

**A Historical Review of Epidemics and Pandemics**  
***and***  
**Preparing for Pandemics**

**By Ken Miles**

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*Note: This article is based on my professional knowledge and experiences as a former FDA investigator, and by information provided by American and international public health authorities to the public. My statements and opinions are not necessarily those of any organization that I am associated with.*

As I finalize this article, it's the day before Memorial Day, and the State of California has just announced its "shelter-in-place" guidance for the Covid-19 pandemic can now be relaxed; it's a green light for people to enjoy the sunny outdoors and beaches while maintaining their "social distance" of 6 feet or more. The mainstream media reports that the wave of infections and deaths that started a few months ago are generally decreasing throughout most of the state. People are impatient after having several months of "sheltering-in-place" and are now flocking to the beaches. So far health authorities report about 1,700,000 cases and 100,000 deaths in the U.S. due to Covid-19, with about 2,500 deaths in California alone. The rate of new cases and deaths is slowing down but continues to climb. One wonders, is this the end of the deadly pandemic or just a short pause for now? Time should tell.

We need only to open our history books to learn about the horrific Spanish Flu of 1918-19, a respiratory disease like Covid-19, that swept across the United States and the world, not once but in four waves, killing anywhere from 30 million to 100 million people worldwide (the world's population was estimated to be 1.5 billion to 1.8 billion people) and some 500,000 to 850,000 Americans (with an estimated population of 105 million people). The mortality rate was somewhere between 10% to 20% for infected persons. The Spanish Flu originated in the United States; the first cases of infections in the U.S. were not reported due to World War One secrecy orders, and was eventually reported to the public by the mainstream media after the flu broke out in Spain. Thus, the Spanish Flu acquired its name. The Spanish Flu pandemic finally came to an end during 1920.

Many of us are concerned about the coronavirus pandemic, and even though we heard a lot about the virus and pandemic almost "24/7", most of us find it difficult separating fact from fiction. Much of the news, information, and misinformation we hear daily regards the increasing numbers of infections and deaths in various "hot spots" within this country, sometimes decreasing numbers here and there, and comparisons with other countries' handling of this deadly global outbreak. We have heard a lot of news about Wuhan "wet

markets” and bats as the source of the coronavirus or Covid-19 disease. The Chinese health authorities report they’ve experienced around a 2% mortality rate of infected people.

According to Chinese authorities and confirmed by U.S. health researchers, the coronavirus most likely came from bats sold at a wet market in Wuhan. During the 1980s, while on a U.S. Food and Drug Administration trip to China to inspect manufacturing plants that export medical devices to the U.S., I worked in Wuhan for a week or more. Wuhan appeared to be a prosperous industrial hub of China. As usual, I enjoyed my late-afternoon walks around town, including visiting cultural sites, parks, and marketplaces and usually trying an interesting restaurant or two, and did not see any “wet markets.” I also worked in the Shenzhen industrial area near Hong Kong during the tail end of the SARS outbreak of 2002-2004 and saw local “wet markets” that handled mostly seafood. Shenzhen’s “wet markets” appeared to be similar to open-air seafood markets one might find in Spain, France, Greece, Tunisia, or any coastal town along the rim of the Mediterranean Sea or in the Middle East or Southeast Asia.

Plenty of potentially deadly viruses and bacteria endemic to various environments all over the world could someday become human pathogens to which no one is immune, nor are vaccines available. Deadly pathogens, once lodged within their human host, can silently travel within their host from point A to point B, quickly multiplying while destroying human cells and using various means to cross over and infect other humans. It is only a matter of time before the next pandemic appears.

My goal is to provide some insight about pandemics and what I know about emergency response activities from a public health point of view. This article starts with a review of deadly epidemics and pandemics that have ravaged humankind throughout historical times, and briefly describes basically how the Federal Emergency Management Agency works, or is supposed to work, as I experienced it while working for the U.S. Food and Drug Administration as an investigator.

I began my career in occupational and public health while serving in the Navy and at the University of California Radiation Laboratory at Berkeley as a radiation safety specialist (health physics). I worked in industry for a while until I joined the Food and Drug Administration as a radiological health and medical device specialist, eventually designated as FDA’s Pacific Regional Radiological Health Representative. My primary responsibilities were to conduct inspections and investigations of domestic medical and radiological device manufacturers and distributors located throughout Pacific Region’s 10 western states, Canada, Europe, and Asia.

