

Sarcoptes scabiei

Causes scabies. Presents as itchy bodily areas (e.g., the hands) classically in patients living in close quarters like homeless shelters or group homes.

Causes “linear burrows,” although these might just appear like red dots on the skin in USMLE images.



Tx = topical permethrin.

What USMLE will do is show you above image + tell you a 45-year-old man was living in a homeless shelter for 4 months + topical anti-fungals didn't work; what is the treatment
→ answer = topical permethrin.

Bacterial superinfection with *S. aureus* can occasionally occur on scabies lesions. As I talk about in the [gram \(+\) cocci module](#) regarding *S. aureus*, infections are often treated with oral dicloxacillin or cephalexin.

Pediculosis capitis/corporis

Pediculosis capitis = head lice.

Pediculosis corporis = body lice.

The names of the organisms are the same as the conditions.

The main point here is that you are merely aware that pediculosis is the medical term for lice, since you'll see it sometimes as an answer choice on USMLE.

Tx = topical permethrin (same as scabies).

Cimex lectularius

Causes bed bugs.

Presents as very itchy clusters of erythematous lesions on the trunk and limbs in patients who've slept in dodgy locations or hotels.



Can occur if someone brings a mattress in off the street. Sounds dumb, but we're talking about actual demographics here.

NBME has an image of this in one of its questions:



Treatment is supportive and involves not scratching the lesions. Occasionally calamine or steroid cream can be applied to reduce itching.

1. Which organism can sometimes cause superinfection on scabies?

How is this secondary organism treated?

Bacterial superinfection with *S. aureus* can occasionally occur on scabies lesions. *S. aureus* infections are often treated with oral dicloxacillin or cephalexin.

Treatment for scabies itself is topical permethrin.

Patient who recently took trip to South Carolina.

Diagnosis? What's the arthropod that causes this?

Bed bugs.

Cimex lectularius.

Treatment is supportive and involves not scratching the lesions. Occasionally calamine or steroid cream can be applied to reduce itching.

3. What is the organism that causes bed bugs?

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4. What is an arthropod?

Name four arthropods for USMLE that *themselves* cause infections in humans.

Arthropods

Should be noted that mosquitoes and ticks are tons pole an asLE, This abil Invertebrate animal algorithm shows which arthropods themselves cause infections in humans.
Exoskeleton, segmented body, jointed limbs

Sarcoptes scabiei

Pediculosis capitis Cimex lectularius

Pediculosis corporis

5. What does *Sarcoptes scabiei* cause?

What's the treatment?

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6. What does *Cimex lectularius* cause?

How is it treated?

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7. What is pediculosis?

How is it treated?

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Pediculosis corporis = body lice.

The names of the organisms are the same as the conditions.

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8.

45-year-old man was living in a homeless shelter for 4 months + itchy hands + his hand is shown + topical anti-fungals didn't work; what is the diagnosis and treatment?

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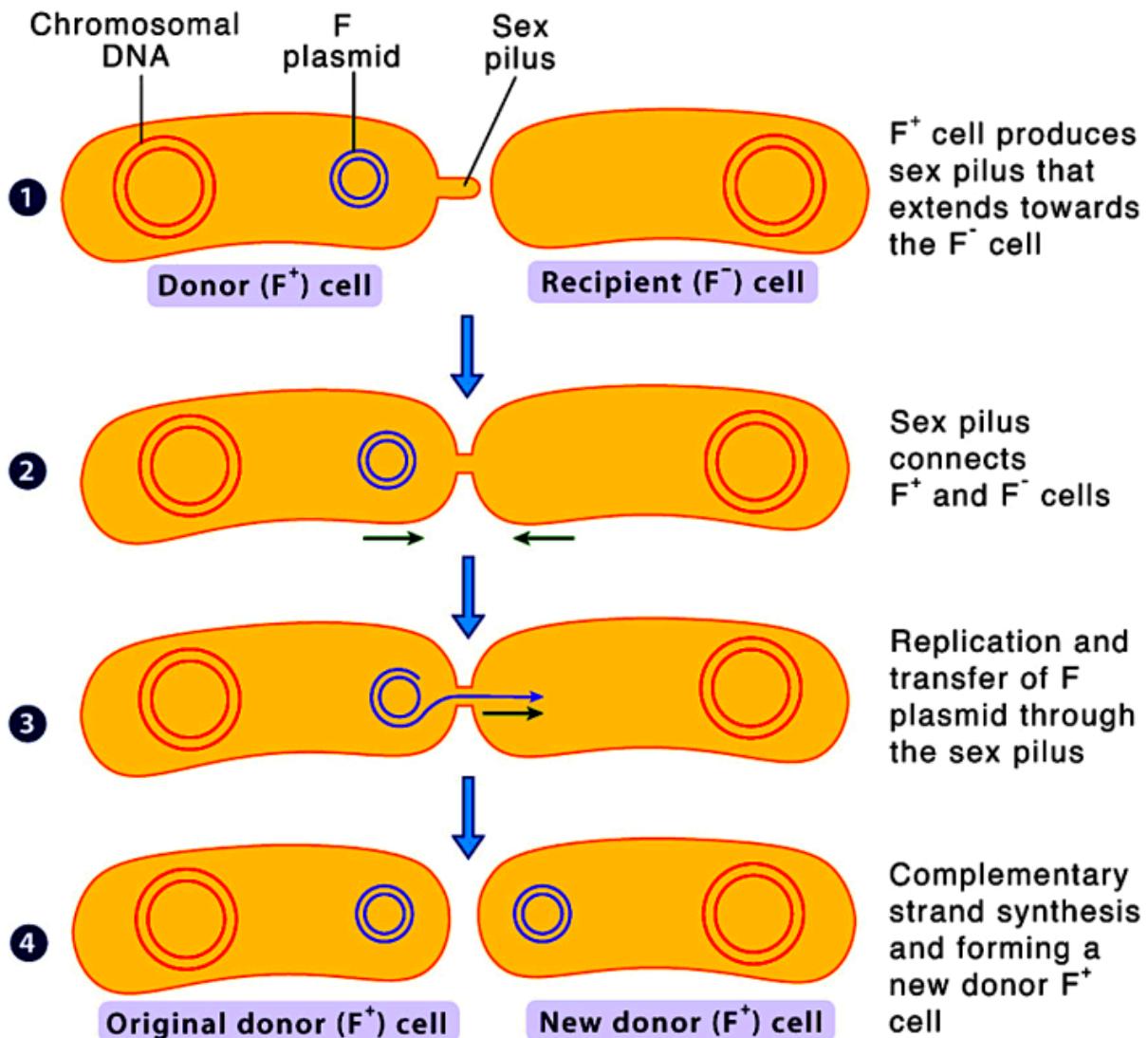
Conjugation, generalized transduction, specialized transduction, and transformation are known as horizontal gene transfer (HGT), which is when genes, especially those conferring antibiotics resistance, can move between bacteria asexually. These processes are annoying when you're first studying for Step 1, but unfortunately the exam asks some questions about these. I consider them fairly basic to know, even during the pass/fail Step 1 era.

Before discussing these specific processes, a HY general principle you need to know is that *most* bacteria carry their antibiotics resistance genes on a plasmid, rather than in their chromosomal DNA. A plasmid is a small, circular, dsDNA molecule that is separate from a bacterium's chromosomal DNA and can replicate independently.

The USMLE will ask something like, "A bacterial colony that is observed to replicate over many generations loses its resistance to vancomycin. Which of the following mechanisms is the most likely explanation for this finding?" And the answer is just "loss of plasmid." Not complicated. But if you don't know the factoid about antibiotics resistance genes normally being carried on the plasmid, you'd be like what the fuck?

Conjugation

Conjugation is when genes (usually for antibiotics resistance) are transferred from one bacterium to another via a tube called a **pilus**.



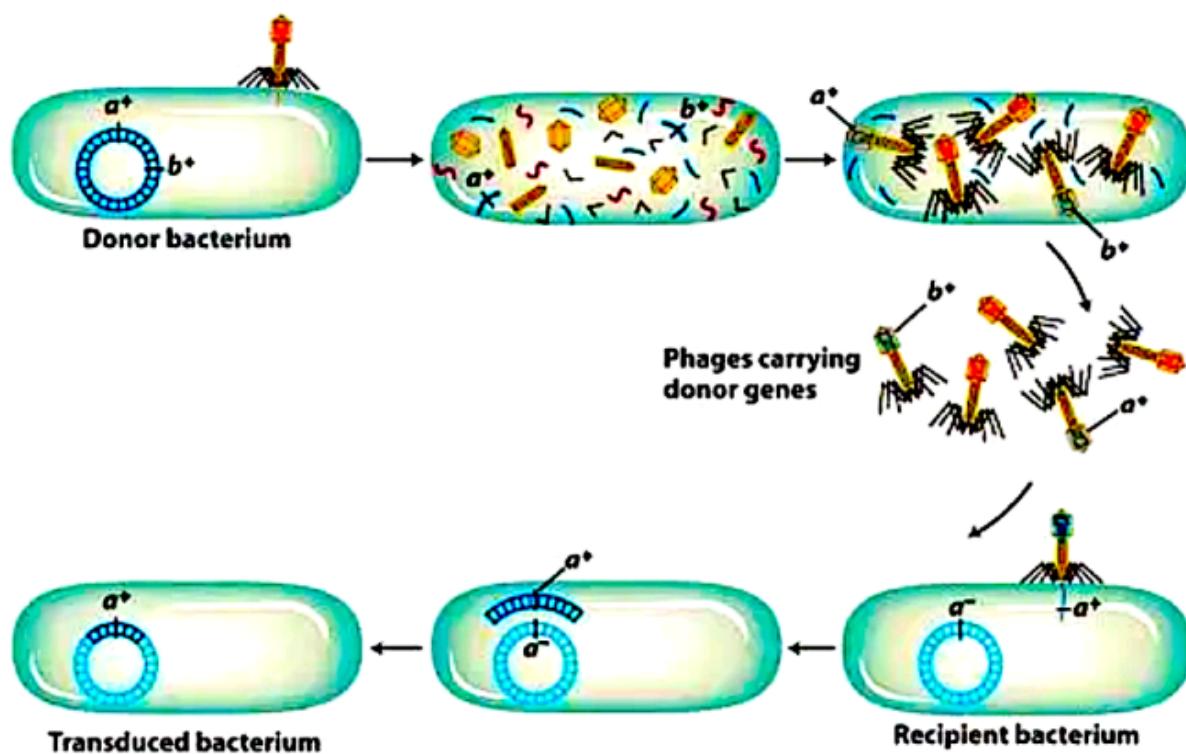
The way the USMLE will ask this is they will say something like, “A researcher is conducting an experiment about antibiotics gene transfer. Which of the following observations would best support the conclusion that conjugation is the method of transfer?” Then the answer is, “direct cell to cell contact.” In other words, the tube/pilus that connects the two bacterium necessitates cell-to-cell contact.

I haven't seen the USMLE specifically assess the notion of F^+ vs F^- , but the detail isn't dramatic to know. The donor is called F^+ and the recipient F^- .

Generalized transduction

Transduction refers to a phage (viral) particle transferring genes from one bacterium to another.

Generalized transduction is when a phage particle enters a bacterial cell, packages up random fragments from the bacterium's DNA genome within its new phage particles, then leaves the cell, infecting a new bacterium and spreading these genes as a result.



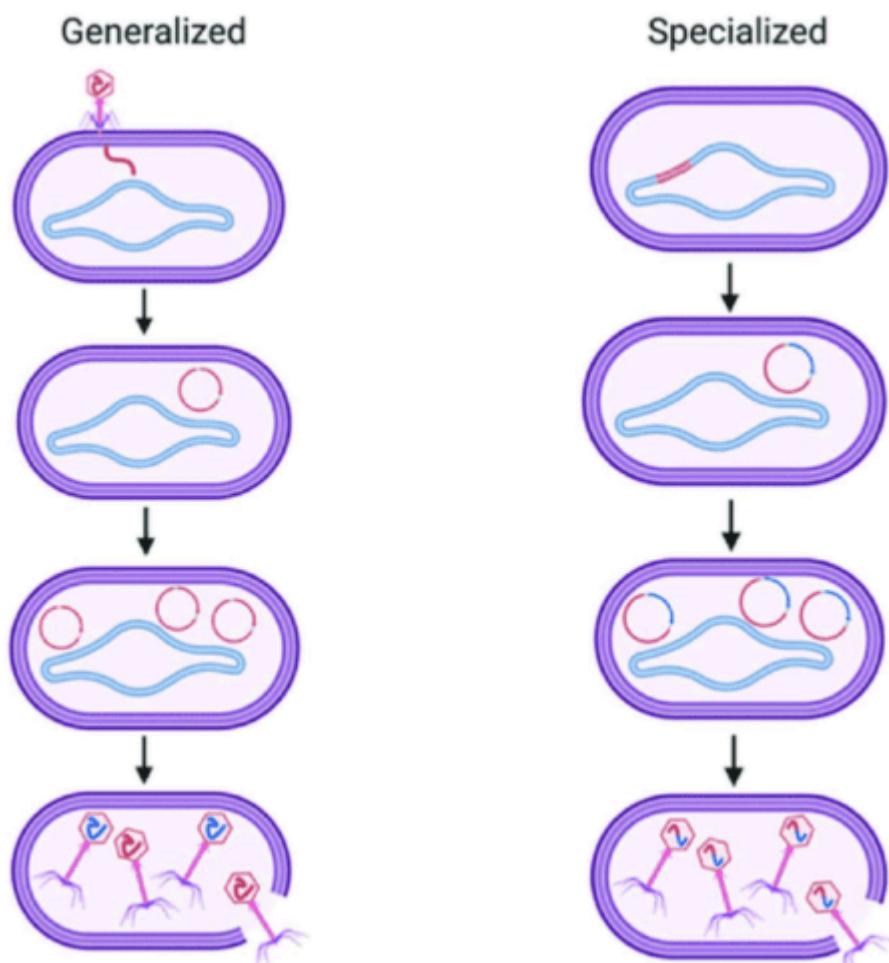
During the process of generalized transduction, the phage particle does not incorporate itself into the bacterial genome when it packages up DNA. In other words, there is no lysogenic process (lysogeny) as part of the process. Lysogeny refers to the ability of some viruses to incorporate themselves into the nucleic acid of the host and then reemerge later.

USMLE Qs on this topic are fairly straightforward. They might say something like, "Which of the following observations by a researcher supports generalized transduction as the mechanism for antibiotics gene transfer?" And the answer will be something like, "Non-lysogenic phage particles present." The answer on its own can sound cryptic/arcane, but now that we discussed it, it's not so bad.

Specialized transduction

Specialized transduction is when a viral (phage) particle enters a bacterial cell, lysogenically incorporates itself into the bacterial's DNA genome, then reemerges with flanking bacterial DNA sequences which are then packaged into new phage particles. These new phage particles then infect other bacterial cells and transfer these flanked genes.

The reason this type of transduction is called specialized is because the transferred bacterial DNA isn't random; it is specific to the site on the bacterium's genome where the virus incorporates itself, which in some cases can predictably be genes encoding toxins or antibiotics resistance.

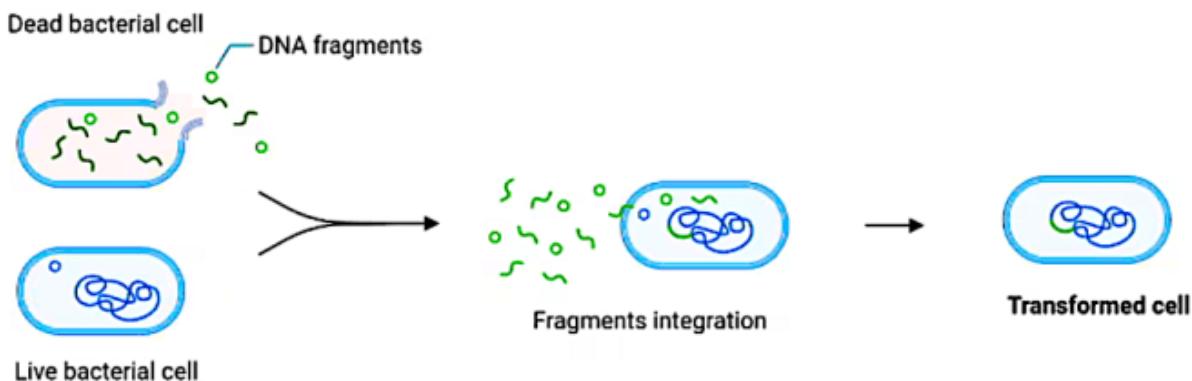


In comparison to generalized transduction, you can see that in specialized, once the virus enters the cell, its nucleic acid becomes integrated lysogenically within the bacterium's. Upon reemergence, we now have viral nucleic acid with flanking bacterial sequences.

The USMLE could ask which of the following observations by a researcher about transferred bacterial genes would support specialized transduction as the mechanism. The answer will be something like, “Genes traced to locus adjacent viral excision site.” Wording can seem a bit recondite, but it’s not hard now that we discussed it.

Transformation

Transformation is when a bacterial cell picks up free DNA fragments/genes directly from the extracellular medium.



Bacteria that are capable of transformation are known as “competent.” *S. pneumoniae* is known as a natural transformer, and is therefore competent.

The highest yield point for USMLE is that transformation can be disrupted when DNase is added to the surrounding medium. This is because it will break down any free DNA fragments/genes that are floating around and exposed.

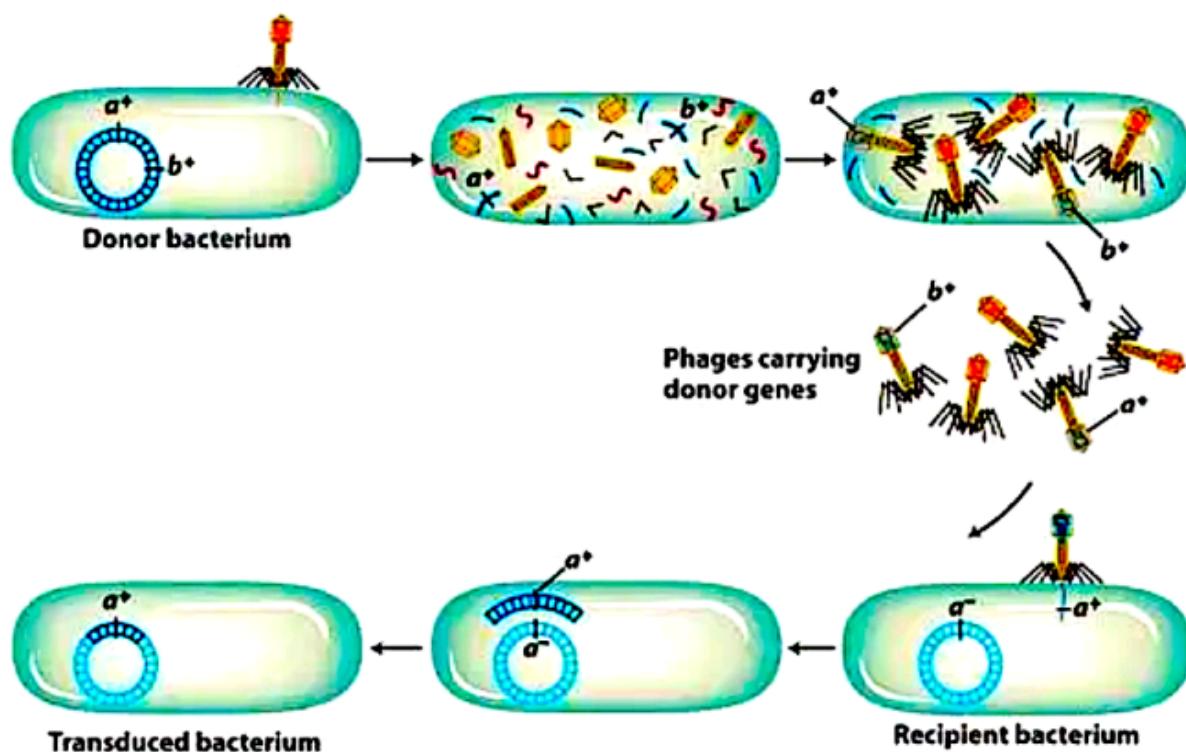
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Or they can say, “A researcher is conducting an experiment regarding bacterial antibiotics gene transfer. It is observed that the process is disrupted by the addition of DNase. What is the most likely mechanism of gene transfer?” Answer = transformation.

2. Which observation by a researcher supports generalized transduction as the mechanism for antibiotics gene transfer?

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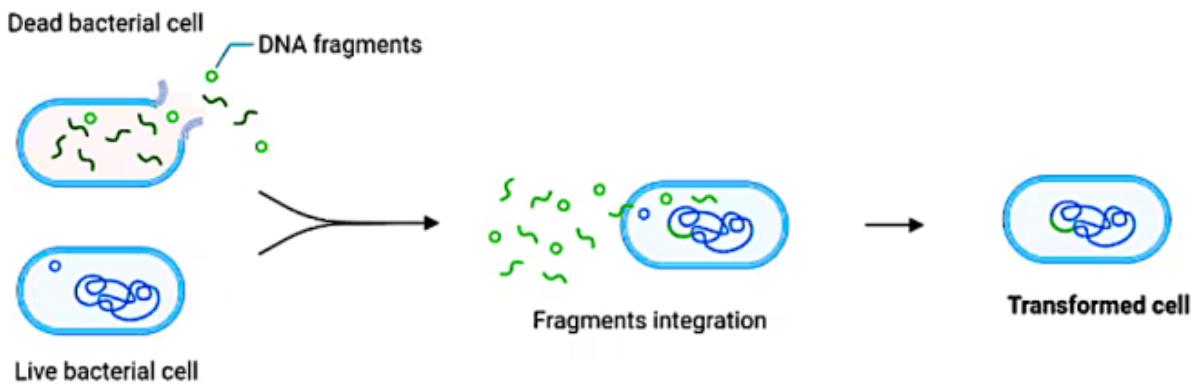
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5. What is lysogeny?

How does this relate to transduction types?

Lysogeny refers to the ability of some viruses to incorporate themselves into the nucleic acid of the host and then reemerge later.

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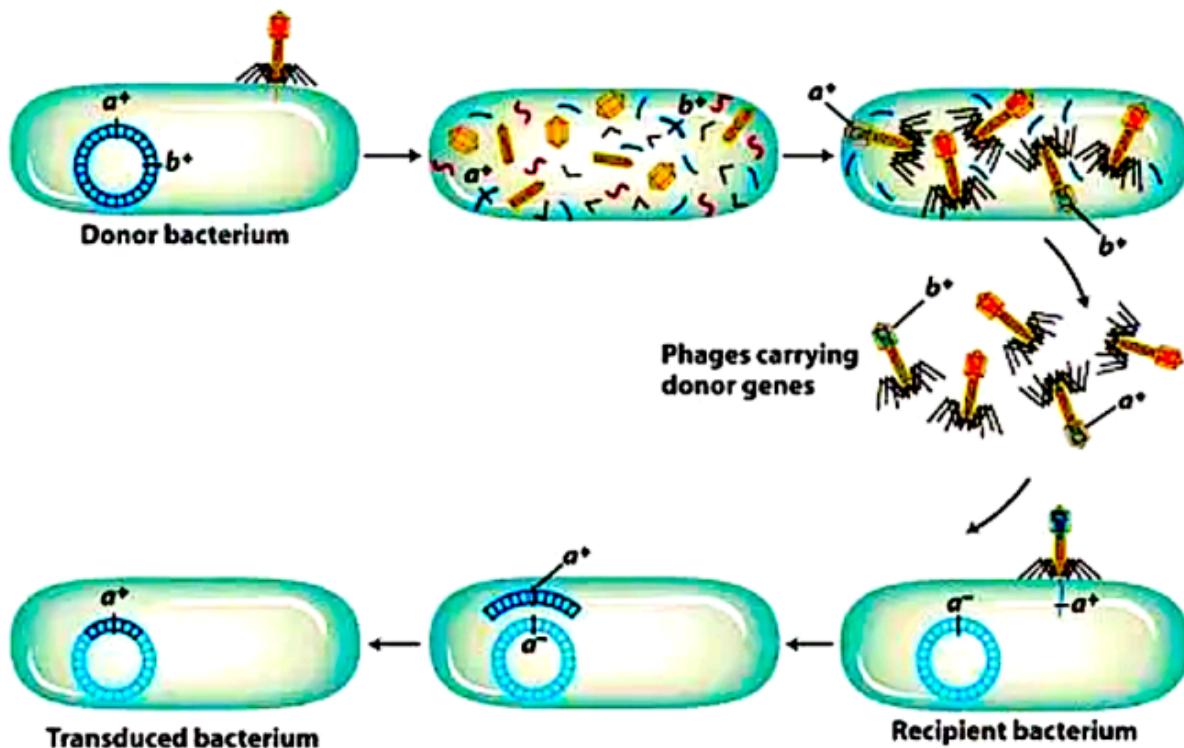
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6. What is transduction (in one sentence)?

Transduction refers to a phage (viral) particle transferring genes from one bacterium to another.

7. What is generalized transduction?

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8. What are bacteria capable of transformation called?

Which bacterium in particular is a well-known natural transformer?

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9. A researcher observes that a bacterial colony replicated over many generations loses its resistance to vancomycin. What mechanism is the most likely explanation for this finding?

"Loss of plasmid."

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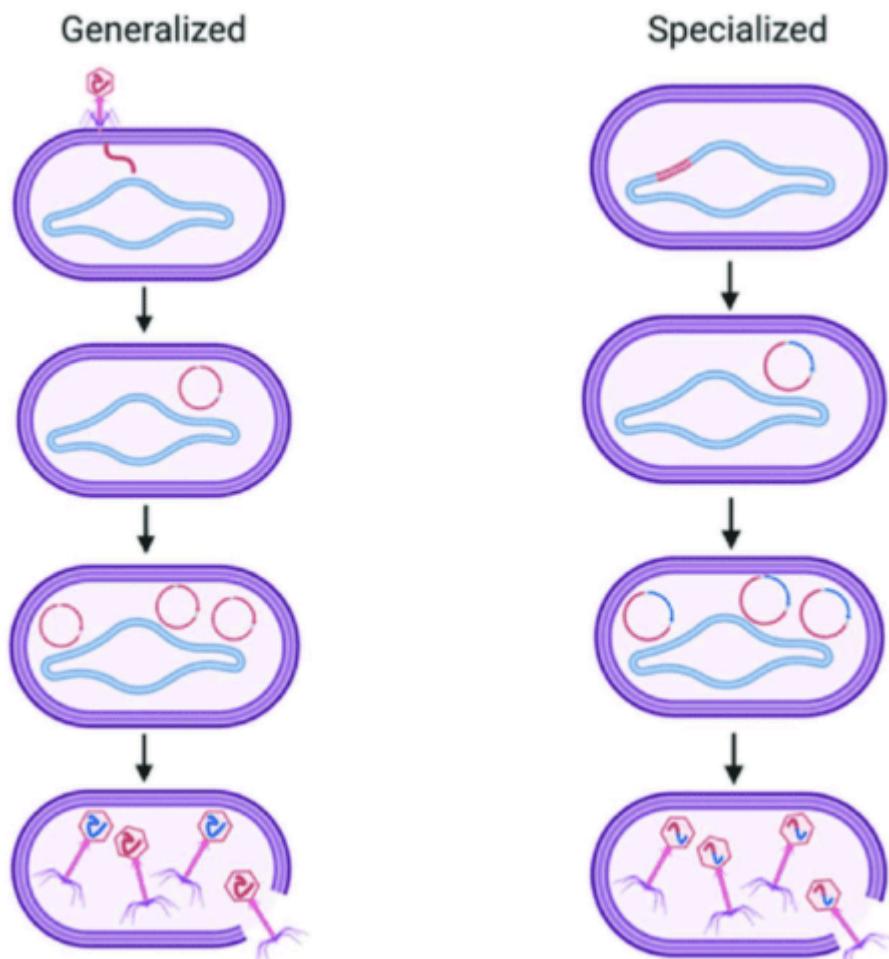
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10. Which observation by a researcher about transferred bacterial genes would support specialized transduction as the mechanism? Answer can be something like "Genes traced to locus adjacent viral excision site."

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11. What is transformation (in one sentence)?

Transformation is when a bacterial cell picks up free DNA fragments/genes directly from the extracellular medium.

13. A researcher is conducting an experiment about antibiotics gene transfer. Which observation would best support the conclusion that conjugation is the method of transfer?

The way the USMLE will ask this is they will say something like, “A researcher is conducting an experiment about antibiotics gene transfer. Which of the following observations would best support the conclusion that conjugation is the method of transfer?” Then the answer is, “direct cell to cell contact.” In other words, the tube/pilus that connects the two bacterium necessitates cell-to-cell contact.

Conjugation is when genes (usually for antibiotics resistance) are transferred from one bacterium to another via a tube called a **pilus**.

14. Where do most bacteria carry their antibiotics resistance genes?

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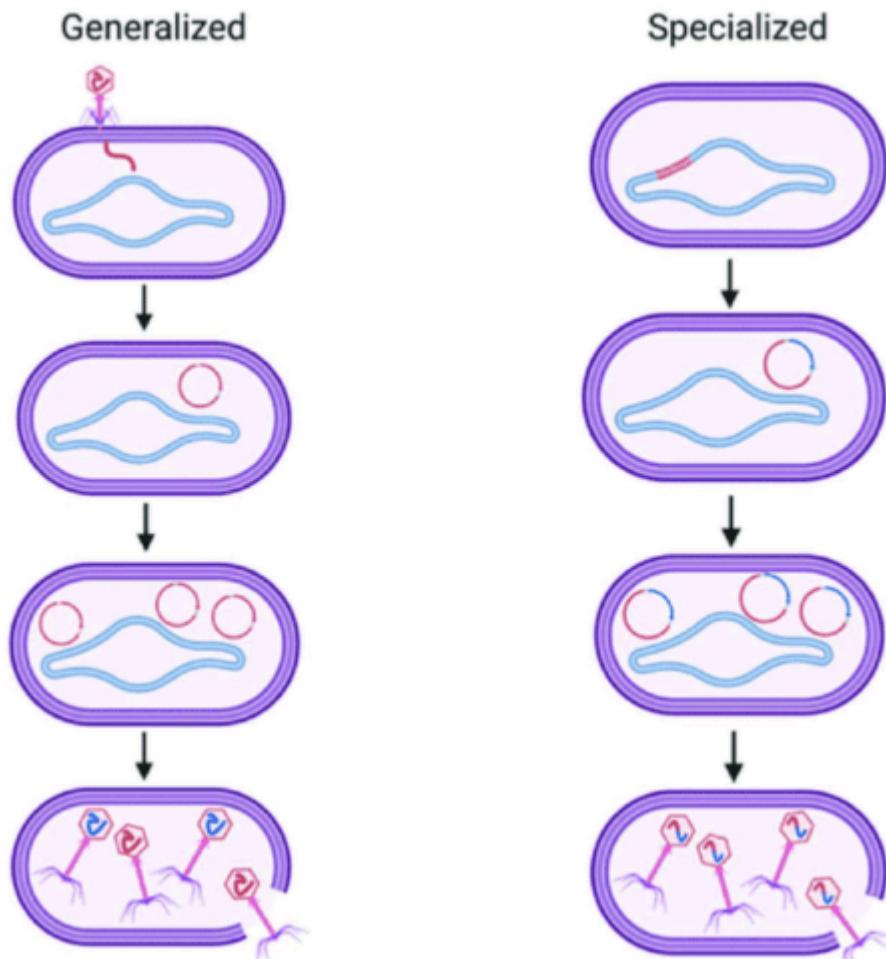
15. What is conjugation (in one sentence only)?

Antibiotics resistance genes are transferred from one bacterium to another via a tube called a **pilus**.

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Parvovirus B19

Causes Fifth disease = “slapped cheek” facial erythema in Peds.



Once child has developed the red cheeks, he/she has immunologically cleared the illness (i.e., if they turn it into a behavioral science Q, tell parents to chill the fuck out / relax because the child has cleared the virus).

Can cause exanthem (body rash) +/- arthritis in adults, especially in **daycare workers** (USMLE is obsessed with this).



Can cause pure-RBC aplasia (i.e., only RBCs are low) or full-blown aplastic anemia (where all cell lines – RBCs, WBCs, and platelets – are down).

There is increased risk of pure-RBC aplasia and aplastic anemia if the infection occurs *in utero* and in sickle cell patients.

Next best step in diagnosis for Fifth disease or exanthem/arthritis is check serum IgM titers.

If any of the hematologic cell lines are down, do bone marrow biopsy to confirm diagnosis.

Human papillomavirus (HPV)

HPV 6+11 cause condylomata acuminata (genital warts).

However, the warts caused by strains 6+11 are not limited to the genitalia and can cause **laryngeal papillomatosis** in neonates and infants (warts of the vocal cords), which is asked on NBME. Lesions will have papillary structures on biopsy. Acquired vertically via exposure from maternal vaginal canal.

HPV 16+18 cause squamous cell carcinoma of genitalia/anus; risk of overt SCC is increased in immunocompromised (i.e., HIV in MSM) and heavy smoking. Students will get maniacal about other SCC-causing strains beyond 16+18 but USMLE doesn't give a fuck.

JC polyomavirus

Causes progressive multifocal leukoencephalopathy (PML).

Presents as neurodegeneration over weeks to months in immunocompromised patient – i.e., AIDS patient with CD4 count <100, patients undergoing chemoradiotherapy, or those on immunosuppressant drugs.

USMLE wants you to know this condition is due to “reactivation of latent infection,” which means the patient is infected at some point during life years ago, but the condition now manifests due to immunosuppression. “Acute infection in immunocompromised patient” is the wrong answer.

BK polyomavirus

Causes kidney infections in kidney transplant patients. Rare. You could just be aware it exists. I believe one Q ever in history exists on NBME somewhere.

Adenovirus

Most common cause of viral conjunctivitis.

Will present as teary eye that is either unilateral or bilateral, and either itchy or non-itchy.

Treatment is supportive with saline rinse.

Can also cause hemorrhagic cystitis (albeit more rare). For example, USMLE can give easy vignette of viral conjunctivitis in a school-age kid + ask what else is most likely to develop in the patient → answer = hematuria.

Hepatitis B

Mandatory stuff for USMLE is the serology (I discuss below).

Most common hepatitis infection in the worldwide. USMLE likes **China** for hepatitis B. Just a pattern I've noticed. Due to increased unvaccinated. In the USA, HepC is most common.

Parenteral; can be acute or chronic.

Transmitted vertically from mother to neonate, sex, IV drugs, or blood exposure.

Present in all body fluids, including breast milk.

Serology very HY (I discuss meaning of variables below the table):

Hepatitis B serology interpretation

	HBsAg	HBsAb	HBcAb	HBcAb IgM	HBcAb IgG	HBeAg
Acute infection (low infectivity)	+	-	+	+	-	-
Acute infection (high infectivity)	+	-	+	+	-	+
Chronic infection (low infectivity)	+	-	+	-	+	-
Chronic infection (high infectivity)	+	-	+	-	+	+
Immune (previous infection) <6 months	-	+	+	+	-	-
Immune (previous infection) >6 months	-	+	+	-	+	-
Immune (vaccinated)	-	+	-	-	-	-
Window period	-	-	+	+	-	-
Susceptible (not immune)	-	-	-	-	-	-

HBsAg = HepB surface antigen.

HBsAb = HepB surface antibody; if positive, patient is immune; if negative, patient is not immune.

HBcAb = HepB core antibody; if positive, patient either currently has HepB or had it in the past (i.e., cleared it).

HBcAb IgM = has acute infection.

HBcAb IgG = has chronic HepB or has cleared it.

Window period = Once a susceptible patient is exposed to HepB and the immune system attempts to clear it, sometimes Surface antigen will decline to the point that it is no longer detectable. But at the same time, the Surface antibody might not be high enough / at detectable levels yet. This is called the “window period,” where both Surface antigen and antibody are negative, so it can appear as though the patient doesn’t have an infection. However, Core antibody IgM will be (+). So the key point is that 1) you know the double-negative Surface antibody/antigen combo is seen in the window period, and 2) that Core antibody IgM is most reliable during the window period.

Vaccination against HepB is at birth, 2 months, and 6 months (no longer at 4 months).

Only give HepB IVIG to neonate if mom is confirmed (+). A 2CK NBME Q gives mother’s status as unknown when child is born → answer = “Give HepB vaccine now + only give IVIG if mother is positive.”

If patient has Hx of completed HepB vaccination but has titers that show susceptibility, the answer is just “give more vaccine.” Sometimes people’s immunity wanes.

USMLE really doesn’t give a fuck about HepB pharm (i.e., entecavir, tenofovir). Waste of time. You could be aware that interferon-alpha can be used for HepB.

Poxvirus

Largest DNA virus.

Causes molluscum contagiosum, which presents as skin-colored or reddish papules with central umbilication. Very HY spot-diagnosis for Peds.



USMLE likes giving vignette where kid went to a recent pool party.

You can also be aware of another poxvirus called Vaccinia, which is similar to smallpox and was used in the development of the smallpox vaccine. “Vaccinia” shows up as an answer on a new NBME where they talk about smallpox eradication.

Herpes simplex (HSV) 1/2

Causes painful vesicular lesions of the lips and genitalia that recur at varying intervals (usually months).

