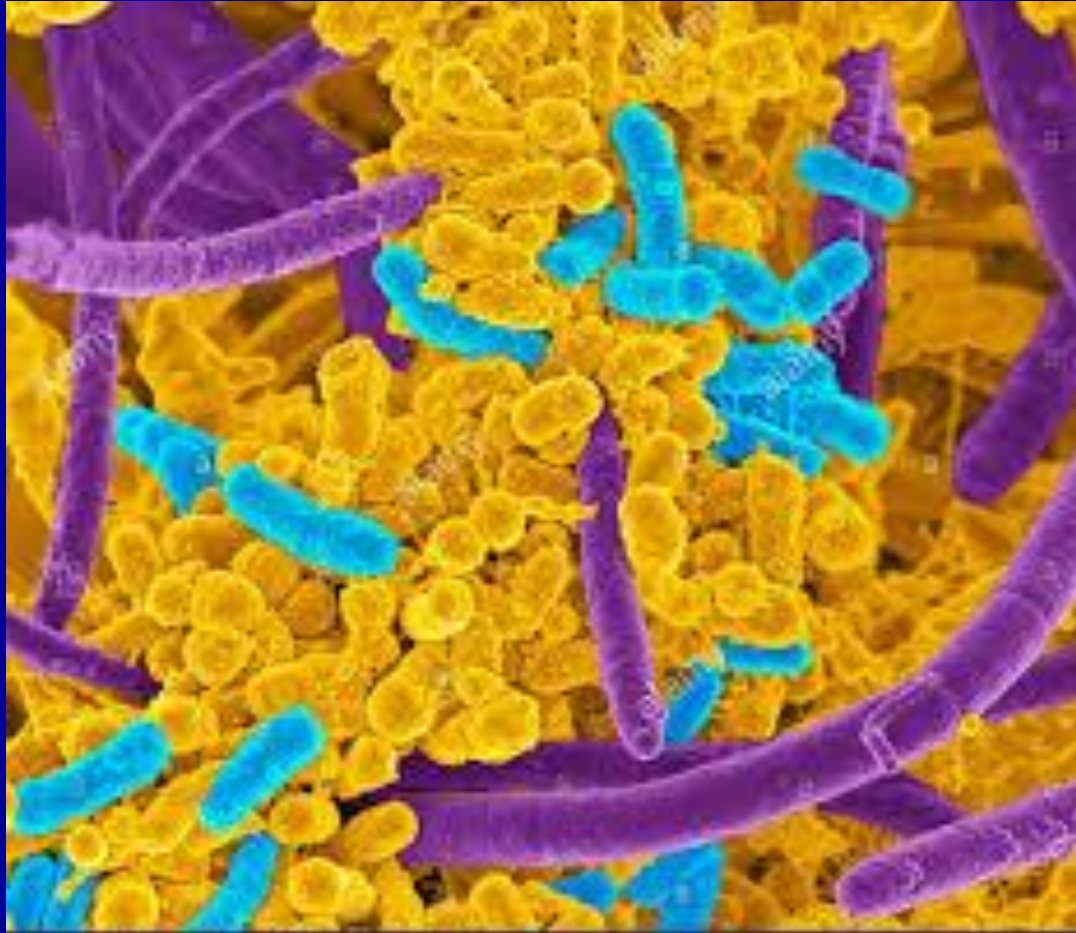


Bacteriology



Around 166 CE Marcus Aurelius, Emperor of Rome sent 3 envoys to the Han Dynasty to open up trade negotiations.



Rome had heard that you could get a lot of good stuff in China cheap. (Actually not.)



They made it and met the Emperor
of China.



This established the Silk Road. Silk, spices, dyes and porcelain flowed from the East, and gold and silver flowed from the West.



We know about this trade mission from the Chinese records. The Roman records were lost as was Rome.



The Huns get the credit.



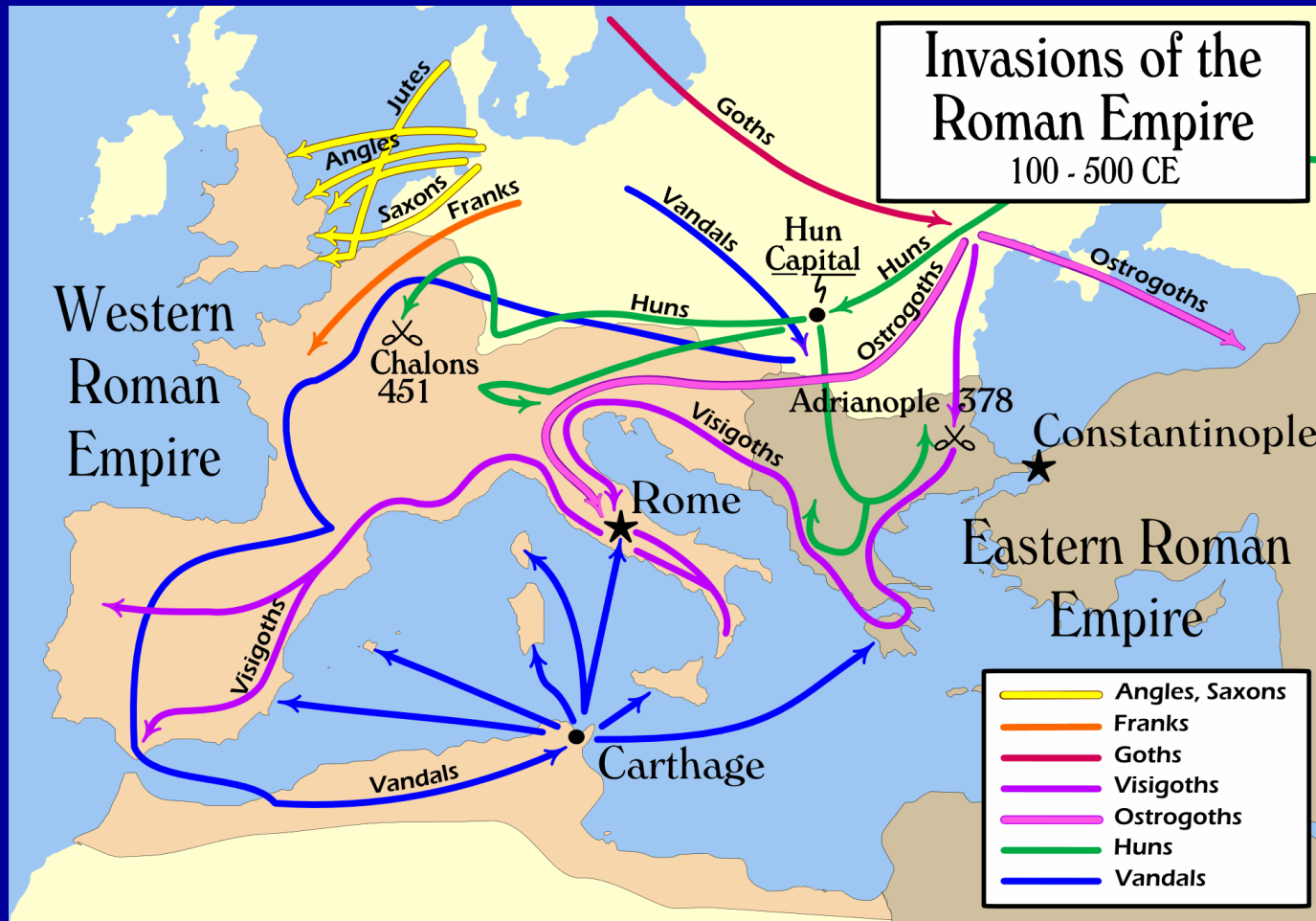
But it was mostly the plague. There was an import on the silk route that Rome hadn't counted on.



Rat's travelled on the caravan's too, burrowing into the silk. Rat's carried fleas, and fleas carried *Yersinia Pestis*



Rome was hit again and again, weakening her legions until finally she could not resist the barbarian hordes.



Rome was history, but the Black Death was just warming up. That's why we call it the dark ages.



The plague

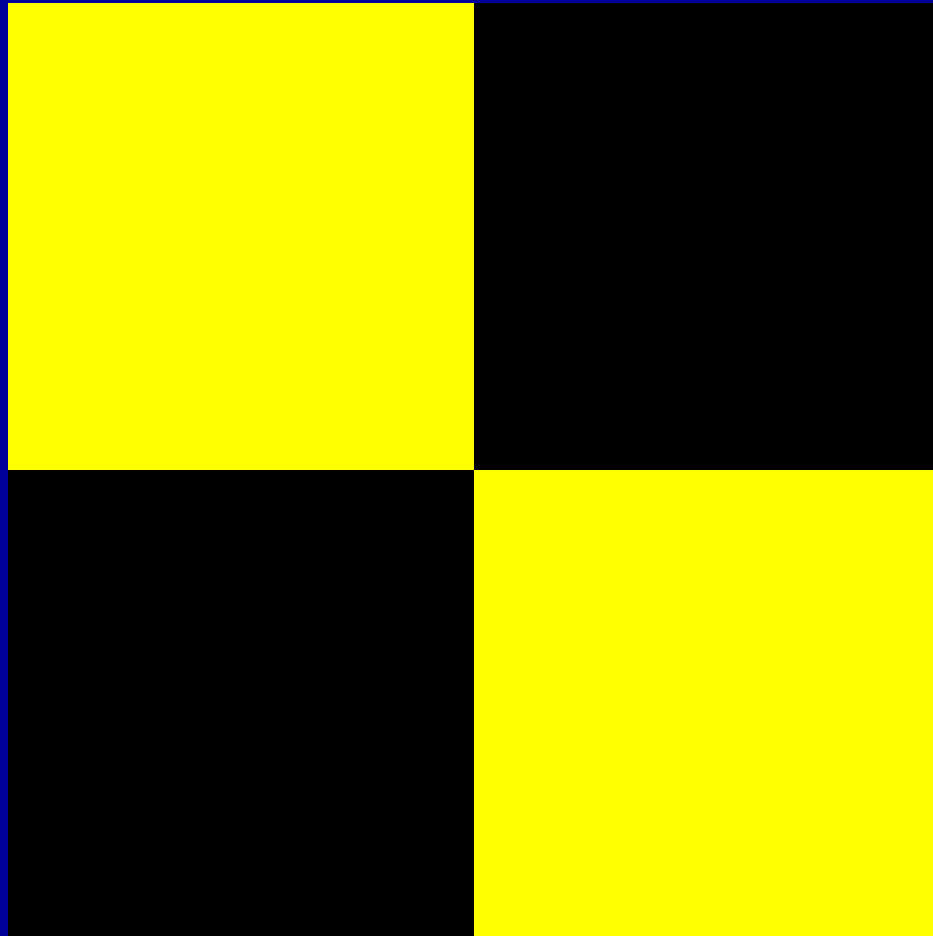
- About every 20 years (when a new crop of people sprang up) the Bubonic plague would visit town to reap that crop. If you caught the plague your chances for survival were about 50/50, which is also true of TB, pneumonia, and a host of other infections before the advent of antibiotics.