My first encounter with a global pandemic occurred during the early 1980s, a few years after I joined the FDA as a field investigator. AIDS was a mysterious disease. Hardly anything was known about the origins of the virus and various ways it could be transmitted. The public was

fearful of becoming infected just by being near an infected person. I joined the FDA's Pacific Region HIV – AIDS investigative team and conducted inspections at blood banks and dialysis centers to assure adherence to safe handling and labeling of infectious materials and record keeping, and investigations of drug developers making false claims.

As the FDA's Pacific Regional Radiological Health Representative, I aided the Federal Emergency Management Administration (FEMA) and other public health and safety agencies in preparing and evaluating procedures for responding to emergencies and disasters. I also assisted FEMA regional personnel with guidance regarding radioactive contamination of food and animal feed in the event of a nuclear power plant's unplanned release of radioactive materials into the environment, such as happened with the release of lethal amounts of radioactive fission products from the Chernobyl nuclear power plant in Ukraine during 1986. I was part of the FDA-USDA-EPA team that collected food and feed samples around the United States and its territories for analysis, and removal of contaminated foods from the marketplace.

The principles for health physicists' radiological occupational health and safety procedures are similar to the principles of public health and safety procedures implemented during an infectious disease outbreak. Both sets of principles require implementing standard protective measures against invisible agents: determine the characteristics of the agent by testing (what it is, where did it come from, how far has it spread, who is impacted); inform all those who need to know (supervisors, workers, public); provide containment and barriers to further movement, post signage; and later, determine the best means to treat impacted people (decontamination, medical therapy).

### **Pandemics, Past and Present**



1918–19 "Spanish flu" pandemic resulted in dramatic mortality worldwide.

Epidemics and pandemics have been around since mankind first walked the earth. The Four Horsemen of the Apocalypse symbolize Pestilence, War, Famine, and Death as mentioned in the Bible's Book of Revelations. The Four Horsemen represented the greatest known threats to mankind during biblical times. Surely Pestilence described plagues of locusts and rats that ravaged ancient towns and countryside, while Death personified the unexpected and deadly diseases that killed scores of family, friend, and foe. The biblical writers unknowingly recorded outbreaks of deadly diseases that we would define today as epidemics or pandemics.

The difference between epidemics and pandemics is scope. According to Merriam-Webster, an *epidemic* occurs when a disease spreads over a wide area and many people become ill at the same time. When an epidemic spreads across an even wider geographical area and a significant portion of the population becomes affected, it becomes a *pandemic*. There are some basic factors to consider whenever we address or describe an outbreak of a disease: infectious agent, its origins and habitat, vectors, hosts, symptoms, diagnosis, cure, and eradication.

Listed below are some of the infamous epidemics and pandemics that have occurred around the world from ancient to modern times, when many millions of people died of widespread diseases:

**Typhoid fever.** It is difficult to determine the cause of plagues and infectious diseases in early history, although some speculation is usually allowed. Some historians believe that typhoid fever was responsible for a widespread plague in Athens in 430 BC, which proved fatal for one third of the population, including the leader at the time, Pericles. The disease is most common in India. Children are most affected. Rates of disease decreased in the developed world in the 1940s as a result of improved sanitation and use of antibiotics to treat the disease. Each year in the United States, about 400 cases are reported, and the disease occurs in an estimated 6,000 people. In 2015, it resulted in about 149,000 deaths worldwide – down from 181,000 in 1990. The risk of death may be as high as 20% without treatment. With treatment, it is between 1% and 4%. Typhus is a different disease. The name typhoid means "resembling typhus" due to the similarity in symptoms.

