= Helicobacter pylori =

Helicobacter pylori , previously Campylobacter pylori , is a gram @-@ negative , microaerophilic bacterium found usually in the stomach . It was identified in 1982 by Australian scientists Barry Marshall and Robin Warren , who found that it was present in a person with chronic gastritis and gastric ulcers , conditions not previously believed to have a microbial cause . It is also linked to the development of duodenal ulcers and stomach cancer . However , over 80 % of individuals infected with the bacterium are asymptomatic , and it may play an important role in the natural stomach ecology .

More than 50 % of the world 's population harbor H. pylori in their upper gastrointestinal tract . Infection is more prevalent in developing countries , and incidence is decreasing in Western countries . H. pylori 's helical shape (from which the genus name is derived) is thought to have evolved to penetrate the mucoid lining of the stomach .

= = Signs and symptoms = =

Up to 85 % of people infected with H. pylori never experience symptoms or complications . Acute infection may appear as an acute gastritis with abdominal pain (stomach ache) or nausea . Where this develops into chronic gastritis , the symptoms , if present , are often those of non @-@ ulcer dyspepsia : stomach pains , nausea , bloating , belching , and sometimes vomiting or black stool .

Individuals infected with H. pylori have a 10 to 20 % lifetime risk of developing peptic ulcers and a 1 to 2 % risk of acquiring stomach cancer . Inflammation of the pyloric antrum is more likely to lead to duodenal ulcers , while inflammation of the corpus (body of the stomach) is more likely to lead to gastric ulcers and gastric carcinoma . However , H. pylori possibly plays a role only in the first stage that leads to common chronic inflammation , but not in further stages leading to carcinogenesis . A meta @-@ analysis conducted in 2009 concluded the eradication of H. pylori reduces gastric cancer risk in previously infected individuals , suggesting the continued presence of H. pylori constitutes a relative risk factor of 65 % for gastric cancers ; in terms of absolute risk , the increase was from 1 @.@ 1 % to 1 @.@ 7 % .

H. pylori has been associated with colorectal polyps and colorectal cancer . It may also be associated with eye disease .

= = Microbiology = =

H. pylori is a helix @-@ shaped (classified as a curved rod , not spirochaete) Gram @-@ negative bacterium about 3 ?m long with a diameter of about 0 @.@ 5 ?m . It is microaerophilic ; that is , it requires oxygen , but at lower concentration than is found in the atmosphere . It contains a hydrogenase which can be used to obtain energy by oxidizing molecular hydrogen (H2) produced by intestinal bacteria . It produces oxidase , catalase , and urease . It is capable of forming biofilms and can convert from spiral to a possibly viable but nonculturable coccoid form , both likely to favor its survival and be factors in the epidemiology of the bacterium .

H. pylori possesses five major outer membrane protein families . The largest family includes known and putative adhesins . The other four families are porins , iron transporters , flagellum @-@ associated proteins , and proteins of unknown function . Like other typical Gram @-@ negative bacteria , the outer membrane of H. pylori consists of phospholipids and lipopolysaccharide (LPS) . The O antigen of LPS may be fucosylated and mimic Lewis blood group antigens found on the gastric epithelium . The outer membrane also contains cholesterol glucosides , which are found in few other bacteria . H. pylori has four to six lophotrichous flagella ; all gastric and enterohepatic Helicobacter species are highly motile owing to flagella . The characteristic sheathed flagellar filaments of Helicobacter are composed of two copolymerized flagellins , FlaA and FlaB .

= = = Microscopy = = =

H. pylori can be demonstrated in tissue by Gram stain , Giemsa stain , haematoxylin @-@ eosin stain , Warthin @-@ Starry silver stain , acridine @-@ orange stain , and phase @-@ contrast microscopy .

= = = Genome = = =

H. pylori consists of a large diversity of strains , and the genomes of three have been completely sequenced . The genome of the strain " 26695 " consists of about 1 @.@ 7 million base pairs , with some 1 @,@ 576 genes . The two sequenced strains show large genetic differences , with up to 6 % of the nucleotides differing .