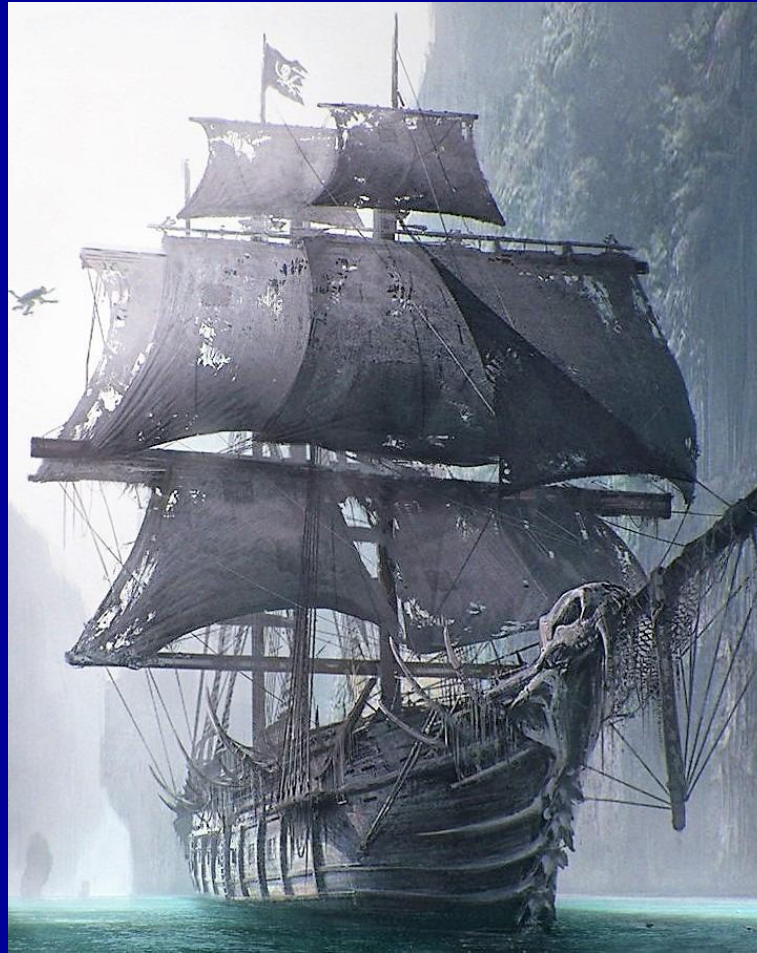
The population of Europe was reduced by about a third, over and over again, and then as now, global trade spread it around.



Rat's love ships and a plague ship could infect a whole city. Plague ships flew the "Yellow Jack" to warn other ships off.



If such a ship did make port it was quarantined (40 days). Any desperate sailors jumping ship would be shot in the water. Sometimes the ship didn't make port. There are accounts of ships, still under sail, manned by a dead crew. Even the rats were dead. If you came across such a ship, you'd stay upwind and set it afire.



Great Fire of London



1666

- Plague struck London and fire broke out too. Huge tracts of the city burned, including Whitehall - Henry VIII's palace, and St Paul's cathedral. The Plague never returned to London in such numbers so common wisdom assumed the plague had been burned out. After that it was standard procedure to burn a city to the ground if it had plague. It didn't actually work, but they kept doing it anyway.
- That's why we have the scientific method. If you test something and it doesn't work, you stop doing it.

Plague was used as a biological weapon against cities. If a city was under siege, they would catapult the bodies of people and animals that had died of the plague over the city walls to infect the inhabitants.



So why did plague not return to London? It wasn't the fire. It was the rebuilding of London after the fire.



William Shakespeare's London was covered with picturesque **thatched** rooves. But a thatch had to be replaced every few years.



England had more money now so they rebuilt with slate and tile and copper rooves; more expensive to put on, but less maintenance once on.



Where is the plague now?

- Another advantage of slate, tile, copper is that rats don't live in it. Plague still existed in London after 1666, but as long as you didn't have rats right over you, dropping fleas on you and inoculating you with the plague it didn't get around as much.
- Plague may still be in NY (DNA traces found in the subway), but again, by separating the source from the host you just don't have that many cases, and those that you do can be knocked out by antibiotics. There hasn't been a major outbreak of plague in the US since 1925 Los Angeles.
- There are some places where Plague is simply endemic, like the Gila valley. There are cases there every year. During the Gulf War they were blamed on Saddam Hussein and his terrorist biological weapons program, ignoring the 500 years before and every year after.

Gila Valley



In the 1960s it was widely thought that by the year 2000, all infectious disease would be wiped out. There was a lot of optimism in the 60's. We made it to the moon.



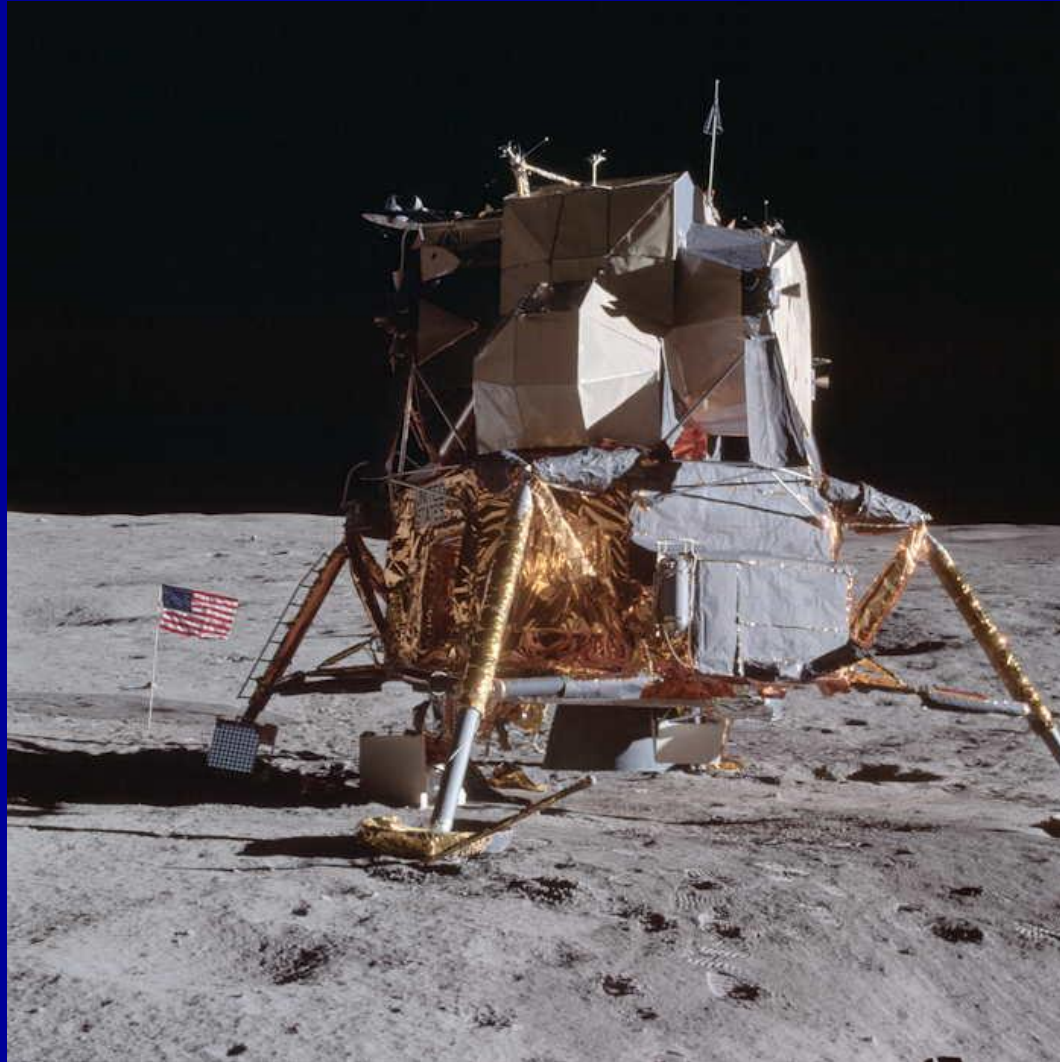
The Mets won the World Series. We thought we could do anything!



But the optimism was misplaced. Bacteria aren't going anywhere!

- Bacteria are the oldest form of life. We sprang from bacteria. It is still the most dominant life form by life mass and number of species, and evolutionary adaptation.
- The original bacteria, archeobacteria, went underground when the earth grew its oxygen envelope. It fills the earth's crust down to 2 miles. It comes up on drillbits all over the world.
- If we find life on **Mars**, it will be bacteria. It is possible that our bacteria – and therefore we – came from space. (Pan spermia)
- It can breed inside the **macrophages** we send to kill it.
- It lives in the cooling piles of nuclear reactors exposed to radiation that would kill anything else.

It's already been to the **moon**.



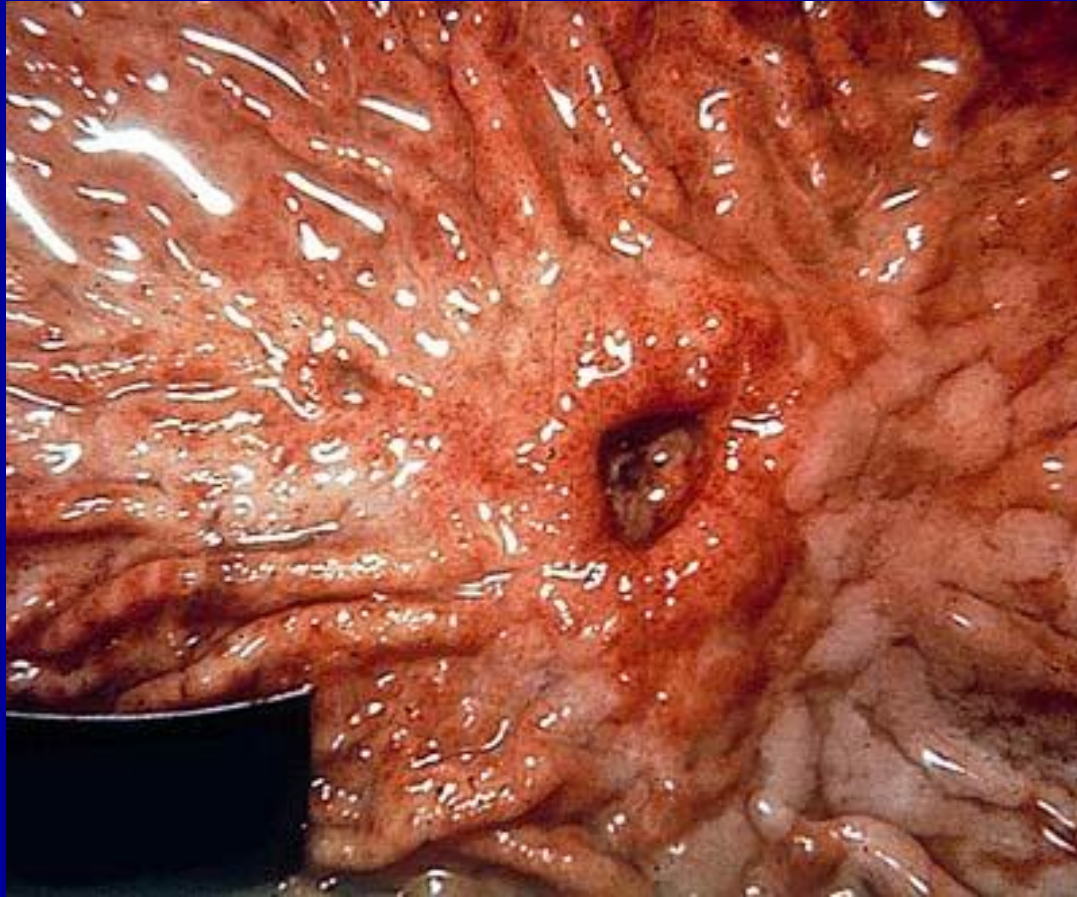
It lives in the great prismatic springs of Yellowstone and it is still viable after being frozen for 30,000 years in Antarctica.



