SOARING Rx

BY DR. DANIEL L. JOHNSON

Avoiding Infections

If thou wilt diligently hearken
to the voice of the LORD thy God,
and wilt do that which is right in his sight,
and wilt give ear to his commandments,
and keep all his statutes,
I will put none of these diseases upon thee,
which I have brought upon the Egyptians:
for I am the LORD that healeth thee.
Exodus 15:26

Despite the quote above, today's essay is about infection, not theology. Infections are more or less disabling, hindering our most important activities, flying, work, and social interaction.

Here's the bottom line: *Wash your hands before you pick your nose; cough into your sleeve, not your hand.*

Three millennia ago, Torah (law), enscribed by Moses, contained effective techniques for avoiding and limiting infectious disease. It's thought-provoking that God gave the rules without explaining the pathophysiology, and that it was about three millennia before the human race discovered the mechanisms of infectious disease on its own. However, this column is not about theology, so we will let that thought go. Anyway, neither the microscope nor microbiology had been invented, so an explanation would have increased the confusion.

The discovery of micro-organisms was merely about 150 years ago, and so it's only since then that understanding their role in disease has developed. Before that, the intellectual leaders of my medical profession hotly denied the existence of contagion, a myth believed by the unwashed masses.

Meanwhile, Jews, and, later, Christians, have misunderstood these instructions to be a guide to spiritual purity, when, in reality, they are a guide to health. Wash your hands before you eat? *Intestinal infection.* Don't eat pork? *Trichinosis.* Bury your excrement? *Dysentery.* No sex during menstruation? *Pelvic infection.* Monogamy? *Venereal diseases.* Send the rashy person ("leprosy") outside the encampment? *Quarantine.* Treat body fluids as "unclean?" *Universal precautions.*

In addition, it's been known for a more than 50 years that male circumcision greatly decreases the risk of cervical cancer in women. Cervical cancer is an infectious disease, caused by certain strains of the venereal wart virus. And more recently, male circumcision has been shown to decrease HIV transmission so greatly that adult circumcision campaigns are undertaken in endemic areas.

Infections are very common, though in our society, most infections are merely annoying. Still, dangerous infections are not rare, and even the merely annoying ones can disable us from flying for a short time.

Because our goal is to get into the cockpit as a safe and healthy pilot, and because we have just had The Great Holiday Germ Exchange, we will assume that you are at least temporarily interested in how to avoid infectious illness, or how not to give it to others. This is relevant to flying because every pilot lives in a world full of germs – some friendly, some hostile – and because in clubs, at contests, and at conventions, our normal social activity spreads infection.

For that matter, our enculturated handshaking behavior increases risk. An embrace is much safer than a handshake bacteriologically, never mind that it might disclose that concealed weapon.

What are the ways in which we get (or give!) infections?

Sources of infections.

Self. Our skin is covered with bacteria; our colon is filled with bacteria. Mouth, nose, and vagina contain live cultures of bacteria that are part of our defense against disease. But inside, we are sterile. Our lungs, bladder, sinuses, and tissues are pristine, kept that way by interesting and complex defense mechanisms.

If these flexible, living and dynamic barriers are breached by the bacteria living upon us, our immune defenses must work harder, and sometimes fail. This failure we call "infection."

With surgery, the greatest risk of infection is of bringing the patient's own bacteria in through the incision, for the surgical crew can be swaddled in sterile coverings, but the bacteria nestled in the skin's crevices are hard to kill.

However, in general, these self-infections are not transmitted to others. They have their own bacteria, with whom they have worked out a truce, as long as barriers are not breached. Within families, these bacteria are shared, especially with the mom, and also with the dog and cat.

From Others ("contagion")

Most of our infections are acquired from other people, in three ways:

- We *touch* other people (shaking hands, kissing, sex)
- We *inhale* their airspace (sneezing, coughing, spitting)
- We touch things they've touched – *fomites.* (Disease-germ-bearing objects, pronounced FOE-mites in the USA. "Touching" includes sharing needles, doorknobs, playing cards, money, buffet spoons.)

Infectious organisms are in whatever secretions or exudates a disease produces. In Torah, *if any man hath a running issue, he is unclean until the even.* And everything he touches or sits on is unclean, as is everyone who touches any of those things. This is the way *contact transmission* works. And he, and his clothing, and everything he has touched, must be washed in flowing water. If you're sick, do your laundry.

In general, drying and exposure to atmospheric oxygen kills most micro-organisms overnight, especially if visible contamination is washed away; and direct sunlight sterilizes surfaces quickly, one reason to have an outdoor clothesline.

