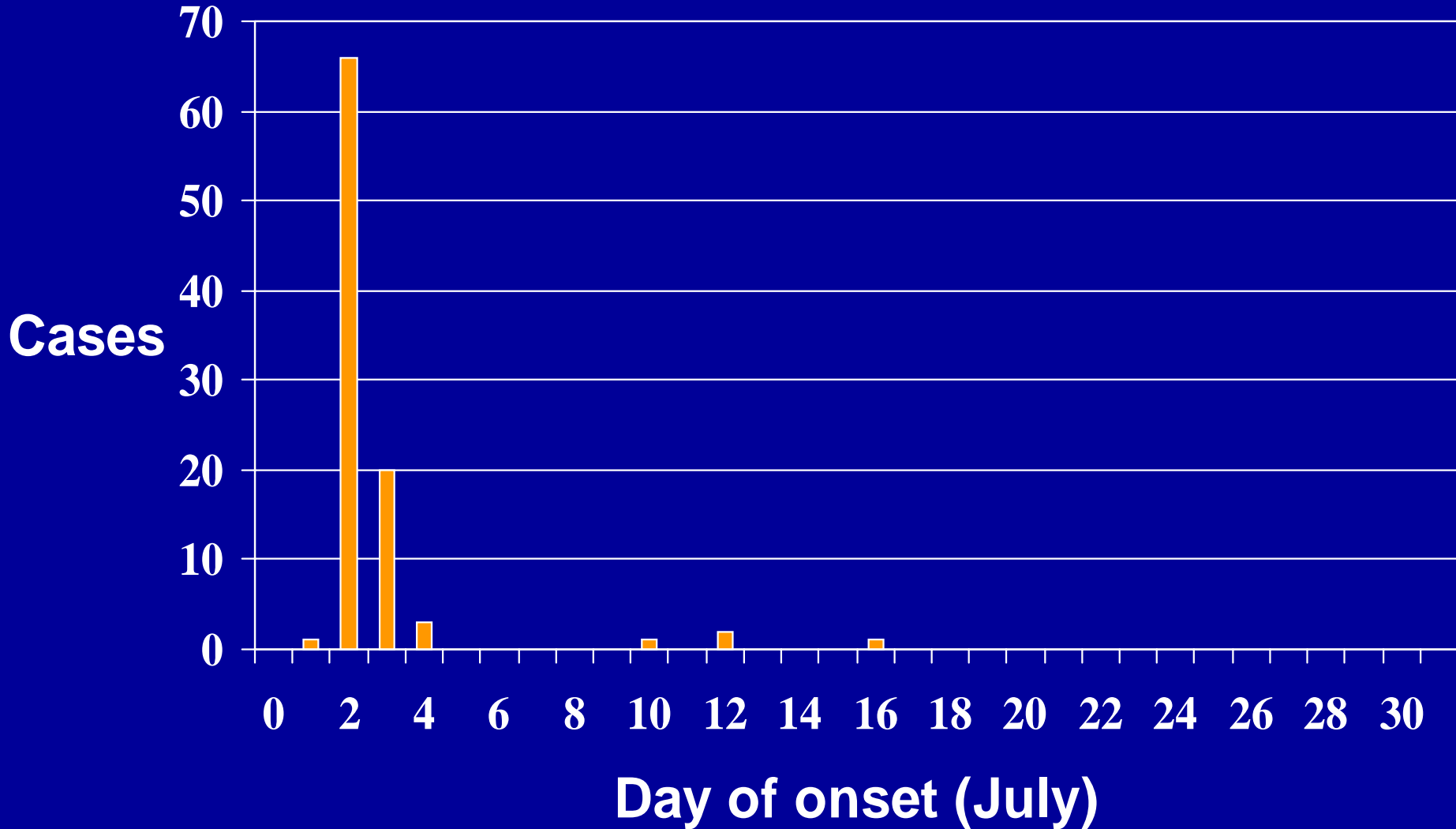