We used to think our relationship with bacteria was adversarial. The truth is much more nuanced.

- Bacteria is neither “good” nor “bad.” It’s trying to stay alive, just like us, and sometimes we get along, sometimes not. The same bacteria can be helpful or harmful depending on where it finds itself in the body and under what conditions.
- A major function of bacteria is recycling. It breaks down cells and tissues, releasing the raw materials back into nature for next generation.
- Without decomposition, there would be no raw materials for rebirth. Everything that ever died would still be lying around.
- Bacteria communicate with each other and with us, influencing our moods, our actions, our choices and our health in ways that are helpful and harmful to us, sometimes both at the same time (*helicobacter pylori*).

Hylobacillus Pyloris can cause gastric ulcers if the immune system is off balance, but it also protects against esophageal cancer



- **In the beginning** we didn't know bacteria existed or were a cause of disease.
- Antony van Leeuwenhoek (1632-1723) constructed his own microscopes and saw bacteria (animalcules)
- Robert Koch and Louis Pasteur (1880s) jointly proposed the 'germ theory' of disease.
- This overturned the prevailing “Miasma” hypothesis that illness was caused by “bad air”.
- Dr John Snow was also a strong proponent of germ theory, tracing a cholera epidemic in London to a single street pump contaminated with feces from a cellar ten feet away. (John Snow does know something.)



1/2 of all human disease is caused by pathogens

- We are no longer hunted by lions tigers and bears, but there are still animals that successfully prey on us. If you don't die of a heart attack or a stroke, chances are some little cootie is going to get you.



It was not always this way.

- Running around in East Africa there were very few people around, they were widely spaced, and they didn't stay in one place. They followed the herds, always moving away from their own excrement. Therefore infection was a low threat.



Wild animals today do not stay in great concentrations in one place, but farm animals do. If they are organic and not treated with antibiotics there is a huge risk of infection.



Workers approaching the chicken enclosures have to wear haz-mat suits so they don't infect the chickens.



The invention of cities was also the invention of widespread disease. Permanent settlements are the result of agriculture. Crops don't move around.



Big concentrations in cities represent several problems. How do you get food and water to the cities, and what do you do with all that poop!



Food was brought in from the surrounding farms into markets. The steak could be walked into the city and the veggies carted in, but that did lead to more poop from all the animals.



Human poop presented a daily problem.
Most people would have a chamber pot.



And dump it out the window



GRIEVANCES OF LONDON.

All this presented a big health concern because a lot of disease is spread by fecal oral contact.

- Consuming fecal matter is an almost universal taboo. There is even a saying about the act which I am sure you know. The main problem is accidental contamination of food and water sources.
- Typhoid Mary was a food service worker. Today every restaurant in the country has a sign, “Employees must wash their hands before leaving the restroom.”
- Half of earaches in kids are caused by fecal oral contact.
- The likelihood of getting hit in the head by a flying turd was probably part of the reason for the popularity of hooded cloaks in the “good old days.”

Cathedral of St Giles



Contaminated drinking water remained a problem.



Without antibiotics, all we could do is improve cities.

- Population of cities topped out at 1 million with a lot of death. The city population was stable only because it was constantly being replenished from the countryside. In the city you would constantly have epidemics of plague, cholera, smallpox. It never ended.
- The major causes of this were the lack of sanitary conditions
 - - no clean water
 - - no sewage system (Fleet Street)
 - - a perishable and contaminated food supply
 - - cramped, unhealthy living conditions
 - - no protection from infection in health care

Clean water was brought into the city.



Croton Aqueduct



The building codes were changed, requiring windows



Dr Semmelwies of Vienna realized that the high mortality rate in childbirth was largely due to doctors not washing their hands.



Universal precautions to control the spread of infectious disease were introduced

- NYS Practice guidelines for massage: Massage therapists will maintain their premises, including supplies, in a sanitary manner. This includes adherence to techniques of communicable disease control (universal precautions).
- Wash your hands before and after each client.
- Wash linens in hot water
- If you reuse bottles, disinfect them too.
- Wash down all massage surfaces with disinfectant. (i.e. a cup of bleach in a gallon of water.) I use isopropyl alcohol right out of the bottle.
- **NEVER TOUCH YOUR FACE DURING A MASSAGE!!!!**

The introduction of antibiotics revolutionized medicine. Alexander Fleming



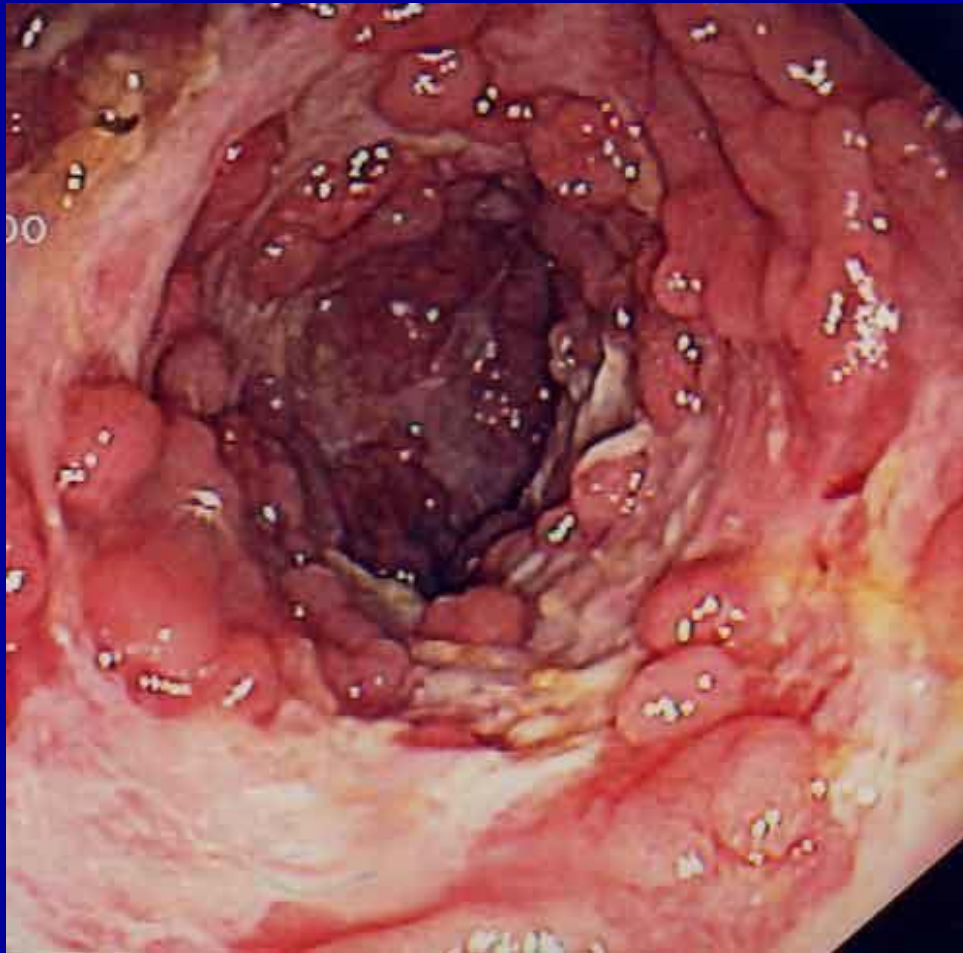
Development of antibiotics

- Many indigenous peoples were aware of the antibiotic properties of some plants and foods.
- Chimpanzees have a well developed cultural pharmacology. They know about aspirin (willow bark), antibiotics and intoxicants.
- Penicillin was (re)discovered in 1928 when bacterial samples were killed by contamination with mold.
- It became widely available after WW II
- Antibiotics damage the cell wall of bacteria and they pop. Since your own cells do not have a cell wall they are unaffected. Thus antibiotics are a “magic bullet” that kills bacteria and leaves your own cells alone.

Based on our incomplete understanding of bacteria we treated it all as bad, with 5 undesirable consequences:

- 1) Antibacterial soap wipes out what is called a biological defense. The existing flora keeps out stuff you don't want by creating an environment uninviting to them. Staph on the hands and strep on your nose protect you against other bacteria. Your whole body is covered in specialists for each body part. Antibacterial soap wipes them out and then the first bacteria that lands after washing (as you're drying) becomes the dominant lifeform, and that may not be what you want. Also, the active ingredient in antibacterial soap (triclosan) weakens skeletal muscle. Antibacterial soap is supposed to be banned by the FDA, but they haven't gotten around to it.
- 2) dysbiosis – antibiotics knock out all the bacteria, including the beneficial bacteria in the gut, leading to a host of diseases. Crone's disease and autism are currently being treated with fecal transplants to restore the biome.

Crohn's Disease



But wait, there's more.

- 3) Rise in allergies. If you are raised too clean, your immune system is uneducated as to what is harmful and what is not. It makes antibodies against harmless materials like pollen.
- 4) Since antibiotics have worked so well for so long people have become careless: TB; syphilis, gonorrhea, chlamydia are all on the rise. Everything old is new again.
- 5) Bacteria have adapted resistance to antibiotics. It now takes 2X as much antibiotics to clear infections as it used to and it is only getting worse. Since antibiotics kill bacteria they select for resistance. The friendly gut bacteria gets the most exposure of all. It gets hit whenever you take oral antibiotics. It has developed some resistance. The problem is bacteria share their DNA via plasmids so the tricks the friendly bacteria have learned ends up in the dangerous bacteria.

2 million Americans/year are infected with multiresistant bacteria and 23K die.

- 1928 penicillin
- 1940's widespread use
- 1955 Staph develops resistance to penicillin (it can make penicillinase)
- 1959 Methicillin developed to work against Staph.
- 1963 Tsutomu Watanabe, dealing with dysentery published a paper on infective heredity.
- 1972 Staph resisted to Methicillin (MRSA)
- 1972 Vancomycin could vanquish all that
- late 1980's harmless Enterococcus bacteria (friendly) resistant to Vancomycin with vanA gene
- late 1990's van A had jumped into Staph
- 2016 a strain of ecoli is resistant to colistin - our last defense. The gene in question is mcr – 1 which rides on a plasmid.
- Resistant microbes kill hundreds of thousands of people annually around the world.

