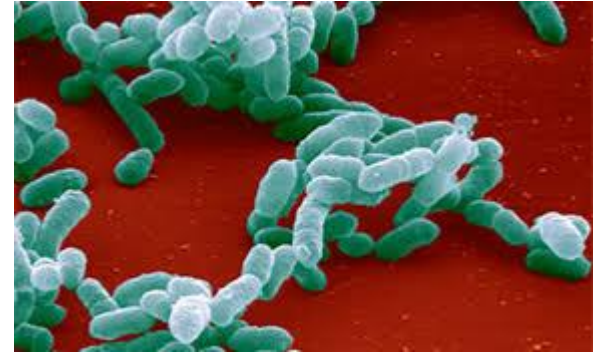


*Haemophilus bacteria*

Dr. Alyaa



# HAEMOPHILUS



## ***Haemophilus***

The genus *Haemophilus* is traditionally defined as being comprised of small, pleomorphic, Gram-negative rods (often coccobacilli) with growth requirements for one or more factors present in blood (NAD and/or hemin); hence the name *Haemophilus* (blood-loving). This is a diverse genus, comprised of both animal and human pathogens, as well as a number of species that are primarily commensals of the mucous membranes. The organisms are not free-living in nature

## **Some of the diseases and infections caused by Haemophilus include:**

Haemophilus is a genus of bacteria that can cause various infections, ranging from mild ear infections to severe meningitis. The most common type of Haemophilus is Haemophilus influenzae, which is not related to the flu virus.

Haemophilus bacteria need certain blood factors, such as hemin and NAD, to grow. They can be identified by their requirement for these factors in laboratory tests .

Ear infection (otitis media): An infection of the space behind your eardrum (the middle ear).

Bronchitis: An infection that occurs when the air-carrying tubes in your lungs (bronchioles) are inflamed and make too much mucus.

**Sinusitis:** An infection of the air-filled spaces in your skull (sinuses) that are connected to your nose.

**Pneumonia:** An infection that inflames the air sacs in one or both lungs.

**Meningitis:** An infection of the fluid and membranes that surround your brain and spinal cord.

**Epiglottitis:** An infection that causes swelling of the flap of tissue at the back of your throat (epiglottis), which can block your airway.

**Septic arthritis:** An infection of one or more joints, usually caused by bacteria entering the bloodstream from another site of infection.

**Cellulitis:** An infection of the skin and the tissue beneath it, usually caused by bacteria entering through a break in the skin.

## Haemophilus influenzae Epidemiology

- Haemophilus species are typically considered to be normal flora in the upper respiratory tract of humans. They are found in the nasopharynx of approximately 75% of healthy individuals. Normal flora H .influenzae are non-encapsulated. Less than 5% of healthy individuals harbour an encapsulated strain of Haemophilus influenzae, which serotypes as type b. **Type b (Hib) has historically been considered to be the most common cause of bacterial meningitis in young children ages 3 months to 6 years.**

Chancroid: A sexually transmitted infection that causes painful sores on the genitals

**Haemophilus** infections can be treated with antibiotics, but some strains may be resistant to certain drugs. The best way to prevent Haemophilus infections is to get vaccinated against Haemophilus influenzae type b (Hib), which is the most dangerous type of Haemophilus. The Hib vaccine is recommended for all children under 5 years of age and some adults who are at high risk of Hib infection