**Smallpox.** Smallpox is caused by the *variola virus*, first thought to appear within the Egyptian Empire around the 3<sup>rd</sup> century BCE (Before Common Era). The earliest written description of a disease that clearly resembles smallpox appears in China in the 4<sup>th</sup> century CE (Common Era). On the average, 3 out of every 10 people who got it died. Those who survived were usually left with severe scars. The global spread of smallpox can be traced to the growth and spread of civilizations, exploration, and expanding trade routes over the centuries. Below is a timeline

illustrating how smallpox infections slowly spread around the world, suggesting that a series of epidemics can become a moving pandemic:

- 6<sup>th</sup> Century, Increased trade with China and Korea introduces smallpox into Japan.
- 7<sup>th</sup> Century, Arab expansion spreads smallpox into northern Africa, Spain, and Portugal.
- 11<sup>th</sup> Century, Crusades further spread smallpox in Europe.
- 15<sup>th</sup> Century, Portuguese occupation introduces smallpox into part of western Africa.
- 16<sup>th</sup> Century, European colonization, and the African slave trade imported smallpox into the Caribbean and Central and South America.
- 17<sup>th</sup> Century, European colonization imports smallpox into North America.
- 18<sup>th</sup> Century, Exploration by Great Britain introduces smallpox into Australia.

**Measles.** Most estimates based on modern molecular biology place the emergence of measles as a human disease sometime after 500 CE. It is a highly contagious infectious disease. Symptoms usually develop 10–12 days after exposure to an infected person and last 7 to 10 days. Initial symptoms typically include fever, often greater than 104 °F. Measles is caused by the measles virus, a single-stranded, negative-sense, enveloped RNA virus of the genus *Morbillivirus* within the family *Paramyxoviridae*. In 1529, a measles outbreak in Cuba killed two-thirds of those natives who had previously survived smallpox. Two years later, measles was responsible for the deaths of half the population of Honduras, and it had ravaged Mexico, Central America, and the Inca civilization. Between roughly 1855 and 2005, measles has been estimated to have killed about 200 million people worldwide.

**Plague of Justinian (542–546 to 750 CE)** was the first plague pandemic recorded to hit Europe. The Plague of Justinian was a pandemic that afflicted the Byzantine (Eastern Roman) Empire as well as the Sasanian Empire and port cities around the entire Mediterranean Sea, as merchant ships harbored rats that carried fleas infected with plague. Historians believe the Plague of Justinian was one of the deadliest pandemics in history, resulting in the deaths of an estimated 25–100 million people during two centuries of recurrence, a death toll equivalent to as much as half of Europe's population at the time of the first outbreak. In 2013, researchers confirmed earlier speculation that the cause of the Plague of Justinian was a bacterium, *Yersinia pestis*, the same bacterium responsible for the Black Death (1347–1351).

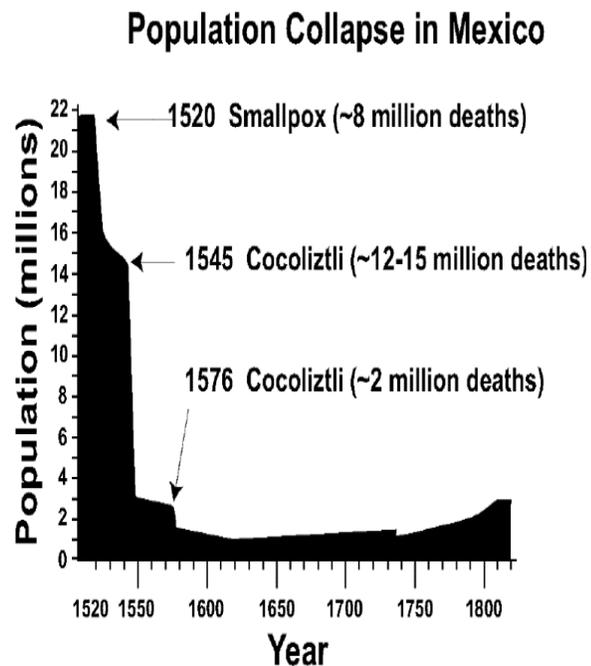
**The Black Death (1347 to 1351)**, also known as the Pestilence and the Plague, was the most fatal pandemic recorded in human history, resulting in the deaths of up to 75–200 million people in Eurasia and North Africa, peaking in Europe from 1347 to 1351, persisting as a pandemic for nearly 200 years, and still has not been completely eradicated.