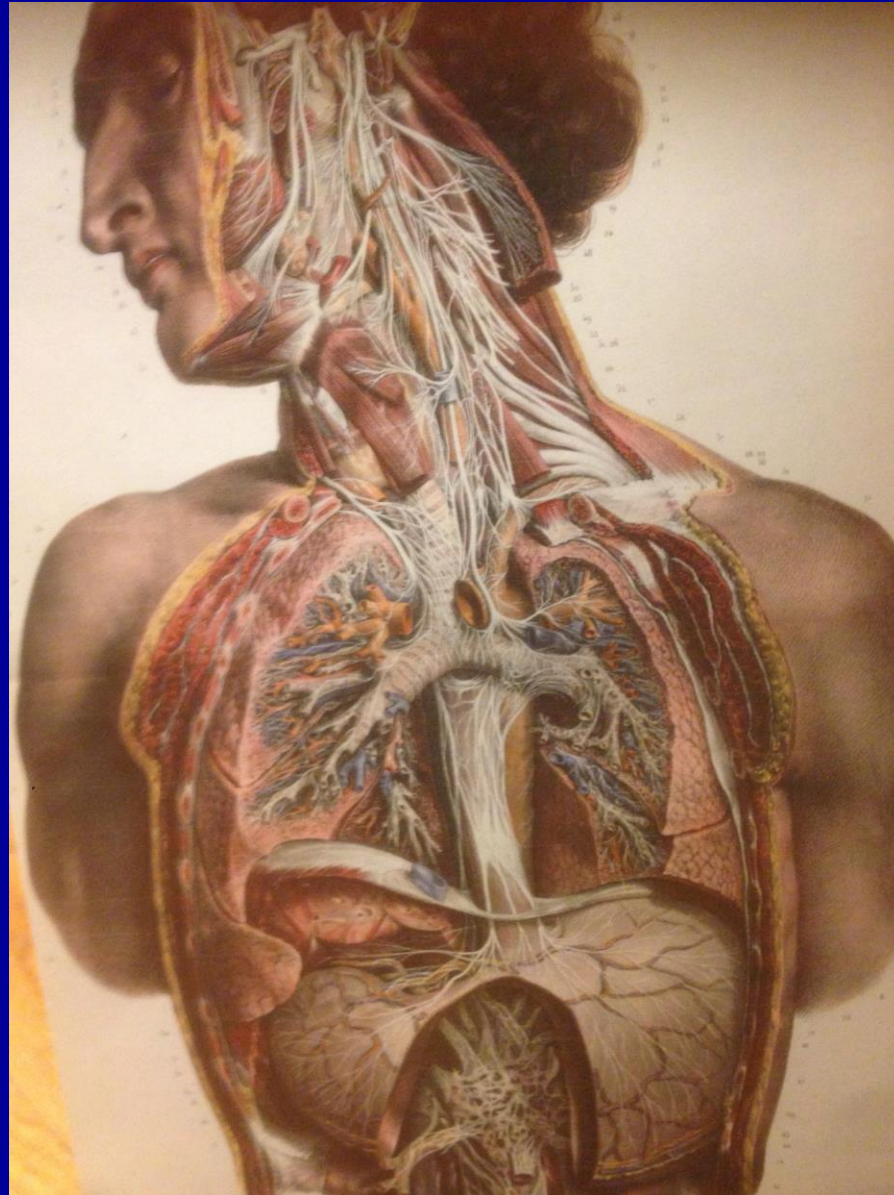
Even our attempts to correct the situation can backfire. The probiotic problem:

- The probiotics that are manufactured are made because they are easy to make. There is no evidence they work. Research indicates they don't stick around in the gut very long and excess probiotic use has been linked to bloating and brain fog.
- **Brain Fog.** Bacteria in the small intestine were making large quantities of D-lactic acid, which is a brain toxin. Halting probiotics and taking antibiotics stopped the fogginess. Do not take probiotics indiscriminately or in large quantities. You normally don't have bacteria in the small intestine, only in the large intestine, but if you take too much, it happens.
- Good food sources of probiotics include yogurt, sauerkraut, kimchi, kefir and dark chocolate, which are generally safe because of the small amounts of bacteria present. The best advice is to eat a balanced diet. We really don't understand the complexity of the biome, but here are some things we have recently discovered:

artificial sweeteners and sport supplements containing them are toxic to gut bacteria, and some are carcinogenic



Enteric Nervous system



Enteric Nervous system:

- It is gigantic and sends ten times more information up to the brain than it gets from the brain.
- Some neurologists consider it a second brain. It has a huge influence on our emotions, immune function and overall health, and it interacts with bacteria in ways we are only beginning to fathom.
- **Clinical depression** linked to gut bacteria that makes insufficient gaba (an inhibitory neurotransmitter.) Gaba probably communicates with newly discovered cells in the small intestine which then communicate with the vagus and thence to the brain. It may be treatable by making a better biome. Gaba keeps arousal under control so that you can be alert, but not too much (anxiety). It could be that the forms of depression linked to anxiety are caused by this problem.

Enteric Nervous System

- Junk food, known to cause inflammation, also causes depression. In an international metaanalysis of over 100,000 people, those with a diet of fast food, cake and processed meat had a 40% greater likelihood of depression. Study is need to see if a Mediterranean diet can decrease depression. (maybe by improving the biome)
- **-And we have it** - An analysis of data from almost 46,000 people has found that weight loss from a better diet can reduce the symptoms of depression. None of the diets were highly specialized; they basically avoided junk/processed food and refined sugar in favor of more veggies and grains. Women had even more benefit then men (Don't know why) and when the diets were combined with exercise the results were even better.

Enteric Nervous System

- High sugar diets suppress gut bacteria that can process raw vegetables seen in healthier diets. It was long thought that sugar never reached the gut, having been absorbed as a nutrient in the small intestine. However, if there is enough concentrated sugar in the diet it reaches the colon and influences the biome. Lactobacillus breaks down sugars and makes lactic acid, again a brain toxin. This is particularly bad with low motility or proton pump inhibitors or opioid use.
- Mice on a high fat diet gave birth to mice with Aspergers and low levels of lactobacillus ruteri bacteria in the gut. When the bacterial level were restored, the Asperger's improved. The bacteria stimulates the vagus nerve which releases oxytocin which promotes social interaction. (This may be the same way massage creates a feeling of the warm fuzzies. It could also be the mechanism through which massage has been found to decrease the anxiety and negative emotional impact of Alzheimers.)

Enteric Nervous System

- 70 % of processed foods have inorganic phosphate which interferes with muscle metabolism, making it harder to exercise and more likely to be a couch potato. Processed meats and frozen foods and sodas have this. Organic phosphate is not absorbed by the gut, but inorganic phosphate is. For example, parmesan cheese has organic phosphate, but commercially grated parm may also have inorganic phosphate to prevent sticking. Avoid foods with **calcium phosphate, disodium phosphate or monopotassium phosphate.**
- The takeaway from all this is we really don't know what we are doing and extreme diets and junk food are always bad. The more processed a food, the worse it is.
- Many of our diseases are being caused by disruption of the biome.
- Fibromyalgia exhibits a disrupted biome, but we don't know if it causes the problem or is a result of the problem.

Antibacterial mouthwash

- Antibacterial mouthwash can increase blood pressure and reduces the blood pressure reducing benefit of exercise.
- “Listerine kills the germs that cause bad breath.” It also kills the germs regulate blood pressure.
- “Post-exercise hypotension and skeletal muscle oxygenation is regulated by nitrate-reducing activity of oral bacteria”. Raul Bescos et al.
Free Radical Biology and Medicine.
[doi:10.1016/j.freeradbiomed.2019.07.035](https://doi.org/10.1016/j.freeradbiomed.2019.07.035)

Enteric Nervous System

- Bacteria can control our behavior. For example, if you eat a lot of carbs, the bacteria that like carbs will be fruitful and multiply, and they will release neurotransmitters to make you crave carbs, securing their own food supply.
- They also communicate and interact with the immune system in ways that are only beginning to be understood. It seems that they educate the immune system as to what bugs are to be tolerated, and which are dangerous.

**Influence is not always
benign:
Toxoplasmosis
(protozoa)**



- Humans contract Toxo by inhalation of cat feces by cleaning the litter box.
- Most people with cats have toxo infecting the central nervous system – for life.
- For most people the infection seems relatively harmless, but it is extremely dangerous for the immune compromised. (HIV, transplant patients, cancer)
- Toxo can only reproduce in the gut of a cat.

Toxoplasmosis (protozoa)



- Normal rats are afraid of cat urine (because cats would be around)
- Toxo rewires the olfactory system making the rat attracted to cat urine.
- They approach the cat.
- They get eaten.
- Toxo makes its way into the cat gut to reproduce.
- One wonders if a component of cat hoarding is caused by a rewiring of the human olfactory system. How else would people be able to tolerate it?
- Is toxo rewiring their brains so they will hoard toxo factories?

Know the frenemy:

- A bacterium is a single celled organism – a prokaryote. (DNA is not contained in the nucleus but dispersed throughout the cell)
- 99% of the bacteria out there have nothing to do with us.
- Those that interact with us can be helpful or harmful depending on the day or the environment. (1/3 of you have MRSA right now)
- For every cell in your body there are 10 bacterial cells, so think of yourself as a walking UN.

Bacterial activities: What do they do? Break things down. They are the original recyclers.

- When an organism dies bacteria break it down, freeing the basic compounds to be used by the generations to come. It's one of those circle of life kind of things. When you die that's what they will do to you. Problem is when they start to break us down and we're not dead yet. That's when we use antibiotics.
- Freezing food works by stopping bacterial action. Canning is done in a sterilized environment. No bacteria in the tuna fish can, no deterioration.
- Sometimes we want deterioration. Yoghurt, cheese, anything that goes through fermentation is being changed by bacteria. Some make alcohol as a byproduct of breaking down sugars. No fermentation, no beer or wine.

When bacteria are damaging us they are doing it by:

- Directly attacking and killing your cells – Plague, TB, Strep. Staph
- Making toxins that poison us – botulism, tetanus, Strep. Staph
- Septicemia ((blood poisoning) is a condition where bacteria are poisoning the bloodstream. It was the usual cause of death from infected wounds before antibiotics.
- This leads to toxic shock.
- Lymphangitis is infection of the lymphatic system.
- Always look out for dark streaks coming from a wound site or a cast.

