Viruses hide among all living things—some are harmless, and some have the potential to wipe out huge swaths of people.

The Ebola virus’s sister virus, Marburg, first appeared in the 1960s. Marburg and Ebola have only emerged a handful of times since, but most of the victims and communities hit with Marburg or Ebola have been devastated by the viruses’ brutal physical attacks, high infectiveness, and astronomical kill rates.

We’ll discuss the known outbreaks of Ebola and Marburg, as well as the potential for future outbreaks. But first, let’s talk about what the virus is and does.

The Filovirus Family

Ebola belongs to a family of viruses named filoviruses, meaning “thread viruses,” because they look like threads or ropes under a microscope.

There are four viruses in the filovirus family:

1. Marburg, the mildest strain, with a kill rate of 1 in 4
2. Ebola Sudan, with a kill rate of about 1 in 2
3. Ebola Zaire, the deadliest strain, with a kill rate of 9 in 10
4. Ebola Reston, the most recently discovered strain, which we’ll get to later

(Shortform note: Since the book’s publication, three more filoviruses have been identified, all of which are strains of Ebola: Bundibugyo, Tai Forest, and Bombali.)

Viruses are parasites. They lie dormant until they can latch onto another cell, at which point they use the cell’s materials to replicate ceaselessly, until the cell either bursts or is exhausted and destroyed.

The Ebola virus targets its host’s immune system, preventing the host’s body from fighting off the disease. But viruses need a living host to survive, so when a victim dies, the virus must jump hosts. Ebola is transmitted through exposure to the blood or bodily fluids of an infected victim or corpse.

With the exception of Ebola Reston, filoviruses don’t appear to discriminate between people and animals, and they can jump easily from one to the other.

Scientists still don’t know what the filoviruses’ hosts are—whether insects or animals—but the viruses can be transmitted to primates or duikers, a type of antelope. Nor do scientists know where the hosts live, but most cases originated in the region around Mount Elgon, on the border of Kenya and Uganda, not far from Sudan. Specifically, a few cases trace back to Kitum Cave, on the eastern slope of Mount Elgon.

(Shortform note: Scientists still don’t know the hosts of filoviruses, but evidence points to fruit- and insect-eating bats as major carriers—though that doesn’t rule out the possibility that an insect or rat is the original host and simply infected the bats through a bite. Scientists also suspect there could be multiple hosts.)

Marburg Virus

Marburg virus attacks organs, intestines, skin, and connective tissue through the body. Its symptoms include:

- Blood clots throughout the body, from organs to extremities
- Hemorrhages from every orifice
- Black vomit, a mixture of arterial blood and black specks that indicate hemorrhage
- Impairment of the central nervous system
- Destruction of the brain, leading to personality changes, memory loss, and an expressionless face

(Shortform note: Besides the kill rate, there are no major identifiable differences between Marburg and Ebola. Scientists don’t know why Ebola is deadlier than Marburg.)

Marburg first appeared in several Ugandan villages around Mount Elgon in the early 1960s, but the “microbreaks” went relatively unnoticed. Then, in 1967, the virus killed 31 people in Marburg, Germany.

The virus arrived through a shipment of Ugandan monkeys to a vaccine factory in Marburg. There could have been as few as two or three sick monkeys among several hundred—and they may have been in the incubation period, during which they wouldn’t have had any visible symptoms.
Ebola Sudan
The first known case of Ebola was in 1976 in southern Sudan, about 500 miles from Mount Elgon. The first victim unknowingly spread the virus to coworkers, who then spread it to friends, families, and a nearby hospital. The hospital’s practice of reusing dirty needles caused the number of cases to explode.

With a 50 percent kill rate, Ebola Sudan killed hundreds of people in central Africa.

Ebola Zaire
Just two months after the Ebola Sudan outbreak, Ebola Zaire appeared 500 miles away, at a rural hospital in northern Zaire.

Ebola Zaire is the most aggressive of the filoviruses. The virus digests...

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The Hot Zone Summary Part 1: Deadly Viruses Emerge in Africa

In the 1960s, the export of primates for medical research became a big business in Africa. Inevitably, some of the monkeys were sick when they were caught from the wild. As different monkey species were held in close quarters and shipped to industrialized countries around the world, it created prime conditions for viruses to jump species and then cross borders.

Some experts believe the monkey export business led to the international spread of AIDS and other viruses, including the deadly Ebola virus and its sister virus, Marburg.

Scientists still don't know what the filoviruses' hosts are—whether insects or animals—but the viruses can be transmitted to primates or duikers, a type of antelope.

