Module: Infection & Immunity
Semester: 5
Session: 4
Lecture Duration: 2h.

Lecture Title: Examples of hospital acquired infection

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This Lectur was loaded in blackboard and you can find the material in:
Jawetz, Meinik & Adelberg's MEDICAL MICROBIOLOGY, 27 th Edition

For more detailed instructions, any question, or you have a case you need help in, please post to the group of session

Learning Objectives (LOs)

1. To describe the characteristics of *Clostridium difficile*, its pathogenesis and management
2. To describe the characteristics of *Staphylococcus aureus* with regard to hospital acquired infections and drug resistance
3. To describe the characteristics of norovirus and application of infection prevention principles

Clostridia

LO-1

- It is Gram-positive, spore-forming, obligate anaerobic bacilli
- It is mainly free-living in soil but there are many species are major human pathogens

Classification of clostridia according to pathogenicity LO-1

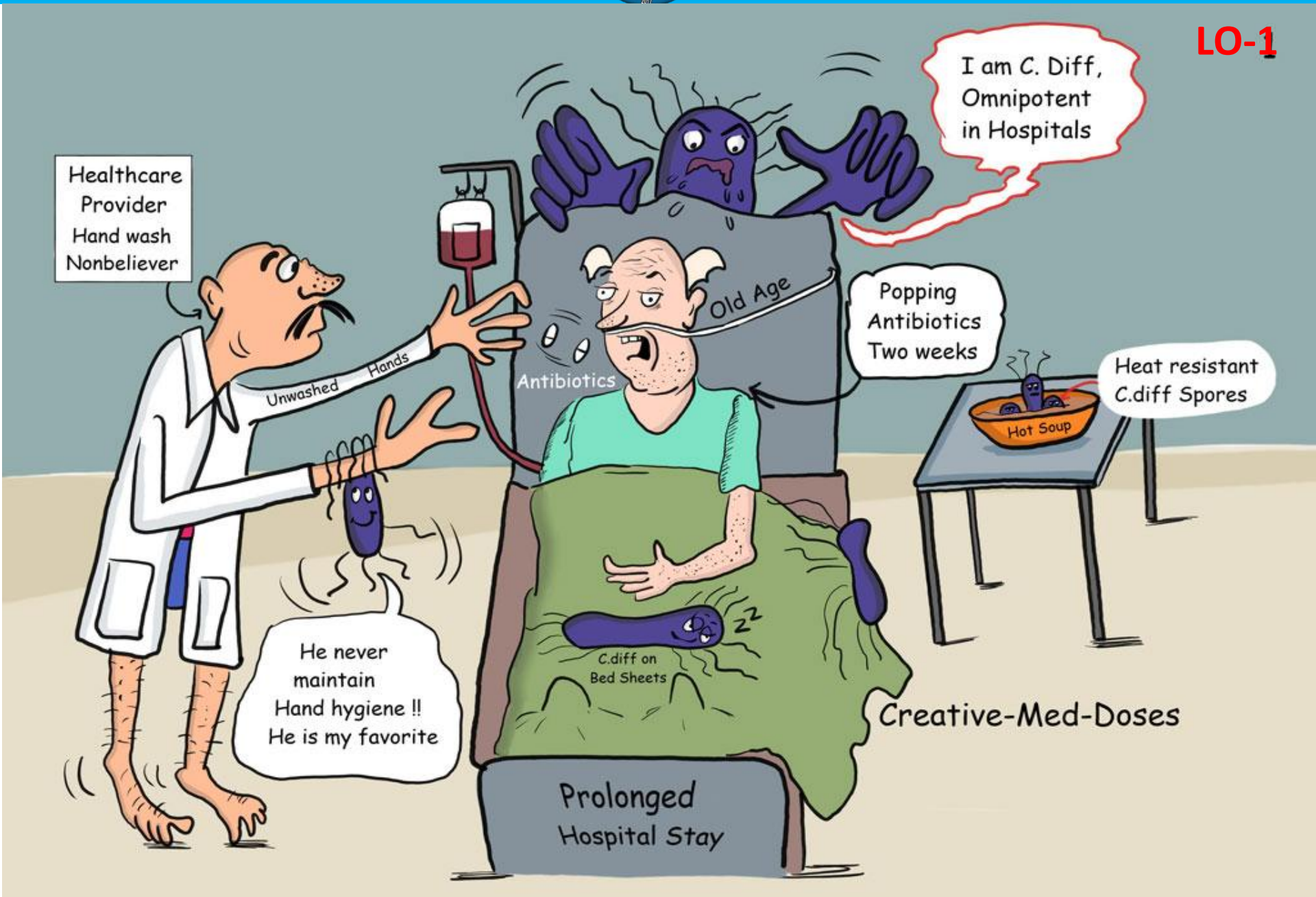
Group	*Species*
Tetanus	*C.tetani*
Acute colitis	*C.difficile*
Food poisoning	
• Gastroenteritis	*C.perfringens* type A
• Botulism	*C.botulinum*
Gas gangrene	*C.perfringens*
	C.septicum
	C.novyi
	C.histolyticum
	C.fallax

