

M2-Medically Important Bacteria

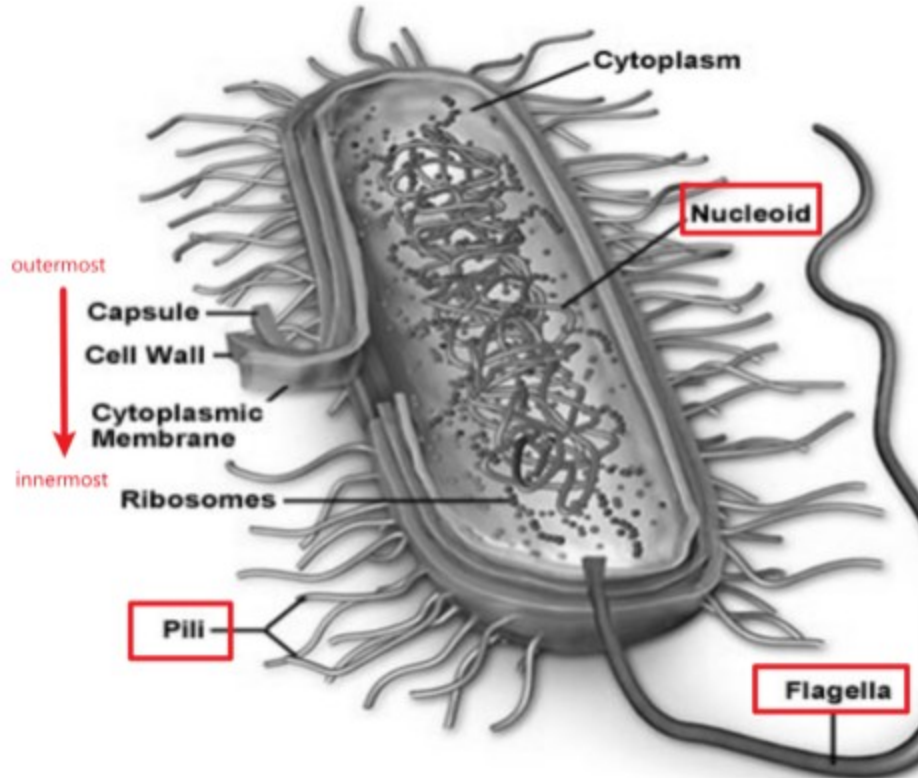
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Learning Objective

1. Basic approaches for identification
2. Common bacterial infections and transmission routes
3. Simple classification of medically important bacteria
4. Some key examples of medically important bacteria

Identification & Classification

Some common structures of Prokaryotes



- The Capsule
 - Protects the cell by acting as a **barrier** that prevents **water loss** due to desiccation.
 - The capsule can also **hide the cell's surface antigens**, preventing the host's immune system from recognizing and attacking the cell.
 - The slippery surface of the capsule can **inhibit phagocytosis**.
- The nucleoid is the **region of a prokaryotic cell where the genetic material is located**.
 - It is not surrounded by a membrane.
 - It contains a **single, circular chromosome** that contains all of the necessary genetic information for the cell
 - It may also contains extrachromosomal elements (Plasmid)
 - 🐜 M1-Introduction to Microbiology - Plasmids
- Pili are hair-like structures that extend out from the surface of some prokaryotic cells.
 - They are involved in processes such as **adherence to surfaces** and **conjugation**, which is the **transfer of genetic material between cells**.
- Flagella are whip-like structures that extend out from the surface of some prokaryotic cells.
 - They are involved in processes such as **movement** and **chemotaxis**
 - ▼ Addition: Chemotaxis
 - The ability of a cell to move in response to chemical stimuli.

Bacterial Identification

1. Colony morphology

- Colony morphology is the visual appearance of the colonies formed by a bacterial species on an agar plate.
- The size, shape, color, and texture of the colonies can provide important information about the bacterial species.
- Some examples of colony morphology features that can be used for identification include:
 - Colony shape: circular, irregular, filamentous, etc.
 - Colony margin: entire, undulate, lobate, filamentous, etc.
 - Colony elevation: flat, raised, convex, pulvinate, umbonate, etc.
 - Colony texture: smooth, rough, mucoid, dry, etc.
 - Colony color: white, yellow, red, blue, etc.

▼ Chinese Translation

菌落形态是指细菌在琼脂平板上生长形成的可见菌落的外观特征。菌落的大小，形状，颜色和质地等外观特征都可以提供有关细菌种类的重要信息。一些可用于鉴定的菌落形态特征包括：

- 菌落形状：圆形，不规则形，丝状等。
- 菌落边缘：整体的，波浪的，裂片状的，丝状的等。
- 菌落高度：平坦的，隆起的，凸出的，肿起的，等。
- 菌落质地：光滑的，粗糙的，粘液的，干燥的等。
- 菌落颜色：白色，黄色，红色，蓝色等。

2. Requirements for Oxygen

- Aerobic
- Anaerobic (厭氧)

3. Cell shape, size & Structure

Some common shape of bacteria will be mentioned below: ¶ Intro to some medically important bacteria.

There are also some special structure:

- Endospore
 - Origin: Greek, endo- meaning "within" and spora meaning "seed"
 - 中文翻译：芽孢
- Flagella
 - Origin: Latin, meaning "whip"
 - 中文翻译：鞭毛

4. Cell Arrangement

There are some common cell arrangement, including

- in pair,
- form chains, and
- hypha [菌絲]

5. Staining Reaction

- ▼ Gram stain
 - Gram staining differentiates bacterial species based on the composition of their cell walls.
 - Gram-positive bacteria have a thick layer of peptidoglycan :
[Polysaccharides + Protein] (about 30-100 nm) in their cell walls, which stains purple when exposed to crystal violet dye.
 - Do notice that:
Gram-positive bacteria contains large amounts of teichoic acid (Polymer of ribitol).
 - Gram-negative bacteria have a thin layer of peptidoglycan (about 20-30 nm) and an outer membrane that is not stained by crystal violet but the counterstain safranin.
- ▼ Acid Fast Stain
 - Acid fast stain can differentiate bacterial species based on cell wall composition.
 - This staining is useful for identifying Mycobacterium species with a unique cell wall structure that includes mycolic acids.
 - The process involves staining bacterial cells with carbol fuchsin, which binds to mycolic acids in the cell wall.
 - An acid-alcohol solution removes the stain from cells that do not have an acid-fast cell wall.
 - Cells are counterstained with methylene blue or another contrasting stain.
 - Acid-fast cells appear red or pink under a microscope, while non-acid-fast cells appear blue or green.