# **Overview- Haemophilus**

**Small**

**Non-motile**

**Gram-negative rods**

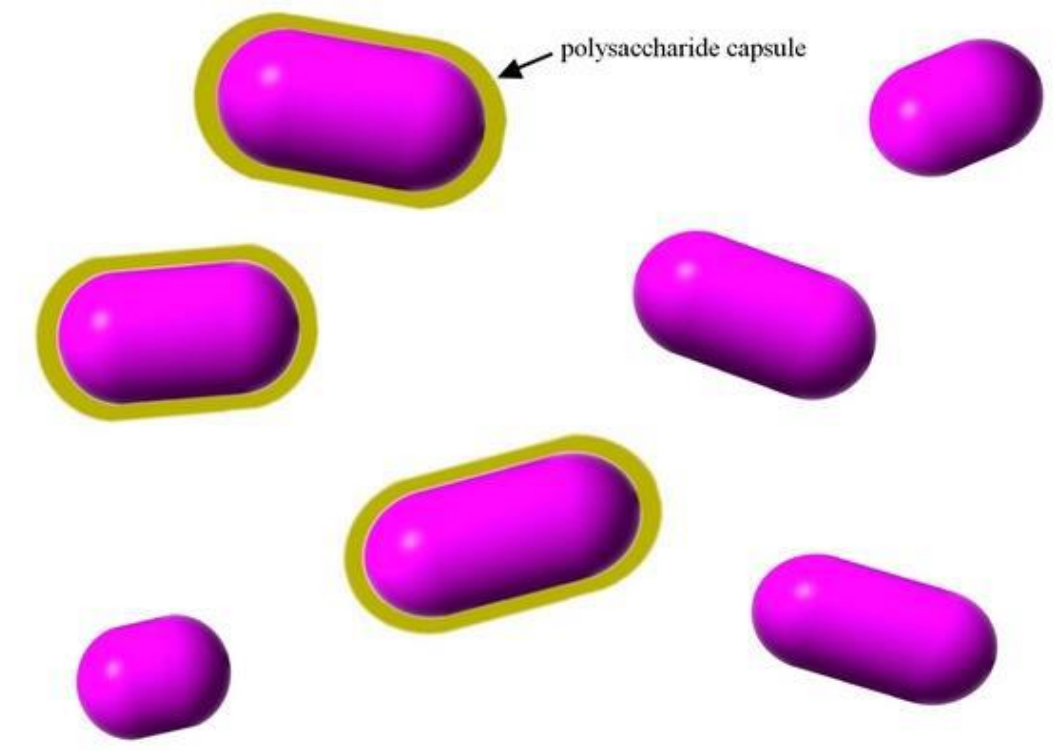
**Transmitted via respiratory droplets, or  
direct contact with contaminated  
secretions**

**Normal flora of the human respiratory  
tract and oral cavity.**



This is a group of small, gram-negative, pleomorphic bacteria that require enriched media, usually containing blood or its derivatives, for isolation.

*Haemophilus influenzae* type b is an important human pathogen; *Haemophilus ducreyi*, a sexually transmitted pathogen, causes chancroid; other *Haemophilus* species are among the normal flora of mucous membranes and only occasionally cause disease.



polysaccharide capsule

1 μm

*Haemophilus influenzae*

# *H. influenzae*

## Important Properties

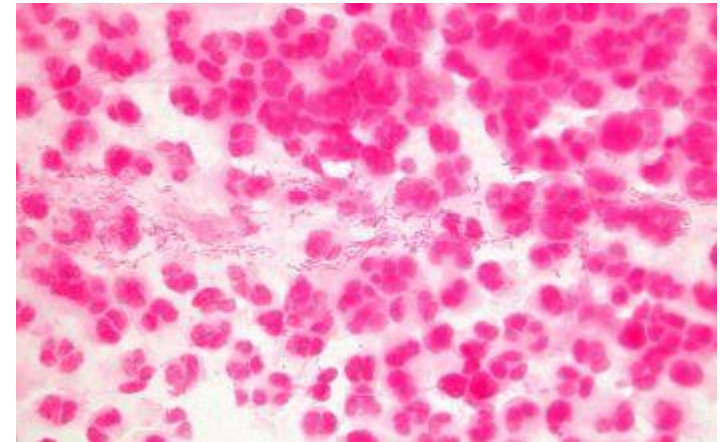
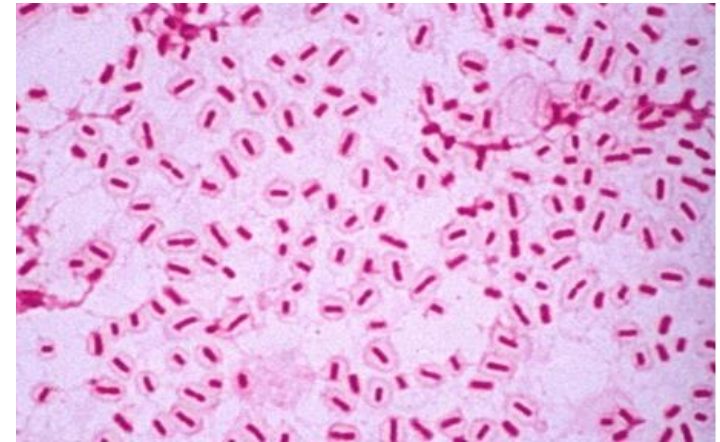
*H. influenzae* is a small gram-negative rod (coccobacillus)

