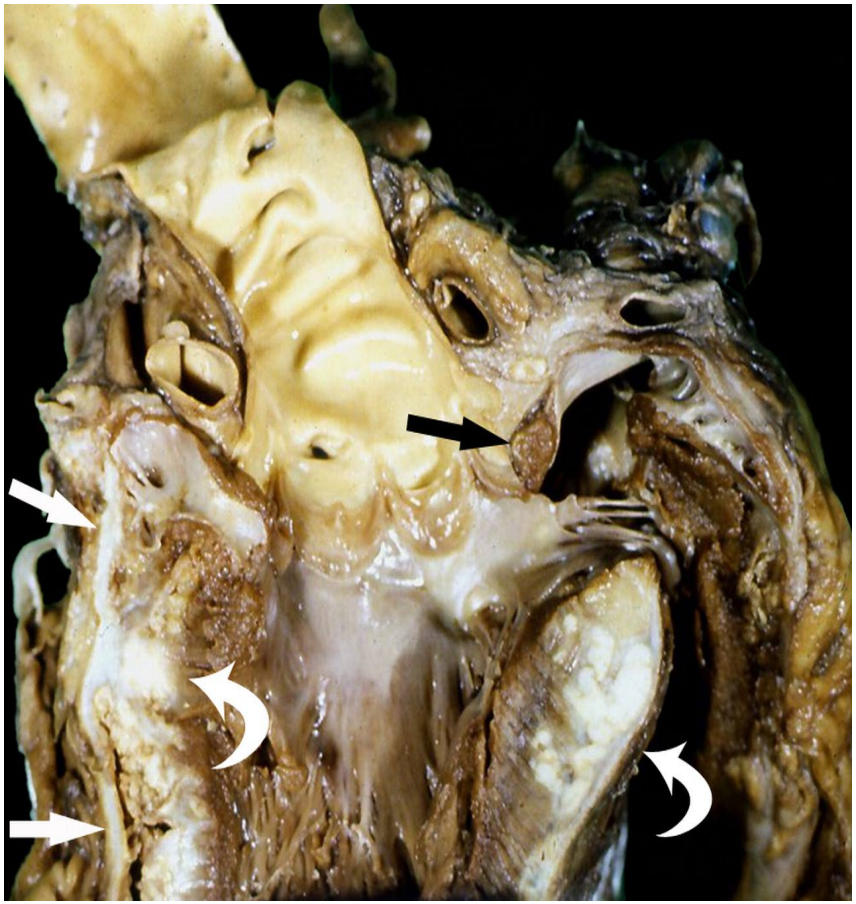
2022 Microbiology Review

HACEK Organisms

Case Study: Endocarditis

A 62-year-old male reports to the ED with a complaint of flu-like symptoms and a general feeling of being unwell. Physical examination reveals fever, elevated blood pressure and heart rate, and respiratory distress. Laboratory tests revealed an elevated WBC and normocytic, normochromic anemia. The echocardiogram revealed mitral valve insufficiency.

Past History: A root canal 2 weeks prior the development of flu-like illness.



Agents of Endocarditis

- *Staphylococcus aureus* (skin/catheterization)
- *Enterococci (gastrointestinal or urinary tract)*
- *Viridans streptococci (mouth flora)*
- *Nutritionally variant streptococci*
- *Streptococcus pneumoniae (respiratory flora)*
- *Pseudomonas species*
- *Candida species*
- *Streptococcus bovis (bowel flora or colon cancer)*
- *Clostridium septicum (bowel flora or colon cancer)*
- *HACEK organisms (oral and respiratory flora)*

