

Virus or Bacteria... which needs the iron?

"Some people with iron overload have the misconception that a virus spreads in the presence of iron. Though some therapies used to treat viral infections such as viral hepatitis B or C are improved when body iron is lowered, the virus itself is not presently known to proliferate as a result of excess body iron."

**E.D. Weinberg, Ph.D. Professor, Microbiology
Indiana University, Iron Disorders Institute
Scientific Advisory Board, Publications, Chair**

Bacteria and viruses are very different in structure and each has its own relationship with iron. When these invaders get into our body, often an infection is the consequence. Pathogens enter our body through the skin or mucous membranes. These membranes are located in the lining of the mouth, eyes, nasal passages, lungs, gastrointestinal tract, vagina, and urethra. If the immune system is challenged in any way, the body cannot defend itself against some of the invading organisms and symptoms such as fever, vomiting, diarrhea, headache, nausea, joint pain, heart problems and anemia can result.

Bacteria:

Every surface of the human body is host to some type of bacteria. Mostly these bacteria are friendly; they are called normal flora. Normal body flora is part of our defense system that keeps harmful bacteria under control. These friendly bacteria assist the immune system.

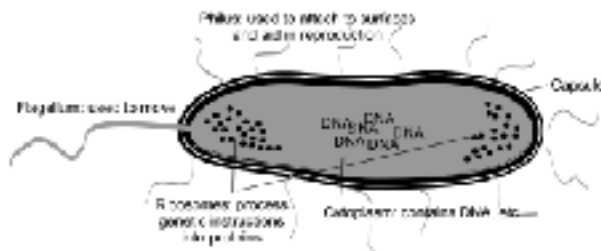
Bacteria are single cell organisms with a nucleus that is amorphous, meaning without specific shape. There are three different shapes of bacteria: spherical-round like a ball, spiral or rod shaped. Bacteria can divide, synthesize DNA and RNA, and they can adapt to hostile environments and grow resistant to antibiotics. Staphylococcus is one of the best illustrations of the ability of bacteria to adapt to antibiotics.

Disease producing bacteria can be transmitted sexually, by contaminated food or water, by insect bites, or by casual contact such as touching, kissing, drinking after or breathing air exhaled by an infected person. Harmful pathogens are able to infiltrate the body by attaching directly on the surface of cells of an organ or by secreting toxins, which can cause disease locally or systemically by getting into the bloodstream of the host.

Some virulent microorganisms can be harmful in one part of the body but not in other parts. To survive, regardless of where they are in the body, nearly all of these bacteria need iron and each obtains the metal in its own way. For example, the bacteria that causes tuberculosis can enter a macrophage, a cell that is intended to destroy the harmful germ.

Macrophages, a type of white blood cell, engulf old red blood cells so that the iron in the hemoglobin of these cells can be recycled. When the bacteria enters the macrophage, they ingest the iron, which insures their survival.

Other ways bacteria can get iron is from heme in hemoglobin or transferrin, an iron-transport protein found in the blood. Other bacteria can get iron directly from lacto-



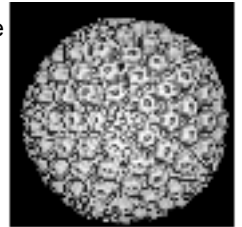
ferrin, a defense iron binding protein found in body fluids such as saliva, tears, breast-milk, vaginal and seminal (semen) secretions. Helicobacter is an example of a pathogen that can get iron from lactoferrin. Helicobacter (*H. pylori*) is the leading cause of stomach ulcers and stomach cancers. This pathogen can be present in a person for decades before symptoms are noticed. Often symptoms of *H. pylori* infection will be attributed to stress or diet.

Bacteria such as *Vibrio vulnificus* can enter the body by ingesting contaminated raw shellfish or walking barefoot over contaminated beaches. *V. vulnificus* can become highly virulent in an iron rich environment. Persons with excessive body iron who become infected with *V. vulnificus* can die within hours due of sepsis. Sepsis is the spread of an infection from its initial site to the bloodstream.

Viruses

Structurally, viruses are less complex than bacteria. Unlike bacteria, viruses do not require iron to survive or proliferate. Viruses hijack cells and inject their DNA or RNA into these cells. Then the virus uses the overtaken cells to reproduce. Once inside a cell, viruses alter DNA or RNA and here they are nurtured and multiply.

When enough virulent material has replicated within the cell, the cell bursts and the contents gets released into other tissues. Viruses are highly efficient at reproduction, but they cannot evolve or thrive without a specific host cell. For example, the Influenza virus can only proliferate in cells of the respiratory system. Herpes Simplex survives in tissues of the mouth.



Antibiotics, which work on bacterial infections, do not work on viral infections. Specific antiviral drugs are now available for many viral infections. Viruses are vulnerable outside the body if a surface has been disinfected with some product such as common household bleach. Some of the better known viruses include AIDS, viral Hepatitis A, B & C, Poliovirus and Rubella, which causes German Measles.

References:

- Weinberg, E.D. "Roles of metallic ions in host-parasite interactions." *Bacteriological Reviews* 30 (1966):1336-51.
- Weinberg, E.D. Iron and susceptibility to infectious disease. *Science* 184 (1974):952-6.
- Weinberg, E.D. "Patho-ecological implications of microbial acquisition of host iron." *Reviews in Medical Microbiology* 9 (1998):171-8.