

**Bugs Gone Bad
ARO's In LTC**

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Objectives

- Review antibiotic history and language
- Review issues with antibiotics
- Look at the organisms
- See why they can be an issue
- Discuss ways to make them less of an issue!

Thanks!

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Antibiotics

- Agents or molecules that kill or stop the growth of microorganisms, including bacteria and fungi
- Antiviral – do the same to viruses



Definitions

- **Bactericidal**
 - Antibiotic that kills bacteria
- **Bacteriostatic**
 - Antibiotic that stops the growth of but does not kill bacteria
 - Allows time for the body's defense mechanisms to kick in

Definitions

- **Prophylactic therapy**
 - Antimicrobial given to prevent infection before the infection develops
- **Empiric therapy**
 - Broad spectrum antimicrobial given before culture and sensitivity results available.
 - Patient is sufficiently ill to warrant treatment

Definitions

■ Therapeutic therapy

- Antimicrobial therapy initiated when infecting agent is known and susceptibility results available

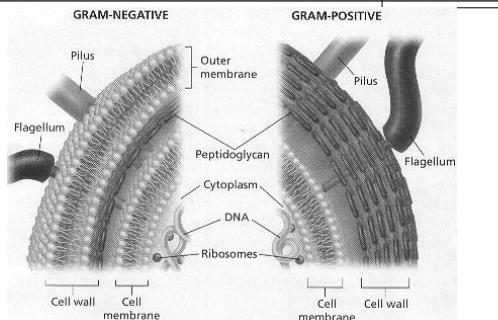
Definitions

- Normal Flora: bacteria that are with us all the time (skin, gut, etc.)
- Transient: picked up from the environment
- Colonization: present and growing on the body, but the body does not respond or care!
Can be normal or transient
- Infection: body response: pus, redness, fever, heat, etc.

The Gram Stain

- Developed in the late 1800's by Dr. Hans Christian Gram, a pathologist
- Originally noted while staining lung
- Gram positive organisms are purple
- Gram negative organisms are red
- Based on cell wall composition

Cell Wall Composition – Simple!



Gram Stain

- Gives a quick look at the specimen
- Can interpret quality of specimen
 - Number of “pus” (polymorphonuclear) cells present - Infection
 - Number of epithelial cells present - Surface
 - Number of bacteria present (and likely Genus) - Normal vs. abnormal

Gram Stain

- Can help direct antibiotic therapy
 - Based on cell wall composition
- Not so helpful if lots of normal flora present
- Quite significant on sterile body sites
- Assists in the interpretation of culture results

Antibiotic Classes	
Class of Antibiotic	Examples
Beta-lactam	Penicillin, Cephalosporins, Carbapenems (Imipenem), Monobactams (Aztreonam)
Tetracyclines	Tetracycline, Doxycycline

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

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

Sensitivity testing (Antibiogram)

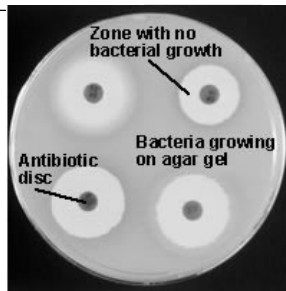
- Done to determine appropriate antibiotic therapy
- Some bacteria require specialized testing
 - For some bugs, this is still not standardized
- Many methods available
 - Manual
 - Automated
- MIC: Minimum Inhibitory Concentration

Manual Method

- Pure growth of the organism is swabbed on the agar and the antibiotic impregnated discs are placed on top.
- The antibiotic diffuses from the disc into the agar becoming weaker the farther away it is, in a standard gradient

Manual Method

- If the organism is killed or inhibited by the concentration of the antibiotic there will be **NO growth** in the immediate area around the disc
 - This is called the **zone of inhibition**



Antibiogram - susceptibility report

■ S = sensitive

- Antibiotic will kill the bacteria if serum concentration reached
- That antibiotic can be used to treat the infection