Primary infection is most severe, often with fever, regional lymphadenopathy, burning/stinging/itching pain (herpetic neuralgia), and many vesicles. Recurrences are often less severe and preceded by herpetic neuralgia. USMLE wants you to know herpes goes latent in **sensory nerves** (makes sense, since recurrences cause neuralgia/pain).

Don't confuse HSV1/2 with chancroid caused by the bacterium *Haemophilus ducreyi*. HSV1/2 will be usually be clusters of painful lesions that demonstrate *recurrence*, whereas chancroid will be a singular lesion that is not recurrent. There is one Q out there where they give you a singular painful lesion with recurrence, and the answer is HSV, not *H. ducreyi*. In this case, the recurrence is what tells you it's HSV1/2. Perhaps in some cases, herpetic infections can start as a single vesicle before erupting into the typical cluster-appearance. *H. ducreyi* is also typically acquired overseas, e.g., in backpackers traveling in the third-world.

HSV1/2 can cause herpes encephalitis (confusion + blood in CSF due to temporal lobe hemorrhage).

I would say 4/5 herpes encephalitis Qs mention blood in the CSF. There's one 2CK neuro form Q where the blood is negative, but the CSF findings are otherwise viral (normal glucose and protein; high lymphocytes).

You also need to know that CT of the head can be negative. I mention this because even though it can cause temporal lobe hemorrhage, the Q can say CT shows no abnormalities. They might mention spikes over the temporal region (implying there's still abnormality/hemorrhage there). So they can say something like: 24-year-old male with confusion and fever + viral CSF findings + blood in CSF + CT of head shows no abnormalities + EEG shows spikes over temporal region. Answer = intravenous acyclovir.

Can cause herpetic whitlow, which presents as vesicles on the finger in a child who's touched a mother's cold sore while breastfeeding, or in dental workers/hygienists.



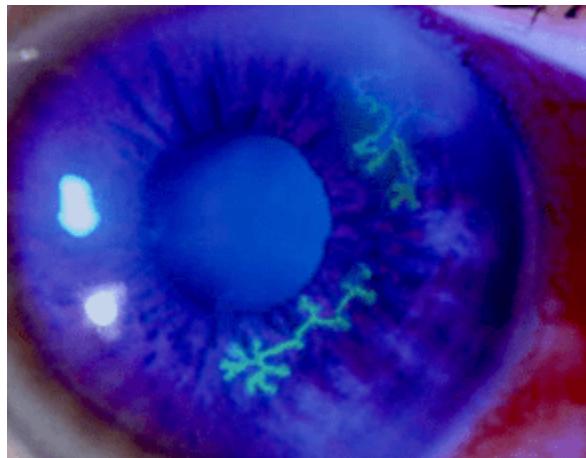
Herpetic whitlow

Can cause eczema herpeticum, which is HSV1/2 infection superimposed on eczema. Can present with stinging/burning pain (herpetic neuralgia). Treat with acyclovir.



Eczema herpeticum

Can cause herpes keratitis (inflammation of the cornea). Presents as dendritic (tree-like) pattern on fluorescein instillation of the eye. It may or may not present with periorbital vesicles.



Herpes keratitis

Herpes esophagitis presents as punched-out ulcers and odynophagia (pain with swallowing). This is in contrast to CMV esophagitis, which causes linear/confluent ulcers.

Viral culture can be negative in stem (not 100% sensitive).

Treat with acyclovir (or valacyclovir), which is a DNA polymerase inhibitor. HSV1/2 resistance to acyclovir occurs via altered viral thymidine kinase.

[Varicella zoster virus \(VZV; human herpes virus-3; HHV-3\)](#)

Causes chickenpox; can be described as clusters of vesicles at different stages of healing on an unvaccinated child or adult. Chickenpox Qs are exceedingly rare for USMLE. What they actually care about is shingles.

Shingles is aka herpes zoster. Herpes zoster is not the name of a virus. This is just another name for shingles. So we can say, shingles, aka herpes zoster, is caused by varicella zoster virus.

Shingles presents as vesicles erupting in a dermatomal distribution (i.e., usually on the flank or back of neck) idiopathically in middle-age individuals or older. Can be brought on by stress or transient negative flux in immunity.

Once the vesicles rupture, they can sometimes look black. So just know it's weird but possible. What's most telling for herpetic infections (whether it be HSV1/2, or VZV causing shingles) is that they form characteristic clusters of small vesicles. It's this characteristic clustering that can be buzzy/easy for herpetic infection.

Shingles can occur in immunocompromised kids (e.g., those undergoing chemotherapy). This is called pediatric shingles. Just know "it's a thing." Because most students think it only occurs in middle age or older.



Pediatric shingles

Can cause herpes zoster ophthalmicus (periorbital vesicles), which means shingles of the eye. This may or may not co-present with keratitis (and the dendritic pattern) that looks identical to that caused by HSV1/2.

Can cause herpes zoster oticus (vesicles in the ear), which means shingles of the ear. This may or may not present with concurrent Bell's palsy due to CN VII involvement. Bell's palsy due to shingles is called Ramsay-Hunt syndrome type II.



Herpes zoster oticus

Vaccination against VZV occurs with two doses: the first at 12-15 months; the second at 4-6 years.

Shingles vaccine is given at age 50 (on new Family Med form).

These vaccines are live-attenuated.

Treat shingles with acyclovir (or valacyclovir).

Varicella can cause pneumonia in immunocompromised and pregnant women. Slightly unusual, but just know it's possible.

VZV immunoglobulin is given to a neonate if an unvaccinated pregnant woman develops a chickenpox rash within 5 days prior to 2 days post-parturition.

If pregnant woman contracts chickenpox, the fetus may develop congenital varicella syndrome, which can present as microcephaly and skin vesicles demonstrating a “zig-zag” pattern.

[Ebstein-Barr virus \(EBV; human herpes virus-4; HHV-4\)](#)

Causes mononucleosis, nasopharyngeal carcinoma, oral hairy leukoplakia, and both Hodgkin and non-Hodgkin (notably Burkitt) lymphomas.

Mononucleosis is usually caused by EBV, but can also be CMV.

The virus invades B cells, which then stimulates the immune system to produce CD8+ T cells attacking the viral-infected B cells. In mono, these CD8+ T cells are called “atypical lymphocytes.” The USMLE wants you to know these are **reactive CD8+ T cells**. They are “reactive” because they are responding to the viral-infected B cells.

Primary infection presents usually in teenager or young adult with fever >38 C, lymphadenopathy, tonsillar exudates, and lack of cough, making the presentation appear bacterial (in the [HY Pulmonary PDF](#), I talk about CENTOR criteria for differentiating bacterial from viral URTIs). As a result, it is often misdiagnosed as *Strep pharyngitis*.

If amoxicillin or penicillin is given to treat EBV, this can cause a rash. This is not to be confused with a rash caused by allergy to beta-lactams. If pre-adolescent receives beta-lactam and gets a rash, that is likely beta-lactam allergy. If a patient adolescent or older gets a rash, we do a heterophile antibody (Monospot) test as next best step in diagnosis, as EBV mono is more likely.

The heterophile antibody test is how we diagnose EBV, where for some magical reason, the antibodies we produce against EBV cross-react with horse and sheep RBCs, hence the antibodies like (-phile) different (hetero-) antigens.

Following the primary infection, mono can present as recurrent episodes of extreme fatigue that arise at interval of months to years.

Nasopharyngeal carcinoma is a type of squamous cell carcinoma.

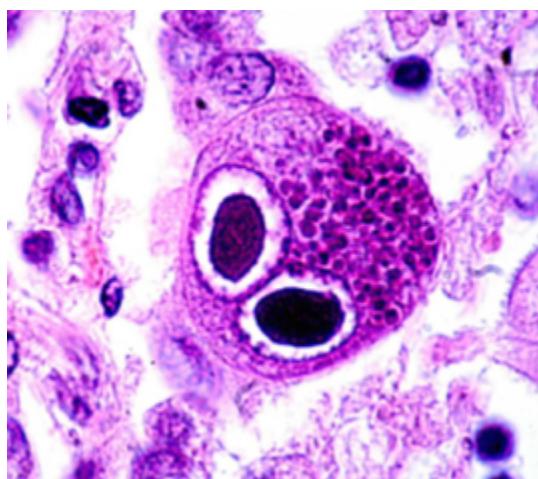
Oral hairy leukoplakia presents as white lesions on the tongue that cannot be scraped off. They are not pre-cancerous (no dysplasia on biopsy). This is in contrast to “regular” leukoplakia caused by tobacco, which is a precursor to SCC.

The increased risk of Hodgkin and non-Hodgkin lymphomas is because EBV invades B cells.

Cytomegalovirus (CMV; human herpes virus-5; HHV-5)

Most common organism transmitted via blood transfusions and organ transplants.

Causes infections of many different organ systems (e.g., lung, kidney, GI tract, retina), as well as CMV mono. There is an NBME Q where they give CMV pneumonia in patient following renal transplant, where they show the buzzy owl-eye appearance of cells.



USMLE likes “intranuclear inclusions” or “intranuclear inclusion bodies” for CMV. This refers to the “owl eyes” that can be seen on histo.

CMV esophagitis presents as linear/confluent ulcers and odynophagia. This is in contrast to HSV1/2, which cause punched-out ulcers.

CMV colitis presents as linear/confluent ulcers in AIDS patients with CD4 counts under 50-100.

Blurry vision in HIV patient = CMV retinitis until proven otherwise.

CMV mono is differentiated from EBV mono in that the former has a negative heterophile antibody (Monospot) test. Additionally, CMV can cause cold autoimmune hemolytic anemia due to the production of IgM antibodies against RBCs, with a positive Coombs test (means we have antibodies against RBCs). So if patient with mono has low hemoglobin and high LDH, for instance, that could point toward CMV over EBV. High LDH on USMLE almost always means hemolysis, since RBCs are packed with LDH.

CMV is treated with ganciclovir, which is a DNA polymerase inhibitor. CMV resistance to ganciclovir occurs via altered viral thymidine kinase. The MOA and resistance mechanisms are the same as HSV1/2 and VZV with respect to acyclovir.

The stem might mention a patient who had a kidney transplant 6 months ago who now has deteriorating renal function + intra-nuclear inclusions seen on biopsy. The answer is just “ganciclovir therapy.”

Human herpes virus-6 (HHV-6)

Causes roseola infantum, aka Sixth disease, or exanthema subitum.

Very easy/buzzy descriptor for USMLE: causes a “spiking fever followed by a rash” in a kid.

USMLE will literally say something to the effect of a kid having a maculopapular body rash that was preceded by a worrisome fever of 39C for the 3 days prior. Once the rash has formed, the child has cleared the infection (similar to slapped cheek appearance with Fifth disease due to Parvo).

Virus is self-limiting / no treatment necessary.

Human herpes virus-7 (HHV-7)

Causes pityriasis rosea, which is a rash that starts as Herald patch (larger pink ellipse), usually on the back or trunk, then spreads upward onto the shoulder blades ("Christmas tree distribution"); USMLE will show you image and expect you can make spot-diagnosis.



Can occur in teenagers, although more common in the 20s. May or may not be itchy.

Virus is self-limiting / no treatment necessary.

Kaposi sarcoma-associated herpesvirus (KSAH; human herpes virus-8; HHV-8)

Kaposi sarcoma is violaceous, tumorous lesions of vascular-lymphatic origin.

Usually seen in immunocompromised patients (i.e., AIDS, chemotherapy).



Q can show you image such as above and then the answer is just "anti-neoplastic" for the Tx (whereas answers like anti-fungal, anti-bacterial, etc., are wrong).

Bacillary angiomatosis caused by *Bartonella henselae* (normally causes cat-scratch disease) can present as Kaposi sarcoma-like lesions. What USMLE will do is give you a vignette that sounds just like Kaposi sarcoma (i.e., AIDS patient with violaceous skin lesions), followed by asking you for the organism that causes it. You'll notice that HHV-8 (as well has HepC for lichen planus) isn't listed, where all the answers are bacteria, and you just select *Bartonella henselae*.

1. What type of hepatitis B serology (i.e., HBs Ag, HBs Ab, HBc Ab) would be expected for patient who's been vaccinated against HepB?

HBsAg = HepB surface antigen.

HBsAb = HepB surface antibody; if positive, patient is immune; if negative, patient is not immune.

HBcAb = HepB core antibody; if positive, patient either currently has HepB or had it in the past (i.e., cleared it).

HBcAb IgM = has acute infection.

HBcAb IgG = has chronic HepB or has cleared it.

2. How does roseola present?

Roseola infantum, aka Sixth disease, or exanthema subitum, presents as very easy/buzzy “spiking fever followed by a rash” in a kid.

USMLE will literally say something to the effect of a kid having a maculopapular body rash that was preceded by a worrisome fever of 39C for the 3 days prior. Once the rash has formed, the child has cleared the infection (similar to slapped cheek appearance with Fifth disease due to Parvo).

Virus is self-limiting / no treatment necessary.

3. In mononucleosis, EBV invades which type of cells?

What are “atypical lymphocytes”?

The virus invades B cells, which then stimulates the immune system to produce CD8+ T cells attacking the viral-infected B cells. In mono, these CD8+ T cells are called “atypical lymphocytes.” The USMLE wants you to know these are **reactive CD8+ T cells**. They are “reactive” because they are responding to the viral-infected B cells.

Pityriasis rosea, caused by human herpesvirus-7 (HHV-7), which is a rash that starts as Herald patch (larger pink ellipse), usually on the back or trunk, then spreads upward onto the shoulder blades (“Christmas tree distribution”); USMLE will show you image and expect you can make spot-diagnosis.



Can occur in teenagers, although more common in the 20s. May or may not be itchy.

Virus is self-limiting / no treatment necessary.

5. What is the taxonomy/categorization of the Poxvirus?

Inner tubular nucleocapsid, enveloped, ds-linear

6. What is the taxonomy/categorization of the herpesviridae?

Icosahedral nucleocapsid, enveloped, ds-linear

7. What is most common viral cause of conjunctivitis?

Adenovirus.

Most common cause of viral conjunctivitis.

Will present as teary eye that is either unilateral or bilateral, and either itchy or non-itchy.
Treatment is supportive with saline rinse.

Can also cause hemorrhagic cystitis (albeit more rare). For example, USMLE can give easy vignette of viral conjunctivitis in a school-age kid + ask what else is most likely to develop in the patient → answer = hematuria.

CMV is most common organism transmitted via blood transfusions and organ transplants. It causes infections of many different organ systems (e.g., lung, kidney, GI tract, retina), as well as CMV mono. There is an NBME Q where they give CMV pneumonia in patient following renal transplant, where they show the buzzy owl-eye appearance of cells.

USMLE likes “intranuclear inclusions” or “intranuclear inclusion bodies” for CMV. This refers to the “owl eyes” that can be seen on histo.

9. What is the taxonomy/categorization of human papillomavirus (HPV)?

Icosahedral nucleocapsid, non-enveloped, ds-circular

10. What does HPV 6+11 cause vs HPV 16+18?

HPV 6+11 cause condylomata acuminata (genital warts).

However, the warts caused by strains 6+11 are not limited to the genitalia and can cause laryngeal papillomatosis in neonates (warts of the vocal cords), which is asked on NBME. Lesions will have papillary structures on biopsy. Acquired vertically via exposure from maternal vaginal canal.

HPV 16+18 cause squamous cell carcinoma of genitalia/anus; risk of overt SCC is increased in immunocompromised (i.e., HIV in MSM) and heavy smoking. Students will get maniacal about other SCC-causing strains beyond 16+18 but USMLE doesn't give a fuck.

11. What is the most common organism transmitted via blood transfusions and organ transplants?

CMV

12. What are five conditions EBV causes?

Causes mononucleosis, nasopharyngeal carcinoma, oral hairy leukoplakia, and both Hodgkin and non-Hodgkin (notably Burkitt) lymphomas

13. What are two ways CMV mono can be differentiated from EBV mono?

CMV mono is differentiated from EBV mono in that the former has a negative heterophile antibody (Monospot) test. Additionally, CMV can cause cold autoimmune hemolytic anemia due to the production of IgM antibodies against RBCs, with a positive Coombs test (means we have antibodies against RBCs). So if patient with mono has low hemoglobin and high LDH, for instance, that could point toward CMV over EBV. High LDH on USMLE almost always means hemolysis, since RBCs are packed with LDH.

14. How does pityriasis rosea present?

What virus causes it?

Starts as Herald patch (larger pink ellipse), usually on the back or trunk, then spreads upward onto the shoulder blades ("Christmas tree distribution"); USMLE will show you image and expect you can make spot-diagnosis.



Can occur in teenagers, although more common in the 20s. May or may not be itchy.

Caused by human herpesvirus-7 (HHV-7).

Virus is self-limiting / no treatment necessary.

15. What is the taxonomy/categorization of JC polyoma virus?

Icosahedral nucleocapsid, non-enveloped, ds-circular

Molluscum contagiosum, caused by poxvirus.

Presents as skin-colored or reddish papules with central umbilication. Very HY spot-diagnosis for Peds.



USMLE likes giving vignette where kid went to a recent pool party.

17. How are herpes vs CMV esophagitis differentiated on endoscopy?

How are they treated?

Herpes esophagitis presents as punched-out ulcers and odynophagia (pain with swallowing). This is in contrast to CMV esophagitis, which causes linear/confluent ulcers.

Herpes → acyclovir.

CMV → ganciclovir.

18. Blurry vision in HIV patient. Diagnosis until proven otherwise?

Blurry vision in HIV patient = CMV retinitis until proven otherwise.

19. What type of hepatitis B serology (i.e., HBs Ag, HBs Ab, HBc Ab) would be expected for chronic infection?

HBsAg = HepB surface antigen.

HBsAb = HepB surface antibody; if positive, patient is immune; if negative, patient is not immune.

HBcAb = HepB core antibody; if positive, patient either currently has HepB or had it in the past (i.e., cleared it).

HBcAb IgM = has acute infection.

HBcAb IgG = has chronic HepB or has cleared it.

20. What virus causes nasopharyngeal carcinoma?

EBV

21. How does shingles present?

Which virus causes it?

How is it treated?

Shingles is aka herpes zoster. Herpes zoster is not the name of a virus. This is just another name for shingles. So we can say, shingles, aka herpes zoster, is caused by varicella zoster virus (VZV).

Shingles presents as vesicles erupting in a dermatomal distribution (i.e., usually on the flank or back of neck) idiopathically in middle-age individuals or older. Can be brought on by stress or transient negative flux in immunity.

Once the vesicles rupture, they can sometimes look black. So just know it's weird but possible. What's most telling for herpetic infections (whether it be HSV1/2, or VZV causing shingles) is that they form characteristic clusters of small vesicles. It's this characteristic clustering that can be buzzy/easy for herpetic infection.

Treatment is acyclovir (or valacyclovir).

22. 3-year-old boy has spiking fever followed by a rash. What's the diagnosis and treatment?

Human herpesvirus-6 (HHV-6) causing roseola infantum, aka Sixth disease, or exanthema subitum.

Very easy/buzzy descriptor for USMLE: causes a “spiking fever followed by a rash” in a kid.

USMLE will literally say something to the effect of a kid having a maculopapular body rash that was preceded by a worrisome fever of 39C for the 3 days prior. Once the rash has formed, the child has cleared the infection (similar to slapped cheek appearance with Fifth disease due to Parvo).

Virus is self-limiting / no treatment necessary.

23.



18-year-old wrestler. Has history of eczema. Presents as stinging/burning pain over area of eczema.

What's the diagnosis and treatment?

Eczema herpeticum, which is HSV1/2 infection superimposed on eczema. Can present with stinging/burning pain (herpetic neuralgia).

Treat with acyclovir.

24. What is shingles of the eye vs ear called? What about if there's Bell's palsy?

Can cause herpes zoster ophthalmicus (periorbital vesicles), which means shingles of the eye. This may or may not co-present with keratitis (and the dendritic pattern) that looks identical to that caused by HSV1/2.



Can cause herpes zoster oticus (vesicles in the ear), which means shingles of the ear. This may or may not present with concurrent Bell's palsy due to CN VII involvement. Bell's palsy due to shingles is called Ramsay-Hunt syndrome type II.



25. 70-year-old man develops vesicles around his ear + Bell's palsy. Diagnosis?

Can cause herpes zoster oticus (vesicles in the ear), which means shingles of the ear. This may or may not present with concurrent Bell's palsy due to CN VII involvement. Bell's palsy due to shingles is called Ramsay-Hunt syndrome type II.



26. What is the taxonomy/categorization of Parvovirus B19?

Icosahedral nucleocapsid, non-enveloped, ss-linear

27. What is the taxonomy/categorization of the hepatitis B?

Icosahedral nucleocapsid, enveloped, ds-circular

28. Which virus can cause stridor in an infant due to growths in the throat, where the virus was acquired from the mother's vaginal canal?

HPV 6+11 cause condylomata acuminata (genital warts). However, the warts caused by strains 6+11 are not limited to the genitalia and can cause **laryngeal papillomatosis** in neonates and infants (warts of the vocal cords), which is asked on NBME. Lesions will have papillary structures on biopsy. Acquired vertically via exposure from maternal vaginal canal.

HPV 16+18 cause squamous cell carcinoma of genitalia/anus; risk of overt SCC is increased in immunocompromised (i.e., HIV in MSM) and heavy smoking. Students will get maniacal about other SCC-causing strains beyond 16+18 but USMLE doesn't give a fuck.

29. 17-year-old boy with suspected *Strep* pharyngitis develops a rash after receiving amoxicillin. What two possibilities for the rash must be considered?

Either EBV mononucleosis or allergy to beta-lactam.

If amoxicillin or penicillin is inadvertently given to treat EBV, this can cause a rash. This is not to be confused with a rash caused by allergy to beta-lactams. If pre-adolescent receives beta-lactam and gets a rash, that is likely beta-lactam allergy. If a patient adolescent or older gets a rash, we do a heterophile antibody (Monospot) test as next best step in diagnosis, as EBV mono is more likely.

The heterophile antibody test is how we diagnose EBV, where for some magical reason, the antibodies we produce against EBV cross-react with horse and sheep RBCs, hence the antibodies like (-phile) different (hetero-) antigens.

30. Which DNA virus is associated with development of pure-RBC aplasia and aplastic anemia?

Parvovirus B19.

Causes Fifth disease = "slapped cheek" facial erythema in Peds.

Once child has developed the red cheeks, he/she has immunologically cleared the illness (i.e., if they turn it into a behavioral science Q, tell parents to chill the fuck out / relax because the child has cleared the virus).

Can cause exanthem (body rash) +/- arthritis in adults, especially in **daycare workers** (USMLE is obsessed with this).

Can cause pure-RBC aplasia (i.e., only RBCs are low) or full-blown aplastic anemia (where all cell lines – RBCs, WBCs, and platelets – are down).

There is increased risk of pure-RBC aplasia and aplastic anemia if the infection occurs *in utero* and in sickle cell patients.

Next best step in diagnosis for Fifth disease or exanthem/arthritis is check serum IgM titers.

If any of the hematologic cell lines are down, do bone marrow biopsy to confirm diagnosis.

31. Which virus classically causes neuronal degeneration in an AIDS patient?

JC polyoma virus

Causes progressive multifocal leukoencephalopathy (PML).

Presents as neurodegeneration over weeks to months in immunocompromised patient – i.e., AIDS patient with CD4 count <100, patients undergoing chemoradiotherapy, or those on immunosuppressant drugs.

USMLE wants you to know this condition is due to “reactivation of latent infection,” which means the patient is infected at some point during life years ago, but the condition now manifests due to immunosuppression. “Acute infection in immunocompromised patient” is the wrong answer.

32. What does poxvirus cause?

Causes molluscum contagiosum, which presents as skin-colored or reddish papules with central umbilication. Very HY spot-diagnosis for Peds.



USMLE likes giving vignette where kid went to a recent pool party.

You can also be aware of another poxvirus called Vaccinia, which is similar to smallpox and was used in the development of the smallpox vaccine. “Vaccinia” shows up as an answer on a new NBME where they talk about smallpox eradication.

33. What is bacillary angiomatosis?

Bacillary angiomatosis caused by *Bartonella henselae* (normally causes cat-scratch disease) can present as Kaposi sarcoma-like lesions. What USMLE will do is give you a vignette that sounds just like Kaposi sarcoma (i.e., AIDS patient with violaceous skin lesions), followed by asking you for the organism that causes it. You'll notice that HHV-8 (as well has HepC for lichen planus) isn't listed, where all the answers are bacteria, and you just select *Bartonella henselae*.

35. What does BK polyoma virus cause? Causes kidney infections in kidney transplant patients. Rare. You could just be aware it exists. I believe one Q ever in history exists on NBME somewhere.

36.

How do primary vs recurrent HSV1/2 infections present?

Herpes goes latent in what type of nerves?

Causes painful vesicular lesions of the lips and genitalia that recur at varying intervals (usually months).

Primary infection is most severe, often with fever, regional lymphadenopathy, burning/stinging/itching pain (herpetic neuralgia), and many vesicles. Recurrences are often less severe and preceded by herpetic neuralgia.

USMLE wants you to know herpes goes latent in **sensory nerves** (makes sense, since recurrences cause neuralgia/pain).

37. Which bacterium can cause infections sometimes confused with genital herpes infections?

Don't confuse HSV1/2 with chancroid caused by the bacterium *Haemophilus ducreyi*. HSV1/2 will be usually be clusters of painful lesions that demonstrate *recurrence*, whereas chancroid will be a singular lesion that is not recurrent. There is one Q out there where they give you a singular painful lesion with recurrence, and the answer is HSV, not *H. ducreyi*. In this case, the recurrence is what tells you it's HSV1/2. Perhaps in some cases, herpetic infections can start as a single vesicle before erupting into the typical cluster-appearance. *H. ducreyi* is also typically acquired overseas, e.g., in backpackers traveling in the third-world.

38. How does primary mononucleosis infection present vs recurrence of the condition?

Primary infection presents usually in teenager or young adult with fever >38 C, lymphadenopathy, tonsillar exudates, and lack of cough, making the presentation appear bacterial (in the [HY Pulmonary PDF](#), I talk about CENTOR criteria for differentiating bacterial from viral URTIs). As a result, it is often misdiagnosed as *Strep pharyngitis*.

Following the primary infection, mono can present as recurrent episodes of extreme fatigue that arise at interval of months to years.

39. How does adult Parvo presentation tend to differ from children's?

Which adult demographic classically gets Parvo infections that USMLE is obsessed with?

Causes Fifth disease = “slapped cheek” facial erythema in Peds.

Once child has developed the red cheeks, he/she has immunologically cleared the illness (i.e., if they turn it into a behavioral science Q, tell parents to chill the fuck out / relax because the child has cleared the virus).

Can cause exanthem (body rash) +/- arthritis in adults, especially in **daycare workers** (USMLE is obsessed with this).

Can cause pure-RBC aplasia (i.e., only RBCs are low) or full-blown aplastic anemia (where all cell lines – RBCs, WBCs, and platelets – are down).

There is increased risk of pure-RBC aplasia and aplastic anemia if the infection occurs *in utero* and in sickle cell patients.

Next best step in diagnosis for Fifth disease or exanthem/arthritis is check serum IgM titers.

If any of the hematologic cell lines are down, do bone marrow biopsy to confirm diagnosis.

41. 34-year-old IV drug user with CD4 count 40/microliter who has blood in the stool. What's the likely diagnosis?

CMV colitis presents as linear/confluent ulcers in AIDS patients with CD4 counts under 50-100.

42. How does herpes encephalitis present?

What's special about the labs?

Can cause herpes encephalitis (confusion + blood in CSF due to temporal lobe hemorrhage).

I would say 4/5 herpes encephalitis Qs mention blood in the CSF. There's one 2CK neuro form Q where the blood is negative, but the CSF findings are otherwise viral (normal glucose and protein; high lymphocytes).

You also need to know that CT of the head can be negative. I mention this because even though it can cause temporal lobe hemorrhage, the Q can say CT shows no abnormalities. They might mention spikes over the temporal region (implying there's still abnormality/hemorrhage there). So they can say something like: 24-year-old male with confusion and fever + viral CSF findings + blood in CSF + CT of head shows no abnormalities + EEG shows spikes over temporal region. Answer = intravenous acyclovir.

43. What type of hepatitis B serology (i.e., HBs Ag, HBs Ab, HBC Ab) would be expected for patient who's susceptible to HepB (i.e., unvaccinated status)?

HBsAg = HepB surface antigen.

HBsAb = HepB surface antibody; if positive, patient is immune; if negative, patient is not immune.

HBCAb = HepB core antibody; if positive, patient either currently has HepB or had it in the past (i.e., cleared it).

HBcAb IgM = has acute infection.

HBcAb IgG = has chronic HepB or has cleared it.

45. When do we vaccinate against HepB (in terms of patient age)?

And when do we give IVIG to neonate if mother's HepB status is unknown?

Vaccination against HepB is at birth, 2 months, and 6 months (no longer at 4 months).

Only give HepB IVIG to neonate if mom is confirmed (+). A 2CK NBME Q gives mother's status as unknown when child is born → answer = "Give HepB vaccine now + only give IVIG if mother is positive."

If patient has Hx of completed HepB vaccination but has titers that show susceptibility, the answer is just "give more vaccine." Sometimes people's immunity wanes.

46. What are the two things adenovirus causes?

Most common cause of viral conjunctivitis.

Will present as teary eye that is either unilateral or bilateral, and either itchy or non-itchy. Treatment is supportive with saline rinse.

Can also cause hemorrhagic cystitis (albeit more rare). For example, USMLE can give easy vignette of viral conjunctivitis in a school-age kid + ask what else is most likely to develop in the patient → answer = hematuria.

47. What type of hepatitis B serology (i.e., HBs Ag, HBs Ab, HBc Ab) would be expected for patient who's in the HepB window period? What does the window period mean?

Window period = patient is starting to clear the infection; as a result, HBsAg is no longer detected, but at the same time, HBsAb is also not yet detectable, so the patient will be negative for both HBsAb and HBsAg. In this case, HBcAb IgM is most reliable as evidence of the infection.

48. When do we vaccinate against varicella in children and adults?

What kind of vaccine is it (i.e., toxoid, etc.)?

Vaccination against VZV occurs with two doses: the first at 12-15 months; the second at 4-6 years.

Shingles vaccine is given at age 50 (on new Family Med form).

These vaccines are live-attenuated.

Kaposi sarcoma is violaceous, tumorous lesions of vascular-lymphatic origin.

Usually seen in immunocompromised patients (i.e., AIDS, chemotherapy).



Q can show you image such as above and then the answer is just “anti-neoplastic” for the Tx (whereas answers like anti-fungal, anti-bacterial, etc., are wrong).

Bacillary angiomatosis caused by *Bartonella henselae* can present as Kaposi sarcoma-like lesions. What USMLE will do is give you a vignette that sounds just like Kaposi sarcoma (i.e., AIDS patient with violaceous skin lesions), followed by asking you for the organism that causes it. You'll notice that HHV-8 (as well has HepC for lichen planus) isn't listed, where all the answers are bacteria, and you just select *Bartonella henselae*.

Shingles can occur in immunocompromised kids (e.g., those undergoing chemotherapy). This is called pediatric shingles. Just know “it’s a thing.” Because most students think it only occurs in middle age or older.

52. How is CMV treated?

What's the MOA of the drug?

If CMV becomes resistant to it, what's the mechanism of resistance?

CMV is treated with ganciclovir, which is a DNA polymerase inhibitor. CMV resistance to ganciclovir occurs via altered viral thymidine kinase. The MOA and resistance mechanisms are the same as HSV1/2 and VZV with respect to acyclovir.

The stem might mention a patient who had a kidney transplant 6 months ago who now has deteriorating renal function + intra-nuclear inclusions seen on biopsy. The answer is just "ganciclovir therapy."

53. What is an unusual way varicella can present in pregnant women?

When is Varicella IVIG given to the neonate?

How does congenital varicella syndrome present?

Varicella can cause pneumonia in immunocompromised and pregnant women. Slightly unusual, but just know it's possible.

VZV immunoglobulin is given to a neonate if an unvaccinated pregnant woman develops a chickenpox rash within 5 days prior to 2 days post-parturition.

If pregnant woman contracts chickenpox, the fetus may develop congenital varicella syndrome, which can present as microcephaly and skin vesicles demonstrating a "zig-zag" pattern.

54. What does Parvovirus B19 cause?

Which patient group is notably susceptible to more severe illness?

How do we diagnose it?

Causes Fifth disease = “slapped cheek” facial erythema in Peds.

Once child has developed the red cheeks, he/she has immunologically cleared the illness (i.e., if they turn it into a behavioral science Q, tell parents to chill the fuck out / relax because the child has cleared the virus).

Can cause exanthem (body rash) +/- arthritis in adults, especially in **daycare workers** (USMLE is obsessed with this).

Can cause pure-RBC aplasia (i.e., only RBCs are low) or full-blown aplastic anemia (where all cell lines – RBCs, WBCs, and platelets – are down).

There is increased risk of pure-RBC aplasia and aplastic anemia if the infection occurs *in utero* and in sickle cell patients.

Next best step in diagnosis for Fifth disease or exanthem/arthritis is check serum IgM titers.

If any of the hematologic cell lines are down, do bone marrow biopsy to confirm diagnosis.

55. What is the taxonomy/categorization of adenovirus?

Icosahedral nucleocapsid, non-enveloped, ds-linear

56. What does JC polyoma virus cause?

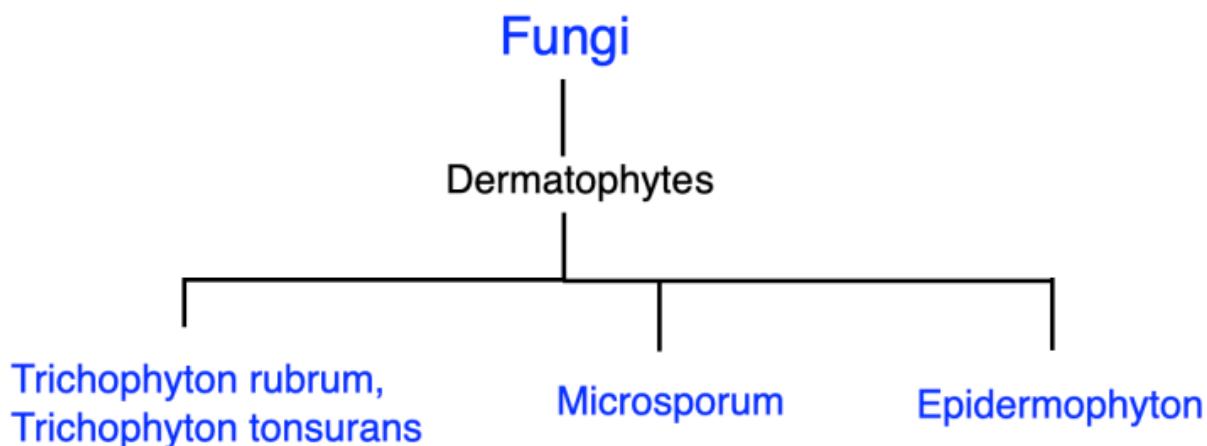
How does it present?

Causes progressive multifocal leukoencephalopathy (PML).

Presents as neurodegeneration over weeks to months in immunocompromised patient – i.e., AIDS patient with CD4 count <100, patients undergoing chemoradiotherapy, or those on immunosuppressant drugs.

USMLE wants you to know this condition is due to “reactivation of latent infection,” which means the patient is infected at some point during life years ago, but the condition now manifests due to immunosuppression. “Acute infection in immunocompromised patient” is the wrong answer.

Many fungi can be grown on Sabouraud agar, so you can memorize this factoid as a starter.



Dermatophytes are fungi that cause skin infections.

Trichophyton spp.

T. rubrum causes many skin infections, including tinea corporis (ring worm), tinea cruris (jock itch), tinea pedis (athlete's foot). It also causes onychomycosis (fungal infection of the nail).

USMLE will usually not play trivia where they list 5 different fungi and you're expected to know *T. rubrum* is the one causing the tinea corporis. What they'll do is literally list 3 bacteria, 1 fungus, and a miscellaneous diagnosis like eczema, and then you just choose the one fungus listed, e.g., *T. rubrum*. It's quite easy.

T. tonsurans is known to cause tinea capitis (fungal infection of the scalp).

Microsporum and *Epidermophyton*

Microsporum causes tinea corporis and tinea capitis. *Epidermophyton* causes tinea pedis and tinea cruris. You do not need to memorize these specific conditions caused by *Microsporum* and *Epidermophyton*. I just want you to know these fungal names are dermatophytes / fungi in general.

What USMLE cares about is you being able to spot-diagnose dermatophyte fungal infections via an image and then choose the treatment.



The above image is tinea capitis. USMLE will show you this image and then the answer is “oral griseofulvin for patient only”; “oral griseofulvin for patient and classmates” is wrong answer. Or they’ll show the above image and then the answer is just “*Trichophyton tonsurans*,” where it’s the only fungus listed.

If the USMLE asks how to prevent tinea capitis, the answer is “avoidance of sharing of hats.” Sounds easy, but it’s asked on an NBME and many students get it wrong. They select answers like “use of anti-fungal shampoo” or “avoidance of wooded areas,” which are wrong.

Tinea capitis is often described as a “circular area of scaling alopecia.”



