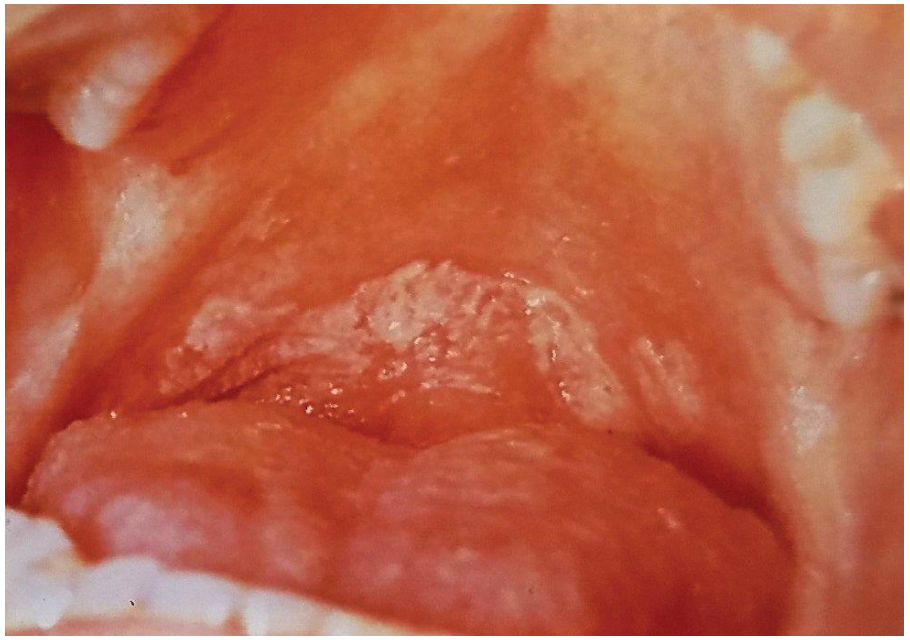
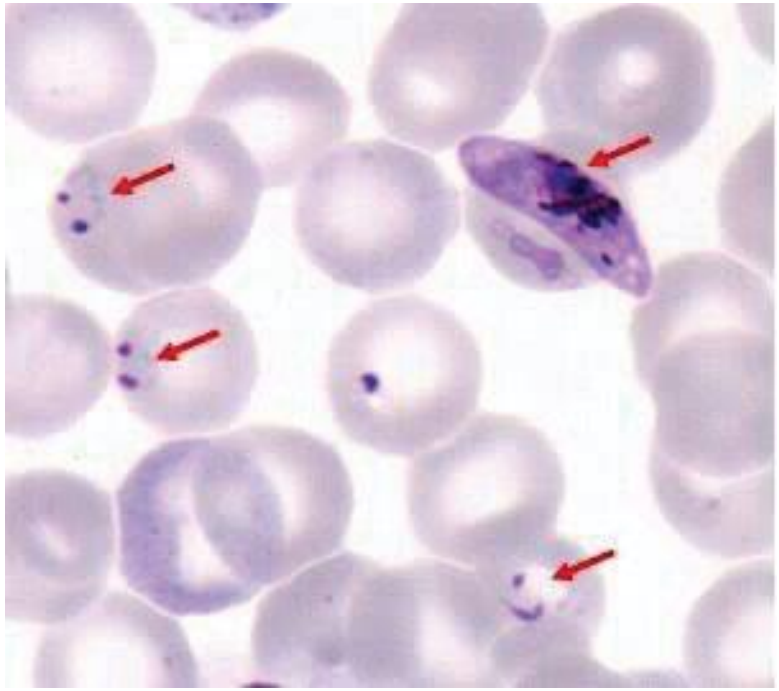
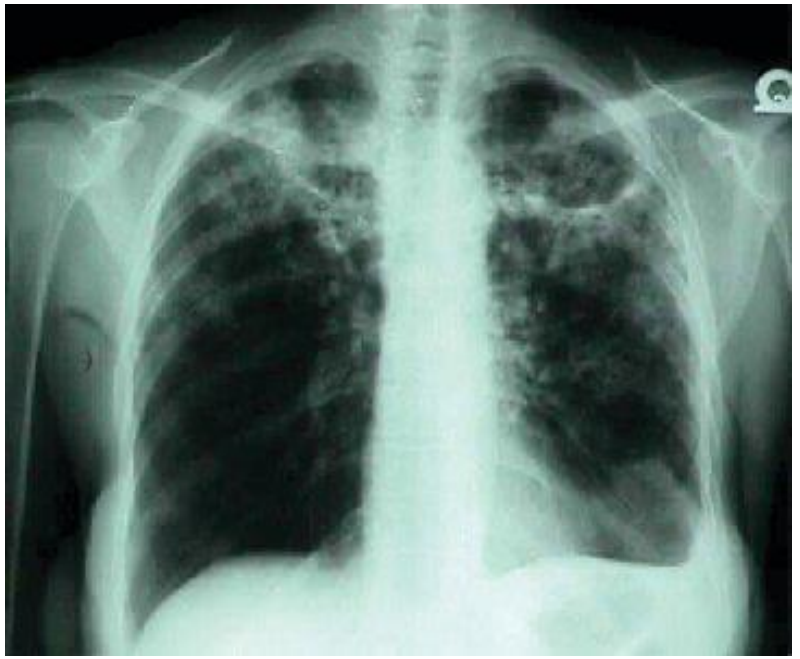


#1

#13





#19

Question 1 - Treat *Candida* esophagitis

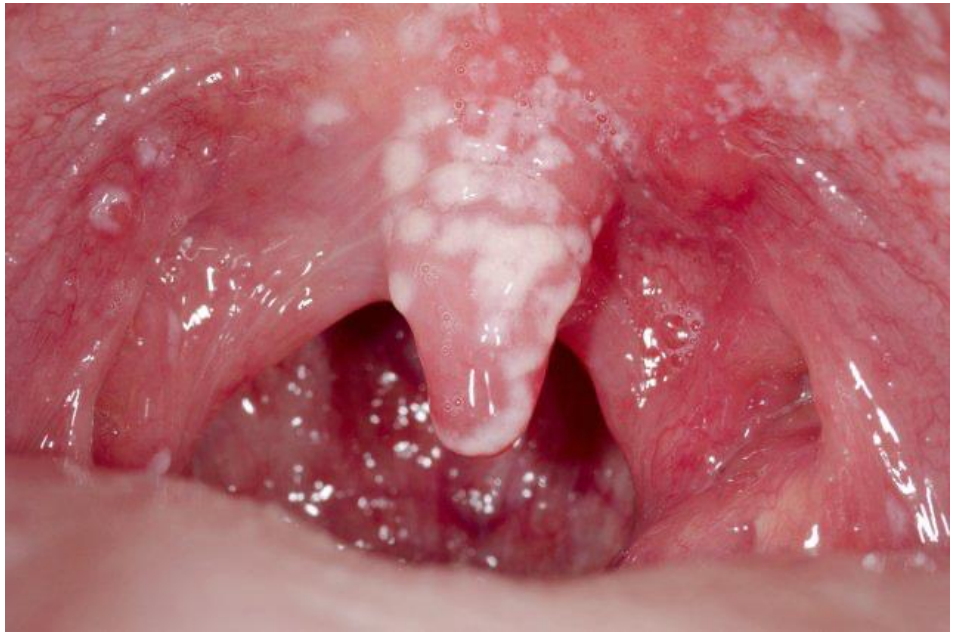
- B, oral fluconazole

- 30 y/o M with recent dx of HIV infection presents with 1 week of sore throat and odynophagia
- Started antiretroviral therapy 2 weeks ago
- Medications are tenofovir alafenamide, emtricitabine, dolutegravir, and trimethoprim-sulfamethoxazole
- Exam reveals whitish plaques on the posterior pharynx and palpable cervical LAD
- CD4 count: 55/µL
- HIV viral load: 138,855 copies/mL

- Presence of oral candidiasis + painful swallowing suggests esophageal involvement
- Esophageal involvement requires systemic antifungal therapy
- Esophageal involvement warrants a prolonged course, 14-21 days of therapy, vs. 7-14 (for oropharyngeal candidiasis alone)
- Fluconazole 400 mg loading dose followed by 200 to 400 mg daily for 14-21 days
- Clinical response should be evident in a few days

Oropharyngeal candidiasis

- Oropharyngeal
  - HIV negative
    - Topical therapy
      - Clotrimazole troches, 5 times a day
      - Miconazole buccal tablets daily
      - Nystatin swish and swallow QID
    - Fluconazole 200 mg loading dose followed by 100 to 200 mg daily
  - HIV positive
    - Can trial topical for first episode of mild thrush
    - Systemic therapy for recurrent or moderate to severe



Other answers

- IV caspofungin – PO therapy appropriate as pt able to swallow pills; fluconazole also with higher rates of complete resolution of disease; do not suspect resistance as pt has not been on long-term azole therapy
- Topical agents (ie. nystatin) are less effective than systemic fluconazole for oropharyngeal candidiasis and especially ineffective for esophageal candidiasis
- Upper endoscopy would be indicated if empiric therapy failed to relieve symptoms
- Valgancyclovir – CMV esophagitis can be seen in immunocompromised hosts, rarely in pts with intact immune system; typically see ulcerative lesions vs. plaques and should be biopsied to confirm dx; also consider HSV esophagitis, which should also be diagnosed with bx

Question 2 – Diagnose osteomyelitis using radiography

- C, plain radiography

- 46 y/o M with poorly controlled type 2 DM with 2 weeks of finger pain and swelling; 10 weeks prior sustained a laceration to the finger at work; laceration was sutured and wound healed
- VS wnl, 4 cm healed wound, but edematous and tender, no erythema
- Labs: ESR 120 mm/h, WBC count 7800/µL (7.8×10^9/L), Cr of 0.6 mg/dL

- Exam not c/w SSTI, as there is no erythema, but elevated inflammatory markers concerning for osteomyelitis
- Cortical bone loss must be > 50% for a plain radiograph to show findings diagnostic of osteomyelitis
  - If negative, does not rule out disease

- Nonhematogenous vs. hematogenous
  - Nonhematogenous: contiguous spread; trauma, surgery, diabetic foot wound, decubitus ulcer; may be polymicrobial
  - Hematogenous: seeding of bone in the setting of bacteremia; usually monomicrobial, *S. aureus* #1; remember salmonella with sickle cell and pseudomonas with injection drug use