= = = Transcriptome = = =

In 2010 , Sharma et al. presented a comprehensive analysis of transcription at single @-@ nucleotide resolution by differential RNA @-@ seq which confirmed the known acid induction of major virulence loci such as the urease (ure) operon or the cag pathogenicity island (see below) . More importantly , this study identified a total of 1 @,@ 907 transcriptional start sites , 337 primary operons , and 126 additional suboperons , and 66 monocistrons . Until 2010 , only about 55 transcriptional start sites (TSSs) were known in this species . Notably , 27 % of the primary TSSs are also antisense TSSs , indicating that ? similar to E. coli ? antisense transcription occurs across the entire H. pylori genome . At least one antisense TSS is associated with about 46 % of all open reading frames , including many housekeeping genes . Most (about 50 %) of the 5 ' UTRs are 20 ? 40 nucleotides (nt) in length and support the AAGGag motif located about 6 nt (median distance) upstream of start codons as the consensus Shine ? Dalgarno sequence in H. pylori .

= = = = Genes involved in virulence and pathogenesis = = = =

Study of the H. pylori genome is centered on attempts to understand pathogenesis , the ability of this organism to cause disease . About 29 % of the loci have a colonization defect when mutated . Two of sequenced strains have an around 40 @-@ kb @-@ long Cag pathogenicity island (a common gene sequence believed responsible for pathogenesis) that contains over 40 genes . This pathogenicity island is usually absent from H. pylori strains isolated from humans who are carriers of H. pylori but remain asymptomatic .

The cagA gene codes for one of the major H. pylori virulence proteins . Bacterial strains with the cagA gene are associated with an ability to cause ulcers . The cagA gene codes for a relatively long (1186 @-@ amino acid) protein . The cag pathogenicity island (PAI) has about 30 genes , part of which code for a complex type IV secretion system . The low GC @-@ content of the cag PAI relative to the rest of the Helicobacter genome suggests the island was acquired by horizontal transfer from another bacterial species .

= = Pathophysiology = =

= = = Adaptation to the stomach ? s acidic environment = = =

To avoid the acidic environment of the interior of the stomach (lumen) , H. pylori uses its flagella to burrow into the mucus lining of the stomach to reach the epithelial cells underneath , where the pH is more neutral . H. pylori is able to sense the pH gradient in the mucus and move towards the less acidic region (chemotaxis) . This also keeps the bacteria from being swept away into the lumen with the bacteria ? s mucus environment , which is constantly moving from its site of creation at the epithelium to its dissolution at the lumen interface .

H. pylori is found in the mucus , on the inner surface of the epithelium , and occasionally inside the epithelial cells themselves . It adheres to the epithelial cells by producing adhesins , which bind to

lipids and carbohydrates in the epithelial cell membrane . One such adhesion , BabA , binds to the Lewis b antigen displayed on the surface of stomach epithelial cells . Another such adhesion , SabA , binds to increased levels of sialyl @-@ Lewis x antigen expressed on gastric mucosa .

In addition to using chemotaxis to avoid areas of low pH , H. pylori also neutralizes the acid in its environment by producing large amounts of urease , which breaks down the urea present in the stomach to carbon dioxide and ammonia . The ammonia , which is basic , then neutralizes stomach acid .

= = = Inflammation , gastritis , and ulcer = = =

H. pylori harms the stomach and duodenal linings by several mechanisms . The ammonia produced to regulate pH is toxic to epithelial cells , as are biochemicals produced by H. pylori such as proteases , vacuolating cytotoxin A (VacA) [this damages epithelial cells , disrupts tight junctions and causes apoptosis] , and certain phospholipases . Cytotoxin associated gene CagA can also cause inflammation and is potentially a carcinogen .

Colonization of the stomach by H. pylori can result in chronic gastritis , an inflammation of the stomach lining , at the site of infection . Helicobacter cysteine @-@ rich proteins (Hcp) , particularly HcpA (hp0211) , are known to trigger an immune response , causing inflammation . Chronic gastritis is likely to underlie H. pylori @-@ related diseases .