HACEK Infections

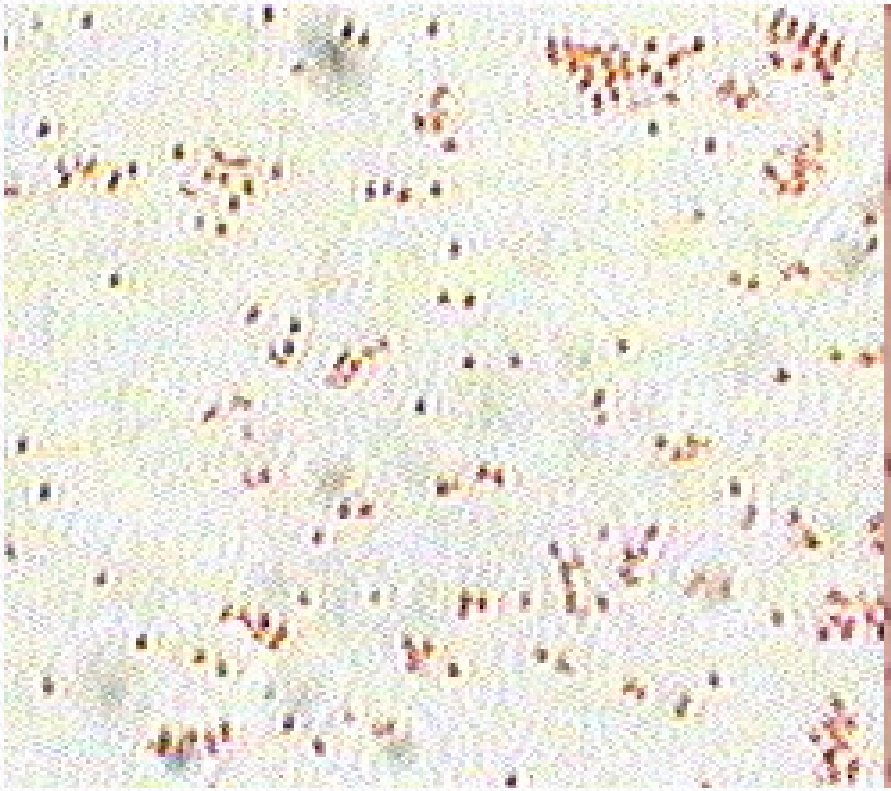
- *Endocarditis – Can account for up to 10% of native infections. Most are subacute infections (exception: H. parainfluenza – may have an acute presentation)*
- *Abscesses*
- *Peridontitis*
- *Septic arthritis*

HACEK Organisms

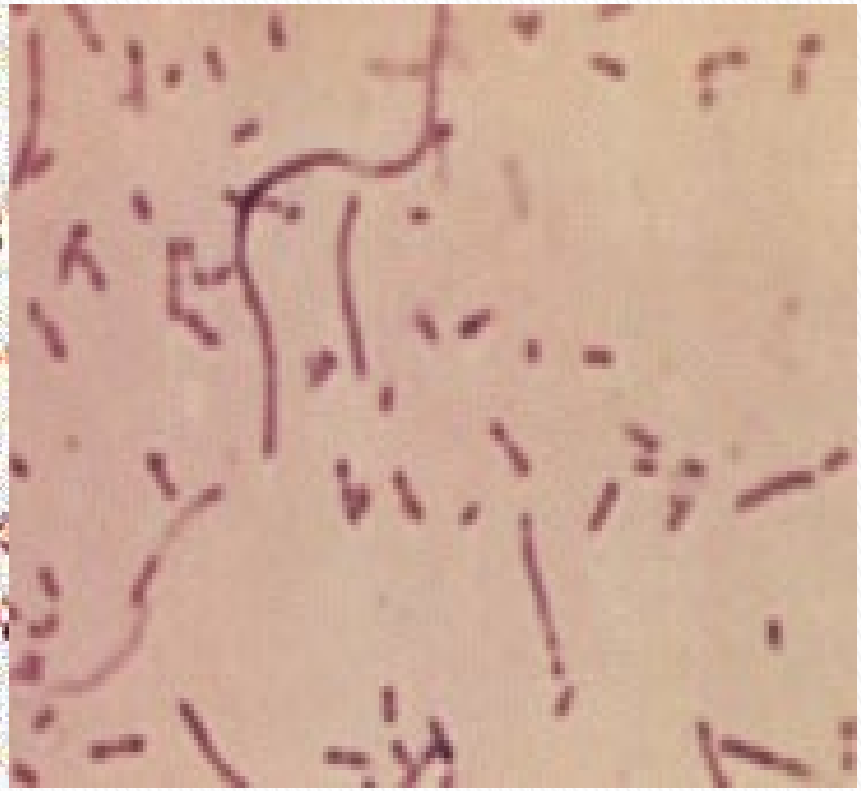
- *Haemophilus species*
- *Aggregatibacter*
- *Cardiobacterium hominis*
- *Eikenella corrodens*
- *Kingella species*