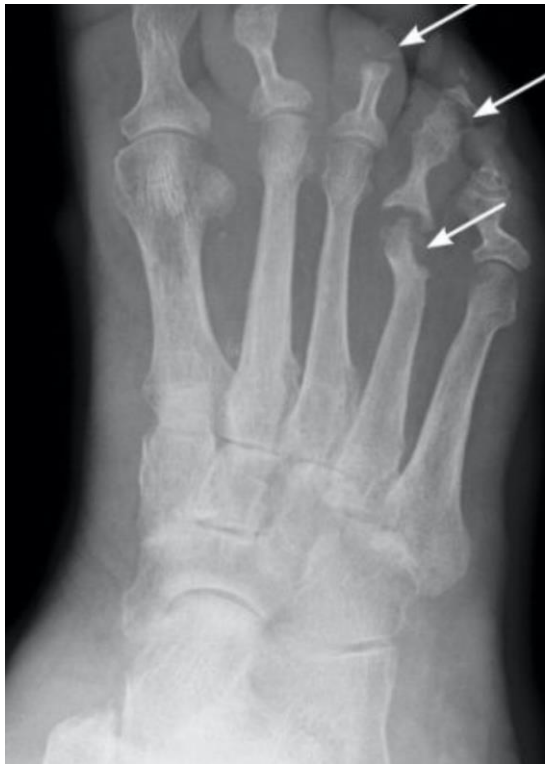
Imaging in osteomyelitis

Summary statistics of imaging modalities for diagnosis of osteomyelitis associated with diabetic foot ulcer

Diagnostic modality	Total patients	Sensitivity (95% confidence interval)	Specificity (95% confidence interval)	Study
Probe-to-bone test or exposed bone	288	0.60 (0.46-0.73)	0.91 (0.86-0.94)	Dinh et al
Radiography	177	0.54 (0.44-0.63)	0.68 (0.53-0.80)	Dinh et al
Magnetic resonance imaging	135 421	0.90 (0.82-0.95) 0.93 (0.82-0.97)	0.79 (0.62-0.91) 0.75 (0.63-0.84)	Dinh et al Lauri et al
Bone scan	185	0.81 (0.73-0.87)	0.28 (0.17-0.42)	Dinh et al
Leukocyte scan	269	0.74 (0.67-0.80)	0.68 (0.57-0.78)	Dinh et al
In-111 oxine WBC	206	0.92 (0.72-0.98)	0.75 (0.66-0.82)	Lauri et al
Tc-99m HMPAO WBC	406	0.91 (0.86-0.94)	0.92 (0.78-0.98)	Lauri et al
18F-FDG PET/CT	254	0.89 (0.68-0.97)	0.92 (0.85-0.96)	Lauri et al

WBC: white blood cell; HMPAO: hexamethylpropyleneamine oxime; 18F-FDG PET/CT: 18F-labeled fluoro-2-deoxyglucose positron emission tomography/computed tomography.

- If symptoms present >2 weeks, conventional radiography is a reasonable initial modality
- MRI may be required if symptoms present <2 weeks or negative plain films
- Cultures:
  - Blood culture
  - Bone culture
  - If a patient is stable, delay antibiotics until a bone culture can be obtained



Question 3 - Prevent *Staphylococcus aureus* surgical site infection by evaluating for *S. aureus* nasal carriage

- A, evaluate for *Staphylococcus aureus* nasal carriage

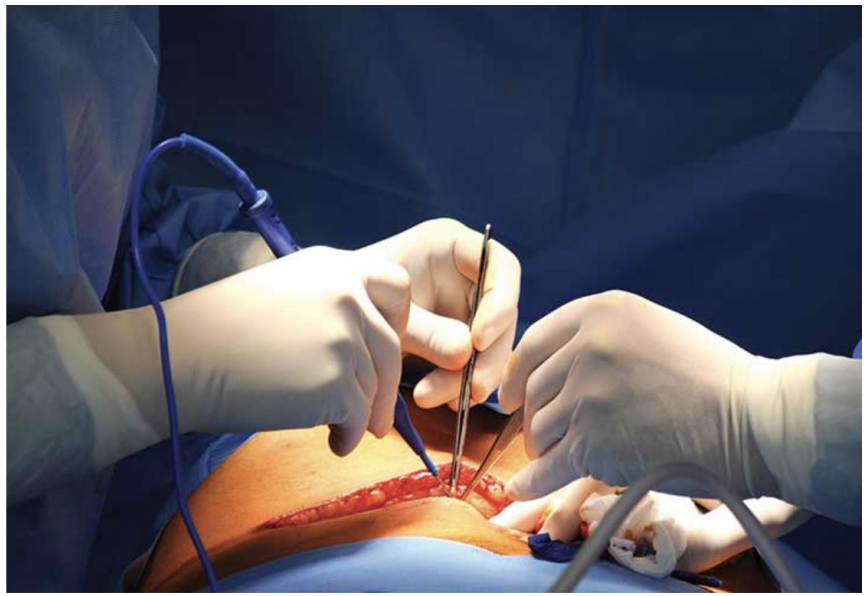
- 68 y/o M scheduled for CABG in 5 weeks
- Steps to lower the risk of a surgical site infection

- Evaluate for *Staphylococcus aureus* nasal carriage 2 weeks before surgery and decolonize if positive
- *S. aureus* is the most common pathogen (23%) associated with surgical site infections (SSIs)
- SSIs following CABG can be serious, including mediastinitis
- Mupirocin ointment for 5 days with or without chlorhexidine gluconate body wash

Preventing surgical site infections

- Infection control
  - Antimicrobial prophylaxis
    - Cefazolin
    - Vancomycin if patient known to be colonized with MRSA or high risk for MRSA colonization
    - 24 hours of perioperative antibiotics recommended; data does not recommend extending period
  - Surgeon hand hygiene and barrier devices
  - MRSA decolonization
  - Skin antisepsis – wash with chlorhexidine
- Do not shave hair – increased risk for SSI

- Patient preparation
  - Smoking increases risk of SSI and other complications
    - Cessation for 4-6 weeks is recommended prior to elective surgery
  - Bowel prep prior to colorectal surgery



Question 4 - Manage candidemia with empiric antifungal therapy

- A, begin empiric therapy with an echinocandin

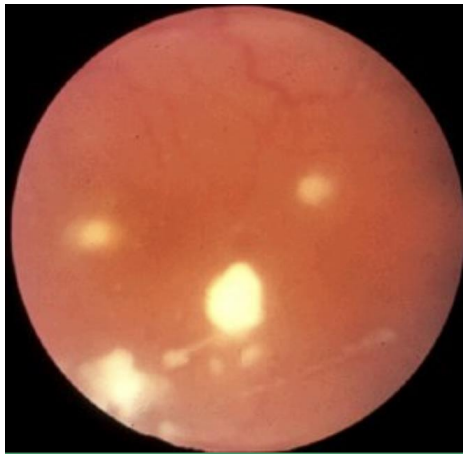
- 55 y/o M with 5-yr hx of type 2 DM hospitalized with acute diverticulitis
- PICC placed and piperacillin-tazobactam initiated; after 72 hours, he becomes hypotensive and tachycardic and is transferred to the ICU
- Temp is 40 °C (104.0 °F), BP is 89/46 mm Hg, HR is 136/min, RR is 32/min, and O2 sat is 92% on RA
- Somnolent; funduscopic examination is unremarkable; abdominal exam LLL soft, TTP
- Blood culture is positive for yeast

Table 27. Risk Factors for Systemic Candidiasis
Central venous catheters
Broad-spectrum antimicrobial agents
Neutropenia
ICU stay for more than 3 days
Total parenteral nutrition
General surgery (especially of the gastrointestinal tract)
Burns
Trauma
Mechanical ventilation for more than 3 days
Transplantation (bone marrow/solid organ)
Hemodialysis-associated catheters
Severe acute pancreatitis

Management of candidemia

- Yeast in a blood culture warrants treatment (single culture is not a contaminant)
- An echinocandin (anidulafungin, caspofungin, or micafungin) is recommended as empiric therapy for most patients with candidemia due to azole resistance
  - Several *Candida* species, such as *C. glabrata, C. auris*, and *C. krusei*, are intrinsically resistant to azoles
  - If azole susceptible, can transition to fluconazole to complete 14-day course

- Ophthalmologic evaluation
  - All patients with candidemia, regardless of symptoms, should undergo exam by an ophthalmologist to look for endophthalmitis (IDSA recommendation)



- Removal of CVC
  - Non-neutropenic
    - Removal
  - Neutropenic
    - May likely have a GI source; case by case
  - Consideration for G-CSF transfusions, as persistent neutropenia assoc. with treatment failure

Question 5 - Manage acute pyelonephritis with bacteremia in a woman

- A, completion of oral ciprofloxacin course

- 38 y/o F following up in the office after an ED visit for pyelo (fever, flank pain and dysuria); urine culture and 2 sets of blood cultures collected, and she received IV ceftriaxone x 1 dose and sent home with 7 days of oral ciprofloxacin
- On physical examination, vital signs and other findings are normal
- *Escherichia coli* susceptible to ciprofloxacin was isolated from her urine culture and one blood culture

- The duration of antimicrobial therapy for acute pyelonephritis need not be extended in setting of bacteremia in the absence of other complicating factors

Complicating Factors in Acute Pyelonephritis

Abnormal urinary tract anatomy or function; obstruction

Chronic catheterization or recent urinary tract instrumentation

Immunosuppression

Increased risk of multidrug-resistant organisms (Table 2)

Male sex*

Older age, frailty

Pregnancy

Significant comorbidities (e.g., diabetes mellitus, organ transplant, sickle cell disease)

Management of pyelonephritis

Options for Outpatient Antibiotic Treatment in Adults with Acute Pyelonephritis

Agent and dosing	Length of treatment	Comments/pregnancy safety
Amoxicillin/clavulanate (Augmentin), 875 mg/125 mg twice daily*	10 to 14 days	May use during pregnancy; has coverage for *Enterococcus* but not useful as empiric treatment for other organisms because of resistance patterns
Cefixime (Suprax), 400 mg once daily*	10 to 14 days	May use during pregnancy, limited evidence for use
Cefpodoxime, 200 mg twice daily*	10 to 14 days	May use during pregnancy, limited evidence for use
Cephalexin (Keflex), 500 mg twice daily*	10 to 14 days	May use during pregnancy, increased resistance risk
Ciprofloxacin, 500 mg twice daily†	7 days	No known risk of teratogenicity based on human and animal data
Ciprofloxacin extended release, 1,000 mg once daily†	7 days	No known risk of teratogenicity based on human and animal data
Levofloxacin (Levaquin), 750 mg once daily†	5 days	No known risk of teratogenicity based on human and animal data
Trimethoprim/sulfamethoxazole, 160 mg/800 mg twice daily‡	14 days	Avoid use during pregnancy

Indications for Hospitalization in Patients with Acute Pyelonephritis

Absolute indications

Concurrent urinary tract obstruction

Failure of outpatient therapy

Oral antibiotic intolerance

Pregnancy

Sepsis

Unstable coexisting medical conditions

Relative indications

Frailty or poor social support

High risk of infection with multidrug-resistant organism; hospital-acquired infection (Table 2)

