

Soap and Water & Common Sense

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The Definitive Guide to Viruses,
Bacteria, Parasites, and Disease

Dr. Bonnie Henry

 juggernaut

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In memory of Dr. Sheela Basrur,
my mentor, friend, and partner in public health.
You are deeply missed.

And for my mentor Perry Kendall

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INTRODUCTION TO THE NEW EDITION

IN JUNE 2003, at the midpoint of the SARS epidemic, I visited my sister, Dr. Bonnie Henry, on the eleventh floor of the public-health building in downtown Toronto, Canada, where she was leading the city's operational response under the direction of the extraordinary, empathetic, and impressive Dr. Sheela Basrur. Almost two decades later, I can still see in my mind's eye one particular scene: my sister leading me through a warren of cubicles and offices into a hushed, windowless boardroom, where we paused for a few minutes while she consulted urgently with colleagues. Left on my own for a moment, my eyes were drawn to the far wall, which featured a whiteboard bristling from end to end with Post-it Notes of various colours, connected by thin unbroken lines of black ink. As I stared at this strangely beautiful abstraction,

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its meaning slowly came into focus: this was the track of the awful disease itself, and these colours were the stages of its relentless progress within the web of people it had infected.

Today, in mid-March 2020, I sit in the sun (spring still proceeds; the cherry trees still blossom) at my sister's kitchen table in British Columbia, Canada, in the messy middle of a far more extensive worldwide pandemic whose full shape and range and effect we do not yet know — although we understand more every day and scramble to assimilate and disseminate life-saving scraps of knowledge before the unyielding calculus of the disease engulfs us. The memory of the rainbow of notes on that whiteboard haunts me, with its eerie combination of the abstract, precise, and mathematical with the fragile and personal. It occurs to me that we all exist, right now, somewhere as-yet undiscovered on that whiteboard — in the space between those poles of the coolly abstract and the shockingly personal. And we are dependent upon the few who can effectively articulate and traverse that space for us, with us, and hopefully one small step ahead of us.

Now, ten years after the publication of the first edition of *Soap and Water & Common Sense*, Dr. Bonnie Henry has emerged as one of the most influential, calm, and compassionate voices tracing the precipitous, dizzying curve of the COVID-19 pandemic in (at the time of this writing) almost-daily press conferences. I stole a few minutes from her nearly impossible schedule to ask her two questions for this updated edition of the book.

LYNN HENRY: Bonnie, in my lifetime and yours we have lived through AIDS, SARS, Ebola, and H1N1, to name but a few infectious diseases that have affected large populations. Yet today we seem to be dealing with something that has no precedent

in living memory, at least where pandemics are concerned. Do you think the COVID-19 pandemic is different and, if so, why and how?

DR. BONNIE HENRY: Well, as you know, I have been studying the transmission of disease nationally and internationally for decades. I've sat on many, many public-health committees in Canada and worldwide and attended countless conferences and gatherings. I've participated in studying the modelling of infectious disease and in drafting numerous responses and plans for outbreaks. But I will be completely honest: I just never, ever, ever thought I would have to do what I am doing right now [declaring a state of emergency to deal with the COVID-19 pandemic in my home province of British Columbia].

Why is this different? Is it really different? Well, yes and no. COVID-19 is not dissimilar to AIDS and Ebola in terms of the fear it generates, although I would suggest that the sense of fear for one's personal physical health around both of those diseases was perhaps greater — especially among those who contracted either of them, and in their early stages. AIDS was, for a time, equivalent to a death sentence. And of course, that fact generated other terrible and destructive fears beyond the physical. The same was, and is, true in a somewhat different fashion with Ebola. But the difference between those two diseases and COVID-19 has to do with the means of transmission: this new coronavirus spreads through droplets in the air, which makes it a far greater unknown and instills in us a sense that we have no individual control over whether or not we come in contact with it. We cannot see its pathway with the naked eye, and the behavioural controls we can exercise involve not just us, but our entire communities (as we are seeing in the

lockdowns of countries at this moment and the practice of so-called social distancing). To know that we can get sick simply by the basic, necessary act of breathing itself — something that is true with COVID-19 but not with AIDS and Ebola — means that of course we are fearful.

When we look at SARS and influenza, we see that in one way COVID-19 is not so different. Those diseases, too, can spread through droplets in the air. But COVID-19 has that perfect storm of qualities: it is far more infectious than SARS, and it is more lethal than influenza. Add to this the fact that we have never before been more physically connected than we are now, with far greater global community interaction, and we arrive at the very moment we are living through.