The bacterium *Yersinia pestis* is believed to have been the cause; *Y. pestis* infection can cause *pneumonic plagues* but most commonly results in *bubonic plague*. The Black Death was the second plague pandemic recorded in historic medical records. The Black Death probably originated in Central Asia or East Asia and travelled along the Silk Road, reaching Crimea by 1347. From there, it was most likely carried by fleas living on the black rats that traveled on Genoese merchant ships, spreading throughout the Mediterranean Basin and reaching Africa, Western Asia, and the rest of Europe via Constantinople, Sicily, and the Italian Peninsula. The outbreak spread to Chinatown, San Francisco, from 1900 to 1904 and then to Oakland and the East Bay from 1907 to 1909. It has been present in the rodents of western North America ever since, as fear of the consequences of the outbreak on trade caused authorities to hide the dead of the Chinatown residents long enough for the disease to be passed to widespread species of native rodents in outlying areas. The disease has not been eradicated to this day. *Y. pestis* viral outbreaks can reemerge from time to time, spreading from rodents and fleas to transmission by other sources. There are 3 forms of *Y. pestis* infections that can occur as described below:

- **Bubonic plague.** *Y. pestis* spreads through the lymphatic vessels of the infected human until it reaches a lymph node, where it causes acute lymphadenitis. When a flea bites a human and contaminates the wound with regurgitated blood, the plague-causing bacteria are passed into the tissue. If the lymph node is overwhelmed, the infection can pass into the bloodstream, causing *secondary septicemic plague* and if the lungs are seeded, it can cause *secondary pneumonic plague*.
- **Septicemic plague** occurs when bacterial endotoxins cause disseminated intravascular coagulation (DIC), causing tiny clots throughout the body and possibly ischemic necrosis (tissue death due to lack of circulation/perfusion to that tissue) from the clots.
- **Pneumonic plague.** The pneumonic form of plague arises from infection of the lungs. It causes coughing and thereby produces airborne droplets that contain bacterial cells and are likely to infect anyone inhaling them. The incubation period for pneumonic plague is short, usually two to four days but sometimes just a few hours. The initial signs are indistinguishable from several other respiratory illnesses; they include headache, weakness and spitting or vomiting of blood. The course of the disease is rapid; unless diagnosed and treated soon enough, typically within a few hours, death may follow in one to six days; in untreated cases mortality is nearly 100%.

**“Cocoliztli”, 1520-1576, Spanish Colonial America**

The “Cocoliztli” epidemic or the great pestilence is a term given to millions of deaths in New Spain (present-day Mexico and Central America) in the 16th century attributed to one or more illnesses collectively called *cocoliztli*, a mysterious illness characterized by high fevers and bleeding. Recent studies suggest bacterium *Salmonella enterica* was partially responsible for this initial outbreak. It might have also been an indigenous viral hemorrhagic fever.



**Syphilis** became known to the Western World during the 16th to 19th centuries. Syphilis was one of the largest public health burdens in prevalence, symptoms, and disability around the world. It is a sexually transmitted disease caused by the bacterium *Treponema pallidum* subspecies *pallidum*. It has a mortality rate of 8% to 58%, with a greater death rate among males if untreated. It is believed syphilis was present in the Americas before European contact and was carried to Europe by Christopher Columbus's crewmen. Some believe it may have existed in Europe previously but went unrecognized until shortly after Columbus's return. The first recorded outbreak of syphilis in Europe occurred in 1494 or 1495 in Naples, Italy. It then spread throughout Europe during the 16<sup>th</sup> and 17<sup>th</sup> centuries. After the 1940s syphilis decreased dramatically with the availability of penicillin and other antibiotics. In 1990 there were 202,000 deaths due to syphilis infections. Since 2000, the rate of syphilis has increased in the U.S., Canada, the U.K., Australia, and Europe. About 45.4 million people worldwide became infected with syphilis and 107,000 people died from it during 2015.

**Typhus** is a group of infectious diseases that include epidemic typhus, scrub typhus, and murine typhus. Typhus has been described in medical journals since at least 1528 CE. Common symptoms include fever, headache, and a rash. Typically, symptoms appear one to two weeks after exposure. The diseases are caused by specific types of bacterial infection. Epidemic typhus is due to *Rickettsia prowazekii* spread by body lice; scrub typhus is due to *Orientia tsutsugamushi* spread by chiggers, and murine typhus is due to *Rickettsia typhi* spread by fleas.