Clostridium difficile

LO-1

- It is a commensal bacterium of the human intestine found in 2-5% of the population.
- *C. difficile* is responsible for antibiotic-associated pseudomembranous colitis and antibiotic-associated diarrhea.

LO-1


I am C. Diff,
Omnipotent
in Hospitals
Healthcare
Provider
Hand wash
Nonbeliever
Unwashed Hands
Old Age
Antibiotics
Popping
Antibiotics
Two weeks
Heat resistant
C.diff Spores
Hot Soup
He never
maintain
Hand hygiene !!
He is my favorite
C.diff on
Bed Sheets
Creative-Med-Doses
Prolonged
Hospital Stay

Toxins

LO-1

Two types of toxins are produced by *Clostridium difficile*:

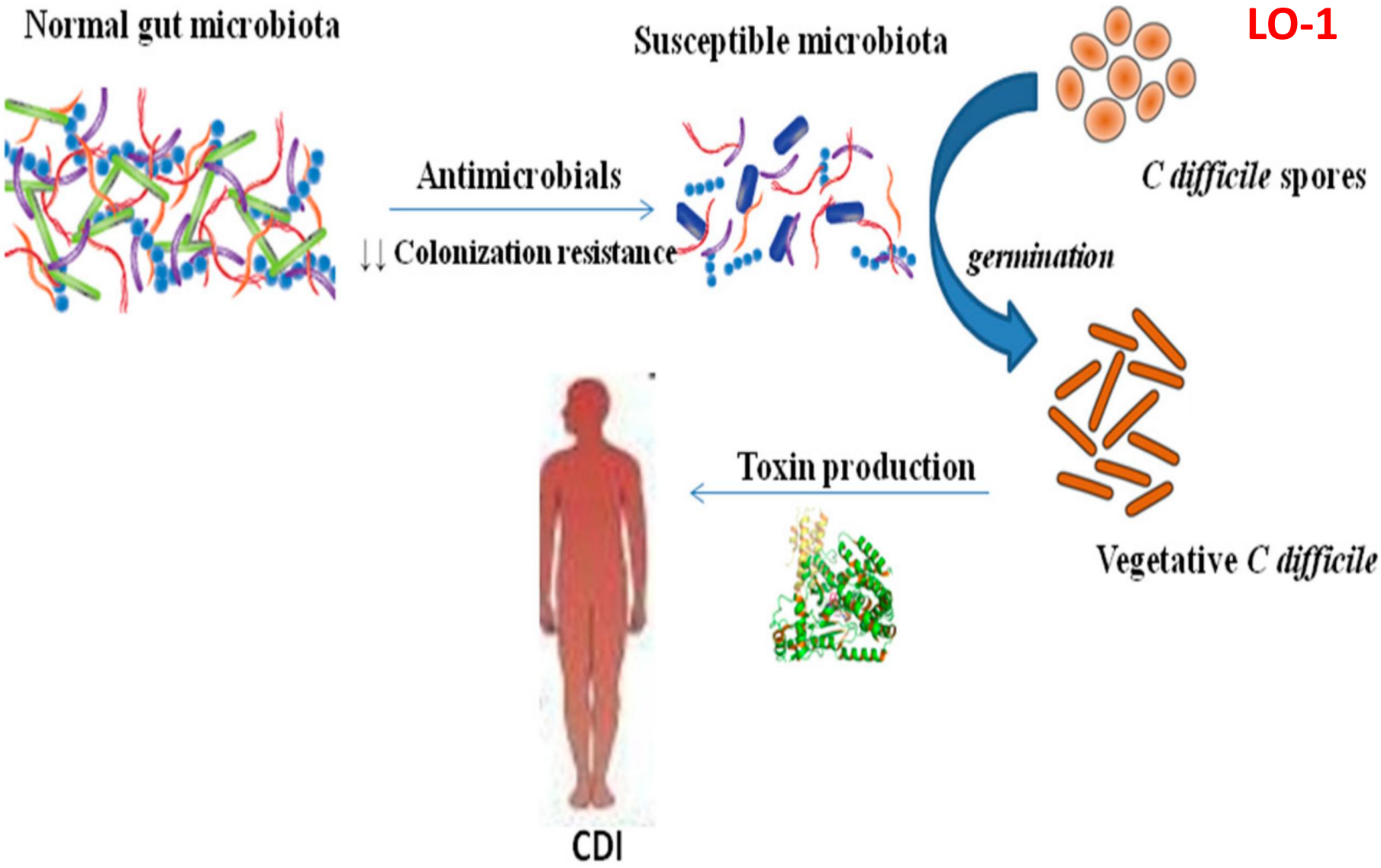
1. **Enterotoxin (toxin A): produces excessive fluid secretion and inflammation on the lining of the bowel wall, that lead to watery diarrhea**
2. **Cytotoxin (toxin B): disrupts protein synthesis within cells and is therefore cytotoxic and causes pseudomembrane formation**