**Almost all are Oxidase positive*

Haemophilus species



Haemophilus influenzae



Haemophilus influenzae

Key Tests for Identification of Haemophilus species

- Small gram-negative bacilli or coccobacilli
- Requirements for X (hemin) and V (nicotinamide-adenine dinucleotide [NAD]) factors
- Satellitism
- Porphyrin Test

- *Some are capnophilic*
- *Hemolysis (5% horse or rabbit blood)*
- *Some strains can be biotyped* (Not usually done today) *using:*
  - *Ornithine decarboxylase*
  - *Indole*
  - *Urea*

Common Haemophilus species

	Oxidase	Catalase	X Factor	V Factor	Hemolysis*	Porphyrin
Haemophilus influenzae	+	+	+	+	–	–
Haemophilus haemolyticus	+	+	+	+	+	–
Haemophilus parainfluenzae	+	V	–	+	–	+
Haemophilus ducreyi	–	–	–	–	–	–

**5% Horse or Rabbit blood; some strains will hemolyse sheep blood*

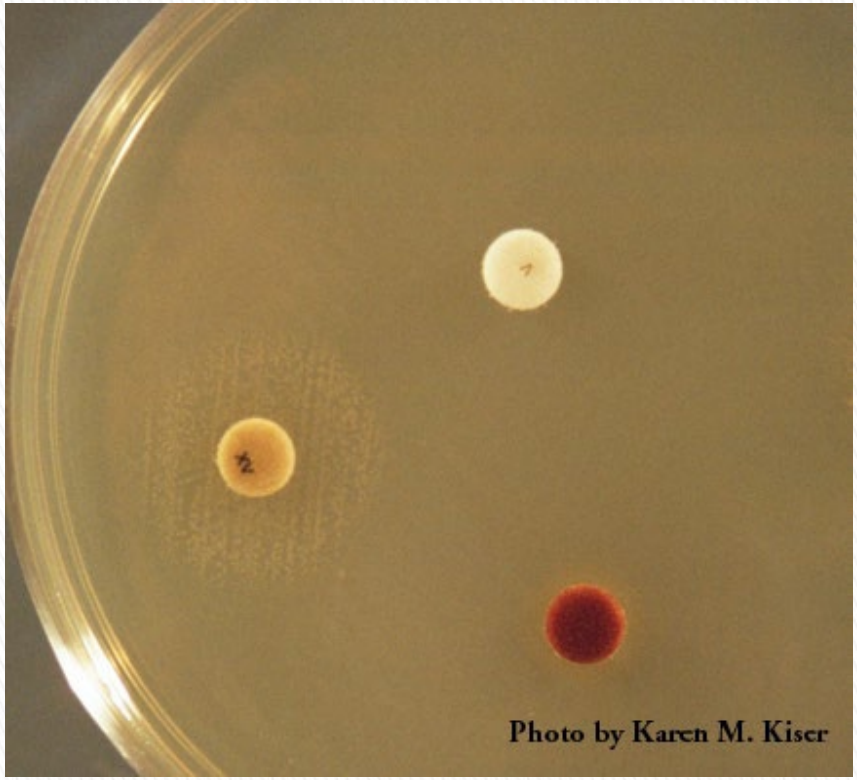
Haemophilus influenzae biotypes

Biotype	Ornithine Decarboxylase	Indole	Urea
I	+	+	+
II	–	+	+
III	–	–	+
IV	+	–	+
V	+	+	–
VI	+	–	–
VII	–	+	–
VIII	–	–	–