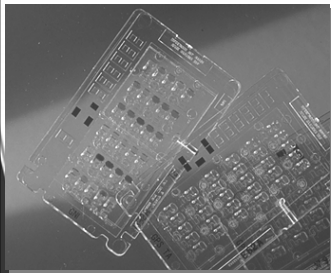
■ R=resistant

- Bacterial growth is not affected by the antibiotic
- That antibiotic is not acceptable for use against the infection at attainable concentrations

■ I= intermediate

- The antibiotic may or may not kill the bacteria

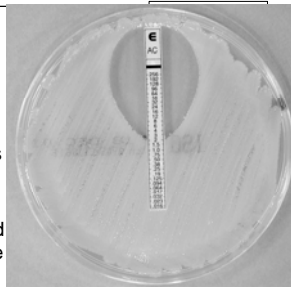
VITEK Card Convenience



- **Compact**
 - easy to handle
 - space saving
 - low waste volume
- **Sealed**
 - spill resistant
 - safe disposal
- **No reagents to add**

E Test

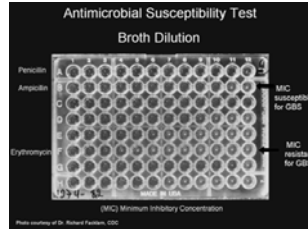
- The E-test consists of a strip containing an exponential gradient of one antibiotic.
- A agar plate is inoculated with an organism, a strip is placed on the plate
- The intersection of the growth on the scale is read to determine the MIC; here it is 2.0 mg/L with an amoxicillin strip.



www.dundee.ac.uk/facmedden/APT/downloads/Reusable%20Objects/An%20E-Test.ppt

Broth Dilution

- Doubling dilutions used in tubes or microwells
- Gives MIC (Minimum Inhibitory Concentration)
 - Smallest amount of antibiotic to kill organism



www.cdc.gov/groupBstrep/lab/slides/thumb10.htm

Antibiotic Testing Pitfalls

- Urinary concentrations can be higher if antibiotic excreted by kidney
- Some organisms harder to grow in standard method

How do antibiotics work ?

- Inhibition of cell wall synthesis
- Inhibition of protein synthesis
- Inhibition of DNA/RNA synthesis
- Metabolic inhibition

Disruption of cell wall synthesis

- These antibiotics actually disturb the structure of the cell wall resulting in lysis or breakdown of the cell
- Includes
 - Beta-lactams
 - Vancomycin

Disruption of Protein Synthesis

- Antibiotics bind to essential proteins thus disrupting processes by which bacteria receive energy
- Includes
 - Aminoglycosides
 - Tetracycline
 - Macrolides

Inhibition of nucleic acid synthesis

- Some antibiotics interfere with the production of essential proteins (DNA/RNA)
- Includes
 - Fluoroquinolones

Metabolic Inhibitors

- Inhibit formation of folic acid required for nucleic acids by imitating PABA (para-aminobenzoic acid)
- Includes
 - Sulphonamides
 - Trimethoprim
- Or combination of both
 - Trimethoprim-sulphamethoxazole (SXT, Septra)

Antimicrobial Resistance

- The inability to inhibit or kill the organism with clinically achievable antimicrobial concentrations
- May be natural (innate) or acquired (genetic change)

Antimicrobial Resistance

- Factors which may speed up development of resistance
 - Inadequate treatment (duration or strength of treatment)
 - Overuse/ misuse of antibiotic
 - Viral infections

Mechanisms of Resistance

- Genetic mutation
- Inactivation/destruction of antibiotic
- Altered binding site
- New binding sites
- Efflux pumps
- By-pass of metabolic pathways

Antibiotics Through the Years

- Early scientists were concerned with Gram Positive bacteria:
 - Pneumococcus (*Streptococcus pneumonia*)
 - Scarlet Fever (Group A Streptococci)
 - Diphtheria (*Corynebacterium diphtheria*)
 - Anthrax (*Bacillus anthracis*)
 - Staphylococcal infections

First

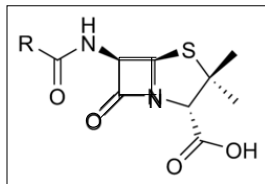
- Sulphonamides
 - 1932 – 1935
- Dye based
- Huge rush to manufacture variations
 - Deaths reported from ethylene glycol

Then Came...