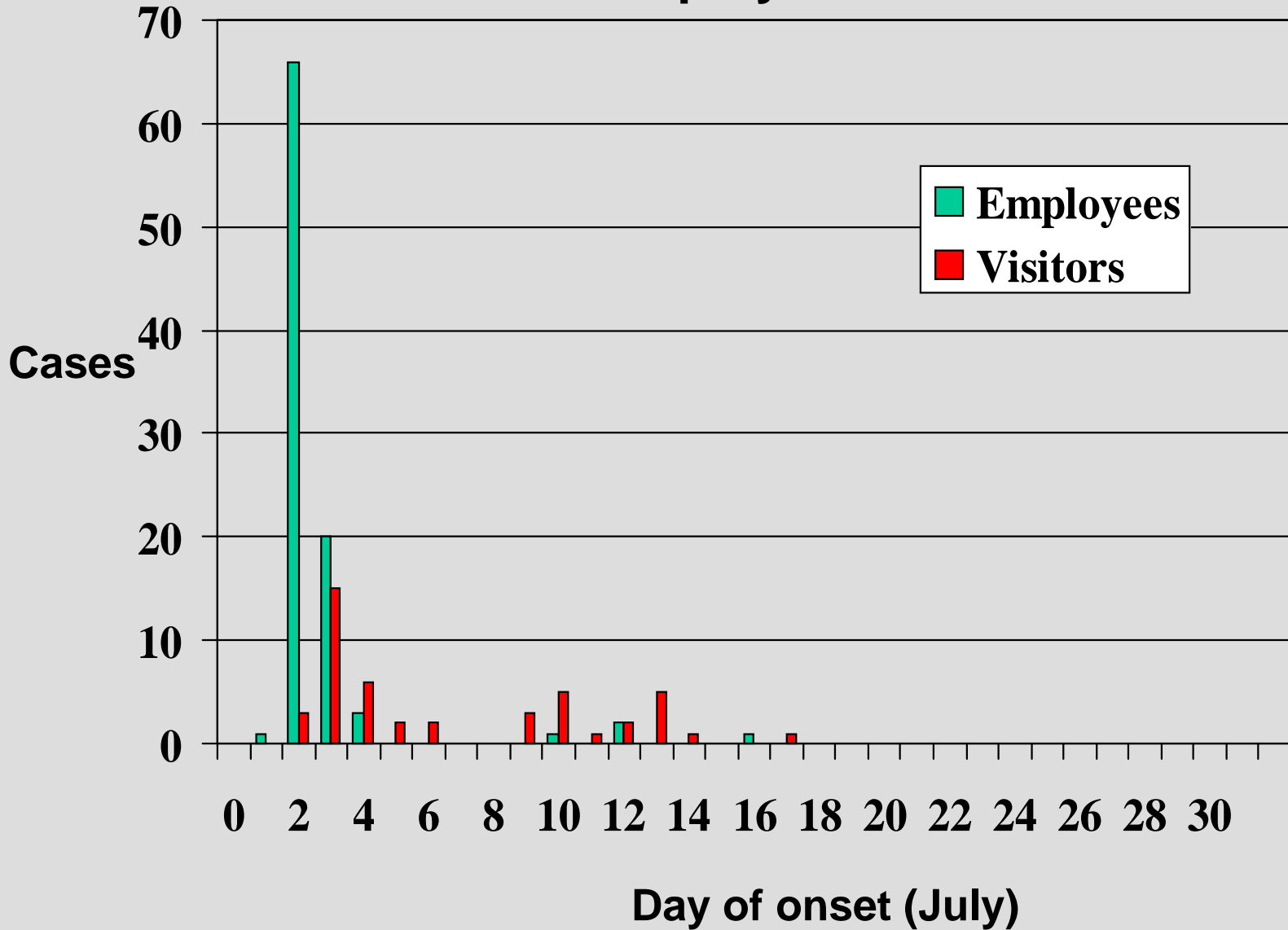