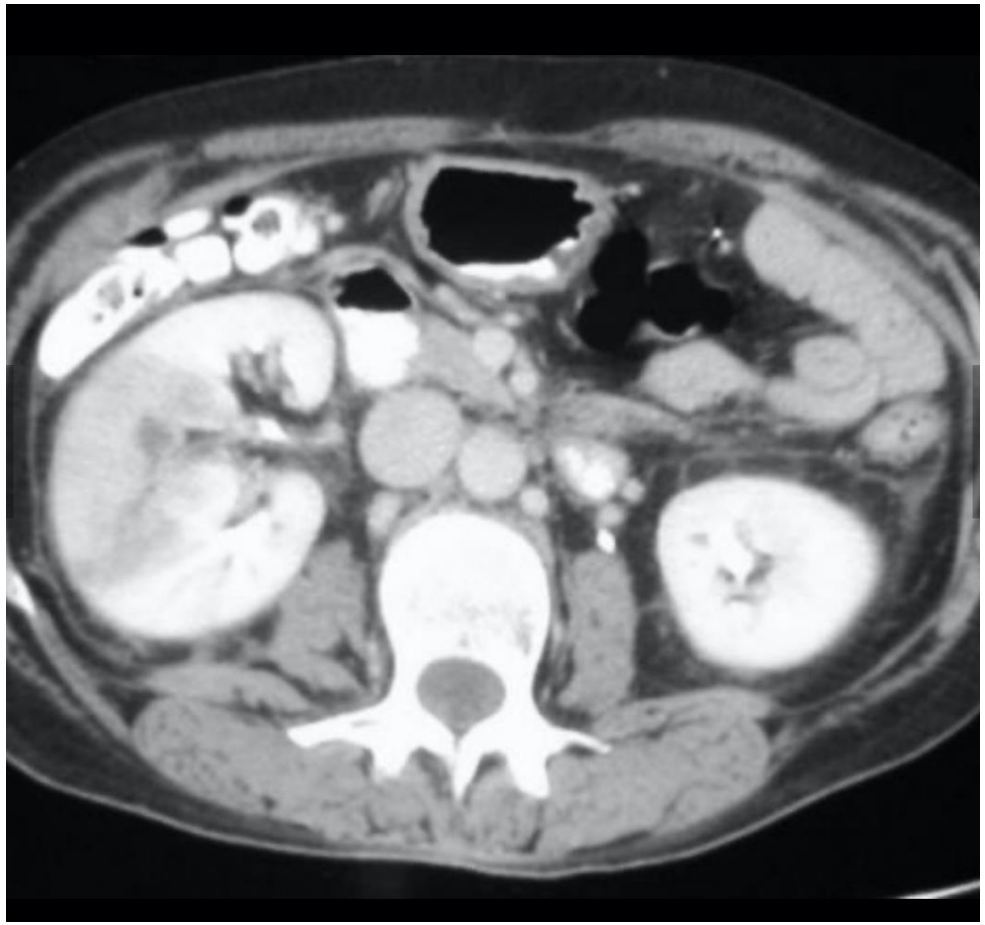
Severe, refractory pain

Significant comorbidities or immunosuppression (e.g., diabetes mellitus, malignancy, organ transplant, sickle cell disease)

Unreliable follow-up care

Management of pyelonephritis

- Need for imaging:
  - Not recommended in uncomplicated cases
  - Consider in the following circumstances:
    - Sepsis
    - Concern for urolithiasis
    - New renal insufficiency
    - Known urologic abnormalities
    - Failure to respond to appropriate therapy within 48 to 72 hours



Question 6 - Diagnose *Mycobacterium fortuitum* infection

- B, mycobacterium fortuitum

- 67 y/o M with hx of HTN and tobacco use presents with 3 mos of a chronic, non-healing L foot ulcer
- Ulcer developed at a sauna after stepping on a sharp object
- No improvement with several courses of antibiotics
- Ulcer continues to expand in size and deepen
- On exam, he has a 2- × 2-cm ulcerated lesion on the plantar aspect of the metatarsal region of the great toe, with surrounding erythema, yellowish discharge, and firm edges

- *M. fortuitum* is one of the rapidly growing, nontuberculous mycobacteria (NTM) capable of producing chronic, nonhealing wounds including skin, soft tissue, surgical sites and prosthetic devices
- Should always be considered in chronic wounds, especially when conventional antimicrobial therapy has been ineffective
- Diagnose with deep biopsy of chronic wound tissue
  - Histopathology to stain for bacteria, mycobacteria, and fungi + microbiology for similar stains and cultures

Nontuberculous Mycobacteria (NTM) Infections

Table 25. Classification of Common Nontuberculous Mycobacteria
Slow-growing Mycobacteria
M. kansasii
M. marinum
M. gordonae
M. scrofulaceum
M. avium complex
M. ulcerans
M. xenopi
Rapidly Growing Mycobacteria
M. abscessus
M. chelonae
M. fortuitum

- Risk factors for nontuberculous mycobacteria infections include immunocompromise, chronic lung disease, and postoperative status
- Mycobacterium avium complex is the most common cause of chronic lung infection worldwide, causing cavitary lung disease
- M. kansasii infection mimics pulmonary tuberculosis with cavitary lung disease; predisposing conditions include underlying lung disease, alcoholism, cancer, and immunocompromised status
- Rapidly growing mycobacteria
  - Mycobacterium abscessus, Mycobacterium chelonae, and Mycobacterium fortuitum can produce lung disease, adenitis, skin and soft tissue infections, surgical site infections, and prosthetic device infections

Other answers

- Most common presentation of NTM infection is pulmonary disease and MAC Is the most common organism; disseminated MAC develops in patients with HIV and CD4 count < 50/µL; clinical presentation of fever, night sweats, weight loss and GI sxs, not a solitary, nonhealing cutaneous ulcer
- *Mycobacterium kansasii* most commonly causes a lung infection that mimics TB, with cough, fever, weight loss, and cavitary lung disease; RFs are COPD, cancer, HIV, alcohol abuse and immunosuppression; *M. kansasii* does not cause isolated chronic skin or soft tissue infections
- Leprosy is caused by the acid-fast bacillus *Mycobacterium leprae* and is a slow-growing organism; should be considered in the setting of chronic skin lesions that fail to respond to treatment of common skin conditions or if associated sensory loss; rapid development of a nonhealing ulcer after an initial injury 1 month ago is not compatible with infection caused by *M. leprae*

Question 7 - Diagnose meningitis caused by herpes simplex virus type 2

- B, herpes simplex virus type 2

- 33 y/o F no pMHx with 3 days of fever, headache, stiff neck and photophobia in January
- On exam, T 38.5 °C (101.3 °F), BP 136/86 mm Hg, HR 100/min and RR is 18/min; neuro exam with photophobia, fundoscopic exam without papilledema
- CSF: leukocyte count 324/µL with 60% neutrophils, glucose of 58 mg/dL and protein level of 125 mg/dL; gram stain is negative, culture pending

- Viral meningitis is the most common cause of "aseptic" meningitis, in which cerebrospinal fluid (CSF) gram stain and cultures are negative
- HSV meningitis syndromes can be related to primary infections, with CNS involvement as a secondary consequence, or reactivation of latent infection presenting as aseptic meningitis
- HSV-2 is more commonly associated with meningitis and is the most common cause of recurrent meningitis; HSV-1 is associated with encephalitis

Other answers

- Enteroviruses are the most common cause of viral meningitis, but usually present between May and November in the Western Hemisphere; sxs of headache, fever, nuchal rigidity, photophobia, nausea, vomiting, myalgias, pharyngitis, maculopapular rash, and cough
- Measles, mumps, and rubella vaccine has lowered the incidence of mumps-related meningitis has; however, meningitis from mumps virus can occur at any point during the course of clinical mumps infection; parotitis or orchitis may be present
- With West Nile neuroinvasive disease, focal motor weakness is common, either combined with meningoencephalitis or as an isolated myelitis; infection of the anterior horn cells can cause a symmetric or asymmetric flaccid paralysis; diagnose through identification of IgM antibody in CSF; mosquito-borne illnesses are most commonly seen between June and October

Meningitis vs. encephalitis

- Meningitis characterized by headache, fever and nuchal rigidity and altered mentation

Symptoms on presentation	
Headache — no./no. evaluated (%)	544/626 (87)
Nausea — no./no. evaluated (%)	449/610 (74)
Neck stiffness — no./no. evaluated (%)	569/685 (83)
Rash — no./no. evaluated (%)	176/683 (26)
Systolic blood pressure — mm Hg	144±33
Diastolic blood pressure — mm Hg	79±20
Body temperature	
Mean — °C	38.8±1.2
≥38°C — no./no. evaluated (%)	522/678 (77)
Score on Glasgow Coma Scale§	
Mean	11±3
<14 (indicating change in mental status) — no. (%)	477 (69)
<8 (indicating coma) — no. (%)	96 (14)

- Most common causes of encephalitis:
  - Herpes simplex virus types 1 and 6
  - Varicella-zoster virus
  - West Nile virus
  - Autoimmune diseases

TABLE 1. Diagnostic criteria for encephalitis[14]

Major criterion (required)
Subacute onset of impairment in the domains of consciousness, memory, mental status, or new onset psychiatric changes without alternative cause.
Minor criterion (at least 2 for diagnosis of possible encephalitis)
1. Fever ≥38° C (100.4°F) within the 72 h before or after presentation
2. Seizures (focal or generalized) not attributable to a previous seizure disorder
3. Cerebrospinal fluid pleocytosis (white blood cell count > 5/cubic mm)
4. Evidence of brain parenchymal inflammation on neuroimaging (acute or subacute)

Question 8 - Treat ventilator-associated pneumonia for 7 days

- A, continue antibiotic therapy for a total of 7 days

- 67 y/o F intubated and in the ICU for 3 days with respiratory failure 2/2 Guillain-Barré syndrome
- She was diagnosed with ventilator-associated pneumonia diagnosis and empiric antibiotics were started; sputum culture grew methicillin-sensitive *Staphylococcus aureus;* blood cultures negative
- On exam, temperature is 37.6 °C (99.6 °F), blood pressure and pulse rate are normal, and respiration rate is 15/min; O2 sat is 97% breathing 40% FIO_2; scattered rhonchi on lung exam
- CXR with right middle and lower lobe infiltrates without effusions

- VAP - pneumonia developing 48 hours after endotracheal intubation
- Early onset (<5 days after hospitalization or intubation) - *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Staphylococcus aureus*, and antibiotic-susceptible gram-negative bacteria)
- Late onset (≥5 days after hospitalization or intubation) is more likely with multidrug-resistant organisms (MDROs), including *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Acinetobacter* species, *Stenotro phomonas maltophilia*, *Burkholderia cepacia*, and methicillin-resistant *S. aureus*

Ventilator-associated PNA

- Empiric antibiotics should be based on local resistance patterns (antibiogram), RFs for drug-resistant organisms, presence of underlying disease and current and historic culture data
- Considerations
  - If a patient has recently received antibiotics, chose a different class for empiric therapy
  - Narrow based on susceptibility to culture data
  - If no growth at 48-72 hours from a high quality specimen, narrow coverage
- IDSA/ATS 2016 guidelines – 7 days non-inferior to longer durations and reduction in emergence of resistant organisms