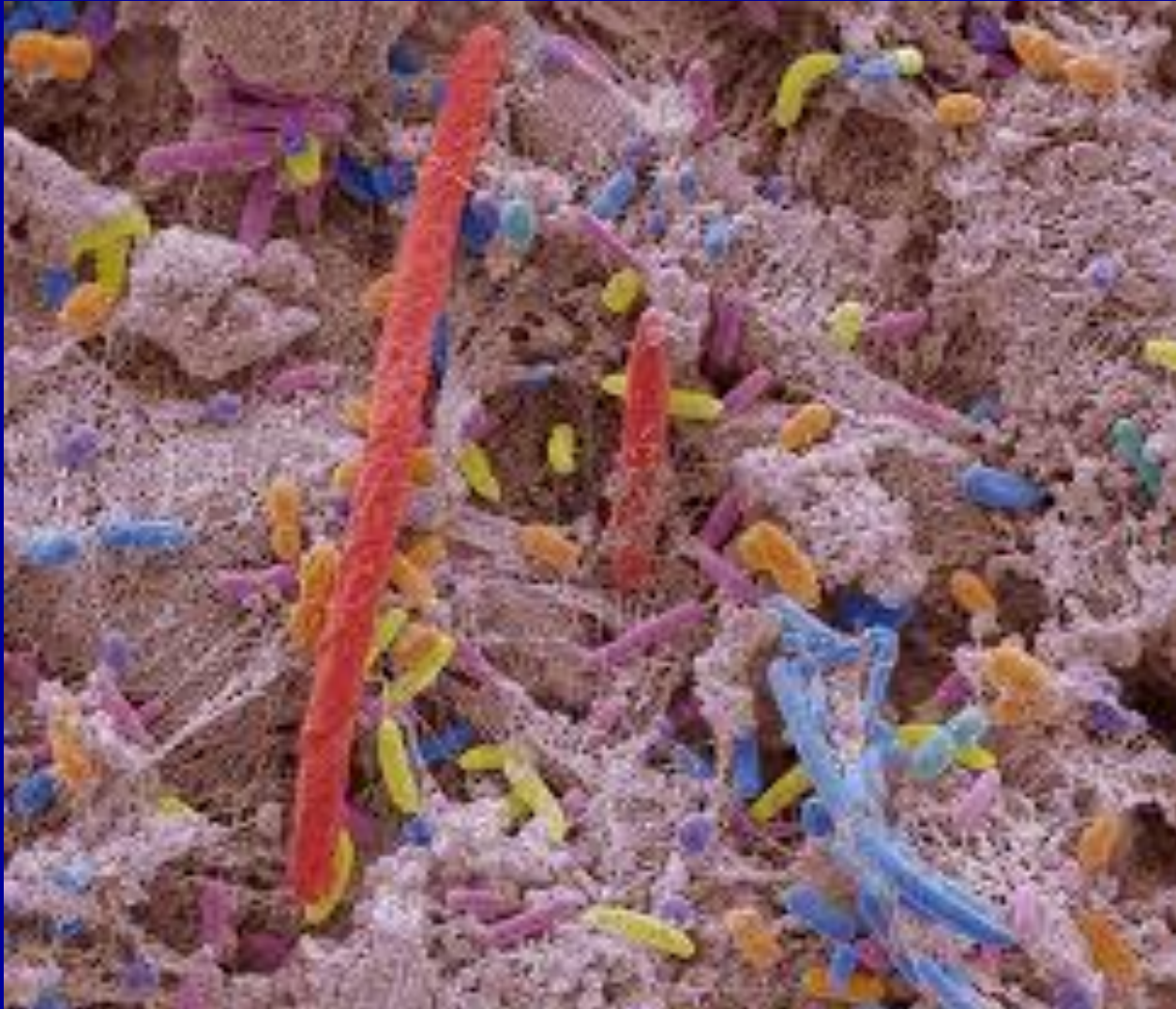
Lymphangitis (from septicemia)



Quorum Sensing

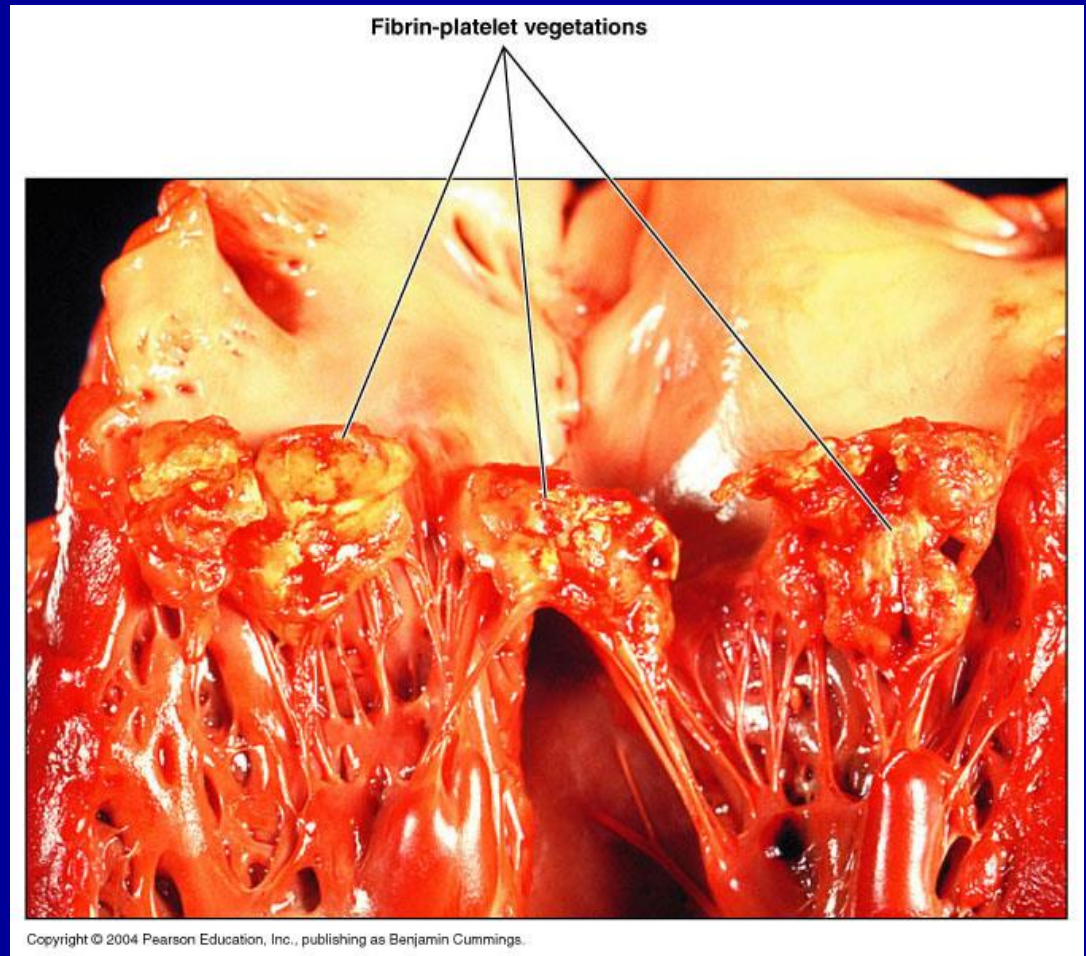
- Bacteria also change their own behavior when there are enough of them around through Quorum sensing. Individual bacteria can't do much on their own, so they lay low and don't make trouble, but they can communicate with each other. When they detect that they have reached a certain population, they act up and start to behave like multicellular life with different bacteria performing different functions.
-
- One of the results of this is plaque on your teeth which is very difficult to eradicate. Some form mats to adhere to the teeth, some make glue, some gather nutrients. This is why the inflammatory response blows things up. If you have an injury and it is infected, flooding the area with inflammatory exudate dilutes the bacteria, basically putting them out of earshot with each other. That that gives the immune system more time to hunt them down individually.

Oral bacteria



Endocarditis

Endocarditis can occur with faulty valves. If there is an eddy behind the valve, bacteria can accumulate and they start to make plaques on your valve like they do on your teeth. Bacteria like stasis so they can get together.



Fecal transplants

- The vast majority of bacteria in and on us seem to want to maintain the status quo. Keeping us alive and healthy keeps them alive and healthy – hence the biological defense. It is a lack of balance for us and them that is a problem, often caused by extreme diets, junk foods, antibiotics, probiotics, and antibacterial soaps.
- For example: A patient was suffering from Crone's disease due to dysbiosis. A fecal transplant from a healthy donor (good shit) restored balance to the patient's biome (bad shit) and the symptoms of Crone's dissipated. They are working on a pill form.
- There are now clinical trials that show great promise in treating autism with fecal transplants. The same genetic mutation linked to autism also disrupts the biome. Fecal transplants have been shown to alleviate autism.

BACTERIA SHAPES

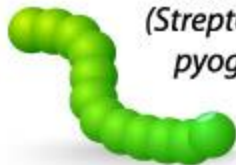
SPHERES (COCCI)



Diplococci
(*Streptococcus pneumoniae*)



Staphylococci
(*Staphylococcus aureus*)



Streptococci
(*Streptococcus pyogenes*)

Tetrad



Sarcina
(*Sarcina ventriculi*)

RODS (BACILLI)



Chain of bacilli
(*Bacillus anthracis*)



Flagellate rods
(*Salmonella typhi*)



Spore-former
(*Clostridium botulinum*)

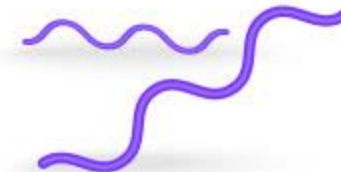
SPIRALS



Vibrios
(*Vibrio cholerae*)



Spirilla
(*Helicobacter pylori*)

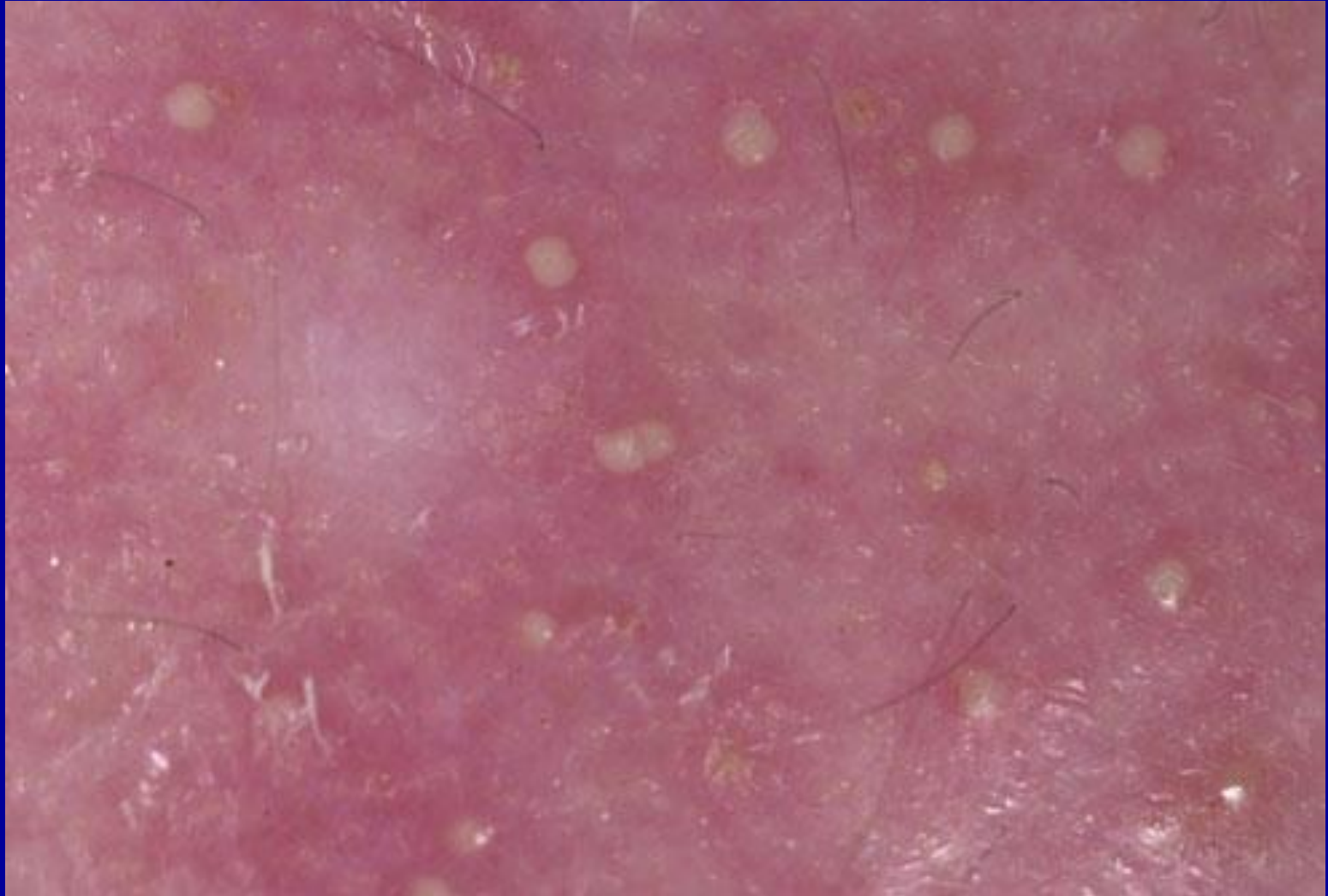


Spirochaetes
(*Treponema pallidum*)

