

## Staphylococcus Aureus Bacteria

S. aureus are:

1. Cocci shaped (round) bacteria
2. Non-motile (no flagella)
3. Commonly found as harmless commensal bacteria on skin
4. Replicate extracellularly
5. Use fast replication + toxins to survive in host
6. Regarded as an extracellular bacterium

However it can invade and survive within human cells

Evades immune system, antibiotic treatment, and allows bacterial proliferation

Host cell exit is associated with cell death, tissue damage, and spread of infection

Fluid inflammation helps spread bacteria

S. aureus can inhabit nasal passages of up to 40% of humans without causing disease

Is an opportunistic pathogen

→ When able to invade tissues (get under skin, into blood), they can cause disease

## Toxins

Toxins are virulence factors released by bacteria to provide better survival in the host Most toxins cause damage to the host or access to their tissues in host or immune evasion or better transmission  
Common toxins are:

1. Hemolysin (Red Blood Cells)
2. Leukotoxin (White Blood Cells(Neutrophils))
3. Exfoliative Toxins (Removes Skin for access)
4. Enterotoxins (Food poisoning)
5. Toxic Shock Syndrome Toxin-1 (TSST-1)

## Diseases

### Non-Healthcare Associated Diseases

Local skin infection

1. Pimples
2. Boils

Toxin-mediated disease

1. Impetigo
  - Exfoliative
  - Primarily in children
  - Treated with antibiotics
2. Staphylococcal Scalded Skin Syndrome
  - Exfoliative
  - Primarily in children
  - Treated with antibiotics
  - Causes scarring but usually not death
3. Staphylococcus toxin-mediated food poisoning
  - Staphylococcal Enterotoxins (SEA, SEB, SEC)
  - Bacteria can be killed but toxins are heat stable
  - No fever but severe nausea and vomiting
4. Toxic Shock syndrome
  - menstrual
  - nonmenstrual

### Healthcare Associated Diseases

1. Bacteremia or sepsis when bacteria spreads to bloodstream
2. Pneumonia usually found in patients with lung disease or on mechanical ventilators
3. Endocarditis (infection of heart valves) which can lead to heart failure or stroke
4. Osteomyelitis (bone infection) can happen after bacteremia or surgery/injury

## Toxic Shock Syndrome

### Background

First used in 1978 to describe staph outbreak in children

Bacteria could not be isolated from blood, indicating a toxin might be involved

January 1980 - Epidemiologists in Wisconsin and Minnesota reported appearance of TSS mostly in menstruating women

→ Acute fever, vomiting, rash, and high number of deaths

September 1980 - Users of Rely tampons were at greater risk for TSS

Tampons developed in 1936, 90% sold by Tampax

No regulations, but widespread usage by 1960

### **Rely Tampons**

To compete with Tampax, other companies made "super absorbent" tampons with synthetics, not cotton

→ Rely tampons were made with polyester and carboxymethyl cellulose

Excessive absorbency led to altered "microbial ecosystem"

Viscosity of vaginal fluids increased

Increased bacterial growth

New strain secreting TSST-1 now found in about 20% of isolates

### **Menstrual TSS**

Starts within 2 days of beginning or end of menses

Associated with high absorbency tampons

### **Nonmenstrual TSS**

Caused by colonization of various sites (lung, skin, surgery)

Wounds don't seem inflamed

Can be caused by TSST-1 (<50%) or other toxins / superantigens

Proper treatment results in mortality <5%

### **Superantigens**

Toxins responsible for TSS and Staph mediated food poisoning are superantigens

Cause non-antigen specific mediated inflammation

→ Superantigens "glue" the TCR to the MHC regardless of peptide

Less than 0.01% of T-cells normally respond to a given pathogen

→ T cells in immune response don't help with removing the bacteria / virus

Process:

1. Activate lots of T cells
2. Make lots of cytokines
3. Activate lots of macrophages
4. Make more cytokines
5. Create inflammation