Risk factors for multidrug-resistant ventilator-associated pneumonia

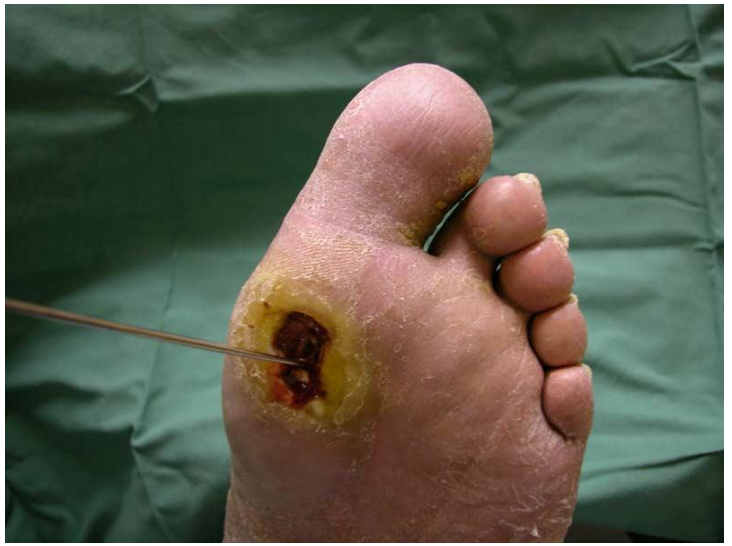
Risk factors for MDR pathogens:
▪ IV antibiotic use within the previous 90 days
▪ Septic shock at the time of VAP
▪ ARDS preceding VAP
▪ ≥5 days of hospitalization prior to the occurrence of VAP
▪ Acute renal replacement therapy prior to VAP onset
Risk factors for MDR *Pseudomonas* and other gram-negative bacilli:
▪ Treatment in an ICU in which >10 percent of gram-negative isolates are resistant to an agent being considered for monotherapy
▪ Treatment in an ICU in which local antimicrobial susceptibility rates are not known
▪ Colonization with OR prior isolation of MDR *Pseudomonas* or other gram-negative bacilli
Risk factors for MRSA:
▪ Treatment in a unit in which >10 to 20 percent of *Staphylococcus aureus* isolates are methicillin resistant
▪ Treatment in a unit in which the prevalence of MRSA is not known
▪ Colonization with OR prior isolation of MRSA

Question 9 - Evaluate osteomyelitis in a diabetic foot infection

- A, bone biopsy and culture

- 67 y/o F with DM complicated by neuropathy presents with R foot ulcer
- On exam, T 37.3 °C; other VS wnl; deep 3- × 4-cm necrotic and malodorous ulcer is located on the distal medial compartment of the plantar surface of the right foot; a probe-to-bone test is negative; no surrounding erythema or increased warmth; palpable pulses, warm feet
- ESR and CRP elevated, CBC wnl
- Plan radiograph reveals soft tissue swelling and ulceration; MRI reveals findings consistent with osteomyelitis of the first metatarsal head

- Osteomyelitis (OM) in a patient with a diabetic foot ulcer (DFU) and no evidence of skin or soft tissue infection or sepsis requires a bone biopsy before antibiotics
- Consider OM when a DFU is deep (presence of exposed bone), large (>2 cm in diameter), or chronic (nonhealing after 6 weeks of standard care)



Antibiotics for DFU-associated OM

Table 4. Suggested Route of Administration and Duration of Antibiotic Therapy for Diabetic Foot Osteomyelitis

Bone or joint infection	*Route of administration*	*Duration of therapy*
No residual infected tissue (e.g., postamputation)	Parenteral or oral	2 to 5 days
Residual infected soft tissue (but not bone)	Parenteral or oral	1 to 3 weeks
Residual infected (but viable) bone	Initially parenteral, then consider oral	4 to 6 weeks
No surgery, or residual dead bone postoperatively	Initially parenteral, then consider oral	≥ 3 months

Adapted with permission from Lipsky BA, Berendt AR, Cornia PB, et al.; Infectious Diseases Society of America. 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. Clin Infect Dis. *2012;54(12):e158.*

Question 10 - Treat vertebral osteomyelitis

- A, continue cefazolin to complete 6 weeks of antibiotic therapy

- 58 y/o M with uncomplicated L3 vertebral osteomyelitis, suspected to be 2/2 bacteremia during hemodialysis
- CT-guided bone biopsy identified methicillin-susceptible *Staphylococcus aureus* infection
- 2 weeks of antibiotic therapy completed, with fever resolution and improved pain
- On exam, VS nml; lower lumbar spine is minimally tender to palpation

- Recommended treatment duration for vertebral osteomyelitis is 6 weeks
- Always get blood cultures if vertebral osteo is suspected
- MRI is preferred imaging modality
- Neurologic compromise or spinal instability warrant evaluation for immediate surgical intervention
- Monitoring of inflammatory markers can assist in assessing the success of therapy; follow-up MRI is not recommended in patients who respond clinically

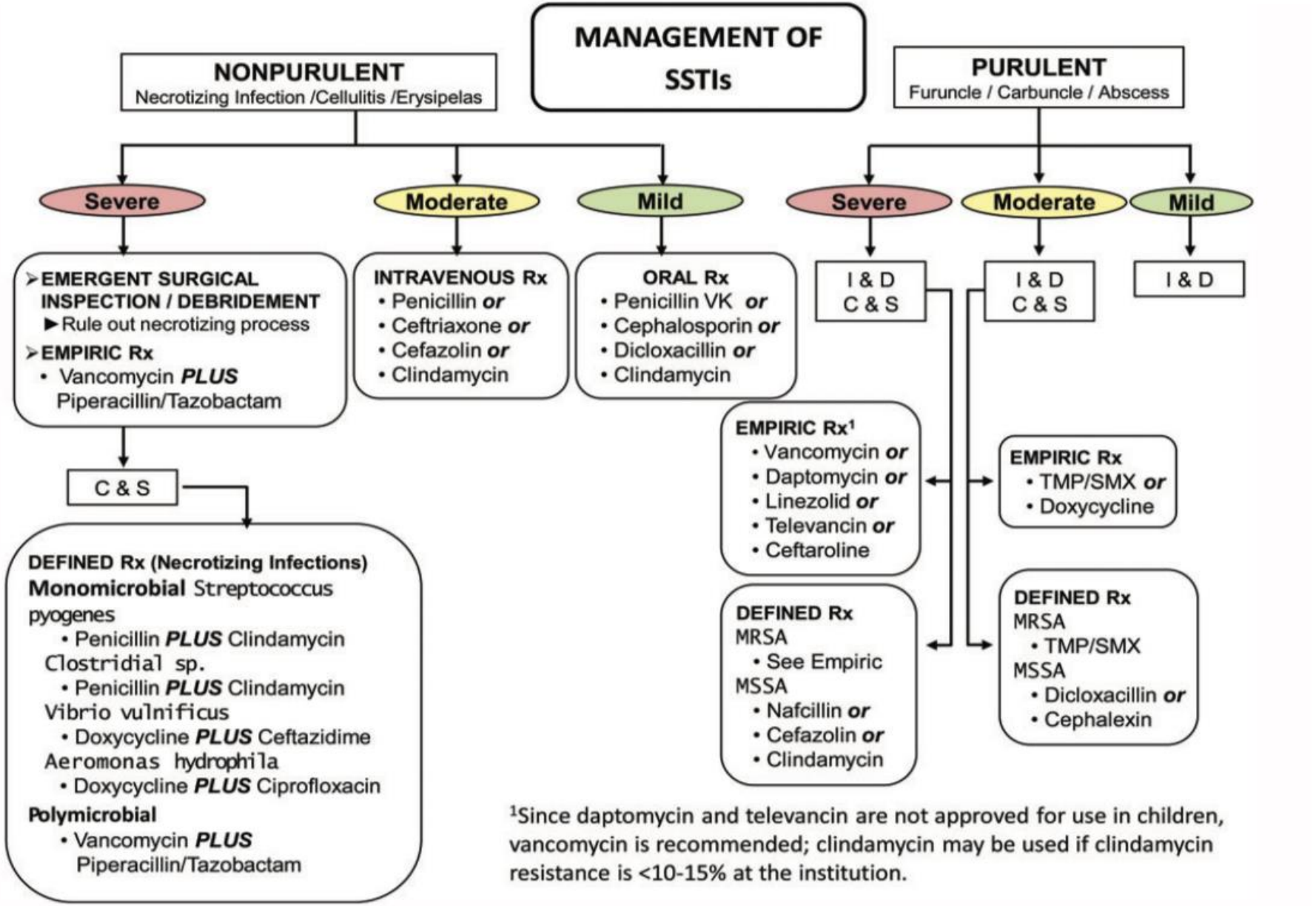
Question 11 - Treat a patient with necrotizing fasciitis and toxic shock syndrome secondary to group A *Streptococcus*

- D, change to penicillin and clindamycin

- 25 y/o M who uses injection drugs presenting with left hand pain at site of injection
- On exam, T39.3 °C (102.7 °F), BP 88/50 mm Hg, HR 110/min, RR 26/min; violaceous, swollen, indurated area is noted on the dorsum of the left hand at the site of recent injection drug use; it is warm to the touch and tender
- Hct 36%, leukocyte count 25,000/µL, platelet count 100,000/µL, ALT 65 U/L, AST 105/UL, Cr 2.5 mg/dL
- Started empirically on vancomycin and piperacillin-tazobactam and goes for surgical debridement with Intraoperative findings confirming necrotizing fasciitis, and tissue and blood cultures with group A *Streptococcus*

- Surgical debridement is the primary treatment for GAS NF
- IDSA recommends penicillin plus clindamycin for antibiotic treatment of GAS NF; although *S. pyogenes* is susceptible to penicillin, clindamycin is added for suppression of streptococcal toxin production

IDSA SSTIs


MANAGEMENT OF SSTIs
NONPURULENT
Necrotizing Infection /Cellulitis /Erysipelas
PURULENT
Furuncle / Carbuncle / Abscess
Severe
Moderate
Mild
Severe
Moderate
Mild
➢EMERGENT SURGICAL INSPECTION / DEBRIDEMENT
►Rule out necrotizing process
➢EMPIRIC Rx
• Vancomycin PLUS Piperacillin/Tazobactam
INTRAVENOUS Rx
• Penicillin or
• Ceftriaxone or
• Cefazolin or
• Clindamycin
ORAL Rx
• Penicillin VK or
• Cephalosporin or
• Dicloxacillin or
• Clindamycin
I & D C & S
I & D C & S
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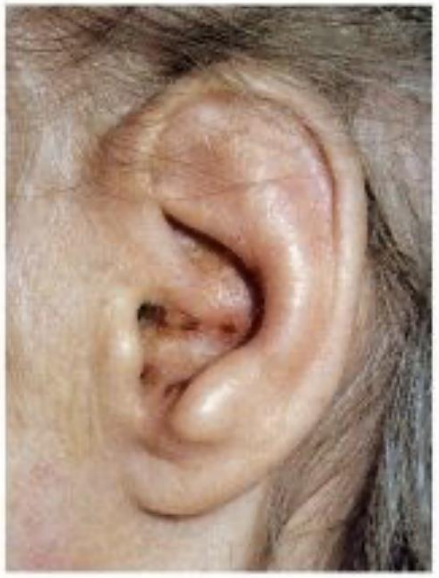
C & S
DEFINED Rx (Necrotizing Infections)
Monomicrobial Streptococcus pyogenes
• Penicillin PLUS Clindamycin
Clostridial sp.
• Penicillin PLUS Clindamycin
Vibrio vulnificus
• Doxycycline PLUS Ceftazidime
Aeromonas hydrophila
• Doxycycline PLUS Ciprofloxacin
Polymicrobial
• Vancomycin PLUS Piperacillin/Tazobactam
EMPIRIC Rx[1]
• Vancomycin or
• Daptomycin or
• Linezolid or
• Televancin or
• Ceftaroline
EMPIRIC Rx
• TMP/SMX or
• Doxycycline
DEFINED Rx
MRSA
• See Empiric
MSSA
• Nafcillin or
• Cefazolin or
• Clindamycin
DEFINED Rx
MRSA
• TMP/SMX
MSSA
• Dicloxacillin or
• Cephalexin
[1]Since daptomycin and televancin are not approved for use in children, vancomycin is recommended; clindamycin may be used if clindamycin resistance is <10-15% at the institution.

