Al Balqa Applied University

College of Medicine

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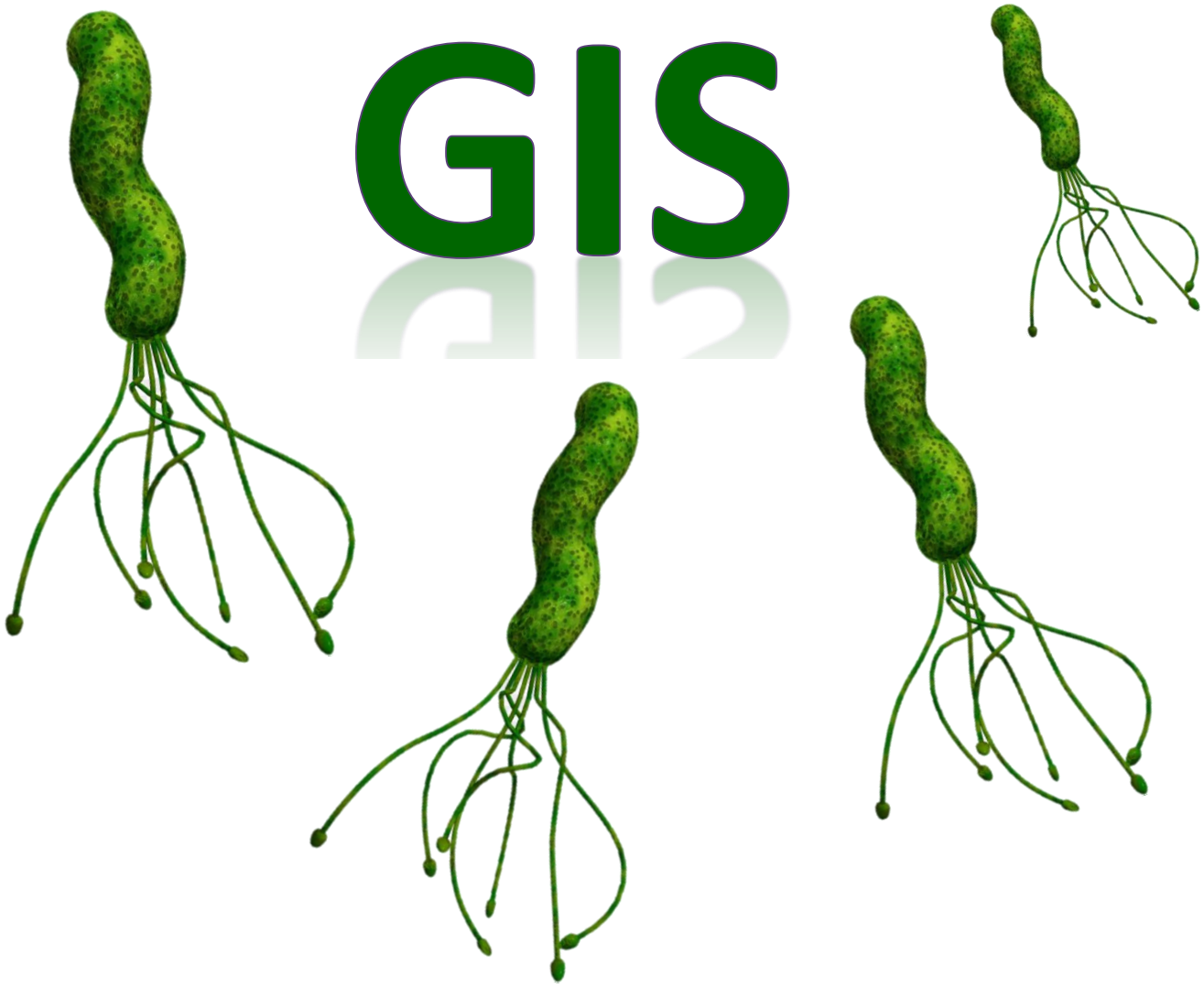