**Predominant biotype for meningitis*

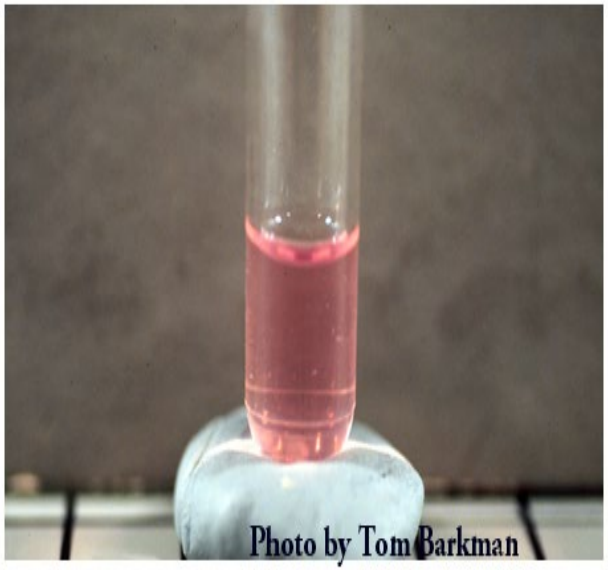
Haemophilus Identification Tests

Satellite Test

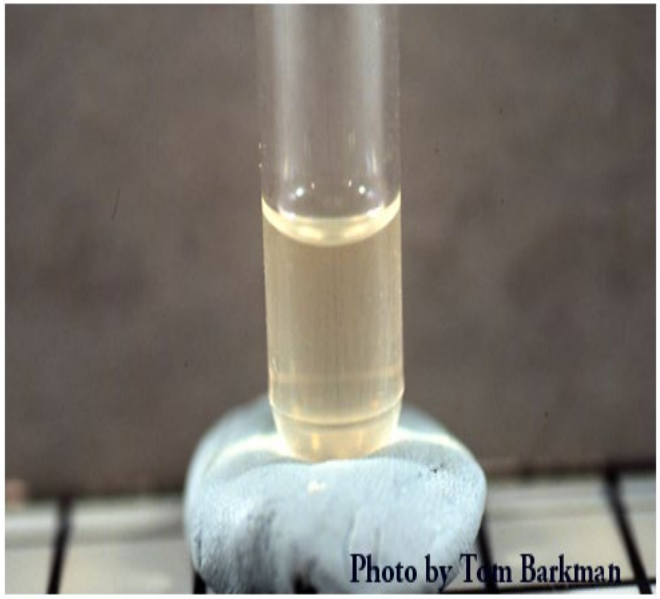


X and V Factors

Haemophilus Identification Tests



Porphyrin Positive



Porphyrin Negative

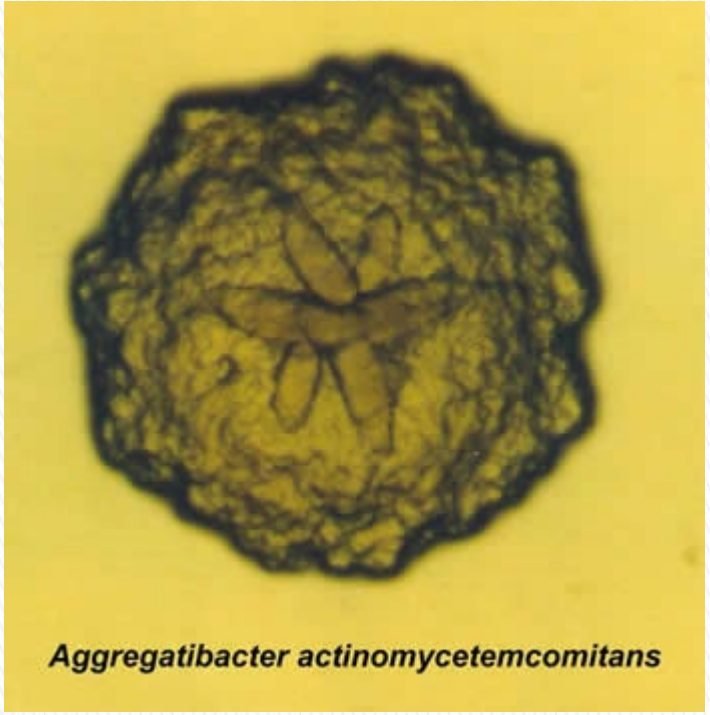
Haemophilus Identification Tests

Positive Porphyrin Synthesis

Negative Porphyrin Synthesis

Aggregatibacter actinomycetemcomitans
formerly
Haemophilus actinomycetemcomitans/Actinobacillus actinomycetemcomitans)

- Small gram-negative bacilli or coccobacilli
- Does not require X or V factors; growth on BAP
- Catalase positive
- Oxidase variable
- Urease negative
- Glucose fermenter (reaction may be weak and may require serum enhancement)
- Colony shows star shape in center of colony (use stereoscope or 100x magnification on the microscope