Cases in employees



Cases in employees and visitors



Secondary attack rate

$$\frac{\text{Cases in household members}}{\text{Total number of household members}} \times 100$$

- **Epidemiology:** the study of diseases in populations
- **Epidemic:** an unusual occurrence (a significant increase in incidence above baseline)
- **Epidemiologist:** someone who studies epidemics.

An Epidemic of an Unknown Disease

- Place: the Oakland County, Michigan, Health Department
- Time: July 1
- Problem: acute febrile illness in most of the employees of the health department
- As an EIS officer at the CDC, you are sent to investigate the outbreak.

Incubation periods

- **< 24 hours**
 - Staphylococcal food poisoning
 - chemical toxins
- **1 - 3 days**
 - influenza
 - Shigellosis
- **1 - 3 weeks**
 - whooping cough
 - psittacosis
 - *Mycoplasma pneumonia*

You and two other EIS officers arrive on the scene and begin work in the building on Saturday, July 6. You continue working through the weekend. On Tuesday evening, all of you become ill with the syndrome. The air conditioning system had been turned off over the weekend and turned on again Monday morning.

Secondary Attack Rates

- High
 - Influenza
 - Measles, mumps, chickenpox
 - Diphtheria
- Low
 - Meningitis
 - Pneumococcal pneumonia
 - Hansen's Disease

Symptom	Number with symptom	% with symptom
Malaise	93	98
Myalgia	90	95
Fever	86	91
Chills	86	91
Headache	86	91
Cough	54	57
Dizziness	51	54
Nausea	44	46
Chest pain	43	45
Joint pain	41	43
Sore or dry throat	31	33
Abdominal pain	26	27
Confusion	22	23
Bizarre dreams	8	8
Irritability	3	3

Bacterial species isolated from water at the base of the evaporative condenser

- *Corynebacterium* sp.
- *Bacillus* sp.
- *Pseudomonas* sp.
- *Flavobacterium* sp.
- *Pseudomonas stutzeri*
- *Pseudomonas maltophilia*

Which organism caused the outbreak?

Find the defect in the air conditioning system

- Place smoke bombs in the system, follow the smoke.
- Place guinea pigs in the system, look for illness.
- Inspect the system, look for leaks.
- Culture the water, ducts, etc.

Establish the microbial etiology

- Culture the ill guinea pigs.
- Test the guinea pigs (real and human) for rises in antibody titers toward likely pathogens.
- Compare antibody titers in ill and well persons.
- Freeze down the samples and wait.

1976. An outbreak of severe pneumonia among participants in the National Convention of the American Legion, Philadelphia, PA

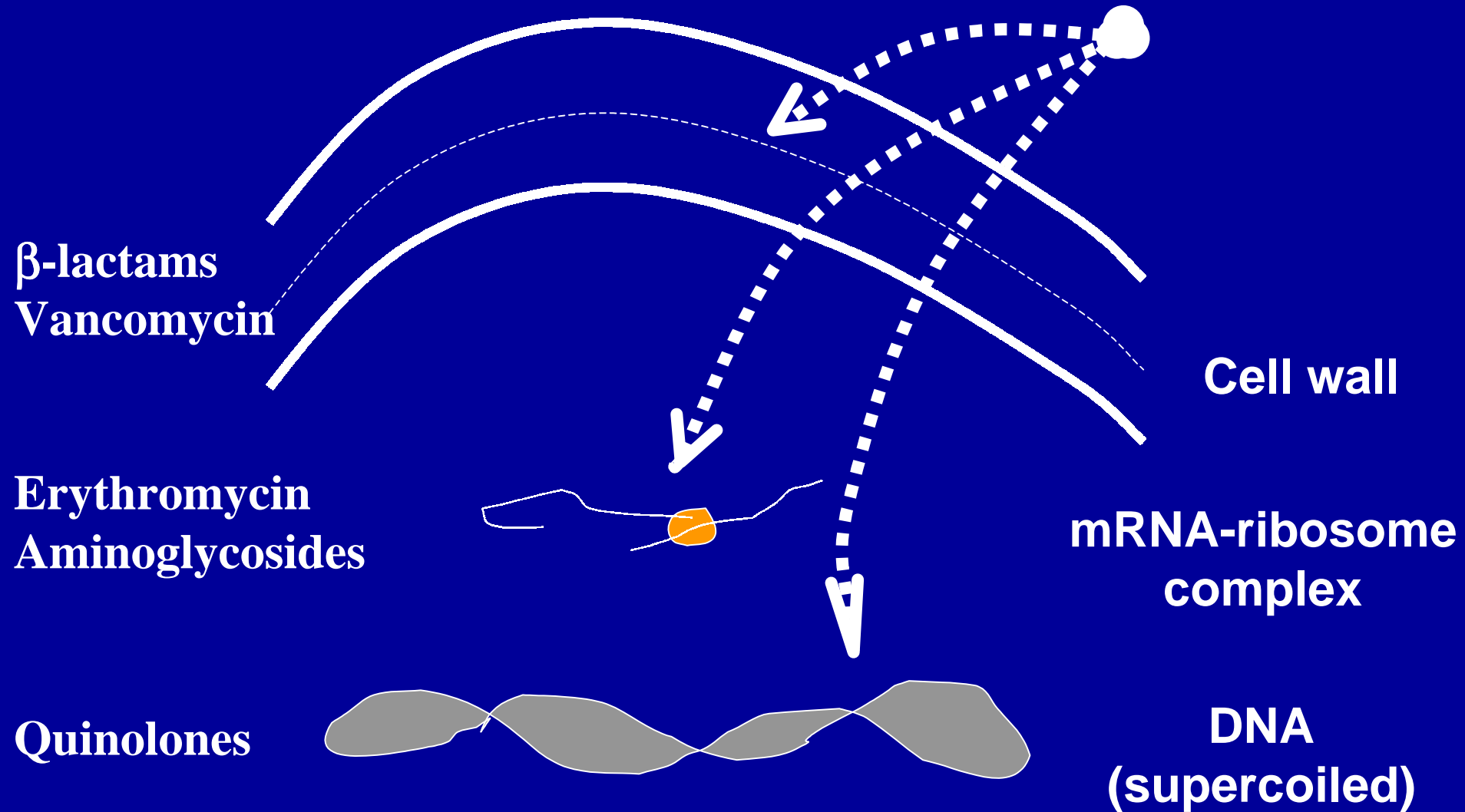
- A newly-recognized cause of human disease, *Legionella pneumophila*, was discovered.
- Using the correct culture techniques, *L. pneumophila* was isolated from the guinea pig tissues stored at CDC from the Michigan outbreak.
- Both the ill employees and EIS officers had significant antibody titers to *L. pneumophila*.