Pathogenesis

LO-1

- Prolonged use of antibiotics, especially those with a broad spectrum of activity can result in disruption of normal intestinal flora, leading to an overgrowth of *Clostridium difficile*.
- Use of amoxicillin, cephalosporins, quinolones or clindamycin are frequently associated with a *Clostridium difficile* infection
- It thereby results in acute colitis with Pseudomembranous colitis (PMC) or without membrane formation.

LO-1


Normal gut microbiota
Susceptible microbiota
Antimicrobials
↓↓ Colonization resistance
C difficile spores
germination
Vegetative C difficile
Toxin production
CDI

LO-1

C. diff Infection

Common symptoms include:

Watery diarrhea.

Blood in your poop.

Persistent abdominal pain.

Swollen, distended abdomen.

Nausea and vomiting.

Loss of appetite.

Fever.

Rapid heart rate.

Clinical signs

LO-1

- The diarrhea may be mild and watery or bloody and accompanied by abdominal cramping and fever.
- In PMC, it progresses to a severe, occasionally lethal inflammation of the colon that can be demonstrated by endoscopic examination.

Pseudomembranous colitis (PMC)

LO-1

LO-1

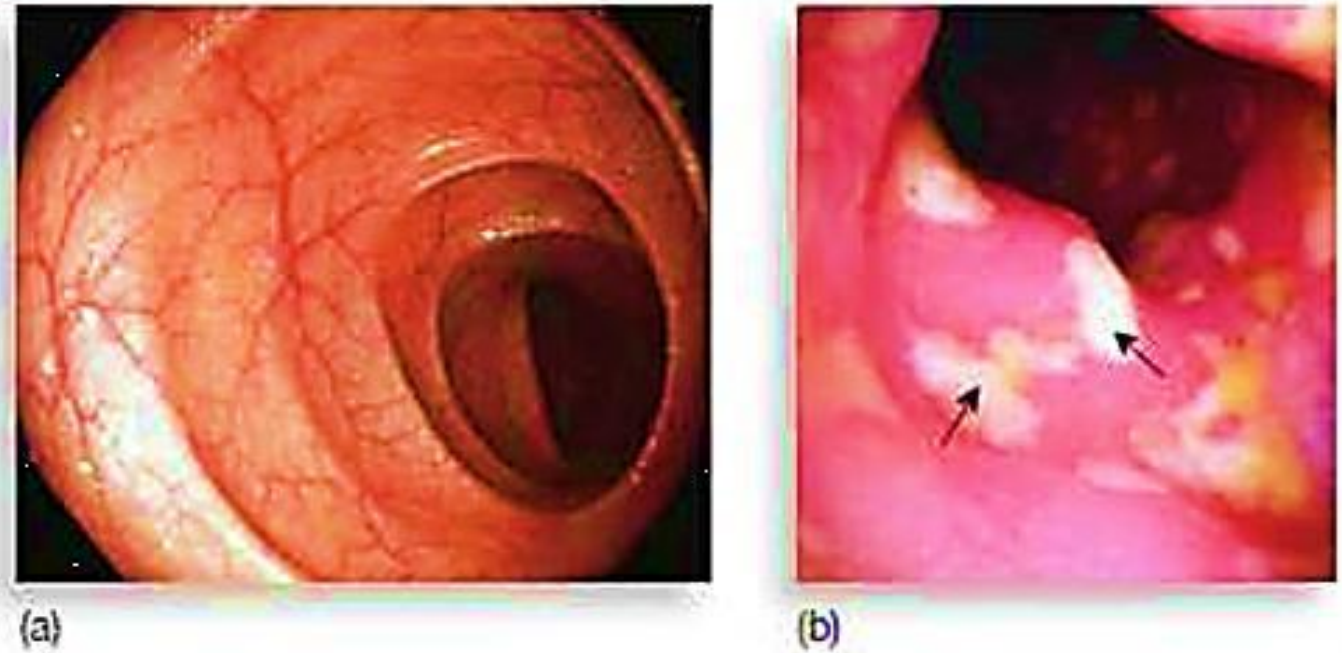


Figure Antibiotic-associated colitis as imaged by a sigmoidoscope during colonoscopy.