Ulcers in the stomach and duodenum result when the consequences of inflammation allow stomach acid and the digestive enzyme pepsin to overwhelm the mechanisms that protect the stomach and duodenal mucous membranes . The location of colonization of H. pylori , which affects the location of the ulcer , depends on the acidity of the stomach . In people producing large amounts of acid , H. pylori colonizes near the pyloric antrum (exit to the duodenum) to avoid the acid @-@ secreting parietal cells at the fundus (near the entrance to the stomach) . In people producing normal or reduced amounts of acid , H. pylori can also colonize the rest of the stomach .

The inflammatory response caused by bacteria colonizing near the pyloric antrum induces G cells in the antrum to secrete the hormone gastrin , which travels through the bloodstream to parietal cells in the fundus . Gastrin stimulates the parietal cells to secrete more acid into the stomach lumen , and over time increases the number of parietal cells , as well . The increased acid load damages the duodenum , which may eventually result in ulcers forming in the duodenum .

When H. pylori colonizes other areas of the stomach , the inflammatory response can result in atrophy of the stomach lining and eventually ulcers in the stomach . This also may increase the risk of stomach cancer .

= = = The cag pathogenicity island = = =

The pathogenicity of H. pylori may be increased by genes of the cag pathogenicity island ; about 50 ? 70 % of H. pylori strains in Western countries carry it . Western people infected with strains carrying the cag PAI have a stronger inflammatory response in the stomach and are at a greater risk of developing peptic ulcers or stomach cancer than those infected with strains lacking the island . Following attachment of H. pylori to stomach epithelial cells , the type IV secretion system expressed by the cag PAI " injects " the inflammation @-@ inducing agent , peptidoglycan , from their own cell walls into the epithelial cells . The injected peptidoglycan is recognized by the cytoplasmic pattern recognition receptor (immune sensor) Nod1 , which then stimulates expression of cytokines that promote inflammation .

The type @-@ IV secretion apparatus also injects the cag PAI @-@ encoded protein CagA into the stomach 's epithelial cells , where it disrupts the cytoskeleton , adherence to adjacent cells , intracellular signaling , cell polarity , and other cellular activities . Once inside the cell , the CagA protein is phosphorylated on tyrosine residues by a host cell membrane @-@ associated tyrosine kinase (TK) . CagA then allosterically activates protein tyrosine phosphatase / protooncogene Shp2 . Pathogenic strains of H. pylori have been shown to activate the epidermal growth factor receptor (EGFR) , a membrane protein with a TK domain . Activation of the EGFR by H. pylori is

associated with altered signal transduction and gene expression in host epithelial cells that may contribute to pathogenesis . A C @-@ terminal region of the CagA protein (amino acids 873 ? 1002) has also been suggested to be able to regulate host cell gene transcription , independent of protein tyrosine phosphorylation . A great deal of diversity exists between strains of H. pylori , and the strain with which one is infected is predictive of the outcome .

= = = Cancer = = =

Two related mechanisms by which H. pylori could promote cancer are under investigation . One mechanism involves the enhanced production of free radicals near H. pylori and an increased rate of host cell mutation . The other proposed mechanism has been called a " perigenetic pathway " , and involves enhancement of the transformed host cell phenotype by means of alterations in cell proteins , such as adhesion proteins . H. pylori has been proposed to induce inflammation and locally high levels of TNF @-@ ? and / or interleukin 6 (IL @-@ 6) . According to the proposed perigenetic mechanism , inflammation @-@ associated signaling molecules , such as TNF @-@ ? , can alter gastric epithelial cell adhesion and lead to the dispersion and migration of mutated epithelial cells without the need for additional mutations in tumor suppressor genes , such as genes that code for cell adhesion proteins .

The strain of H. pylori to which a person is exposed may influence the risk of developing gastric cancer . Strains of H. pylori that produce high levels of two proteins , vacuolating toxin A (VacA) and the cytotoxin @-@ associated gene A (CagA) , appear to cause greater tissue damage than those that produce lower levels or that lack those genes completely . These proteins are directly toxic to cells lining the stomach and signal strongly to the immune system that an invasion is underway . As a result of the bacterial presence , neutrophils and macrophages set up residence in the tissue to fight the bacteria assault .