Diseases caused by *L. pneumophila*

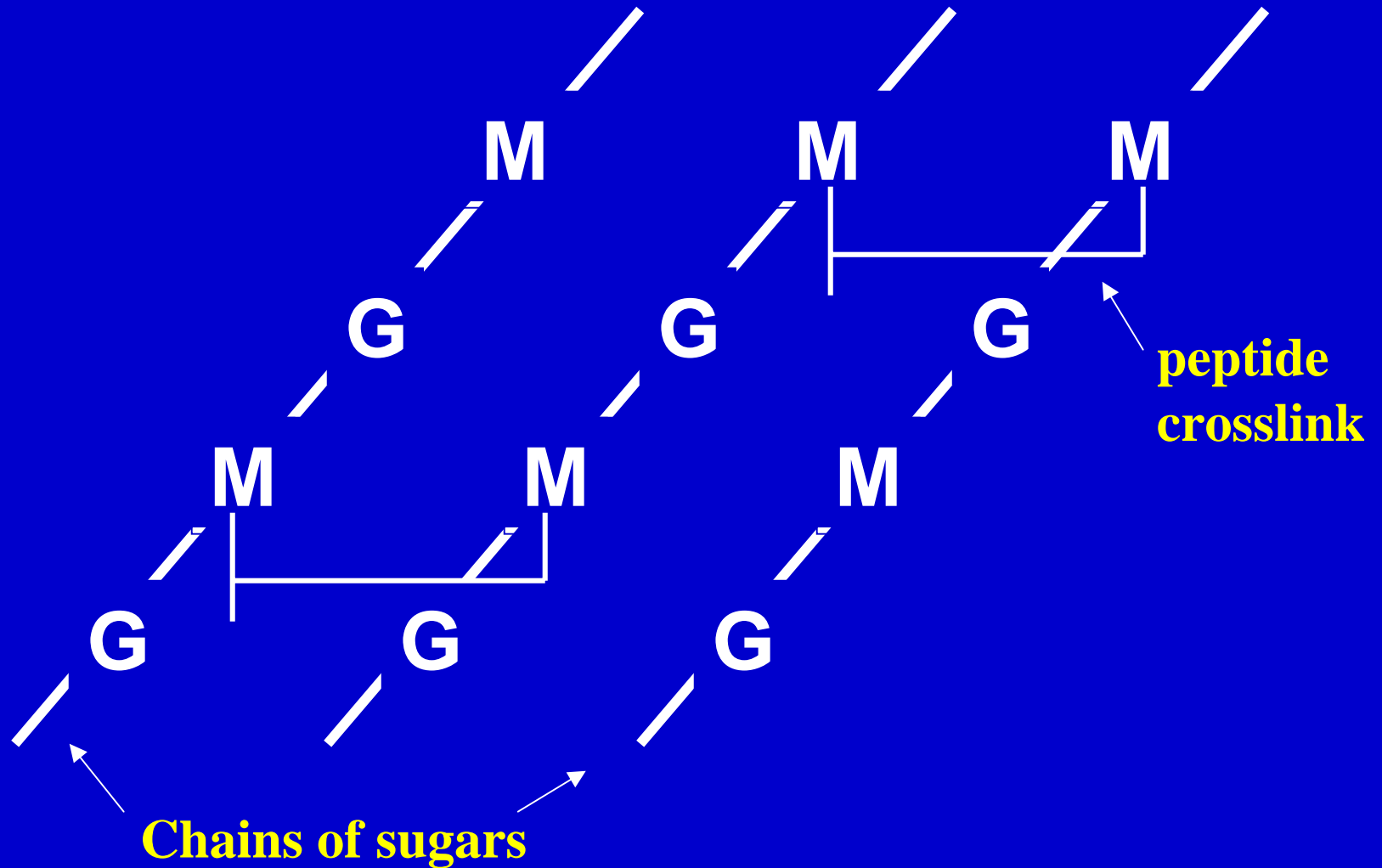
- **Legionnaire's Disease**
 - pneumonia, often fatal
- **Pontiac Fever**
 - influenza-like illness, rarely fatal

