

New Evidence

Linking Water to Stomach Ulcers:

An Update on *Helicobacter pylori*

By Kelly A. Reynolds, Ph.D.



SOURCE: Helicobacter Foundation

H*elicobacter pylori* (*H. pylori*) is a spiral shaped bacterium that makes its home in the gastric mucus layer, or the cell lining, of the human stomach. As the bacteria colonize the stomach, the lining is weakened and vulnerable to irritation from natural stomach acids. The result—an ulcer.

H. pylori causes about nine out of 10 duodenal ulcers, and more than eight of 10 gastric ulcers. A clear link has been established associating long-term infection with *H. pylori* to the development of gastric cancer, the second most common cancer worldwide. Such cancer is especially prevalent in Colombia and China where *H. pylori* is found to infect over half of the population in early childhood.

Prior to the discovery in 1982 by two Australian physicians, Robin Warren and Barry Marshall, that *H. pylori* was linked to ulcers, the disease was thought to be caused by stress or even spicy foods. It wasn't until 1994 that the medical community acknowledged the strong association between the bacterium and ulcer disease. In 1995, only 5 percent of ulcer patients were receiving antibiotic therapy. The first antibiotics for *H. pylori* treatment were approved by the U.S. Food and Drug Administration (FDA) in 1996. The next year, the Centers for Disease Control and Prevention (CDC) launched a nationwide campaign

educating the public that ulcers are a curable infection.¹

Populations at risk

Approximately two-thirds of the world's population is infected with *H. pylori*. An estimated 2.5 million new *H. pylori* infections occur each year in the United States. Associated costs for peptic ulcer disease—affecting nearly 5 million people—exceeds \$4 billion for treatment alone. Approximately 16,000 people die annually from the affliction.

In countries with poor sanitation, 90 percent of the adult population are infected with *H. pylori*. About 30-to-60 percent of the people in the United States, Europe and Australia harbor *H. pylori* in their stomachs. Certain factors are known to predispose populations to increased *H. pylori* infections. In the United States, *H. pylori* is more prevalent among older adults, African Americans, Hispanics and lower socioeconomic groups. In underdeveloped areas, infections are more commonly found in children whose mothers and/or older siblings were infected. Children attending nursery school were also more likely to become infected. *H. pylori* is primarily acquired in infancy (under 2 years of age).

Most infections of *H. pylori* are chronic and asymptomatic, with an estimated one in six actually developing ulcers. Symptoms range from

nausea and vomiting to bloating and abdominal pain. Diagnosis of the infection is achieved by a blood antibody test, urease breath test or gastrointestinal endoscopy and biopsy. Although controversial, other implications of *H. pylori* infections have been suggested including a potential cause for skin rashes, SIDS (sudden infant death syndrome) and reactive arthritis.

While five *H. pylori* treatment regimens have been approved by the FDA, certain strains of the organism have developed resistance to one or more antibiotic treatments. One study showed that as many as 42 percent of patients with *H. pylori* infections didn't respond to at least one of the recommended antibiotic treatments.² The highest treatment success rates (70-to-90 percent cured) have been found from a combined three-drug regimen.

Evidence of waterborne route

Researchers have looked for *H. pylori* in tap and well water, cow feces, flies and field soil samples in Japan, where the incidence of infection was high. All sample categories were found to harbor the bacterium. Although the organism appears to be nearly ubiquitous in natural environments, the primary transmission route has yet to be determined. Also a mystery is why some infections manifest as clinical symptoms, while others go unnoticed.

The bacteria are most likely spread via person-to-person either through the fecal-oral or oral-oral routes. Successful isolation of *H. pylori* from stools of infected people is evidence of a likely fecal-oral route, where contaminated food and water are suspected reservoirs. Increased prevalence of infection has been associated with consumption of food from street vendors, suggesting that improperly prepared foods may play a role in transmission of *H. pylori* infections. In addition, *H. pylori* has been found in more than 75 percent of tested surface water samples, indicating that the organism is pervasive in drinking water sources.