Question 12 - Diagnose Ramsay Hunt syndrome caused by varicella-zoster virus infection

- D, varicella-zoster virus

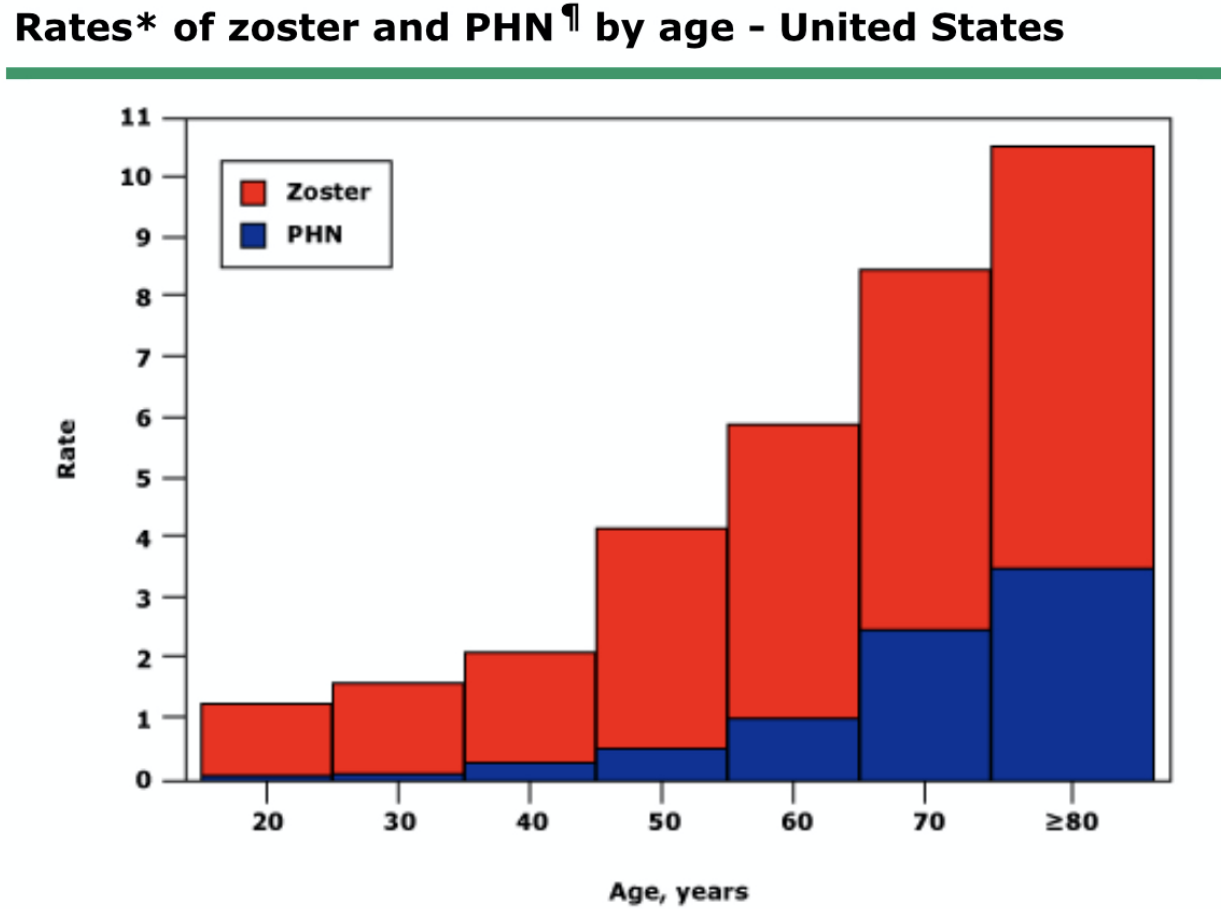
- 72 y/o F with 2 days of L facial droop and severe burning and stinging pain on the left ear helix and into the ear canal, with muffled hearing and tinnitus
- Received the live-attenuated zoster vaccine at age 60 years
- On exam, VS normal; left-sided peripheral facial droop; TM nml; no rash; diminished hearing

- Triad of ipsilateral facial paralysis, ear pain and vesicles in the auditory canal or the auricle
- Reactivation of latent VZV in the geniculate ganglion and spread of infection to the 8th CN
- Antiviral therapy (acyclovir, valacyclovir, and famciclovir) speeds recovery and decreases the severity and duration of neuropathic pain if begun within 72 hours of VZV rash onset



VZV vaccination

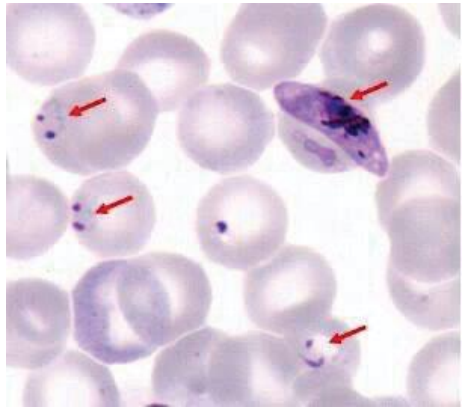
- The live attenuated zoster vaccine has 64% efficacy that decreases to 36% after 6 years (Zostavax); no longer sold in US
- A novel recombinant zoster vaccine, approved in 2017, has 97% efficacy and should be given to this patient
- VZV vaccine is recommended for adults ≥ 50 y/o
  - Typically wait 1 year after acute VZV infection to give vaccine, as they will have immunity due to the infection itself; but should eventually be given
- Recommend giving to those previously vaccinated with live vaccine
- 2 doses, 2 to 6 mos apart



Question 13 - Diagnose *Plasmodium falciparum* malaria

- A, *plasmodium falciparum*

- 27 y/o F 20 weeks pregnant with 5 days of fever, headache, myalgias and abd cramps
- Returned from 1 week in Kenya and Tanzania where she hiked
- Declined pretravel immunizations and antimalarial chemoprophylaxis
- On exam, T 39.1°C (102.3 °F), BP 98/64 mm Hg, HR 112/min, RR 16/min; icteric conjunctivae



- Most common cause of febrile illness in returning travelers, particularly from sub-Saharan Africa and large parts of Asia
- Preventive measures - limiting outdoor exposure between dusk and dawn, using insecticide-impregnated bed nets, insect repellants and antimalarial chemoprophylaxis
- Sxs: fever (48- or 72-hour cycles), headache, myalgia and gastrointestinal symptoms
- Severe disease usually with *Plasmodium falciparum*
  - Mental status changes, seizures, hepatic failure, DIC, hemolysis, metabolic acidosis, kidney disease, hemoglobinuria and hypoglycemia; may develop anemia, thrombocytopenia, splenomegaly and elevated aminotransferase levels

Plasmodium Species

Table 43. Characteristics of Plasmodium Species

Characteristics	***P. vivax***	***P. ovale***	***P. malariae***	***P. falciparum***	***P. knowlesi***
Incubation period	10-30 days	10-20 days	15-35 days	8-25 days	Indeterminate
Geographic distribution	Tropical and temperate zones	West Africa and Southeast Asia	Tropical zones	Tropical and temperate zones	South and Southeast Asia
Parasitemia	Low	Low	Very low	High	Can be high
Risk for disease severity	Low risk	Low risk	Very low risk	High risk	High risk
Disease relapse risk	Yes	Yes	Yes	No	No
Chloroquine resistance	Yes	No	Rare	Yes	No

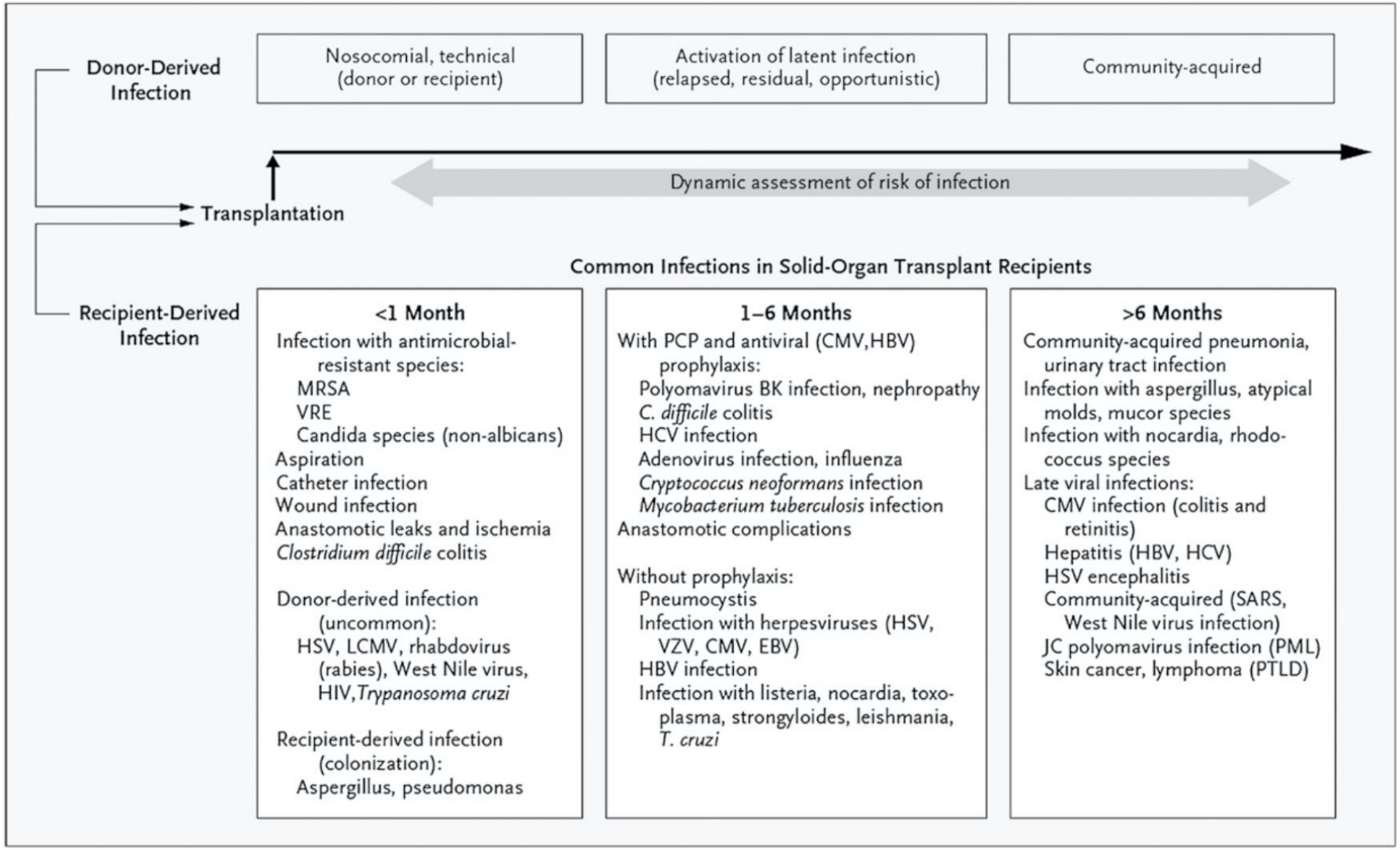
Question 14 - Diagnose *Clostridium difficile* colitis after transplantation