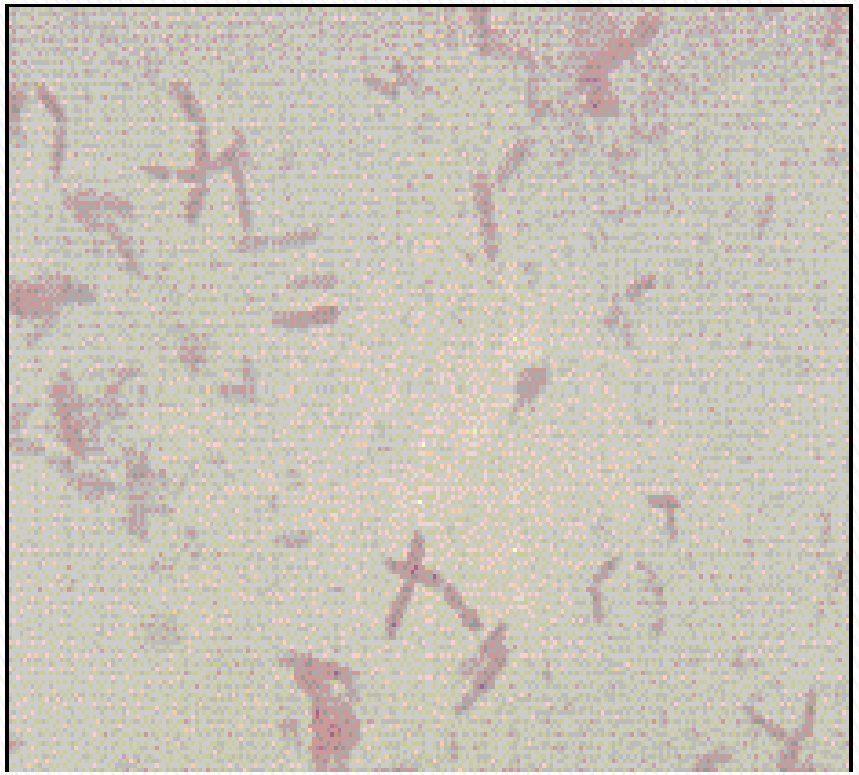


Aggregatibacter aphrophilus
formerly
Haemophilus aphrophilus

- Small gram-negative bacilli or coccobacilli
- Does not require X or V factors; growth on BAP
- Catalase negative
- Oxidase variable
- Urease negative
- Glucose fermenter
- Needs a high CO2 concentration