with a polysaccharide capsule.

It is one of the three important encapsulated pyogens, along with the pneumococcus and the meningococcus.

Serologic typing is based on the antigenicity of the capsular polysaccharide.

Of the six serotypes, type b causes most of the severe, invasive diseases, such as meningitis and sepsis.

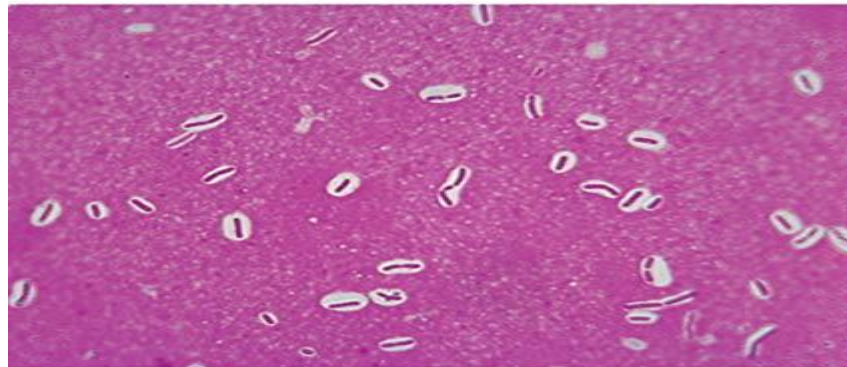


## *H. influenzae*

The type b capsule is composed of polyribitol ribose phosphate.

Unencapsulated strains can also cause disease, especially diseases of the upper respiratory tract such as sinusitis and otitis media, but are usually noninvasive.

Growth of the organism on laboratory media requires the addition of two components, heme (factor X) and NAD nicotinamide-adenine-dinucleotide (factor V), for adequate energy production.



## *H. influenzae*

Most infections occur in children between the ages of 6 months and 6 years, with a peak in the age group from 6 months to 1 year.

This age distribution is attributed to a decline in maternal IgG in the child with the inability of the child to generate sufficient antibody against the polysaccharide capsular antigen until the age of approximately 2 years.

## **D. Mode of Transmission:**

Mode of transmission is person-to-person by inhalation of respiratory tract droplets or by direct contact with respiratory tract secretions<sup>1</sup>. In neonates, infection is acquired intrapartum by aspiration of amniotic fluid or by contact with genital tract secretions containing the organism. Most of the time *H. influenzae* is spread by people who have the bacteria in their noses and throats but who are asymptomatic<sup>4</sup>

# *H. influenzae*

## Clinical Findings

Meningitis the bacilli reach the meninges from the nasopharynx, apparently through the blood stream. The disease is more common in children between two months and three years of age.

Meningitis caused by *H. influenzae* cannot be distinguished on clinical grounds from that caused by other bacterial pathogens (e.g., pneumococci or meningococci).

The rapid onset of fever, headache, and stiff neck, along with drowsiness, is typical.

Sinusitis and otitis media cause pain in the affected area, and redness with bulging of the tympanic membrane.