SUB-SYSTEM: MICROBIOLOGY

LECTURE: HELICOBACTER PYLORI – SHEET 1

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DATE: 10-4-2019

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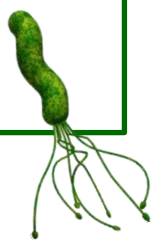
Helicobacter pylori **is a spiral-shaped gram-negative rod. *H. pylori* is associated with antral gastritis, duodenal (peptic) ulcer disease, gastric ulcers, gastric adenocarcinoma and gastric mucosa-associated lymphoid tissue (MALT) lymphomas. Other *Helicobacter* species that infect the gastric mucosa exist, but are rare.**

Sheet notes:

- **Helicopter Pylori, Campylobacter and Vibrio Cholera can all cause Gastritis or Ulcer but H.Pylori is the most common cause.**
- **H.Pylori is a curved shape rod (considered an S-Shaped bacterium as Campylobacter but more spiral)**
- **H.Pylori is a Gram Negative bacterium, means it has Lipopolysaccharide which is an important virulence factor.**
- **Antral portion is the end part of the stomach.**
- **H.Pylori is motile and has Lophotrichous Flagella.**



Morphology and Identification

A. Typical Organisms

Spiral with multiple flagella at one pole and is actively motile.

B. Culture

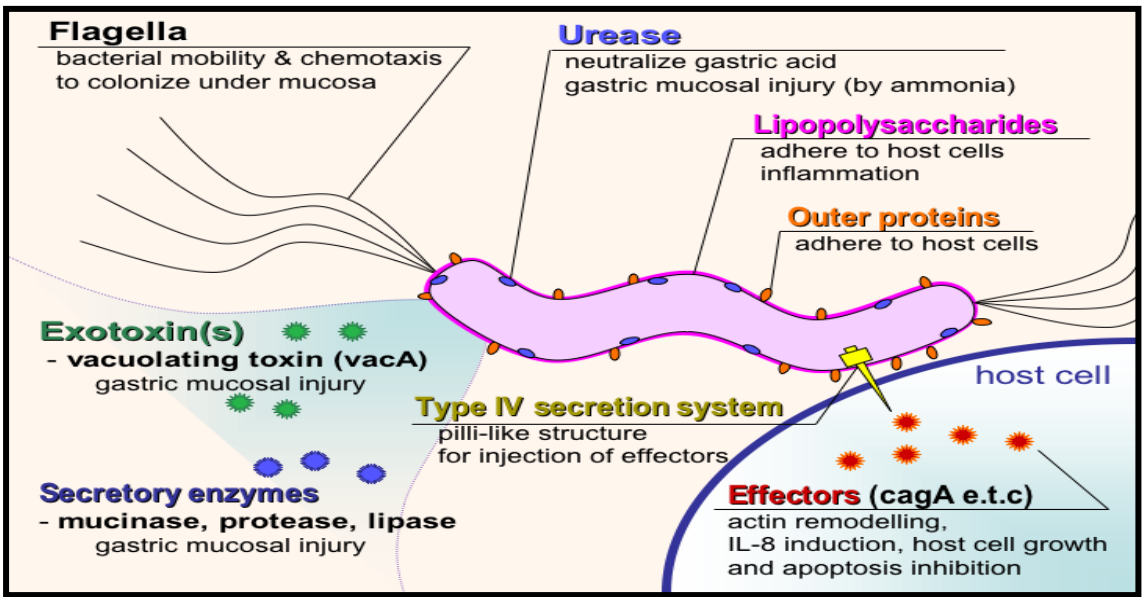
The media for primary isolation include **Skirrow's medium** with antibiotics, chocolate medium, and other selective media with antibiotics

C. Biochemical Characteristics

H. pylori is **oxidase** positive and **catalase** positive, and is a strong producer of **urease.**

Sheet notes:

- **Skirrow's medium is the most selective media for H.Pylori and Campylobacter.**
- **H.Pylori has Urease as in Proteus, but with a stronger effect. In fact, H.Pylori has the strongest Urease effect among bacteria.**
- **Proteus needs 24 hours for indication of Urease after inoculation on agar, but H.Pylori only needs 1 hour.**



Sheet notes:

- **Virulence factors of H.Pylori :**

1. **Flagella for motility and chemotaxis to colonize under mucosa.**

- **H.Pylori is a Neutrophilic bacteria. It exists in the Submucosa , which help it protects itself from the acidic media (1-2 pH in the stomach)**
- **Most bacteria are not acidophilic, but there are few species as lactic acid bacteria that resist acidity of genital tract (4.5 pH) and considered acidophilic.**

2. **Urease** catalyzes the conversion of urea into carbon dioxide and ammonia. This can :

- Cause gastric mucosal injury.
- Modulate the environment to reach a neutral state of (6.8 – 7.4 pH), and work as a buffering activity as other enzymes secreted by the bacteria (Protease , lipase , mucinase)

3. **Lipopolysaccharide**

- Has a role in adherent to host cells and inflammation

4. **Outer proteins**

- Adherent and attachment to host cells.