6. Chemical Content

7. Growth characteristic

Kenny Wong Aug 25 (edited)

這與Cell Shape, Size & Structure 并不相同，這強調的是細菌如何聚落在一起，聚落在一起的特色是什麼。

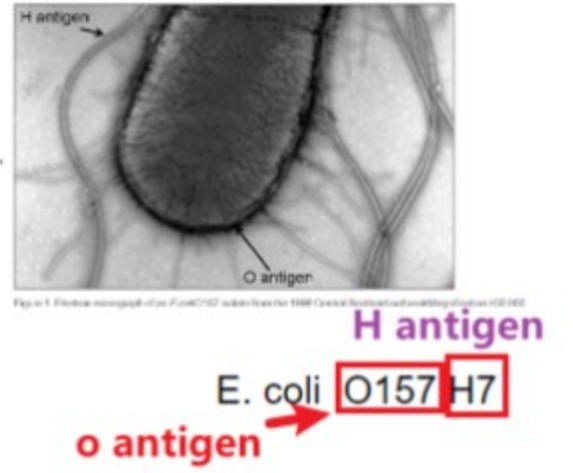
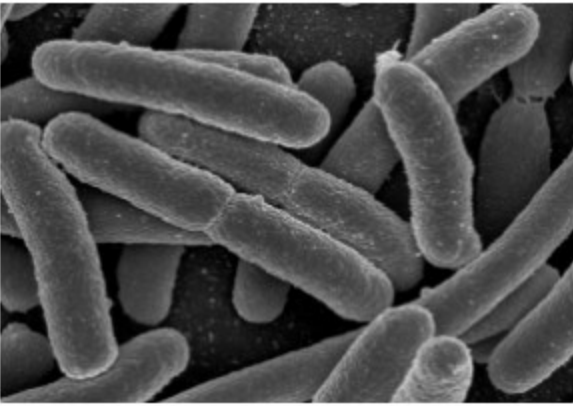
Take streptococci pneumoniae as an example, 'strepto-' means a chain of ... more

- a. Nutritional requirements
 - b. Physical conditions requirements for growth
8. Biochemical test - [API 20E Test]
- Measure various aspects of bacterial metabolism
 - C and N sources the bacteria can use
 - End products of their metabolic processes
 - Enzymes produce for these processes
9. Immunological test
- Antigens of the cell
 - Distinctive for certain kind of microbiology
10. Genetic Test
- DNA Sequence (Homology)
 - DNA base content
 - Ribosomal Sequencing

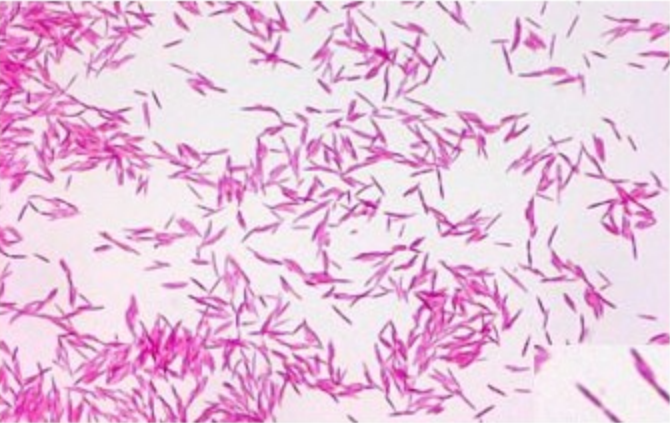
Intro to some medically important bacteria

Shape	Examples
Rod-shaped (bacilli)	<i>Escherichia coli</i>
Bacilli with tapered ends (fusiform bacilli)	<i>Fusobacterium nucleatum</i>
Spherical (cocci)	<i>Stapylococcus aureus</i>
Kidney-shape cocci (vibrios)	<i>Vibrio cholerae</i>
Spiral (spirilla)	<i>Spirillum volutans</i>
Flexible spirilla (spirochaetes)	<i>Treponema pallidum</i>
Fugus-like threads (hyphae)	<i>Strptomyces albus</i>
Irregular (pleomorphic)	<i>Mycoplasma pneumoniae</i>
Group	
Pairs	<i>Neisseria gonorrhoeae</i>
Palisades	<i>Corynebacterium diphteriae</i>
Clusters	<i>Stapylococcus aureus</i>
Chains	<i>Streptococci pneumoniae</i>

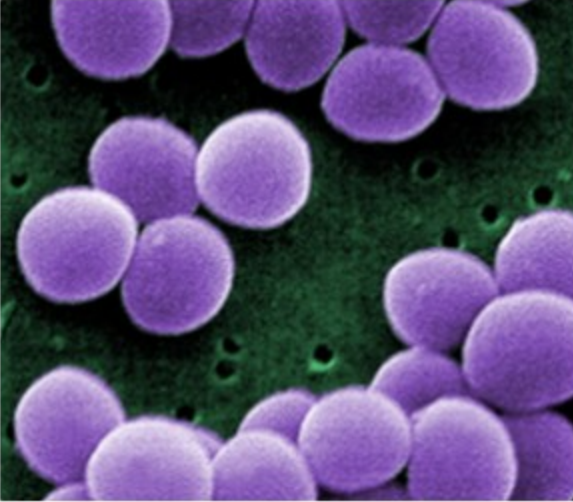
Escherichia Coli [Rod-shaped / Bacilli]



Fusobacterium nucleatum [Bacilli with tapered ends / fusiform bacilli]