= = = Survival of H. pylori = = =

The pathogenesis of H. pylori depends on its ability to survive in the harsh gastric environment characterized by acidity , peristalsis , and attack by phagocytes accompanied by release of reactive oxygen species . In particular , H. pylori elicits an oxidative stress response during host colonization . This oxidative stress response induces potentially lethal and mutagenic oxidative DNA adducts in the H. pylori genome .

Vulnerability to oxidative stress and oxidative DNA damage occurs commonly in many studied bacterial pathogens , including Neisseria gonorrhoeae , Hemophilus influenzae , Streptococcus pneumoniae , S. mutans , and H. pylori . For each of these pathogens , surviving the DNA damage induced by oxidative stress appears to be supported by transformation @-@ mediated recombinational repair . Thus , transformation and recombinational repair appear to contribute to successful infection .

Transformation (the transfer of DNA from one bacterial cell to another through the intervening medium) appears to be part of an adaptation for DNA repair . H. pylori is naturally competent for transformation . While many organisms are competent only under certain environmental conditions , such as starvation , H. pylori is competent throughout logarithmic growth . All organisms encode genetic programs for response to stressful conditions including those that cause DNA damage . In H. pylori , homologous recombination is required for repairing DNA double @-@ strand breaks (DSBs) . The AddAB helicase @-@ nuclease complex resects DSBs and loads RecA onto single @-@ strand DNA (ssDNA) , which then mediates strand exchange , leading to homologous recombination and repair . The requirement of RecA plus AddAB for efficient gastric colonization suggests , in the stomach , H. pylori is either exposed to double @-@ strand DNA damage that must be repaired or requires some other recombination @-@ mediated event . In particular , natural transformation is increased by DNA damage in H. pylori , and a connection exists between the DNA damage response and DNA uptake in H. pylori , suggesting natural competence contributes to persistence of H. pylori in its human host and explains the retention of competence in most clinical

isolates .

RuvC protein is essential to the process of recombinational repair , since it resolves intermediates in this process termed Holliday junctions . H. pylori mutants that are defective in RuvC have increased sensitivity to DNA @-@ damaging agents and to oxidative stress , exhibit reduced survival within macrophages , and are unable to establish successful infection in a mouse model . Similarly , RecN protein plays an important role in DSB repair in H. pylori . An H. pylori recN mutant displays an attenuated ability to colonize mouse stomachs , highlighting the importance of recombinational DNA repair in survival of H. pylori within its host .

= = Diagnosis = =

Colonization with H. pylori is not a disease in and of itself , but a condition associated with a number of disorders of the upper gastrointestinal tract . Testing for H. pylori is recommended if peptic ulcer disease or low @-@ grade gastric MALT lymphoma is present , after endoscopic resection of early gastric cancer , first @-@ degree relatives h gastric cancer , and in certain cases of dyspepsia , not routinely . Several ways of testing exist . One can test noninvasively for H. pylori infection with a blood antibody test , stool antigen test , or with the carbon urea breath test (in which the patient drinks 14C ? or 13C @-@ labelled urea , which the bacterium metabolizes , producing labelled carbon dioxide that can be detected in the breath) . Also , a urine ELISA test with a 96 % sensitivity and 79 % specificity is available . None of the test methods is completely failsafe . Even biopsy is dependent on the location of the biopsy . Blood antibody tests , for example , range from 76 % to 84 % sensitivity . Some drugs can affect H. pylori urease activity and give false negatives with the urea @-@ based tests . The most accurate method for detecting H. pylori infection is with a histological examination from two sites after endoscopic biopsy , combined with either a rapid urease test or microbial culture .