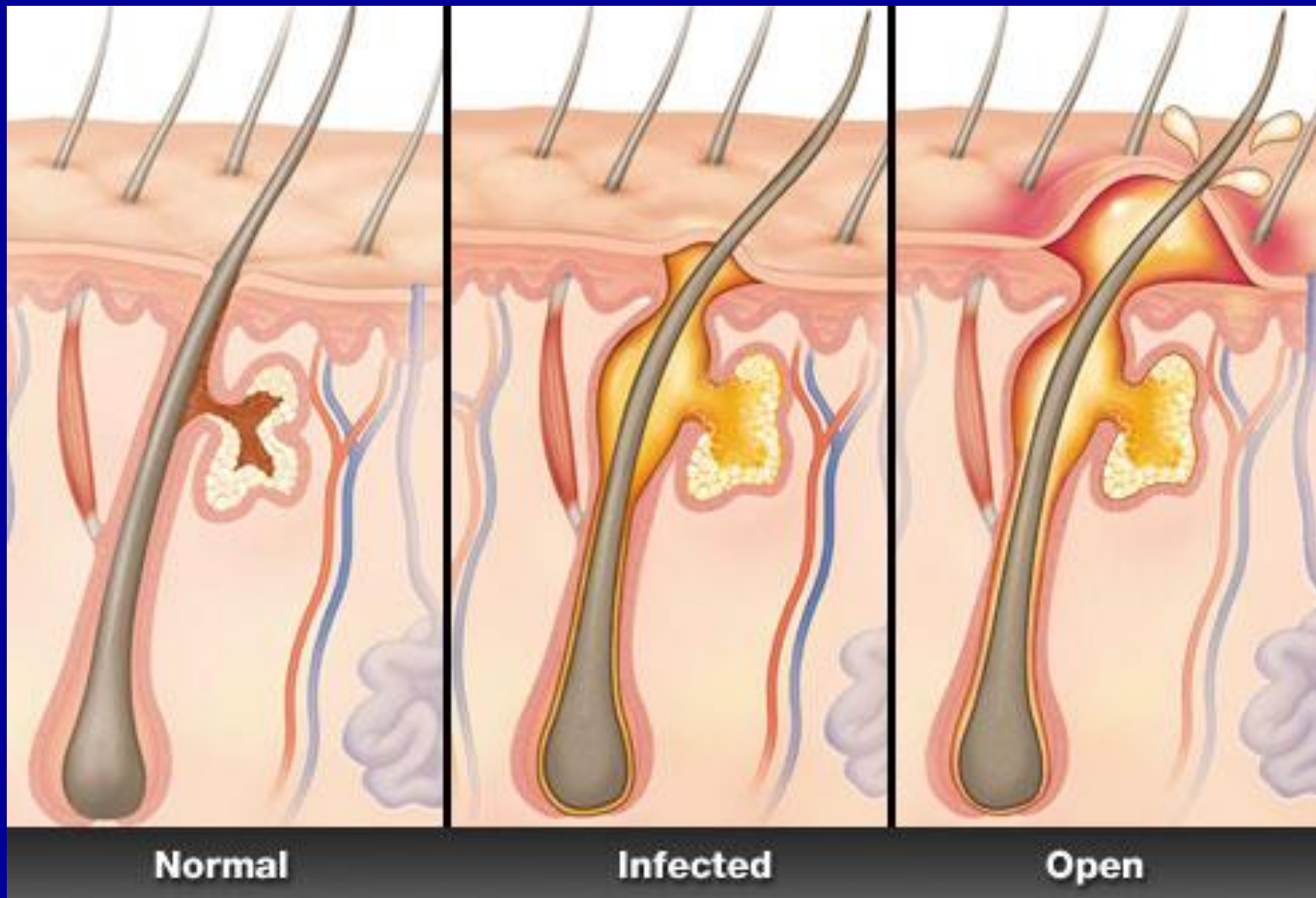
Dangerous bacterial infections

- As massage therapists, it is important to be able to identify dangerous and contagious bacterial infections so that we don't catch them ourselves or spread them around on our clients.
- Any kind of skin outbreak is a contraindication unless you recognize it as otherwise or the client knows it is benign.
- The following slides include bacterial infections as well as harmless conditions that look really awful.

Folliculitis / Furuncle : infected follicles



Boil : one infected follicle



Boil



Boil



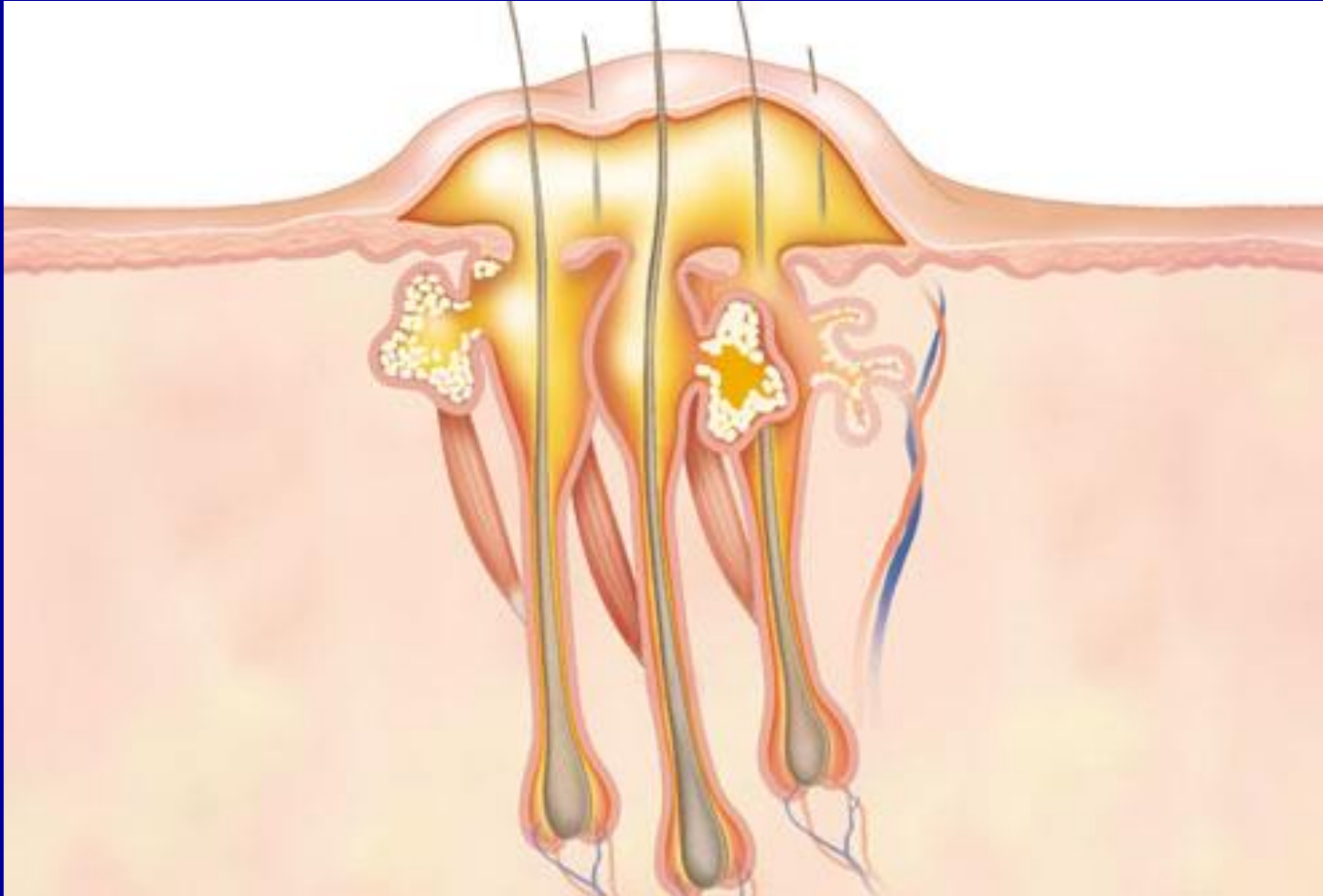
Sty : Boil of an eyelash



MRSA Boil (Methicillin Resistant Staph Aureus)



Carbuncle : merged infected follicles



Carbuncle



Cellulitis

Life threatening infection of the superficial fascia. Requires immediate hospitalization and massive antibiotics.