5. **Type IV secretion system**

- Pilli-like structure that helps in the in injection of **Effectors.**

6. **Effectors (cagA etc.):**

- Actin remodeling (Polymerization and depolymerization of actin) which aids in the mobilization from one cell to the other along with the flagella, unlike Shigella which only depend on actin remodeling for motility.
- IL-8 induction, host cell growth and apoptosis inhibition for the continuity of replication and survival.

7. **Exotoxin(s) :**

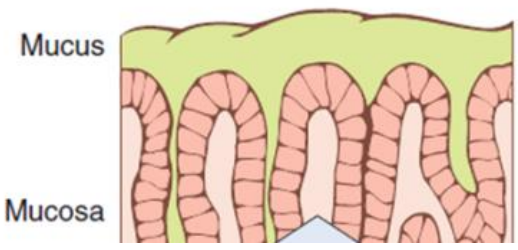
- Vacuolating toxin (VacA) causes gastric mucosal injury.

8. **Secretory enzymes :**

- Mucinase, lipase and protease also cause gastric mucosal injury.

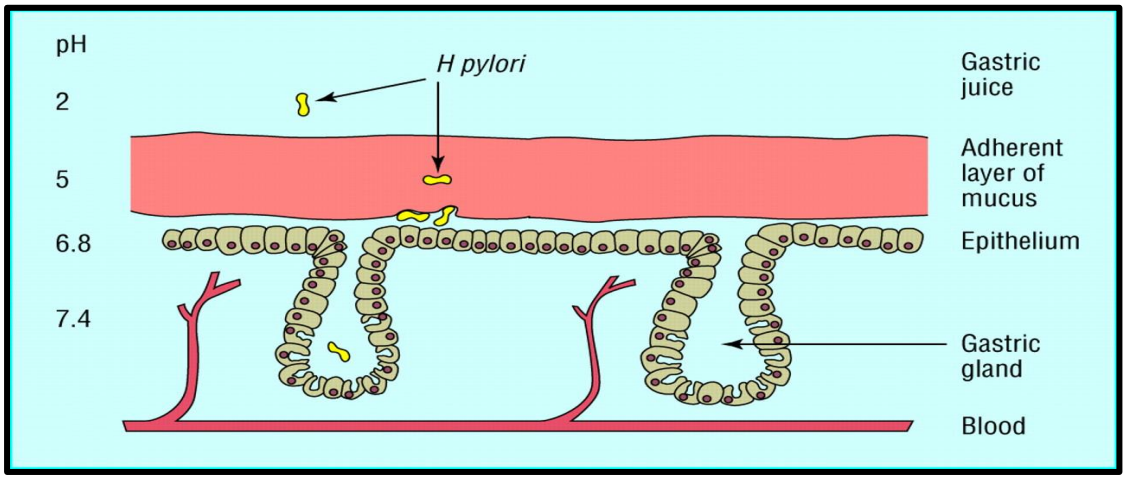
❖ **Mechanism of gastric mucosal injury :**

- Virulence factors of H.Pylori which causes damage on mucosa (an impermeable cover for acidity) , exposes host epithelial cells to the acidity of the lumen and eventually causes **Ulcer** .



Pathogenesis and Pathology

- *H. pylori* grows optimally at a pH of 6.0–7.0 and would be killed or not grow at the pH within the gastric lumen.
- Gastric mucus is relatively impermeable to acid and has a strong buffering capacity.
- On the lumen side of the mucus, the pH is low (1.0–2.0); on the epithelial side, the pH is about 6.8- 7.4. *H. pylori* is found deep in the mucous layer near the epithelial surface where physiologic pH is present.



