

Cephalosporins	
1st Generation	Effective against
Cefazolin	Mainly gram positive Some gram negative
2nd Generation	
Cefoxitin Cefuroxime	Weaker against gram positive Better against gram negative
3rd/4th Generation	
Cefotaxime Ceftriaxone Ceftazidime	Excellent against gram negatives Good for some gram positives

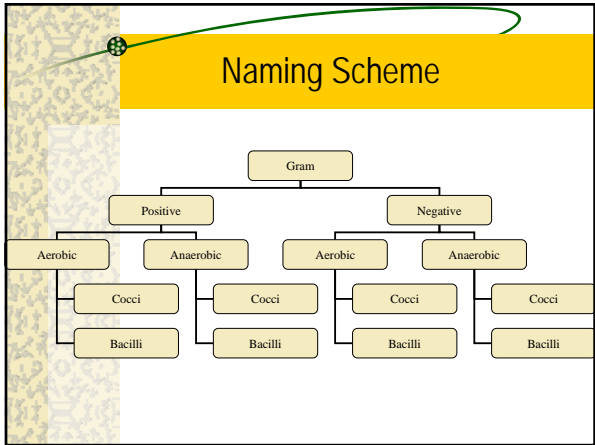
Antibiotic Classes	
Macrolides	Erythromycin, Azithromycin (Zithromax), Clarithromycin (Biaxin)
Aminoglycosides	Gentamycin, Tobramycin, Amikacin
Quinolones	Nalidixic Acid, Norfloxacin, Ciprofloxacin, Levofloxacin, Moxifloxacin
Glycopeptides	Vancomycin



**SUPER
ANTIBIOTIC
MAN!!**

How do antibiotics work ?

- ✦ Inhibition of cell wall synthesis
- ✦ Inhibition of essential protein synthesis
- ✦ Inhibition of DNA/RNA synthesis
- ✦ Metabolic inhibition
- ✦ I don't want to kill you all, so I will leave it at this!



Gram Positive

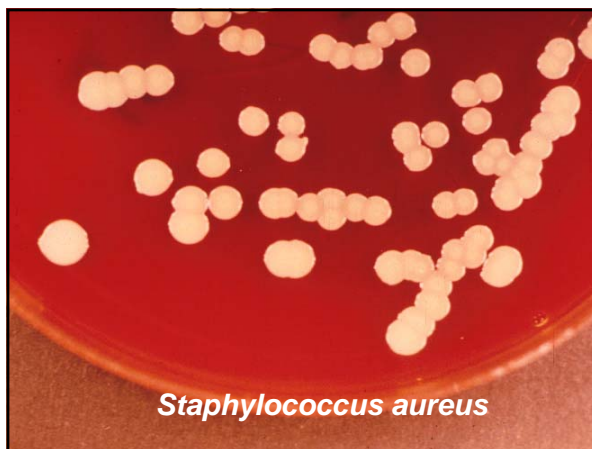
- ✦ Aerobic Cocci
 - Staphylococcus, Streptococcus*, Enterococcus* spp.
- ✦ Anaerobic Cocci
 - Peptostreptococcus, Peptococcus spp.
- ✦ Aerobic Bacilli
 - Bacillus, Listeria, Corynebacterium, Erysipelothrix spp.
- ✦ Anaerobic Bacilli
 - Clostridium, Propionibacterium spp.

Gram Negative

- ✦ Aerobic Cocci
 - Neisseria, Moraxella (Branhamella) spp.
- ✦ Aerobic Bacilli
 - Haemophilus*, Pseudomonas, Stenotrophomonas spp.
- ✦ Facultative Anaerobic
 - Escherichia, Klebsiella, Enterobacter spp.
- ✦ Anaerobic
 - Prevotella, Bacteroides spp.