Epidemic typhus generally occurs in outbreaks when poor sanitary conditions and crowding are present. Scrub typhus occurs in Southeast Asia, Japan, and northern Australia. Murine typhus occurs in tropical and subtropical areas of the world.

**Tuberculosis (TB)** is caused by mycobacterium *M. tuberculosis*. The tuberculosis complex (MTBC) consists of closely related species that cause tuberculosis in both humans and animals and remains one of the leading causes of morbidity and mortality throughout the world. TB has existed since antiquity. It is unclear whether tuberculosis originated in bovines, then transferred to humans, or whether both bovine and human tuberculosis diverged from a common ancestor. In Europe, rates of tuberculosis began to rise in the early 1600s, reaching a peak level in the 1800s, when it caused nearly 25% of all deaths. TB caused widespread public concern in the 19th and early 20th centuries as the disease became common among the urban poor. In 1815 one in four deaths in England was due to "consumption," a common name for TB. By 1918, TB still caused one in six deaths in France. It was determined to be contagious, and campaigns were started to stop people from spitting in public places. Infected people were placed in sanatoria. During the early 1900s, under the best conditions, 50% of those who entered the sanatoria died within five years. One of the U.S. Public Health Service's missions was to inspect new immigrants and to remove and quarantine anyone thought to be infected with TB.

**Chickenpox**, also known as varicella, is a highly contagious disease caused by the initial infection with *varicella zoster* virus (VZV) and infects people throughout the world. Chickenpox was thought to be related to smallpox until the late 19th century. In 1888 its connection to shingles was determined. Chickenpox is an airborne disease that spreads easily through the coughs and sneezes of an infected person. Symptoms begin 10 to 21 days after exposure to the virus. The disease results in a characteristic skin rash that forms small, itchy blisters. Other symptoms may include fever, tiredness, and headaches. Symptoms usually last five to seven days. Complications may occasionally include pneumonia, inflammation of the brain, and bacterial skin infections. The disease is often more severe in adults than in children. In 2013 there were 140 million cases of chickenpox and *herpes zoster* ("Shingles," caused by a reactivation of the chickenpox *varicella zoster* virus) worldwide. Before routine immunization the number of cases occurred at a rate similar to the number of people born each year. Since immunization, the number of infections in the United States has decreased nearly 90%. In 2015 chickenpox resulted in 6,400 deaths globally – down from 8,900 in 1990. Death occurs in about 1 per 60,000 cases.

**Polio (1900s).** The occurrence of polio (poliomyelitis) infections extends into prehistory. The disease has caused paralysis and death for much of human history. Over millennia, polio survived quietly as an endemic pathogen, until the 1900s when major epidemics began to occur in Europe. Soon after, widespread epidemics appeared in the United States and Canada. By 1910, frequent epidemics became regular events throughout the developed world, primarily in cities during the summer months. During 1916, 9,000 cases occurred in New York City, calling for quarantines, and 25% of polio's victims died. Five years before 39-year-old Franklin Delano Roosevelt was diagnosed with polio, the paralyzing disease struck thousands in the U.S., killing some 6,000. At its peak in the 1940s and 1950s, polio would paralyze or kill over half a million people worldwide every year. In the 1950s Dr. Jonas Salk finally developed polio vaccine. Thanks to early recognition of the disease and improved treatment (iron lungs, physical therapy, etc.) the death rate is now down to 5%.

**Spanish flu (1918 – 1919)** was an unusually deadly influenza pandemic. When an infected person sneezes or coughs, more than half a million virus particles can spread to those nearby. Most influenza outbreaks disproportionately kill the young and the old, with a higher survival rate for those in between. The Spanish flu pandemic, however, resulted in a higher than expected mortality rate for young adults. The first case of Spanish flu of 1918 originated at Camp Funston in Kansas and was transported to Europe by an infected soldier. The so-called Spanish flu was the first of two pandemics caused by the *H1N1 influenza virus*; the second pandemic was the swine flu of 2009. Two more waves occurred until the pandemic finally ended during 1920. The Spanish flu infected 500 million people, about a third of the world's population (estimated to be 1.5 to 1.9 billion people). The death toll may have been 17 million to 50 million, and possibly as high as 100 million people, making it one of the deadliest pandemics in human history. It is estimated that mortality rate for infected people was 10% to 20%. In the U.S. with a population of 105 million people, 30 million became infected and of those, 500,000 to 850,000 people died of the Spanish flu. See: [https://en.wikipedia.org/wiki/Spanish\\_flu](https://en.wikipedia.org/wiki/Spanish_flu).