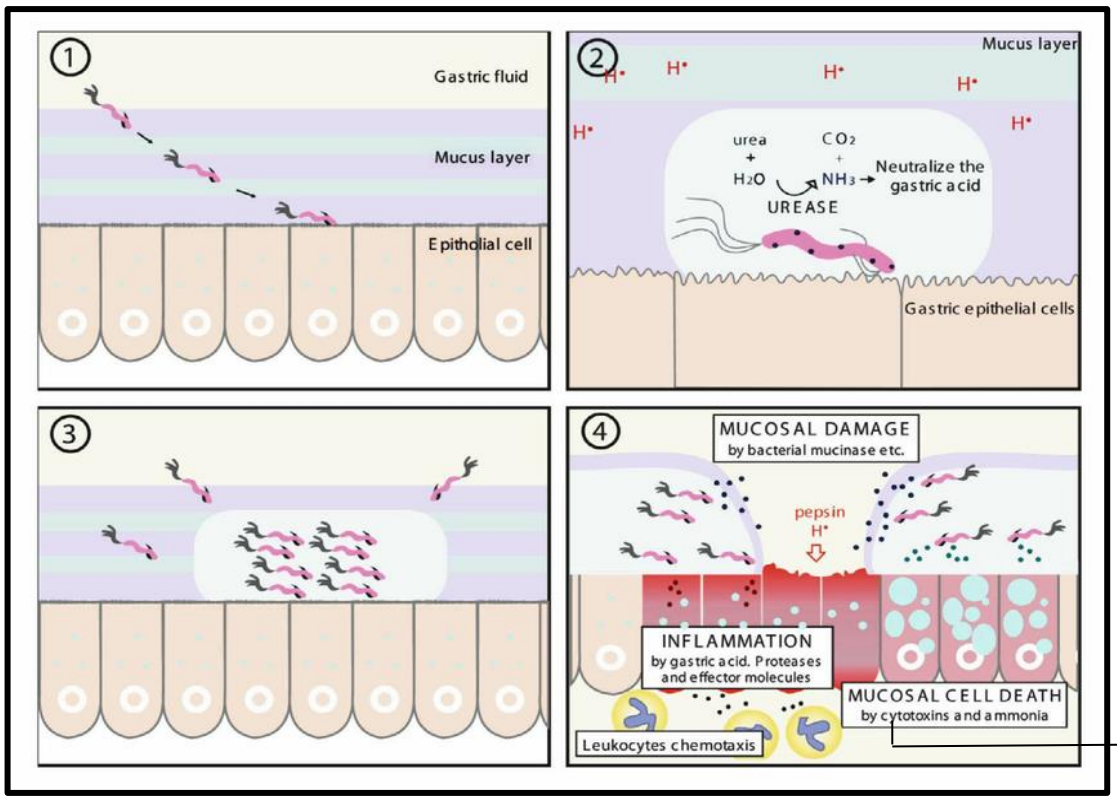
- *H. pylori* also produces a **protease** that modifies the gastric mucus. Also have potent **urease** activity, which yields ammonia and further buffering of acid.
- The mechanisms by which *H. pylori* causes mucosal inflammation and damage are not well defined but probably involve both bacterial and host factors.
- The bacteria invade the epithelial cell surface to a limited degree. **Vacuolating toxins** and **lipopolysaccharide** may damage the mucosal cells, and the **ammonia** produced by the urease activity may also directly damage the cells.
- **Histologically**, gastritis is characterized by acute and chronic inflammation.

Sheet notes:

- **Most cases of acute H.Pylori infections are recognized late after a period of time (maybe 20-30 years), either by chance or biopsy test, and that's because H.Pylori only exists in the submucosa, so stool tests of this organism are always negative.**

- **Nowadays, new technologies as Stool antigen tests are used (antigens not the organism itself) or by detection of antibodies in the serum.**
- **Osama asked : How H.Pylori can be transmitted by fecal-oral route, if it's stool negative :**
- **Doctor answer: it can be transmitted through contaminated animal products or water, and might exist in stool in very severe ill patients.**
- **Google answer: The mode of transmission of H. pylori remains poorly understood; no single pathway has been clearly identified. Person-to-person contact is considered the most likely transmission route.**
- **Please read transmission paragraph on page 2 (https://www.who.int/bulletin/archives/79(5)455.pdf)**