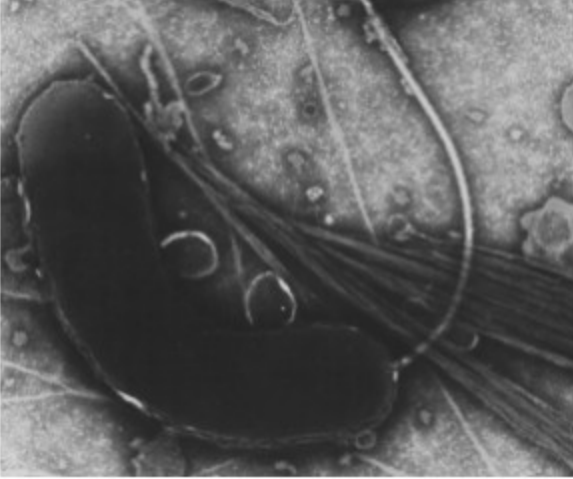
Staphylococcus aureus [Spherical / cocci]



Vibrio cholerae [Kidney shape cocci / vibrio]
- 霍亂弧菌

▼ Disease - Asiatic Cholera

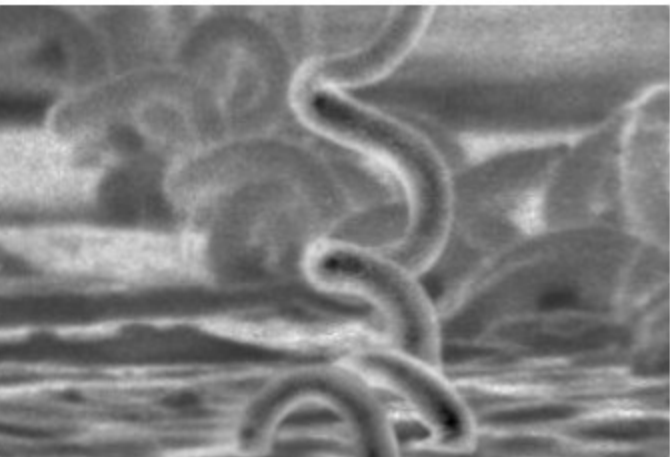
Asiatic cholera, also known as cholera, is a bacterial infection caused by the bacterium Vibrio cholerae. It is typically spread through contaminated water or food and causes severe diarrhea and dehydration, which can lead to death if left untreated.



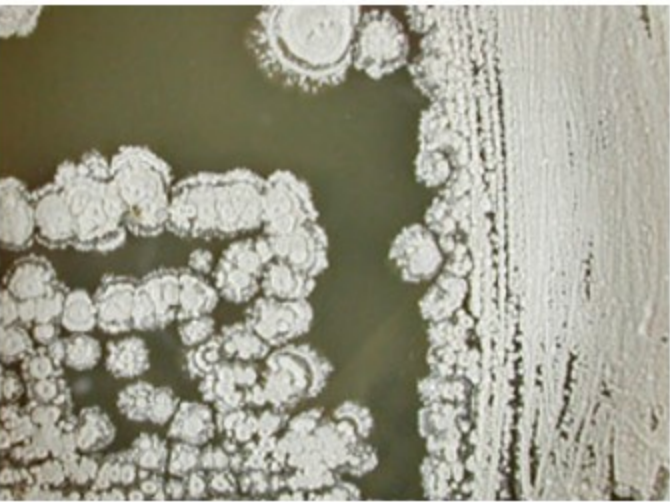
Spirillum volutans [Spiral / Spirilla]
- 華蘭氏閉性細菌



Treponema pallidum [Flexible spirilla / Spirochaetes]
- 梅毒螺旋菌



Streptomyces albus [Fugus-like threads / hyphae]
- 白色鏈黴菌



Kenny Wong Aug 24
Escherichia coli [Rod-shaped, Bacilli]
- where *coli* comes from Latin word "Colon"

Kenny Wong Aug 24 (edited)
Fusobacterium nucleatum [Oral bacterium]
- where *Fuso* means "spindle" in English.
(Origin: Latin "fusus", Chinese "紡錘形")
- where *nucleatum* means "appearing in ... more"

Kenny Wong Aug 24
Staphylococcus aureus
"Staphylo-" means grape-like clusters
"-coccus" means berry
"aureus" means golden

Kenny Wong Aug 24
Vibrio cholerae
Vibrio means "vibrate"
cholerae means "bile/gastrointestinal fluid"
Which means leading to "severe diarrhea"

Kenny Wong Aug 24
Spirillum volutans
- *Spirillum* means "coil". It refers to the spiral shape of this bacterium.
- *Volutans* means "to roll".

Kenny Wong Aug 24
Spirochaetes shape
"Spiro-" means spiral
"-chaetes" means hair
Treponema pallidum (梅毒螺旋菌)
- "Trepo-" means turn... more

Kenny Wong Aug 24
- "Streptos-" means twisted
- "-myces" means fungus
- "albus" means white

Mycoplasma pneumoniae [Irregular / pleomorphic]

- 肺炎支原体

Additional Information related to Pleomorphic bacteria

The term 'pleomorphic' does come from Latin roots. It breaks down as:

Pleo- = from the Greek root 'pleion' meaning 'more'

-Morph = from Greek morphē meaning 'form'

-Ic = a Latin suffix denoting "having the nature of"

So pleomorphic means "having many forms". It refers to bacteria that can assume multiple shapes or growth patterns.

Some key points about pleomorphic bacteria:

- They are able to **transition between different forms including cocci, bacilli, and spirals.**
- This ability to **alter shape is related to stages of their growth cycle.**
- Their pleomorphism is facilitated by the **lack of a rigid cell wall.**
- Some examples are Mycoplasma and Spirillum.