LYNN HENRY: It has been ten years since the original publication of *Soap and Water & Common Sense*. We know that there have been advances in certain diseases since 2009, so of course some of the information has changed a bit, and that there have been setbacks in some areas and with some diseases, too — an alarming rise in TB in some places, for example. But is there anything you would change or add to the basic advice and public health tenets you cover in this book? I ask this being mindful especially of our current moment, when people worldwide are isolating to try to “flatten the curve” of the new pandemic.

DR. BONNIE HENRY: Perhaps it seems a little odd to say, but William Osler’s words from more than a century ago remain true and are, if anything, more relevant than ever: “Soap and water and common sense are the best disinfectants.” I would perhaps expand or amend the basic rules just a little, to say:

- Clean your hands (whether with soap and water, or with alcohol-based hand rubs).
- Cover your mouth when you cough (preferably not with your hand; use your elbow or a tissue instead).
- Avoid touching your face, especially your mouth, nose, and eyes.
- Stay at home and away from others when you are sick.
- And during this time of community disease transmission, rigorously practice social distancing (staying at least two metres away from other people).

I would also add one further life-enhancing daily practice, something that we can all do, and that will undoubtedly save us in troubling times: let us all show kindness and awareness and compassion.

— Lynn Henry and Dr. Bonnie Henry, March 2020

“... what we learn in times of pestilence: that there
are more things to admire in men than to despise.”

— Albert Camus, *The Plague*

“If you can't explain it simply,
you don't understand it well enough.”

— Albert Einstein

MICROBES INC.



ONE

GOOD BUGS, BAD BUGS

THE DOCTOR QUICKLY scanned the chart as she opened the door to the examining room. It was a busy day, and the patient had been squeezed into her schedule. The new mom with the crying infant on her lap looked harried and tired. The baby had developed a fever overnight, was clearly irritable, and looked unwell. His mother had tried some medication to relieve the fever but was certain the child had developed another ear infection and needed antibiotics. Feeling the pressure of the crowded waiting room and knowing she was already at least a half-hour behind schedule, the doctor hesitated. Her instincts told her the baby had probably caught a virus and the symptoms would resolve on their own in a day or two. But the child's mother was insistent; she couldn't take another sleepless night of worry.

This dilemma is faced every day by doctors around the world. With our overburdened health-care systems, taking the time to reassure patients and explain why antibiotics won't work is difficult for many health professionals to do. It is far easier and takes less precious time to succumb to the demand for antibiotics. These powerful medications have been available for only a few decades, and they have earned their reputation as “miracle drugs” by saving people from infections that used to kill. But the fact that they are effective only against bacteria — not viruses — has been lost in the excitement. We now know that the overuse and misuse of these miracle drugs are having long-term effects on our precious medical defences and are putting our health at risk. If only people knew the difference.



EVERY DAY, THE media inundate us with medical stories covering everything from miracle drugs to superbugs. In addition, we are bombarded with aggressive advertising campaigns from drug companies that tout medications promising to cure whatever ails us. It's nearly impossible to separate fact from fiction. Understanding how we get sick and what causes those nasty infections can help.

This book will navigate you through the complex world of bugs — those that cause illness and also those that play a role in keeping us healthy. We will cover the myths and misconceptions your doctor doesn't always have time to explain, and we will explore why the fundamental differences between viruses, bacteria, fungi, and parasites are important to our health. We will demystify the complex world of drugs, and we will look at the fascinating history of vaccines, antibiotics, and other measures that have been developed to protect us

from some of the worst culprits in the ever-changing microbe world. We will explore the world of superbugs, and show how our actions can contribute to making these bugs so much more dangerous. We will lay naked the bug and expose its inner workings, and we will look at the three simple rules that can help us stay healthy: clean your hands, cover your mouth when you cough, and stay at home when you have a fever. Dr. William Osler's words ring as true today as they did more than a hundred years ago: "Soap and water and common sense are the best disinfectants."

MICROBES INCORPORATED

Thousands of people get sick from diseases caused by microorganisms that we inadvertently pick up from contaminated surfaces, ingest in our food, or inhale from the air. Countless hours of misery are caused by bugs called viruses, bacteria, fungi, and parasites — yet much of this suffering is preventable.