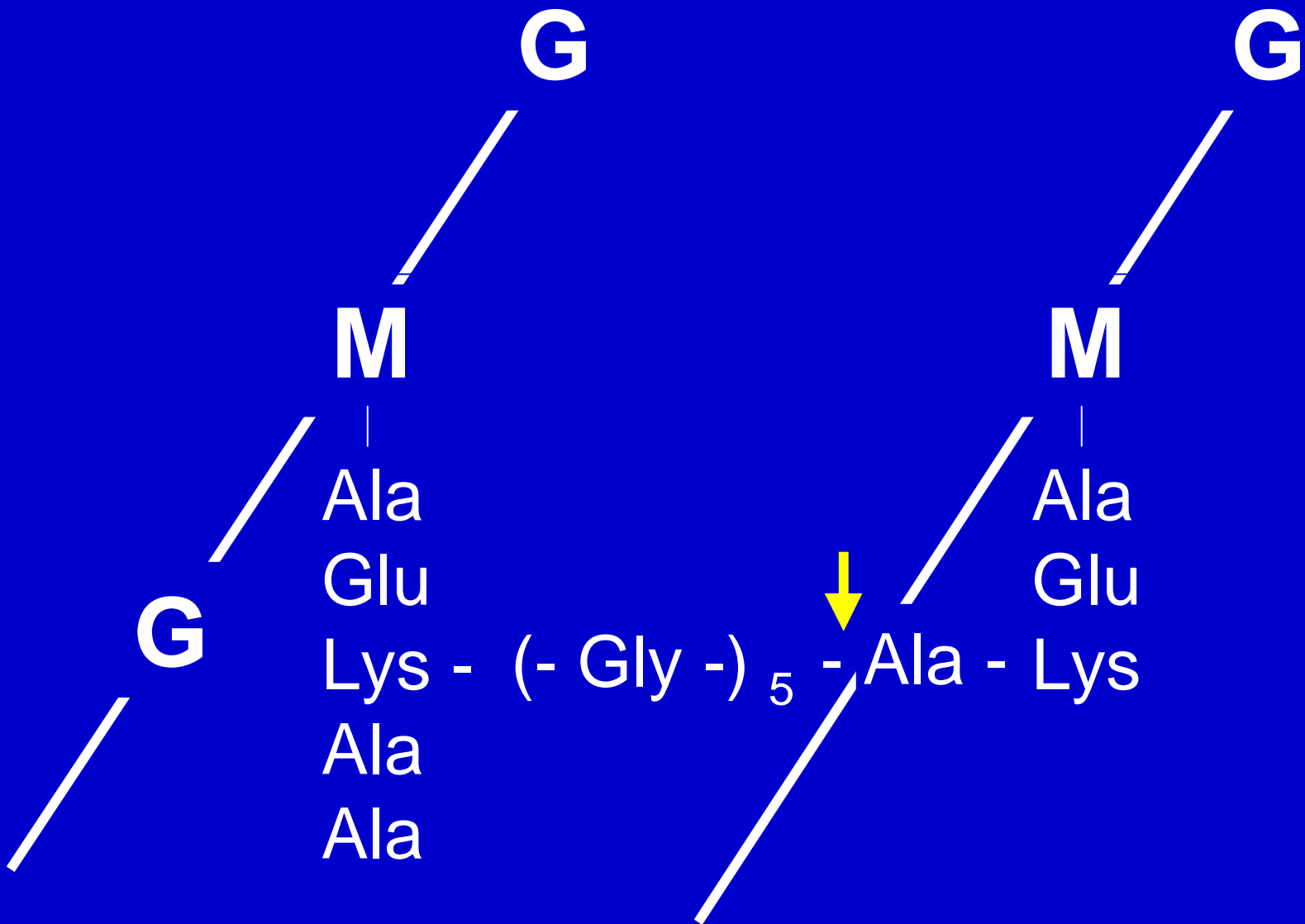
*The same microbe causes both kinds of disease.
The reasons for the differences are still not
completely understood.*

