Identifying the Enemy

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Abstract:

We are surrounded by tiny organisms all around us. To scientists, they are microorganisms, but the general public usually identifies them as “bugs.” To get a better idea of what they are capable of, we need to understand what these bugs are, and why they can be dangerous.

Main Article:

What you don’t see can hurt you. Invisible to the naked eye, a world of microorganisms (living things so small you need a microscope to see them) lives in soil, on your skin, in your mouth, on the floor, and on doorknobs, cell phones, walls, computer keyboards, or countertops — pretty much everywhere.

Not all microorganisms are harmful, but a number of them can cause illness or even death — and waste no time multiplying exponentially, inside the human body or out. Controlling the growth of harmful microorganisms is vital to health and the prevention of infections. But before you can do that, you have to understand who your opponents are and how they get into your body.

Looking into the Basic Bugs

Some types of infectious microorganisms (also known as *germs, microbes, bugs,* or *pathogens*) are discussed in the following sections.

Bacteria

Bacteria are single-celled microorganisms that exist as independent (free-living) organisms or as *parasites* (dependent on another organism for life). You’d have to magnify a single *coccus* (round bacterium) 500 times to make it as large as the period at the end of this sentence.

Some bacteria are especially hardy, because they form *spores* (tough structures that protect their key parts). Bacterial spores can resist extremes of temperature and even chemical onslaught. You need a very potent disinfectant to penetrate the hard outer covering and kill spores.

Bacteria are most vulnerable during their *vegetative stage* (the period when they reproduce). However, as vegetative cells multiply in colonies, they begin to form a *biofilm* (protective slime), which requires active scrubbing or other disruption — not just chemical contact — to disperse.

C. diff (*Clostridium difficile*), MRSA (methicillin-resistant *Staphylococcus aureus*) and VRE (vancomycin-resistant *Enterococcus faecalis*) are just a few of the sometimes deadly antibiotic-resistant bacteria that can take up residency in a hospital patient who came in for a completely different reason.

Fungi

Fungi feed on organic matter and can be either single-celled or multicellular. Molds, mildews, yeasts, and mushrooms are common examples of fungi. Some fungi cause disease in humans. Different types of fungi include: mold on the shower curtain, airborne mold riding on dust particles, athlete's foot, and yeast infections.

Fungi can cause a life-threatening infection in an *immunocompromised* person (someone who has a weakened immune system) or in specific skin disorders.

Viruses

Even smaller than bacteria, ***viruses*** must borrow components from a host in order to live. Viruses may reproduce with errors or mutations. The ability to mutate is responsible for the ability of some viruses to change slightly in each infected person, making treatment more difficult.

During the 1980s and early 1990s, HIV (Human Immunodeficiency Virus), HBV (Hepatitis B Virus), and HCV (Hepatitis C Virus) emerged and remain a life-threatening global issue.

Noroviruses (viruses that cause the stomach flu or gastroenteritis and are common in cruise ships, schools, and other public places) and *rhinoviruses* (causing the common cold) are also common viral threats.

Mapping the Routes to Infection

Your risk of infection depends on many factors, including your own resistance and degree of exposure. A single microorganism doesn't have much chance of making you sick; overcoming your body's defenses usually requires a team of bugs, and those bugs fare better if they can survive outside a *host* (a live carrier for a disease-causing germ) long enough to get into *your* body.

For a pathogenic bug to make you its potential victim, it needs to find a way into your body. The following sections show you how microorganisms can get inside you.

The chain of infection consists of three parts:

1. The source
2. Means of transmission
3. A susceptible host in the right environment

Person to person

People can infect one another, as you've likely noticed with the common cold.

The common cold, flu, bronchitis, pneumonia, tuberculosis, and measles are all carried in the droplets of an infected person's cough or sneeze. Any time you inhale near persons having these kinds of illnesses, you may be bringing pathogens into your body. People can also transmit some infections when they touch each other and then their nose, mouth, or other mucous membrane, or by eating food that has been touched by germy hands.

Extreme example: Typhoid Mary was a real woman carrying typhoid fever (but without symptoms herself), spreading it

to many people during the course of her career as a cook. Three of them died.

Object to person

You can also get sick by touching a germy object (known in healthcare lingo as a *fomite*) then your nose or mouth or other mucous membrane. Studies have shown that, on average, we touch our nose, mouth or eyes 18-30 times an hour and that brief touch could be introducing pathogenic organisms picked up by our hands.

Borne on blood

Bloodborne pathogens (harmful bugs transmitted by blood) can enter people by the following ways:

- Through breaks in the skin, such as open wounds or sores
- Via injection with a needle or other instrument that can cut or break the skin
- Through contact with mucous membranes (that is, eyes, nose, or mouth)
- By sexual intercourse

Borne on air

Bacteria and viruses also take flight and ride on dust particles that can be inhaled. Mold spores, such as those of *Aspergillus* (causing Aspergillosis, a disease of the respiratory tract) can also be inhaled. Just being in the proximity of a person with measles, mumps, tuberculosis or whooping cough places you at risk of infection.

Via insect or animal

Microorganisms hitch a ride on or live inside insects and animals. Mosquitoes may carry malaria, West Nile Virus, and other diseases. Fleas may carry bubonic plague (though, generally, you must be bitten by them to catch illnesses from mosquitoes or fleas). Houseflies may carry 100 or more pathogens — including anthrax, *Salmonella, Staphylococcus, E. coli,* and *Shigella* — as they flit from contaminated to clean surfaces, leaving pathogens every time they land.

Rats were the vehicles of fleas that carried the bubonic plague (Black Death), which killed tens of millions of people in China and Europe in the four-year period from 1347 to 1351. Poultry and migratory birds carry bacteria and viruses capable of infecting other birds, animals, or humans. In the United States during a six month period from December 2014 to June 2015, poultry farmer’s lost 50 million chickens and turkeys that died or had to be destroyed.