Welcome to the awe-inspiring world of Microbes Inc., a global corporation that has dominated our planet for three billion years. As in any global conglomerate, there are several divisions in the world of bugs, or microbes, and while they can all cause illness, some can be beneficial too. Let's take a tour through the halls of Microbes Inc. and explore the different divisions.

Viruses

The first group of bugs is the smallest and often the most lethal: the viruses. Viruses are small packets of genetic material that have evolved over billions of years to infect humans, animals, and even plants; no living organism can

escape from the destructive touch of viruses. Viruses need to use another organism's cells in order to replicate and survive. They reproduce by inserting themselves into the cells of the body, where they hijack the programming mechanism that the cells use to replicate, making thousands and thousands of copies of themselves instead. The replicated viruses then burst out into the bloodstream, killing the initial infected cell and sending the legions of copies to find and infect more cells.

Viruses can cause illness by destroying human cells in a matter of hours or days, and they have been the cause of some of the most frightening and deadly diseases we know. And because viruses are made up of such small pieces of genetic material, they can change or mutate rapidly and have perfected this skill to evade our best efforts at containing them.

Human genetic material, or genes, consists of two strands of deoxyribonucleic acid, or DNA: the fascinating double helix that was first discovered by Nobel Prize-winning scientists James Watson and Francis Crick. This discovery revolutionized our understanding of how human genes replicate and how they determine everything from our hair and eye colour to whether we will develop diseases like cancer or Parkinson's. DNA is formed when two strands of ribonucleic acid (RNA) match in very specific ways. Each strand of RNA is composed of basic building blocks called bases, which are strung together in very specific patterns. There are four types of bases: adenine (A), cytosine (C), guanine (G), and thymine (T). Pairs of bases form a pattern that determines how the gene will be expressed in the person. So whether you will have blue eyes or brown eyes depends on how the RNA strands match up. If just one base is out of place or replaced, it can lead to very different outcomes.

It turns out that bugs have the same type of genetic material as humans, with the exception of a whole family of

viruses, the RNA viruses, which have only a single strand of genetic material, or RNA. So while humans and DNA viruses have a double-checking mechanism for every time they replicate, the RNA viruses lack this biological trait. This means that the RNA viruses can reproduce much more quickly and are much more likely to introduce coding errors (like a base out of place) while they are replicating. We call this phenomenon “mutation.”

Some mutations can affect the virus’s ability to infect cells. These viruses die out quickly because they can no longer replicate their genetic material. But every now and then a mutation will come along that allows the virus to increase its rate of infection of new cells or hosts or to work around any defences we have developed (such as vaccines or antibodies). These mutations can open up whole new worlds to the virus’s destructive power.

About five thousand viruses are known and have been characterized, but there are probably a hundred times more that we have not yet encountered. Let’s look at a few viruses that have caused some of the most frightening illnesses known to humankind.

Smallpox

Throughout history the diseases caused by viruses have disrupted nations and destroyed everything from livestock to food supplies to entire communities. In the world of Microbes Inc. the senior VP of the virus department would have to be smallpox. Until the disease was eradicated in 1979, smallpox caused untold suffering for at least a thousand years in communities around the world. The smallpox virus invaded the cells of the skin, causing large, painful blisters that burst open, spewing highly contagious fluids and leaving the sufferer

scarred for life. Tombs of ancient Egyptian kings are engraved with images of people marked by smallpox scars. The disease is also known to have decimated Native populations across North America. One of our greatest medical achievements has been the removal of this scourge from the planet.

SARS

The 2003 SARS (severe acute respiratory syndrome) outbreak is a perfect example of the havoc a virus can wreak around the globe. This ambitious upstart probably emerged from the untimely mixing of two or more rather tame viruses in wild animals, leading to mutations that enabled the new virus to infect humans. Scientists worldwide scrambled to track the origins of this deadly new bug, which spread suddenly and rapidly between people, causing severe influenza-like symptoms that could quickly lead to death. The bug was first detected in southern Guangdong Province in China in November 2002. But because the Chinese government for several months denied any outbreak of disease, this new and dangerous bug was given a timely head start. It managed to reach Hong Kong in February 2003, hitchhiking in the lungs of a doctor from Guangzhou, the province's capital, and within days had started its destructive journey to countries around the world. Over the next six months SARS spread from Hong Kong to Singapore to Vietnam to Taiwan to Beijing and Toronto.