Antibacterial drugs: sites of action

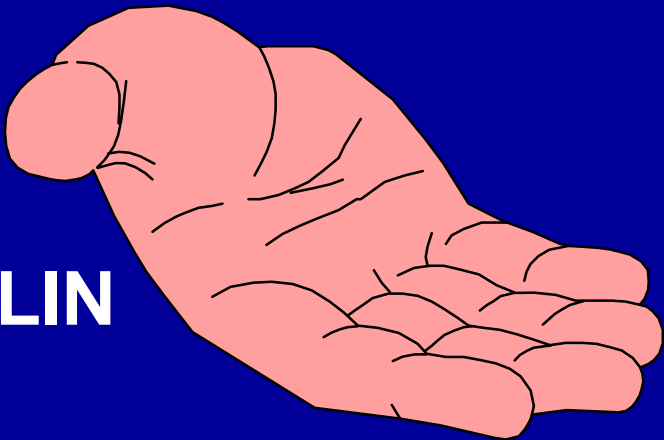
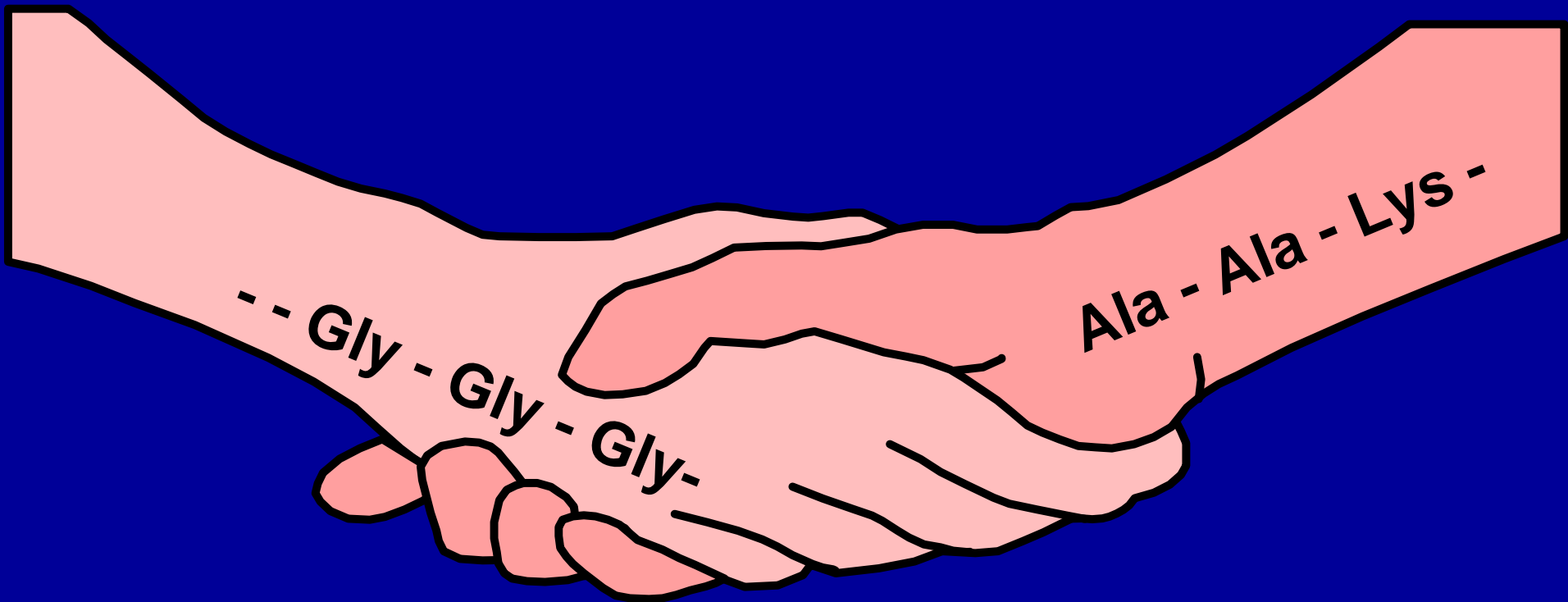