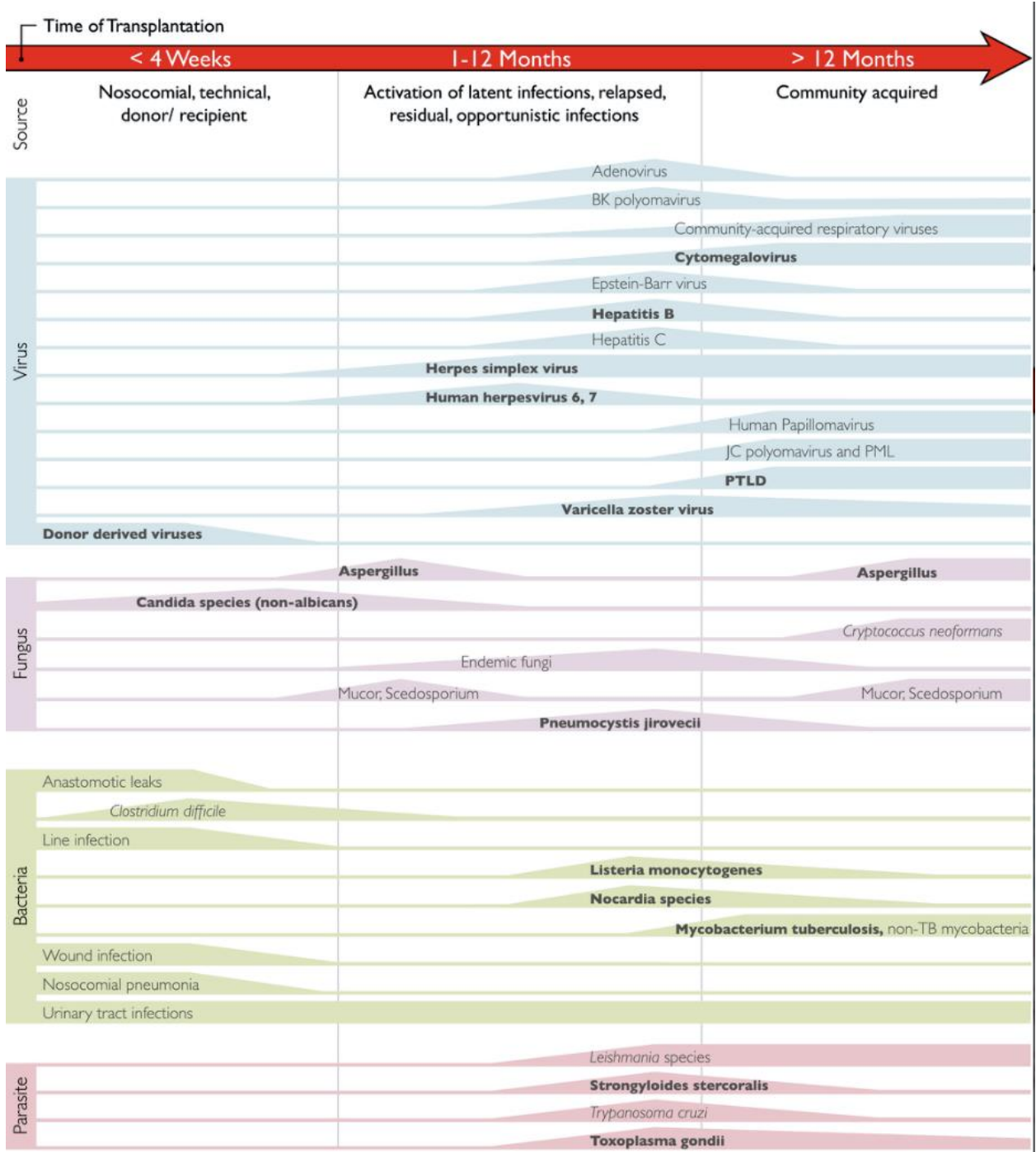
- A, *clostridium difficile* colitis

- 37 y/o M s/p kidney transplant 3 weeks PTA with 3 days of abdominal pain, fever, and increasing diarrhea
- Postoperative course complicated by pneumonia and wound infection, which resolved with antibiotic treatment
- CMV- pre-transplant, transplant CMV+
- Medications are prednisone, tacrolimus, mycophenolate mofetil, valganciclovir, and trimethoprim-sulfamethoxazole
- On exam, T 38.4 °C (101.2 °F), BP 122/85 mm Hg, HR 110/min, RR 18/min; LLQ TTP

- 1st month after transplant - infections are nosocomial and similar to those in patients who have had other surgeries
- Recently completed antibiotics for pneumonia and wound infection, increasing his risk for *C. difficile* colitis
- CMV D-/R+ - significant risk of developing CMV disease; prophylaxis with valganciclovir significantly lowers the risk; CMV typically occurs in the “middle” period; 1 to 6 months after transplantation

Timeline of Common Infections after Solid Organ Transplantation




Time of Transplantation
< 4 Weeks
1-12 Months
> 12 Months
Source
Nosocomial, technical, donor/ recipient
Activation of latent infections, relapsed, residual, opportunistic infections
Community acquired
Virus
Adenovirus
BK polyomavirus
Community-acquired respiratory viruses
Cytomegalovirus
Epstein-Barr virus
Hepatitis B
Hepatitis C
Herpes simplex virus
Human herpesvirus 6, 7
Human Papillomavirus
JC polyomavirus and PML
PTLD
Varicella zoster virus
Donor derived viruses
Fungus
Aspergillus
Aspergillus
Candida species (non-albicans)
Cryptococcus neoformans
Endemic fungi
Mucor, Scedosporium
Mucor, Scedosporium
Pneumocystis jirovecii
Bacteria
Anastomotic leaks
Clostridium difficile
Line infection
Listeria monocytogenes
Nocardia species
Mycobacterium tuberculosis, non-TB mycobacteria
Wound infection
Nosocomial pneumonia
Urinary tract infections
Parasite
Leishmania species
Strongyloides stercoralis
Trypanosoma cruzi
Toxoplasma gondii

Question 15 - Treat suspected tuberculous meningitis

- C, rifampin, isoniazid, pyrazinamide, ethambutol and dexamethasone

- 34 y/o M from Mexico with 4 weeks of fever, headaches, stiff neck
- On exam, he is alert, T 38.9 °C (102 °F), BP 92/60 mm Hg, HR 124/min, RR 24/min; nml neuro exam, passive neck flexion elicits painful resistance
- CSF: leukocyte count 424/µL with 92% lymphocytes, glucose level 22 mg/dL, protein level 278 mg/dL
- HIV negative, CSF gram stain and cryptococcal antigen test results are negative; cultures pending
- CXR: nml

- Tuberculosis and cryptococcus are the most common causes of chronic meningitis
- Lymphocytic meningitis with very low BG
- CSF AFB stains and cultures may take up to 6 weeks to grow
- Patients with a high suspicion for TB should be treated empirically with rifampin, isoniazid, pyrazinamide, and ethambutol pending culture results and clinical improvement
- For TB meningitis, dexamethasone decreases mortality and should be started concomitantly with anti-TB therapy

TB meningitis

- Low glucose in CSF:

Etiologies commonly associated with hypoglycorrhachia
Infectious causes
▪ Bacterial meningitis (including *Nocardia* and *Brucella*)*
▪ Fungal meningitis*
▪ Mycobacterial (tuberculous) meningitis*
▪ Amebic meningoencephalitis
▪ Cytomegalovirus-associated progressive polyradiculopathy or meningoencephalitis
Noninfectious causes
▪ Carcinomatous meningitis*
▪ Glucose transporter 1 deficiency
▪ Leukemia/lymphoma with CNS involvement*
▪ Subarachnoid hemorrhage*

- Other answers:
  - Cryptococcal meningitis – most common fungal meningitis in US; CSF analysis resembles TB meningitis although monocytes may predominate and the opening pressure often > 200 mm H_2O; India ink preparation of the CSF + in 80% of patients with a high organism burden; tx with amphotericin B and 5-fluorocytosine
  - Bacterial meningitis is an acute infection with progression of symptoms over hours to days; vancomycin, ceftriaxone and dexamethasone