**Hepatitis C** is a liver disease caused by the *hepatitis C virus* (HCV) and transmitted to anyone who has been exposed to infected blood. Globally, an estimated 71 million people have chronic hepatitis C virus infection. WHO estimated that in 2016 approximately 399,000 people died from hepatitis C, mostly from cirrhosis and hepatocellular carcinoma (liver cancer). The virus can cause both acute and chronic hepatitis, ranging in severity from a mild illness lasting a few weeks to a serious lifelong illness. There is no vaccine to prevent it.

**Hong Kong flu (also known as H3N2 flu, 1968).** This flu pandemic outbreak occurred in 1968 and 1969 and killed an estimated one million people all over the world, including about 100,000 in the U.S, with a population of 200 million people at that time. The pandemic was caused by an H3N2 strain of the influenza A virus, descended from H2N2 through antigenic shift, a genetic process in which genes from multiple subtypes reassorted to form a new virus.

**West Nile virus (WNV)** was detected in 1999 in North America, where thousands of cases a year are reported, with most outbreaks of this disease occurring during August and September. The WNV was discovered in Uganda in 1937 and spread to Europe, Africa, Asia, Australia, and North America. WNV is a single-stranded RNA virus that causes West Nile fever. It is a member of the family *Flaviviridae*, specifically from the genus *Flavivirus*, which also includes the Zika virus, dengue virus, and yellow fever virus. West Nile virus is primarily transmitted by mosquitoes, mostly species of *Culex*. The primary hosts of WNV are birds, so that the virus remains within a "bird–mosquito–bird" transmission cycle. A surveillance system for detecting WNV in birds is useful for early detection of a potential human outbreak. The risk of death among those in whom the nervous system is affected is about 10%. All ages are equally likely to be infected, but there is a higher amount of death in people 60-89 years old. Recovery may take weeks to months.

**Ebola virus disease (EVD) (1976 to ?)** is a viral hemorrhagic fever of humans and other primates caused by an Ebola virus. Ebola has a high mortality rate among primates. In 2012, it was demonstrated that the virus can travel without contact from pigs to nonhuman primates. Signs and symptoms typically start between two days and three weeks after contracting the virus. Symptoms include fever, sore throat, muscular pain and headaches. Vomiting, diarrhea and rash usually follow, along with decreased function of the liver and kidneys. Some people begin to bleed both internally and externally. The disease kills 25% to 90% of those infected depending on availability of early treatment, with an average death rate of about 50%. Ebola was first identified in 1976, in two simultaneous outbreaks in South Sudan and in the Democratic Republic of the Congo. EVD outbreaks continue to occur intermittently in tropical regions of sub-Saharan Africa. Between 1976 and 2013, the World Health Organization reported 24 outbreaks involving 2,387 cases, with 1,590 deaths. The largest outbreak to date was the epidemic in West Africa, which occurred from December 2013 to January 2016, with 28,646 cases and 11,323 deaths. Other outbreaks in Africa began in the Democratic Republic of the Congo in 2017 and 2018. In July 2019, the World Health Organization declared the Congo Ebola outbreak a world health emergency.