Peptidoglycan

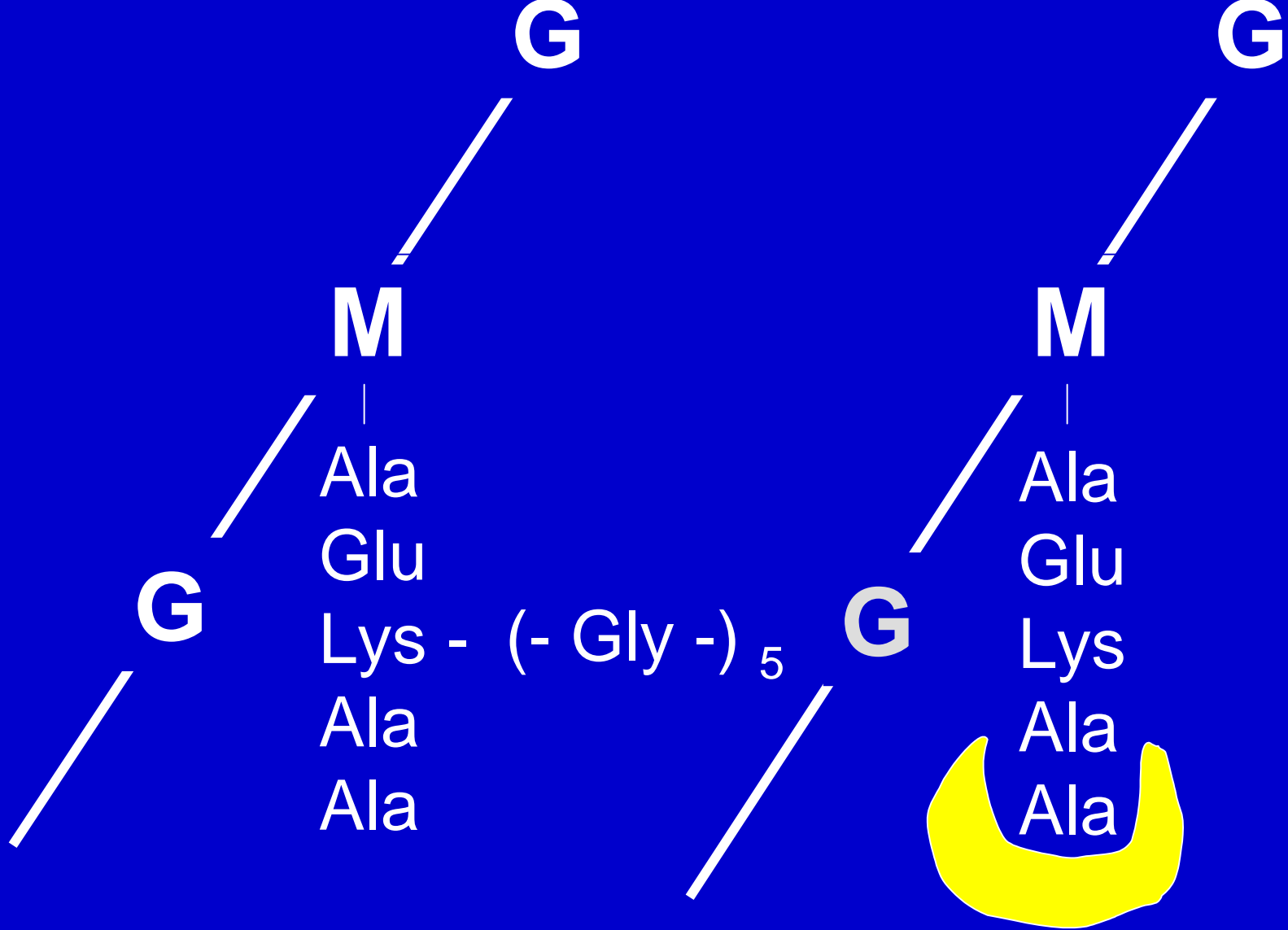




A peptide cross-link. The arrow shows the bond created by the transpeptidase (penicillin-binding protein).
 G and M are sugar molecules.