The above image is tinea corporis (ring worm). The Q can say a patient has pet dogs or uses yoga mats at the gym. USMLE will show you this image and then the answer is just “clotrimazole” or “miconazole.” We treat tinea corporis, tinea pedis, and tinea cruris with topical -azoles. You need to know clotrimazole and miconazole are specifically topical, whereas others like fluconazole and itraconazole are oral. Tinea pedis can also be treated with topical terbinafine.

Tinea pedis presents as itchy scaling between the webs of the feet.



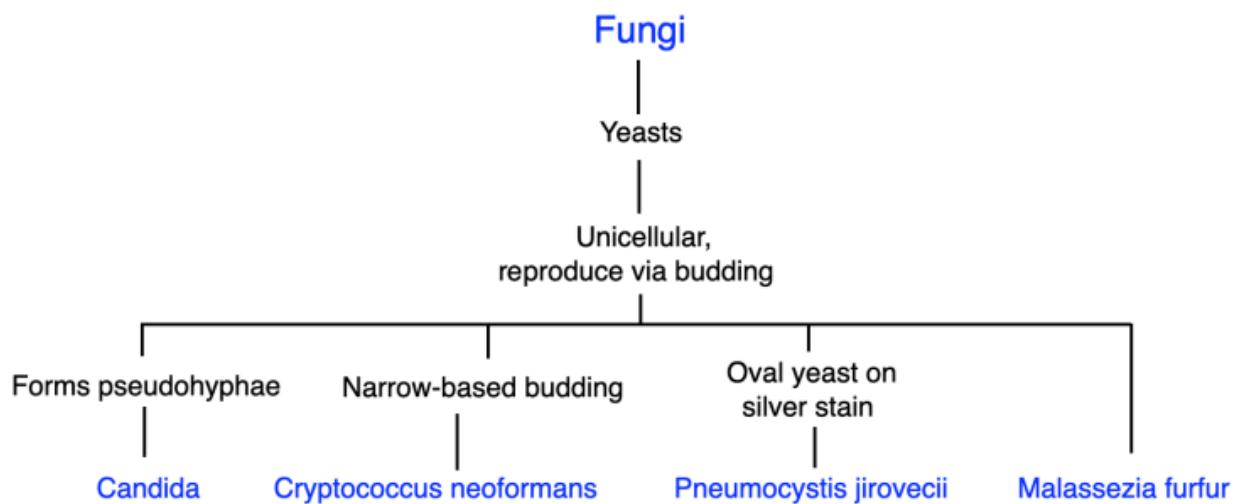
Above image shows tinea pedis. There is an NBME has a Q where they tell you a febrile patient has itchy, erythematous scaling on the foot that extends up the dorsum of the foot onto the ankle + they ask the cause of the fever in the patient. The wrong answer is *Trichophyton*. The correct answer is *S. aureus*. Students get confused by this, but there's two points: 1) they ask for the cause of the fever; fungi rarely cause fever, whereas *S. aureus* is a more likely culprit; and 2) tinea pedis usually presents as itchy,

scaling webs between the toes; the erythematous extension up to the ankle is likely a bacterial cellulitis that has superimposed on the cracked skin.

In this case, oral dicloxacillin or cephalexin would treat the *S. aureus* skin infection; topical -azole or terbinafine could be used for the tinea pedis.



Above image is onychomycosis. USMLE can show you this image and then the answer is just “oral terbinafine for 12 weeks.” You don’t have to memorize that 6 weeks is for fingernails and 12 weeks is for toenails. I’m just saying what the answer can show up as, where all the others are clearly wrong. Oral terbinafine is classic for onychomycosis because it has a unique ability to concentrate in keratinous tissues. Topical terbinafine, in contrast, is used for tinea pedis (or topical -azoles).



Yeast are a single-celled fungi and reproduce through budding. They tend to be round or oval in shape.

Candida

Forms pseudohyphae. This detail for whatever reason is HY. Hyphae are multicellular structures formed by mold (a form of fungus). However, candida is a yeast, not a mold, so the structures it forms look like hyphae, but they're not, hence pseudohyphae. The image is HY:



Skin infections with *Candida* tend to occur opportunistically – i.e., in diabetics, immunocompromised patients, or those receiving ongoing broad-spectrum antibiotics (e.g., for endocarditis). In contrast, dermatophyte infections tend to occur sporadically in immunocompetent patients.

Persistent skin infections can occur in those with T cell dysfunction or deficiency. Chronic mucocutaneous candidiasis is a T cell dysfunction disorder. The USMLE will give a 17-year-old girl who's had candidal skin infections since birth, and then the answer will just be “impaired cell-mediated immunity.” The answer can also just be “T cell” for which cell that's fucked up.

Diabetes causes dysglycemia, which is a major risk factor for candidal skin infections, as well as vulvovaginal candidiasis. This is because persistently elevated glucose can weaken the immune system (i.e., impair neutrophil and macrophage function). In addition, candida likes high-glucose environments, so persistent glycosuria supports growth. And high glucose also facilitates candidal biofilm production and growth on mucosal surfaces.

USMLE will give an obese woman with diabetes who has a moist, red plaque underneath one of her breasts + they ask for biggest risk factor → answer = diabetes, where obesity is wrong. When both answers are listed together, choose diabetes (or dysglycemia). Obesity is only an indirect risk factor in that it leads to insulin resistance and dysglycemia, so the latter is the direct risk factor. Treatment for candidal skin infections is topical or oral -azole.

You also need to be aware of diaper rash, which can be caused by candida. The USMLE might show you reddish maculopapular clusters in the groin of a baby, and the answer is *Candida*.

Systemic candidal infections can occur in those receiving total parenteral nutrition (TPN; hyperalimentation), since a central venous line can become colonized and TPN contains glucose.

Systemic infections can also occur in those with neutropenia (agranulocytosis).

Vulvovaginal (and penile, albeit more rare) candidiasis is treated with oral fluconazole or topical nystatin. USMLE will give you an easy vignette where they describe thick white discharge per vaginum (buzzy for candida), or they'll say there's vulvovaginal erythema and itchiness, without saying there's discharge, and then show you the image of the pseudohyphae, and then they'll ask the MOA of the oral agent to be prescribed → answer = "Inhibition of P-450-mediated demethylation," which refers to fluconazole. -Azoles inhibit 14 α -demethylase, which blocks the conversion of lanosterol to ergosterol (fungal equivalent of cholesterol in the cell membrane).

Oropharyngeal candidiasis (oral thrush) can be seen in immunocompromised patients, but it is also seen in asthma patients who use inhaled corticosteroids (e.g., fluticasone). Patients must rinse their mouths out with water following inhaled corticosteroids, otherwise oropharyngeal mucosal immunity can be weakened. Oral thrush presents as white plaques on the palate or tongue that bleed when scraped off. Treatment for oral thrush is nystatin mouthwash. Nystatin pokes holes in the ergosterol cell membrane.

Oropharyngeal candidiasis is not to be confused with candidal esophagitis, which always occurs in immunocompromised patients. Odynophagia (pain with swallowing) in an immunocompromised patient is candidal esophagitis till proven otherwise. Endoscopy will show white streaks. Treatment is oral fluconazole. In contrast, herpes esophagitis will show punched-out ulcers. CMV esophagitis will show linear/confluent ulcers.

Cryptococcus neoformans

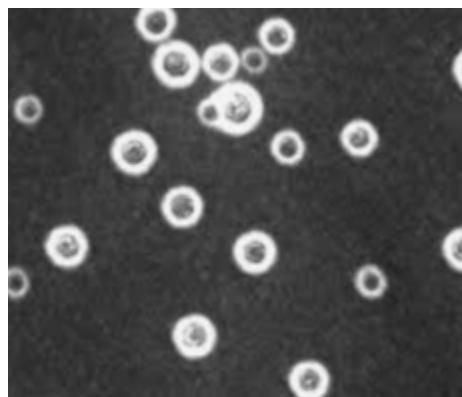
Demonstrates narrow-based budding. The N's go together – i.e., **N**arrow-based budding for *C. neoformans*. This is in contrast to **B**lastomycosis, which is **B**road-based budding.

Causes fungal meningitis in immunocompromised patients (usually AIDS).

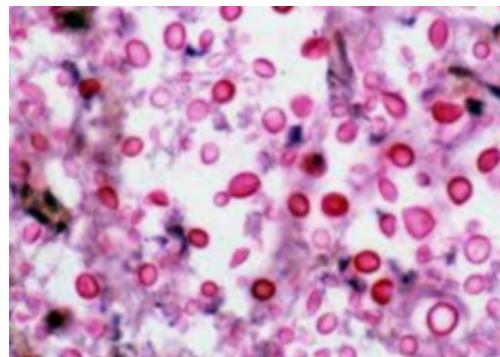
CSF analysis will show low glucose, high protein, and high lymphocytes.

High opening pressure can sometimes be seen with fungal meningitis and may be suggestive, although it is not specific, so do not use it as confirmatory when you are reading vignettes.

Latex agglutination testing of the CSF is most accurate, although India ink prep and mucicarmine staining are also often done.



The India ink prep is a spot-diagnosis for *C. neoformans*. There is a black background, where the only thing that doesn't stain dark is the halo-like polysaccharide capsule of *C. neoformans*.



Mucicarmine staining is red. You don't have to be a pathologist. The vignette might give you an IV drug user with fever, stiff neck, and photophobia (i.e., meningitis symptoms) + they show you this stain, and then the answer is just "*C. neoformans*," or "amphotericin B" as the treatment.

Amphotericin B, similar to nystatin, pokes holes in the ergosterol membrane. It is hard-hitting and used for CNS and disseminated fungal infections. For example, if a patient has a simple fungal pneumonia, he or she might receive oral fluconazole. But if a patient has fungemia with rigors, chills, and high fever (implying serious systemic infection), then amphotericin B is used.

Pneumocystis jirovecii

Causes bilateral pneumonia (*Pneumocystis jirovecii* pneumonia; PJP) in immunocompromised patients (usually HIV/AIDS). Can sometimes be described as "ground-glass," although this descriptor is only seen in a minority of Qs.

A HY point about PJP is that it is specifically **bilateral**. If the vignette gives you an HIV patient with a lobar pneumonia, the answer is *S. pneumo*, not PJP. Students get this wrong all of the time, where they choose PJP in an AIDS patient with a lobar pneumonia, and then they're somehow flummoxed that they got it wrong.

Comes in at a CD4 count of 200 in HIV/AIDS. Prophylaxis and treatment is trimethoprim/sulfamethoxazole (TMP/SMX).

As I talk about in the HIV section of the [RNA viruses – Part II module](#), TMP/SMX is also the prophylaxis for Toxoplasmosis, although the treatment for Toxo is instead sulfadiazine and pyrimethamine. What USMLE loves to do is give you a patient with a low CD4 count (e.g., 47) who has ring-enhancing lesion of the brain who is taking HAART and TMP/SMX. The diagnosis is primary CNS lymphoma, not Toxo. And the way we know Toxo is wrong is because the patient is on TMP/SMX, which is the prophylaxis for both *Pneumocystis* and Toxo. So commencing TMP/SMX at a CD4 count of 200 for PJP is "two birds with one stone" by the time the patient gets to CD4 of 100, which is when Toxo comes in. It's only patients who aren't on TMP/SMX by the time they fall to CD4 of 100 who get Toxo.

PJP is diagnosed with **bronchoalveolar lavage** (after the CXR shows bilateral ground-glass pneumonia), which is when sterile saline is injected into the lungs via a

bronchoscope and then aspirated/collected for examination. *Pneumocystis* is classically visualized as oval yeast on silver stain.

Malassezia furfur

Causes tinea versicolor, which is an extremely buzzy and pass-level spot-diagnosis on USMLE. This is a fungal infection of the shoulder blades, back, and upper torso that tends to occur in sub-tropical or tropical areas, where the patient presents with spotty hypopigmentation.

The hypopigmentation is due to fatty acid degradation within the skin, which releases an acidic product by the fungus that inhibits tyrosinase (enzyme necessary for melanin synthesis).

The vignette will give a 24-year-old male who frequently goes surfing in Florida + they show you the buzzy image:



Then the answer is just “topical selenium,” which is extremely HY as the treatment.

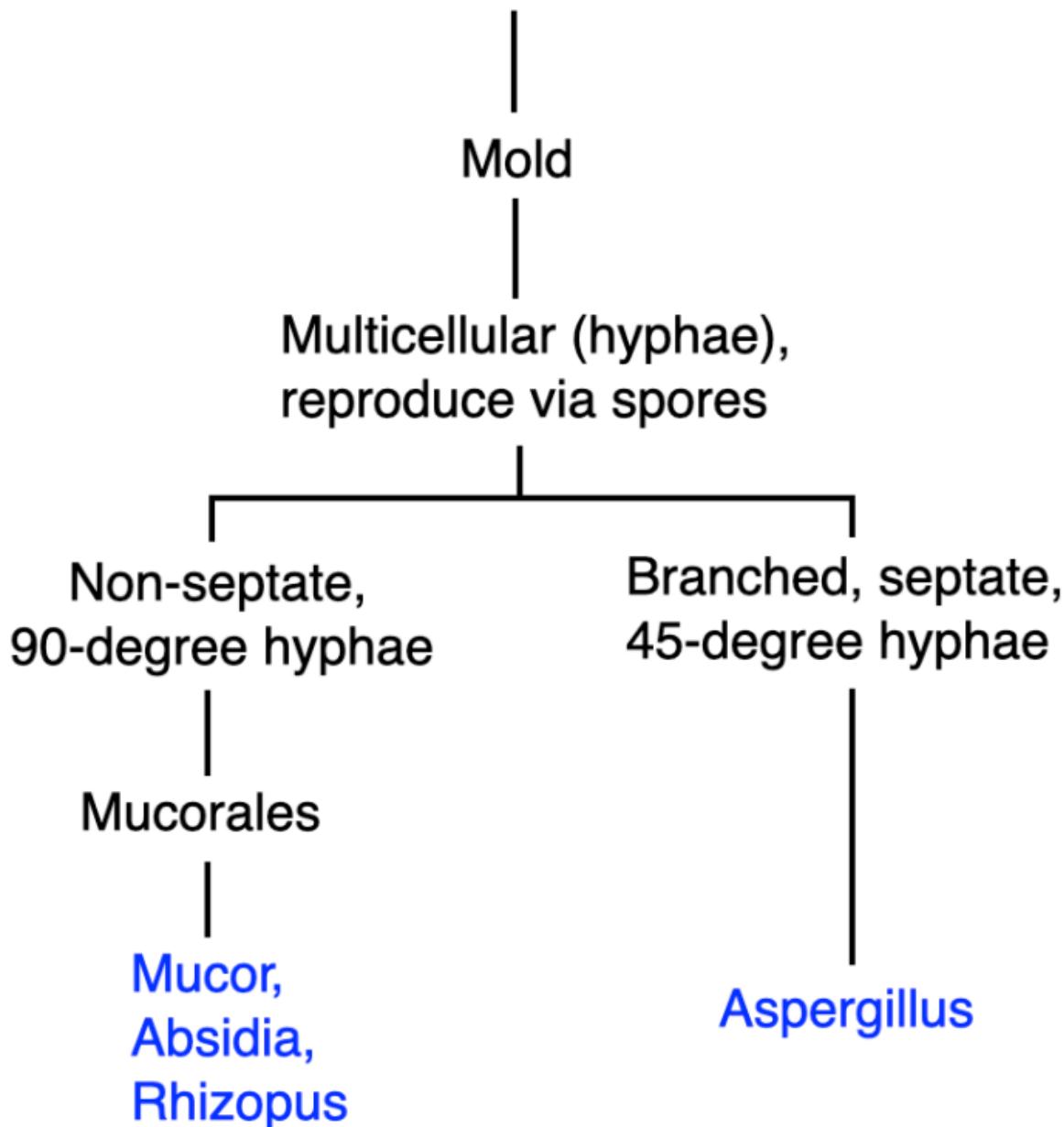
Malassezia furfur can also cause seborrheic dermatitis (aka dandruff), which is a fungal infection of the scalp, hairline, and sometimes face. It presents as an itchy, flaky scalp in someone with otherwise no observable cutaneous findings, or more severely as a scaly, erythematous hairline with weeping papules. Occasionally it affects the face itself. This is not to be confused with tinea capitis, which instead presents as a circular area of scaling alopecia.



Seborrheic dermatitis is treated with selenium or -azole shampoo.

Don't confuse seborrheic dermatitis with seborrheic keratoses, which are dark, stuck-on, greasy lesions on the faces of elderly and smokers, where they appear as though they can be peeled off.

Fungi



Mold is fungus that is multicellular (hyphae) and reproduces via spores.

Mucorales

Order of fungi that are referred to as “bread mold” and are found ubiquitously in the environment.

Have non-septate hyphae that branch at 90-degree (wide) angles. This is in contrast to *Aspergillus*, which produces branched, 45-degree (acute angle) septate hyphae.

They cause mucormycosis, which is a serious fungal infection that loves to infect the sinuses, eyes, and brain, causing blindness and death. Infected tissue can appear black.

Immunocompromised patients and those with **uncontrolled diabetes** are at greatest risk.

USMLE can say a 9-year-old girl has a 4-year history of diabetes + has gangrene of the forehead and sinuses + light microscopy shows 90-degree hyphae → answer = “mucormycosis” as the diagnosis, or “*Rhizopus*” as one of the causal fungi, or “amphotericin B” as the treatment.

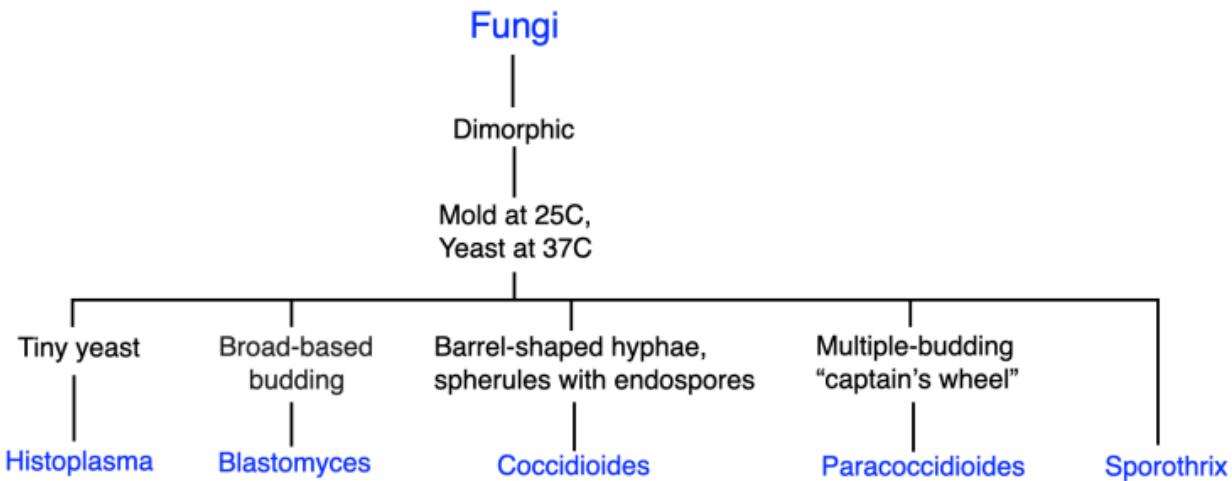
Aspergillus

Forms 45-degree, branched, septate hyphae.

Causes Aspergilloma (“fungus ball”), which can present as a nodular density on chest x-ray, especially in those with history of TB. The latter can leave cavities within the lung that *Aspergillus* likes to occupy. NBME Q wants “biopsy and culture of the mass” as the answer for what is most likely to confirm the diagnosis (makes sense).

Acute bronchopulmonary *Aspergillosis* (ABPA) presents as respiratory exacerbation in a patient with asthma or cystic fibrosis who has hypersensitivity to *Aspergillus* antigens. The diagnosis is easy, so the main point is just that you know ABPA “is a thing” / exists. The vignette will say 30-year-old + Hx of asthma + in respiratory distress and low-grade fever + skin test shows strong reactivity to *Aspergillus* antigens.

Aspergillus is also the most common cause of fungal otitis externa. NBME will give a vignette of black necrotic tissue of the ear + simply ask for the diagnosis (i.e., necrotizing otitis externa).



Histoplasma

Known for very small size (2-4 μm); smaller than RBCs.

Found in the Ohio-Mississippi river valley (although not limited to). Associated in particular with **caves** (i.e., spelunking) and **bird droppings** (i.e., person who feeds pigeons in park).

Can cause pulmonary infections that resemble TB.

Disseminated histoplasmosis can cause adrenal insufficiency (you could be aware of it as a rare cause).

Treat simple infections with oral fluconazole. Treat severe/disseminated infections with IV amphotericin B.

Blastomyces

Demonstrates broad-based budding. The B's go together – i.e., **Broad-based budding** for ***Blastomycosis***. This is in contrast to *C. neoformans*, which is **Narrow-based** budding.

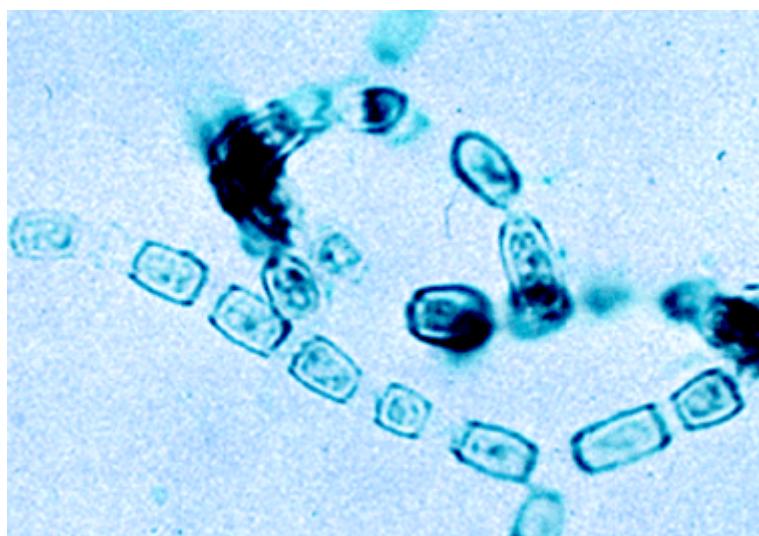
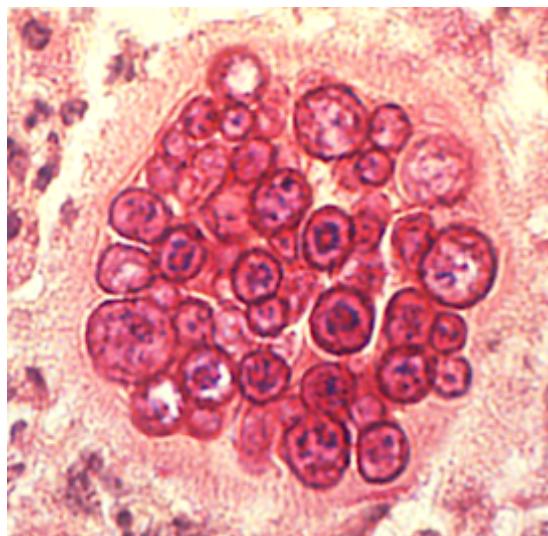
Found in the Ohio-Mississippi river valley (although not limited to). Associated in particular with **decaying wood**.

Likes to cause skin infections, resulting in **ulcerative/necrotic lesions**. Can sometimes present as pneumonia or osteomyelitis.

Treat simple infections with oral fluconazole. Treat severe/disseminated infections with IV amphotericin B.

Coccidioides

Presents usually as uncomplicated fungal pneumonia in patient living in western / south-western United States. Dust is the major risk factor, particularly in the setting of earthquakes (dumb, buzzy event USMLE likes).



Classic textbook descriptor of the histo is “spherules filled with endospores” (left image), although USMLE doesn’t really give a fuck about that. What they will do is show you the barrel-shaped hyphae (right image) in a patient who lives in California + ask you for the diagnosis → answer = *Coccidioides*. I point this out because, if you know the descriptor “spherules filled with endospores,” but then they show you the image on the right, you’re like what the fuck? So it’s to my observation based on the NBMEs that “barrel-shaped hyphae” is more important for Coccidiomycosis.

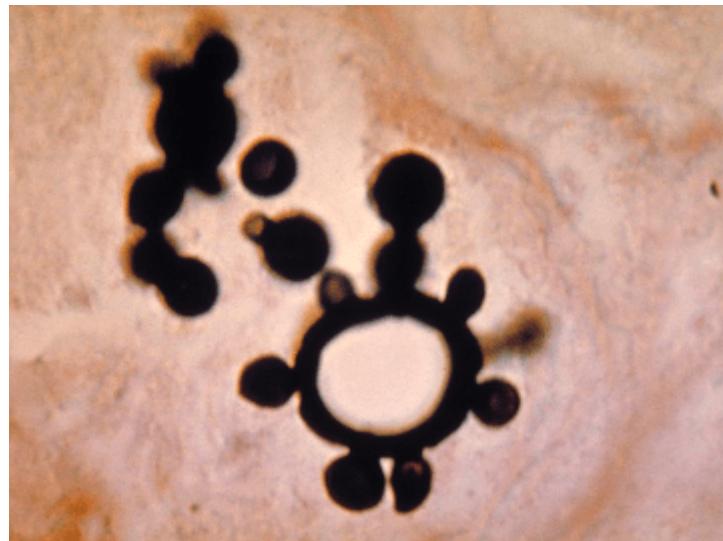
Uncomplicated fungal pneumonia is treated with fluconazole. I believe there’s a UWorld question floating around where they have “no treatment necessary” for simple pneumonia caused by *Coccidioides*, but this is garbage for USMLE. You give the patient fluconazole.

Treat severe/disseminated infections with IV amphotericin B.

Paracoccidioides

Found usually in South America; also in central America. Easy to remember, as the main species is *Paracoccidioides brasiliensis* (i.e., Brazil).

Causes pulmonary infections, ulcerative lesions of the pharynx, and skin infections.

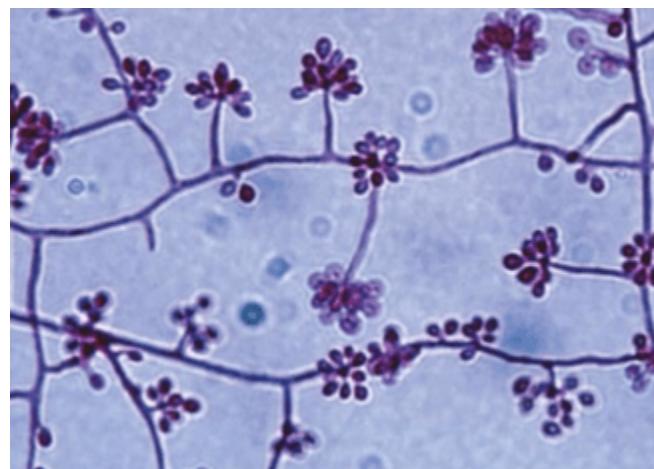


Forms a distinctive “captain’s wheel” appearance, which is multiple buds in a radiating pattern from a singular parent cell.

Simple infections are treated with itraconazole. Treat severe/disseminated infections with IV amphotericin B.

Sporothrix schenkii

Causes rosette- or daisy-like clusters of conidiophores (spores).



Classically causes a papule at the finger in gardeners following a prick by a rose thorn. This is extremely buzzy and I'd say only mentioned in about 1/3 of vignettes.

The higher yield point about sporotrichosis is that it causes **lymphangitis** (i.e., lymphocutaneous sporotrichosis), where it ascends to the axilla as either an erythematous streak, or as erythematous ulcerative lesions on the forearm.



What the USMLE will do is show you the above image in guy who was doing house/yard work presents, and then they ask what is causing it (i.e., arteritis, phlebitis, lymphangitis, etc.), and the answer is just lymphangitis.

You should also be aware tangentially that lymphangitis causing the pink streak can also be caused by general trauma and burns (i.e., it is not limited to sporotrichosis). USMLE can give you a guy who burned his hand + show you the image of the pink streak, and the answer is once again just lymphangitis.

Infections are treated with itraconazole.

Lymphocutaneous sporotrichosis.

Sporotrichosis only presents in about a third of vignettes as the stereotypical papule on the finger following a prick by a rose thorn in a gardener. That presentation is too easy.

The higher yield point about sporotrichosis is that it causes **lymphangitis** (i.e., lymphocutaneous sporotrichosis), where it ascends to the axilla as either an erythematous streak, or as erythematous ulcerative lesions on the forearm.



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2. Which agar can many fungi grow on?

Sabouraud agar.

3. 30-year-old + Hx of asthma + in respiratory distress and low-grade fever + skin test shows strong reactivity to *Aspergillus* antigens. Diagnosis?

Acute bronchopulmonary *Aspergillosis* (ABPA) presents as respiratory exacerbation in a patient with asthma or cystic fibrosis who has hypersensitivity to *Aspergillus* antigens. The diagnosis is easy, so the main point is just that you know ABPA “is a thing” / exists. The vignette will say 30-year-old + Hx of asthma + in respiratory distress and low-grade fever + skin test shows strong reactivity to *Aspergillus* antigens.

4. What is the taxonomy/categorization of Mucorales fungi? (i.e., yeast, mold, dimorphic, dermatophytes)?

Mold, multicellular (hyphae) that reproduce via spores, non-septate 90-degree hyphae, mucorales

Mold is fungus that is multicellular (hyphae) and reproduces via spores.

5. 48-year-old IV drug user with a CD4 count of 27 who has ring-enhancing lesion of the brain who is taking HAART and TMP/SMX. Diagnosis?

Primary CNS lymphoma, not Toxo.

TMP/SMX is also the prophylaxis for Toxoplasmosis, although the treatment for Toxo is instead sulfadiazine and pyrimethamine. What USMLE loves to do is give you a patient with a low CD4 count (e.g., 47) who has ring-enhancing lesion of the brain who is taking HAART and TMP/SMX. The diagnosis is primary CNS lymphoma, not Toxo. And the way we know Toxo is wrong is because the patient is on TMP/SMX, which is the prophylaxis for both *Pneumocystis* **and** Toxo. So commencing TMP/SMX at a CD4 count of 200 for PJP is “two birds with one stone” by the time the patient gets to CD4 of 100, which is when Toxo comes in. It’s only patients who aren’t on TMP/SMX by the time they fall to CD4 of 100 who get Toxo.

Malassezia furfur causing tinea versicolor, which is an extremely buzzy and pass-level spot-diagnosis on USMLE. This is a fungal infection of the shoulder blades, back, and upper torso that tends to occur in sub-tropical or tropical areas, where the patient presents with spotty hypopigmentation.

The hypopigmentation is due to fatty acid degradation within the skin, which releases an acidic product by the fungus that inhibits tyrosinase (enzyme necessary for melanin synthesis).

The vignette will give a 24-year-old male who frequently goes surfing in Florida + they show you the buzzy image:



Then the answer is just “topical selenium,” which is extremely HY as the treatment.

7. What does *Cryptococcus neoformans* look like on light microscopy?

Yeast that demonstrates narrow-based budding. The N's go together – i.e., **N**arrow-based budding for *C. neoformans*. This is in contrast to **B**lastomycosis, which is **B**road-based budding.

8. What are the three main ways *Aspergillus* infections present on USMLE?

- 1) Aspergilloma ("fungus ball"), which can present as a nodular density on chest x-ray, especially in those with history of TB. The latter can leave cavities within the lung that *Aspergillus* likes to occupy. NBME Q wants "biopsy and culture of the mass" as the answer for what is most likely to confirm the diagnosis (makes sense).
- 2) Acute bronchopulmonary *Aspergillosis* (ABPA) presents as respiratory exacerbation in a patient with asthma or cystic fibrosis who has hypersensitivity to *Aspergillus* antigens. The diagnosis is easy, so the main point is just that you know ABPA "is a thing" / exists. The vignette will say 30-year-old + Hx of asthma + in respiratory distress and low-grade fever + skin test shows strong reactivity to *Aspergillus* antigens.
- 3) Most common cause of fungal otitis externa. NBME will give a vignette of black necrotic tissue of the ear + simply ask for the diagnosis (i.e., necrotizing otitis externa).

9. How is sporotrichosis treated?

Itraconazole.

10. How does *Blastomyces* appear on light microscopy?

Demonstrates broad-based budding. The B's go together – i.e., **B**road-based budding for **B**lastomycosis. This is in contrast to *C. neoformans*, which is **N**arrow-based budding.

11. What is the taxonomy/categorization of *Aspergillus*? (i.e., yeast, mold, dimorphic, dermatophytes)?

Branched, septate, 45-degree hyphae that reproduce via spores (mold)

12. What kind of infection does *Histoplasma* classically present?

How is it treated?

Can cause pulmonary infections that resemble TB.

Disseminated histoplasmosis can cause adrenal insufficiency (you could be aware of it as a rare cause).

Treat simple infections with oral fluconazole. Treat severe/disseminated infections with IV amphotericin B.

13. What is the taxonomy/categorization of *Malassezia furfur*? (i.e., yeast, mold, dimorphic, dermatophyte)

Yeasts, unicellular, reproduce via budding

Yeast are a single-celled fungi and reproduce through budding. They tend to be round or oval in shape.

14. What is main drug used in the treatment of *Cryptococcal neoformans* meningitis?

What is the MOA of the drug?

Amphotericin B. It is hard-hitting and used for CNS and disseminated fungal infections.

For example, if a patient has a simple fungal pneumonia, he or she might receive oral fluconazole. But if a patient has fungemia with rigors, chills, and high fever (implying serious systemic infection), then amphotericin B is used.

Coccidioides.

Classic textbook descriptor of the histo is “spherules filled with endospores” (left image), although USMLE doesn’t really give a fuck about that. What they will do is show you the barrel-shaped hyphae (right image) in a patient who lives in California + ask you for the diagnosis → answer = *Coccidioides*. I point this out because, if you know the descriptor “spherules filled with endospores,” but then they show you the image on the right, you’re like what the fuck? So it’s to my observation based on the NBMEs that “barrel-shaped hyphae” is more important for *Coccidioidomycosis*.

16. Where is *Blastomyces* typically found, and it is acquired from where?

What kinds of infections does it cause?

How is it treated?

Found in the Ohio-Mississippi river valley (although not limited to). Associated in particular with **decaying wood**.

Likes to cause skin infections, resulting in **ulcerative/necrotic lesions**. Can sometimes present as pneumonia or osteomyelitis.

Treat simple infections with oral fluconazole. Treat severe/disseminated infections with IV amphotericin B.

17. Black necrotic tissue of the ear caused by a fungus. Most likely cause?

Aspergillus is also the most common cause of fungal otitis externa. NBME will give a vignette of black necrotic tissue of the ear + simply ask for the diagnosis (i.e., necrotizing otitis externa).

18. What is the taxonomy/categorization of *Sporothrix*? (i.e., yeast, mold, dimorphic, dermatophyte)

Dimorphic fungi, mold at 25C, yeast at 37C

19. What is the confirmatory test for *Pneumocystis jirovecii* pneumonia?

What do we see?

You can see that catalase (+) vs (-) is how we differentiate the *Staph* vs *Strep*.

Staph aureus

Gram (+) cocci in clusters; catalase (+); coagulase (+).

Grows yellow on culture medium (“golden staph”).

Produces Protein A, which can cleave the Fc region of IgG.

Humans can carry *S. aureus* within the nares (nostrils). If USMLE asks about nosocomial transmission, the answer is “carried within the nares of hospital staff.”

Highest yield points for USMLE is that it causes:

- Acute endocarditis (no previous valve abnormality); usual organism for IV drug users.
- Skin infections (cellulitis, erysipelas, impetigo, abscesses). *S. aureus* eclipses Group A Strep (*Strep pyogenes*) for cellulitis, as well as for both bullous and non-bullous impetigo. Group A Strep eclipses *S. aureus* for erysipelas.
- Mastitis in breastfeeding women.
- Osteomyelitis; most cases are *S. aureus*. In sickle cell, however, there is increased risk of *Salmonella* osteomyelitis.
- Septic arthritis; most cases are *S. aureus*. If vignette explicitly talks about promiscuity or gives cutaneous papules/pustules, the answer is *Gonorrhea* instead.
- Toxic shock syndrome; TSST toxin is a super-antigen that bridges MHC-II on macrophages with T-cell receptor on CD4+ T cells. Once the bridging has occurred, macrophages release cytokines. TNF- α causes hypotension; IL-1 causes fever. Do not confuse this mechanism with endotoxic shock, which is when the lipid A component of lipopolysaccharide (LPS) from gram-negative bacteria binds to CD14 (Toll-like receptor) on macrophages; the macrophages then release cytokines.
- Staphylococcal scalded skin syndrome (SSSS); exfoliative toxin causes a generalized salmon-pink rash and desquamation of palms and soles in neonates.

- Food poisoning due to heat-stable pre-formed toxin in meats or dairy products (i.e., creams, potato salad) that have been sitting at room temperature for a while. Presents as vomiting 1-6 hours after consumption (diarrhea is +/-).
- Pneumonia following influenza infection.
- Bacterial superinfection on scabies lesions.
- Common organism in many immunodeficiency Qs, including leukocyte adhesion deficiency and chronic granulomatous disease (NADPH oxidase deficiency).