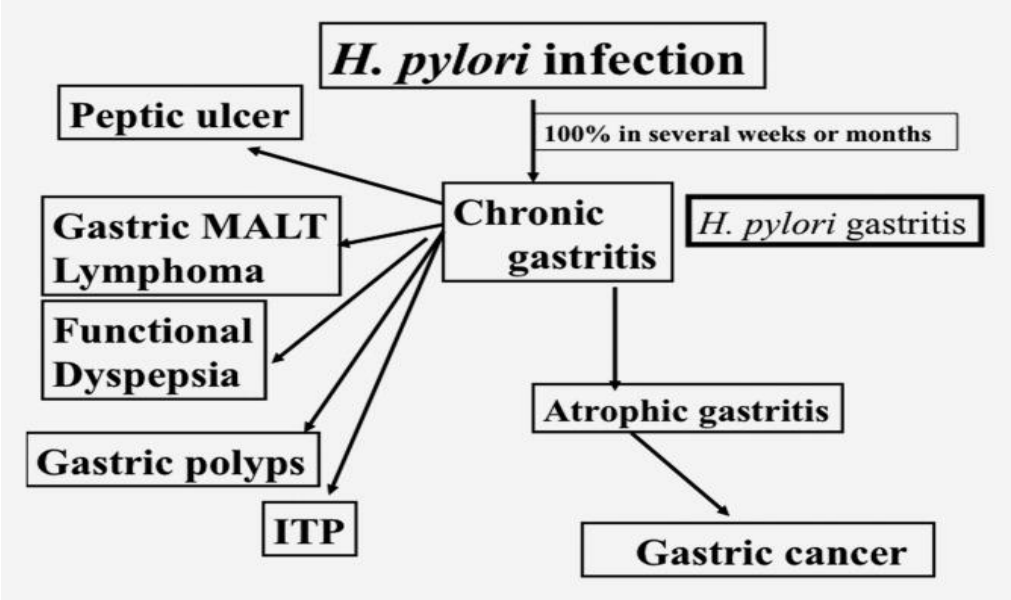
- PMN and mononuclear cell infiltrates are seen within the epithelium and lamina propria.
- Ingestion of *H. Pylori* resulted in the development of gastritis and **hypochlorhydria (Because it affects the cells that secrete HCL)**
- There is a strong association between the presence of *H. pylori* infection and duodenal ulceration.
- **The bacteria invade the epithelial cell surface. Toxins and LPS may damage the mucosal cells, and the ammonia produced by the urease activity may also directly damage the cells.**



Cytotoxins cause necrosis of host cells.

- Some *H. pylori* bacteria use a needle-like appendage to inject a toxin produced by a gene called **cytotoxin-associated gene A (*cagA*)** into the junctions where cells of the stomach lining meet. This toxin (known as CagA) alters the structure of stomach cells and allows the bacteria to attach to them more easily. Long-term exposure to the toxin causes chronic inflammation. However, not all strains of *H. pylori* carry the *CagA* gene; those that do are classified as *CagA*-positive. **(Because of this , some acute patients appear with clinical symptoms, and that depends on the dose, immune state of the patient and the availability of some virulence factors or not , such as cagA)**

- Vacuoles within cells are often pronounced. Destruction of the epithelium is common, and glandular atrophy may occur. *H. pylori* thus is a major risk factor for gastric cancer. (ITP, Idiopathic Thrombocytopenia) **which may cause bleeding and further consuming of platelets.**



Clinical Findings

- Acute infection can yield an upper gastrointestinal illness with nausea and pain; heart burn, dyspepsia, belching تجشؤ, poor appetite, bloody stool, vomiting and fever **may** also be present. **(most of these symptoms don't necessarily appear , and H.Pylori usually detected with screening)**
- The acute symptoms may last for less than 1 week or as long as 2 weeks. **(If acute symptoms occur, they will give a great chance for treating the infection early)**

For whom listened to the record: retching means try to vomit and not belching, sorry for that.

- After colonization, the *H. pylori* infection **persists for years** and perhaps decades or evens a lifetime.
- About 90% of patients with duodenal ulcers and 50–80% of those with gastric ulcers have *H. pylori* infection.