(a) View of a normal colon.
(b) Arrows indicate white patches or pseudomembranes that are caused by inflammation and desquamation of epithelial cells that line the colon.

Laboratory diagnosis

LO-1

1. *C. difficile* can be isolated from the faeces
2. Toxin can be detected in the patient's faeces
3. Highly sensitive PCR (polymerase chain reaction)
4. Endoscopic evidence

Treatment

LO-1

- Stop antibiotics where possible
- Fluid and electrolytes loss caused by diarrhoea should be replenished
- If no markers of severe disease; start metronidazole for 10 days
- If markers of severe disease; start vancomycin (+/- metronidazole).

Nosocomial infection

LO-1

- Although infection is endogenous in most cases, hospital outbreaks have clearly established that the environment can be the source as well.
- Its spores persist in hospital and other environments

Staphylococci

LO-2

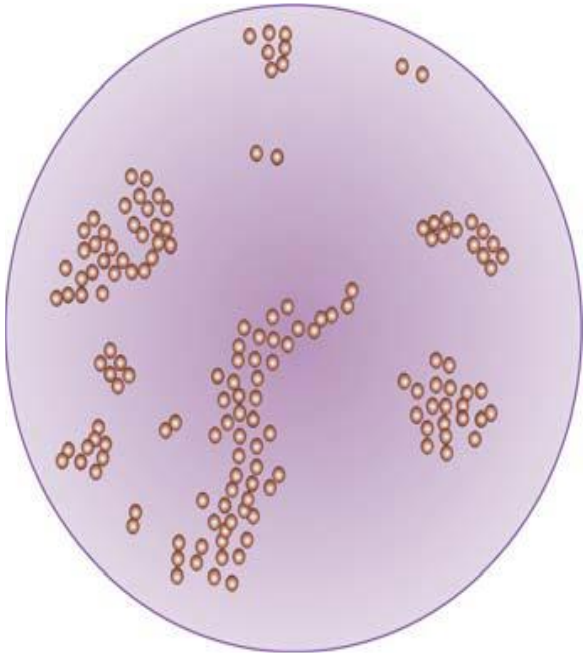
Staphylococci classified into

1. **Pathogenic species: *Staphylococcus aureus* produces coagulase**
2. **Nonpathogenic species: Coagulase-negative staphylococci include *S. epidermidis*, important in infecting prostheses and catheters, and *S. saprophyticus*, a cause of urinary infections.**