Even with respiratory infections that can be transmitted through the air with a cough or sneeze, touching objects with soiled hands is more important than breathing. The British have thoroughly studied the transmission of the common

cold. Their standard regime is to have a person with a good wet cold play cards with three uninfected persons. Wiping the nose with a bare hand transmits the cold via the cards about 80% of the time. Hand-washing reduces this below10%.

Please don't cover your cough with your hand!! Every hand you shake, every doorknob you touch, every bill you hand the cashier, every serving spoon in the cafeteria, then becomes an agent of infection. After you are done in the public restroom open the door with the towel before tossing it (there should be a waste can at the door).

In Torah, everything that has become unclean, and the person, and his clothing, was to be *washed* with *flowing* water. Washing dislodges adherent micro-organisms from surfaces, and removes contaminated secretions. Using flowing water ensures that the organisms are taken away.

Today, we have two tools that enhance water's effect. *Soap* allows water to remove grease and oil and improves the release of adherent micro-organisms. *Disinfectants* actively kill or denature them. These are active against bacteria and fungi, but *not* viruses.

Alcohol kills bacteria as it dries. When you use alcohol-based cleaners on your hands, it's important to let it dry. Wave your hands around a bit. Ethanol or isopropyl alcohol generally denatures viruses in about 10 seconds. Other organisms require up to several minutes of direct alcohol exposure; about five minutes for fungi.

Triclosan, available for fifty years, kills bacteria and fungi directly. It was first available in SafeGuard bar soap in 1964, and today is in far too many things, including cosmetics and toys. Bacterial resistance is occurring, and it's damaging the ecology of streams.

Iodine, now usually available as *iodophors*, kills bacteria directly. Dilute solutions are more effective than concentrated ones. These are unpopular because they irritate skin and stain clothing.

Chlorhexidine and related disinfectants generally act more slowly but more thoroughly.

It's harder to disinfect viruses than bacteria. A 1:250 solution of chlorine bleach is satisfactory, and commercial virucidal solutions are available (search for "virucidal disinfectant," and for a technical discussion, download the Centers for Disease Control guide to disinfectants in hospitals (pdf) http://tinyurl.com/on23asw).

In general, with healthy people, outside of hospitals, soap and water is enough. This greatly reduces contamination, and is sufficient except for dangerous diseases and prolonged contact with the ill. Excessive use of soap removes essential skin oils. Moisturizing creams compensate for this loss.

Gastrointestinal diseases – cholera, dysentery, and gastroenteritis – are transmitted by hands as well, for the obvious reason of the paperwork that is needed after the job is done.

In this regard, public sanitary sewers and sewage treatment, and public water supplies and purification have done more to save lives and increase health

than all the doctors and hospitals that have ever existed. In modern history, this began in 19th-century Britain, decades before the discovery of micro-organisms. That's a history worth reading. Sanitary engineering is far more important to each of us, and much more challenging, than people realize.

Animals as a source of infection.

Infections gotten directly from animals, in the West, are chiefly arthropod borne, mainly ticks, flies, and mosquitoes. Direct contact with animals is thought to be the origin of many human infectious diseases, based on genomic analysis. For example, HIV is believed to likely have crossed to humans about a hundred years ago, possibly in a bloody encounter between a chimpanzee and a hunter. Influenza was probably also acquired from animals initially, and animals remain an important reservoir for it.

The Torah prohibits eating types of animals from which, as we've discovered through modern science, disease might be acquired by doing so. In the day, this was most prominently trichinosis, a disease of muscle from eating pork. Our food laws effectively forbid practices that permit this and other such infections.

Flies transmit disease by walking around on infected surfaces and then on our food. They chiefly transmit gastrointestinal infections, doing so when untreated excrement is in the open. The Torah commanded everyone to have a spade in their kit, and to bury "what came forth." If you can't get rid of flies, get rid of their sidewalk.

In biting us, mosquitoes may transmit diseases like malaria and dengue fever, which remain problems in tropical and semitropical areas. West Nile virus has been a growing problem in the USA during the past decade.

One of the most troublesome diseases in the U.S. is tick-borne disease. We were slow to discover Lyme disease, about 40 years ago, and it, and other tick-borne diseases, are spreading steadily, geographically. Partly because it's new and partly because it's subtle at first – and partly because the tick painlessly exchanges fluids overnight, usually in a dark hidden place, and drops off surreptitiously when it's done. Thus, it's often not recognized until it has reached a chronic phase, when it can be very debilitating. Lyme disease is the best-known tick-borne disease. It's possible to have more than one such infection simultaneously. It's also possible to get Lyme disease more than once, as I have.