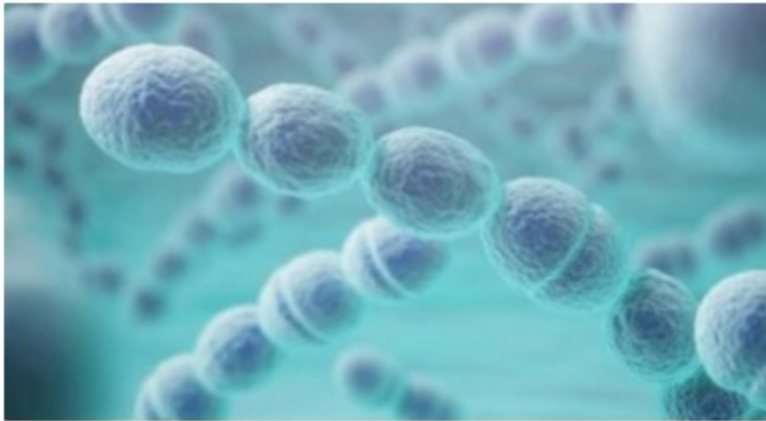
So in summary, the term pleomorphic derives from Greek and Latin roots 'pleion' and 'morphē' meaning many forms. It is an apt descriptor for bacteria that can assume a variety of shapes due to their flexible cell structure. The etymology reflects the defining trait.



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Streptococci pneumoniae

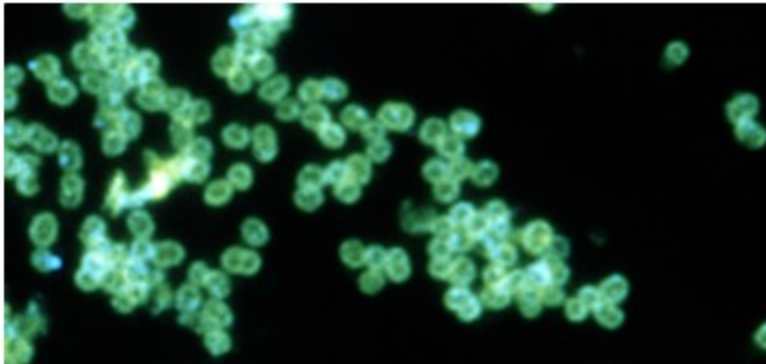
- 肺炎链球菌



1

Neisseria gonorrhoeae

- 淋病双球菌 (性传播疾病)



1

Corynebacterium diphtheriae

- 白喉杆菌

Additional knowledge to leathery pseudomembrane

- It is a **thick, leather-like coating** that forms over the tonsils, pharynx, larynx, or nasal cavity. This gives it a tough, leathery texture.
- It is composed of **dead cells, fibrin, bacteria, and inflammatory cells.**



1

Kenny Wong Aug 24
"Myc-*"* originate from "*mykes*" which means fungus
"-*plasma*" means formed or molded refers to "lack of cell wall"
"*Pneumon-*" means lung...
... more

Kenny Wong Aug 24
"*Strepto-*" means twisted
"-cocci" means berries
Thus, "Streptococci" is chained, spherical bacteria

Kenny Wong Sep 11 (edited)
- Neisseria is named after Albert Neisser

- Gonorrhoeae comes from :
"*Gonos*" meaning seed, and
"*rhoia*" meaning flow.
Together they refer to the discharge... more

Kenny Wong Aug 24 (edited)
Corynebacterium Diphtheriae

"*Coryne-*" means club, describing the club-like shape of the bacteria

"Diphtheriae" is from Greek "*diphtheria*..." more

Some Medically Important Bacteria

Medically important bacteria

Bacterial pathogen

Gram-negative bacteria

Coliforms (e.g. E. coli, Enterobacter)
Salmonella enterica
Salmonella typhi
Shigella dysenteriae
Yersinia pestis
Pseudomonas aeruginosa

Vibrio cholerae
Bordetella pertussis
Haemophilus influenzae
Helicobacter pylori
Campylobacter jejuni
Neisseria gonorrhoeae
Neisseria meningitidis
Brucella abortus
Bacteroides fragilis

Gram-positive bacteria

Staphylococcus aureus
Streptococcus pyogenes (Group A strep)
Streptococcus pneumoniae
Bacillus anthracis
Bacillus cereus
Clostridium tetani
Clostridium perfringens
Clostridium botulinum
Clostridium difficile
Corynebacterium diphtheriae
Listeria monocytogenes
Not typed by Gram stain
Mycobacterium tuberculosis
Mycobacterium leprae
Chlamydia trachomatis
Chlamydia pneumoniae
Mycoplasma pneumoniae
Rickettsias
Treponema pallidum
Borrelia burgdorferi

Disease(s)

Gastroenteritis, urinary tract infections, neonatal meningitis
Gastroenteritis
Typhoid fever
Bacillary dysentery
Bubonic plague
Opportunistic infections, swimmer's ear, hot tub itch, cellulitis, pneumonia, more
Asiatic cholera
Whooping cough
Meningitis, pneumonia, sinusitis
Gastric and duodenal ulcers
Gastroenteritis
Gonorrhea
Meningococemia and meningitis
Undulant fever
Anaerobic infections

Food poisoning, wound infections, toxic shock syndrome, more
Strep throat, scarlet fever, mastitis, necrotizing fasciitis, more
Pneumonia, otitis media, meningitis
Anthrax
Food poisoning
Tetanus
Food poisoning, gas gangrene, uterine infections
Botulism, infant botulism
Antibiotic-associated diarrhea, pseudomembranous colitis
Diphtheria
Listeriosis

TB (tuberculosis)
Leprosy
Chlamydia, lymphogranuloma venereum, trachoma
Pneumonia
Atypical pneumonia
Rickettsiosis: typhus, RMSF
Syphilis
Lyme disease