(Shortform note: To this day, scientists don't know the hosts of filoviruses, but evidence points to fruit- and insect-eating bats as major carriers—though that doesn't rule out the possibility that an insect or rat is the original host and simply infected the bats through a bite. Scientists also suspect there could be multiple hosts.)

Scientists don't know where...

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The Hot Zone Summary 1962-1976: The First Outbreaks

The first recorded outbreaks of the filoviruses occurred in a 15-year stretch in the 1960s and '70s. Distinct symptoms like victims’ red eyes helped doctors draw connections among the diseases.

1960s: First Marburg Outbreak
Between 1962 and 1965, several Ugandan villages around Mount Elgon—not far from Kitum Cave—were hit with outbreaks of an unusual disease that killed not only villagers but also monkeys. The symptoms included a strange skin rash and bleeding.

The village microbreaks went relatively unnoticed, but in 1967 a vaccine factory in the German city of Marburg experienced an outbreak that infected 31 people and killed seven.

The German factory imported African green monkeys in order to harvest their kidney cells to make vaccines. The virus came in with a shipment of several hundred monkeys from a monkey trader in Uganda who exported thousands of monkeys to Europe each year.
The monkey trader's standard practice was to perform only a visual inspection of the monkeys before they were exported, and to remove any that looked sick or injured. The sick monkeys were then released on a small nearby island in Lake Victoria, making the island a potential hotbed of...

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The Hot Zone Summary 1980: The Case of Charles Monet

In 1980, Charles Monet, a French expatriate living in Western Kenya, spent New Year's Day exploring Kitum Cave with a friend. A week later, he began getting sick.

The cave holds a petrified rainforest from a volcanic eruption seven million years ago, and the petrified rocks are surrounded by sharp crystals made of minerals. Additionally, the cave's surfaces are coated with elephant dung and the excrement of both fruit- and insect-eating bats. Monet could've easily scratched himself on a sharp rock or crystal, exposing him to viruses in the animal dung.

First, Monet got a throbbing headache. In the following few days, he developed other symptoms, including:

- Aching, bright red eyeballs
- Aching temples
- Severe backache
- Intense vomiting and dry heaves
- Lifeless, expressionless face with drooping eyelids
- Yellowish skin on his face, speckled with bright red spots
- Personality changes, becoming more hostile
- Memory loss, despite being lucid

After several days, Monet's coworker took him to a nearby hospital. The doctors didn't recognize the illness, nor did they know how to treat it. When antibiotics didn't help, they suggested he go to the best...

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The Hot Zone Summary 1983: U.S. Army Ebola Experiments

In 1983, a U.S. Army civilian scientist and Ebola expert named Eugene Johnson led research on the Ebola and Marburg viruses. Johnson and his team infected monkeys with Ebola Zaire, then gave them various drugs in hope of finding one that either treated or cured the virus.

Johnson conducted his experiments at the United States Army Medical Research Institute of Infectious Diseases (USAMRIID) at Fort Detrick, Maryland. The work at USAMRIID focused on fighting viruses and bacteria—whether weaponized or naturally occurring—by developing vaccines and studying how to contain outbreaks.

USAMRIID Level 4 Hot Zones

USAMRIID researchers studied Biosafety Levels 0, 2, 3, and 4 agents (there is no Level 1). Ebola was a Level 4 hot agent, which are lethal viruses that have no vaccines or cures.

Before entering a Level 4 hot zone, researchers went through a multistep safety process, including:

1. Removing all their jewelry and clothing, including underwear
2. Putting on sterile surgical pants and shirt
3. Covering hair with a surgical cap
4. Getting bathed in ultraviolet light, which impaired viruses from replicating
5. Putting on latex gloves and taping the edges closed...

Why people love using Shortform

*I LOVE Shortform as these are the BEST summaries I've ever seen...and I've looked at lots of similar sites. The 1-page
In September 1987, a 10-year-old Danish boy died at Nairobi Hospital after traveling around Kenya with his parents and sister. The boy, known as Peter Cardinal, had symptoms that included:

- Skin turning blue with red spots, which eventually turned into large bruises
- Skin nearly separating from the tissue underneath it, as a result of blood pooling there
- Mucus in his lungs that made it difficult to breathe
- Bleeding around his brain

Johnson, who ran the Ebola experiments at the USAMRIID, infected monkey cells with a sample of the boy's blood. The monkey cells quickly exploded and were destroyed. The same thing happened to guinea pig cells, which meant the virus was adaptable to different species.