Staphylococcus aureus

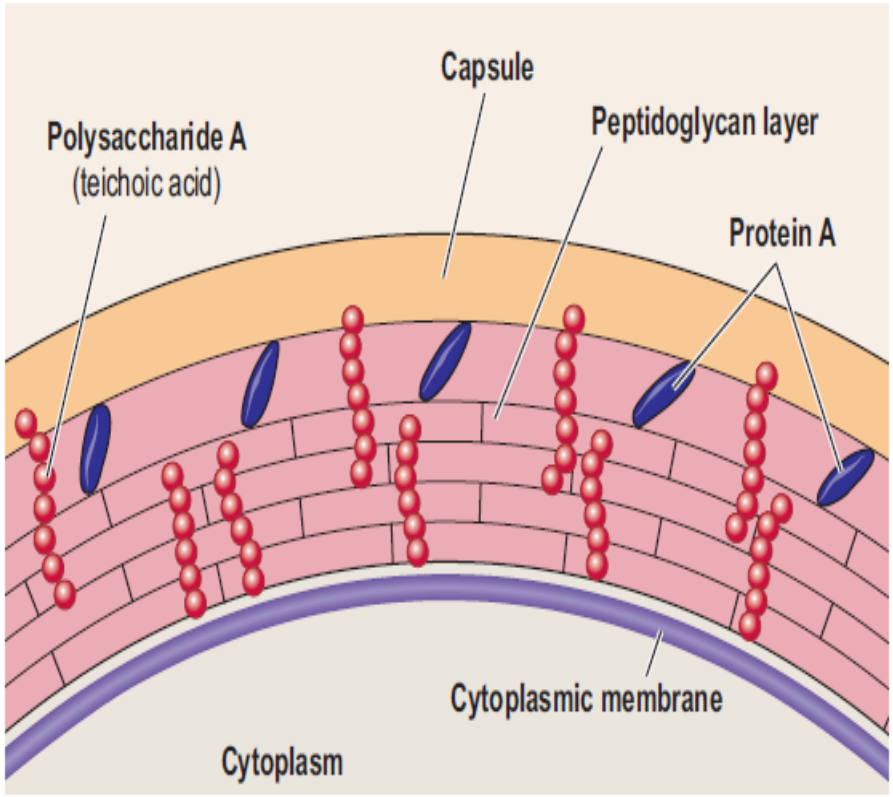
LO-2

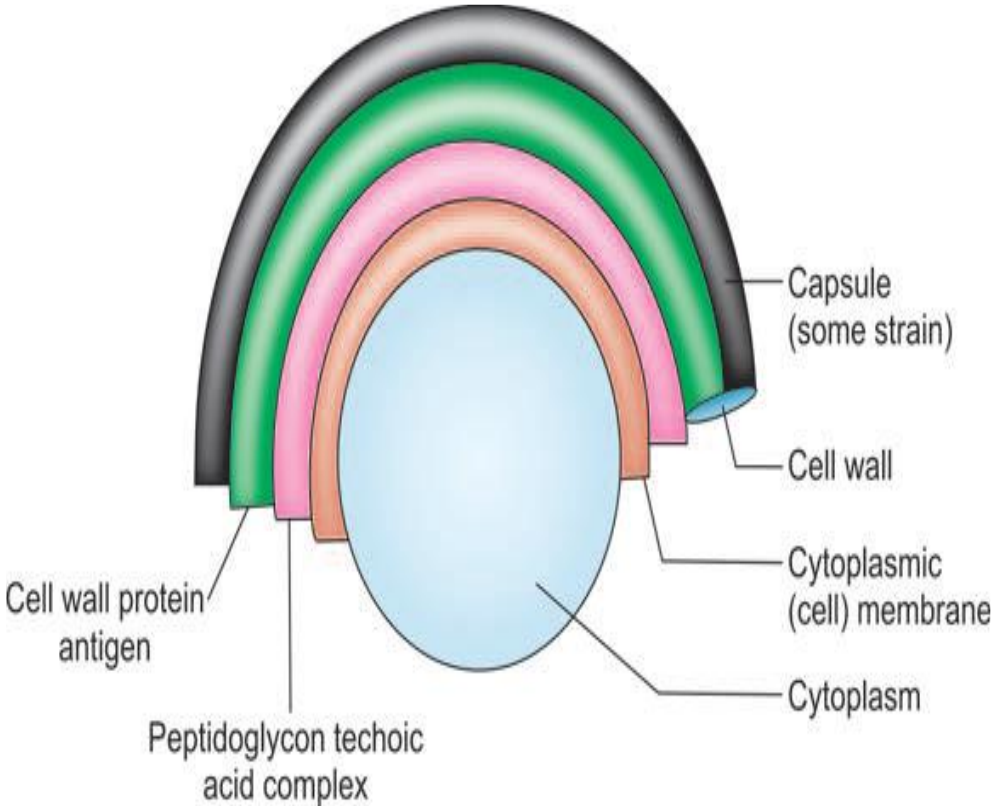
- It is ovoid or spherical, non-motile, aerobic, rarely capsulated, nonspore forming and is Gram-positive.
- It is arranged in clusters (grapelike)
- *S. aureus* is present in the nose of 30% of healthy people and may be found on the skin.



Antigenic structure of *Staphylococcus aureus*

LO-2





LO-2

Virulence factors of *Staph. aureus*

Virulence factor	Activity
Cell wall polymers	
Peptidoglycan	Inhibits inflammatory response; endotoxin-like activity
Teichoic acid	Phage adsorption; reservoir of bound divalent cations
Cell surface proteins	
Protein A	Reacts with Fc region of IgG
Clumping factor	Binds to fibrinogen
Fibronectin-binding protein	Binds to fibronectin
Exoproteins	
α-Lysin β-Lysin γ-Lysin δ-Lysin	Impairment of membrane permeability; cytotoxic effects on phagocytic and tissue cells
Panton–Valentine leucocidin	Dermo-necrotic and leucocidal
Epidermolytic toxins	Cause blistering of skin
Toxic shock syndrome toxin	Induces multi-system effects; superantigen effects
Enterotoxins	Induce vomiting and diarrhoea; superantigen effects
Coagulase	Converts fibrinogen to fibrin in plasma
Staphylokinase	Degrades fibrin
Lipase	Degrades lipid
Deoxyribonuclease	Degrades DNA

LO-2

Infections caused by *Staph. aureus*

Pyogenic infections	Toxin-mediated infections
Boils, carbuncles	Scalded skin syndrome
Surgical site (wound) infection	Pemphigus neonatorum
Abscesses, e.g. spinal	Toxic shock syndrome
Impetigo	Food poisoning
Mastitis	
Bloodstream infections	
Osteomyelitis	
Pneumonia, e.g. ventilator-associated	
Endocarditis	

LO-2

Huge abscess (carbuncle) on back with yellow pus, necrosis and ulceration.