Staphylococci

- ✦ Catalase Positive
- ✦ Coagulase divides group into *Staph. aureus*, and coagulase negative Staph.
 - Allows *Staph. aureus* to be a great pathogen, as it can cover itself in a coagulated shield of plasma, evading treatment
- ✦ All are potential pathogens

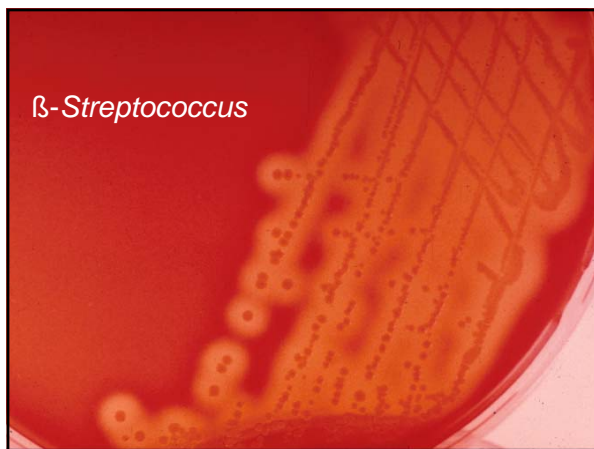


Staphylococci

- ✦ *Staph. aureus* can be normal flora
 - Nose, skin, vagina, rectum, feces, mouth
- ✦ All CNS are considered skin flora
 - Presence in blood or sterile body fluid needs to be interpreted carefully
 - Collection is very important
 - antiseptics

Streptococci, Enterococci

- ✦ Catalase negative
- ✦ Streptococci
 - Facultative anaerobic
 - Normal flora – alpha haemolytic
 - Oral flora, viridans streptococci, *Str. pneumoniae**
 - Pathogenic – beta haemolytic
 - Groups A – G potential pathogens



Enterococci

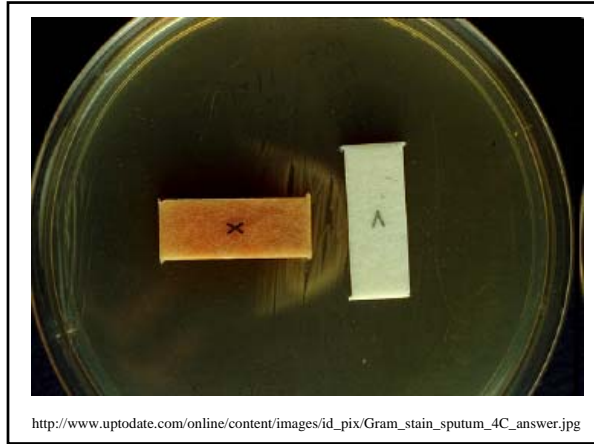
- ✦ Gut flora
 - Over half of the bacteria in feces can be Enterococci
- ✦ Not very virulent
 - Third leading cause of urinary tract infections
 - Fecally contaminated abscess
 - Resistance
 - VRE

Gram Negatives

- ✦ Neisseria
 - N. gonorrhoea, N. meningitidis
 - Pathogenic
 - N. lactamica, N. sicca
 - normal respiratory flora
- ✦ Moraxella catarrhalis
 - Many name changes, potential pathogen
 - Neisseria, Branhamella

Haemophilus

- ✦ Coccobacilli
- ✦ Normal flora of throat, nose
- ✦ "Satellites" around Staph. Aureus
 - X and V factors...
- ✦ Finicky growth requirements
- ✦ Was leading cause of meningitis in children until HIB vaccine developed
 - Numerous serotypes – A, B, C, etc.



Enterobacteriaceae

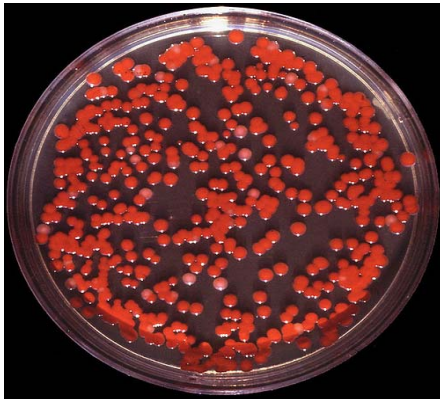
- ✦ Gram negative, facultative AnO₂, rods
- ✦ All ferment glucose
- ✦ Catalase positive
- ✦ Many are gut flora
- ✦ Many cause nosocomial infections
- ✦ Many are referred to as "coliforms"
 - From the gut
- ✦ Grow on MacConkey Agar – selective-differential



Enterobacteriaceae

- ✦ E. coli, Klebsiella, Citrobacter, Enterobacter, Proteus, Morganella, Providencia, **Serratia***,
- ✦ Shigella, Salmonella, Yersinia
- ✦ Numerous species of each
- ✦ Various pathogenic mechanisms
 - Toxins, invasive
- ✦ Infection Control – think feces