Impetigo : highly contagious



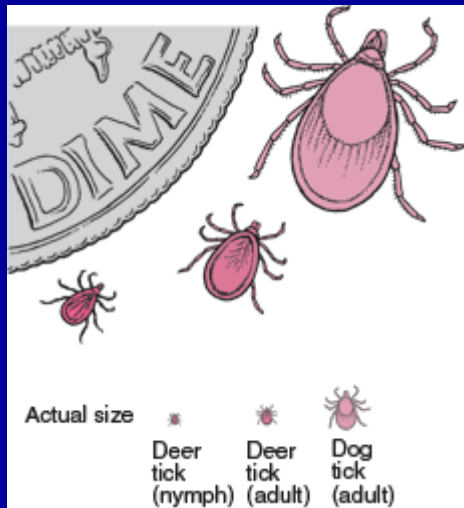
Lyme Disease



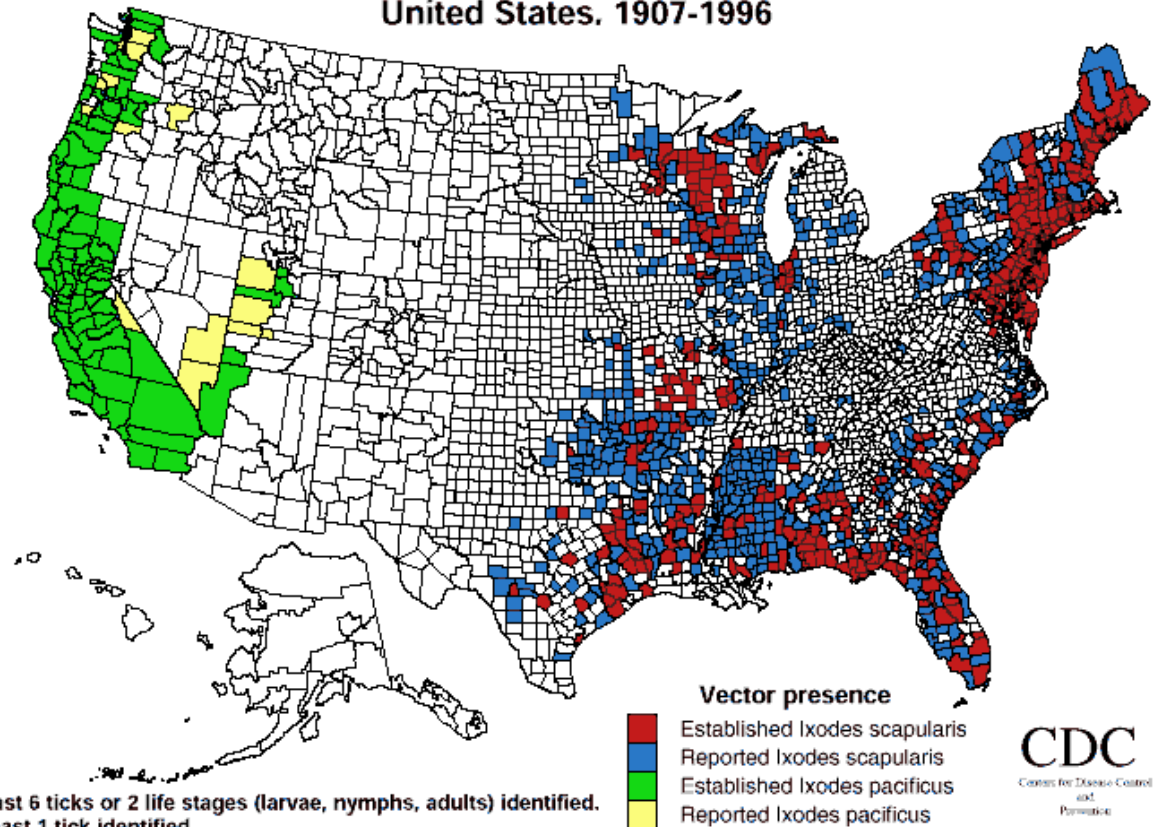
Lyme disease

- Carried by a tick (so are a lot of other diseases)
- Tick waits on the edge of grass to hook on to something passing by
- Pets bring them into the house (they get sick too)
- Takes several hours to infect (get tick off)
- Mild flu like symptoms followed by oligoarthritis
- Treatable by long term antibiotics
- Can pass the blood brain barrier if left untreated

The deer tick nymph is extremely small



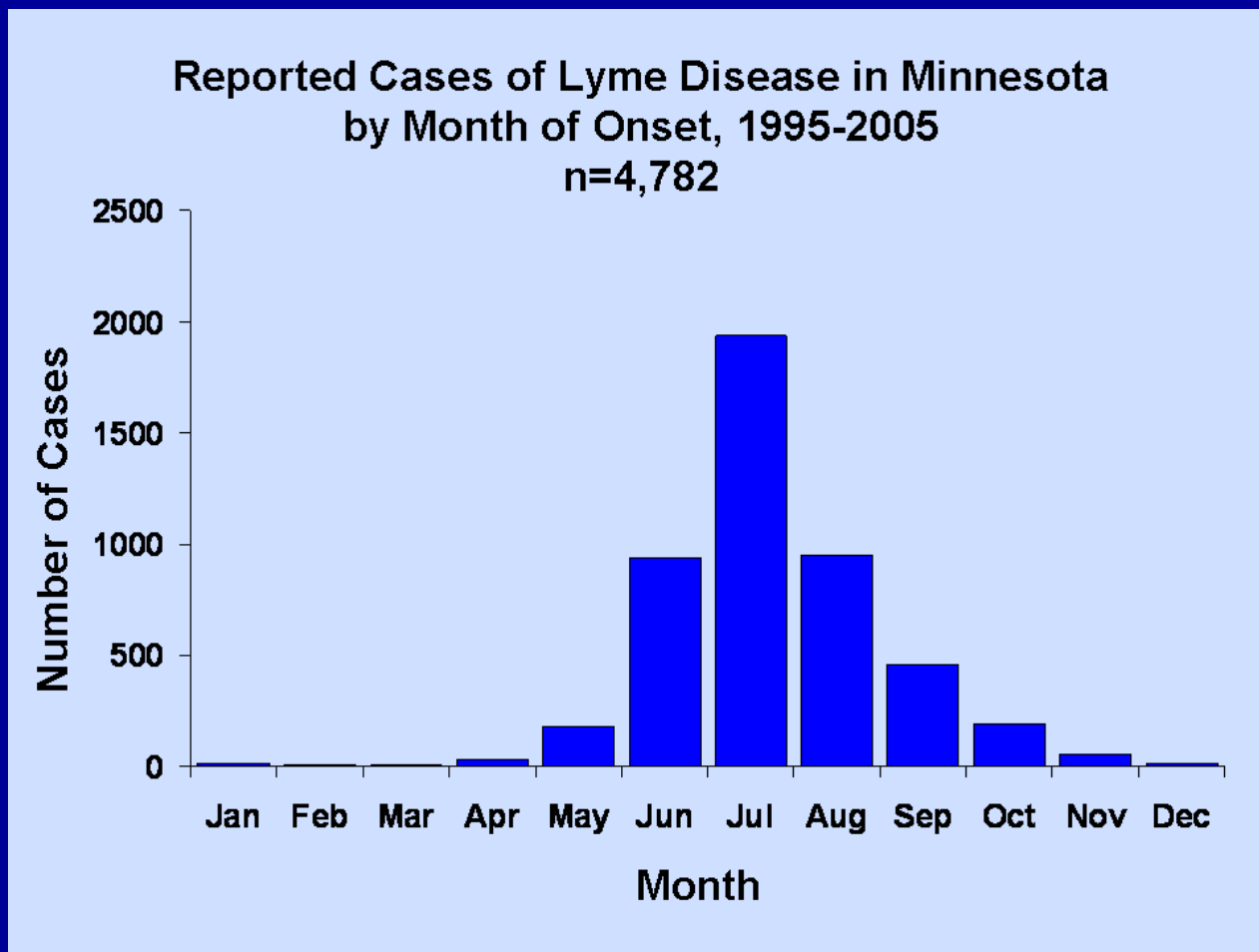
Established* and reported** distribution of the Lyme disease vectors *Ixodes scapularis* (*I. dammini*) and *Ixodes pacificus*, by county, United States, 1907-1996



Removal in a few hours often avoids infection.



Seasonal but not completely



Protection

It's Lyme Time!

Protect Yourself Against Lyme Disease*
in Spring, Summer, and Fall

1 Walk in the middle of trails, away from tall grass and bushes.

2 Wear a long-sleeved shirt.

3 Wear white or light-colored clothing to make it easier to see ticks.

4 Wear a hat.

5 Spray tick repellent on clothes and shoes before entering woods.

6 Wear long pants tucked into high socks.

7 Wear shoes—no bare feet or sandals.



**Lyme disease, the most common tick-borne disorder in the U.S., can affect the skin, joints, nervous system, heart, and eyes.*

Lyme disease is transmitted by a tiny tick the size of the period at the end of this sentence.

Non bacterial skin eruptions;

- Hard to tell one skin eruption from another
- Patterns can help
- Unless *they* know what it is, hands off!
- Local or total contraindications

Contact Dermatitis –turtleneck?



Contact Dermatitis - Poison Ivy



Type 1 allergic reaction Urticaria (hives)



Urticaria



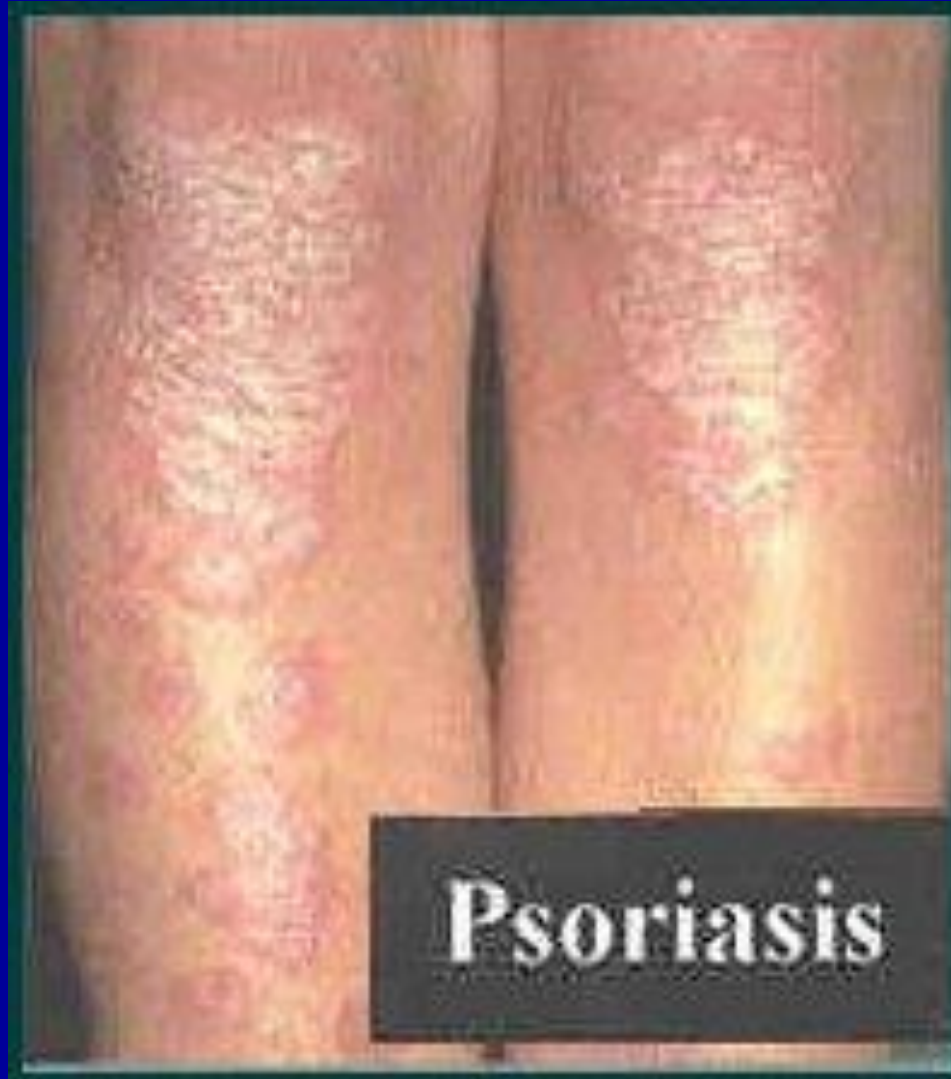
Looks bad but you can work on it (sometimes).

- Non-bacterial forms of skin inflammation

Psoriasis



Psoriasis



Eczema



Stasis dermatitis (Beware bact. superinfection)



Varicose ulcer

After the varicosity is addressed gentle circular friction at the perimeter and vibration over the lesion through a sterile gauze.

Beware bacterial superinfection.



Fungal and Viral skin eruptions

- I have a whole seminar on viral infections but consider this a rogue's gallery of what not to touch.