- Penicillin
- John Tyndall – 1875
- Ernest Duchesne – 1897
 - Paper not accepted by Institut Pasteur because of his age!
- Clodomiro (Clorito) Picado Twight 1915 – 1927 – Costa Rica

But was credited to...

- Fleming's penicillin 1928
 - General use by 1941, by 1948 60% were penicillin resistant
 - Resistance seen within 2 years of being introduced
 - Has Beta-Lactam Ring



Streptomycin

- 1943 by Albert Schatz
- First Aminoglycoside
- From bacteria *Streptomyces griseus*
- First tuberculocidal antibiotic

Chlortetracycline

- 1945 from soil sample by Benjamin Duggar
- First Broad spectrum antibiotic of the tetracycline class

Chloramphenicol

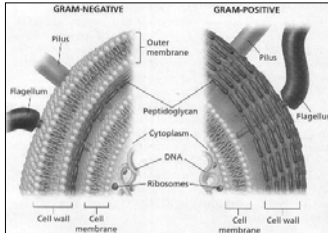
- 1949 – David Gottlieb from bacteria
- Rare side effect of aplastic anemia
- Most commonly used in eye drops

Then there was more...

- Erythromycin – 1952
- Vancomycin – 1955
- Methicillin – 1960
- Metronidazole – 1960
- Ampicillin – 1961
- Sulfamethoxazole – 1961
- Cloxacillin – 1962

Antibiotics

- Beta lactam ring stops the synthesis of the peptidoglycan layer of cell wall: significant in Gram positive organisms



Mechanisms of Resistance

- Beta Lactamase
 - Beta lactam ring core of the Penicillin class
 - Enzyme which breaks the ring rendering antibiotic useless
 - Sometimes the organism has the beta lactamase present
 - Sometimes the organism turns it on (inducible)

Antibiotics

- Beta Lactamase Inhibitors
 - No real antimicrobial action but slows down the action of beta lactamases.
 - Clavulanic Acid, Sublactam, Tazobactam

Bugs Gone Bad

MRSA

- Methicillin Resistant *Staphylococcus aureus*
- Still just a Staph bug which can cause boils, abscesses, wound infections, or just colonize body areas
- Has developed resistance to cloxacillin (methicillin is a British term)
- Regular *Staph. aureus* will be in 30-40% of noses in this room

All Staphylococcus species

- Spread by contact with infected secretions or colonized skin or environmental surfaces.
- Easily killed with hospital grade disinfectants.
- Easily washed off of hands!

Staph

- Still one of the leading causes of sepsis in hospitals
- >95% are now resistant to Penicillin
 - Yawn-able in most hospitals, clinics, etc.

MRSA

- Who are at risk?
 - Hospitalized or institutionalized
 - Portal of Entry
 - Wounds
 - Skin breakdown
 - Lines (Central catheters, IV, PICC)
- Now evidence of increased morbidity and possibly mortality (usually invasive)

Presentation Soft Skin/Tissue

- Insect or spider bite
- Folliculitis, pustular lesions
- Furuncle, carbuncle (boils)
- Abscess (esp. with tissue necrosis)
- Cellulitis
- Impetigo
- Infected wound



CA-MRSA

- Community-Acquired MRSA
- Teams, crowding, families
- Sharing of 'fomites'
 - Inanimate objects which can carry bacteria
- Different sensitivity pattern
- Different virulence factors (Panton-Valentine leukocidin)

VRE

- Vancomycin Resistant Enterococci



Vancomycin

- Great Gram positive spectrum of activity
- Very expensive (still)
- First drug of choice for febrile neutropenics
- Overuse in some parts of USA
 - For *Clostridium difficile*

Enterococci

- Enterococci are normal flora in the gut, and female genital tract.
- Enterococci can cause disease, but these are not a common occurrence in the hospital.
- Can make up over half the flora of feces.
- One microgram of feces can contain one million organisms!

