may show GPC or GNC/GNR
Virus, "Aseptic"	Usually normal	Usually normal	<100 per mm^3	Lymphocytes	Normal to elevated	Gram stain, negative
Fungi	Variable	Low	Variable	Lymphocytes	Elevated	India ink (Crypto), positive
TB	Variable	Low (can be extremely low)	Variable	Lymphocytes	Elevated	AFB stain, positive

Antibiotic susceptibility testing: Key Terms

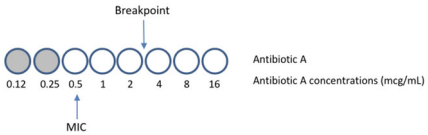
- Antibiotic = A drug that kills or inhibits the growth of microorganisms
- Resistant = An antimicrobial will NOT inhibit bacterial growth at clinically achievable concentrations
- Susceptible = An antimicrobial WILL inhibit bacterial growth at clinically achievable concentrations
- Intermediate= An antimicrobial may not inhibit bacterial growth at typical doses

Key Terms

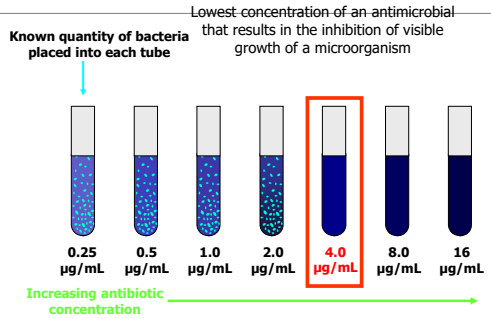
MIC = Minimal inhibitory concentration. Lowest concentration of antimicrobial that inhibits growth of bacteria. Commonly used in clinical lab

MBC = Minimal bactericidal concentration. Concentration of an antimicrobial that kills bacteria. Used clinically only in special circumstances

Breakpoint = The MIC that is used to designate between susceptible and resistant. Set by an expert committee (CLSI).



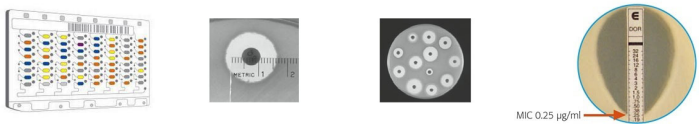
Methods for Testing Susceptibility: Minimal Inhibitory Concentration



Sinus and Allergy Health Partnership. *Otolaryngol Head Neck Surg.* 2000;123(1 Pt 2):S1.

Methods for Testing Susceptibility

- Broth dilution = MIC testing (Automated system) = a number
- Disc Diffusion = Kirby Bauer (Manual) = a zone size
- E test = "Strip" (Manual) = a number

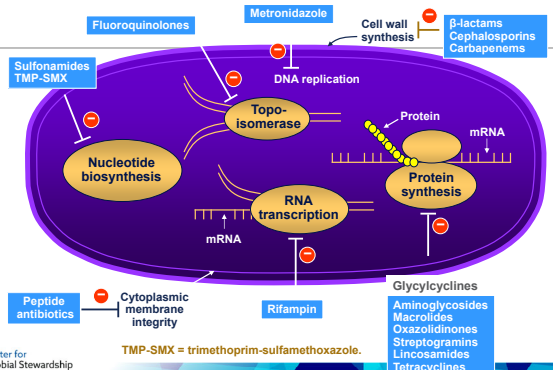


Resistance Mechanisms

Intrinsic- inherited by the organism species
- E.g. *Serratia* is intrinsically resistant to cefazolin

Acquired- results from altered cellular structure and physiology caused by changes in the genetic make-up
- Efflux pump
- Point mutation on a penicillin binding protein
- Beta lactamase production:
  - ESBL *K. pneumoniae* acquired resistance from a plasmid from *E. coli*
- Carbapenemase production

Mechanisms of Action of Antibiotics



TMP-SMX = trimethoprim-sulfamethoxazole.

Adapted from: Chopra I. *Curr Opin Pharmacol.* 2001;1:464-470.

10

SELECTED PATHOGENS

Duke University School of Medicine

dcasip.medicine.duke.edu

Practice Question:

The ED reports 3 cases of cramping, abdominal pain, and diarrhea within a 24-hour period. All persons are from the same community, and onset of symptoms was within 12 to 36 hours of a picnic they all attended. The IP suspects which of the following foodborne illnesses:

A. *Salmonella*

B. Hepatitis A

C. *Staphylococcus aureus*

D. *Clostridium perfringens*

Foodborne Diseases

Foodborne diseases

Etiology and Incubation period

- *Staph aureus* 30 min to 8 hrs, ave. 2-4 hrs.
- *Bacillus cereus* 1-6 hrs vomiting, 6-24h diarrhea

} Ingestion of toxin

- Salmonella 6-72 hrs, avg. 12-36 hrs
- Shigella 12-96 hrs, avg. 1-3 days
- *S. dysenteriae* up to 1 week
- Campylobacter 1-10 days, avg. 2-5 days
- *Clostridium perfringens* 6-24 hrs, avg. 10-12 hrs

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Practice Question

A patient is admitted with pruritic lesions on the hands, webs of fingers, wrists, the extensor surfaces of the elbows and knees, and the outer surfaces of the feet, armpits, buttocks, and waist. The most likely diagnosis is:

A. Scarlet fever

B. Herpes zoster

C. Scabies

D. Measles

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Practice Question

A patient who was hospitalized for 2 days calls 3 days after discharge complaining that he has developed healthcare-associated scabies due to his recent inpatient stay. The IP knows that his scabies infestation is not healthcare-associated because:

A. Scabies is only transmitted through contaminated linens, and the IP confirmed that all linens the patient came into contact with had been properly laundered

B. the incubation period for scabies is longer than 5 days

C. the incubation period for scabies is shorter than 3 days

D. Scabies is only transmitted through direct contact and none of the healthcare personnel who cared for the patient are infested

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Quick and dirty on parasites

- *"any organism living within or on another living creature and deriving advantage from doing so while causing disadvantage to the host"*

Multicellular	Protozoa	Worms
Lice Scabies Myiasis (maggots) Bed bugs	Water or food borne Vector borne Animal Sexually transmitted	Round (Intestine) Round (Tissue) Tape Fluke

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Practice Question

The causative organism of Creutzfeldt-Jakob disease is a:

A. helminth

B. diphtheroid

C. spirochete

D. prion

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Prion Diseases

"Transmissible neurodegenerative diseases" or "Transmissible spongiform encephalopathies (TSE)"

- Infectious protein replicates in the CNS and interrupts neuron functioning
- Rapidly progressive, ultimately fatal
- Spongiform appearance of neurologic tissues on path, no inflammatory response

Ways to acquire TSEs: Sporadic disease; Iatrogenic; Familial transmission (gene mutation); Ingestion of prions (e.g. bovine encephalopathies)

Transmission key features:

- Long incubation period
- Highly resistant to routine methods of disinfection/sterilization: requires prolonged cycle/increased temps and/or chemical disinfection for equipment exposed to infectious tissues
- Early recognition is KEY for the healthcare setting

Humans:
Creutzfeldt-Jakob disease (CJD)
Kuru
Gerstmann-Straumlussler-Scheinker (GSS)
Fatal familial insomnia

In animals:
Bovine spongiform encephalopathy (BSE, cattle)
Scrapie (sheep)
Chronic wasting disease (deer, elk)

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Practice Question

Which is TRUE about a tuberculin skin test (TST):

A. Positive TST indicates active tuberculosis (TB) infection

B. Negative TST rules out active TB infection

C. Positive TST indications past exposure to TB

D. Negative TST indicates past exposure to TB

Practice Question

The optimal time to collect a sputum specimen for acid-fast bacilli (AFB) testing to rule out TB would be:

A. First thing in the morning

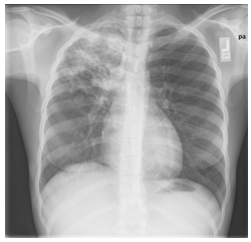
B. After a respiratory treatment

C. Prior to the patient going to bed

D. Prior to a respiratory treatment

Mycobacterium tuberculosis

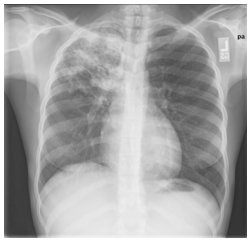
- Acid-fast bacilli
- Clinical features of pulmonary disease: subacute onset, cough/congestion (sputum may be bloody), weakness, fatigue, weight loss, chills, fever, night sweats
- Diagnostic testing: acid-fast smear/culture of sputum, PCR DNA probe, chest x-ray
- TST/PPD or IGRA is a screening test for latent disease or prior exposure



https://radiopaedia.org/cases/pulmonary-tuberculosis-29

Mycobacterium tuberculosis

- Transmission: airborne by inhalation of droplet nuclei
- Prevention: negative pressure isolation room, N95 mask, direct observed therapy for all new cases
- Treatment: 4-drug therapy: isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), ethambutol (EMB); others if drug-resistant (streptomycin, bedaquiline, FQ)



https://radiopaedia.org/cases/pulmonary-tuberculosis-29

Practice Question

A 14yo boy from rural Maryland was seen in the emergency department with fever, fatigue, chills, headache, and a large annular lesion on his left thigh. What is the most probable vector of this child's illness?

A. tick

B. mosquito

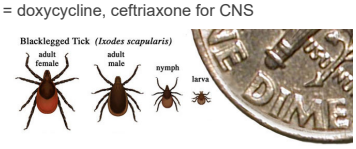
C. flea

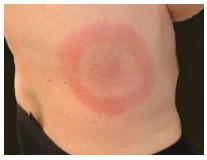
D. louse

Spirochetes: spiral shaped bacteria

Lyme (*Borrelia burgdorfori*): tick borne illness in the NE US (but expanding)

- Target lesions (erythema migrans), fever, headache, arthralgias; can also cause CNS disease and associated with Bell's palsy; cardiomyopathy
- Confusing diagnostics (serology and protein detection)
- Tick = Ixodes scapularis "black legged"
- Treatment = doxycycline, ceftriaxone for CNS





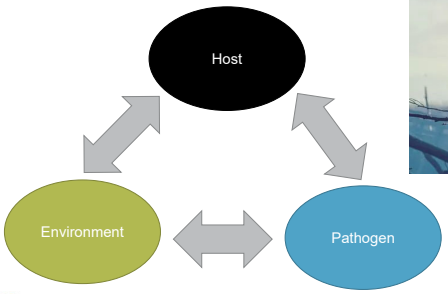
Spirochetes: spiral shaped bacteria

Syphilis (*Treponema pallidum*): "the great imitator" – sexually transmitted

- Multiple stages of clinical disease: primary, secondary, early latent, late latent, tabes dorsalis, tertiary, ocular, congenital
- Darkfield microscopy is classical diagnostic, but never used now
- Serology IgG plus confirmatory testing for screening
- Trending of VDRL or RPR titers for response to therapy and detection of new exposures
- Treatment = penicillin

www.giantmicrobe.com

Good Luck!



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