Through more tests, Johnson confirmed what he suspected: **Cardinal's...**

**The Hot Zone Summary Part 2: 1989—Ebola Appears in the U.S.**

The mysteries surrounding filoviruses' source and transmission intensified when Ebola appeared in the U.S. two years later.

In October of 1989, 100 wild monkeys were shipped from the Philippines to the Reston Primate Quarantine Unit in Reston, Virginia. The facility was an arm of Hazleton Research Products, a company that imported and sold lab animals. When imported wild monkeys arrive in the United States—typically for laboratory testing—they must be held in quarantine for a month before they're sent anywhere else in the country.

When this shipment of monkeys arrived, two were already dead. A few dead monkeys wasn't unusual, but in less than a month, 29 of the 100 monkeys had died.

**A Mystery Disease at the Reston Facility**

The monkey colony manager, Bill Volt, considered the fact that the building's air system was broken, and the heat was running high. The relentless heat could have put a strain on the monkeys and caused the deaths—but that didn't explain why most of the deaths had been in just one room, Room F. Volt called Hazleton's consulting veterinarian, Dan Dalgard, to take a look at the monkeys.

When Dalgard inspected the remaining monkeys in Room F, he...

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**The Hot Zone Summary The Reston Virus Spurs the Army to Action**

Jahrling's tests showed that the monkey samples reacted to Ebola Zaire, meaning that the blood sample of an Ebola Zaire victim glowed under ultraviolet light when it mixed with virus cultures made from the monkeys. The glow signaled that the virus in the...
culture was the same or similar to the virus in the victim's blood sample.

The tests weren't proof positive that the virus was Ebola Zaire. This virus could be something closely related—something new and unknown.

The prospect of a new filovirus was even more terrifying than Ebola Zaire because that would mean they knew nothing about how deadly it was or how it was transmitted. If this virus was anything like the other filoviruses, they'd be facing a potent killer without knowing how to protect themselves or prevent an outbreak.

The news quickly spread up the chain of command:

- Jahrling alerted Peters.
- Jahrling and Peters alerted Colonel David Huxsoll, the commander of USAMRIID.
- Huxsoll immediately set up a meeting with Major General Philip K. Russell, the commander of the Army's Medical Research and Development Command.
- Huxsoll and Peters called in Nancy Jaax, who had been appointed chief of...

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The Hot Zone Summary Part 3: The Army Sterilizes the Monkey House

Within a few days, the media had caught wind of the viral outbreak at Reston. On the morning of the Army's first sterilization operation at Reston, the front-page story in The Washington Post was about the discovery of Ebola in the monkey house.

Peters had given the reporter a quote for the story, speaking carefully to avoid raising panic and to assure the public that everything was under control. The Army had to act as cautiously and inconspicuously as possible during its mission to avoid making a scene at the Reston facility.

As Jerry Jaax and his team prepared to enter the monkey house that morning, no one wore uniforms, and they wouldn't change into their biohazard space suits until they were in a designated staging area inside the building. To onlookers, it appeared to be a benign operation—rather than the serious biohazard mission it was.

Even Dalgard was surprised by the Army's space suits—he'd been handling infected monkey corpses for weeks with much less protection, and he felt fine. Wearing only a respirator, Dalgard led several Army officials into the monkey room, and he picked out the four sickest-looking monkeys to be studied.

The monkeys were...

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The Hot Zone Summary A New Filovirus: Ebola Reston

While Jerry Jaax's team worked through the monkey house, an Army scientist managed to create a rapid test to detect Ebola virus in blood and tissue, called a rapid Elisa test. But when he tested samples from Frantig—the monkey caretaker who vomited and had the high fever—they came up clean.

Frantig was recovering in the hospital and feeling much better. It seemed now that he simply had the flu, so the CDC allowed him to return home.

When Frantig and Purdy—the monkey house worker who'd had a heart attack—each got sick without having had any cuts or blood exposure, it terrified the Army and CDC because it indicated that the virus had gone airborne. However, now both Frantig and Purdy appeared to be fine.

Meanwhile, Jahrling continued testing his and Geisbert's blood for the virus, and they still tested negative for Ebola. It had been nearly three weeks since they'd sniffed the vial with the virus, and neither had shown any symptoms.

Either Jahrling, Geisbert, and the monkey house workers had dodged infection, or they were dealing with a new filovirus.

Ebola Reston Looks Like Ebola Zaire But Acts Differently

As the CDC tried to track down the origin of this...
What do you do regularly to keep yourself safe from microscopic threats, like viruses and bacteria?

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