HY points about treating *S. aureus*:

90% of community *Staph* (i.e., methicillin-sensitive *S. aureus*; MSSA) produces beta-lactamase. This means penicillin, amoxicillin, or ampicillin alone will usually not work and are wrong treatments. Oral amoxicillin combined with clavulanate (Augmentin), or IV ampicillin combined with sulbactam, serve the purpose of covering *S. aureus*, since clavulanate and sulbactam are beta-lactamase inhibitors, but giving amoxicillin or ampicillin *alone* should be considered inadequate for covering *Staph*.

What this means is, when we treat *S. aureus*, we want to give a methicillin-class beta-lactam, since these are heavily steric and are beta-lactamase resistant. Methicillin isn't given clinically because it causes interstitial nephritis (eosinophils in the urine + rash), but oral dicloxicillin (not doxycycline) and IV flucloxacillin are frequently given, since these cover *Staph*.

So for skin, we can give oral dicloxacillin or cephalexin out-patient, or IV flucloxacillin or cephazolin in-patient, as these will cover *S. aureus* in addition to Group A Strep.

First-generation cephalosporins, such as cephalexin and cephazolin, are also beta-lactamase resistant and are the same as the methicillin-class beta-lactams for all intents and purposes.

For impetigo only, USMLE likes topical mupirocin, but for oral meds, use as per above.

The only other methicillin-class beta-lactam you need to know for USMLE is nafcillin, which is hard-hitting and used for confirmed MSSA endocarditis. It is also known to cause interstitial nephritis.

I've seen this on NBME. Other agents like cloxacillin, oxacillin, etc., I've never seen show up on NBME, but students get fanatical about listing off different drugs.

For USMLE, they might ask you why *Staph* is resistant to amoxicillin but not to cephalexin; the answer is “production of penicillinase,” or “production of beta-lactamase,” as we said.

If they ask how MSSA → MRSA, the answer is “altered penicillin-binding protein.” We know “production of beta-lactamase” is wrong here because MSSA *already produces beta-lactamase*, so clearly that mechanism can’t be the reason why it can become MRSA.

MRSA endocarditis is treated with vancomycin. Vancomycin, however, has poor skin penetration, so if a cutaneous infection is caused by MRSA, we treat that with clindamycin, doxycycline, or trimethoprim-sulfamethoxazole. You do not need to memorize these latter three treatments and USMLE won’t ask. I’m just saying as a medicine 301-level tangential point that vancomycin isn’t used for MRSA skin infections. But it’s pass-level you know that MRSA endocarditis is treated with vancomycin.

Empiric Tx for endocarditis is vancomycin (covers gram-positives, including MRSA) and gentamicin (covers gram-negatives). There are other regimens, but you should know that one. Do blood cultures before antibiotics (asked on 2CK NBME).

Staph epidermidis

Normal skin flora.

Can cause infections of prostheses, including heart valves and joint replacements.

Vancomycin + gentamicin is the normal empiric Tx for endocarditis. If the patient has prosthetic material in the heart, add rifampin.

Staph saprophyticus

Can cause UTIs leading to staghorn calculi (aka struvite, or ammonium magnesium phosphate stones), which resemble rams horns.

This is because it is urease (+), and struvite stones form at high pH.

Points about hemolysis types:

Group A and B Strep both refer to β -hemolytic Strep (i.e., Group A and B Streps do *not* equal α - vs β -hemolytic, respectively).

β -hemolysis means complete hemolysis (clear zone of hemolysis on blood agar).

α -hemolysis means partial hemolysis (green zone of hemolysis on blood agar).

γ -hemolysis means no hemolysis (no change on blood agar).

Strep pyogenes (Group A Strep)

Gram-positive cocci in chains.

Infections cause elevation of anti-streptolysin titers.

Causes *Strep* pharyngitis, scarlet fever (strawberry tongue + salmon pink body rash [due to erythrogenic toxin]), and skin infections (cellulitis, erysipelas, impetigo).

Post-streptococcal glomerulonephritis (PSGN) is a type-III hypersensitivity (immune complex deposition) that can occur following both pharyngitis as well as cutaneous infections (i.e., it is not just caused by pharyngitis). It presents as red urine (hematuria) 1-3 weeks following the infection. This is not to be confused with IgA nephropathy, which is red urine 1-3 days (not weeks) following a viral infection. In PSGN, serum complement protein C3 will be decreased.

Rheumatic heart disease is a type-II hypersensitivity that only occurs following pharyngitis. The immune system makes antibodies against the M-protein of *S. pyogenes* that cross-reacts (molecular mimicry) with the mitral valve (on USMLE, RHD will be mitral 29/30 times). Penicillin must be given to treat *Strep* pharyngitis to prevent rheumatic heart disease. However, penicillin will not prevent PSGN. In RHD, the patient will have mitral regurg acutely, followed by mitral stenosis years later after the valve scars over. 99% of mitral stenoses are due to history of RHD.

Pediatric Autoimmune Neuropsychiatric Disorder Associated with Streptococci (PANDAS) is a psych condition asked on USMLE, where a child can develop a tic, ADHD, or OCD following a *Strep pyogenes* infection.

S. pyogenes can cause toxic shock-like syndrome due to exotoxin A production, where the vignette can give cellulitis + shock, and the answer is just “MHC-II and TCR” as the

immunologic receptors bound. In other words, TSST toxin of *S. aureus*, as well as exotoxin A of *S. pyogenes*, both can cause shock via the same mechanism.

Strep agalactiae (Group B Strep)

Gram-positive cocci in chains.

Causes neonatal meningitis, pneumonia, and sepsis.

Rectovaginal swabs performed in pregnant women at 36 weeks' gestation to determine whether intrapartum IV penicillin or ampicillin prophylaxis is given.

For 2CK/3, indications for GBS prophylaxis:

- Positive swab at 36 weeks' gestation.
- GBS bacteriuria at any point in the current pregnancy, even if successfully treated.
- Hx of prior pregnancy where there was early-onset GBS disease in the neonate (i.e., meningitis, pneumonia, or sepsis). *Mere colonization* (i.e., mere positive test) in a prior pregnancy is *not* an indication for giving prophylaxis in current pregnancy.
- If the mother's GBS status is unknown at parturition, give prophylaxis if any one of the following met: 1) maternal fever >38C; 2) rupture of membranes >18 hours; 3) premature delivery (<37 weeks).

Neonatal infections on USMLE will be caused by GBS, *Listeria*, or *E. coli*. If they say a neonate has an infection caused by gram-positive cocci, the answer is GBS; if they say gram-positive rods, that's *Listeria*; if they say gram-negative rods, that's *E. coli*.

Enterococcus

Gram-positive cocci in chains.

Normal flora within the gastrointestinal and urinary tracts.

The answer on USMLE for endocarditis following genitourinary manipulation (e.g., catheterization or TURP for BPH).

Treated with ampicillin. If resistant to ampicillin, we treat with vancomycin. If resistant to vancomycin (VRE; vancomycin-resistant enterococci), drugs such as linezolid or daptomycin can be used. USMLE will not assess the latter two treatments for VRE. The important point is that you are merely aware VRE is an important nosocomial pathogen, same as MRSA.

Strep gallolyticus / Strep infantarius

Formerly known as Strep bovis, but USMLE is old school, so it is not a guarantee the nomenclature has changed on the exam.

Can cause endocarditis in the setting of colon cancer.

Strep pneumoniae

Gram-positive diplococci (don't confuse with *Neisseria gonorrhoea* and *meningitidis*, which are gram-negative diplococci).

Most common cause of lobar pneumonia and otitis media.

Can also cause meningitis and sinusitis.

Ultra-HY as cause of sepsis in asplenia and sickle cell (auto-splenectomy).

USMLE might give chest infection in a teenager or young adult, where they say there's right lower lobe dullness to percussion. You know that's *S. pneumo*. If they give bilateral interstitial infiltrates, that is most likely *Mycoplasma*. Pneumonia discussion is lengthy.

You don't want to memorize *S. pneumo* as the "most common" organism for meningitis because USMLE wants you to differentiate it from *Neisseria meningitidis* (meningococcus). If they give college dormitories, military barracks, or close quarters, this suggests *N. meningitidis* over *S. pneumo*. In addition, *N. meningitidis* causes non-blanching rash (i.e., does not turn white when pressed); this can refer to purpura or ecchymoses. If they mention a rash, the answer is meningococcus, not *S. pneumo*. Meningococcus also can cause Waterhouse-Friderichsen syndrome (bilateral hemorrhagic necrosis of the adrenal cortices, leading to hypotension non-responsive to norepinephrine).

Empiric Tx for community-acquired pneumonia (CAP) is azithromycin on USMLE.

USMLE doesn't assess levofloxacin (respiratory fluoroquinolone) for pneumonia Tx, but you could be aware that patients who've had antibiotics in the past 3 months, or who have significant comorbidities, sometimes they are upgraded to a respiratory fluoroquinolone. But offline NBME 8 for 2CK has azithromycin straight-up as the answer.

For CAP where the patient is septic, ceftriaxone +/- vancomycin is given. Ceftriaxone is powerful and effective against *S. pneumo*. Some strains are developing resistance, so vancomycin can be added (asked on one 2CK Q).

Meningitis empiric Tx is ceftriaxone + vancomycin. In elderly, ampicillin can be added.

Empiric Tx for otitis media is penicillin or amoxicillin. *Recurrent* otitis media, however, we can add clavulanate (Augmentin). But initially, we just give amoxicillin or penicillin alone for otitis media.

Empiric Tx for sinusitis is amoxicillin/clavulanate (Augmentin). This is because sinusitis can be caused by other organisms as well, including *S. aureus*, so we need expanded coverage straight-up.

Patients with asplenia / sickle cell have increased risk of infections due to encapsulated organisms. This namely refers to *S. pneumo*, *H. influenzae* type B, and *N. meningitidis*, which all have polysaccharide capsules. This is because encapsulated organisms require opsonization (with C3b or IgG) and phagocytosis for clearance, and the spleen is where we have 50% of the immune system's reservoir of macrophages. So if we lose the spleen, we lose substantial phagocytic capacity. Patients must receive additional rounds of vaccination against these three organisms.

If USMLE asks which organism we are most worried about when we give penicillin prophylaxis to sickle cell patients (or any asplenia patient for that matter), the answer is *S. pneumo*. Choose this answer over *H. influenzae* type B and *N. meningitidis*, even though, yes, the latter two are clearly important to cover as well.

For 2CK, we vaccinate against *S. pneumo* by giving PCV20 alone, OR by giving PCV15 + PPSV23 months later. I talk about this stuff in detail in my HY Pulmonary PDF.

Strep viridans (Strep mitis, mutans, sanguinis)

Cause subacute endocarditis (i.e., patient has previous valve abnormality, such as from history of rheumatic heart disease, or bicuspid aortic valve), classically following a dental procedure; can create limit-dextrins, which are carbohydrate structures that can adhere to heart valves.

1. What is the mechanism of toxic shock syndrome versus endotoxic shock?

TSST toxin is a super-antigen that bridges MHC-II on macrophages with T-cell receptor on CD4+ T cells. Once the bridging has occurred, macrophages release cytokines. TNF- α causes hypotension; IL-1 causes fever.

Do not confuse this mechanism with endotoxic shock, which is when the lipid A component of lipopolysaccharide (LPS) from gram-negative bacteria binds to CD14 (Toll-like receptor) on macrophages; the macrophages then release cytokines.

2. What is PANDAS?

Pediatric Autoimmune Neuropsychiatric Disorder Associated with Streptococci (PANDAS) is a psych condition asked on USMLE, where a child can develop a tic, ADHD, or OCD following a *Strep pyogenes* infection.

. What is the categorization of *Strep viridans* (*mitis*, *mutans*, *sanguinis*)?

Gram (+) bacteria, cocci, catalase (-), alpha-hemolytic, green hemolysis on blood agar, optochin resistant

4. Which bacterium classically can cause bacterial superinfection on scabies lesions? *S. aureus*.

5. What is the categorization of *Strep agalactiae*?

Gram (+) cocci, catalase (-), beta-hemolytic, clear hemolysis on blood agar, bacitracin resistant

6. Which organisms are gram (+) cocci in clusters vs gram (+) diplococci?

(Give one organism each)

S. aureus is gram (+) cocci in clusters.

Strep pneumo is gram (+) diplococci.

The other Strep (i.e., pyogenes, agalactiae, viridans) are gram (+) cocci in chains.
Enterococci is also gram (+) cocci in chains.

7. What is bacitracin used for?

Distinguishes *S. pyogenes* (Group A Strep) from *S. agalactiae* (Group B Strep).

8. What is the categorization of *S. epidermidis*?

Gram (+) cocci, catalase (+), coagulase (-), novobiocin sensitive

9. What is the mechanism via which *Strep pyogenes* can cause shock (e.g., in the setting of cellulitis)?

S. pyogenes can cause toxic shock-like syndrome due to exotoxin A production, where the vignette can give cellulitis + shock, and the answer is just “MHC-II and TCR” as the immunologic receptors bound. In other words, TSST toxin of *S. aureus*, as well as exotoxin A of *S. pyogenes*, both can cause shock via the same mechanism.

10. What is protein A?

Protein produced by *S. aureus* that cleaves the Fc region of IgG.

11. What is most common cause of osteomyelitis? What about in sickle cell?

Most cases are *S. aureus*. In sickle cell, however, there is increased risk of *Salmonella* osteomyelitis.

12. How is *S. aureus* transmitted in hospital?

Humans can carry *S. aureus* within the nares (nostrils). If USMLE asks about nosocomial transmission, the answer is “carried within the nares of hospital staff.”

13. What is the categorization of *S. aureus*?

Gram (+) bacteria, cocci, catalase (+), coagulase (+)

14. What type of infection does *Staph saprophyticus* cause?

Can cause UTIs leading to staghorn calculi (aka struvite, or ammonium magnesium phosphate stones), which resemble rams horns.

This is because it is urease (+), and struvite stones form at high pH.

15. What is the categorization of *S. saprophyticus*?

Gram (+) bacteria, cocci, catalase (+), coagulase (-), novobiocin resistant

16. How is *Enterococcus* treated?

Treated with ampicillin. If resistant to ampicillin, we treat with vancomycin. If resistant to vancomycin (VRE; vancomycin-resistant enterococci), drugs such as linezolid or daptomycin can be used. USMLE will not assess the latter two treatments for VRE. The important point is that you are merely aware VRE is an important nosocomial pathogen, same as MRSA.

17. When is *Enterococcus* the answer for endocarditis?

The answer on USMLE for endocarditis following genitourinary manipulation (e.g., catheterization or TURP for BPH).

18. What is empiric Tx for meningitis?

Meningitis empiric Tx is ceftriaxone + vancomycin. In elderly, ampicillin can be added.

19. What color is *S. aureus* when it grows?

Yellow (“golden staph”).

USMLE Q can mention “yellow crusties” as impetigo, as an example.

20. What is most common cause of septic arthritis?

Most cases are *S. aureus*. If vignette explicitly talks about promiscuity or gives cutaneous papules/pustules, the answer is *Gonorrhea* instead.

21. What is the mechanism via which MSSA → MRSA?

If they ask how MSSA → MRSA, the answer is “altered penicillin-binding protein.”

We know “production of beta-lactamase” is wrong here because MSSA *already produces beta-lactamase*, so clearly that mechanism can't be the reason why it can become MRSA.

90% of community *Staph* (i.e., methicillin-sensitive *S. aureus*; MSSA) produces beta-lactamase.

22. What is the mechanism for rheumatic heart disease?

What kind of hypersensitivity is it?

How is it treated?

Rheumatic heart disease is a type-II hypersensitivity that only occurs following pharyngitis. The immune system makes antibodies against the M-protein of *S. pyogenes* that cross-reacts (molecular mimicry) with the mitral valve (on USMLE, RHD will be mitral 29/30 times).

Penicillin must be given to treat *Strep* pharyngitis to prevent rheumatic heart disease. However, penicillin will not prevent PSGN.

In RHD, the patient will have mitral regurg acutely, followed by mitral stenosis years later after the valve scars over. 99% of mitral stenoses are due to history of RHD.

23. What is the most common cause of mastitis in breastfeeding women?

How is it treated?

S. aureus.

Give oral dicloxacillin (not doxycycline). This is assessed directly on a 2CK form (if you're studying for Step 1, just know it. Relax.).

Also, continue breastfeeding through the affected breast. This detail USMLE cares about for some reason.

24. What is the categorization of *Enterococci*?

Gram (+) bacteria, cocci, catalase (+), gamma hemolytic, no hemolysis on blood agar, yes, grows in 6.5% NaCl

25. What does α, β, and γ hemolysis mean?

α-hemolysis means partial hemolysis (green zone of hemolysis on blood agar).

β-hemolysis means complete hemolysis (clear zone of hemolysis on blood agar).

γ-hemolysis means no hemolysis (no change on blood agar).

26. What is the categorization of *Strep pneumoniae*?

Gram (+) bacteria, cocci, catalase (-), alpha hemolytic, green hemolysis on blood agar, optochin sensitive

27. When is *Strep bovis* the answer?

Strep gallolyticus/infantarius (formerly known as *Strep bovis*) can cause endocarditis in the setting of colon cancer.

28. What is the empiric Tx for endocarditis?

Empiric Tx for endocarditis is vancomycin (covers gram-positives, including MRSA) and gentamicin (covers gram-negatives). There are other regimens, but you should know that one. Do blood cultures before antibiotics.

29. How do we treat impetigo?

Topical mupirocin.

30. What is acute vs subacute endocarditis? And which main organisms cause both?

Acute → no previous valve abnormality; usual organism for IV drug users. Caused by *S. aureus*.

Subacute endocarditis (i.e., patient has previous valve abnormality, such as from history of rheumatic heart disease, or bicuspid aortic valve), classically following a dental procedure. Caused by *Strep viridans* (aka *Strep mitis, mutans, sanguinis*).

31. What is scarlet fever?

What causes it?

How is it treated?

Strawberry tongue + salmon pink body rash due to erythrogenic toxin of *Strep pyogenes*.

Treat with penicillin.

32. What is the most common cause of lobar pneumonia and otitis media?

Strep pneumoniae.

Gram-positive diplococci (don't confuse with *Neisseria gonorrhoea* and *meningitidis*, which are gram-negative diplococci).

33. What's the empiric Tx for community-acquired pneumonia (CAP) on USMLE?

Empiric Tx for community-acquired pneumonia (CAP) is azithromycin on USMLE.

USMLE doesn't assess levofloxacin (respiratory fluoroquinolone) for pneumonia Tx, but you could be aware that patients who've had antibiotics in the past 3 months, or who have significant comorbidities, sometimes they are upgraded to a respiratory fluoroquinolone. But offline NBME has azithromycin straight-up as the answer.

For CAP where the patient is septic, ceftriaxone +/- vancomycin is given. Ceftriaxone is powerful and effective against *S. pneumo*. Some strains are developing resistance, so vancomycin can be added (asked on one 2CK Q).

34. How does post-streptococcal glomerulonephritis present?

What kind of hypersensitivity is it?

Post-streptococcal glomerulonephritis (PSGN) is a type-III hypersensitivity (immune complex deposition) that can occur following both *Strep pyogenes* pharyngitis as well as cutaneous infections (i.e., it is not just caused by pharyngitis).

It presents as red urine (hematuria) 1-3 weeks following the infection.

This is not to be confused with IgA nephropathy, which is red urine 1-3 days (not weeks) following a viral infection.

In PSGN, serum complement protein C3 will be decreased.

35. What is an important cause of bacterial pneumonia following recovery from influenza viral illness?

S. aureus.

Can cause bacterial pneumonia following influenza infection.

36. What does *Strep viridans* cause?

Cause subacute endocarditis (i.e., patient has previous valve abnormality, such as from history of rheumatic heart disease, or bicuspid aortic valve), classically following a dental procedure; can create lecithin-dextrins, which are carbohydrate structures that can adhere to heart valves.

37. What is empiric Tx for otitis media and sinusitis?

Empiric Tx for otitis media is penicillin or amoxicillin. *Recurrent* otitis media, however, we can add clavulanate (Augmentin). But initially, we just give amoxicillin or penicillin alone for otitis media.

Empiric Tx for sinusitis is amoxicillin/clavulanate (Augmentin). This is because sinusitis can be caused by other organisms as well, including *S. aureus*, so we need expanded coverage straight-up.

38. What is the categorization of *Strep bovis* (*Strep gallolyticus* / *Strep infantarius*)?

Gram (+) bacteria, cocci, catalase (-), gamma hemolytic, no hemolysis on blood agar, no growth in 6.5% NaCl

39. What are the three organisms most commonly associated with neonatal infections (i.e., sepsis, meningitis, pneumonia)?

Neonatal infections on USMLE will be caused by GBS, *Listeria*, or *E. coli*.

If they say a neonate has an infection caused by gram-positive cocci, the answer is GBS.

If they say gram-positive rods, that's *Listeria*.

If they say gram-negative rods, that's *E. coli*.

40. Which vaccines do asplenia and sickle cell patients need? And why?

Patients with asplenia / sickle cell have increased risk of infections due to encapsulated organisms. This namely refers to *S. pneumo*, *H. influenzae* type B, and *N. meningitidis*, which all have polysaccharide capsules. This is because encapsulated organisms require opsonization (with C3b or IgG) and phagocytosis for clearance, and the spleen is where we have 50% of the immune system's reservoir of macrophages. So if we lose the spleen, we lose substantial phagocytic capacity. Patients must receive additional rounds of vaccination against these three organisms.

If USMLE asks which organism we are most worried about when we give penicillin prophylaxis to sickle cell patients (or any asplenia patient for that matter), the answer is *S. pneumo*. Choose this answer over *H. influenzae* type B and *N. meningitidis*, even though, yes, the latter two are clearly important to cover as well.

For 2CK, we vaccinate against *S. pneumo* by giving PCV20 alone, OR by giving PCV15 + PPSV23 months later. I talk about this stuff in detail in my HY Pulmonary PDF.

41. What is the categorization of *Strep pyogenes*?

Gram (+) cocci, catalase (-), beta hemolytic, clear hemolysis on blood agar, bacitracin sensitive

42. What is optochin used for?

Distinguishes *S. pneumo* from *S. viridans*.

43. How do we treat *S. aureus* skin infections? And why.

90% of community *Staph* (i.e., methicillin-sensitive *S. aureus*; MSSA) produces beta-lactamase. This means penicillin, amoxicillin, or ampicillin alone will usually not work and are wrong treatments. Oral amoxicillin combined with clavulanate (Augmentin), or IV ampicillin combined with sulbactam, serve the purpose of covering *S. aureus*, since clavulanate and sulbactam are beta-lactamase inhibitors, but giving amoxicillin or ampicillin *alone* should be considered inadequate for covering *Staph*.

What this means is, when we treat *S. aureus*, we want to give a methicillin-class beta-lactam, since these are heavily steric and are beta-lactamase resistant. Methicillin isn't given clinically because it causes interstitial nephritis (eosinophils in the urine + rash), but oral dicloxicillin (not doxycycline) and IV flucloxacillin are frequently given, since these cover *Staph*.

So for skin, we can give oral dicloxacillin or cephalexin out-patient, or IV flucloxacillin or cephazolin in-patient, as these will cover *S. aureus* in addition to Group A Strep.

First-generation cephalosporins, such as cephalexin and cephazolin, are also beta-lactamase resistant and are the same as the methicillin-class beta-lactams for all intents and purposes.

For impetigo only, USMLE likes topical mupirocin, but for oral meds, use as per above. The only other methicillin-class beta-lactam you need to know for USMLE is nafcillin, which is hard-hitting and used for confirmed MSSA endocarditis. It is also known to cause interstitial nephritis. I've seen this on NBME. Other agents like cloxacillin, oxacillin, etc., I've never seen show up on NBME, but students get fanatical about listing off different drugs.

For USMLE, they might ask you why *Staph* is resistant to amoxicillin but not to cephalexin; the answer is "production of penicillinase," or "production of beta-lactamase," as we said.

44. What is novobiocin used for?

Distinguishes *S. epidermidis* from *S. saprophyticus*.

45. How does food poisoning caused by *S. aureus* present?

How does one acquire it (i.e., what foods, etc.)?

Food poisoning due to heat-stable pre-formed toxin in meats or dairy products (i.e., creams, potato salad) that have been sitting at room temperature for a while.

Presents as **vomiting** 1-6 hours after consumption (diarrhea is +/-).

46. What is the mechanism of Staphylococcal scalded skin syndrome?

Who gets it?

How does it present?

Staphylococcal scalded skin syndrome (SSSS) is caused by *S. aureus* exfoliative toxin.

Seen in neonates.

Causes a generalized salmon-pink rash and desquamation of palms and soles.

47. What kind of infections does *Staph epidermidis* cause?

Normal skin flora.

Can cause infections of prostheses, including heart valves and joint replacements.

Vancomycin + gentamicin is the normal empiric Tx for endocarditis. If the patient has prosthetic material in the heart, add rifampin.

48. What are the most common organisms causing cellulitis, erysipelas, and impetigo?

How are they treated?

S. aureus eclipses Group A Strep (*Strep pyogenes*) for cellulitis, as well as for both bullous and non-bullous impetigo. Group A Strep eclipses *S. aureus* for erysipelas. For skin, we can give oral dicloxacillin or cephalexin out-patient, or IV flucloxacillin or cephazolin in-patient, as these will cover *S. aureus* in addition to Group A Strep. First-generation cephalosporins, such as cephalexin and cephazolin, are also beta-lactamase resistant and are the same as the methicillin-class beta-lactams for all intents and purposes.

For impetigo only, USMLE likes topical mupirocin, but for oral meds, use as per above.

Bacillus cereus

Causes vomiting and diarrhea following consumption of reheated rice / fried rice due to germination of spores.

Can also cause eye infections post-surgery (e.g., for cataracts). What the USMLE will do is tell you a patient had recent eye surgery + now has an infection caused by a gram-positive rod, where *B. cereus* is the only gram-positive rod listed. This is how you can arrive at the answer (i.e., if you know the taxonomy), even if you haven't heard of *B. cereus* causing an eye infection before.

Bacillus anthracis

Causes pulmonary and cutaneous anthrax.

Pulmonary anthrax will be a hemorrhagic mediastinitis. Cutaneous anthrax presents as a **black eschar with surrounding edema**.

Anthrax produces edema factor, which functions as an adenylate cyclase enzyme, thereby increasing cAMP.

USMLE will usually mention the patient is a postal worker. They are very buzzy this way, and I've seen this on NBME.

Anthrax is aka "wool-sorter disease," because its spores can survive on the dry hides of farm animals due to their protein structure. Anthrax is the only organism with a protein capsule (poly-D-glutamic acid).

Clostridium tetani

Causes spastic paralysis.

Tetanus toxin of *Clostridium tetani* inhibits presynaptic SNARE protein, resulting in decreased release of presynaptic neurotransmitters GABA and glycine, which are normally inhibitory.

Can present as opisthotonus (arched back) and trismus (lock-jaw).

Presents in two patients on USMLE: 1) neonate born at home whose umbilical cord was cut with a kitchen knife + tied with twine; 2) random dude who cut himself in back yard.

DTaP given at 2, 4, 6, months, then again at 15-18 months, then again at 4-6 years.

School-age kids require booster at 11-12 years, followed by booster every 10 years thereafter.

Pregnant women should get DTaP at 27-36 weeks to protect neonate from pertussis.

For cuts/wounds post-vaccine:

- 0-5 years post-vaccine: no Tx is necessary.
- 6-9 years post-vaccine: if clean wound: no Tx; if dirty wound: give Td booster.
- 10+ years post-vaccine: if clean wound: give Td booster; if dirty wound: IVIG + vaccine.
- In other words, only ever give IVIG if it's a dirty wound + has been 10+ years.

Tetanus is a toxoid vaccine (inactivated toxin/protein).

Clostridium botulinum

Causes flaccid paralysis.

Botulin toxin of *Clostridium botulinum* inhibits presynaptic SNARE protein, resulting in decreased release of presynaptic acetylcholine, which is normally stimulatory at muscles.

Can present as floppy baby syndrome; can also cause cranial nerve palsies.

USMLE can be weird about the answer, where I've seen them write on an NBME exam something along the lines of "prevents acetylcholine from binding to its receptor" as the MOA of the toxin, even though this isn't technically the direct effect.

Acquired as spores in honey in infants under 1; acquired as pre-formed toxin from canned goods in anyone older.

NBME exam wants you to know that administering the toxin does not change the effect of strength of the effect of acetylcholine binding to its receptor. This is because the toxin isn't a competitive inhibitor + only decreases endogenous ACh release; this has no impact on any ACh administered exogenously.

Clostridium difficile

Diarrhea (pseudomembranous colitis) ~7-10 days after commencing oral antibiotics.

Antibiotics kill off normal bowel flora, allowing *C. difficile* to overgrow.

C. difficile is not normal flora, however. It is acquired via **consumption of spores**.

USMLE doesn't care about which antibiotics per se cause pseudomembranous colitis; you just need to know any antibiotics in general can technically cause it if the patient has been inoculated with spores prior. But you could be aware that clindamycin is a classic agent known to increase risk, since it is a very powerful agent that essentially deletes your GI flora, leaving *C. diff* without competition for growth.

Can be watery or bloody diarrhea on NBME. Can also cause LLQ cramping (not RLQ as with *Yersinia*, which causes pseudo-appendicitis).

There is NBME Q where they say 28-year-old with LLQ cramping and bloody diarrhea 7 days after starting oral antibiotics → answer = *C. diff*; wrong answer is *Yersinia*.

Diagnose with **stool AB toxin test; stool culture is wrong answer**.

If toxin test is already performed, if they ask how to further confirm the diagnosis, the answer is colonoscopy.

Never perform colonoscopy if a patient has toxic megacolon (which is possible with *C. diff*). Toxic megacolon will present as fever and distended abdomen, often with SIRS vitals (means abnormal vitals). Do abdominal x-ray to diagnose toxic megacolon.

Treat with **oral vancomycin**.

Vancomycin has poor oral bioavailability, so is given IV for things like endocarditis and meningitis. But for *C. diff* infection, *that's a good thing* because we want it to stay within the GI tract. If USMLE asks why vancomycin is given orally for *C. diff*, the answer can be something like "has poor oral bioavailability," which on the surface sounds like a bad thing when reading answer choices, but as I already said, this is favorable when we are treating *C. diff*.

Other fancy Abx like fidaxomicin, rifaximin, etc., I've never seen on NBME.

Clostridium perfringens

Causes watery/secretory diarrhea following consumption of **poultry**.

Causes gas gangrene (CO₂ gas) due to production of α-toxin/phospholipase; presents as black skin / **crepitus** (subcutaneous emphysema).

Can also cause emphysematous cholecystitis (air in gall bladder wall).

C. perfringens is known to be associated with necrotizing fasciitis, which is deep infection along fascial planes. I reiterate that crepitus is HY. If the question specifically tells you that there is no crepitus + the infection started from some sort of scratch or puncture wound, the answer will be Group A Strep or *S. aureus* instead.

Listeria monocytogenes

Can be described as gram-positive rod with tumbling motility.

Can grow at very low temperatures (i.e., 0-4 degrees C).

USMLE will say neonate who has pneumonia, meningitis, or sepsis caused by gram-positive rod (if gram-positive coccus, that's GBS; if gram-negative rod, that's *E. coli*).

Can be acquired by pregnant women via deli meats and soft cheeses.

Can cause some obscure condition called granulomatosis infantiseptica, which presents as black skin lesions in the neonate.

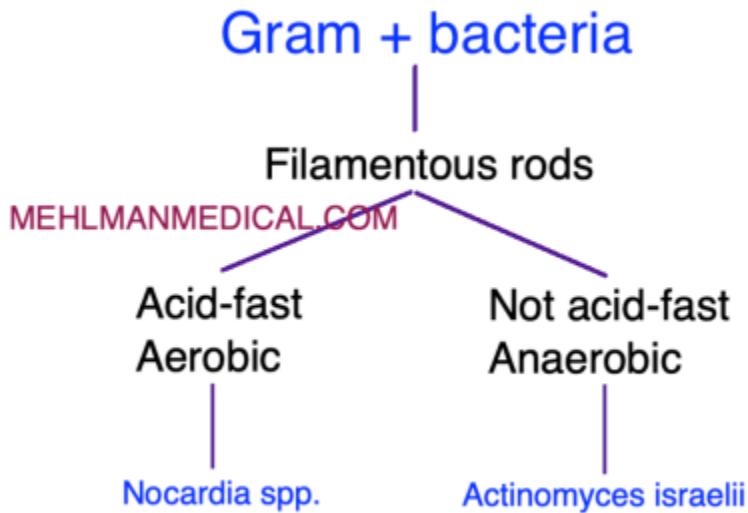
Corynebacterium diphtheriae

Causes diphtheria, which presents in unvaccinated or immigrant children as a grey pseudomembrane in the posterior oropharynx. I've seen this grey pseudomembrane detail show up in one Q that wasn't diphtheria, but the association is 9/10 times diphtheria.

Can cause myocarditis if untreated.

Diphtheria toxin inhibits **protein translation** by inhibiting elongation factor 2 (EF2).

Vaccine is a toxoid (inactive toxin).



Nocardia

Weakly acid-fast on staining; aerobic.

Can cause pulmonary infection resembling TB.

Can occasionally cause disseminated disease leading to osteomyelitis and meningitis.

SNAP → Sulfonamides for *Nocardia*; *Actinomyces* use Penicillin.

Actinomyces

Not acid-fast; anaerobic.

Causes formation of yellow sulfur granules.

Causes draining sinus tracts in the oral cavity.

SNAP → Sulfonamides for *Nocardia*; *Actinomyces* use Penicillin.

Question 1

What two presentations will *Bacillus cereus* cause on USMLE?

- **Answer:**
 - Vomiting and diarrhea following consumption of reheated rice/fried rice due to germination of spores.
 - Eye infections post-surgery (e.g., cataract surgery).
-

Question 2

What is the taxonomy/categorization of *Bacillus cereus*?

- **Answer:** Gram-positive rod.
-

Question 3

What is the taxonomy/categorization of *Nocardia*?

- **Answer:** Weakly acid-fast, aerobic, gram-positive filamentous rod.
-

Question 4

What are the two classic presentations for tetanus on USMLE?

- **Answer:**
 - Neonate born at home with umbilical cord cut with a kitchen knife and tied with twine.
 - A person who cut themselves in the backyard.
 - Presents as opisthotonus (arched back) and trismus (lockjaw).
-

Question 5

What does *Clostridium difficile* cause, and how is it acquired?

- **Answer:**

- Causes diarrhea (pseudomembranous colitis) ~7-10 days after starting antibiotics.
 - Acquired via consumption of spores.
-

Question 6

If someone has botulism, what effect will administering exogenous acetylcholine have?

- **Answer:** No change, as botulin toxin only decreases endogenous acetylcholine release and does not affect exogenous acetylcholine.
-

Question 7

How do we manage giving someone tetanus vaccine versus immunoglobulin in the context of a dirty vs clean wound?

- **Answer:**
 - 0–5 years post-vaccine: no treatment necessary.
 - 6–9 years post-vaccine: Td booster for dirty wound, none for clean wound.
 - 10+ years post-vaccine: Td booster for clean wound; IVIG + vaccine for dirty wound.
-

Question 8

What is the taxonomy/categorization of *Corynebacterium diphtheriae*?

- **Answer:** Gram-positive rod.
-

Question 9

Which bacterium has a poly-D-glutamic acid capsule?

- **Answer:** *Bacillus anthracis*.

Question 10

How is *C. difficile* diagnosed?

- **Answer:** Stool AB toxin test (stool culture is incorrect). Confirm diagnosis with colonoscopy if needed.
-

Question 11

What kind of infections does *Nocardia* cause? How is it treated?

- **Answer:**
 - Causes pulmonary infection resembling TB, osteomyelitis, and meningitis.
 - Treated with sulfonamides (*SNAP*: Sulfonamides for *Nocardia*).
-

Question 12

Which organism is acquired by pregnant women eating deli meats or soft cheeses?

- **Answer:** *Listeria monocytogenes*.
-

Question 13

What is the taxonomy/categorization of *Actinomyces*?

- **Answer:** Gram-positive filamentous rod, anaerobic.
-

Question 14

What is special about the growth of *Listeria monocytogenes*?

- **Answer:** Can grow at very low temperatures (0–4°C).

Question 15

Which gram-positive filamentous organism can present similarly to TB and also cause meningitis and osteomyelitis?

- **Answer:** *Nocardia*.
-

Question 16

What kind of infections does *Actinomyces* cause? How is it treated?

- **Answer:**
 - Causes draining sinus tracts in the oral cavity and yellow sulfur granules.
 - Treated with penicillin (*SNAP*: Penicillin for *Actinomyces*).
-

Question 17

How is *Listeria* acquired? What does it classically cause?

- **Answer:**
 - Acquired by pregnant women eating deli meats or soft cheeses.
 - Causes pneumonia, meningitis, or sepsis in neonates.
-

Question 18

What is the taxonomy/categorization of *Clostridium tetani*?

- **Answer:** Gram-positive rod.
-

Question 19

How is *Clostridium perfringens* acquired? What does it cause?

- **Answer:**
 - Acquired from poultry.
 - Causes watery diarrhea, gas gangrene, and crepitus.
-

Question 20

How is botulin toxin inadvertently acquired?