**Swine flu (also called the H1N1 flu, 2009)** was the second pandemic caused by the H1N1 influenza virus; the first H1N1 pandemic was the Spanish flu of 1918-1919. Influenza A virus subtype H1N1 (A/H1N1) is the subtype of *Influenza A virus* that was the most common cause of human influenza (flu) in 2009 and is associated with the 1918 flu pandemic. Some strains of H1N1 are endemic in humans and cause a small fraction of all influenza-like illness and a small fraction of all seasonal influenza. H1N1 strains caused a small percentage of all human flu infections in 2004–2005. Other strains of H1N1 are endemic in pigs (swine influenza) and in birds (avian influenza). The most recent infections started in early to mid-2009. The World Health Organization (WHO) declared the new strain of swine-origin H1N1 a pandemic. This novel virus spread worldwide and had caused 18,500 laboratory-confirmed deaths with an estimated 151,700 to 575,400 deaths total in about 20 months. On August 10, 2010, the World Health Organization declared the H1N1 influenza pandemic over, saying worldwide flu activity had returned to typical seasonal patterns.

**HIV/AIDs (Human immunodeficiency virus infection and acquired immune deficiency syndrome)** is a spectrum of conditions caused by infection with the human immunodeficiency virus (HIV). HIV made the jump from other primates to humans in west-central Africa in the early to mid-20th century. AIDS was first recognized by the United States Centers for Disease Control and Prevention (CDC) in 1981, and its cause, HIV infection, was identified in the early part of the decade. Following initial infection a person may not notice any symptoms, or may experience a brief period of influenza-like illness. In 2018 about 37.9 million people worldwide were living with HIV and there were 770,000 deaths. An estimated 20.6 million of these infected persons live in eastern and southern Africa. Between the time that AIDS was identified in the early 1980s and 2018, AIDs caused an estimated 32 million deaths worldwide. HIV/AIDS is considered a pandemic, a disease outbreak that is present over a large area and is actively spreading.

**Coronaviruses: SARS, MERS and Covid-19.** There are 7 known types or strains of human coronaviruses. Most of them cause infections with mild illness in the upper respiratory tract. Four of them--229E, NL63, OC43, and NKU1--are common and are not considered dangerous. These are usually manifested as symptoms of the common cold. There are three coronaviruses that are known to be much more severe, to the extent of causing actual death. In the past twenty years, these three coronaviruses that have caused major outbreaks are SARS, MERS and most recently, COVID-19:

- **SARS (2002-2004)** was an epidemic involving severe acute respiratory syndrome (SARS) and was caused by coronavirus strains SARS-CoV or SARS-CoV-1. The outbreak was first identified in Foshan, Guangdong, China, during November 2002 and grew into pandemic

proportions as it spread to 29 countries and more than 8,000 people became infected, causing at least 774 deaths worldwide. The major part of the outbreak lasted about 8 months, since the World Health Organization declared SARS contained by early July 2003. Additional SARS cases were reported until May 2004.

- **MERS (2012)** The **Middle East Respiratory Syndrome outbreak (MERS)** was a continuing set of infections of the Middle East respiratory syndrome (MERS-CoV). MERS originated in countries on the Arabian Peninsula, where most cases were reported. Several hundred cases of MERS per year were reported from 2012 to 2018, with the highest number of cases occurring during 2015. A total of 41 deaths were reported. Symptoms usually appear 2 to 14 days after exposure and include fever, cough, shortness of breath and difficulty breathing.
  
- **Covid-19 (2019 to?)** is primarily a pulmonary disease that results in pneumonia and blood clots. This disease is believed to have originated in the Hubei province of China during late 2019. It is likely caused by transfer of the virus from bat to human. Little is currently known about the disease, and currently no therapeutic vaccines exist to treat this disease. Chinese health officials reported the disease has a 2% death rate for those infected. The disease has spread quickly around the globe and has reached pandemic proportions, creating crises for health agencies unprepared for handling numerous patients requiring critical healthcare and medical resources. Some countries, such as Iran, Italy, France, the U.K., and the U.S., have experienced high rates of infections and deaths. Hospitals in the New York City area, for example, overwhelmed in caring for hundreds of critically ill patients, experienced a 6% mortality rate. As of this report, East Asian countries (e.g. South Korea, Taiwan, Vietnam, Singapore and China) that successfully responded to the SARS pandemic appear to be sufficiently keeping their rate of infections low through maintaining emergency supplies ready for such events, consulting the advice provided by physicians and epidemiologists, establishing early testing of numerous people, and quarantining residents in impacted communities and people arriving from other countries.