Enterococci are Hardy!

- Survive on environmental surfaces (up to 7 days)
 - One study was 42 days on a bench!
- Rides around on hands, bed rails, thermometers, equipment.
- Ends up in the environment through poor handling of feces

VRE

- Colonize patients in 98% of cases
- Not harmful in healthy people
- No more capable of causing disease than other enterococci
- Killed by hospital grade disinfectants
- Easily washed off of hands!

VRE

- Hard to treat when infected
- Fear is resistance will be passed along
- Easy to spread if poor habits or cleaning related to feces

Clostridium Species

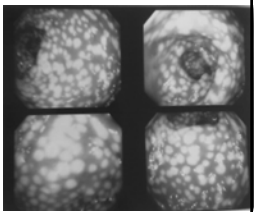
- Gram positive anaerobic rods
- All *Clostridium* species have spore
 - Able to survive harsh environmental conditions
- *Clostridium tetani*
 - Tetanus
- *Clostridium perfringens*
 - Gas gangrene

C. difficile

- First described in 1935, importance 1978
- Normal flora in some healthy neonates, up to about 2 years old
- 4% of healthy adults may carry organism asymptotically
- Has been found in sand; hay; soil; dung of horses, cows, donkeys, dog, cat, rodents, and humans

Clostridium difficile Associated Disease (CDAD)

- Causes antibiotic associated diarrhea
- Causes pseudomembranous colitis
- Has a spore or "egg"
- These survive in the environment for a long time
- Spores not killed by hospital grade disinfectants
 - but with good cleaning techniques, can be removed!



C. difficile

- Diarrhea can be caused by all classes of antibiotics and several anticancer chemotherapeutic agents.
- Treatment is Flagyl (metronidazole) or vancomycin
- New strain out there, more toxin, more diarrhea, more problems for patients
 - Increased resistance to Clindamycin and fluoroquinolones

C. difficile Risk Groups

- History of antibiotic use
- Bowel surgery
- Chemotherapy
- Prolonged hospitalization
- Increased age
- Serious underlying illness or debilitation

Definition of Diarrhea

- Loose/watery bowel movements (conform to the shape of the container AND
- The bowel movements are unusual or different for the patient, AND
- There is no other recognized etiology for the diarrhea (e.g.: laxative use, medication)

Definition of CDAD

- Diarrhea with laboratory confirmation of a positive toxin assay (A/B) for *Clostridium difficile* OR
- Visualization of pseudomembranes on sigmoidoscopy or colonoscopy OR
- Histological/pathological diagnosis of pseudomembranous colitis

Definition of Nosocomial

- Onset >72 hours after admission OR
- Symptoms present at admission but patient admitted to the same facility within the last 4 weeks AND
- Patient has not had CDAD in the past 8 weeks
- These may change for LTC

CDAD Impact

- One study estimates each case to be associated with:
 - \$3700 USD excess health care costs
 - 3.6 extra days of hospitalization

CDAD Alternate Treatments

- Fecal bacteriotherapy
 - Enemas of "normal" fecal flora
- Probiotics
 - Still controversial
 - What to use, route, etc.

ESBL

- Extended Spectrum Beta Lactamase
 - An enzyme that breaks down certain extended spectrum antibiotics (usually 3rd Generation Cephalosporins)
 - Organism generally is present in feces
 - Causes urinary tract infections, etc.