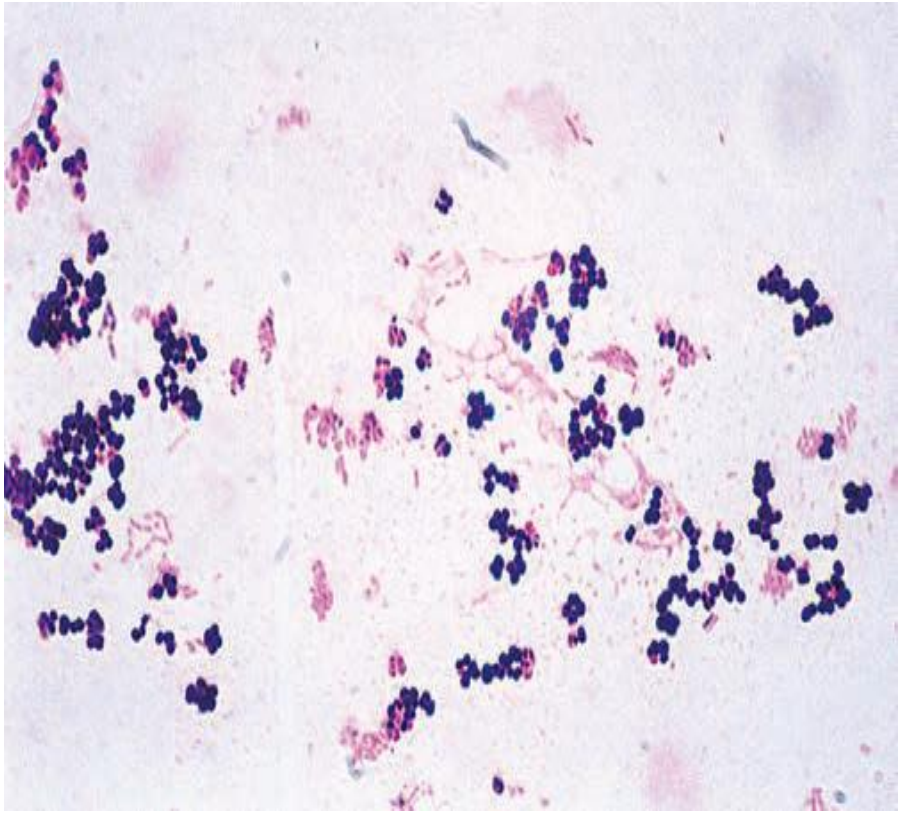
Scalded skin syndrome (toxic epidermal necrolysis)

LO-2

Laboratory Diagnosis

- Smear examination. It is stained with Gram method Gram positive cocci arranged in cluster or in small groups.
- Isolation of organism: The specimen is plated on blood agar media. They are golden yellow colonies, showing beta hemolysis.
- The colonies are tested for coagulase production

LO-2



Staphylococci in grape-like clusters

S. Aureus beta hemolysis on blood agar

Resistance

LO-2

Penicillin resistance may be classified into following three types:

1. **Production of beta lactamase**
2. **It may be by alteration in bacterial receptors. It reduces binding of beta lactam to cells. This resistance includes resistant penicillin, e.g. methicillin and cloxacillin. These strains are also called methicillin resistant *Staphylococcus aureus* (MRSA).**
3. **There may be development of tolerance to penicillin. It means that organism is inhibited and not killed.**

MRSA

LO-2

- Methicillin resistance is encoded by the methicillin resistance gene (mecA) is present in methicillin resistant *S. aureus* strain.
- Multidrug resistance is a common feature of MRSA.
- MRSA strains are resistant to all β-lactam agents, and often to other agents such as the aminoglycosides and fluoroquinolones.
- Isolates of MRSA with reduced susceptibility or full resistance to glycopeptide antibiotics are uncommon, but have been detected sporadically. These isolates have either thickened cell walls (reduced susceptibility) or the vanA gene (fully resistant).

LO-2

Treatment

- Penicillin is a quite effective antibiotic against sensitive strains.
- Flucloxacillin can be used unless MRSA is endemic.
- Erythromycin, clindamycin or vancomycin is also indicated.
- MRSA are sensitive to vancomycin, but these agents are relatively expensive and may be toxic
- Ciprofloxacin has been suggested the alternative for the treatment of MRSA infections.

Nosocomial infection

LO-2

- MRSA is endemic in hospitals globally
- MRSA is responsible for more than 50 percent nosocomial infections.
- MRSA in many hospitals and increasingly in the community has become a major public health issue.

Control of infection

LO-2

- Staphylococcal infections can never be completely eradicated because of carrier state in man.
- Control of spread of infection both in home and in the hospital requires proper hygiene care and proper disposal of pus contaminated material.