Transmission

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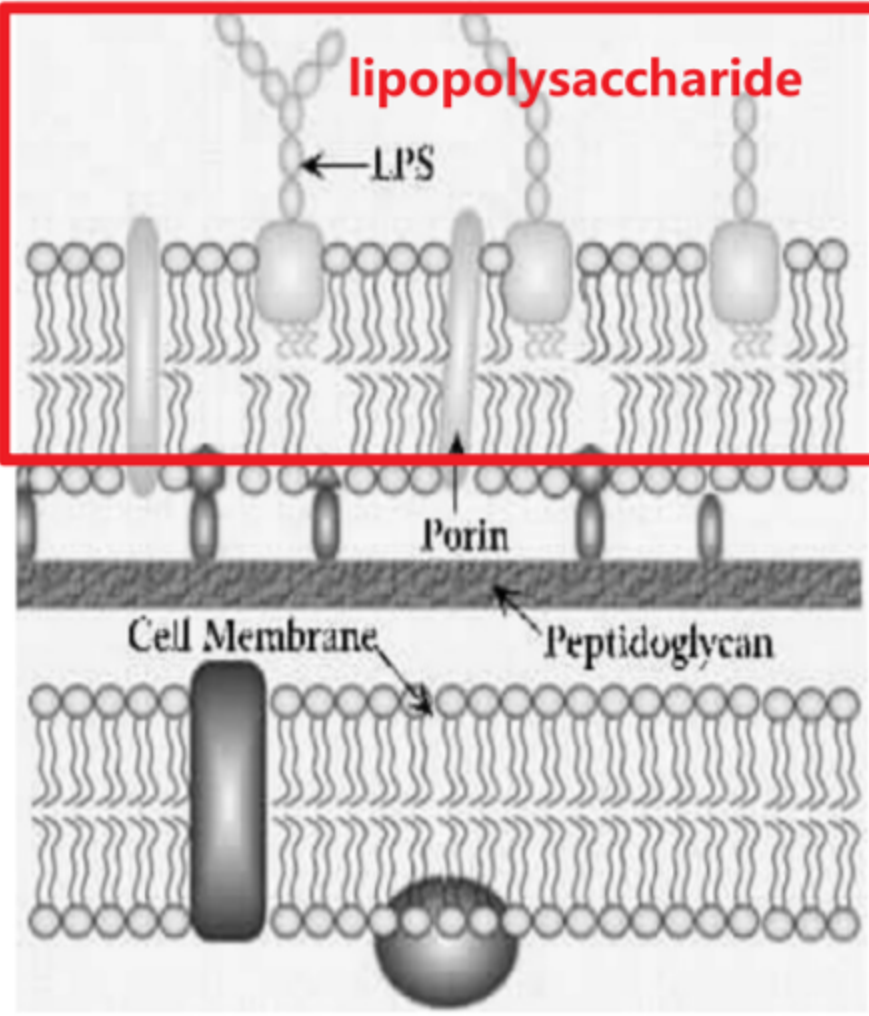
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KEY TO TRANSMISSION.

C = Contact
E = Endogenous
F = Food borne
HA = Hospital Acquired
IA = Infected Animal
IV = Insect Vector
M = Milk
RC = Respiratory Contact
SC = Sexual Contact
S = Soil
W = Water

Gram-Negative



大部分為性傳染病、引發腦膜炎、GE

▼ Coliforms (E. coli, Enterobacter)

- "Coli-" meaning "of the colon", and
- "-form" meaning "appearance".

▼ Enterobacter

- 'Entero-' from Greek "enteron," meaning **intestine**

▼ Diseases

Gastroenteritis, urinary tract infections, neonatal meningitis

- "Gastro" meaning "stomach", and
- "Enteritis" meaning "inflammation of the intestines"
- "Urinary tract infections" refer to infections of the bladder, urethra, or kidneys.
- "Neonatal meningitis" is an inflammation of the meninges, which are the *membranes that surround the brain and spinal cord in newborns*.

▼ Chinese Translation

Gastroenteritis, urinary tract infections, neonatal meningitis

- "Gastro" 意思是 "胃", and
- "Enteritis" 意思是 "腸炎"
- "Urinary tract infections" 指膀胱，尿道或腎脏的感染。
- "Neonatal meningitis" 是新生儿脑膜炎，是新生儿脑部疾病的一种。

▼ Salmonella Enterica

- "Salmonella" is named after the American pathologist Dr. Daniel E. Salmon, and
- "Enterica" refers to its **ability to infect the intestines**.

▼ Disease

Gastroenteritis

▼ Salmonella Typhi

- The species name "Typhi" is derived from the Greek "typhos" meaning "fever", which refers to the symptoms of typhoid fever caused by the bacteria.

▼ Disease:

- Typhoid fever is a specific illness caused by the bacteria Salmonella Typhi. It is characterized by a **sustained high fever**, along with other symptoms such as abdominal pain, weakness, and loss of appetite (食欲).

▼ Shigella Dysenteriae (痢疾)

- "Shigella" is named after the Japanese scientist Kiyoshi Shiga, and
- "Dysenteriae" which refers to the disease dysentery.

▼ Disease:

Bacillary dysentery characterized by **severe diarrhea (便便)** with blood and mucus, fever, and abdominal pain.

▼ Yersina Pestis

- "Yersinia" is named after Alexandre Yersin, and
- "Pestis" means "plague" in Latin, referring to the bacterium's role in causing bubonic plague.

▼ Disease:

- It is primarily spread through the **bites of infected fleas**, which can be found on rodents such as rats.
- Symptoms of bubonic plague include fever, chills, weakness, and swollen lymph nodes.
- The infection can spread to other parts of the body.

▼ Chinese Translation:

- 主要是通过感染跳蚤的叮咬传播，跳蚤可以在老鼠等啮齿动物身上找到。
- 恶性瘤疫的症状包括发热、寒战、虚弱和淋巴结肿胀。
- 感染可以扩散到身体的其他部位。

▼ Pseudomonas aeruginosa [绿脓杆菌]

- "Pseudo" means false, "monas" means a unit or entity, and
- "aeruginosa" means **copper rust**.