ESBL

- Usually organisms like *E. coli* and *Klebsiella pneumoniae* (Gram negative rods)
- Also seeing in *Pseudomonas aeruginosa*
- Has been seen in Enterobacter, Proteus, Salmonella and Serratia

ESBL

- Screening patients is still quite controversial
- Isolation of patients harboring this organism is usually based on location

Infection Control

- Acute Care vs. Long Term Care vs. Home Care

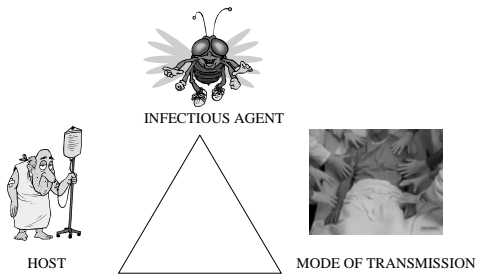
Typical Acute Care

- Sicker patients
- Numerous staff in and out each day
- Neighbors
 - Room mates
 - Ward mates
 - Floor mates
- Teaching vs. community hospitals

LTC

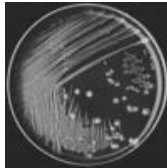
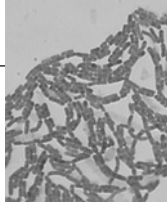
- Level of patient/resident acuity is less
 - But this is changing
- Room mates
- Wanderers

The Bermuda Triangle or Chain of Infection



Infectious Agent

- Bug, Germ
 - What can I say?
 - Can you pronounce "Ubiquitous"?



Susceptible Host

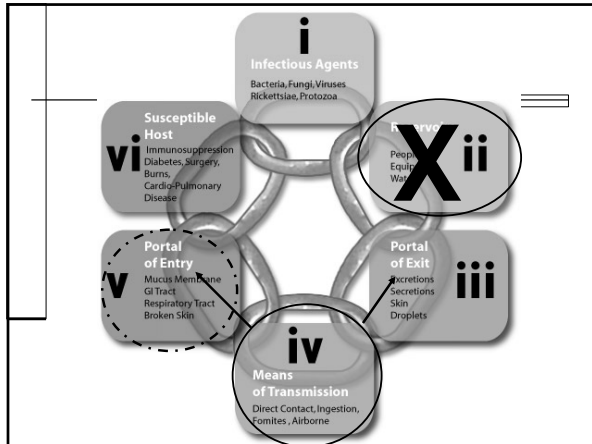
- Age
- Portals of Entry
- Immunization



Mode of Transmission

- Must be able to move bug from reservoir through portal of exit to portal of entry into susceptible host utilizing a means of transmission (whew!)





Routine Practices in a Nutshell

- If they are leaking:
 - Limit their movement
 - Really applies to patients, visitors and staff!
 - Protect yourself appropriately
- If it is dirty or you have used it:
 - Clean it!
 - In a consistent, effective manner

Routine Practices

- Your practices should never change based on a diagnosis
Or an acronym!!

STOP THE MADNESS!!

Routine Practices – PPE

- Gloves:
 - If wet or icky (sticky and not yours)
- Gowns
 - Risk of splashing, spraying or contact with wet or icky
- Mask and Eye Protection
 - Risk of splashing, spraying or contact with wet or icky

Routine Practices – PPE

- We do not make this PPE readily available
- Should be within each room
- Staff have to be comfortable to use



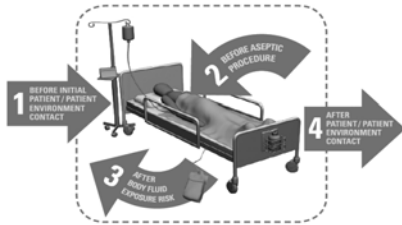
Additional Precautions

- Contact – MRSA, VRE, CDAD, ESBL?
- Droplet – Particles >5 um
- Airborne – Particles <5 um

Precautions

- Is there soiling of environment or patient?
 - No
 - "Normal" skin (1×10^6 organisms per finger)
 - "Normal" saliva (1×10^8 organisms per mL)
 - "Normal" contact with our environment
 - Clean consistently between patients
 - Hand Hygiene

Your 4 Moments for Hand Hygiene



LTC Challenges

- Dementia and soiling/wandering
 - Regular hand hygiene of patient (s)
 - Increased environmental sanitization (pop up wipes)
- Spitters
 - Tough one...