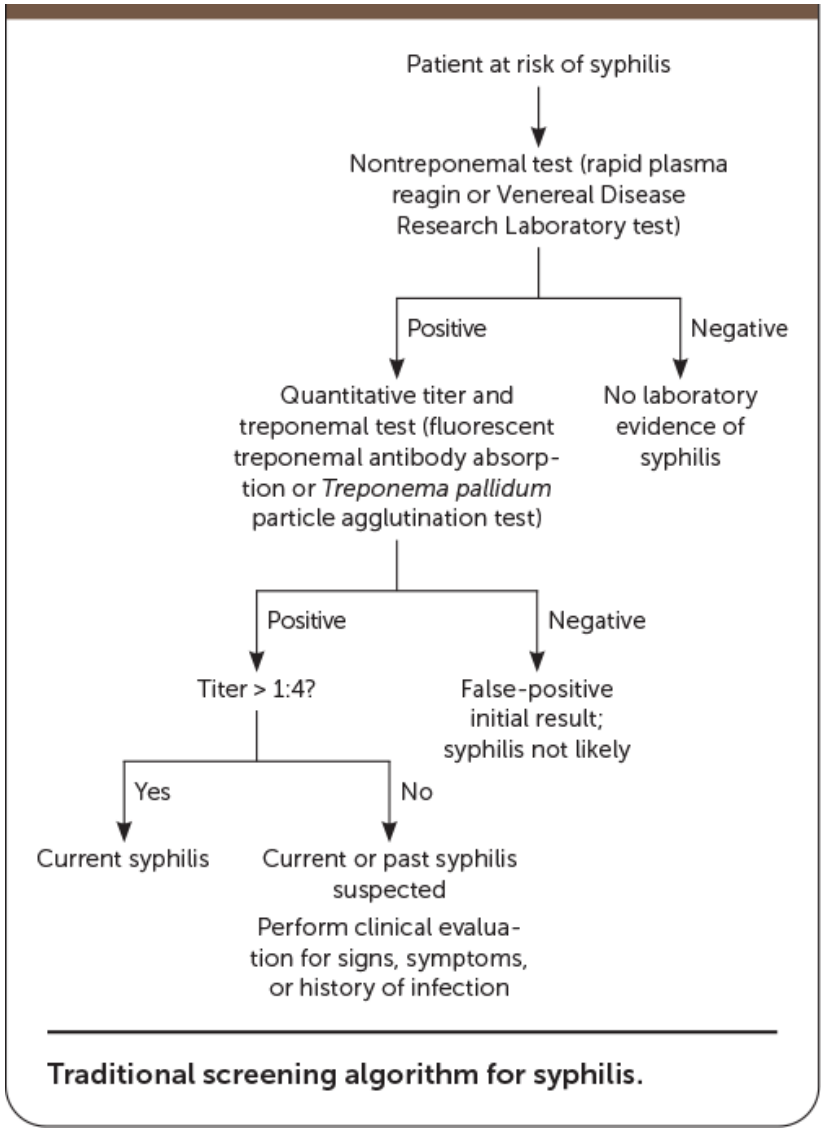
Question 16 - Manage a patient based on syphilis serology results

- D, no further testing or treatment

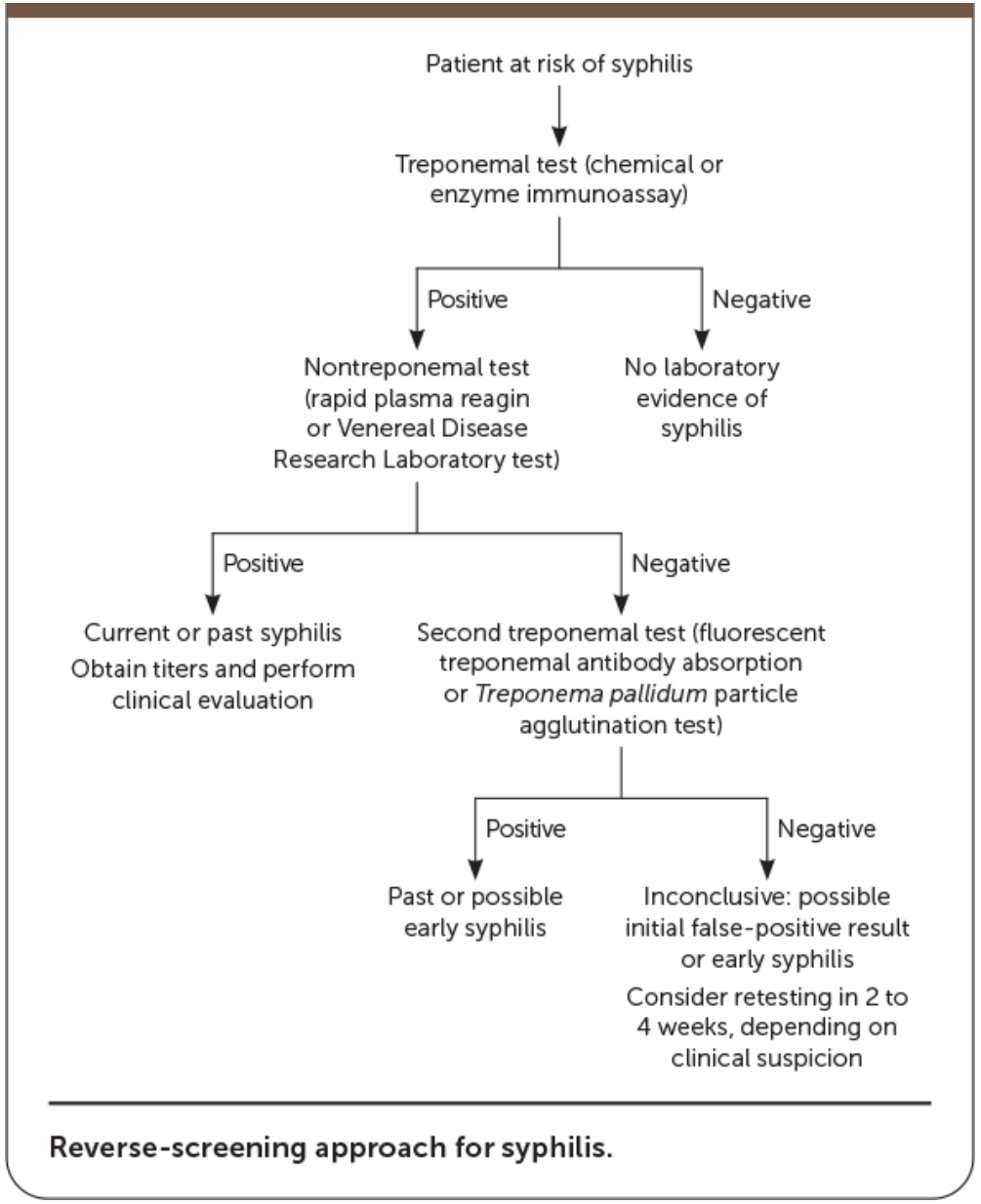
- 32 y/o F with new sexual partner
- Hx of chlamydia cervicitis 5 years ago and treated for syphilis 6 years ago
- On exam, VSS and exam unremarkable
- Syphilis enzyme immunoassay is positive; rapid plasma reagin testing is negative; fluorescent treponemal antibody test is positive
- Nucleic acid amplification testing is negative for *Neisseria gonorrhoeae* and *Chlamydia trachomatis;* HIV antigen/antibody combination testing is negative

- Treponemal tests – stay positive
  - TP-EIA, TPPA, FTA-ABS
- Non-treponemal tests – negative following treatment
  - RPR, VDRL

Syphilis testing algorithm



Traditional screening algorithm for syphilis.



Reverse-screening approach for syphilis.

Syphilis stages and management

Stages, Time Course, and Manifestations of Syphilis

Stage	Duration	Manifestations	
		Common	Uncommon
Primary	10 to 90 days	Chancre	Local lymphadenopathy
Secondary	1 to 3 months	Arthralgias, condylomata lata, fatigue, generalized lymphadenopathy, headache, hepatosplenomegaly, maculopapular/ papulosquamous exanthema, myalgias, nephrotic syndrome, pharyngitis	Annular syphilis, iritis, pustular syphilis, pyrexia, syphilitic alopecia, ulcerative nodular syphilis
Early latent	After primary and secondary stages, up to 1 year of no symptoms	None	Secondary symptoms can recur
Late latent	More than 1 year of no symptoms	None	None
Tertiary	Months to years	Late neurosyphilis*	Cardiovascular or gummatous syphilis

*—Neurosyphilis, particularly ocular manifestations, may occur at any stage of infection.

Adapted with permission from Mattei PL, Beachkofsky TM, Gilson RT, et al. Syphilis: a reemerging infection. Am Fam Physician. *2012;86(5):434.*

Treatment Regimens for Syphilis

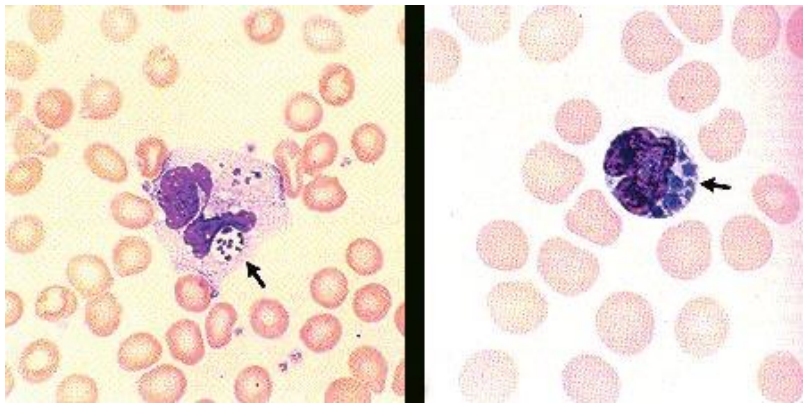
Syphilis type	Treatment
Primary and secondary	Penicillin G benzathine, 2.4 million units IM 1 time *In people allergic to penicillin:* Doxycycline, 100 mg orally 2 times per day for 14 days (preferred) *or* Tetracycline, 500 mg orally 4 times per day for 14 days *or* Ceftriaxone (Rocephin), 1 to 2 g IM or IV per day for 10 to 14 days* *or* Azithromycin (Zithromax), single 2-g oral dose has been effective in some populations†
Early latent	Penicillin G benzathine, 2.4 million units IM 1 time
Late latent or latent of unknown duration	Penicillin G benzathine, 2.4 million units IM at 1-week intervals for 3 weeks
Tertiary	Penicillin G benzathine, 2.4 million units IM at 1-week intervals for 3 weeks
Ocular or neurosyphilis	Aqueous crystalline penicillin G, 18 to 24 million units IV per day, given as 3 to 4 million units every 4 hours or as continuous infusion, for 10 to 14 days *Alternative if compliance is ensured:* Penicillin G procaine, 2.4 million units IM 1 time per day for 10 to 14 days *plus* Probenecid, 500 mg orally 4 times per day for 10 to 14 days
Syphilis during pregnancy	Penicillin regimen appropriate for infection stage (desensitization may be required)
Congenital	Penicillin-based regimen that differs based on probability of infection (as determined by serology and cerebrospinal fluid testing)‡

Question 17 - Diagnose human monocytic ehrlichiosis

- B, human monocytic ehrlichiosis

- 42 y/o M with 7 days of fevers, headache and myalgias
- He is a trail runner and 10 days ago participated in a 10-kilometer race in North Carolina; no known tick bite
- On exam, ill-appearing, T 39.4 °C (102.9 °F), BP 102/78 mm Hg, HR 102/min, RR 24/min; no tonsillar enlargement, cervical LAD, HSM or skin lesion noted
- WBC 15,000/µL (70& neutrophils), platelet count 34,000/µL, ALT 667 U/L, AST 995 U/L
- Empiric doxycycline therapy is initiated for a started for possible tick-borne infection and defervesces within 24 hours and in 48 hours, CBC normalizes; serologic testing negative