▼ Diseases:

Opportunistic infections, swimmer's ear, hot tub itch, cellulitis, pneumonia

• Opportunistic infections

- These are infections that occur in people with weakened immune systems, such as those with HIV/AIDS or those undergoing chemotherapy. Opportunistic infections are caused by bacteria, viruses, fungi, or parasites that are normally harmless to healthy individuals.
- *Chinese Translation:*
 - 机会性感染。这些感染发生在免疫系统被削弱的人身上，例如那些患有HIV / AIDS或正在接受化疗的人。机会性感染是由通常对健康人无害的细菌，病毒，真菌或寄生虫引起的。

• Swimmer's ear

- Swimmer's ear (otitis externa) is an infection of the outer ear canal. It is often caused by water that remains in the ear after swimming, creating a moist environment that is conducive to bacterial growth.
- *Chinese Translation:*
 - 游泳者耳朵。游泳者耳朵（外耳道炎）是外耳道的感染。它通常是由游泳后留在耳朵中的水引起的，从而形成了有利于细菌生长的潮湿环境。

• Hot tub itch

- Hot tub itch (Pseudomonas folliculitis) is a skin infection caused by the bacterium Pseudomonas aeruginosa. It is often associated with the use of hot tubs, particularly those with inadequate levels of chlorine or other disinfectants.
- *Chinese Translation:*
 - 温泉瘙痒症。温泉瘙痒症（假单胞菌毛囊炎）是由假单胞菌引起的皮肤感染。它通常与使用热水浴缸有关，特别是那些氯或其他消毒剂水平不足的人。

• Cellulitis

- Cellulitis is a skin infection that can occur anywhere on the body. It is caused by bacteria, usually Streptococcus or Staphylococcus, entering the skin through a cut, scratch, or other injury.
- *Chinese Translation:*
 - 蜂窝织炎。蜂窝织炎是一种可以在身体的任何部位发生的皮肤感染。它是由细菌引起的，通常是链球菌或葡萄球菌，通过切口，擦伤或其他损伤进入皮肤。

• Pneumonia

- Pneumonia is an infection of the lungs that can be caused by bacteria, viruses, or fungi. It can result in inflammation of the air sacs in the lungs, making it difficult to breathe.
- *Chinese Translation:*
 - 肺炎。肺炎是肺部的感染，可以由细菌，病毒或真菌引起。它可能导致肺部气泡发炎，使呼吸困难。

• Vibrio Cholerae

▼ Bordetella pertussis

- Pertussis is the medical term for whooping cough, a highly contagious respiratory infection caused by the bacterium Bordetella pertussis.
- Whooping cough is highly contagious（傳染性）
- Symptoms include severe coughing fits, a "whooping" sound when breathing in, and vomiting after coughing

▼ Chinese Translation:

百日咳，也称百日咳，是由百日咳杆菌引起的特定呼吸道感染。它非常具有传染性，特点是严重的咳嗽发作，在呼吸时出现"Whooping"的声音以及咳嗽后呕吐。咳嗽是一种更普遍的症状，可能由多种疾病引起，包括普通感冒，流感和肺炎。

▼ Haemophilus influenza

- "Haemo-" means "**blood**" and "-philus" means "**lover of**".
 - The name is somewhat misleading, as it was originally thought to be the cause of influenza, but it is not related to the virus that causes the flu.
 - it is named for its **ability to grow in the blood**, and
 - its frequent association with respiratory infections.

▼ Disease

- Meningitis
Inflammation of the meninges, which are the membranes that surround the brain and spinal cord.

└ *Chinese Translation: 脑膜炎*

• Pneumonia

Infection that inflames the air sacs in one or both lungs, which may fill with fluid.

└ *Chinese Translation: 肺炎*

• Sinusitis

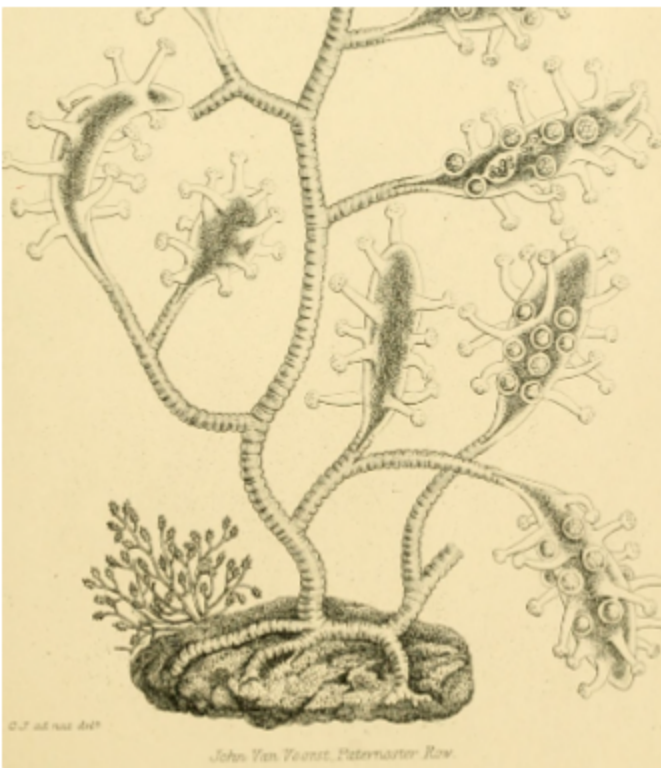
Inflammation or swelling of the tissue lining the sinuses.

└ *Chinese Translation: 鼻窦炎*

▼ Helicobacter pyloric

- "Helico-" means spiral or helix, and
- "Pylori" refers to the location where is the pylorus