- **Answer:**
 - As spores in honey for infants under 1 year old.
 - As pre-formed toxin from canned goods for others.
-

Question 21

Which organism causes skin lesions described as a black eschar with surrounding edema?

- **Answer:** *Bacillus anthracis*.
-

Question 22

Which bacterium causes vomiting/diarrhea from eating reheated rice?

- **Answer:** *Bacillus cereus*.
-

Question 23

How does anthrax present? What is special about its structure? What is the mechanism of the toxin?

- **Answer:**
 - Presents as pulmonary anthrax (hemorrhagic mediastinitis) or cutaneous anthrax (black eschar).
 - Has a protein capsule (poly-D-glutamic acid).
 - Toxin increases cAMP via edema factor (adenylate cyclase).

Question 24

What is the taxonomy/categorization of *Listeria monocytogenes*?

- **Answer:** Gram-positive rod.
-

Question 25

What is the taxonomy/categorization of *Clostridium difficile*?

- **Answer:** Gram-positive rod.
-

Question 26

What is the mechanism of botulin toxin? What kind of paralysis does it cause?

- **Answer:**
 - Inhibits presynaptic SNARE protein, decreasing acetylcholine release.
 - Causes flaccid paralysis.
-

Question 27

What is the mechanism of diphtheria toxin?

- **Answer:** Inhibits protein translation by blocking elongation factor 2 (EF2).
-

Question 28

What is the taxonomy/categorization of *Clostridium botulinum*?

- **Answer:** Gram-positive rod.
-

Question 29

Which gram-positive filamentous organism causes draining sinus tracts in the oral cavity and produces yellow sulfur granules?

- Answer: *Actinomyces*.
-

Question 30

How is *C. difficile* treated? And what route is the medication given? Why is it given this route?

- Answer:
 - Treated with oral vancomycin.
 - Given orally due to poor bioavailability, allowing it to act locally in the GI tract.
-

Question 31

What is the mechanism of tetanus toxin? What kind of paralysis does it cause?

- Answer:
 - Inhibits presynaptic SNARE protein, decreasing GABA and glycine release.
 - Causes spastic paralysis.
-

Question 32

What is the taxonomy/categorization of *Bacillus anthracis*?

- Answer: Gram-positive rod.
-

Question 33

What classic presentation does *Corynebacterium diphtheriae* cause?

- **Answer:**
 - Grey pseudomembrane in the posterior oropharynx, usually in unvaccinated children.
 - Can cause myocarditis if untreated.
-

Question 34

Which organism causes crepitus (subcutaneous emphysema)?

- **Answer:** *Clostridium perfringens*.
-

Question 35

What is the taxonomy/categorization of *Clostridium perfringens*?

- **Answer:** Gram-positive rod.

It's pass-level to know that *Neisseria* are gram-negative diplococci. Don't confuse with *Strep pneumo*, which is gram-positive diplococci.

Neisseria meningitidis

The answer on USMLE for cause of meningitis in three groups:

- 1) College-age students living in close quarters or military barracks;
- 2) Child or older who has non-blanching rash (means doesn't turn white when pressure applied); can be described as purpuric or ecchymotic;
- 3) Patient with terminal complement deficiency, where there is Hx of recurrent gonococcal or meningococcal disease in family member or patient. Terminal complement deficiency (C5-9), aka "total hemolytic complement deficiency" (seen NBME write it like this), causes recurrent *Neisseria* infections.

Waterhouse-Friderichsen syndrome is bilateral hemorrhagic necrosis of the adrenal cortices secondary to meningococcal septicemia. This can present with or without meningitis. The USMLE might show you a picture of a purpuric rash on a child + low BP.

The key point about WFS is that cortisol is low. Cortisol normally helps maintain basal BP by upregulating alpha-1 receptors on peripheral arterioles. This allows norepinephrine and epinephrine to bind (i.e., “cortisol is permissive of the effects of catecholamines”) and constrict arterioles. In the setting of WFS, giving saline + vasoconstrictors (such as norepinephrine) won’t work, since the underlying glucocorticoid (cortisol) isn’t there. So the USMLE wants **hydrocortisone** as the pharmacologic treatment after normal saline.

N. meningitidis is encapsulated. This means there is increased risk of infection in those with asplenia / sickle cell. Encapsulated organisms require opsonization (with C3b or IgG) and phagocytosis for clearance, and the spleen is where we have 50% of the immune system’s reservoir of macrophages. So if we lose the spleen, we lose substantial phagocytic capacity. Patients must receive additional rounds of vaccination against these three organisms.

If USMLE asks which organism we are most worried about when we give penicillin prophylaxis to sickle cell patients (or any asplenia patient for that matter), the answer is *S. pneumo*. Choose this answer over *H. influenzae* type B and *N. meningitidis*, even though, yes, the latter two are clearly important to cover as well.

Neisseria gonorrhoeae

Causes STI with mucopurulent discharge; this may progress to pelvic inflammatory disease (PID) in females, with increased risk of ectopic pregnancy due to scarring of Fallopian tubes.

There will be gram-negative diplococci on light microscopy. In contrast, *Chlamydia* will not show any organisms on LM. So if we see the gram-negative diplococci, we always co-treat for *Chlamydia*.

In other words, if the gram-(-) diplococci are seen under LM, there’s no way to know if *Chlamydia* is also there or not since the latter shows no organisms, so if a patient has *Gonorrhea*, the proper Tx is IM ceftriaxone (for gonococcus), PLUS either oral azithromycin or doxycycline (for *Chlamydia*).

If patient develops PID despite having been treated early with ceftriaxone for *Gonorrhea*, the answer for why this happened can be “Hx of improper antibiotic treatment,” where the patient was supposed to be co-treated for *Chlamydia* with azithromycin or doxy but was only given the ceftriaxone for *Gonorrhea*.

If patient presents with PID who's septic (i.e., high fever, tachy, high WBCs), USMLE wants "admit to hospital + IV antibiotics," not the outpatient combo of IM + oral antibiotics.

2CK form assesses that if an asymptomatic patient comes in after a partner tested positive for *Gonorrhea* or *Chlamydia*, the answer is give treatment without waiting for test results.

Gonorrhea doesn't cause reactive arthritis; it causes gonococcal arthritis, which will present one of two ways on NBME: 1) monoarthritis of the knee; or 2) triad of mono- or polyarthritis + **cutaneous papules/pustules** + tenosynovitis (inflammation of tendon sheaths; stems like to give deQuervain tenosynovitis).

Reactive arthritis (usually caused by *Chlamydia*), in contrast, presents as triad of urethritis, polyarthritis, and conjunctivitis. Rarely it can be caused by GI infections. But the point is that reactive arthritis is not caused by Gonococcus. The latter causes gonococcal arthritis, which presents as per above.

Treat gonococcal arthritis same as urethritis → ceftriaxone + azithro or doxy, since the patient may also carry *Chlamydia*.

Gonococcus is notoriously difficult to culture in patients who have arthritis but no overt urethritis. That is, the patient may have a negative arthrocentesis and throat/urethral swabs. So the diagnosis of arthritis is often made clinically. If the Q mentions papules/pustules on the skin, this makes it hyper-obvious for *Gonorrhea*. I mention this because occasionally an NBME Q will say the arthrocentesis is negative, and this somehow confuses students. But arthrocentesis is not very sensitive for organisms in the setting of septic arthritis. This can apply to *S. aureus* as well (I've seen this on NBME), but false-negative results for gonococcus are notably common, so don't be thrown off by that.

Can cause ophthalmia neonatorum (fancy way of saying neonatal conjunctivitis).

Gonococcal conjunctivitis will present in the first week of life with yellow discharge from the eye(s). *Chlamydia* tends to present after the first week.

The USMLE vignette will be vague, where the student says, "But how are we supposed to know it's not *Chlamydia*, just because it's first week of life, that's it?" And my response is: if they give you *Chlamydia* ophthalmia neonatorum, they'll **always** tie it to

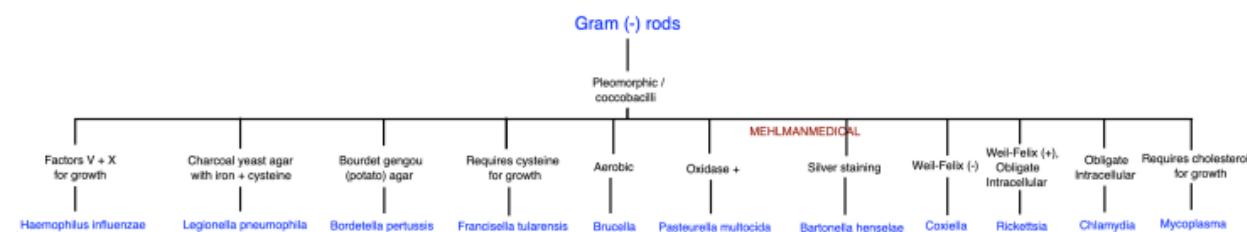
subsequent pneumonia somehow, since that is such a HY point. You need to be aware that *Chlamydia* drains through the nasolacrimal duct down into the lungs, so if they give you a 3-week old with pneumonia following conjunctivitis, you know that's *Chlamydia*.

Prophylaxis for gonococcal conjunctivitis is erythromycin ointment; treatment in the neonate is IM 3rd-gen cephalosporin (usually cefotaxime in pediatrics).

Prophylaxis for chlamydial conjunctivitis is treatment of the mother while pregnant; treatment in the neonate is oral erythromycin.

Same as with *N. meningitidis*, patients have increased risk of infection with terminal complement (C5-9) deficiency. Sometimes the vignette can give a patient with recurrent *N. gonorrhoeae* or *N. meningitidis* + ask what is likely deficient, and the answer can simply be "C7" or "C8." Seems weird/out of place, but it's easy if you know terminal complement deficiency is exceedingly HY for *Neisseria* infections.

A vaccine cannot be made against *N. gonorrhoeae* because it has pilus proteins on its cell surface that undergo antigenic variation. This is in contrast to *N. meningitidis*, where we make a vaccine against the polysaccharide capsule. *N. gonorrhoeae*, however, does not have a capsule.



Haemophilus influenzae

You need to be aware of *H. influenzae* type B as well as non-typeable.

H. influenzae type B (HIB) causes epiglottitis and meningitis.

H. influenzae non-typeable is a less common cause of otitis media (compared to *S. pneumoniae*) and can also cause pneumonia in COPD. I've never seen it assessed on NBME as the answer for otitis media, but I'm letting you know that occasionally you might read about *H. influenzae* being a cause of otitis media after *S. pneumoniae*. But this

refers to *H. influenzae* non-typeable, not type B. I've seen one Q only on NBME of *H. influenzae* non-typeable pneumonia in a COPD patient.

HIB has a polysaccharide capsule. The vaccine is a conjugate vaccine, where a protein is attached to the polysaccharide capsule so that it can be expressed on MHC-II. USMLE wants you to know that T-independent antigens are non-proteinaceous (i.e., polysaccharide capsules, LPS of gram-negatives, etc.) and therefore cannot be expressed on MHC-II molecules. Therefore, by attaching a protein to it (e.g., flagellin), it can be expressed on MHC-II and presented to CD4+ T cells for a more robust immune response. This vaccine point is HY for immuno for USMLE.

Epiglottitis is seen in unvaccinated and immigrants (can be unvaccinated), as well as patients with asplenia or sickle cell (auto-splenectomy).

X-ray of neck shows "thumbprint sign."

Presents as child who has fever + difficulty breathing. They can say the kid is drooling and/or in tripod positioning (facilitates use of accessory muscles).

USMLE wants intubation as immediate answer. Epiglottitis is a medical emergency that can lead to sudden occlusion of the airway.

Antibiotic Tx following intubation = 3rd-gen cephalosporin (cefotaxime in peds, or ceftriaxone); give rifampin to close contacts.

Legionella

Classically acquired via aerosols from air conditioners. The question can simply say "residential facility" or "business trip" to imply exposure to large AC units. If the Q gives *Legionella* pneumonia + they ask about acquisition, the answer can be "environmental aerosols."

Cause of atypical pneumonia (interstitial pneumonia), with bilateral interstitial infiltrates. "Legionnaire's disease" refers to severe pneumonia/illness due to *Legionella*.

Can also cause hyponatremia and diarrhea.

Diagnosed with urine antigen test.

Treat with azithromycin or doxycycline.

Mycoplasma

Most common bacterial cause of atypical pneumonia (interstitial pneumonia). Viruses are technically most common, but for USMLE, if a patient has a bilateral pneumonia with interstitial infiltrates, *Mycoplasma* is the likely cause.

Referred to as “walking pneumonia,” which refers to a young, healthy adult who’s literally been walking around but who has a dry cough + low-grade fever, where the CXR shows bilateral infiltrates. There is an NBME Q that literally trolls the concept of walking pneumonia, where they say a 23-year-old male was hiking for 8 hours the day before + has a pneumonia, and the answer is *Mycoplasma*.

In general, you need to be aware that lobar pneumonia is usually *S. pneumo*, and bilateral pneumonia is usually *Mycoplasma* (in AIDS patients, bilateral pneumonia is *Pneumocystis*).

There is one NBME Q that gives right lower lobe interstitial infiltrates, with *Mycoplasma* as the correct answer, where *S. pneumo* isn’t listed. This means the word “interstitial” wins over location.

Can cause cold agglutinins (IgM antibodies against RBCs), leading to hemolysis. In other words, bilateral pneumonia + low Hb = *Mycoplasma*. High LDH can also sometimes be seen. RBCs are packed with LDH, so high LDH on USMLE is often their way of saying hemolysis.

Treat with azithromycin or doxycycline.

HY for Step 1 NBMEs: they will ask why beta-lactams such as amoxicillin are ineffective against *Mycoplasma*. The answer is because it lacks a peptidoglycan cell wall.

Chlamydia

Obligate intracellular.

Chlamydia pneumoniae (not *Chlamydia trachomatis*) is technically another cause of interstitial/atypical pneumonia after *Mycoplasma* and *Legionella*, but I’ve never seen this assessed on NBME.

Chlamydia psittaci is a cause of atypical pneumonia in bird owners or those who work at a pet store with birds.

Treat with azithromycin or doxycycline.

Chlamydia trachomatis D-K (the actual STI) can cause pneumonia in neonates following conjunctivitis. This is HY. The Q will give a 3-week-old who had conjunctivitis 1-2 weeks earlier, who now has low-grade fever + bilateral wheezes. The labs can show a high % of lymphocytes, since *Chlamydia* lives intracellularly so requires cell-mediated immunity to clear it. In contrast, other organisms, like *S. pneumo*, which live outside the cell, cause a neutrophilic shift instead, since neutrophils are used for humoral immunity.

Prophylaxis for *Chlamydia* neonatal conjunctivitis is treating the mom while pregnant. Treatment in the neonate is **oral** erythromycin. Topical is wrong because it will not kill what has already entered the nasolacrimal duct. Topical erythromycin is used as prophylaxis for gonococcal conjunctivitis; Tx for the latter is cefotaxime.

Bordetella pertussis

Classic whooping cough presents as succession of many coughs followed by an inspiratory stridor.

What you need to know for USMLE is that this can absolutely present in an adult and that they can be vague about it, just describing it as a regular cough. There is an NBME Q where they give pertussis in a 19-year-old, and I see students confused thinking it must be a kid. This is not the case. Write a letter to NBME if you disagree.

The way you'll know it's pertussis, however, is they will say there's **hypoglycemia** and/or **post-tussive emesis**, which means vomiting after coughing episodes.

Pertussis can cause super-high WBC counts in the 30-50,000-range, where there are >80% lymphocytes. This is called **reactive lymphocytosis**. *This makes it resemble ALL*. So you should know for Peds that ALL-like laboratory findings + cough = pertussis.

Q will ask number-one way to prevent → answer = vaccination (not hard, but they ask it). Pertussis is part of TDaP. The pertussis component is killed-acellular; the tetanus and diphtheria are toxoid.

Erythromycin can be given to patients with active cough; USMLE doesn't give a fuck about pertussis stages.

Close contacts should also receive erythromycin.

Francisella tularensis

Cause of atypical pneumonia in patients with exposure to rabbits.

Can sometimes cause ulcerated skin lesions.

Infection is called tularemia.

Rickettsia

Refers to a genus of bacteria that are obligate intracellular (same as *Chlamydia*, which is also obligate intracellular).

Rickettsia rickettsii causes Rocky Mountain spotted fever (RMSF), which is a palms and soles rash (sometimes the Q can say wrists/ankles instead of palms/soles) that migrates toward the trunk (centripetal rash).

RMSF is considered a form of vasculitis and is spread by dermacentor wood tick. It is treated with doxycycline.

“Typhus” refers to rash + fever+ headache conditions caused by rickettsia.

Rickettsia prowazekii causes epidemic typhus; spread by louse.

Rickettsia typhi causes endemic typhus; spread by fleas.

Rickettsia tsutsugamushi causes scrub typhus; spread by mites.

Rickettsia cause a positive Weil-Felix test, which means there are positive titers to Proteus-O antigen. Sounds weird, but I don't know what to tell you.

Coxiella burnetii

Causes Q-fever, an atypical pneumonia in those with exposure to farm animals, especially cattle.

Was once considered a type of Rickettsia, but has now been recategorized into its own genus. It is Weil-Felix negative.

Brucella

Acquired from unpasteurized goat products (i.e., cheese, milk).

Brucellosis causes undulating fever, which presents as afternoon fevers and normal body temperature in the morning.

Invasion to the CNS is called neurobrucellosis, which can present as meningoencephalitis.

Pasteurella multocida

Can cause skin infection following a cat or dog *bite*.

Bartonella henselae

Can cause skin infection following cat or dog *scratch* (hence cat-scratch disease).

Causes non-caseating granulomatous inflammation seen on silver stain.

The Q need not say the patient has a pet. NBME might say there is an 8-year-old girl with a papule on the finger, where biopsy shows granulomatous inflammation on silver stain, and the answer is simply *Bartonella henselae*.

Treat with azithromycin.

Can cause bacillary angiomatosis in immunocompromised patients, which is proliferating blood vessels presenting as raised, red/violaceous skin lesions. The condition is known to resemble Kaposi sarcoma.

1. What is the taxonomy/categorization of *Legionella*?

- **Answer:** Gram-negative rod. Acquired via aerosols from air conditioners. Causes atypical pneumonia (interstitial pneumonia) with bilateral infiltrates.
-

2. What is bacillary angiomatosis? What causes it?

- **Answer:** Proliferating blood vessels presenting as raised, red/violaceous skin lesions. Caused by *Bartonella henselae* in immunocompromised patients.
-

3. What does *Rickettsia prowazekii* cause? What spreads it?

- **Answer:** Epidemic typhus; spread by louse.
-

4. What is Weil-Felix test? What is its relevance?

- **Answer:** Positive titers to Proteus-O antigen indicate *Rickettsia* infection. Weil-Felix test distinguishes *Rickettsia* (positive) from *Coxiella* (negative).
-

5. What does *Coxiella burnetii* cause? How is it acquired?

- **Answer:** Causes Q-fever, an atypical pneumonia, acquired via farm animals, especially cattle.
-

6. What are the three main ways to know *N. meningitidis* is the cause of meningitis over *S. pneumo*?

- **Answer:**
 1. College-age students living in close quarters (e.g., dorms, military barracks).
 2. Non-blanching purpuric/ecchymotic rash in a child or older patient.
 3. Terminal complement deficiency with recurrent *Neisseria* infections.

7. Which bacterium can cause reactive lymphocytosis that resembles ALL?

- **Answer:** *Bordetella pertussis*. Causes reactive lymphocytosis with WBC counts in the 30-50,000 range and >80% lymphocytes.
-

8. What is an important point about sensitivity of arthrocentesis for organisms, especially gonococcus?

- **Answer:** *Gonococcus* is difficult to culture in patients with arthritis but no overt urethritis. Arthrocentesis can be false-negative.
-

9. Which organism causes whooping cough? What are three findings apart from the cough?

- **Answer:** *Bordetella pertussis*.
 - Findings: Hypoglycemia, post-tussive emesis, and reactive lymphocytosis.
-

10. Which bacterium causes undulating fever?

- **Answer:** *Brucella*. Causes brucellosis, acquired from unpasteurized goat products.
-

11. How do we differentiate gonococcal vs chlamydial neonatal conjunctivitis? What is the prophylaxis and treatment?

- **Answer:**
 - *Gonorrhea*: Presents in the first week of life; treat with IM cefotaxime.
 - *Chlamydia*: Presents after the first week and is associated with pneumonia; treat with oral erythromycin.
-

12. What is the taxonomy/categorization of *Mycoplasma*?

- **Answer:** Lacks a peptidoglycan cell wall. Causes atypical pneumonia (interstitial) and hemolysis via cold agglutinins.
-

13. What does *Pasteurella multocida* cause? How is it acquired?

- **Answer:** Causes skin infection following cat or dog bites.
-

14. Which bacterium causes Rocky Mountain Spotted Fever? What is the vector? How does it present? How is it treated?

- **Answer:**
 - Bacterium: *Rickettsia rickettsii*.
 - Vector: Dermacentor wood tick.
 - Presentation: Palms and soles rash migrating to the trunk.
 - Treatment: Doxycycline.
-

15. How does gonococcal arthritis present? How is it treated?

- **Answer:** Presents as monoarthritis (knee) or triad: arthritis, cutaneous papules/pustules, and tenosynovitis. Treat with ceftriaxone + azithro/doxy.
-

16. Why can't a vaccine be made against *N. gonorrhoeae* but one can be made against *N. meningitidis*?

- **Answer:** *N. gonorrhoeae* has pilus proteins that undergo antigenic variation, whereas *N. meningitidis* has a stable polysaccharide capsule.
-

17. What kind of vaccine is *Haemophilus influenzae* type B? What is the immunologic purpose of making the vaccine in such a way?

- **Answer:** Conjugate vaccine. Protein is attached to polysaccharide capsule to enable MHC-II presentation and robust CD4+ T cell response.
-

18. What does *Brucella* cause? How is it acquired?

- **Answer:** Causes undulating fever; acquired from unpasteurized goat products.
-

19. What is the taxonomy/categorization of *Bordetella pertussis*?

- **Answer:** Gram-negative coccobacillus. Causes whooping cough.
-

20. Why are beta-lactams such as amoxicillin ineffective against *Mycoplasma*?

- **Answer:** *Mycoplasma* lacks a peptidoglycan cell wall.
-

21. What is the taxonomy/categorization of *Neisseria meningitidis*?

- **Answer:** Gram-negative diplococci.
-

22. What is the most common bacterial cause of atypical pneumonia (after viruses)? What is the colloquial name for the pneumonia? What is a special lab finding it can cause? How is it treated?

- **Answer:**
 - Cause: *Mycoplasma*.
 - Colloquial name: Walking pneumonia.
 - Lab finding: Cold agglutinins.
 - Treatment: Azithromycin or doxycycline.
-

23. Which bacterium is acquired from rabbits? What does it cause?

- **Answer:** *Francisella tularensis*. Causes tularemia and atypical pneumonia.
-

24. What is the taxonomy/categorization of *Coxiella burnetii*?

- **Answer:** Gram-negative coccobacillus. Causes Q-fever.
-

25. What is Waterhouse-Friderichsen syndrome, and how is it treated?

- **Answer:** Bilateral hemorrhagic necrosis of adrenal cortices due to meningococcal septicemia. Treated with hydrocortisone and fluids.
-

26. What is the taxonomy/categorization of *Rickettsia*?

- **Answer:** Obligate intracellular, Gram-negative.
-

27. What is the taxonomy/categorization of *Brucella*?

- **Answer:** Gram-negative rod.
-

28. Explain when *Chlamydia trachomatis* D-K can cause pneumonia.

- **Answer:** In neonates following conjunctivitis; presents with low-grade fever and wheezing.
-

29. Pneumonia caused by which organism is sometimes accompanied by hyponatremia and/or diarrhea?

- **Answer:** *Legionella*.

30. What is the taxonomy/categorization of *Francisella tularensis*?

- **Answer:** Gram-negative rod.
-

31. What is the taxonomy/categorization of *Bartonella henselae*?

- **Answer:** Gram-negative rod. Causes cat scratch disease.
-

32. What two main infections does *Haemophilus influenzae* type B cause?

- **Answer:** Epiglottitis and meningitis.
-

33. Who is prone to getting epiglottitis caused by *H. influenzae* type B?

- **Answer:** Unvaccinated individuals, immigrants, asplenia, or sickle cell patients.
-

34. Which bacterium causes cat scratch disease? How does it present? What is seen on biopsy?

- **Answer:**
 - Bacterium: *Bartonella henselae*.
 - Presentation: Skin infection.
 - Biopsy: Non-caseating granulomas.
-

35. How is *Francisella tularensis* acquired? What does it cause?

- **Answer:** Acquired from rabbits; causes tularemia.
-

36. What does *Rickettsia typhi* cause? What spreads it?

- **Answer:** Endemic typhus; spread by fleas.
-

37. What type of immunodeficiency makes patients prone to recurrent *Neisseria* infections?

- **Answer:** Terminal complement deficiency (C5-9).
-

38. What is the taxonomy/categorization of *Neisseria gonorrhoeae*?

- **Answer:** Gram-negative diplococci.

Serratia marcescens

Cause of nosocomial UTIs; urease-positive; can lead to struvite (ammonium magnesium phosphate; staghorn) calculi, since these form at higher pH.

Grows cherry red on culture medium.

Catalase-positive. *Serratia* sepsis can be mentioned on USMLE in patients with NADPH oxidase deficiency (chronic granulomatous disease), since these patients have susceptibility to catalase-positive organisms (Big SPACES → *Burkholderia*, *S. aureus*, *Pseudomonas*, *Aspergillus*, *E. coli*, *Serratia*).

Escherichia coli

Most common cause of UTIs, cystitis, and pyelonephritis. USMLE wants you to know **fimbriae** or **P-pilus** are virulence factors that enable adhesion to urothelium.

Causes prostatitis and epididymitis in males 40s and older (NBME gives male who's 45 with prostatitis where *E. coli* is correct and *Chlamydia* is wrong).

Increased risk of infections in patients with NADPH oxidase deficiency (because *E. coli* is catalase-positive).

ETEC

Enterotoxigenic *E. coli* (ETEC) causes traveler's diarrhea, which is self-limiting watery or brown-green diarrhea following trips overseas to, e.g., Mexico or the Middle East.

Classically acquired via water or lettuce contaminated with human feces.

The mechanism for ETEC diarrhea is heat-labile toxin that ADP-ribosylates adenylyl cyclase, increasing cAMP, as well as heat-stable toxin that ADP-ribosylates guanylyl cyclase, increasing cGMP.

In other words, HL toxin increases cAMP; HS toxin increases cGMP.

The HL toxin increasing cAMP is the same mechanism as cholera toxin (*Vibrio cholerae*); the difference is cholera causes profuse, high-volume stool, with liters and liters of rice-water stool, whereas traveler's diarrhea, even if it is described as occurring 8-12 times daily (I've seen this on NBME), they will not describe it as profusely high-volume the way cholera presents.

The HS toxin increasing cGMP is the same mechanism as *Yersinia enterocolitica* toxin. The difference is the latter causes bloody diarrhea and pseudo-appendicitis (RLQ pain) or arthritis, whereas traveler's diarrhea is not bloody.

EHEC O157:H7

Enterohemorrhagic *E. coli* (EHEC) causes bloody diarrhea (dysentery) in isolation, or can also cause full-blown hemolytic uremic syndrome (HUS). Classically acquired from beef.

HUS presents as triad of: 1) thrombocytopenia; 2) hemolytic anemia with **schistocytes**; and 3) renal insufficiency with or without hematuria.

The combination of thrombocytopenia + schistocytosis = microangiopathic hemolytic anemia (MAHA).

The mechanism for HUS is: *E. coli* EHEC O157:H7 (and *Shigella*) both secrete toxins (Shiga-like toxin and Shiga toxin, respectively) that cause inflammation of renal microvasculature → ADAMTS13 protein inactivation → failure of cleavage of vWF multimers → platelet adherence to vascular endothelium cannot be as readily reversed → platelet aggregations protrude into vascular lumen causing shearing of RBCs flying past → fragmentation of RBCs (schistocytes, aka helmet cells).

Shiga-like and Shiga toxins cleave the eukaryotic 60S ribosomal subunit, thereby interfering with protein translation.

Klebsiella

Urease (+); can cause struvite stones.

Can cause cavitary pneumonia with currant jelly (thick, dark red) sputum; classically seen in alcoholics or those with aspiration risk.

Proteus

Urease (+); can cause UTIs leading to struvite stones, same *Klebsiella* and *Serratia*.

Salmonella

Causes food poisoning (*Salmonella enteritidis* and *typhimurium*), resulting in bloody diarrhea. Acquired from consumption of poultry or eggs, as well as from interaction with reptiles (i.e., pet lizards, snakes, etc.).

Salmonella typhi causes typhoid fever, which is high fever + prostration (patient is lying down ill / in pain) + rose spots on the abdomen + either constipation or diarrhea.

Humans are the reservoir for *Salmonella typhi*, and it is acquired via fecal contaminated food/water. It can remain latent in the gall bladder.

Shigella

Acquired from beef.

Can cause shigellosis, which is isolated bloody diarrhea (dysentery), or can cause full-blown HUS (same as EHEC, as discussed above).

Requires inoculation with relatively few organisms to cause infection (in comparison to *Salmonella*, which requires more organisms to cause infection).

Shiga-toxin cleaves the eukaryotic 60S ribosome (same as EHEC), but its main virulence factor is its ability to invade GI mucosa. If *Shigella* loses its ability to invade, it is severely impeded in its ability to cause infection. EHEC does not invade.

Pseudomonas

Causes pneumonia in cystic fibrosis patients. I've talked about in prior content that *S. aureus* exceeds *Pseudomonas* prior to age 10 and that *Pseudomonas* exceeds *S. aureus* after age 10. But I'm not convinced that USMLE gives a fuck. I'm not going to go fish for and remove that detail about age from my prior content, however.

Can cause infections on burns. Appears blue-green due to a pigment it produces called pyocyanin. If a burn has a yellow color, in contrast, this is likely *S. aureus* ("golden Staph"), not *Pseudomonas*.

Diabetic patients have increased general infection risk due to *Pseudomonas*. This notably is in reference to osteomyelitis and foot ulcers. However, a caveat is that a new NBME Q for 2CK has "polymicrobial" as the answer for the most likely cause of diabetic foot ulcer, where both *Pseudomonas* and *S. aureus* are wrong answers. I mention this because resources over the years have pushed *Pseudomonas* for foot ulcers. So I just want you to be aware "polymicrobial" is correct if it's listed alongside *Pseudomonas*.

Pseudomonas is very important cause of nosocomial pneumonia (i.e., hospital- and ventilator-acquired pneumonia). If a patient has a nosocomial pneumonia (which is defined as a pneumonia starting >48 hours following becoming an in-patient), he or she must receive coverage for both MRSA as well as *Pseudomonas*. This is accomplished by giving vancomycin (covers MRSA) PLUS either ceftazidime (a 3rd-gen ceph) or cefepime (a 4th-gen ceph).

Ceftriaxone (a 3rd-gen ceph) does not cover *Pseudomonas*, so the combo of vanc + ceftriaxone is wrong for nosocomial infections. This combo is used for community-acquired sepsis or meningitis. For community-acquired pneumonias where there is not sepsis, we give simple azithromycin to treat.

There are other agents that cover *Pseudomonas*, such as carbapenems, piperacillin/tazobactam, amikacin (an aminoglycoside), etc., but I have not seen NBME assess these. What I have seen that is incredibly HY on forms is the vancomycin + cephalosporin combos as I mentioned above.

Pseudomonas can cause otitis externa (swimmer's ear) and hot tub folliculitis.

Treat otitis externa with topical ciprofloxacin + hydrocortisone drops.

Prophylaxis for otitis externa (e.g., in someone who does crew who can't avoid water exposure) is topic alcohol-acetic acid drops. Answers such as ear plugs are wrong. Carbamide peroxide drops are for earwax buildup (distractor on NBME).

Pseudomonas produces a toxin that inhibits Elongation Factor 2 (EF2), same as *Diphtheria*.

Vibrio

Vibrio cholerae (cholera) presents as "liters and liters" of rice-water stool in someone who went traveling to, e.g., Mexico. Acquired fecal-oral (i.e., fecal-contaminated food/water).

MOA of toxin is same as ETEC heat-labile toxin causing traveler's diarrhea, which is ADP-ribosylation of adenylyl cyclase (increases cAMP). The way you can differentiate this from ETEC traveler's diarrhea is that cholera is notably **profusely high-volume**.

Both ETEC and cholera vignettes can tell you the patient has 8-12 stools daily, so it's not the # of stools that matters; it's the emphasis on volume. Cholera causes death via severe dehydration and electrolyte disturbance.

Tx is **oral rehydration** on USMLE; if patient has low BP or altered mental status (i.e., confusion/coma), IV hydration is done.

Vibrio parahemolyticus doesn't cause profuse, watery diarrhea the same way cholera does. I've seen this organism asked once in an NBME vignette where the patient ate sushi (can be acquired from sushi and shellfish).

Vibrio vulnificus causes severe sepsis in half of patients. This is asked on offline NBME 19 where a dude went running on a beach and got sepsis, with no mention of consumption of food. But it's apparently acquired from shellfish.

Yersinia

Causes bloody diarrhea + either **appendicitis-like (i.e., RLQ) pain or arthritis.**

The RLQ pain is from mesenteric adenitis or terminal ileitis.

Toxin has same MOA as ETEC heat-stable toxin (i.e., ADP-ribosylates guanylyl cylase, thereby increasing cGMP).

There is an NBME Q where they tell you a patient was on antibiotics for a week + has bloody stool + LLQ pain, and the answer is *C. diff*, not *Yersinia*. *C. diff* can cause either watery or bloody stool, and sometimes pain. Pseudo-appendicitis due to *Yersinia* will be RLQ; it will not be LLQ.

Helicobacter pylori

Spiral-shaped gram-negative rod.

Responsible for almost all duodenal ulcers (>95%), whereas it causes a lower % (only >60%) of gastric ulcers. This is merely because the latter are caused by many other things as well, so we simply have decreased fraction caused by *H. pylori*. In other words, there's no special tropism of *H. pylori* toward duodenal over gastric mucosa.

Mechanism for ulcers that shows up on USMLE is: "secretes proteinaceous substrates that damage mucosal lining." This is correct over "increases gastric acid secretion" if both are listed side-by-side, even though *H. pylori* does gastrin levels, which increases acid secretion.

Produces urease, which causes increased ammonia production around the organism, allowing it to survive in the decreased pH of the stomach.

Antral/pyloric ulcers can lead to gastric outlet obstruction. They will mention this on NBME as a "succussion splash."

Increased risk of MALT lymphoma, a type of B-cell lymphoma; can be obstructive at the pylorus, as well as at the cardia of the stomach adjacent the lower esophageal sphincter.

Diagnose *H. pylori* with urease breath test or stool antigen. Endoscopy + biopsy can be performed to confirm diagnosis in some cases via visualization of the spiral-shaped organisms.

Treat *H. pylori* with CAP – i.e., clarithromycin, amoxicillin, PPI (e.g., omeprazole).

USMLE really doesn't give a fuck about the treatment, but CAP is safe to know. Metronidazole, tetracycline, bismuth, and PPI tetrad is used if CAP fails (students ask about those other drugs).

Perforated duodenal ulcer will present as sudden-onset rigid abdomen (involuntary guarding). Patient will often have SIRS, with abnormal vitals due to sympathetic activation. USMLE wants “X-rays of the chest and abdomen” to look for air under the diaphragm (HY finding that indicates ruptured viscus).

Campylobacter jejuni

Bloody diarrhea 1-3 days after consumption of **poultry**.

Can cause Guillain-Barre syndrome (ascending paralysis + decreased tendon reflexes + albuminocytologic dissociation in the CSF → Tx with IVIG + plasmapheresis).

I would say only about 1/4 of GBS Qs will mention any type of preceding infection. So don't rely on the dude going to some BBQ or getting diarrhea beforehand as a crutch for GBS Qs.

Grows best at high temperatures (42 degrees).

Bacteroides

Normal GI flora for mouth to anus. Most important detail is that it is strictly anaerobic.

Anaerobic infections on USMLE can present as “foul-smelling sputum” or “foul-smelling discharge.”

Causes **pulmonary abscess** and aspiration pneumonia.

USMLE wants “aspiration of oropharyngeal normal flora,” or “aspiration of oropharyngeal anaerobes” as the cause of pulmonary abscess.

Oropharyngeal normal flora = *Bacteroides* (strictly anaerobic gram-negative rods); as well as *Peptostreptococcus* and *Mobiluncus*. The latter two are not HY, but *Bacteroides* is. I mention all three, however, because the Q can say sputum sample shows “gram-negative rods, gram-positive cocci, and gram-positive rods,” which refers to all three. But the bigger picture concept is, this = mixed normal flora.

Q will give aspiration risk factor, such as alcoholism, dementia (can cause loss of gag reflex), Hx of stroke (leading to dysphagia), or epilepsy. Q can also mention broken or missing teeth (hypodontia) as risk factor. Pulmonary abscess is often described on NBME as pulmonary lesion with an **air-fluid level**. This is buzzy, but not a mandatory descriptor. This refers to the top half of the circle being air, and the bottom being pus, the latter settling due to gravity.