- Human monocytic ehrlichiosis - nonfocal febrile illness associated with leukopenia, thrombocytopenia, elevated hepatic enzyme levels and a rapid response to tetracycline
- Low sensitivity of antibody testing 1st week of illness; seroconversion typically occurs within 2 to 4 weeks of symptom onset
- Early diagnosis can be achieved by buffy coat staining or PCR



Feature	HME	HGA	RMSF
Vector	Lone Star tick	Black-legged deer tick	American dog tick, brown dog tick, Rocky Mountain wood tick
Geography	Southeastern, mid-Atlantic, and south-central United States	Northeastern and upper Midwest United States	Throughout the United States[a]
Coinfection	Not reported; potential for coinfection with STARI or Heartland virus because of common vector	Lyme disease, babesiosis, Powassan virus, *Borrelia miyamotoi*	None
Incubation period	5-14 days	5-14 days	3-12 days
Presenting signs and symptoms	Fever, headache, myalgias, nausea, vomiting, diarrhea, conjunctival injection	Fever, headache, myalgias, chills	Fever, headache, chills, mylagia, nausea, abdominal pain, photophobia, aseptic meningitis
Cutaneous signs	Nonspecific rash in <30% of adults, with median onset 5 days after fever	Rash rare (<10%)	Maculopapular eruption in >90% of patients, progressing to petechia with involvement of palms and soles, edema; onset, median of 3 days after fever
Laboratory study abnormalities	Leukopenia, thrombocytopenia, increased serum aminotransferase levels, mild anemia	Leukopenia, thrombocytopenia, increased serum aminotransferase levels, mild anemia	Thrombocytopenia, increased serum aminotransferase levels, normal or slightly increased leukocyte count, hyponatremia
Diagnosis	Morulae in monocytes (<30%), acute and convalescent serologies, whole-blood PCR	Morulae in neutrophils (~50%), acute and convalescent serologies, whole-blood PCR	Acute and convalescent serologies, biopsy of skin with immunohistochemical analysis
Treatment	Doxycycline	Doxycycline	Doxycycline
Fatality	3%	<1%	5%-10%

Question 18 - Treat an infected cat bite in a patient with risk factors for methicillin-resistant *Staphylococcus aureus*

- A, ampicillin-sulbactam plus vancomycin

- 50 y/o F seen in the ED for a cat bite
- Hx of MRSA skin infection 6 mos ago
- Work in an animal shelter
- On exam, T 38.5 °C (101.3 °F), BP 98/66 mm Hg, HR 110/min and RR 22/min; she has a tender puncture wound on the dorsum of the right hand with surrounding warmth and erythema as well as purulent discharge
- Plan Xray hand shows no evidence of gas, foreign body, or bony involvement

- Cat bites > dog bites; sharp, narrow teeth
- Infections are caused by organisms from the animal's mouth flora and the host's skin flora
  - Streptococci, staphylococci, and *Bacteroides*, *Fusobacterium*, *Porphyromonas, Pasteurella*s species
- Include MRSA coverage if:
  - Presence of pus
  - MRSA risk factors (including prior MRSA infection or colonization within the last year)
  - Local MRSA prevalence is high

Animal bites

Table 1. Factors That Increase the Risk of Infection from an Animal Bite

Bite in extremities with underlying venous and/or lymphatic compromise	Delayed presentation Greater than 6 to 12 hours for bites to the arm or leg
Bite involving the hand	Greater than 12 to 24 hours for bites to the face
Bite near or in a prosthetic joint	Puncture wounds
Cat bites	Victim with diabetes mellitus or immunosuppression
Crush injuries	

Information from references 10, 11, and 16.

- Consider antibiotic closure for all bites requiring closure and high risk bites

Table 2. Prophylactic Antibiotic Dosages for Animal Bites

Adults

First-line

Amoxicillin/clavulanate (Augmentin), 875/125 mg every 12 hours

Alternatives

Clindamycin, 300 mg 3 times per day *plus* ciprofloxacin (Cipro), 500 mg twice per day

Doxycycline, 100 mg twice per day

Penicillin VK, 500 mg 4 times per day *plus* dicloxacillin, 500 mg 4 times per day

A fluoroquinolone; trimethoprim/sulfamethoxazole, 160/800 mg twice per day; or cefuroxime axetil (Ceftin), 500 mg twice per day *plus* metronidazole (Flagyl), 250 to 500 mg 4 times per day, or clindamycin, 300 mg 3 times per day

Question 19 - Diagnose active tuberculosis infection

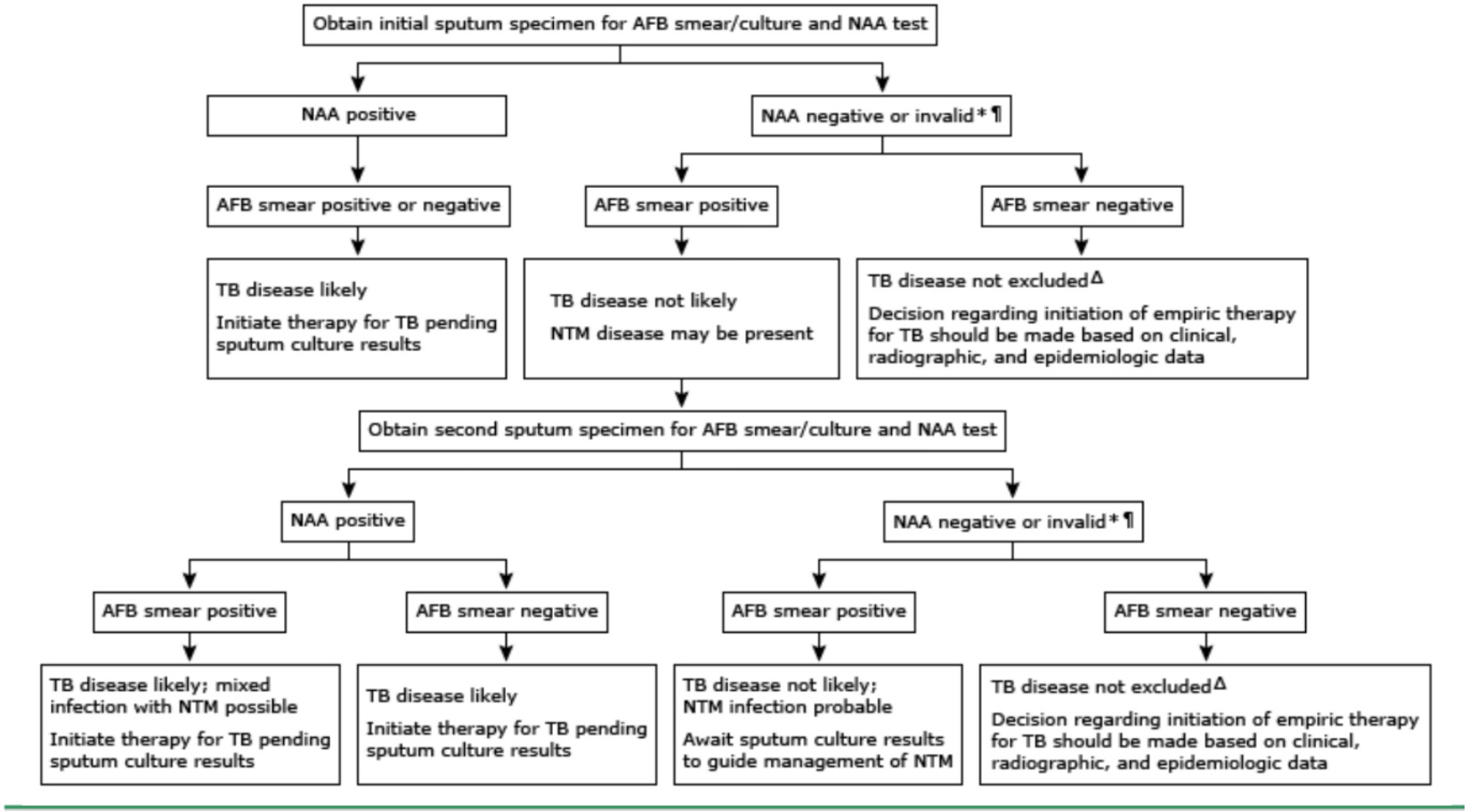
- D, obtain sputum specimen for acid-fast bacilli stain and culture

- 45 y/o M with fatigue, 9.1-kg (20 lb) weight loss and cough
- Unemployed and sleeping in homeless shelters; daily ETOH
- On exam, T 38.3 °C (100.9 °F), BP 110/60 mm Hg, HR 90/min, RR 18/min; b/l inspiratory crackles on the upper posterior thorax
- Interferon-γ release assay is positive; HIV antibody testing is negative
- CXR with b/l upper lobe cavitary infiltrates and a left pleural effusion

- 3 AFB specimens 8-24 hours apart, one being an early morning sample; at least 3 mL of sputum should be obtained, though 5 to 10 mL preferred
- Sputum sample (may need induction) preferred to bronchoscopy; increased sensitivity
  - Smear – sensitivity 45 – 80%; increases with concentration of specimen and specimen #
  - Culture – can take weeks to grow
- NAA testing
  - Can be used for more rapid diagnosis (24 to 48 hours); excellent PPV in AFB+ specimens for determining TB from NTM infections

Pulmonary TB diagnosis

Approach to interpretation of sputum AFB smear and NAA test for diagnosis of pulmonary tuberculosis disease in adults



Question 20 - Diagnose *Giardia lamblia* infection

- C, giardia lamblia

- 25 y/o F with several months of chronic intermittent nonbloody diarrhea with associated abdominal cramping, burping, and bloating
- Hx of selective IgA deficiency with recurrent sinopulmonary infections
- On exam, T 37.3 °C (99.1 °F); VS otherwise normal; bowel sounds are present with minimal diffuse tenderness to palpation
- Stool testing for occult blood is negative

- Symptoms of *Giardia:* watery diarrhea that is fatty and foul smelling, bloating, crampy abdominal pain, flatulence, and nausea; fever is uncommon; post-infection lactose intolerance
- Lasts 2 to 4 weeks in immunocompetent hosts
- In patients with humoral immunodeficiency, such as hypogammaglobulinemia or selective IgA deficiency, *Giardia* infection may be prolonged because of impaired protection against *Giardia* adherence to the intestinal epithelium

Selective IgA deficiency

Selective IgA deficiency	
Epidemiology	• Most common primary immune deficiency
Clinical features	• Usually asymptomatic • Recurrent sinopulmonary & gastrointestinal infections • Associated with autoimmune disease (eg, celiac) & atopy (eg, asthma, eczema) • Anaphylaxis during transfusions
Diagnosis	• Low or absent IgA • Normal IgG, IgM levels, B cells
Treatment	• Supportive care • Medical alert bracelet for transfusion reactions (for severe deficiency)