Signage

- Signs, signs, everywhere a sign
 - Do sign audit one day...#/meter?
 - FRI signs
 - Visiting Signs
 - Upcoming events
 - Hand hygiene signs
-
- Do we need a Routine Practices sign?

WARNING!!

This patient has:

- Skin!
- Feces!
- Mucous Membranes!

PERFORM HAND HYGIENE AFTER CONTACT
WITH THIS PATIENT OR THEIR
ENVIRONMENT!

Signage

- Contact Precautions
 - What does this sign mean to staff?
 - Is it necessary if patient is not soiling their environment?

CONTACT PRECAUTIONS

- WE JUST FOUND OUT THAT THIS RESIDENT HAS A BUG THAT COULD BE CARRIED TO THE NEXT RESIDENT.
- NOW WE REALLY MEAN YOU HAVE TO PERFORM HAND HYGIENE AND TRY NOT TO SOIL YOUR UNIFORM!
- WE ARE NOT SURE ABOUT THE GUY NEXT DOOR, YET, SO DO WHATEVER YOU WANT!

Signage

- Droplet Precautions
 - Warns staff that they may need face protection in room
 - For all tracheotomies?
 - Hot, coughing patients

Use of Additional Precautions

- Aim for common sense
- Judge each resident
 - Mental competence
 - General behaviour
- Leaking? – No Question

Home Care

- Oh give me a home
- Where the bugs just don't roam
- Where good hand hygiene saves the day
- We clean as we go
- In case there's bugs we don't know
- Routine Practices is the way...

Heavens, there is more!

- Bugs! They're everywhere!
- On their skin, in their nose, on their hair!
- If we let down our guard
- We are making it hard
- To stop the spread of acronym bugs!

Home Care

- Staff need to be in control
 - Establish clean areas for equipment
 - Carry hand sanitizer / wipes / cloths
- Treat what you see, not what you know
 - Leaking wounds
 - Open skin
 - Diarrhea / vomiting
 - Cough, fever, etc.

Home Care

- What do you want to do with the acronym knowledge?
 - Change practices?
 - Wear gloves for procedures that you would not normally?
 - Use a disposable gown if there is no risk of icky sticky?
 - Bring in the 3 meter pole?

Febrile Respiratory Illness (FRI)

- PIDAC recommends calling first to check
- Be prepared with mask and eye shield if you need to be there
- OR if doing splashy kind of things!



Febrile Respiratory Illness (FRI)

- Protects you from influenza, adenovirus, rhinovirus, RSV, etc.



So, Why Are We Here

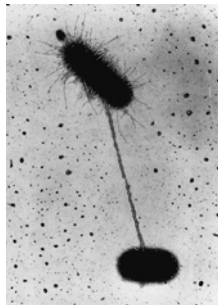
- Antibiotics are used for viral infections
- Antibiotics are not taken to the last pill
- People share antibiotics
- Some countries they are 'over the counter'
- Animal feeds

What Can We Do?

- Be part of the education with patients, families, public
- Stop offering the bugs a mode of transmission
- Think about the 'portal of entry'

Remember!

- The bugs have been here for a few billion years
- They are very adaptable
- Sneaky, too!



<http://www.cbs.dtu.dk/staff/dave/roanoke/genetics980316.htm>

Summary

Summary

- We have learned about our history with antibiotics
- We have learned about how we spread things
- We have looked at some of the issues facing us in LTC and Home Care

Summary

- We really do need to stop worrying about the bugs and start focusing on the resident
 - Leaking?
 - Compliant?
- We have to realize that the bugs are much smarter than we are!

Questions?