Other serious infections caused by this organism include: septic arthritis, cellulitis, and sepsis, the latter occurring especially in splenectomized patients.

*Haemophilus influenzae* is transmitted person to person by inhalation of respiratory tract droplets or by direct contact with respiratory tract secretions<sup>1</sup>. Children under 5 years of age who have not been vaccinated are at increased risk for invasive *H. influenzae* serotype b (Hib) disease<sup>2</sup>.



## *H. influenzae*

Epiglottitis, which can obstruct the airway, occurs. A swollen "cherry-red" epiglottis is seen.

This life-threatening disease of young children is caused almost exclusively by *H. influenzae*.

Pneumonia in elderly adults, especially those with chronic respiratory disease, can be caused by untypeable strains of *H. influenzae*.



# Diagnosis

- A patient sample must be acquired. It is important to note that Haemophilus spp. **are fastidious organisms** and particular attention should therefore be paid to the **collection, storage and transport of the specimen.** This organism can be **very susceptible to changes in environmental conditions** such as temperature, humidity and atmosphere. If Haemophilus infection is suspected, care should be taken that the proper conditions are provided during recovery and transport, and that the specimen is cultured for growth as soon as possible.

## **Biochemical tests**

In meningitis, presence of pleomorphic in CSF, and Gram-negative bacilli that do not stain well are suspicion of *H. influenzae* infection. The capsular polysaccharide antigen may be present in the CSF in meningitis and in urine in systemic infection. Its demonstration by latex particle agglutination or CIE is useful in diagnosis.

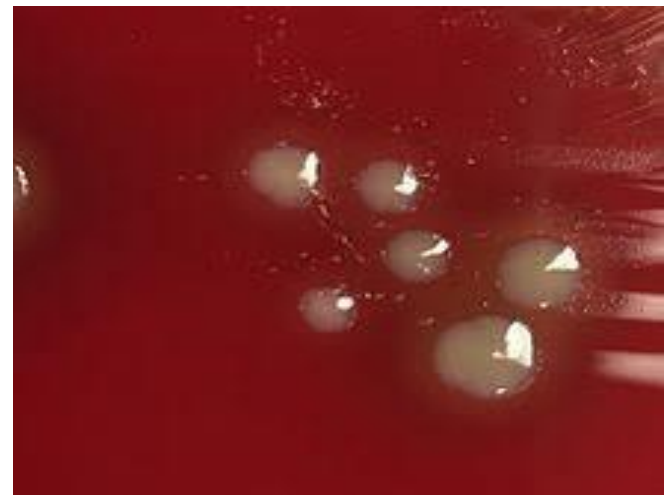
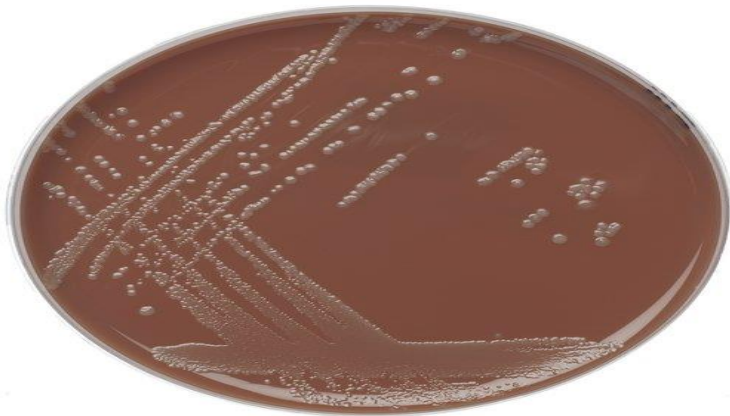
# *H. influenzae*

## Laboratory Diagnosis

### 1. Culture

Laboratory diagnosis depends on isolation of the organism on chocolate agar enriched with two growth factors required for bacterial respiration, namely, factor X (a heme compound) and factor V (NAD nicotinamide-adenine-dinucleotide).