In May 1999, at the 99th meeting of the American Society for Microbiology in Chicago, a research team from Penn State Harrisburg, lead by Dr. Katherine H. Baker, presented the first direct link found between bacteria in drinking water and stomach ulcers.³ Interviews with residents that drank water from private, untreated well supplies revealed there was a significant correlation between presence of *H. pylori* and cases of stomach ulcers.

Once in the stomach, *H. pylori* may also be transmitted to the mouth via reflux action where a portion of the stomach's contents is forced up the esophagus. The organism has also been isolated from dental plaque of 30 percent of people with gastric infection.

Monitoring difficulties

Methods for direct culture detection of *H. pylori* haven't been fully developed. Part of the difficulty in detecting this pathogen is that changes in cell morphology, metabolism and growth patterns occur when the organism is exposed to different environmental stimuli, including the condition of viable but non-culturable organisms. This phenomenon has been described in association with other bacteria such as *Vibrio cholerae*, the agent that causes

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For more information on *Helicobacter pylori*, visit the **National Foundation on Infectious Diseases** website: <http://www.nfid.org/library/recommended/helicobacter.html>

Following are other related sites of interest:

The Helicobacter Foundation

www.helico.com/

Canadian Helicobacter pylori Susceptibility Study 2000

www.helicobactercanada.com/

Virtual Hospital

www.vh.org/providers/teachingfiles/GIAtlas/pages/2-Stomach/GastritisHPIImages.html

cholera. Viable but non-culturable organisms are particularly worrisome because they're capable of eluding conventional culture analysis, falsely indicating safe water. Non-cultural methods of detection may be used such as microscopy or molecular methodologies, but these are often limited by interfering compounds and small equivalent volumes. In addition, they don't determine if the organism is viable, and thus a threat to humans. *H. pylori* is known to survive in tap water for up to four days; however, the viable but non-culturable form may survive nearly twice as long.

The water industry has relied on bacterial indicators—coliform bacteria—to evaluate the safety of source waters for decades. Unfortunately, *H. pylori* is commonly found in waters where coliform indicators were absent. The high prevalence of *H. pylori* in the limited number of monitoring efforts to date indicate an urgent need for the development of rapid, specific and reliable detection methods in order to evaluate the potential impact of the waterborne role in *H. pylori* infections.

A need for water treatment

The good news is that *H. pylori* is sensitive to conventional methods of

water treatment (i.e., chlorination) and thus isn't thought to be a problem with properly treated water supplies.⁴ Yet, studies using ultraviolet light or ozone aren't in great abundance. In addition, proper antibiotic treatment can completely eradicate the organism, with little chance of its reoccurrence. Treatment of asymptomatic patients with *H. pylori* infections isn't warranted unless there's a history of gastric cancer or chronic *H. pylori* infections in the family. Preventative programs of vaccination in early childhood may be available in the future.

Conclusion

Since the source of *H. pylori* is still under investigation, the CDC recommends that people continue to practice methods of good hygiene by washing hands frequently and thoroughly, eating food that has been properly prepared and drinking water from a safe, clean source. Stomach cancer in the United States is now one-fourth as common as it was in 1930. Improved sanitation and water treatments are thought to be the main reasons for the reduction.

References

1. Centers for Disease Control and Prevention (CDC), "Fact Sheet on *Helicobacter pylori*," 2000: www.cdc.gov/ncdod/dbmd/md.htm
2. Mendonca, S., et al., 2000, "Prevalence of *Helicobacter pylori* resistance to metronidazole, clarithromycin, amoxicillin, tetracycline, and furazolidone in Brazil," [In Process Citation], 5:79-83, 2000.
3. Baker, K., "Researchers find link between contaminated water and stomach ulcers," 99th General Meeting of the American Society for Microbiology, Session 241, Paper Q319, Chicago, May 30- June 3, 1999.
4. Johnson, C.H. et al., 1997. "Inactivation of *Helicobacter pylori* by chlorination," *Applied Environmental Microbiology*, 63:4969-4970.

About the author

◆ Dr. Kelly A. Reynolds is a research scientist and microbiologist at the University of Arizona with a focus on the development of methods for detecting human pathogens in drinking water. She also has been a member of the WC&P Technical Review Committee since 1997.