Tx for pulmonary abscess = clindamycin. Clindamycin is used for “anaerobes above the diaphragm” (metronidazole for “anaerobes below the diaphragm”). Some students have asked about potentially updated/alternative pharm for pulmonary abscess, but I can tell you clindamycin is all over 2CK NBMEs.

Additionally, USMLE can give some sort of abdominal infection (e.g., after surgery), where the site drains “foul-smelling sputum.” You know right away they’re talking about anaerobes, specifically *Bacteroides*.

What is the taxonomy/categorization of *Klebsiella*?

- Urease (+); can cause struvite stones and cavitary pneumonia with currant jelly sputum, classically seen in alcoholics or aspiration risk patients.

Which bacterium notably causes pseudo-appendicitis? What is the MOA of the toxin?

- *Yersinia enterocolitica*. Toxin ADP-ribosylates guanylyl cyclase, increasing cGMP. Causes bloody diarrhea, appendicitis-like RLQ pain, or arthritis.

What is the taxonomy/categorization of *Bacteroides*?

- Strictly anaerobic gram-negative rod, part of normal GI flora. Causes pulmonary abscesses and anaerobic infections.

Which two organisms must we cover when treating nosocomial pneumonia? How do we treat it?

- MRSA and Pseudomonas. Treated with vancomycin plus ceftazidime or cefepime.

What does "foul-smelling sputum" or "foul-smelling discharge" mean on USMLE?

- Indicates anaerobic infections like pulmonary abscess caused by Bacteroides.

What is the mechanism via which E. coli causes UTIs and cystitis?

- Fimbriae or P-pilus, enabling adhesion to the urothelium.

How is Shigella acquired? What conditions does it cause? What is the mechanism of its virulence?

- Acquired from beef. Causes shigellosis (bloody diarrhea) or HUS. Virulence: invasion of GI mucosa.

How does cholera present? Which organism causes it and what is the MOA of the toxin?

- Presents as profuse rice-water stool caused by Vibrio cholerae. Toxin ADP-ribosylates adenylyl cyclase, increasing cAMP.

Which two organisms' toxins cleave the eukaryotic 60S ribosomal subunit?

- EHEC O157:H7 and Shigella.

Which organism is responsible for most peptic ulcers? What is the mechanism for causing ulcers?

- H. pylori. Mechanism: secretes proteinaceous substrates that damage mucosa.

What organism causes infections on burns with blue-green color vs. yellow?

- Blue-green: Pseudomonas; Yellow: S. aureus.

Who gets Serratia infections on USMLE and why?

- Nosocomial UTI patients. Urease (+), leads to struvite stones. Serratia sepsis occurs in NADPH oxidase deficiency.

What are two conditions Klebsiella causes?

- Struvite stones and cavitary pneumonia with currant jelly sputum.

What does EHEC O157:H7 cause? What is the mechanism of the toxin?

- Causes bloody diarrhea or HUS. Toxin cleaves the 60S ribosomal subunit, interfering with protein translation.

What does Campylobacter jejuni cause? How is it acquired?

- Causes bloody diarrhea, Guillain-Barré syndrome. Acquired from poultry.

Which organism causes traveler's diarrhea? What is the MOA of the toxins?

- ETEC. Heat-labile toxin increases cAMP; heat-stable toxin increases cGMP.

What does Vibrio parahemolyticus and Vibrio vulnificus cause? How are they acquired?

- V. parahemolyticus: mild diarrhea from sushi/shellfish. V. vulnificus: sepsis from shellfish.

Which organism causes hot tub folliculitis?

- Pseudomonas.

How does a perforated duodenal ulcer present? What is the first step in diagnosis?

- Sudden rigid abdomen (involuntary guarding). First step: X-rays for air under the diaphragm.

How is H. pylori diagnosed?

- Urease breath test, stool antigen, or endoscopy with biopsy.

What is the taxonomy of Serratia?

- Gram-negative rod; catalase-positive; nosocomial pathogen.

What is the important organism causing pneumonia in cystic fibrosis patients?

- Pseudomonas.

Which organism causes profuse, high-volume rice-water stool? What is the MOA of the toxin?

- Vibrio cholerae. Toxin ADP-ribosylates adenylyl cyclase, increasing cAMP.

How is pulmonary abscess treated? Which organism causes it?

- Treated with clindamycin. Common cause: Bacteroides.

Which organisms cause hemolytic uremic syndrome?

- EHEC O157:H7 and Shigella.

Points about pharm:

Nematode infections on USMLE are basically always treated with -bendazoles (i.e., mebendazole, albendazole, etc.). These are microtubule inhibitors. Don't confuse with -azoles (antifungals).

Pyrantel pamoate is another agent that can be used for nematodes, but lower yield. Diethylcarbamazine is non-existent.

Ivermectin is an odd-one out used for *Onchocerca volvulus* (discussed below).

Praziquantel is used for cestodes and trematodes. This causes worm paralysis.

In short, **mebendazole and praziquantel** are the two highest yield anti-helminth agents for USMLE.

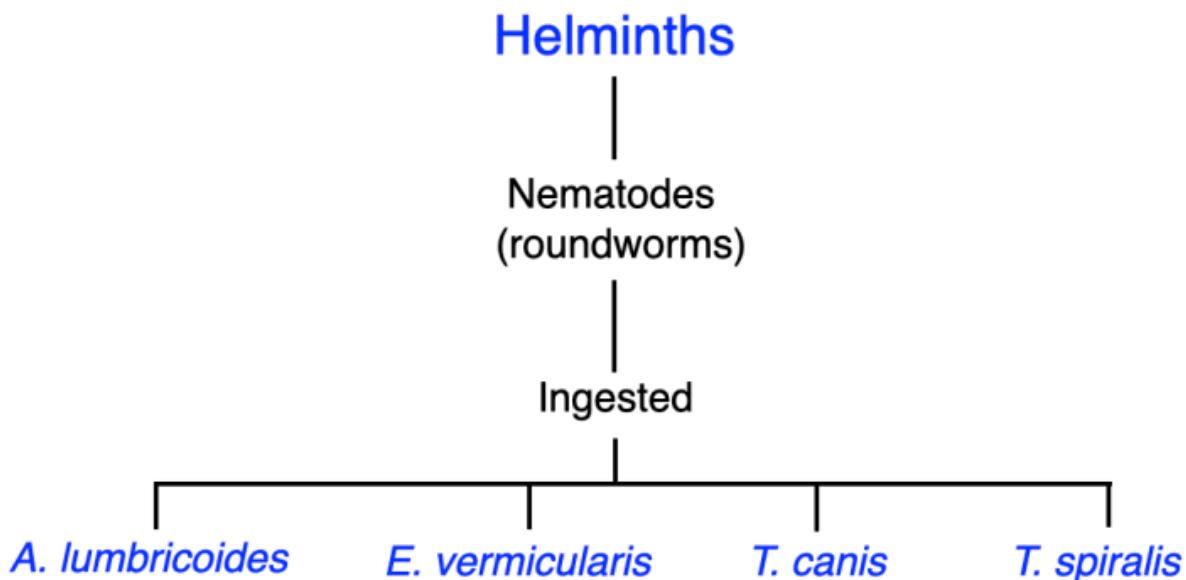
It is extremely rare USMLE lists more than one anti-helminthic agent as answers to a question. Usually the Q is very easy, where the answer is the only anti-helminthic listed. But there are a couple questions out there where they list a -bendazole and praziquantel side by side. So you must know that mebendazole is used for nematodes; praziquantel is used for cestodes and trematodes.

HY point about bloods:

Eosinophils can classically be elevated in helminth infections. This is because eosinophils play a role in killing helminths via release of major basic protein. Normally

eosinophils should be <5%. In helminth infections, they can be >6-8%. Questions where eosinophils are, e.g., 15-20% would be considered flamingly obvious and pass-level.

Eosinophils can occasionally be elevated in *fungal* infections as well, so don't be confused by this. In other words, although eosinophilia is classically associated with helminth infections, just be aware this is not 100% specific and it can occasionally be seen with fungal infections too.



For the following helminths, the USMLE can give a vignette where you are easily able to diagnose the organism, but then they ask how it's acquired, where they have answers such as "ingestion of fecal-contaminated soil," "through the feet," "mosquito bite," "fly bite," etc., and the answer is the former. Even if the "fecal-contaminated soil" part sounds weird, it might be the only answer that involves ingestion, which you therefore know must be correct.

Ascaris lumbricoides

Giant roundworm. Infection is called Ascariasis.

Causes intestinal obstruction.

USMLE can give vignette of patient with eosinophilia with high-pitched or absent bowel sounds (both findings that can reflect obstruction), and the answer is just Ascariasis or *Ascaris lumbricoides*. Not dramatic.

Treat with mebendazole.

Enterobius vermicularis

Aka pinworm (asked on USMLE, where student got easy vignette + all of the worms listed were colloquialisms rather than actual binomial nomenclature).

Causes perianal itching.

Diagnosed via Scotch tape test, where eggs around the anal verge can be collected using tape.

Treat with mebendazole.

Toxocara canis

Carried by pet dogs. Acquired through ingestion of contaminated-soil/food.

Causes visceral larva migrans, which can cause hepatosplenomegaly.

Treat with mebendazole.

Trichinella spiralis

Acquired from pork and **bear meat consumption**.

Trichinosis presents as triad of 1) fever, 2) myalgias, and 3) periorbital edema in patient who ate bear meat or pork.

Treat with mebendazole.

Helminths

Nematodes
(roundworms)

Skin penetration

Hookworms

S. stercoralis

A. duodenale

N. americanus

Strongyloides stercoralis

Invades usually through the feet. Travels through the bloodstream to the lungs, causing pulmonary symptoms. The larvae ascend the trachea and are then swallowed into the GI tract, where they cause abdominal symptoms.

USMLE will give you school-age girl in rural Louisiana (I've seen this on NBME) who has pulmonary and abdominal symptoms + worms isolated from the GI tract + they ask for the mode of transmission → answer = "through the feet."

Treat with mebendazole.

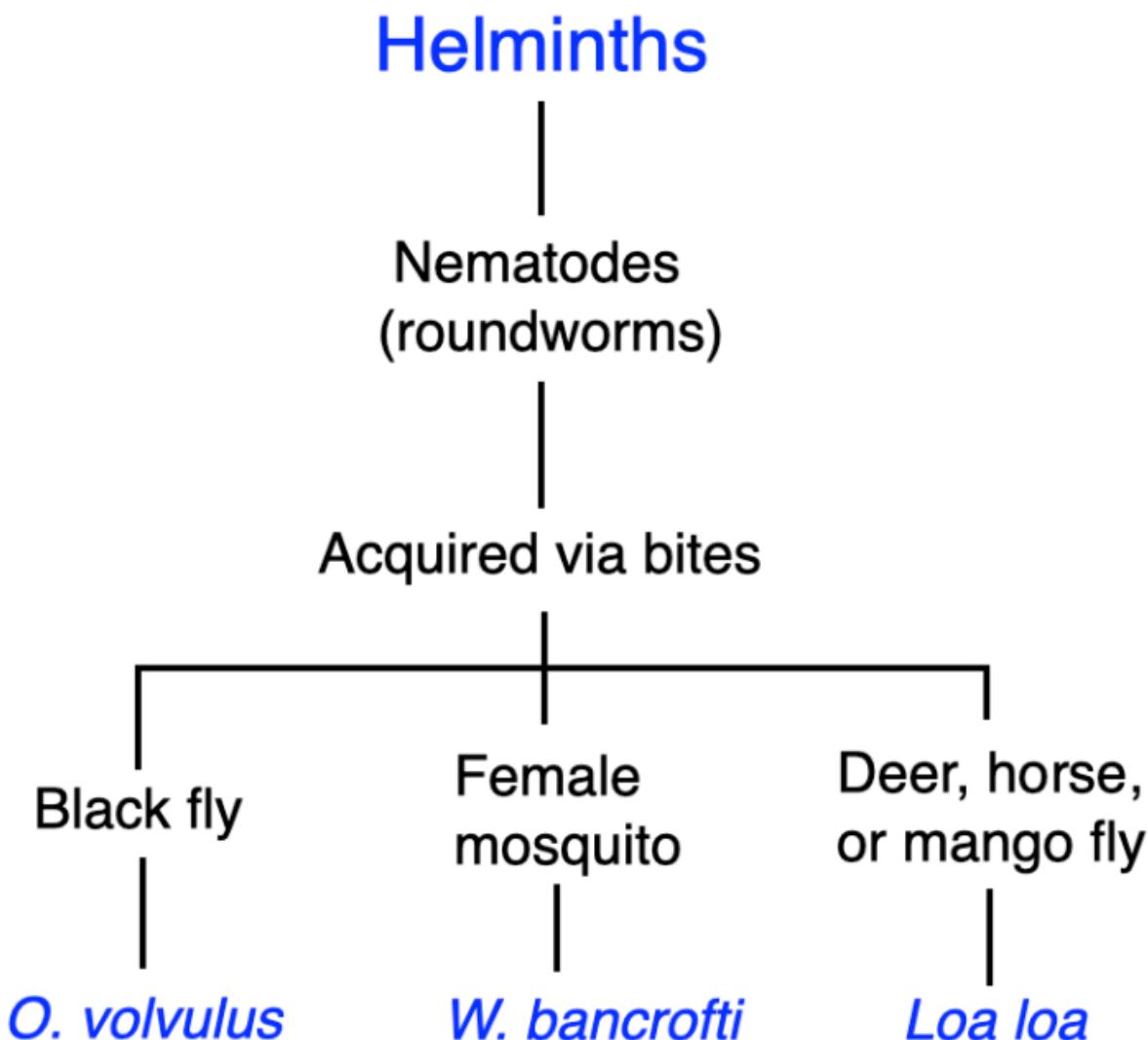
Hookworms

Ancylostoma duodenale and *Necator americanus* are hookworms. USMLE loves these.

They enter through the feet + travel to the lungs, same as *Strongyloides*. The difference is that when they eventually enter the GI tract, they suck blood from their site of attachment in the small bowel, causing **microcytic anemia due to iron deficiency**.

The USMLE will not list *Strongyloides* alongside the hookworms as separate answers in the setting of pulmonary symptoms. What they will do is give you patient with eosinophilia + microcytic anemia, where the answer is a hookworm. Or they will give helminth infection + pulmonary symptoms + microcytic anemia, and the answer is simply “through the feet,” or one of the hookworms as the Dx.

Treat with mebendazole.



Onchocerca volvulus

Causes onchocerciasis (river blindness). Transmitted by black fly and causes black skin lesions and blindness.

Everything is Black: Black fly, Black bite, Black eyesight (blindness).



Will be kid in South America or Africa who has a skin lesion + blindness, where *Onchocerca volvulus* is only helminth listed that causes blindness.

Treat with ivermectin.

Wuchereria bancrofti

Causes elephantiasis (aka lymphatic filariasis), which is massive swelling due to lymphatic insufficiency.



Transmitted by female mosquito.

Treat with mebendazole.

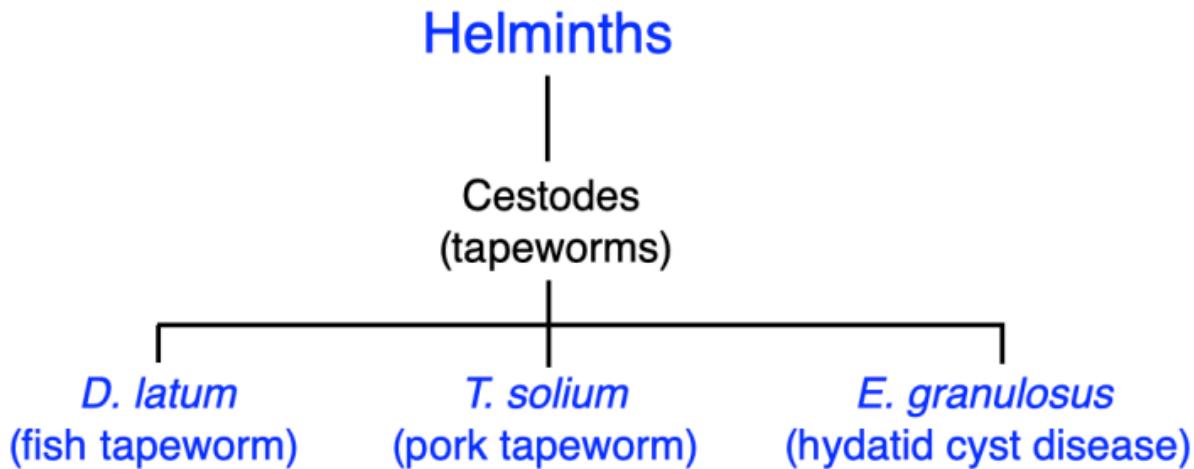
Loa Loa

Roundworm that presents crawling in the eyeball.

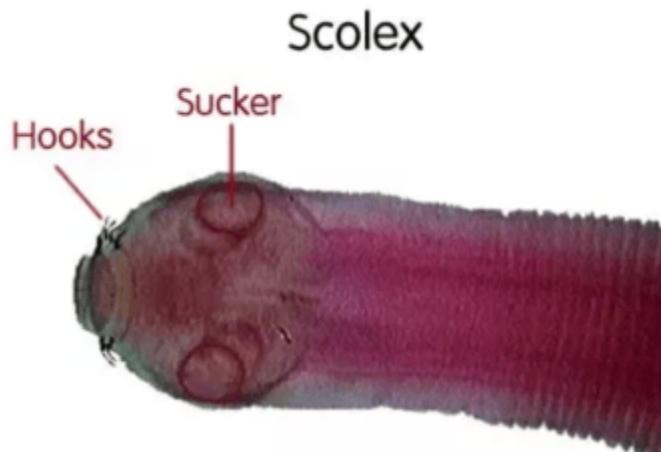


Transmitted by deer, horse, or mango fly.

Treat with mebendazole.



USMLE wants you to know that tapeworms have a segmented body and a **scolex**, which refers to the head of the tapeworm that has “suckers and hooks.” USMLE is known to show this image on the real exam + expect you to know you’re looking at a tapeworm because of the characteristic scolex.



Diphyllobothrium latum

Aka fish tapeworm. Acquired from ingesting – you'd never guess it – fish.

Causes **B12 deficiency**, leading to macrocytic anemia and hypersegmented neutrophils.

This is in contrast to hookworms (*N. americanus* and *A. duodenale*; nematodes), which cause microcytic anemia.

Treat with praziquantel.

Taenia solium

Aka pork tapeworm. Acquired from pork consumption, usually in someone who went abroad to, e.g., Mexico.

Causes cysticercosis, which presents as muscle pain/cysts, and neurocysticercosis, which presents as lesions within the brain. The latter can present one of three ways on NBME (as per my observation): 1) swiss-cheese appearance of brain (buzzy); 2) one or two ring-enhancing lesions; 3) cystic, soap-bubble-appearing lesions within the ventricles.

I've specified in the past that praziquantel is preferred for cysticercosis and albendazole for neurocysticercosis (rare use of a -bendazole for a non-nematode), but USMLE actually doesn't give a fuck, and they won't list both side by side anyway. You should just know that praziquantel is basically always the answer for cestodes and trematodes,

but that albendazole (normally a nematode agent) can be used for neurocysticercosis. But if you're ever asked this on the real exam, they will give you obvious *Taenia solium* infection, where the answer is the only anti-helminth drug listed, so there won't be any confusion.

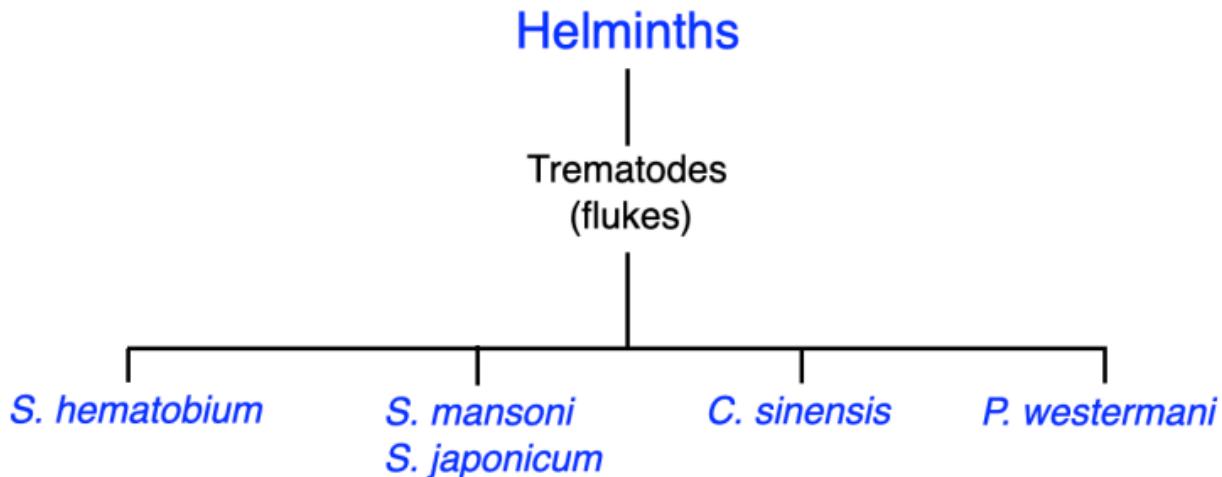
Don't confuse *Taenia solium* (pork cestode) with *Trichinella spiralis* (pork/bear nematode, which is triad of 1- periorbital edema, 2- myalgias, 3- fever, in someone who ate pork or bear).

Echinococcus granulosus

Causes hydatid cyst disease.

Presents with **liver cysts**, and sometimes jaundice and general flu-like symptoms.

Do not biopsy the cysts. This can cause anaphylaxis. The correct management is **surgical excision** of the cysts + praziquantel.



Schistosoma hematobium

Snails are the reservoir. But the trematode isn't acquired via consumption. It is acquired through the skin in someone swimming in (usually) Africa. Travels to the cystic veins draining the bladder + the bladder wall.

Causes hematuria and squamous cell carcinoma of the bladder.

USMLE vignette will say some guy was swimming in Africa + now has hematuria and eosinophilia. The Q need not ask about SCC of the bladder.

This is in contrast to smoking, industrial (aniline) dyes, and naphthylamine (moth balls), which cause transitional cell carcinoma of the bladder and urothelial tract.

Treat with praziquantel.

Schistosoma mansoni/japonicum

Same as *S. hematobium*, snails are the reservoir, but the trematode isn't acquired via consumption. It is acquired through the skin in someone swimming in (usually) Africa. Travels to the mesenteric veins / intestines, before making its way to the liver.

Can cause hepatosplenomegaly, liver damage, and GI symptoms.

There is Q on NBME exam where they show picture of a worm + say there's hepatosplenomegaly, and then *Schistosoma mansoni* is the answer, but it's not a hard Q because it's the only reasonable organism listed.

Treat with praziquantel.

Clonorchis sinensis.

Acquired via consumption of contaminated fish.

Can cause **cholangiocarcinoma** (bile duct cancer).

Treat with praziquantel.

Paragonimus westermani

Acquired via consumption of crab meat or crayfish.

Travels from the GI tract to the lungs, where it causes **hemoptysis**.

Treat with praziquantel.

Question 1

Question: How is *Strongyloides stercoralis* acquired?

How does infection present?

How is it treated?

Answer:

- Invades usually through the feet. Travels through the bloodstream to the lungs, causing pulmonary symptoms.
 - The larvae ascend the trachea and are then swallowed into the GI tract, where they cause abdominal symptoms.
 - Treat with mebendazole.
-

Question 2

Question: Which trematode can cause hepatosplenomegaly, liver damage, and GI symptoms?

Answer:

- *Schistosoma mansoni* and *japonicum*.
 - Snails are the reservoir. Acquired through the skin while swimming (usually in Africa). Travels to mesenteric veins and intestines, eventually affecting the liver.
 - Treat with praziquantel.
-

Question 3

Question: Which helminth is acquired via consumption of infected crab meat or crayfish?

What does it cause?

How is it treated?

Answer:

- *Paragonimus westermani*.
- Causes hemoptysis by traveling from the GI tract to the lungs.
- Treat with praziquantel.

Question 4

Question: Which helminth causes visceral larva migrans?

How is it acquired?

How is it treated?

Answer:

- *Toxocara canis*.
 - Acquired via ingestion of contaminated soil or food.
 - Causes hepatosplenomegaly.
 - Treat with mebendazole.
-

Question 5

Question: What does *Toxocara canis* cause?

How is it acquired?

How is it treated?

Answer:

- Causes visceral larva migrans, which leads to hepatosplenomegaly.
 - Acquired through contaminated soil/food.
 - Treat with mebendazole.
-

Question 6

Question: Which helminth causes perianal itching and is diagnosed with Scotch tape test?

Answer:

- *Enterobius vermicularis* (pinworm).
- Causes perianal itching.
- Diagnosed via Scotch tape test.
- Treat with mebendazole.

Question 7

Question: Which helminth causes elephantiasis?

What transmits it?

Answer:

- *Wuchereria bancrofti*.
 - Transmitted by female mosquito.
 - Treat with mebendazole.
-

Question 8

Question: What does *Onchocerca volvulus* cause?

How is it transmitted?

How is it treated?

Answer:

- Causes onchocerciasis (river blindness), black skin lesions, and blindness.
 - Transmitted by black fly.
 - Treat with ivermectin.
-

Question 9

Question: What is the taxonomy/categorization of *Paragonimus westermani*?

Answer:

- Trematode (fluke).
-

Question 10

Question: Which helminth can cause hematuria in someone who went swimming in Africa?

What might this refer to?

Answer:

- *Schistosoma hematobium*.
- Can cause squamous cell carcinoma of the bladder.

Here is the continuation of the questions and answers (11–48):

Question 11

Question: How is *Clonorchis sinensis* acquired?

What does it cause?

How is it treated?

Answer:

- Acquired via consumption of contaminated fish.
- Causes cholangiocarcinoma (bile duct cancer).
- Treat with praziquantel.

Question 12

Question: How is *Trichinella spiralis* acquired?

What does it cause?

How is it treated?

Answer:

- Acquired via pork and bear meat consumption.
- Trichinosis presents with fever, myalgias, and periorbital edema.
- Treat with mebendazole.

Question 13

Question: What is the taxonomy/categorization of *Strongyloides stercoralis*?

Answer:

- Nematode (roundworm).

Question 14

Question: What is the taxonomy/categorization of *Necator americanus*?

Answer:

- Nematode (roundworm).
-

Question 15

Question: What do *Schistosoma mansoni* and *japonicum* cause?

How are they treated?

Answer:

- Causes hepatosplenomegaly, liver damage, and GI symptoms.
 - Treat with praziquantel.
-

Question 16

Question: What is another name (colloquialism) for *Ascaris lumbricoides*?

What does it cause?

How is it treated?

Answer:

- Known as the giant roundworm.
 - Causes intestinal obstruction.
 - Treat with mebendazole.
-

Question 17

Question: Diagnosis? How is it spread? Treatment? (*Image shows a worm crawling in the eye*)

Answer:

- Diagnosis: *Loa loa*.
 - Spread by deer, horse, or mango fly.
 - Treat with mebendazole.
-

Question 18

Question: What is the taxonomy/categorization of *Schistosoma spp.*?

Answer:

- Trematode (fluke).
-

Question 19

Question: Which helminth is also known as the giant roundworm?

What does it cause?

How is it treated?

Answer:

- *Ascaris lumbricoides*.
 - Causes intestinal obstruction.
 - Treat with mebendazole.
-

Question 20

Question: Which helminth causes hemoptysis and is treated with praziquantel?

Answer:

- *Paragonimus westermani*.
-

Question 21

Question: Which type of leukocyte (WBC) is increased in helminth infections?

Answer:

- Eosinophils.
-

Question 22

Question: What is pyrantel pamoate usually used to treat?

Answer:

- Used for nematode infections.
-

Question 23

Question: What is the taxonomy/categorization of *Loa loa*?

Answer:

- Nematode (roundworm).
-

Question 24

Question: What is the taxonomy/categorization of *Clonorchis sinensis*?

Answer:

- Trematode (fluke).
-

Question 25

Question: Which helminth is classically treated with ivermectin?

Answer:

- *Onchocerca volvulus*.
-

Question 26

Question: What is the taxonomy/categorization of *Wuchereria bancrofti*?

Answer:

- Nematode (roundworm).
-

Question 27

Question: 35-year-old man in Alaska had BBQ with friends where he made bear hotdogs and hamburgers.

If this patient develops a helminth infection, how might it present?

Answer:

- Likely infection: *Trichinella spiralis*.
 - Presents with fever, myalgias, and periorbital edema.
 - Treat with mebendazole.
-

Question 28

Question: What is the taxonomy/categorization of *Diphyllobothrium latum*?

Answer:

- Cestode (tapeworm).
-

Question 29

Question: What is the reservoir for *Schistosoma hematobium*?

What does it cause?

How is it treated?

Answer:

- Reservoir: Snails.
- Causes hematuria and squamous cell carcinoma of the bladder.

- Treat with praziquantel.
-

Question 30

Question: What are the hookworms? How are they acquired? What do they cause? How are they treated?

Answer:

- *Ancylostoma duodenale* and *Necator americanus*.
 - Acquired through the feet.
 - Cause microcytic anemia due to iron deficiency.
 - Treat with mebendazole.
-

Question 31

Question: What is the taxonomy/categorization of *Ancylostoma duodenale*?

Answer:

- Nematode (roundworm).
-

Question 32

Question: What is the taxonomy/categorization of *Onchocerca volvulus*?

Answer:

- Nematode (roundworm).
-

Question 33

Question: What is the taxonomy/categorization of *Toxocara canis*?

Answer:

- Nematode (roundworm).

Question 34

Question: What's the MOA of mebendazole? What are -bendazoles usually used to treat?

Answer:

- MOA: Microtubule inhibitor.
 - Used for nematode infections.
-

Question 35

Question: Which helminths cause iron deficiency anemia leading to microcytic anemia?

Answer:

- *Ancylostoma duodenale* and *Necator americanus*.
-

Question 36

Question: What is the taxonomy/categorization of *Echinococcus granulosus*?

Answer:

- Cestode (tapeworm).
-

Question 37

Question: Which helminth is classically acquired via consumption of bear meat? What is the name of the condition it causes? How does it present?

Answer:

- *Trichinella spiralis*.
- Condition: Trichinosis.
- Presents with fever, myalgias, and periorbital edema.

Question 38

Question: What does *Enterobius vermicularis* cause?

What is another name for it? How is it diagnosed? How is it treated?

Answer:

- Causes perianal itching.
 - Also known as pinworm.
 - Diagnosed via Scotch tape test.
 - Treat with mebendazole.
-

Question 39

Question: What is the taxonomy/categorization of *Taenia solium*?

Answer:

- Cestode (tapeworm).
-

Question 40

Question: What is the taxonomy/categorization of *Trichinella spiralis*?

Answer:

- Nematode (roundworm).
-

Question 41

Question: An 18-year-old man living in South America has recent diminishing vision. Diagnosis and treatment?

Answer:

- Diagnosis: *Onchocerca volvulus*.

- Treat with ivermectin.
-

Question 42

Question: Which helminth is spread by the deer, horse, or mango fly? What does it cause?

Answer:

- *Loa loa*.
 - Causes crawling in the eyeball.
-

Question 43

Question: Which helminth causes cholangiocarcinoma?

Answer:

- *Clonorchis sinensis*.
-

Question 44

Question: What is the taxonomy/categorization of *Enterobius vermicularis*?

Answer:

- Nematode (roundworm).
-

Question 45

Question: Which helminth causes this? Diagnosis? How is it spread? (*Image shows lymphatic filariasis/elephantiasis*)

Answer:

- *Wuchereria bancrofti*.
- Spread by female mosquito.

Question 46

Question: What is praziquantel usually used for? What is its MOA?

Answer:

- Used for cestodes and trematodes.
 - MOA: Causes worm paralysis.
-

Question 47

Question: What is the taxonomy/categorization of *Ascaris lumbricoides*?

Answer:

- Nematode (roundworm).
-

Question 48

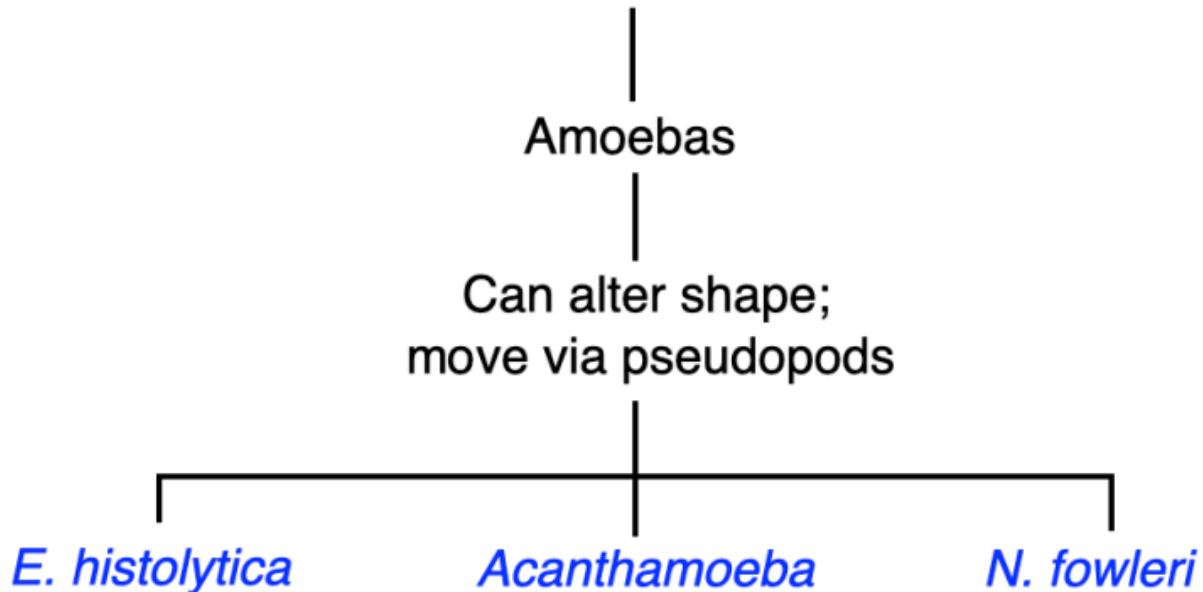
Question: Which helminth is classically acquired via ingestion of infected pork or beef?

Answer:

- *Taenia solium* or *Taenia saginata*.

Protozoa are unicellular eukaryotes.

Protozoa



Amoebas move and feed by extending pseudopods, which are temporary extensions of the cytoplasm.

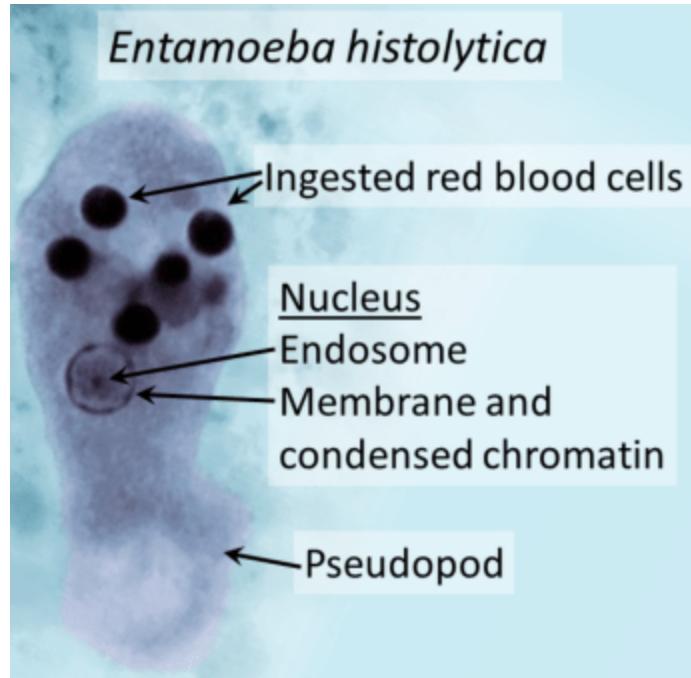
Entamoeba histolytica

Acquired as cysts in fresh water. Organisms that are acquired as cysts in fresh water are **ECG** → *Entamoeba*, *Cryptosporidium*, *Giardia*.

Causes **bloody diarrhea + liver abscesses**, usually in patient who's traveled outside the United States to Mexico or third-world country. I've seen one NBME Q where the latter was described as a "cystic lesion" on CT, even though it's not a cyst (such as with *Echinococcus granulosus*, a tapeworm that causes hydatid cyst disease).

Can cause flask-shaped ulcers of the small bowel.

Demonstrates erythrophagocytosis (ingestion of RBCs). This is mentioned in an NBME Q.



NBME Q gives patient who traveled abroad + has bloody diarrhea + has abscess seen in the liver on CT + they ask for next best step in diagnosis → answer = antigen testing for *E. histolytica*. Not difficult.

Treated with metronidazole + iodoquinol.

Acanthamoeba

Causes keratitis (inflammation of the cornea) and encephalitis.