= = Prevention = =

H. pylori is a major cause of certain diseases of the upper gastrointestinal tract . Rising antibiotic resistance increases the need to search for new therapeutic strategies ; this might include prevention in form of vaccination . Much work has been done on developing viable vaccines aimed at providing an alternative strategy to control H. pylori infection and related diseases , including stomach cancer . Researchers are studying different adjuvants , antigens , and routes of immunization to ascertain the most appropriate system of immune protection ; however , most of the research only recently moved from animal to human trials . An economic evaluation of the use of a potential H. pylori vaccine in babies found its introduction could , at least in the Netherlands , prove cost @-@ effective for the prevention of peptic ulcer and stomach cancer . A similar approach has also been studied for the United States .

The presence of bacteria in the stomach may be beneficial , reducing the prevalence of asthma , rhinitis , dermatitis , inflammatory bowel disease , gastroesophageal reflux disease , and esophageal cancer by influencing systemic immune responses .

Recent evidence suggests that nonpathogenic strains of H. pylori may be beneficial , e.g. , by normalizing stomach acid secretion , and may play a role in regulating appetite , since its presence in the stomach results in a persistent but reversible reduction in the level of ghrelin .

= = Treatment = =

Once H. pylori is detected in a person with a peptic ulcer , the normal procedure is to eradicate it and allow the ulcer to heal . The standard first @-@ line therapy is a one @-@ week " triple therapy " consisting of proton pump inhibitors such as omeprazole and the antibiotics clarithromycin and amoxicillin . Variations of the triple therapy have been developed over the years , such as using a different proton pump inhibitor , as with pantoprazole or rabeprazole , or replacing amoxicillin with metronidazole for people who are allergic to penicillin . Such a therapy has revolutionized the

treatment of peptic ulcers and has made a cure to the disease possible . Previously , the only option was symptom control using antacids , H2 @-@ antagonists or proton pump inhibitors alone .

An increasing number of infected individuals are found to harbor antibiotic @-@ resistant bacteria . This results in initial treatment failure and requires additional rounds of antibiotic therapy or alternative strategies , such as a quadruple therapy , which adds a bismuth colloid , such as bismuth subsalicylate . For the treatment of clarithromycin @-@ resistant strains of H. pylori , the use of levofloxacin as part of the therapy has been suggested .

Ingesting lactic acid bacteria exerts a suppressive effect on H. pylori infection in both animals and humans , and supplementing with Lactobacillus- and Bifidobacterium @-@ containing yogurt improved the rates of eradication of H. pylori in humans . Symbiotic butyrate @-@ producing bacteria which are normally present in the intestine are sometimes used as probiotics to help suppress H. pylori infections as an adjunct to antibiotic therapy . Butyrate itself is an antimicrobial which destroys the cell envelope of H. pylori by inducing regulatory T cell expression (specifically , FOXP3) and synthesis of an antimicrobial peptide called LL @-@ 37 , which arises through its action as a histone deacetylase inhibitor .

The substance sulforaphane , which occurs in broccoli and cauliflower , has been proposed as a treatment . Periodontal therapy or scaling and root planing has also been suggested as an additional treatment .

= = Prognosis = =

H. pylori colonizes the stomach and induces chronic gastritis , a long @-@ lasting inflammation of the stomach . The bacterium persists in the stomach for decades in most people . Most individuals infected by H. pylori will never experience clinical symptoms despite having chronic gastritis . About 10 ? 20 % of those colonized by H. pylori will ultimately develop gastric and duodenal ulcers . H. pylori infection is also associated with a 1 ? 2 % lifetime risk of stomach cancer and a less than 1 % risk of gastric MALT lymphoma .

In the absence of treatment , H. pylori infection ? once established in its gastric niche ? is widely believed to persist for life . In the elderly , however , infection likely can disappear as the stomach 's mucosa becomes increasingly atrophic and inhospitable to colonization . The proportion of acute infections that persist is not known , but several studies that followed the natural history in populations have reported apparent spontaneous elimination .