- ▼ Gastric and duodenal ulcers (潰瘍)
 - The bacteria damage the protective lining of the stomach or duodenum, allowing acid and other digestive fluids to irritate the tissues underneath
 - Symptoms of gastric and duodenal ulcers can include abdominal pain, bloating, nausea, and vomiting
 - ▼ Campylobacter jejuni
 - 'Campylo-' meaning curved, and
 - 'jejuni' is derived from the Latin word *jejunos*, meaning empty or fasting, as it was originally thought to be a cause of "empty" or non-specific gastroenteritis.
 - Diseases: GE
 - Neisseria Gonorrhoeae
 - Neisseria Meningitidis
 - ▼ Brucella abortus
 - "Abortus" is a Latin term meaning "miscarriage" or "abortion".
 - Brucella abortus named after its ability to cause abortions in cattle and other domestic animals.
 - It can infect the reproductive organs of pregnant animals and cause miscarriages or stillbirths.
 - ▼ Diseases:
 1. Miscarriages
 2. Undulant fever
 - Undulant fever, also known as brucellosis, is caused by the Brucella bacteria.
 - It is usually transmitted through the consumption of contaminated animal products, such as unpasteurized milk or cheese.
 - Symptoms include fever, chills, sweating, fatigue, and muscle and joint pain.
 - In some cases, the infection can become chronic and lead to complications such as arthritis (關節炎) and inflammation of the heart or nervous system.
 - ▼ Bacteroides fragilis
 - "Fragilis" is a Latin word that means "fragile" or "easily broken",
 - which refers to the fact that this bacterium is an easily damaged organism that requires special handling techniques in the laboratory.
 - It is commonly found in the human gut
 - ▼ Diseases: Anaerobic infections
 - Anaerobic infections in the gut caused by Bacteroides fragilis may cause symptoms such as:
 - Abdominal pain
 - Diarrhea
 - Fever
 - Nausea
 - Bloating
 - Constipation
 - Loss of appetite
- ▼ Gram-Positive
- Staphylococcus aureus
 - ▼ Streptococcus pyogenes (Group A strep)
 - "Pyogenes" is derived from the Greek word "pyon" meaning "pus" and "genes" meaning "producing". Therefore, Streptococcus pyogenes is a bacteria that produces pus (膿).
 - Streptococcus pneumoniae
 - ▼ Bacillus anthracis
 - The word "anthracis" in Bacillus anthracis refers to the disease anthrax (炭疽病), which is caused by this bacterium.
 - ▼ Bacillus cereus
 - The origin of the name "cereus" is actually from Latin. It means "wax-like", likely in reference to the bacterium's ability to produce spores (孢子) that have a shiny, wax-like appearance.
 - ▼ Clostridium tetani
 - "Clostridium" means spindle.
 - "Tetani" means "stiff". This is a reference to the characteristic muscle stiffness that occurs in individuals infected with Clostridium tetani, the bacterium responsible for causing tetanus (破傷風).
 - ▼ Clostridium perfringens
 - "perfringens" means "to penetrate." This name was chosen due to the bacterium's ability to produce various enzymes and toxins that can break down and destroy tissues in the body.
 - ▼ Clostridium botulinum (肉毒桿菌)
 - Botulinum is named after the Latin word "botulus", which means sausage. This is because the bacterium was first identified as the cause of contaminated sausages.
 - ▼ Clostridium difficile
 - Clostridium difficile is named after its ability to be difficult to culture in the laboratory. The word "difficile" is derived from the Latin word "difficilis," which means "difficult".
 - ▼ Corynebacterium diphtheriae



- Diphtheriae (白喉)
 - "Coryne-" comes from the Greek "koryne", meaning club-shaped, and the Latin "bacterium", meaning small staff.
 - ▼ Listeria monocytogenes
 - Causing Listeriosis
- ▼ Not typed by Gram stain
- ▼ Mycobacterium tuberculosis
 - Mycobacterium tuberculosis is non-free living bacteria.
 - ▼ Mycobacterium leprae
 - Causing Leprosy (麻瘋)
 - ▼ Chlamydia trachomatis (沙眼衣原体)
 - 沙眼衣原体是一种绝对寄生病原体，披衣菌是一种在构造上介于细菌和病毒之间的微生物。
 - Causing Chlamydia, lymphogranuloma venereum, trachoma
 - 引起沙眼衣原体感染，淋巴肉芽肿性淋巴管炎，沙眼
 - ▼ More about Chlamydia Bacteria
 - Obligate intracellular pathogens
 - No cell wall
 - Chlamydia pneumoniae
 - ▼ Mycoplasma pneumoniae
 - Causing Atypical pneumonia
 - ▼ Rickettsias - Bacilli or Coccus Shape
 - Rickettsias are parasitic bacteria that live in arthropods (ticks and mites) → replicate inside of host cells.
 - Obligate intracellular parasites
 - Cause Rocky Mountain spotted fever, typhus
 - ▼ Treponema pallidum
 - Treponema pallidum is a type of bacteria that causes syphilis, a sexually transmitted infection.
 - Treponema pallidum is named for its spiral shape (treponema means "spiral body" in Greek) and its ability to cause a pale (pallid) rash on the skin, which is a characteristic symptom of syphilis.
 - ▼ Borrelia burgdorferi
 - Causing Lyme disease, through Insect Vector

▼ Staphylococcus spp.

β -hemolytic	α -hemolytic	γ -hemolytic
clear, complete hemolysis	green, partial hemolysis	no hemolysis

Characteristics:

- clustered
- gram-positive (with thick cell wall)
- beta-hemolytic (beta-血溶性) bacteria.
- >80% of CoNS and SA has Methicillin

There are two groups of Staphylococci, which is classified by Coagulase Test:

- CoNS (Coagulase-negative Staph):
 - More than 30 Species, 15 of them are pathogens
- CoPS (Coagulase-positive Staph):

- One Species: *Staphylococcus aureus* (**SA**), with Methicillin resistance is **MRSA**
- Enterotoxins** (肠毒素)
- Epidermolytic toxins** (Toxins that affect epidermis)
- Toxic shock syndrome toxin**

💡 The coagulase test is one way to differentiate the highly pathogenic *S. aureus* from the other less pathogenic staphylococcal species on the human body.