Epidermophytosis/ Athletes foot, ringworm

Tinea pedis



Tinea cruris



Candidiasis



Warts



Herpes Simplex



Herpes Zoster



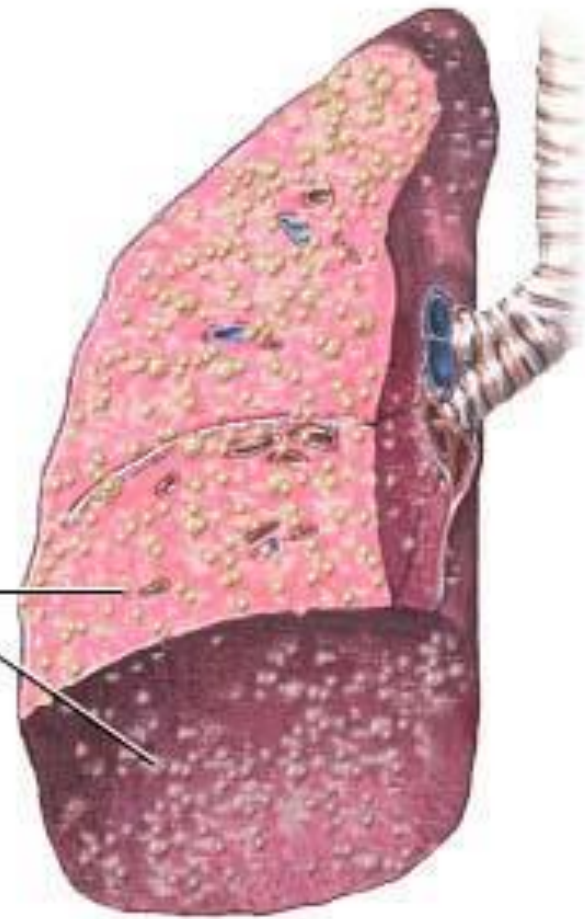
Herpes Zoster



Internal bacterial infections (TB)



Granulomas from
Mycobacterium
tuberculosis



Tuberculosis



Pneumonia



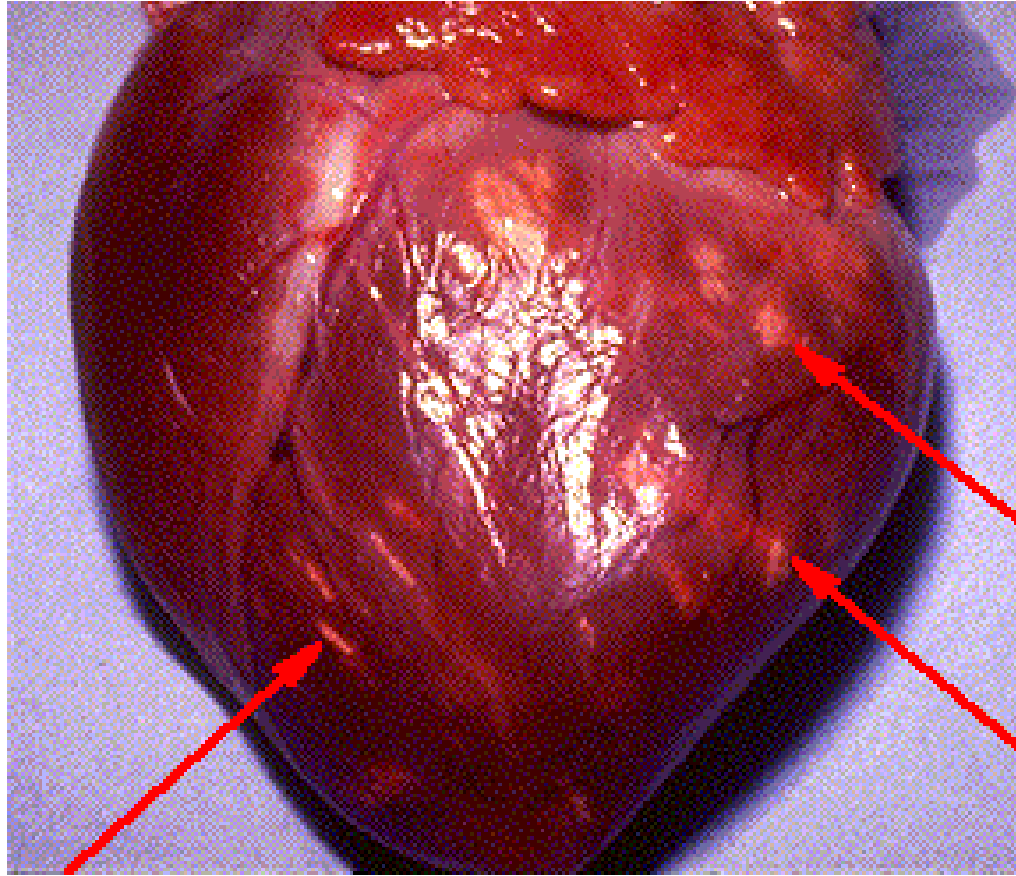
Pneumonia



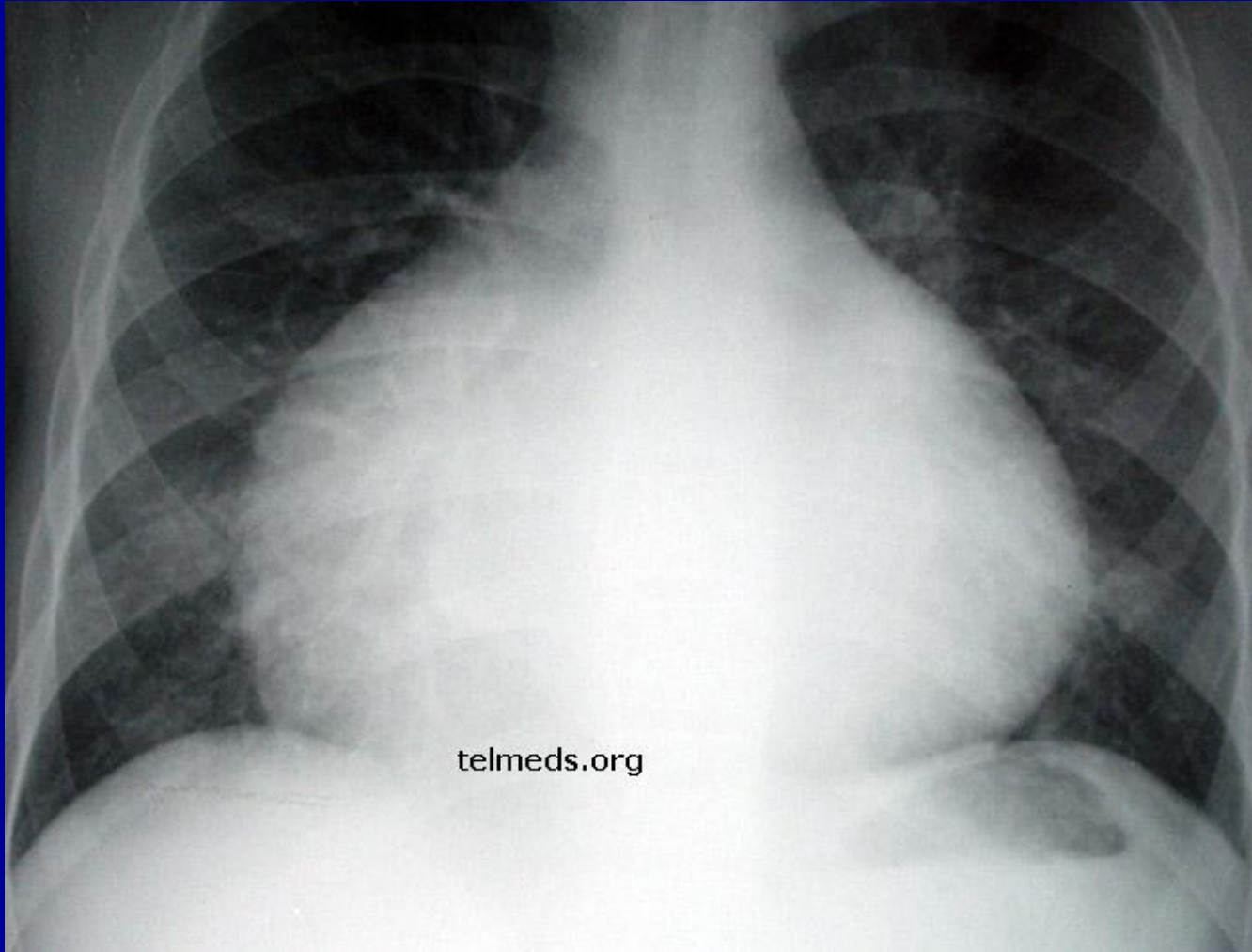
Endocarditis



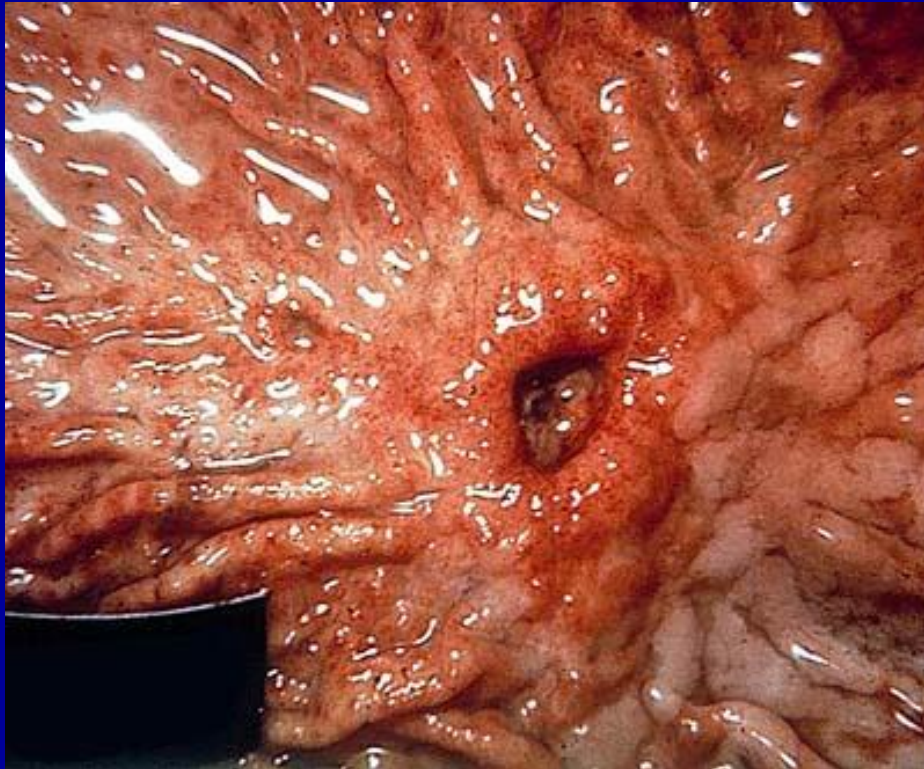
Myocarditis



Pericarditis



Gastric Ulcer



Conclusions

- Everything in this room, including you, is covered in bacteria.
- Everything you eat and drink is covered with bacteria.
- Hygiene is important, but so is balance.
- Take antibiotics only as you need them.
- A balanced diet with NO junk food is the best way to keep your internal Kingdom happy.
- Keeping yourself healthy through moderation in exercise and diet and sleep is the best way to avoid imbalances that lead to illness and vulnerability to infection.