Mounting evidence suggests H. pylori has an important role in protection from some diseases . The incidence of acid reflux disease , Barrett 's esophagus , and esophageal cancer have been rising dramatically at the same time as H. pylori 's presence decreases . In 1996 , Martin J. Blaser advanced the hypothesis that H. pylori has a beneficial effect : by regulating the acidity of the stomach contents . The hypothesis is not universally accepted as several randomized controlled trials failed to demonstrate worsening of acid reflux disease symptoms following eradication of H. pylori . Nevertheless , Blaser has reasserted his view that H. pylori is a member of the normal flora of the stomach . He postulates that the changes in gastric physiology caused by the loss of H. pylori account for the recent increase in incidence of several diseases , including type 2 diabetes , obesity , and asthma . His group has recently shown that H. pylori colonization is associated with a lower incidence of childhood asthma .

= = Epidemiology = =

At least half the world 's population is infected by the bacterium , making it the most widespread infection in the world . Actual infection rates vary from nation to nation ; the developing world has much higher infection rates than the West (Western Europe , North America , Australasia) , where rates are estimated to be around 25 % . The age at which this bacterium is acquired seems to influence the possible pathologic outcome of the infection ; people infected with it at an early age are likely to develop more intense inflammation that may be followed by atrophic gastritis with a higher subsequent risk of gastric ulcer , gastric cancer , or both . Acquisition at an older age brings

different gastric changes more likely to lead to duodenal ulcer . Infections are usually acquired in early childhood in all countries . However , the infection rate of children in developing nations is higher than in industrialized nations , probably due to poor sanitary conditions , perhaps combined with lower antibiotics usage for unrelated pathologies . In developed nations , it is currently uncommon to find infected children , but the percentage of infected people increases with age , with about 50 % infected for those over the age of 60 compared with around 10 % between 18 and 30 years . The higher prevalence among the elderly reflects higher infection rates in the past when the individuals were children rather than more recent infection at a later age of the individual . In the United States , prevalence appears to be higher in African @-@ American and Hispanic populations , most likely due to socioeconomic factors . The lower rate of infection in the West is largely attributed to higher hygiene standards and widespread use of antibiotics . Despite high rates of infection in certain areas of the world , the overall frequency of H. pylori infection is declining . However , antibiotic resistance is appearing in H. pylori ; many metronidazole- and clarithromycin @-@ resistant strains are found in most parts of the world .

H. pylori is contagious , although the exact route of transmission is not known . Person @-@ to @-@ person transmission by either the oral @-@ oral or fecal @-@ oral route is most likely . Consistent with these transmission routes , the bacteria have been isolated from feces , saliva , and dental plaque of some infected people . Findings suggest H. pylori is more easily transmitted by gastric mucus than saliva . Transmission occurs mainly within families in developed nations , yet can also be acquired from the community in developing countries . H. pylori may also be transmitted orally by means of fecal matter through the ingestion of waste @-@ tainted water , so a hygienic environment could help decrease the risk of H. pylori infection .

= = Evolution = =

H. pylori migrated out of Africa along with its human host circa 60 @,@ 000 years ago . Its subsequent evolution created seven prototypes ? Europe (isolated from Europe , the Middle East , India , and Iran) , NE Africa (from northeast Africa) , Africa1 (from countries in Western Africa and South Africa) , Africa2 (from South Africa) , Asia2 (from Northern India and among isolates from Bangladesh , Thailand , and Malaysia) , Sahul (from Australian Aboriginals and Papua New Guineans) and East Asia with the subpopulations E Asia (from East Asians) , Maori (from Taiwanese Aboriginals , Melanesians and Polynesians) and Amerind (Native Americans) . The precursors of these prototypes have been named ancestral Europe1 , ancestral Europe2 , ancestral East Asia , ancestral Africa1 , ancestral Africa2 , and ancestral Sahul . These ancestral prototypes appear to have originated in Africa and Central and East Asia . European and African strains were introduced into the Americas along with its colonisation ? both thousands of years ago and more recently in the slave trade .

Recent research states that genetic diversity in H. pylori , like that of its host , decreases with geographic distance from East Africa . Using the genetic diversity data , researchers have created simulations that indicate the bacteria seem to have spread from East Africa around 58 @,@ 000 years ago . Their results indicate modern humans were already infected by H. pylori before their migrations out of Africa , and it has remained associated with human hosts since that time .