- ▼ **Streptococcus spp.**

Characteristic:

- Gram Positives
- **Facultative anaerobes (兼性厌氧菌)**
 - Facultative anaerobes can survive and grow in both aerobic and anaerobic environments.
 - They can switch between using oxygen for energy (aerobic respiration) and using other molecules or fermentation to produce energy in the absence of oxygen.
- Can be **divided into serological groups of A-V**
- Commonly found as **commensal species** in the upper respiratory tract (常见于上呼吸道的共生物种)
- **Asymptomatic carrier status** (无症状携带者状态)
- Able to produce **a range of toxins** (especially: Streptococcus pyogenes - 化脓性链球菌)

Type of hemolysis on blood agar:

- α -hemolytic (green, partial hemolysis):
 - Pneumoniae
 - Optochin sensitives
 - Have Capsule
 - Viridans (Variant of Streptococcus Spp.)
 - Optochin resistance
 - No Capsule
- β -hemolytic (Complete hemolysis)
 - pyogenes
 - Bacitracin sensitives
 - Produce a range of toxins
 - Agalactiae
 - Streptococcus agalactiae得名于其与乳腺炎的关联，乳腺炎是乳牛的乳腺感染，会导致产奶量降低。“Agalactiae”在希腊语中意为“无奶”。然而，它也常见于人体内，可能引起一系列感染。
 - Bacitracin resistances
- γ -hemolytic (No hemolysis)
 - Enterococcus

▼ Coliform Bacteria

Characteristic:

- Rod-shaped
- Gram-negative

Genra:

- Name after the scientists:
 - Citrobacter
 - Escherichia
 - Hafnia
 - Klebsiella
 - Serratia
- Enterobacter

Infections:

- GI Infection
- Urinary tract infection
- Nosocomial infection (醫院感染)

▼ Salmonella & Shigella

Characteristic:

- Bacilli
- Gram Negative
- Facultative anaerobes
- Causing GE, Enteric Fever (Typhoid Fever), and dysentery (only for shigella, 痢疾)

Salmonella:

- Only 2 Species but with >2000 variants differentiated by surface antigens (serovars)
 - *Salmonella enterica*
 - *Salmonella bongori*

Shigella:

- Very low infective dose
- Produce Potent Shiga toxins and other enterotoxins

▼ Campylobacter & Helicobacter

Characteristic:

- Gram Negative
- Twist (Campylobacter @ Poultry), Curved/Spiral (Helicobacter @ Human reservoirs)

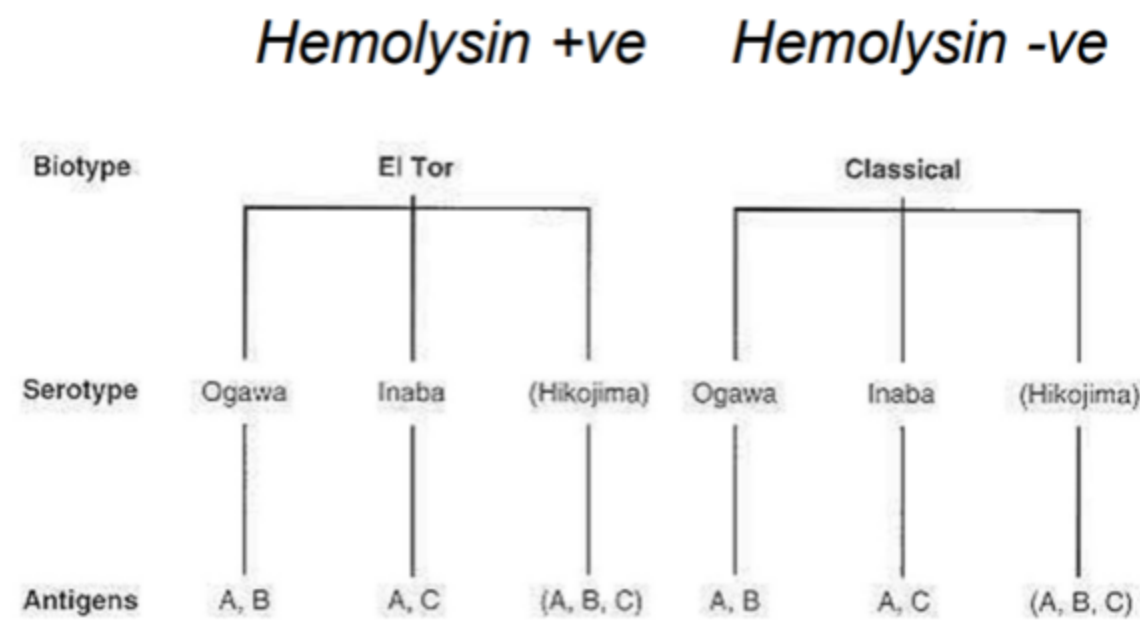
Campylobacter:

- **Aerobic**
- Examples: *Campylobacter jejuni*, *Campylobacter coli* → Acute GE & Guillain-Barre syndrome

Helicobacter pylori:

- Chronic superficial gastritis
- Peptic Ulcer diseases

- ▼ **Vibrio spp.**



Characteristic:

- Gram Negative
- Transmission: Oral Faecal, Wound Infection
- Enterotoxins produced to give large watery diarrhoea
- 2 Main serogroups:
 - O-1
 - By phenotypic traits (Hemolysis)
 - +VE: EI Tor
 - -VE: Classic
 - By Antigenic markers:
 - Ogawa
 - Inaba
 - O-139

▼ **Neisseriaceae**

Characteristic:

- Gram Negative
- Genera:
 - Neisseria

- Moraxella
- Kingella
- Eikenella

• Commonly Found:

- Neisseria gonorrhoeae
 - Asymptomatic
- Neisseria meningitidis
 - Spread by droplet

▼ **Bacillus & Clostridium**

Characteristic:

- Gram Positives
- Facultative anaerobes
- Spore-forming and spores can survive extreme environments
- Causing: Anthrax, Tetanus, Botulism by Exotoxins

Examples:

- **Bacillus anthracis**: associated with herbivores (菌草)
- **Thermophilic Bacillus stearothermophilus**: test heat sterilization process
- Clostridia: @ small intestine

▼ **Filamentous bacteria**

Characteristics:

- Gram positives
- Show true branching
 - Made of Wax & Glycolipid
- Examples:
 - Nocardia
 - Mycobacterium [Different to Mycoplasma]

▼ **Spirochaetes**

Characteristic:

- **Thin-walled Bacteria**: Gram negative
- **slender flexuous spiral filaments**
- **without possession of flagella** (沒有鞭毛)

▼ **Mycoplasma**

Characteristic:

- **Wall-Less Bacteria**: Gram negative
- **Pleomorphic** (多樣性)