Noroviruses

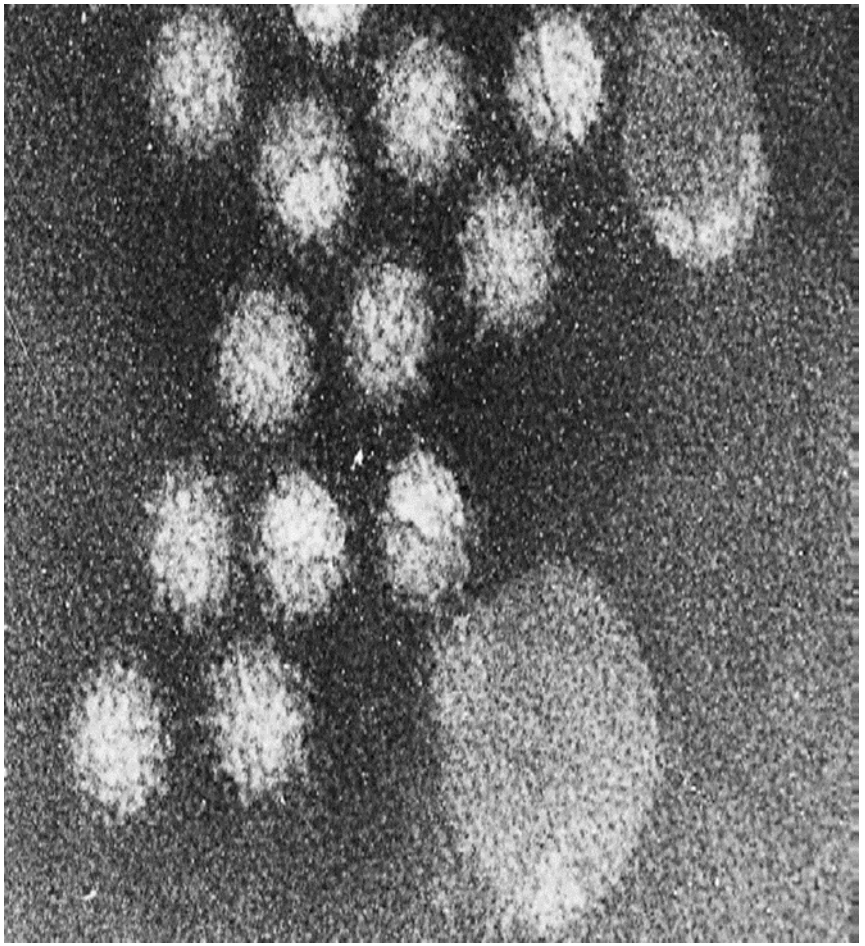
LO-3

- Noroviruses are a major cause of food- and water-associated outbreaks of diarrhea and vomiting, throughout the world.
- They were first associated with an outbreak in Norwalk, Ohio, in 1968 thus called the Norwalk agent.
- Present called Norovirus
- They are classified as members of the Caliciviridae family.
- Norovirus genogroups I, II, and IV are clinically important for humans

Morphology

LO-3

- Noroviruses are small, naked, round contain positive sense single stranded RNA.



Epidemiology

LO-3

- There are several modes of transmission including the faecal oral and also thought to be respiratory. Can be spread following ingestion of contaminated food, direct person-to-person contact or through contact with contaminated surfaces.
- Outbreaks include older children and adults
- Infectious period from onset of symptoms to 48 hours after symptoms stop.
- Noroviruses cause large outbreaks in hospitals, cruise ships and in the community, especially in schools and nursing homes.

Clinical signs

LO-3

- The incubation period is 18–48 hours, and the onset is often sudden.
- Noroviruses are associated with diarrhoea and vomiting (especially projectile vomiting).
- There may be abdominal pain and low-grade fever, but the stools do not contain blood or mucus.
- Norovirus is normally an acute self-limiting disease without long term complications.
- The very young and the very elderly are at risk from the complications of dehydration.

Treatment

LO-3

- No current antiviral or vaccine currently available
- Treatment consists of supportive measures.

Control and prevention

LO-3

- Previous exposure does not confer any long term immunity.
- To prevent the spread potentially contaminated faeces and vomit should be dealt with and removed promptly.
- Good hand washing

“ We always work together as a team ”