= = History = =

H. pylori was first discovered in the stomachs of patients with gastritis and ulcers in 1982 by Drs. Barry Marshall and Robin Warren of Perth , Australia . At the time , the conventional thinking was that no bacterium could live in the acid environment of the human stomach . In recognition of their discovery , Marshall and Warren were awarded the 2005 Nobel Prize in Physiology or Medicine .

Before the research of Marshall and Warren , German scientists found spiral @-@ shaped bacteria in the lining of the human stomach in 1875 , but they were unable to culture them , and the results were eventually forgotten . The Italian researcher Giulio Bizzozero described similarly shaped bacteria living in the acidic environment of the stomach of dogs in 1893 . Professor Walery Jaworski

of the Jagiellonian University in Kraków investigated sediments of gastric washings obtained by lavage from humans in 1899 . Among some rod @-@ like bacteria , he also found bacteria with a characteristic spiral shape , which he called Vibrio rugula . He was the first to suggest a possible role of this organism in the pathogenesis of gastric diseases . His work was included in the Handbook of Gastric Diseases , but it had little impact , as it was written in Polish . Several small studies conducted in the early 20th century demonstrated the presence of curved rods in the stomachs of many people with peptic ulcers and stomach cancers . Interest in the bacteria waned , however , when an American study published in 1954 failed to observe the bacteria in 1180 stomach biopsies .

Interest in understanding the role of bacteria in stomach diseases was rekindled in the 1970s , with the visualization of bacteria in the stomachs of people with gastric ulcers . The bacteria had also been observed in 1979 , by Robin Warren , who researched it further with Barry Marshall from 1981 . After unsuccessful attempts at culturing the bacteria from the stomach , they finally succeeded in visualizing colonies in 1982 , when they unintentionally left their Petri dishes incubating for five days over the Easter weekend . In their original paper , Warren and Marshall contended that most stomach ulcers and gastritis were caused by bacterial infection and not by stress or spicy food , as had been assumed before .

Some skepticism was expressed initially , but within a few years multiple research groups had verified the association of H. pylori with gastritis and , to a lesser extent , ulcers . To demonstrate H. pylori caused gastritis and was not merely a bystander , Marshall drank a beaker of H. pylori culture . He became ill with nausea and vomiting several days later . An endoscopy 10 days after inoculation revealed signs of gastritis and the presence of H. pylori . These results suggested H. pylori was the causative agent . Marshall and Warren went on to demonstrate antibiotics are effective in the treatment of many cases of gastritis . In 1987 , the Sydney gastroenterologist Thomas Borody invented the first triple therapy for the treatment of duodenal ulcers . In 1994 , the National Institutes of Health stated most recurrent duodenal and gastric ulcers were caused by H. pylori , and recommended antibiotics be included in the treatment regimen .

The bacterium was initially named Campylobacter pyloridis , then renamed C. pylori (pylori being the genitive of pylorus , the circular opening leading from the stomach into the duodenum , from the Ancient Greek word ??????? , which means gatekeeper .) . When 16S ribosomal RNA gene sequencing and other research showed in 1989 that the bacterium did not belong in the genus Campylobacter , it was placed in its own genus , Helicobacter from the ancient Greek h?lix / ???? " spiral " or " coil " .

In October 1987 , a group of experts met in Copenhagen to found the European Helicobacter Study Group (EHSG) , an international multidisciplinary research group and the only institution focused on H. pylori . The Group is involved with the Annual International Workshop on Helicobacter and Related Bacteria , the Maastricht Consensus Reports (European Consensus on the management of H. pylori) , and other educational and research projects , including two international long @-@ term projects :

European Registry on H. pylori Management (Hp @-@ EuReg) ? a database systematically registering the routine clinical practice of European gastroenterologists

Optimal H. pylori management in primary care (OptiCare) ? a long @-@ term educational project aiming to disseminate the evidence based recommendations of the Maastricht IV Consensus to primary care physicians in Europe , funded by an educational grant from United European Gastroenterology