Diagnostic Laboratory Tests

A. Specimens

- Gastric biopsy specimens can be used for histologic examination
- Blood is collected for determination of serum antibodies.
- Stool samples may be collected for ***H pylori*** **antigen detection**.

B. Smears & Culture

Curved or spiral-shaped organisms. Culture is performed when patients are not responding to treatment.

C. Special Tests

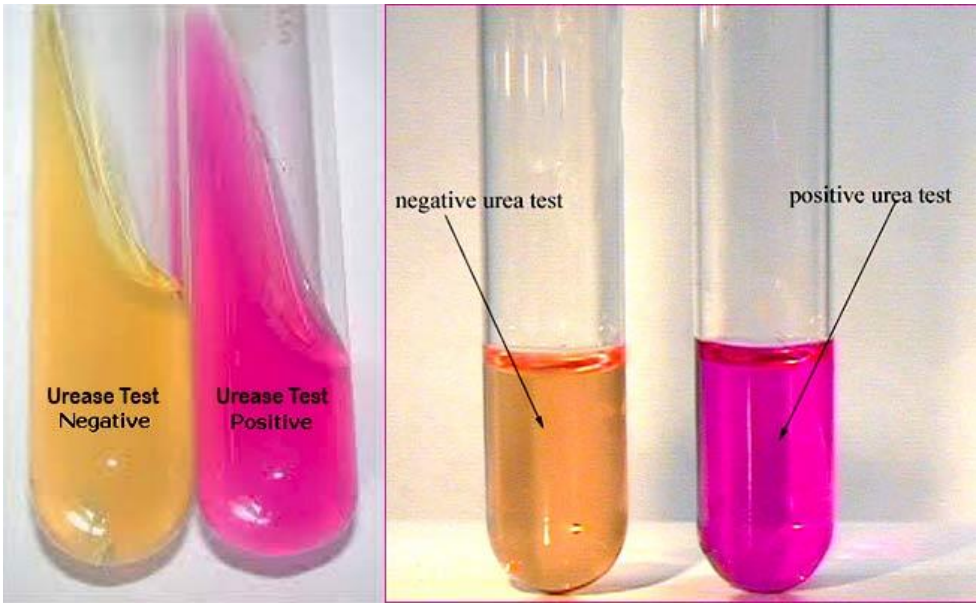
Helicobacter pylori **infection can be diagnosed with:**

1. **Invasive techniques** requiring endoscopy and biopsy (e.g. histological examination, culture and rapid urease test).

Sheet notes:

- **Histological examination: we check its effects on the tissue if it causes ulcer or any damage.**
- **Culture: after we inoculate on Skirrow's medium and do biochemical tests (oxidase, urease, and catalase) and then a sensitivity test.**

Rapid urease test: Gastric biopsy material can be placed onto a urea-containing medium with a color indicator **(Urea agar is basic agar with added 40% urea, with an orange color)** . If *H. pylori* is present, the urease rapidly splits the urea **(1–2 hours),** and the resulting shift in pH yields a color change in the medium **(** فوشي **Pink in color)**



2. **Non-invasive techniques**, such as serology, the urea breath test, or detection of *H. pylori* antigen in stool specimen.

Sheet notes:

- **Serology : antibodies in the serum , and the type of antibodies in the secretion of the mucus is IgA1 which is responsible for the protection**
- **Titer of IgA1 : >2.2 considered positive, but in labs nowadays >1 is significant and they consider it positive.**

In vivo tests for urease activity can be done also. In **urea breath tests**, ^{13}C- or ^{14}C-labeled urea is ingested by the patient. If *H pylori* is present, the urease activity generates labeled **CO2 (radiolabeled)** that can be detected in the patient's **exhaled breath**.

Detection of ***H. pylori* antigen** in stool specimens is appropriate as a test of cure for patients with known H. *pylori* infection who have been treated.

Epidemiology

- *H. pylori* is present on the gastric mucosa of fewer than 20% of persons younger than years 30 but increases in prevalence to 40–60% of persons age 60 years, including persons who are asymptomatic.

- In developing countries, the prevalence of infection may be 80% or higher in adults.

"Carry on my wayward son
You will succeed
When you're done" ♥