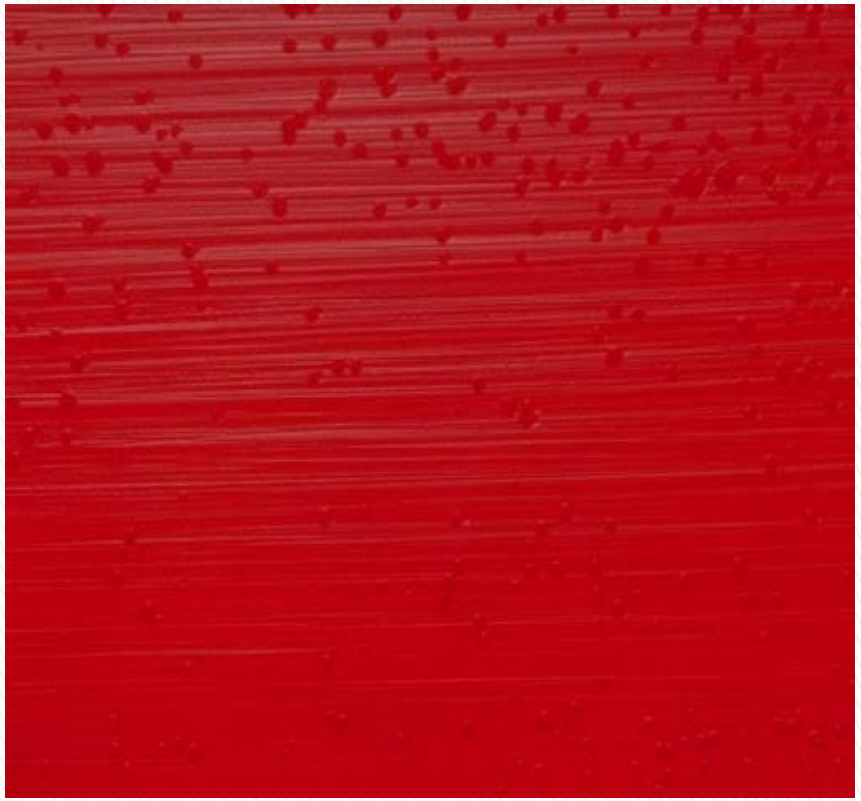
Cardiobacterium hominis

- Small gram-negative bacilli (may tend to form rosettes)
- Does not require X or V factors; growth on BAP
- Catalase negative
- Oxidase positive
- Urease negative
- Glucose fermenter (reactions may be weak; may require serum enhancement)
- Needs a high CO2 concentration



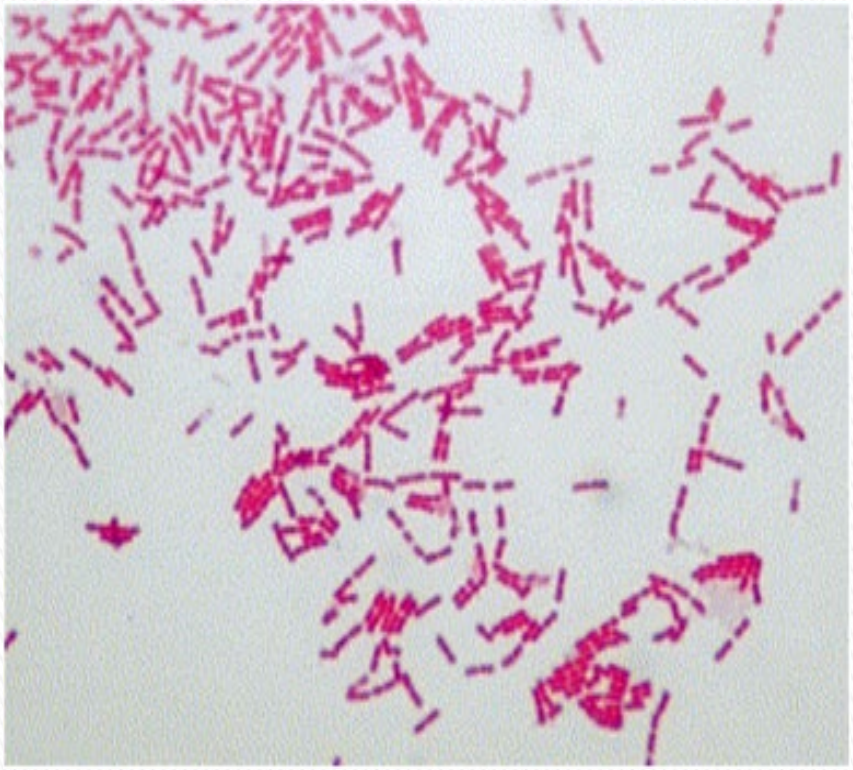
Eikenella corrodens

- Small gram-negative coccobacilli)
- Does not require X or V factors; growth on BAP
- Catalase negative
- Oxidase positive
- <50% pit or corrode the agar
- Assacharolytic
- May produce characteristic bleach odor
- Produces yellow pigment
- Grows best with increased CO2 concentration with hemin



Kingella species

- Small gram-negative coccobacilli or short rods with squared ends that occur in pairs or short chains
- Catalase negative
- Oxidase positive
- Glucose fermenter
- K. denitrificans may be confused with N. gonorrhoeae; may grow on Thayer Martin agar; may pit the agar; may grow at 42°C
- K.kingae may be beta hemolytic; may produce a yellow-brown pigment; may rarely grow on MacConkey agar



Is it K. denitrificans or N. gonorrhoeae?

- gram-negative bacilli
- Growth on Thayer Martin agar
- May pit agar
- 3% Catalase negative
- 30% Catalase (Superoxol) negative
- Nitrate reduction positive
- Growth at 42°C

Kingella denitrificans

- gram-negative diplococci
- Growth on Thayer Martin agar
- Does not pit agar
- 3% Catalase positive
- 30% Catalase (Superoxol) positive
- Nitrate reduction negative
- No growth at 42°C

Neisseria gonorrhoeae