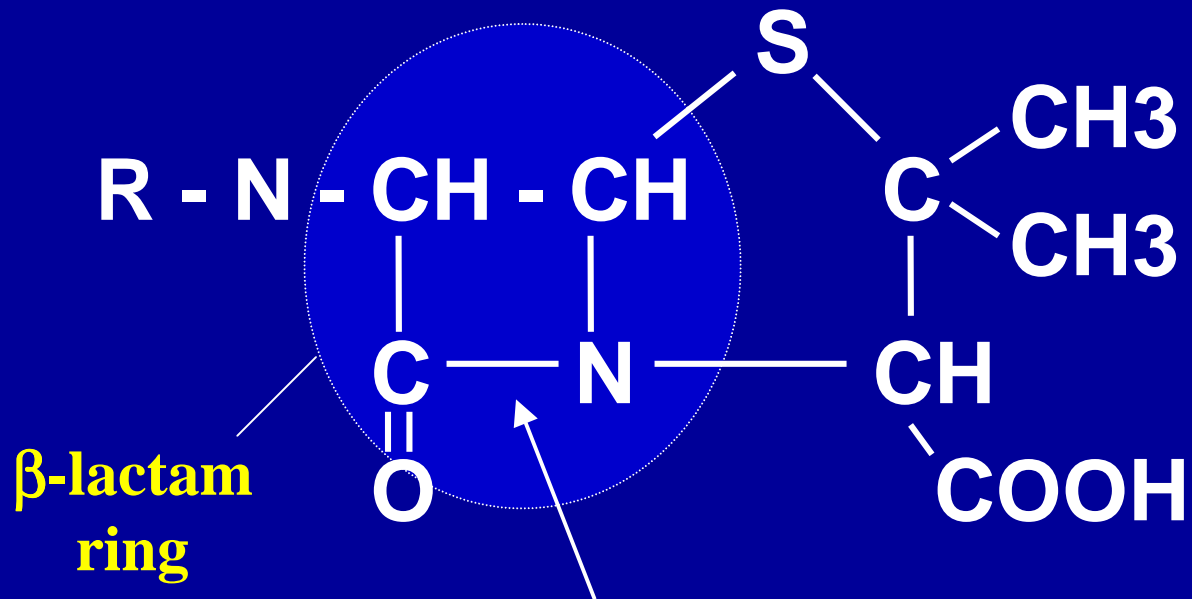


PENICILLIN



Vancomycin covers the Ala - Ala at the end of the peptide chain, preventing it from forming the cross-link.

Penicillin G



**bond cleaved by both
transpeptidase and penicillinase**

Antibiotics and Antibiotic-resistant Bacteria

- How antibiotics work
 - Penicillins
 - Vancomycin
- How bacteria become resistant to antibiotics
 - Penicillins
 - Vancomycin
- How antibiotic resistance spreads
- Some things we can do

Mechanisms of action

- Inhibit cell wall synthesis
 - Penicillins, vancomycin
- Inhibit protein synthesis
 - Erythromycins, aminoglycosides
- Inhibit DNA synthesis
 - sulfonamides, quinolones

An effective antimicrobial drug must inhibit or kill the microbe without harming the host. Selectivity.

How antibiotics work: 2 examples

- Beta-lactams
 - Penicillin G
 - Methicillin, nafcillin, cloxacillin
 - Cephalosporins
- Vancomycin

Bacterial resistance to antibiotics

- Enzymes that destroy the drug
 - Beta-lactamases destroy beta-lactams
- Altered target site
 - Transpeptidase mutations: MRSA
 - Peptidoglycan mutation: VRE
- Decreased cell wall permeability
- Increased antibiotic efflux

How antibiotic resistance spreads ("selection pressures")

- Use of antibiotics in agriculture
 - Livestock, plants
- Environments with intensive antibiotic use
 - Hospitals, nursing homes
 - Day care centers
- Unnecessary use in medicine
 - Uncontrolled usage
 - Unnecessary prescribing

What we can do

- Decrease indiscriminate uses of antibiotics
- Develop better vaccines for preventing otitis media, pneumonia, other infections now treated with antibiotics
- Improve surveillance worldwide
- Develop new antimicrobial drugs and promote intelligent usage