This fascinating journey was carefully pieced together by epidemiologists, the microbe hunters of the medical world, who determined that the origin of the virus was in the “wet markets” of Guangdong Province. There a harmless coronavirus that caused mild sickness in some animals, but not humans, somehow managed to acquire a new piece of genetic material that allowed it to greatly expand its infecting uni-

verse. Testing of animals in the area where the SARS virus first emerged indicates that the bug probably got its start in wild civet cats that were raised in cages in the local wet markets and later served at restaurants. From the markets of Guangzhou the virus spread to Hong Kong, and with the help of travellers it continued to spread to cities around the world. The SARS story is truly a reflection of our modern mobile society.

Ebola

Ebola, another relatively new hire at Microbes Inc., is a virus that invades the blood, organs, and even layers of the skin, causing its victim to bleed everywhere, from the lining of their eyes to their intestines. The virus was named after the Ebola River in Zaire (now Democratic Republic of the Congo), where it first drew international attention in 1976 for decimating the village of Yambuku, affecting four hundred villagers and Belgian missionaries.

The Ebola virus was still very much an enigma in 1995, when another massive outbreak invaded Kikwit, Zaire. The people of Zaire had withstood decades of corruption and greed under the ruthless dictatorship of Mobutu Sese Seko, who had exploited the nation's vast mineral wealth and left the country with severe food shortages, a complete lack of infrastructure, a health system in tatters, and the highest child mortality rates in the world. In this tragic setting where people were used to seeing the young die of disease, starvation, or military assault, the gruesome nature of Ebola left even those who had seen so much suffering in despair.

Ebola is a virus that preys on acts of compassion, infecting those who nurse the sick or care for the bodies of the dead. The bug spread easily between patients and the few health-care workers in the rudimentary hospital, where basic

infection-control measures such as handwashing were not in effect. The Kikwit outbreak was contained through the heroic efforts of the international medical community, particularly experts from the World Health Organization (WHO) and Médecins Sans Frontières, who worked with the traumatized local community. But it was not gone for long.

Despite intensive efforts to understand the workings of this devastating disease, the world was still unprepared when the next major outbreak hit the town of Gulu, Uganda, in 1999–2000. We still do not know where the virus lay dormant between these outbreaks, but many scientists suspect that local bats may have played a role. In addition, there is no effective treatment for the disease, although a vaccine is in development, and no effective early warning system to detect the active virus and prevent its spread in high-risk areas. Like many of the top performers of Microbes Inc., Ebola has shown an uncanny ability to find the areas of the world most affected by poverty, war, starvation, and disease and to exploit an already vulnerable population barely clinging to life.

Influenza

Influenza, another senior manager at Microbes Inc., is a bug that has been credited as being the number-one killer of human populations. Circling the globe annually, this virus preys on the young and the elderly, leading to thousands of deaths worldwide every year. Because this virus has only one strand of nuclear material (RNA), it can change rapidly and takes on new bits of genetic material as quickly as it can. Every year the influenza virus changes just enough that the human immune system no longer recognizes it, and new immunization must be developed to combat the new form of flu. But the virus can also change in a major way at short

notice, leading to major pandemics, or worldwide outbreaks of disease. In the past century and a half, a major global outbreak of influenza has occurred about every forty years.

A pandemic is a disease that circles the world, affecting people in many countries. This is in contrast to an epidemic or an outbreak, which are the terms used for diseases that cause illness in smaller areas. There have been three influenza pandemics in the past century, but the “Spanish flu” of 1918–19 still stands out as the most devastating pandemic in world history.

In the past decade, the emergence in Southeast Asia and China of new variants of “avian” or “bird” influenza viruses has captured the attention of the world medical community. It has even led to the World Health Organization’s urgent pleading for countries around the globe to plan for the next influenza pandemic—all this for a virus strain that has proven lethal to chickens but has yet to pass successfully between people. The unfortunate few who have contracted the disease have died at a much higher rate than those infected by the more common influenza strains that we have seen in the past forty years. In addition, the avian flu virus has made victims of the young and robust, those whose immune systems are not usually as vulnerable to infection. It may be only a matter of time before this adaptable bug manages to find a way to transmit efficiently between people through an innocent cough or sneeze and spread around the world.

While the world was watching Southeast Asia and the avian influenza bug, another virus quietly emerged in Mexico City in mid-April 2009. Hospital staff began reporting severe pneumonia in many young people, some of whom were rapidly dying. Samples were sent to the National Microbiology Laboratory in Canada, and within days a new influenza virus had been identified as the cause.