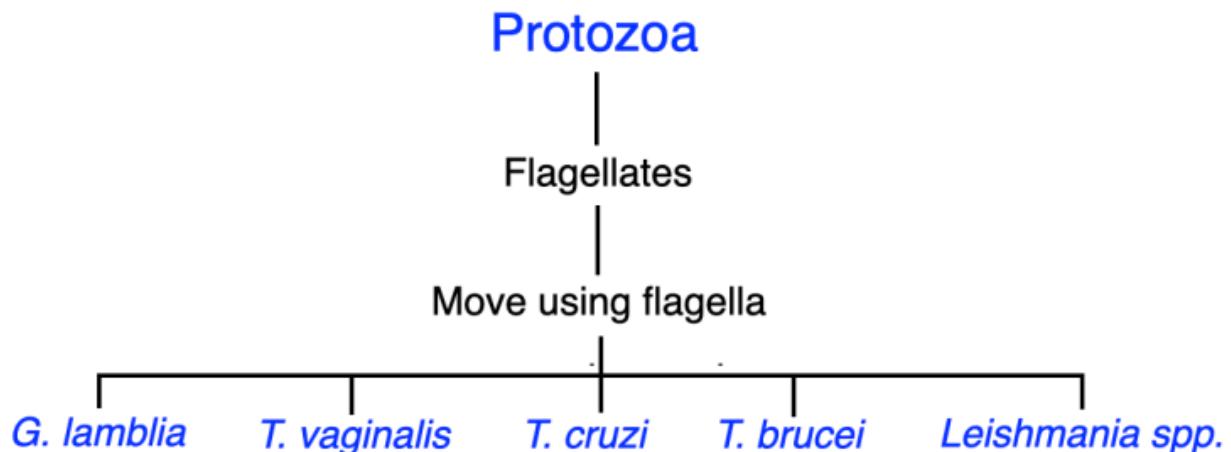
Naegleria fowleri

Found in contaminated fresh water sources, i.e., lakes, hot springs, fountains, and sometimes drinking water.

Causes rapidly progressive meningoencephalitis and death within 1-2 weeks in nearly 100% of patients.

Enters through the cribriform plate in patients who have water enter their nose through diving, splashing, or deliberate washing of their sinuses. Does not cause infection if merely ingested.

This is the organism you see in the news once every 6 months as “brain-eating amoeba” that causes death in someone who swam in a lake.



Giardia lamblia

Acquired as cysts in fresh water. Organisms that are acquired as cysts in fresh water are ECG → *Entamoeba*, *Cryptosporidium*, *Giardia*.

Causes **steatorrhea** (fatty stool), which can be described as extremely foul-smelling stool that floats. The patient can also have bloating.

There is one NBME Q for *Giardia* where they say the patient has foul-smelling *watery* diarrhea and bloating, which is audacious, since *Giardia* causes steatorrhea, but the “foul-smelling” and “bloating” point toward steatorrhea nevertheless.

The diarrhea is **malabsorptive**, where the patient can acquire nutritional and fat-soluble vitamin deficiencies.

Has two phases during its life cycle: **trophozoite** (left image), which is the actively reproducing, motile (with 8 flagella), and infective phase, and the **cyst** (right image), which is the dormant, non-infective stage. Both images are exceedingly HY spot-diagnoses for USMLE.



Patients with IgA deficiency are at increased risk of *Giardia* infection. Sometimes Hx of *Giardia* infection is mentioned in IgA deficiency questions.

Treat with metronidazole.

Trichomonas vaginalis

Causes trichomoniasis.

Presents as yellow-green discharge. Can cause “strawberry cervix,” or punctate hemorrhages on the cervix. If they don’t say this, they can sometimes say yellow-green discharge + a vaginal canal that is erythematous.

Flagellated protozoan. Diagnosed via visualization on **wet mount**.

Treat with metronidazole for patient **and partner** (high rate of reinfection).

Trypanosoma cruzi

Causes Chagas disease, aka American trypanosomiasis.

Spread by Reduviid bug. It is aka “kissing bug” because of its usually soft, painless bite.

Can cause Romaña sign, which is palpebral (eyelid) swelling 1-2 weeks after infection. This occurs when *T. cruzi*-containing feces from the Reduviid bug are rubbed into the eye. That is, the bite need not occur on or near the eye; the feces can be transferred from a bite elsewhere to the eye.

Can cause dilated cardiomyopathy, achalasia, and toxic megacolon.

Treated often with nifurtimox and benznidazole.

Trypanosoma brucei

Causes African sleeping sickness, aka African trypanosomiasis.

Spread by Tsetse fly.

Presents as daytime sleepiness and nighttime insomnia.

Treated often with suramin and melarsoprol.

Leishmania donovani

Causes Leishmaniasis.

Spread by the Phlebotomus sand fly.

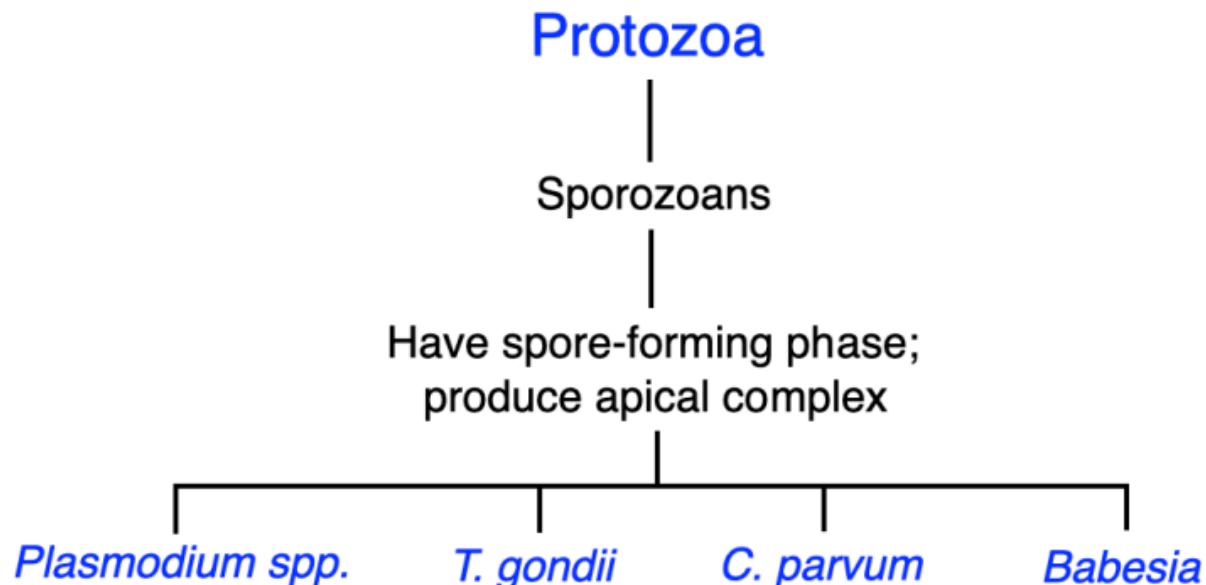
USMLE likes the Middle East as location where it is prevalent. An NBME Q mentions a guy who went to Iraq.

Can cause skin ulceration at bite site (cutaneous leishmaniasis).



It can also cause visceral leishmaniasis (aka kala-azar), which can lead to pancytopenia and hepatosplenomegaly.

Treated often with sodium stibogluconate.



Sporozoans have a spore-forming phase and are distinguished by the presence of an apical complex at one end of the cell, which is used for invading host cells.

Plasmodium spp.

Causes malaria. Presents as flu-like illness with the development of hemolysis and varying fever patterns. *P. falciparum* causes hypoglycemia and cerebral malaria, which is more fatal.

Transmitted to humans by the *Anopheles* mosquito in regions of the world such as **Africa**, South America, and Asia.

Life cycle:

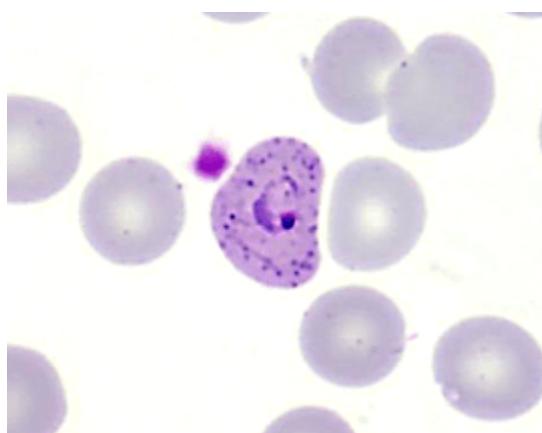
The *Anopheles* mosquito injects the sporozoite form of malaria into the blood. The sporozoites travel to the liver and mature into schizonts within hepatocytes, which undergo asexual reproduction to produce merozoites. A single schizont will contain many merozoites. This phase within the liver is called the hepatic, or **exo-erythrocytic**

stage (I've seen this on NBME). The schizonts containing merozoites are then released into the blood.



USMLE wants you to know this schizont image on blood smear.

Merozoites then invade RBCs (erythrocytic phase). Once inside the RBC, the merozoites mature into **ring-shaped** trophozoites, followed by new schizonts containing new merozoites.



Then the RBCs periodically burst, causing fever patterns. Trophozoites do not develop prior to the schizonts in the liver. So in short, the *Anopheles* mosquito injects *Plasmodium* into the host, then:

Hepatic (exo-erythrocytic) stage: sporozoite → schizont → merozoites → leave liver.

Erythrocytic stage: merozoite → ring-shaped trophozoite → schizont → merozoites → burst RBC (causes fever).

As mentioned above, *Plasmodium falciparum* is the most severe type and causes cerebral malaria (neurologic deficits, seizures, headache), with greatest chance of death. The fever pattern is variable.

USMLE wants you to know that patients with *P. falciparum* can get **hypoglycemia** due to increased consumption of glucose by the organism. This is an answer on one of the NBME exams, where they give a simple vignette of malaria and then ask what is most likely to be seen in this patient, and the answer is hypoglycemia. Strikes students as weird, but it's on the NBME.

Chloroquine can be given as prophylaxis, which inhibits malarial **heme polymerase**. However, some regions have high levels of chloroquine resistance, so mefloquine can be given instead. If they tell you a patient was given chloroquine and develops malaria anyway, the answer USMLE wants is “pharmacologic resistance”; the wrong answer is “non-compliance with medication.”

P. vivax and *ovale* cause tertian fever (every 48 hours; or every 3rd day). They form **hypnozoites** within the liver, which is a latent form. This is one of the highest yield details regarding malaria, where they will say a patient with the disease was treated successfully, but then months later has a resurfacing of symptoms.

Patients with *P. vivax* and *ovale* must receive **primaquine, which kills hypozoites**. I've seen the USMLE ask this numerous ways. They can ask for primaquine as the answer straight up. They can ask why primaquine is given for *P. vivax* and *ovale*, where the answer is “kills hypozoites.” I've also seen “kills the exo-erythrocytic stage.”

P. malariae causes a more mild form of malaria and a quartan fever (every 72 hours; or every 4th day).

P. knowlesi is found predominantly in southeast Asia and causes a quotidian (daily) fever.

Malaria is diagnosed with **thick and thin blood smears**. This is asked on NBME, where “*Plasmodium* antigen testing” is wrong answer.

Toxoplasma gondii

Classically acquired from contact with infected cats, or via consumption of pork.

Toxoplasmosis presents as one or more ring-enhancing lesions on CT of the head. Can be in the context of seizures and/or miscellaneous neurologic symptoms as a result of the CNS infection.

Patient need not be immunocompromised, but HIV patients with CD4 count <100 are at greater risk.

Prophylaxis is trimethoprim/sulfamethoxazole (TMP/SMX), which is the same as that for *Pneumocystis jirovecii* at a CD4 count of 200. So if a patient with a CD4 count of, e.g., 47, commenced TMP/SMX at CD4 count of 200 + has a seizure + ring-enhancing lesion, you know the diagnosis is not Toxo, since he/she is already on prophylaxis. The diagnosis in this case is primary CNS lymphoma (HY for AIDS under CD4 count of 100).

Treatment for Toxo is sulfadiazine + pyrimethamine. This is asked on a 2CK form, where they list both TMP/SMX and sulfadiazine + pyrimethamine; the latter is correct.

Congenital Toxo in neonates presents as a triad of: 1) hydrocephalus, 2) chorioretinitis, and 3) intracranial calcifications.

Cryptosporidium parvum

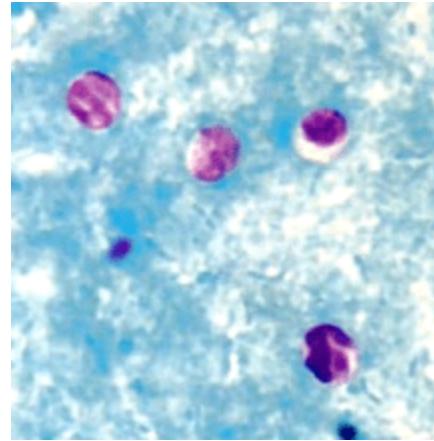
Acquired as cysts in fresh water. Organisms that are acquired as cysts in fresh water are ECG → *Entamoeba*, *Cryptosporidium*, *Giardia*.

Causes watery diarrhea in person who goes overseas to third-world country (e.g., Mexico).

Diarrhea is self-limiting in immunocompetent persons → Tx = supportive care.

Chronic diarrhea can occur in immunocompromised (e.g., HIV) → Tx = nitazoxanide.

Appears as **acid-fast cysts** (same stain as TB).

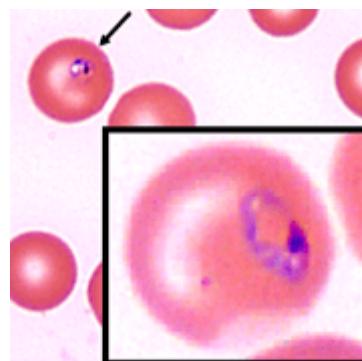


Babesia

Spread by *Ixodes* tick, same as Lyme disease (*Borrelia burgdorferi*), *Ehrlichia*, and *Anaplasma*.

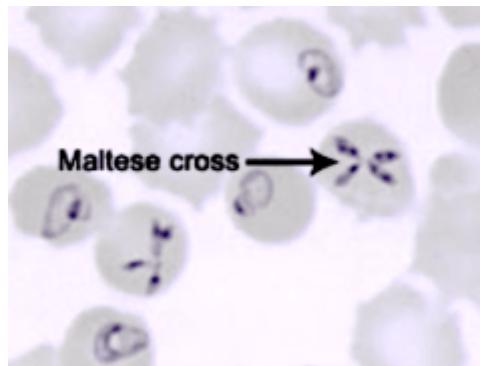
Causes malaria-like hemolytic disease **in patient who never left the United States**. In contrast, if the patient left the United States and went to (usually) Africa, the answer is malaria, not *Babesia*.

Can cause a ring-form on blood smear similar to malaria.



What the USMLE will do is tell you patient has fever + hemolytic disease of some kind + never left the US + show you above image; they will list both malaria and babesiosis as answers → answer = babesia. Even though you're aware malaria can also produce a similar-appearing ring-form, since the patient never left the US, you know it can't be malaria. Conversely, if they show you ring-form and tell you patient recently went to Africa, you know it's malaria, not babesia.

You also need to know *Babesia* can cause a maltese cross within RBCs:



1. **Question:** What protozoa causes malaria?
Answer: Plasmodium species (P. vivax, P. ovale, P. falciparum, P. malariae)
2. **Question:** What are the primary vectors for malaria?
Answer: Female Anopheles mosquitoes.
3. **Question:** What is the life cycle of Plasmodium in humans?
Answer: Sporozoites infect the liver, develop into schizonts, release merozoites, and infect red blood cells.
4. **Question:** What is the most severe species of Plasmodium?
Answer: Plasmodium falciparum.
5. **Question:** What stain is used to identify malaria in blood smears?
Answer: Giemsa stain.
6. **Question:** What is the treatment for P. falciparum malaria?
Answer: Artemisinin-based combination therapy (ACT).
7. **Question:** Which Plasmodium species cause relapsing malaria?
Answer: P. vivax and P. ovale.
8. **Question:** How is relapsing malaria treated?
Answer: Primaquine for liver hypnozoites.
9. **Question:** What protozoa cause toxoplasmosis?
Answer: Toxoplasma gondii.
10. **Question:** What is the primary transmission route of Toxoplasma gondii?
Answer: Ingestion of oocysts from cat feces or undercooked meat.
11. **Question:** What are the symptoms of congenital toxoplasmosis?
Answer: Chorioretinitis, hydrocephalus, and intracranial calcifications.
12. **Question:** What is the treatment for toxoplasmosis?
Answer: Pyrimethamine and sulfadiazine.
13. **Question:** What protozoa cause African sleeping sickness?
Answer: Trypanosoma brucei gambiense and T. brucei rhodesiense.

14. Question: What is the vector for African sleeping sickness?

Answer: Tsetse fly.

15. Question: What are the clinical stages of African sleeping sickness?

Answer: Hemolymphatic stage and CNS involvement.

16. Question: What is the treatment for African sleeping sickness?

Answer: Suramin for blood stage; melarsoprol for CNS stage.

17. Question: What protozoa cause Chagas disease?

Answer: Trypanosoma cruzi.

18. Question: What is the vector for Chagas disease?

Answer: Reduviid bug ("kissing bug").

19. Question: What are the symptoms of acute Chagas disease?

Answer: Romana sign (unilateral periorbital swelling), fever, and lymphadenopathy.

20. Question: What are the symptoms of chronic Chagas disease?

Answer: Cardiomyopathy, megacolon, and megaesophagus.

21. Question: What is the treatment for Chagas disease?

Answer: Benznidazole or nifurtimox.

22. Question: What protozoa cause leishmaniasis?

Answer: Leishmania species (L. donovani, L. major, etc.).

23. Question: What is the vector for leishmaniasis?

Answer: Sandfly.

24. Question: What are the forms of leishmaniasis?

Answer: Cutaneous, mucocutaneous, and visceral.

25. Question: What is the treatment for visceral leishmaniasis?

Answer: Amphotericin B or miltefosine.

26. Question: What protozoa cause amebiasis?

Answer: Entamoeba histolytica.

27. Question: How is amebiasis transmitted?

Answer: Fecal-oral route via cyst ingestion.

28. Question: What are the symptoms of amebiasis?

Answer: Dysentery, liver abscess (anchovy paste), and abdominal pain.

29. Question: What is the treatment for amebiasis?

Answer: Metronidazole followed by a luminal agent like paromomycin.

30. Question: What protozoa cause giardiasis?

Answer: Giardia lamblia.

31. Question: How is giardiasis transmitted?

Answer: Ingestion of cysts from contaminated water.

32. Question: What are the symptoms of giardiasis?

Answer: Steatorrhea, bloating, and diarrhea.

33. Question: What is the treatment for giardiasis?

Answer: Metronidazole or tinidazole.

34. Question: What protozoa cause cryptosporidiosis?

Answer: Cryptosporidium species (C. parvum, C. hominis).

35. Question: How is cryptosporidiosis transmitted?

Answer: Ingestion of oocysts in contaminated water.

36. Question: What are the symptoms of cryptosporidiosis?

Answer: Watery diarrhea, especially in immunocompromised hosts.

37. Question: What is the treatment for cryptosporidiosis?

Answer: Nitazoxanide.

38. Question: What protozoa cause trichomoniasis?

Answer: Trichomonas vaginalis.

39. Question: How is trichomoniasis transmitted?

Answer: Sexual contact.

40. Question: What are the symptoms of trichomoniasis?

Answer: Vaginitis with frothy discharge and strawberry cervix.

41. Question: What is the treatment for trichomoniasis?

Answer: Metronidazole for both partners.

Question: What protozoa cause babesiosis?

Answer: Babesia species (e.g., Babesia microti).

Question: What is the vector for babesiosis?

Answer: Ixodes tick.

Question: What are the symptoms of babesiosis?

Answer: Fever, hemolytic anemia, and "Maltese cross" on blood smear.

Question: What is the treatment for babesiosis?

Answer: Atovaquone and azithromycin or clindamycin and quinine.

Question: What protozoa cause balantidiasis?

Answer: Balantidium coli.

Question: How is balantidiasis transmitted?

Answer: Fecal-oral route.

Question: What are the symptoms of balantidiasis?

Answer: Dysentery and abdominal pain.

Question: What is the treatment for balantidiasis?

Answer: Tetracycline or metronidazole.

Question: What helminths cause schistosomiasis?

Answer: Schistosoma species (S. mansoni, S. haematobium, S. japonicum).

Question: What is the intermediate host for Schistosoma?

Answer: Freshwater snails.

Question: What are the symptoms of schistosomiasis?

Answer: Hematuria, liver fibrosis, and portal hypertension.

Question: What is the treatment for schistosomiasis?

Answer: Praziquantel.

Question: What helminth causes hydatid disease?

Answer: Echinococcus granulosus.

Question: What is the definitive host of Echinococcus granulosus?

Answer: Dogs.

Question: What is the intermediate host of Echinococcus granulosus?

Answer: Sheep or humans (accidental).

Question: What are the symptoms of hydatid disease?

Answer: Liver cysts, lung involvement, and anaphylaxis if cysts rupture.

Question: What is the treatment for hydatid disease?

Answer: Surgical removal and albendazole.

Question: What helminths cause ascariasis?

Answer: Ascaris lumbricoides.

Question: How is ascariasis transmitted?

Answer: Ingestion of eggs from contaminated soil.

Question: What are the symptoms of ascariasis?

Answer: Intestinal obstruction and respiratory symptoms.

Question: What is the treatment for ascariasis?

Answer: Albendazole or mebendazole.

Question: What helminth causes strongyloidiasis?

Answer: Strongyloides stercoralis.

Question: How is strongyloidiasis transmitted?

Answer: Skin penetration by larvae in soil.

Question: What are the symptoms of strongyloidiasis?

Answer: Diarrhea, weight loss, and autoinfection in immunocompromised hosts.

Question: What is the treatment for strongyloidiasis?

Answer: Ivermectin.

Question: What helminths cause hookworm infection?

Answer: Ancylostoma duodenale and Necator americanus.

Question: How are hookworms transmitted?

Answer: Skin penetration by larvae in soil.

Question: What are the symptoms of hookworm infection?

Answer: Iron-deficiency anemia and eosinophilia.

Question: What is the treatment for hookworm infection?

Answer: Albendazole or mebendazole.

Question: What helminth causes filariasis?

Answer: Wuchereria bancrofti.

Question: What is the vector for filariasis?

Answer: Mosquitoes.

Question: What are the symptoms of filariasis?

Answer: Elephantiasis and lymphatic obstruction.

Question: What is the treatment for filariasis?

Answer: Diethylcarbamazine.

Question: What helminth causes trichinosis?

Answer: Trichinella spiralis.

Question: How is trichinosis transmitted?

Answer: Ingestion of undercooked pork or bear meat.

Question: What are the symptoms of trichinosis?

Answer: Muscle pain, fever, and periorbital edema.

Question: What is the treatment for trichinosis?

Answer: Albendazole or mebendazole.

Question: What helminth causes taeniasis?

Answer: Taenia saginata (beef tapeworm) or Taenia solium (pork tapeworm).

Question: How is taeniasis transmitted?

Answer: Ingestion of cysticerci in undercooked meat.

Question: What are the symptoms of taeniasis?

Answer: Mild gastrointestinal discomfort.

Question: What is the treatment for taeniasis?

Answer: Praziquantel.

Question: What helminth causes neurocysticercosis?

Answer: Taenia solium.

Question: How is neurocysticercosis transmitted?

Answer: Ingestion of T. solium eggs.

Question: What are the symptoms of neurocysticercosis?

Answer: Seizures and intracranial calcifications.

Question: What is the treatment for neurocysticercosis?

Answer: Albendazole or praziquantel with corticosteroids.

Question: What helminth causes enterobiasis?

Answer: Enterobius vermicularis (pinworm).

Rhinovirus

Most common cause of common cold (i.e., upper respiratory tract infection, with coryza, dry cough, no exudates, and no fever).

Nothing else you need to know.

Coxsackie A

Causes hand-foot-mouth disease, which presents as vesicles on – you'd never guess it – the hands, feet, and mouth. Almost always a pediatric condition, but adults can sometimes get it as well.

Can also cause herpangina, which is oropharyngeal vesicles.

Coxsackie B

Causes myocarditis with dilated cardiomyopathy.

Can cause diabetes mellitus type I in susceptible patients. The immune system develops antibodies against a viral oligopeptide that cross-reacts with intra-beta-islet cell glutamic acid decarboxylase-65. Hence this one of the reasons why anti-GAD-65 antibodies are positive in some patients with type I DM.

Can cause pleurodynia, which is intercostal muscle spasm presenting with sharp, lateral chest pain, sometimes with an increase in serum CK due to the muscle spasm. Despite its name, it has nothing to do with the lungs and is an MSK condition. It shows up twice on the NBME content for 2CK. For Step 1, I'd still know what it is.

Echovirus

Common cause of aseptic (viral) meningitis.

CSF analysis for viral meningitis is: normal protein; normal glucose; elevated lymphocytes.

Poliovirus

Infects the anterior horns of the spinal cord and causes polio myelitis (inflammation of spinal cord).

Classically causes degeneration of motor neurons in one leg, leading to one leg much smaller than the other leg.

Highest yield points about Polio actually have zero to do with the infection and almost all to do with the vaccines.

Salk vaccine = killed intramuscular.

Sabin vaccine = live-attenuated oral.

Only the live-attenuated vaccine is capable of generating a CD8+ T-cell response and IgA secretion in the gut.

This is because only live virus can invade the cell, leading to expression on MHC-I (which interacts with CD8). This occurs within the gut, since the vaccine is oral, so the Peyer's patches in the ileum can be stimulated to make gut IgA.

The killed intramuscular vaccine can't produce a CD8+ T cell response because killed virus can't invade the cell. And since it doesn't have exposure to the gut, there won't be gut IgA produced.

USMLE will ask what is a common feature of these vaccines that accounts for their efficacy → answer = "neutralizing antibodies in the circulation." Both the killed and oral are capable of generating IgG antibodies in the circulation.

In short: only Sabin does CD8+ response and gut IgA production; both Salk and Sabin produce IgG in circulation.

If you're confused about the immuno, I talk about this stuff in my [HY Immuno PDF](#).

Hepatitis A

The answer for acute hepatitis in the United States most of the time. The Q might say the patient had recent travel to Mexico.

Fecal-oral; only causes acute hepatitis.

ALT is usually > AST for viral hepatitis.

IgM against HepA means acute infection.

IgG against HepA means patient has cleared infection (because there is no chronic HepA).

USMLE wants you to know HepA vaccine is indicated for **MSM and IV drug users**. The latter in particular sounds weird, since HepA isn't parenteral, but it's asked. There's a 2CK NBME Q where they just mention otherwise healthy MSM, and answer is Hep A vaccination. Students are confused, but I don't know what to tell you.

Hepatitis E

Causes fulminant hepatitis / high risk of death in pregnant women.

Same as with HepA, only causes acute hepatitis.

Seen more in Asia, e.g., Tibet. But if USMLE says Mexico + pregnant woman + fast death from hepatitis, you still have to use your head and know that's HepE over HepA.

Norovirus (Norwalk virus)

Most common cause of watery diarrhea in adults and rotavirus-vaccinated children.

Cruise ships and business conferences are buzzy places to acquire (fecal-oral); basically any place with high density of people.

If the Q says a young child + family all have watery diarrhea, the answer is Norwalk, not Rota, since only the young child would get Rota, not the family also.

Rotavirus

Most common cause of watery diarrhea in unvaccinated children < 5 years. Immigrant status (e.g., from China) often implies unvaccinated status on USMLE.

Vaccine normally given orally at 2, 4, and 6 months of age.

Double-stranded, segmented RNA (NBME asks it). Wheel-shaped (also asked on NBME).

Coltivirus

Causes Colorado tick fever, which is a flu-like illness. Mostly occurs in Western USA.

1. **Question:** Which virus causes diabetes mellitus type I?

Answer: Coxsackie B virus. Causes diabetes mellitus type I in susceptible patients. The immune system develops antibodies against a viral oligopeptide that cross-reacts with intra-beta-islet cell glutamic acid decarboxylase-65. Hence, anti-GAD-65 antibodies are positive in some patients with type I DM.

2. **Question:** What is the taxonomy/categorization of rotavirus?
Answer: Double-stranded, segmented RNA. Wheel-shaped. Most common cause of watery diarrhea in unvaccinated children under 5 years.
3. **Question:** What is the taxonomy/categorization of coltivirus?
Answer: Causes Colorado tick fever, a flu-like illness occurring mostly in Western USA.
4. **Question:** What is the taxonomy/categorization of echovirus?
Answer: Common cause of aseptic (viral) meningitis. CSF analysis: normal protein, normal glucose, elevated lymphocytes.
5. **Question:** What does rhinovirus cause?
Answer: Most common cause of the common cold (upper respiratory tract infection with coryza, dry cough, no exudates, and no fever).
6. **Question:** What is the taxonomy/categorization of rhinovirus?
Answer: RNA virus, icosahedral, non-enveloped.
7. **Question:** What does coxsackie B virus cause?
Answer: Causes myocarditis with dilated cardiomyopathy, diabetes mellitus type I, and pleurodynia.
8. **Question:** Which virus has a wheel shape?
Answer: Rotavirus.
9. **Question:** Which virus causes pleurodynia?
Answer: Coxsackie B virus. Intercostal muscle spasm presenting with sharp, lateral chest pain.
10. **Question:** What location in the body does poliovirus specifically like to invade? What does it cause?
Answer: Infects the anterior horns of the spinal cord, causing poliomyelitis and motor neuron degeneration.
11. **Question:** Which virus causes hand-foot-mouth disease?
Answer: Coxsackie A virus. Presents as vesicles on hands, feet, and mouth.
12. **Question:** How are hepatitis A and E differentiated?
Answer: Hepatitis A is acute hepatitis often linked to recent travel. Hepatitis E causes fulminant hepatitis, particularly in pregnant women.
13. **Question:** What is the difference in immunologic effect between Sabin and Salk polio vaccines?
Answer: Sabin (live-attenuated oral) generates a CD8+ T-cell response and gut IgA production. Both Sabin and Salk (killed intramuscular) produce IgG in circulation.
14. **Question:** Which virus is the most common cause of the common cold?
Answer: Rhinovirus.
15. **Question:** What does coltivirus cause?
Answer: Colorado tick fever.

16. **Question:** What does echovirus cause?
Answer: Aseptic meningitis.
17. **Question:** Cruise ships/business conferences/crowded areas + watery diarrhea = which virus?
Answer: Norovirus (Norwalk virus).
18. **Question:** Which virus causes herpangina?
Answer: Coxsackie A virus.
19. **Question:** What is a high-yield cause of viral (aseptic) meningitis?
Answer: Echovirus.
20. **Question:** What does HepA IgG positivity mean?
Answer: Indicates the patient has cleared HepA infection (no chronic HepA).
21. **Question:** What does USMLE want you to know about the structure of rotavirus?
Answer: Double-stranded, segmented RNA. Wheel-shaped. Vaccine normally given at 2, 4, and 6 months of age.
22. **Question:** 1-year-old child from China with watery diarrhea. Most likely diagnosis?
Answer: Rotavirus.
23. **Question:** What does Norovirus (Norwalk virus) cause?
Answer: Watery diarrhea in adults and rotavirus-vaccinated children.
24. **Question:** What is the taxonomy/categorization of Norovirus (Norwalk virus)?
Answer: RNA virus, icosahedral, non-enveloped.
25. **Question:** Apart from endemic areas, which two patient groups require HepA vaccine?
Answer: Men who have sex with men (MSM) and IV drug users.
26. **Question:** What does coxsackie A virus cause?
Answer: Hand-foot-mouth disease and herpangina.
27. **Question:** What is the taxonomy/categorization of poliovirus?
Answer: RNA virus, icosahedral, non-enveloped.
28. **Question:** What is the taxonomy/categorization of hepatitis E virus?
Answer: RNA virus, icosahedral, non-enveloped.
29. **Question:** Which virus likes to invade the anterior horns of the spinal cord?
Answer: Poliovirus.
30. **Question:** What is the taxonomy/categorization of coxsackie A and B?
Answer: RNA virus, icosahedral, non-enveloped.
31. **Question:** Which virus causes myocarditis and dilated cardiomyopathy?
Answer: Coxsackie B virus.

Alphavirus

Causes some obscure brain infection in a farmer called equine encephalitis. Asked maybe once on an old NBME form somewhere.

Rubella (aka German measles)

Causes fever and head-to-toe maculopapular rash in unvaccinated children (and adults).

HY point about the presentation is that it causes **post-auricular and sub-occipital lymphadenopathy**.

Adults can get arthritis. For example, if the USMLE gives you a neonate with congenital rubella syndrome + they ask what symptom the woman most likely had when pregnant, arthritis can be an answer if rash is not listed. USMLE will not force you to choose between rash and arthritis. The point is that you merely are aware arthritis is HY in adults as part of the presentation.

Congenital rubella presents as patent ductus arteriosus (PDA) in a neonate.
Exceedingly HY / pass-level. Cataracts and deafness also possible.

MMR vaccine is live-attenuated and is contraindicated during pregnancy due to theoretical risk to the fetus. If a woman inadvertently receives the vaccine while pregnant or within the month prior to pregnancy, it is not an indication for abortion, but risks to the fetus are increased and proper monitoring is important.

The vaccine is not contraindicated in HIV. Literature says subjectively can be implemented in patients who are severely immunocompromised with consideration of CD4 count, but there is no specific CD4 cutoff. The point is, MMR vaccine is avoided in pregnancy, but not avoided in HIV.

Hepatitis C

Parenteral; can be acute or chronic.

Transmitted almost exclusively from IV drugs/blood exposure. Not present in breastmilk and non-sanguineous body fluids (in contrast to HepB).

In contrast to HepB, HepC is not considered sexually transmitted. Large longitudinal study of couples with one HepC(+) partner showed sexual transmission almost nil

(possibly due to menses exposure). If you're forced to choose for FM / behavioral science Qs, however, still inform that abstinence or barrier contraception minimizes risk.

Hepatocellular damage is due to T cells / death is due to T-cell-mediated apoptosis, not direct viral cytopathicity. This is the highest yield point for HepC on USMLE.

No vaccine due to antigenic variation (i.e., >7 genotypes and 80 subtypes of HepC exist).

IgM against HepC means acute infection.

IgG against HepC means usually means chronic HepC.

Many drugs can be used to treat. USMLE doesn't care. You could in theory be aware of pegylated interferon-a.

West Nile virus

Asked once on an old, offline NBME. USMLE wants you to know it has a bird reservoir and is spread by *Culex* mosquito.

Presents as flu-like illness in most people. The NBME Q simply gives patient with headache and fever + they say the causal organism is spread by *Culex* mosquito and has a bird reservoir → answer = West Nile virus.

Dengue virus

Spread usually by *Aedes* mosquito.

Causes flu-like illness + thrombocytopenia (bleeding gums, petechiae, etc.) + severe joint and abdominal pain.

Yellow fever virus

Spread usually by *Aedes* mosquito.

Causes flu-like illness and jaundice (hence yellow fever) due to hepatocellular damage. Councilman bodies are seen on biopsy of the liver, which are apoptotic bodies.

Zika virus

Spread usually by *Aedes* mosquito.

Causes microcephaly in neonates if mother exposed while pregnant.

Human T-cell lymphotropic virus

Retrovirus similar to HIV.

Causes a cutaneous T-cell lymphoma, known as mycosis fungoides, which appears like a skin rash.



Mycosis fungoides

If this extends to the blood as a T-cell leukemia, it is now called Sezary syndrome. Sezary syndrome usually presents with diffusely red skin, called erythroderma.



Sezary syndrome

Both mycosis fungoides and Sezary syndrome are characterized by cerebriform-shaped cells on light microscopy.

HTLV can also cause an obscure condition called tropical spastic paraparesis, which is antibodies against neuronal cells leading to otherwise unexplained neurodegeneration over weeks to months.

Hepatitis D

Requires hepatitis B in order to infect, which can be due to co-infection (happening at the same time) or superinfection (occurs later in someone who already has HepB).

If USMLE asks how to prevent HepD infection, answer = vaccination against hepatitis **B**. There is no vaccine against HepD.

Apparently HepB antigen forms the envelope for HepD (i.e., forms a circle around HepD).

Human immunodeficiency virus (HIV)

Invades and destroys CD4+ T cells.

Transmitted via blood, IV drug use, and sexually. Also present in breastmilk.

Highly active anti-retroviral therapy (HAART) consists of three drugs: two nucleoside reverse-transcriptase inhibitors (NRTI) + either a non-nucleoside reverse-transcriptase inhibitor (NNRTI) or protease inhibitor.

Pharmacology for HIV is lengthy and involved, so if you want in depth discussion of all of the drugs, you can open as a separate tab my [HIV pharm module here](#).

HAART therapy is initiated immediately upon diagnosis of HIV. We do not wait for CD4 count to fall to a certain level before commencing.

Once CD4 count falls below 200/ μ L, patients are started on trimethoprim/sulfamethoxazole (TMP/SMX) for *Pneumocystis jiroveci* pneumonia (PJP) prophylaxis.

NBME has Q where they give you an HIV patient with CD4 count of, e.g., 550, and then ask what type of drug regimen needs to be commenced. Answer in this case is “three drug anti-retroviral therapy alone,” where “three drug anti-retroviral therapy + *Pneumocystis* prophylaxis” is wrong, as well as all answers that say two-drug regimen.