Serratia marcescens

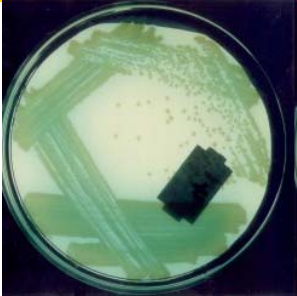


<http://image.blog.livedoor.jp/kiyosawaganka/imgs/b9/b9b673bd.jpg>

Other Gram Negatives

- ✦ Pseudomonas species
 - Environmental bugs
 - Think "water"
- ✦ Stenotrophomonas maltophilia
 - Opportunistic
 - Think "sink drain"

Pseudomonas aeruginosa



<http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/icu8/images/uti/pyocyanin.jpg>


Other Gram Negatives

- ✦ *Acinetobacter calcoaceticus*
 - anitratus, lwoffii
 - Think oral contamination
 - Many showing intrinsic resistance to most if not all antibiotics

Yeasts

- ✦ Single cell organisms
- ✦ Numerous species
 - *Candida albicans*
 - Germ tube test
- ✦ Opportunistic
 - Normal respiratory flora
- ✦ Urinary, vaginal, systemic

Germ Tubes



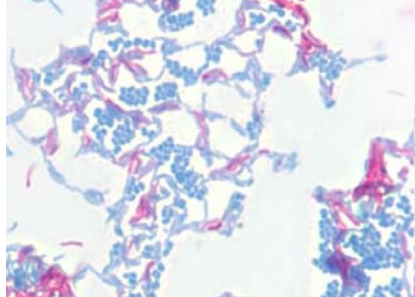
<http://overcomingcandida.com/mycology/candid4.jpg>

A micrograph showing several budding yeast cells with long, thin, hair-like projections called germ tubes extending from them. The cells are stained purple.

Mycobacteria

- ✘ Do not stain with Gram's stain
- ✘ Use carbol fuchsin, heated, then decolorize with Hydrochloric acid and alcohol for 5 minutes
 - Acid fast (AFB)
 - Retain red color
- ✘ *M. tuberculosis* (MTb) [human pathogen]
- ✘ *M. avium-intracellulae* (MAI) [HIV]

AFB



http://inst.bact.wisc.edu/inst/images/book_3/chapter_3/3-17.jpg

A micrograph showing numerous acid-fast bacilli (AFB) stained pink/red, interspersed with blue-stained non-acid-fast bacteria. The AFB are rod-shaped and appear to be in various stages of division or arrangement.

Mycobacteria

- ✦ Divide once every 24 hours
 - 2-8 weeks for visible colonies
- ✦ Some environmental species
 - *M. gordonae*, *M. marinum*
- ✦ MOTT: Mycobacterium other than TB
- ✦ MAIS: Mycobacterium avian-intracellulare

Colonies of *Mycobacterium tuberculosis* on Lowenstein-Jensen medium



<http://bioinfo.bact.wisc.edu/themicrobialworld/mtbcolonies.jpg>

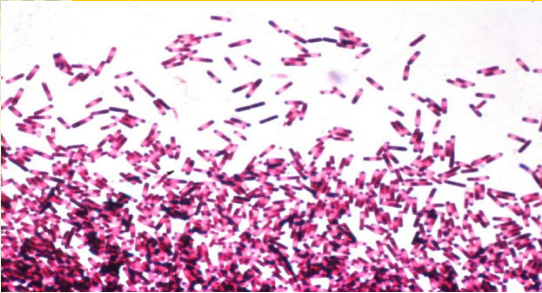
Unusual Organisms?

- ✦ "Atypical" respiratory and genital pathogens
- ✦ Mycoplasma
 - No cell wall, just cell membrane
 - Very fastidious to grow and stain
 - Not Gram!
- ✦ *Ureoplasma ureolyticum*
- ✦ Chlamydia
 - pneumonia, trachomatis

Clostridia

- ✦ Anaerobic Gram positive bacilli
- ✦ Spore bearing
- ✦ C. perfringens
 - Gas gangrene
- ✦ C. difficile
 - Antibiotic associated diarrhea
- ✦ C. tetani
 - Tetanus

Clostridium difficile



http://www.pintopotts.co.uk/public_html/images/clostridium_difficile.jpg

What is a virus?

- ✦ Viruses are NOT like bacteria!
- ✦ Viruses are NOT little bacteria
- ✦ Viruses DO NOT "grow" or divide
- ✦ Viruses make copies of themselves using:
 - Tools (enzymes, proteins) they code for
 - Cell machinery

What is a Virus?