The blood used in chocolate agar is heated to inactivate nonspecific inhibitors of *H. influenzae* growth.



For isolation, samples should be plated promptly on blood agar or chocolate agar and incubated in an **5-10 percent of CO<sub>2</sub> and high humidity**. The specimen should not be refrigerated before inoculation as the bacillus is very sensitive to low temperatures. A strain of staphylococcus should be streaked across the plate. After overnight incubation at 37°C, small opaque colonies appear that show satellitism.

## *H. influenzae*

**Satellitism:** This phenomenon demonstrates the dependence of *H. influenzae* on the V factor.

### *H. influenzae* (culture)

#### Blood agar (**satellitism**):

- *H. influenzae* can grow on blood agar in the presence of *S. aureus*.
- *S. aureus* produces V factor and releases X factor by hemolysing blood.
- *Haemophilus* colonies will form small colonies called "**satellites**" in the hemolytic zone around *Staphylococcus* colonies.



When blood agar is heated to 80-90°C, or boiled for a few minutes, the V factor is released from within erythrocytes & hence these media are superior to blood agar for growing *H. influenzae*. Clear transparent media may be prepared by boiling & filtering a mixture of blood & nutrient broth or by adding a peptic agar is best for primary isolation of *H. influenzae* and gives a copious growth.

Specimens should be cultured to **chocolate agar plates** and incubated in 5-10% CO<sub>2</sub> at 35-37 °C for 24- 72 hours where they will produce small or medium grey, mucoid (if encapsulated) colonies. A characteristic "mousy" odor is often Investigations may begin with the appearance of pale Gram negative coccobacilli or bacilli on a direct Gram stain. It should be noted that *Haemophilus parainfluenzae* may be pleomorphic with long filaments but it may also resemble *H. influenzae*.

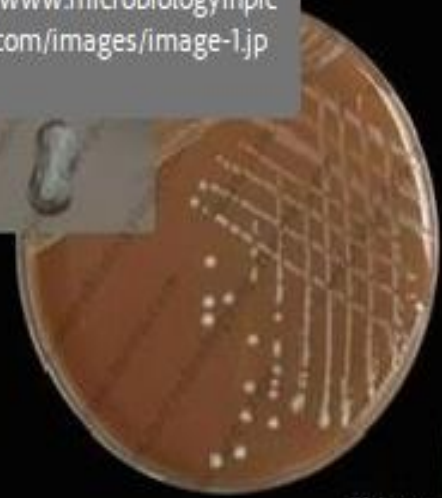
- Laboratories may use a variety of identification schemes to determine the presence of *Haemophilus* in a specimen, and many use the fastidious growth requirements of the bacteria as a method of identification. \*





<http://www.microbiologyinpictures.com/images/image-1.jpg>

requires X and V factors



X + V



X factor

V factor



*Haemophilus influenzae*  
cultivation 24 hours, 37°C, 5% CO<sub>2</sub>  
chocolate agar with supplement  
(sputum, patient with pneumonia)



*Haemophilus influenzae*

## Virulence Factors

- \*presence of capsule
- \*Non-encapsulated strains may possess a variety of cell surface proteins, fimbriae and pili which may aid in host cell attachment

# *H. influenzae*

## Treatment

*H. influenzae* is susceptible to sulphonamides, trimethoprim, chloramphenicol, tetracycline, coamoxiclav, ciprofloxacin, cefuroxime, cefotaxime and ceftazidime.

The treatment of choice for meningitis or other serious systemic infections caused by *H. influenzae* is ceftriaxone.

From 20% to 30% of *H. influenzae* type b isolates produce a  $\beta$ -lactamase that degrades penicillinase-sensitive  $\beta$ -lactams such as ampicillin but not ceftriaxone.

Untreated *H. influenzae* meningitis has a fatality rate of approximately 90%.

*H. influenzae* upper respiratory tract infections, such as otitis media and sinusitis, are treated with amoxicillin-clavulanate.

Thank you