HIV patients with CD4 counts under 200, or those who get any HIV-related opportunistic infection, are said to have Acquired Immunodeficiency Syndrome (AIDS).

Toxoplasmosis comes in with CD4 count under 100. Prophylaxis is TMP/SMX, the same as for PJP, so often times, once TMP/SMX is appropriately commenced at CD4 of 200 for PJP, it’s already “two birds with one stone,” so we don’t have to worry about Toxo prophylaxis later.

However the treatment for Toxo is sulfadiazine + pyrimethamine. For *Pneumocystis* TMP/SMX is both the prophylaxis and treatment. NBME asks the Tx for toxo on one of the forms, where TMP/SMX is also listed and wrong. So you need to know the prophylaxes + treatments for Toxo and PJP.

Under CD4 counts of 50-100, *Mycobacterium avium intracellulare* and **CMV** infections can occur. MAI causes lung infections similar to TB, and also sometimes GI infections. CMV causes retinitis. Blurry vision in an HIV patient is CMV retinitis till proven otherwise.

In addition, progressive multifocal leukoencephalopathy (PML; neuronal degeneration caused by reactivation of **JC polyoma virus**), primary CNS lymphoma, and AIDS complex dementia (presents as wet, wobbly, wacky, similar to normal pressure hydrocephalus) can occur at CD4 counts <50-100.

The USMLE might give you a patient with CD4 count of 47 who has ring-enhancing lesion of the brain who is taking HAART and TMP/SMX. Diagnosis is primary CNS lymphoma; Toxo is wrong. The way we know Toxo is wrong is because the patient is on TMP/SMX, which is the prophylaxis for both *Pneumocystis* **and** Toxo. Commencing TMP/SMX at a CD4 count of 200 for PJP, as I already said, is “two birds with one stone” by the time the patient gets to CD4 of 100, which is when Toxo comes in. It’s only patients who aren’t on TMP/SMX by the time they fall to CD4 of 100 who get Toxo.

Causes *Cryptococcal neoformans* meningitis, which presents with low glucose, high protein, and high lymphocytes. Diagnosed with CSF latex agglutination (most accurate), or India ink prep, or mucicarmine staining.

Adults with severe acute-onset seborrheic dermatitis, disseminated scabies, or molluscum contagiosum should have an HIV test.

HIV increases risk of squamous cell carcinoma in MSM.

HIV can cause focal segmental glomerulosclerosis (FSGS), a nephrotic syndrome. When HIV leads to renal disease, it is called HIV nephropathy. It is almost always FSGS.

HIV can lead to chronic diarrhea caused by *Cryptosporidium parvum*, whereas immunocompetent patients clear it. *C. parvum* is a protozoan (unicellular eukaryote).

Can be a cause of anemia of chronic disease (low Hb, low iron, normal ferritin).

Patients with HIV require Pap smear at time of diagnosis, and then every year (annually) thereafter (asked on Obgyn forms). Normally, Paps are performed every three years from age 21, and then every 5 years from age 30 with HPV co-testing.

To prevent vertical transmission, the most important measure to take is HAART therapy while pregnant + keeping the mother’s viral load as low as possible. She will then receive intrapartum zidovudine, C-section is performed, and then the neonate will receive 6 weeks of zidovudine commenced within 12 hours of birth. Some students will get pedantic about various alternative/updated regimens for neonates, but one of the NBMEs assesses this point about 6 weeks of zidovudine commenced within 12 hours of birth.

Question: What brain infection is associated with Alphavirus?

Answer: Causes some obscure brain infection in a farmer called equine encephalitis. Asked maybe once on an old NBME form somewhere.

Question: What are the key clinical features of Rubella in children and adults?

Answer: Causes fever and head-to-toe maculopapular rash in unvaccinated children (and adults). Post-auricular and sub-occipital lymphadenopathy are high-yield points. Adults can get arthritis.

Question: How does congenital Rubella present in neonates?

Answer: Presents as patent ductus arteriosus (PDA), cataracts, and deafness.

Question: Why is the MMR vaccine contraindicated during pregnancy?

Answer: It is live-attenuated and poses theoretical risks to the fetus. However, inadvertent administration is not an indication for abortion but requires proper monitoring.

Question: How is Hepatitis C transmitted, and what are its clinical implications?

Answer: Transmitted via IV drugs/blood exposure. It is not sexually transmitted and has nearly nil sexual transmission. Hepatocellular damage is due to T-cell-mediated apoptosis.

Question: Why is there no vaccine for Hepatitis C?

Answer: Due to antigenic variation (>7 genotypes and 80 subtypes).

Question: How is West Nile virus spread, and what is its reservoir?

Answer: Spread by Culex mosquito with a bird reservoir. Presents as flu-like illness.

Question: How does Dengue virus present?

Answer: Causes flu-like illness, thrombocytopenia, and severe joint and abdominal pain. Spread by Aedes mosquito.

Question: What is a hallmark finding in Yellow Fever?

Answer: Jaundice due to hepatocellular damage, and Councilman bodies seen on liver biopsy.

Question: How does Zika virus affect neonates?

Answer: Causes microcephaly if the mother is exposed during pregnancy.

Question: What are Mycosis fungoides and Sezary syndrome?

Answer: Mycosis fungoides is a cutaneous T-cell lymphoma presenting as a skin rash. If it extends to the blood, it becomes Sezary syndrome, presenting as erythroderma.

Question: How does Hepatitis D require Hepatitis B?

Answer: Hepatitis D requires Hepatitis B for co-infection or superinfection. Prevention is through vaccination against Hepatitis B.

Question: What are the opportunistic infections associated with low CD4 counts in HIV?

Answer: At CD4 < 200: Pneumocystis jiroveci pneumonia (PJP).

At CD4 < 100: Toxoplasmosis and CMV retinitis.

At CD4 < 50: MAI, CMV, PML, and primary CNS lymphoma.

Question: What renal condition is associated with HIV?

Answer: Focal segmental glomerulosclerosis (FSGS), known as HIV nephropathy.

Question: How is HAART therapy initiated for HIV?

Answer: Initiated immediately upon diagnosis with three drugs: two NRTIs and either an NNRTI or a protease inhibitor.

Question: How is vertical transmission of HIV prevented?

Answer: HAART during pregnancy, intrapartum zidovudine, C-section, and neonatal zidovudine for six weeks.

Question: What are the prophylaxis and treatment options for Pneumocystis jiroveci and Toxoplasmosis?

Answer: TMP/SMX is both prophylaxis and treatment for PJP. Prophylaxis for Toxo is TMP/SMX, while treatment is sulfadiazine + pyrimethamine.

Question: Which organism causes chronic diarrhea in HIV patients?

Answer: Cryptosporidium parvum.

Question: What are three unusual indications for HIV testing?

Answer: Severe acute-onset seborrheic dermatitis, disseminated scabies, or molluscum contagiosum.

Question: What is AIDS dementia complex?

Answer: Presents as wet, wobbly, and wacky, similar to normal pressure hydrocephalus, occurring at CD4 counts < 50-100.

Coronavirus

The virus specifically known as SARS-CoV-2, or COVID-19, caused the 2019 global pandemic.

SARS stands for Severe Acute Respiratory Syndrome.

The pandemic is believed to have started following a laboratory leak in Wuhan, China, although this has been a source of political debate, where initial explanations asserted that there was a natural, zoonotic origin for the virus (i.e., originating from animals, e.g., bats).

Has characteristic spike proteins that create a crown-like appearance on electron microscopy.

The spike proteins bind to ACE2 receptor, allowing for viral fusion with host respiratory epithelium.

Presentation can range from mild respiratory symptoms similar to the common cold (rhinovirus) all the way to severe respiratory disease with multi-organ failure.

Many different vaccine types exist – i.e., mRNA (Moderna; delivers mRNA coding for the spike protein), viral vector (AstraZeneca; delivers mRNA in a harmless viral capsid), and killed (Sinovac; delivers inactivated, killed virus).

Both live viral infection as well as vaccination are known to cause rare adverse effects, such as Bell's palsy and myocarditis, although these effects are not unique to coronavirus and can rarely happen with many viral infections and vaccines.

Vaccination mandates and their political implications were (and still are) a source of contentious debate.

Prior to the 2019 pandemic, coronavirus was known to cause SARS in China in 2002 and Middle Eastern Respiratory Syndrome (MERS) in Saudi Arabia in 2012.

Vaccination schedule for children now recommends IM vaccine starting at 6 months; 2-3-doses.

[**Hantavirus**](#)

Causes pulmonary syndrome and hemorrhagic fever.

Spread by rodents/mice.

This virus is known to get rarely asked on Step 1, where they apparently mention hantavirus in the vignette in a patient with a fatal hemorrhagic pulmonary syndrome, and then the answer is just “mice” for how it’s acquired.

Influenza

Causes respiratory distress, fever, and myalgias (muscle pain). For USMLE purposes, the **myalgias** are exceedingly HY as a vignette finding that usually suggests the flu over other diagnoses.

Has 8 segments, two of which are hemagglutinin and neuraminidase.

Hemagglutinin mediates viral attachment to the cell by enabling its binding at sialic acid receptors.

If a question asks about the molecule most flu vaccines are targeted against, the answer is hemagglutinin.

Neuraminidase allows for newly synthesized viral particles to leave the host cell. This enzyme cleaves sialic acid residues, which normally bind the new viral particles within the cell. Once these residues are cleaved, the viral particles can leave the cell.

Drugs such as oseltamivir and zanamivir are sialic acid analogues that function as neuraminidase competitive inhibitors. In other words, they prevent the virus from leaving the cell. If the USMLE asks which drug prevents viral spread within a community, or they tell you a drug is given and now host cells are “packed with virions” (because they can’t leave the cell), the answer is one of the -mivirs.

Antigenic drift is **point mutations** in hemagglutinin and/or neuraminidase, where the virus has changed slightly. It leads to seasonal epidemics.

Antigenic shift is due to two influenza viruses entering a cell, one of human origin, the other of animal origin (such as bird or swine), where they engage in **reassortment of viral segments**, leading to a completely novel influenza virus. It leads to generational pandemics.

If a patient gets a bacterial lobar pneumonia following recent convalescence from influenza infection, USMLE likes *S. aureus* as a HY cause. The USMLE will not play trivia where they list *S. aureus* alongside *S. pneumo* and you’re forced to choose. What

they'll do is say something about how a guy recently recovered from a viral illness in which he had high fever and myalgias, and now he has a pneumonia caused by a gram-positive coccus in clusters → answer = *S. aureus*. In contrast, *S. pneumo* is gram-positive diplococci.

Vaccine is given **fall or winter** every year. USMLE really cares about this. So much so, they will sometimes say "April" in a vignette, where giving flu vaccine is wrong, or they'll say "January" or "October," where giving it is correct.

IM killed vaccine: start age 6 months, then give yearly throughout life; safe to give during pregnancy.

Intranasal live-attenuated vaccine: ages 2-45; immunocompetent, non-pregnant persons only.

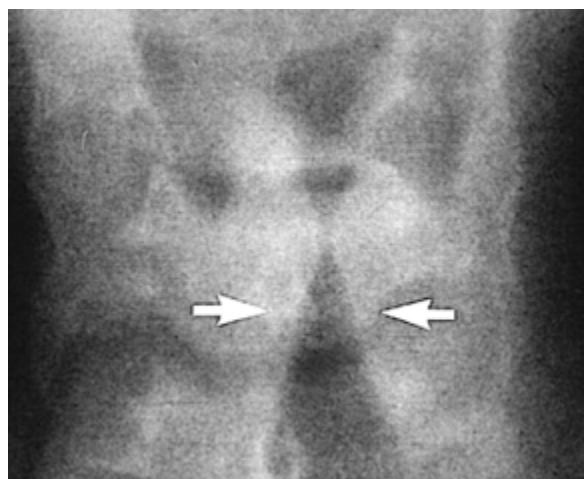
Parainfluenza virus

Aka paramyxovirus.

Causes laryngotracheobronchitis (croup).

Presents as hoarse, barking, or seal-like cough in school-age kid. The Q can say the cough gets better when his dad brings him out into the cold air.

Neck x-ray shows "steeple sign," which is sub-glottic narrowing.



Don't confuse the steeple sign of croup with the thumbprint sign of epiglottitis caused by *H. influenzae* type B.

Sometimes the Q can give you easy vignette of croup, but then the answer is just "larynx" (literally inflammation of the larynx, trachea, and the bronchi). "Sub-glottic" means below the area of the vocal cords. The larynx is the area encompassing the vocal cords.

Tx is supportive. If they force you to choose an actual Tx, however, nebulized racemic epinephrine is the answer.

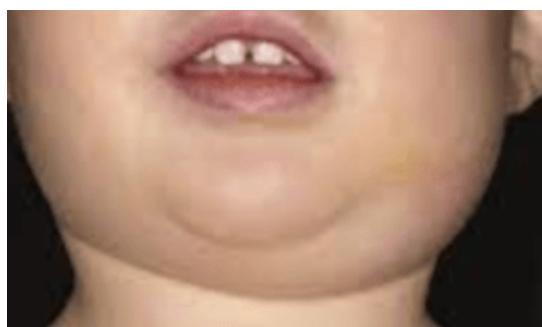
Respiratory syncytial virus (RSV)

Answer on USMLE for a kid <18 months old who has low-grade fever and bilateral wheezes.

Tx is supportive care on USMLE. Don't choose answers like ribavirin or palivizumab.

Mumps

Causes POM → Parotitis, Orchitis, Meningitis.



Doesn't typically cause rash.

Vaccine is MMR, which is live-attenuated.

Measles

Aka rubeola; causes a head-to-toe macular popular rash.

The notion of “cough, coryza, conjunctivitis” as = measles is absolute garbage and a flaming joke. No idea why there have been resources over the years that have perpetuated this trash. These symptoms are non-specific for viral infections in general (e.g., rhinovirus, RSV, etc.). I frequently see students get easy NBME Qs wrong where they think measles is the diagnosis in the setting of these symptoms.

Can cause Koplik spots (pathognomonic whiteish lesions on buccal mucosa).



MMR vaccine is live-attenuated; contraindicated in pregnancy; not contraindicated in HIV.

Immigrant Hx on USMLE sometimes implies unvaccinated status.

Can rarely cause subacute sclerosing panencephalitis (reactivation of latent infection in the CNS in teenagers).

Rubella also causes a head-to-toe macular popular rash, but rather than Koplik spots, suboccipital and post-auricular lymphadenopathy (tenderness on back of head and behind ears) is characteristic.

Rabies

Causes encephalomyelitis that is nearly always fatal.

Spread by the bite or scratch of infected animals, such as bats, skunks, raccoons, and wild dogs.

Travels up peripheral nerves to the CNS. Has very long incubation period of >1-3 months before symptoms appear.

Presents as flu-like illness that progresses to neurologic features, as well as pathognomonic findings such as hydrophobia (fear of water), aerophobia (fear of drafts of air), and hyper-salivation.

Negri bodies are characteristic inclusions seen on electron microscopy of infected neurons.

Ebola

Causes hemorrhagic disease, where patient initially has flu-like illness, followed by development of internal and external bleeding, leading to death nearly always.

Bats are the most likely reservoir, with human-human spread occurring via contact with bodily fluids (i.e., blood, vomitus, feces, sweat).

As of 2019, a recombinant vaccine was created (rVSV-ZEBOV) that has been shown to be 98% effective.

What is the taxonomy/categorization of Ebola virus?

Ebola virus is categorized as a helical RNA virus.

Which symptom of influenza virus presentation does USMLE really like as part of the presentation?

Myalgias (muscle pain) are exceedingly high-yield (HY) and usually suggest the flu over other diagnoses.

What is the taxonomy/categorization of coronavirus?

Coronavirus is a helical RNA virus.

What time of year do we give the influenza vaccine? What is the difference in administration between IM killed vs. intranasal live-attenuated vaccines?

- The vaccine is given in fall or winter every year.
- IM killed vaccine: starts at age 6 months, given yearly throughout life, safe during pregnancy.
- Intranasal live-attenuated vaccine: for ages 2-45, only for immunocompetent, non-pregnant persons.

How many segments does the influenza virus have? What are the two most important ones for USMLE, and what do they do?

- Influenza has 8 segments.
- Hemagglutinin mediates viral attachment by binding to sialic acid receptors.
- Neuraminidase allows newly synthesized viral particles to leave the host cell.

What is the taxonomy/categorization of the influenza virus?

Influenza is a helical RNA virus.

What is the main presentation for measles?

Measles (rubeola) causes a head-to-toe macular popular rash and Koplik spots on the buccal mucosa.

What is seen on neck x-ray in croup vs. epiglottitis?

- Croup: "Steeple sign" (sub-glottic narrowing).
- Epiglottitis: "Thumbprint sign" caused by *H. influenzae* type B.

How does rabies travel through the body, and what is special about its incubation? What are its pathognomonic symptoms?

- Rabies travels up peripheral nerves to the CNS, with a long incubation period (>1-3 months).
- Symptoms: hydrophobia (fear of water), aerophobia (fear of drafts), and hyper-salivation.

How does RSV bronchiolitis present on USMLE, and how is it treated?

- Presentation: Low-grade fever and bilateral wheezes in a child <18 months old.
- Treatment: Supportive care.

What is the molecular mechanism via which coronavirus enters the cell?

- Spike proteins bind to the ACE2 receptor, allowing viral fusion with host respiratory epithelium.

What does parainfluenza virus cause?

- It causes laryngotracheobronchitis (croup), presenting as a hoarse, barking, seal-like cough, which improves in cold air.

What is the taxonomy/categorization of mumps and measles?

Mumps and measles are helical RNA viruses.

What does hantavirus cause, and how is it spread?

- Hantavirus causes pulmonary syndrome and hemorrhagic fever.
- Spread by rodents/mice.

What is the most likely virus associated with *S. aureus* lobar pneumonia after a viral infection?

- Influenza virus.

What does Ebola cause? How is it spread? Is there a vaccine?

- Ebola causes hemorrhagic disease.
- Spread via bodily fluids (e.g., blood, vomitus, feces).
- Vaccine: rVSV-ZEBOV (98% effective).

What are Negri bodies?

- Characteristic inclusions seen on electron microscopy of infected neurons.

What is the taxonomy/categorization of parainfluenza virus?

Parainfluenza virus is a helical RNA virus.

What's the mechanism of action of oseltamivir and zanamivir?

- These drugs are sialic acid analogues that inhibit neuraminidase, preventing viral particles from leaving the host cell.

Which virus causes POM (Parotitis, Orchitis, Meningitis)?

- Mumps virus.

What is the taxonomy/categorization of hantavirus?

Hantavirus is a helical RNA virus.

What is the taxonomy/categorization of rabies virus?

Rabies virus is a helical RNA virus.

What kind of vaccine is measles, and in whom is it contraindicated?

- Measles vaccine is live-attenuated.
- Contraindicated in pregnancy.

What is the diagnosis for a 10-month-old with low-grade fever and bilateral wheezes?

- RSV bronchiolitis.

What does mumps cause, and what kind of vaccine is used?

- Causes POM (Parotitis, Orchitis, Meningitis).
- Vaccine: MMR (live-attenuated).

What is the taxonomy/categorization of RSV?

RSV is a helical RNA virus.

What is a very rare presentation for measles that can occur in teenagers?

- Subacute sclerosing panencephalitis (reactivation of latent infection in the CNS).

What does rabies cause, and how is it spread?

- Rabies causes encephalomyelitis.
- Spread by bites or scratches from infected animals (e.g., bats, skunks).

What is antigenic drift vs. shift, and what is the mechanism of each? Which is worse?

- Drift: Point mutations in hemagglutinin/neuraminidase, leading to seasonal epidemics.
- Shift: Reassortment of viral segments from human and animal influenza viruses, leading to pandemics.
- Shift is worse.

Spirochetes are a group of bacteria with a corkscrew- or question mark-shape that are visualized using a method called dark-field microscopy.

You don't need to know the following for USMLE, but I will clarify for some students who ask: even though *H. pylori* also has spiral-shape similar to spirochetes, it is not a spirochete. Apparently, spirochetes are unique in that they use axial filaments or endoflagella for movement, whereas other bacteria use "regular flagella."

Treponema pallidum

Causes syphilis.

Spirochete (spiral/cork screw-shaped bacterium) visible under dark-field microscopy.

Primary syphilis = **painless** chancre (painless ulcer) on genitalia.

Don't confuse the painless chancre of primary syphilis with chancroid, which is a painful chancre-appearing lesion (-oid means "looks like but ain't") caused by the bacterium *Haemophilus ducreyi*.

Secondary syphilis = 6 weeks to 6 months after appearance and disappearance of the initial chancre, patient can get body rash that **includes palms + soles**, and condylomata lata (painless genital plaques). Don't confuse condylomata lata with condylomata acuminata (genital warts).

Tertiary syphilis = years later, patient can get gummas (appear as painless chancres but are on other areas of the body such as the face/nose), arthritis, and ascending aortitis (tree-barking of vasa vasorum).

Neurosyphilis **can occur at any stage**; it is not sequential where we have 1 → 2 → 3 → neurosyphilis. There is a 2CK Neuro Q that gives neurosyphilis in an 18-year-old.

Neurosyphilis presents as tabes dorsalis (obliteration of dorsal columns, with loss of vibration/proprioception + a positive Romberg sign, where patient falls over when standing with eyes closed), Argyll-Robertson pupil (i.e., "prostitute pupil"; accommodates but doesn't react), and "stroke without hypertension" (i.e., sometimes findings akin to stroke but in a younger patient).

Diagnosis of primary syphilis is made via visualizing the spirochetes from a chancre scraping under dark-field microscopy.

Diagnosis of secondary, tertiary, and neurosyphilis can be done with serology, where a VDRL and/or RPR is done first (sensitive but not specific); an FTA is done as confirmatory (specific but not sensitive).

VDRL test mixes the patient's serum with cardiolipin antigen. If antibodies against *T. pallidum* are present, the test demonstrates clumping/flocculation. The RPR enhances this reaction by using charcoal particles. There is an NBME Q floating around where

they say something about a patient whose test results demonstrate clumping with charcoal particles, and the answer is SLE.

Patients with SLE who have anti-phospholipid syndrome can get false-positive VDRL/RPR tests because this syndrome is often caused by antibodies against cardiolipin (in SLE, we simply call these antibodies “lupus anticoagulant”).

FTA mixes a patient's serum with fluorescent *Treponema* antibodies. If binding occurs, this confirms the diagnosis of syphilis.

USMLE will show you 24-year-old male with rash on his back + KOH prep is negative + ask what's most likely to diagnose→ answer = FTA.

Treatment for all syphilis types is penicillin.

If patient has Hx of anaphylaxis to beta-lactams but is pregnant or has tertiary or neurosyphilis, the answer is desensitize + give penicillin. This is because penicillin is the most efficacious and needs to be given in severe cases.

If patient has Hx of mere rash to beta-lactams, but not anaphylaxis, then the beta-lactam can be given anyway.

Killing of *T. pallidum* spirochetes can sometimes cause a hypersensitivity-type response by the immune system known as Jarisch-Herxheimer reaction. USMLE will say patient was given penicillin for syphilis + gets fever, chills, and myalgias. This is different from beta-lactam allergy, which would be a rash or anaphylaxis (swelling + low BP).

Congenital syphilis can cause tooth abnormalities (mulberry molars/incisors), “saber shins” (bone abnormalities), saddle nose, deafness, and cataracts. There is NBME Q floating around where they are vague + give basically no info apart from “tooth abnormalities,” where the answer is congenital syphilis. So this finding is especially important for USMLE.

Borellia burgdorferi

Spirochete; spiral/corkscrew-shaped.

Causes lyme disease; spread by *Ixodes* tick (same as *Ehrlichia*, *Babesia*, and *Anaplasma*).

Primary Lyme causes a classic target rash known as erythema chronicum migrans, but a HY point is that the rash need not be a target on USMLE. It can merely be circular with no clearing, but the target is classic.

Bells palsy can also be seen in primary Lyme. What the USMLE will do is give two side by side images: 1) circular rash on limb that is not a target; 2) Bells palsy, where the student needs to infer this is Lyme disease even though rash isn't a target, since Bells palsy is HY for Lyme.

Secondary Lyme tends to cause arthritis. Some sources say Bell's palsy is part of secondary Lyme (occurs at least one month after initial infection), but I've seen USMLE give it as part of initial/primary infection.

Tertiary Lyme can cause CNS and/or heart problems.

Treatment is doxycycline for most cases of Lyme.

Ceftriaxone is given for advanced Lyme involving the CNS or heart.

For children <8 and pregnant women, give amoxicillin in place of doxycycline.

There is an NBME Q of a pregnant woman with non-disseminated Lyme, where ceftriaxone is correct over doxycycline, and amoxicillin isn't listed. In other words, if USMLE doesn't want doxy as the answer, they will not play trivia as to whether it's ceftriaxone or amoxicillin to be used as the alternative. But you could be aware that, in theory, ceftriaxone is harder-hitting and preferred if cases are more severe.

Borellia recurrentis

Causes a condition known as relapsing fever.

Spread by body lice, not *Ixodes* tick the way Lyme disease is.

Leptospira interrogans

Question mark-shaped spirochete.

Leptospirosis can present as flu-like illness, jaundice, pulmonary hemorrhage, and meningoencephalitis.

It is usually spread by **animal urine**.

There's two ways USMLE asks *Leptospira*:

- 1) They'll be hyper-obvious and say there's a farmer with a weird, flu-like illness where he was walking in animal urine. Answer is just simply *Leptospira*.
- 2) They'll give easy vignette of syphilis or Lyme disease, followed by asking which of the following organisms is most taxonomically similar (i.e., which of the following is also a spirochete), and the answer is just *Leptospira*.

Mycobacterium tuberculosis

Has unique cell wall composed of mycolic acid that is difficult to gram stain. Requires acid-fast stain.

Produces **cord factor** (asked on NBME) as a virulence factor.

Can present similar to lung cancer, where patient can have B symptoms (i.e., fever, night sweats, weight loss) and hemoptysis.

Living in a homeless shelter or immigrant status from endemic area is buzzy. I've seen rural India and Albania as two locations in NBME Qs. Prisoners/prison workers, healthcare workers, and TB laboratory personnel are of course at risk as well.

Can cause cavitations and calcification in the lung grossly; on histo, causes caseating granulomatous inflammation.

Ghon foci/complexes are textbook descriptors for TB lesions but not assessed eponymously on USMLE. A Ghon focus is a localized area of inflammation. If lymph nodes are involved, the combination of the lesion + lymph node(s) is called a Ghon complex.

Can cause constrictive pericarditis (can also calcify).

Disseminated TB (miliary TB) can affect multiple organ systems, leading to **psoas abscess**, **Pott disease** (TB infection of the vertebrae), adrenal insufficiency, meningitis, osteomyelitis, and arthritis.

First step in diagnosis is PPD test (type IV hypersensitivity).

If PPD test is (+), the next best step is CXR.

If PPD is (+) but CXR (-), next best step is “treat for latent TB,” or “give TB prophylaxis.” This is isoniazid (INH) for 9 months + vitamin B6 (since INH can cause B6 deficiency). It is exceedingly HY you know that neuropathy in a patient being treated for TB has B6 deficiency.

If PPD and CXR are both (+), the next best step is “treat for active TB,” which is RIPE for 2 months + RI for 4 more months (6 months total). RIPE = rifampin, isoniazid, pyrazinamide, ethambutol.

BCG vaccine is live-attenuated. USMLE wants you to know Hx of BCG vaccine does not change management based on PPD guidelines.

If USMLE asks you how long after TB exposure will someone’s sputum cultures be positive, the answer is 2-5 weeks.

Interferon-gamma release assay (Quantiferon Gold) can be used in patients who have Hx of BCG to reduce false (+)s, but USMLE doesn’t assess it. The reason I mention it is because they want you to know interferon-gamma is required for stimulation of alveolar macrophages to control TB.

Patients who have IFN-gamma or IL-12 receptor deficiency have susceptibility to TB infections. If this immuno stuff sounds confusing, I talk about this in detail in my HY Immuno PDF.

TNF-alpha is also required to suppress TB. Therefore drugs such as infliximab, adalimumab, and etanercept increase risk of TB, which is why they should be avoided in silicosis patients (who have increased risk of TB).

What is considered a positive PPD test (in terms of # of mm of induration) differs depending on risk factors:

What is considered a positive PPD test (in terms of # of mm of induration) differs depending on risk factors:

>5mm (+): Hx of close contact to someone with active TB; immunocompromised patient (AIDS, organ transplant recipient receiving immunosuppressants, chronic corticosteroid user); calcification on CXR.

>10mm (+): Health care worker or prisoner/prison worker; immigrant from endemic area; TB laboratory personnel, children <4.

>15mm (+): everyone else.

If a PPD test is (+), never repeat it. If it is negative, it must be repeated in 1-2 weeks (i.e., sometimes false-negatives).

Rifampin is a DNA-dependent RNA polymerase (just remember “RDR” → Rifampin DNA-dependent RNA polymerase). It can cause orange tears/secretions. It also upregulates P-450.

Isoniazide is a mycolic acid synthesis inhibitor. It can cause B6 deficiency (neuropathy and/or seizures) and high anion-gap metabolic acidosis (the I in MUDPILES refers to isoniazid/iron tablets). It also inhibits P-450.

Pyrazinamide inhibits fatty acid synthesis.

Ethambutol inhibits carbohydrate synthesis (arabinosyl transferase). It causes optic neuritis, sometimes with changes in color vision.

Mycobacterium leprae

Causes leprosy; affects skin and peripheral nerves.

Highest yield point for USMLE is that ***M. leprae* grows best at cooler temperatures**, which is why it affects areas like the nose and peripheral nerves. Shows up on an NBME Q where they ask what is most characteristic of the causal organism, and the answer is something like “temperature sensitive.”

Dapsone is used as part of the treatment. It’s HY to know it can cause hemolysis in G6PD.

Mycobacterium avium intracellulare

MAI can cause lung infections similar in presentation to TB; can also cause GI infections. These types of infections are classically seen in immunocompromised patients (i.e., AIDS with CD4 count <50). Azithromycin prophylaxis is no longer indicated for AIDS patients.

MAI can also cause an obscure pneumonitis called “hot tub lung,” which can occur in immunocompetent patients. Shows up on an NBME exam as guy who moved into new apartment building with a hot tub. MAI present in hot tub vapors can cause lung inflammation (hence pneumonitis).

Mycobacterium marinum

Causes red lesion(s) on finger/hand in workers at, or kids who go to, water parks/aquariums.

USMLE will give *Pseudomonas* and *S. aureus* as distractors. So be aware of *M. marinum* as buzzy cause of skin infection associated with water parks and aquariums.

Mycobacterium scrofulaceum

Causes lymphadenopathy in the neck, sometimes with a skin lesion. Not HY, but you can be aware it exists.

What's the MOA of ethambutol in the treatment of TB? What's its notable side-effects?

- MOA: Inhibits carbohydrate synthesis (arabinosyl transferase).
- Side effects: Causes optic neuritis, sometimes with changes in color vision.

What kind of heart problem can TB notably cause?

- Constrictive pericarditis (can also calcify).

What does TB affect in the lung grossly versus on histology?

- Grossly: Cavitations and calcification.

- Histology: Caseating granulomatous inflammation.

How is syphilis treated?

- Penicillin for all types of syphilis.
- If history of anaphylaxis to beta-lactams but the patient is pregnant or has tertiary/neurosyphilis: Desensitize and give penicillin.
- If history of a mere rash to beta-lactams: Beta-lactam can still be given.

How is syphilis diagnosed (i.e., which tests are done)? How do the tests work?

- Diagnosis of primary syphilis: Dark-field microscopy of chancre scraping.
- Secondary, tertiary, and neurosyphilis: VDRL/RPR (sensitive, not specific) followed by FTA (specific, not sensitive).
- VDRL: Clumping/flocculation with cardiolipin antigen.
- RPR: Enhances reaction with charcoal particles.
- FTA: Fluorescent Treponema antibody confirms diagnosis.

Patients with SLE can have a false-positive result on which tests regarding spirochetes?

- VDRL/RPR due to anti-cardiolipin antibodies ("lupus anticoagulant").

Who classically gets TB on USMLE?

- People living in homeless shelters, immigrants from endemic areas, prisoners/prison workers, healthcare workers, and TB lab personnel.

What is Jarisch-Herxheimer reaction?

- A hypersensitivity-type response (fever, chills, myalgias) following penicillin treatment for syphilis due to spirochete killing. Not an allergic reaction.

Which organism causes red lesions on the fingers/hands in workers or kids at water parks/aquariums?

- Mycobacterium marinum.

Which organism causes Lyme disease? How do primary, secondary, and tertiary Lyme present?

- Organism: *Borrelia burgdorferi*.
- Primary: Erythema migrans (target rash, not always classic), Bell's palsy.
- Secondary: Arthritis.

- Tertiary: CNS and heart problems.

What does Borrelia recurrentis cause?

- Relapsing fever.
- Spread by body lice.

24-year-old male with a rash on his back and negative KOH prep. Most likely test for diagnosis?

- Fluorescent Treponema Antibody (FTA).

Which organism causes a lesion that can be confused with the primary chancre of syphilis?

- Haemophilus ducreyi (chancre, painful).

Which Mycobacterium species likes to grow at cooler temperatures?

- Mycobacterium leprae.

What's the MOA of pyrazinamide in the treatment of TB? What's its notable side-effect?

- MOA: Inhibits fatty acid synthesis.
- Side effect: Gout.

What is scrofula?

- Lymphadenopathy in the neck caused by Mycobacterium scrofulaceum.

What does Leptospira cause? What shape is it?

- Cause: Leptospirosis (flu-like illness, jaundice, pulmonary hemorrhage, meningoencephalitis).
- Shape: Question mark-shaped spirochete.

How does neurosyphilis present? At what stage does it occur?

- Presentation: Tabes dorsalis, Argyll-Robertson pupil, "stroke without hypertension."
- Can occur at any stage.

Which organism causes "hot tub lung?"

- *Mycobacterium avium intracellulare*.

Patients with which two immunodeficiencies have susceptibility to TB?

- IFN-gamma or IL-12 receptor deficiency.

Which organism causes syphilis? How do primary, secondary, and tertiary syphilis present?

- Organism: *Treponema pallidum*.
- Primary: Painless chancre.
- Secondary: Rash (including palms/soles), condylomata lata.
- Tertiary: Gummas, arthritis, ascending aortitis.

What locations does *Mycobacterium leprae* like to grow? Why?

- Locations: Nose and peripheral nerves.
- Reason: Cooler temperatures.

How does *Mycobacterium avium intracellulare* present on USMLE?

- Lung infections (like TB), GI infections, or “hot tub lung.”

Patients with which pneumoconiosis have increased susceptibility to TB?

- Silicosis.

List the four organisms spread by Ixodes tick.

- *Borrelia burgdorferi*, *Ehrlichia*, *Babesia*, *Anaplasma*.

Which organism produces cord factor?

- *Mycobacterium tuberculosis*.

What are the RIPE drugs for TB? What are their MOAs and notable side-effects?

- Rifampin: Inhibits DNA-dependent RNA polymerase; orange secretions, P-450 induction.
- Isoniazid: Inhibits mycolic acid synthesis; B6 deficiency, P-450 inhibition.
- Pyrazinamide: Inhibits fatty acid synthesis; gout.
- Ethambutol: Inhibits carbohydrate synthesis; optic neuritis.

Patient treated for syphilis gets fever, chills, and myalgias. Diagnosis?

- Jarisch-Herxheimer reaction.

How does miliary TB present?

- Disseminated TB affecting multiple systems: Psoas abscess, Pott disease, adrenal insufficiency, meningitis.

What's the MOA of rifampin in the treatment of TB? What's its notable side-effects?

- MOA: Inhibits DNA-dependent RNA polymerase.
- Side effects: Orange secretions, P-450 induction.

How does congenital syphilis present?

- Tooth abnormalities, saber shins, saddle nose, deafness, cataracts.

When is Mycobacterium marinum the answer?

- Red lesions in water park/aquarium workers.

How does non-disseminated TB often present on USMLE?

- B symptoms (fever, night sweats, weight loss) and hemoptysis.

What's the MOA of isoniazid in the treatment of TB? What's its notable side-effects?

- MOA: Inhibits mycolic acid synthesis.
- Side effects: B6 deficiency, high anion-gap metabolic acidosis.

What is a spirochete? What are the three important spirochetes for USMLE?

- Corkscrew-shaped bacteria (visible via dark-field microscopy).
- Treponema pallidum, Borrelia burgdorferi, Leptospira.

Farmer with flu-like illness after walking through animal urine. Diagnosis?

- Leptospira interrogans.

What is considered a positive PPD test based on the number of millimeters induration?

- 5mm: Close TB contact, immunocompromised.
- 10mm: Healthcare workers, immigrants.

- 15mm: Everyone else.

How do we treat TB based on PPD and chest X-ray results?

- (+)PPD and (-)CXR: Treat latent TB with INH + B6.
- (+)PPD and (+)CXR: Treat active TB with RIPE regimen.

How is Lyme disease treated?

- Doxycycline for most cases.
- Ceftriaxone for CNS/heart involvement.
- Amoxicillin for children <8 or pregnant women.