- ✦ Obligate intracellular parasite
 - "Pirate of the cell"
- ✦ NOT a cellular organism
 - No organelles or ribosomes, energy-less
- ✦ NOT FREE-LIVING
 - Completely dependent on host cells

Viruses

- ✦ Enveloped
 - Easier to kill, less hardy
 - Herpes
- ✦ Non-enveloped (naked)
 - Hardy, resistant to lower concentrations of alcohol
 - Norovirus
- ✦ Both DNA and RNA viruses

Normal Flora

- ✦ Positive culture doesn't necessarily mean infection or clinical significance
- ✦ Many organisms are part of the "normal flora" of that site
- ✦ Most surface and mucosal surfaces are not "sterile" and are loaded with bacteria

Normal Flora

- ✦ 1 mL of saliva: 1×10^8 organisms
- ✦ 1 g feces: 1×10^{12} organisms
 - 1 μ g: 1×10^6 organisms



Vaginal Flora of Normal Women

Microorganism	%
<i>S. aureus</i>	5 - 10
<i>S. epidermidis</i>	50
Group B Strep	20 - 30
Group A Strep	3
Enterococcus	15
Enterobacteriaceae	15 - 20
Gardnerella	> 50
Lactobacillus	> 50
Peptococcus	80
Peptostreptococcus	30
Bacteroides	15 - 35
Fusobacteria	10
Clostridia	5 - 10
Yeast	15 - 30

(30-40 if pregnant)

Normal Respiratory Flora

- ✦ Oral anaerobes
 - *Fusobacterium*, *Bacteroides*, *Peptostrep*
- ✦ *Streptococci* esp. viridans group
- ✦ *Neisseria* spp. (incl. meningococcus)
- ✦ *Corynebacterium* spp.
- ✦ *Haemophilus* spp.

Normal Respiratory Flora

- ✦ *S. pneumoniae*
- ✦ *H. influenzae*
- ✦ *S. pyogenes* (Group A)
- ✦ *M. catarrhalis*
- ✦ *Enterobacteriaceae*
- ✦ Yeast

But these are also important & recognized causes of pneumonia

Never Normal Flora

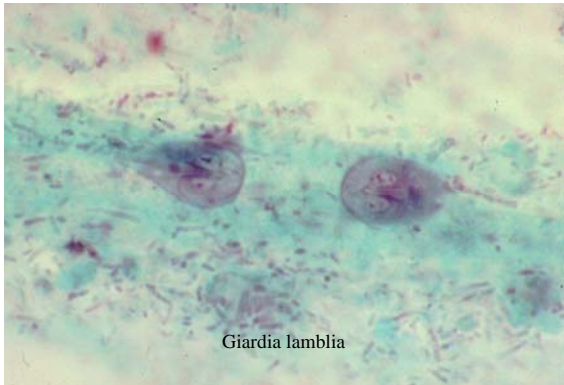
- ✦ *Mycobacterium tuberculosis*
- ✦ *Legionella* spp.
- ✦ *Brucella* spp.
- ✦ etc.

⊕ Not Normal But May Still Be Asymptomatic

- ✦ *Neisseria gonorrhoeae*
- ✦ *Salmonella* spp.
- ✦ *Bacillus anthracis*
- ✦ etc.

⊕ What we Won't Get To!

- ✦ Other Anaerobes
- ✦ Actinomycetes
 - Nocardia, Rhodococcus, Streptomyces
- ✦ Gardnerella/Lactobacillus
- ✦ Brucella, Francisella, Bordatella
- ✦ Parasites
- ✦ Fungus



Giardia lamblia

[http://www.med-chem.com/para/Prob%20of%20Month/IMAGES/Giardia,%20trophs%20\(2\)20in%20mucus%20string.fixed%20great.jpg](http://www.med-chem.com/para/Prob%20of%20Month/IMAGES/Giardia,%20trophs%20(2)20in%20mucus%20string.fixed%20great.jpg)

Summary

- ✦ The names may change but the bugs stay the same
 - Please don't get mad at the lab!
- ✦ Not as rapid a science as we would like
- ✦ Take a good swab to get good results!
- ✦ Learn what your requisition is trying to tell you

Thanks!

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Susan Cooper, MLT, CIC
South Eastern Infection Control Network

Google Images
Wikipedia for trivia!