In general, bacteria and viruses have surface proteins that are specifically matched to particular proteins on hosts. Thus most infections are species-specific. In fact, viruses tend to specifically attach to particular types of tissues: wart virus the skin, cold viruses the nose and upper respiratory tissues, enteroviruses the intestines.

Most infectious organisms are also species-specific. The *zoonoses* are human infections acquired from animals, where there's a reservoir in the animals, and the organism happens to cross a species

barrier. Influenza, HIV, rabies, Lyme disease, plague, toxoplasmosis, and many others are zoonotic. When Torah says not to have sex with animals, it is zoonoses that are being prevented.

Summary

Let's review the guidance. To avoid acquiring an infection:

- Wash your hands before you pick your nose or rub your eyes.
- Use alcohol-based cleanser after going through the cafeteria line.
- Wash your hands for more than 15 seconds, with soap, after using the toilet.
- Let the guy open the door for you (then hand him an antiseptic towelette).
- Do a tick check at bedtime.
- Point the vent above your aircraft seat to wash the breeze over you. This is the purest public air on the planet.

To avoid giving an infection:

- Wear a mask when you're coughing or sneezing. Better yet, stay out of public.
- Or, at least use your sleeve or shirt, not your hands.
- With gastrointestinal illness, please wash your hands, with soap, for a ***minimum*** of **15 seconds.**

This is a lot longer than it seems. Watch others in the restroom for two things: whether they wash, and how long they wash. It's a sobering exercise, especially at a medical meeting, where we ought to know better.

Remember, if you have any increased fluids coming out of yourself, the dried remnants of these fluids remain infectious for at least hours. If you *must* wipe your nose with your bare hand, you *will* contaminate any surface you touch, including the pen you loan to the pen-less person next to you.

If you cough or sneeze, you are spraying virus to every on in the room; if you cover your cough with your bare hand, you'll give the infection to the person who next touches the doorknob or shakes hands with you (etc.). (This is the reason I always politely open the exam-room door for my patient. Well, and for courtesy, too.)

Acknowledgements

Thanks to John Thavis and Ingrid Nelson for corrections of drafts.

Related readings on infectious disease.

Leviticus. Moses.

The first effective, systematic rules for reducing contagion.

Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 8th Ed. J.E. Bennett, R. Dolin. Elsevier, 2014.

The standard medical textbook, in two volumes. Yours for about $400.

http://www.cdc.gov/ The Centers for Disease Control. Some information about infections, and particularly advice for travelers. The CDC website is rich, yet patronizing, with directives that are either too broad or too technical, lacking the "how it works" facets that let the reader understand how to adapt to special situations.

http://www.cdc.gov/hicpac/pubs.html The technical stuff for healthcare workers.

http://www.who.int/en/ The World Health Organization. Similar structure, but global scope.

Interesting reading for your winter enjoyment

There are many, many interesting books on infectious disease. Here are a few:

The Cry and the Covenant. Morten Thompson. Buccaneer Books, Cutchogue, New York, 1949.

A wonderfully told historical novel about Ignaz Semmelweis, the perspicacious Hungarian obstetrician who realized before bacteria were discovered that childbed fever, which killed almost all the mothers who gave birth in hospital, was carried in on the hands of the doctors, from the corpses of those who had died, to the wombs of those giving birth. He was driven to his death by the vicious opposition of doctors.

Plagues and Peoples. William H. McNeill, Anchor Books, 1977, 1989, 1998.

A classic.

Epidemics and History: Disease, Power and Imperialism. Sheldon Watts, Redwood Books, 1997.

Epidemics and Pandemics: Their Impacts on Human History. Jo Hays, ABC-CLIO, 2005.

Spillover: Animal Infections and the Next Human Pandemic. David Quammen, W.W. Norton, 2012.

Angel of Death: The Story of Smallpox. Gareth Williams, Macmillan, 2010.

Captain of Death: The Story of Tuberculosis. Thomas Daniel, MD, Boye, 1999.

Somewhat technical, by an infectious disease specialist.

The Great Influenza: The Story of the Deadliest Pandemic in History. John M. Barry, Penguin, 2004.

The Strange Case of the Broad Street Pump: John Snow and the Mystery of Cholera. Sandra Hempel, Granta, 2006.

The first epidemiologic study, and one of the most important to public health.

The Greatest Killer: Smallpox in History. Donald Hopkins, University of Chicago, 1983, 2002.

An encyclopedic history of this disease.