### **Preparing for Epidemics and Pandemics:**

While I was with FDA, my specific duties with regards to assisting other federal and state agencies with FDA’s responsibilities for radiological emergencies: first, serve alongside Federal Emergency Management Agency’s (FEMA) team as a federal radiological health officer to ensure that the states’ emergency response decisions and operations comply with FDA’s Food Protection Guidelines for Human Foods and Animal Feed during actual declared-emergencies; and second, assist FEMA in evaluation of the states’ and local agencies’ and/or utilities’ (for example, PG&E’s Diablo Canyon Reactor Site near San Luis Obispo) emergency response plans for accordance with the Federal Response Plan during “tabletop exercises.” Note: a “declared-emergency” is when a state governor declares an emergency and requests the U.S. president to provide federal assistance.

FEMA was created in 1978, as a stepchild of the old Civil Defense organization developed during World War II. In 1988, Congress passed the Stafford Disaster Relief and Emergency Assistance Act, which it was up to FEMA to manage and implement. The Act addressed the following types of “all hazards”, and disasters involving human public health and safety: earthquakes, floods, dam failure, hazardous materials, hurricanes, lethal chemical agents, munitions, radiological hazards, terrorism, and tornados.

Later, in April 1992, Congress approved the Federal Response Plan (FRP), which covered emergencies response activities. The FRP outlines how FEMA’s technical staff assists the states in preparing their emergency response plans in conformance with the FRP, evaluates state and local plans by conducting and evaluating “tabletop exercises” at on-site and off-site facilities, and most important, the FRP provides federal technical assistance and advice to the states’ Emergency Operation Center managers during declared-emergencies. Through the FRP, FEMA

and key federal agencies assist the states with natural and man-made emergencies, from hurricanes, tsunamis, and earthquakes to nuclear power plant meltdowns.

The newly created Federal Response Plan was immediately “tested” when FEMA implemented the plan during and following Hurricane Andrew, a Category 5 hurricane that devastated southern Florida and Louisiana, killing 65 people and causing billions of dollars in damages, in August 1992. The media reported on the mix-up of communications between the governor of Louisiana and the president. Critical federal assistance did not arrive for 5 days following the disaster. The Federal Response Plan (FRP) of 1992 was drafted and approved in September, the following month. The FRP provided various emergency support functions (ESFs) to assist state and local governments in preparation of plans and requirements for responding to a man-made or natural emergency to protect the public’s health and safety. FEMA activates its ESFs only after a state’s governor asks the U.S. president for assistance. The basic principles of the FRP are maintained: FEMA and other federal agencies will aid the states after a governor asks the president for assistance. From my perspective, FEMA and the Federal Response Plan of 1992 worked well, as intended.

The FEMA I knew while employed with FDA from 1974 to 2004 consistently demonstrated its ability to work effectively with the FDA Pacific Region’s 10 Western states and local agencies, as well as international agencies and other countries. As I mentioned earlier, FEMA, FDA and other federal agencies responded to the crisis to the U.S. when the Chernobyl reactor meltdown in 1986 released vast amounts of radioactive isotopes into the air. Some settled out in Northern Europe and North America, causing certain crops to become contaminated. FDA, FEMA, the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) and other countries’ nuclear safety organizations worked together, cooperating with one another’s requests and sharing data to assure people around the world would not consume contaminated food or feed. Another example of FEMA and international cooperation and coordination occurred during a tabletop exercise called “RADEX 94.” Held in Anchorage, Alaska, during 1994, the exercise was attended by approximately 400 radiological health and emergency response specialists and managers from Russia, Japan, Canada, the U.S., and the Scandinavian countries. The tabletop scenario involved a radioactive release from a fictitious island in the North Atlantic and the “radioactive cloud” drift across each country. The “players” successfully demonstrated their ability to cooperate, to communicate information, and to coordinate their emergency response activities, despite having different languages, computerized modeling programs, and emergency response plans.

Following “9/11,” the federal government transformed many of its agencies, including FEMA, to respond to terrorist activities abroad and at home. The FRP was rewritten during 2004 and 2006 to become the National Response Plan (NRP), which was rewritten again to become the National Response Framework (NRF) of 2008. While the wording of the NRF appears to stress a

“bottom-up” approach for states’ taking the lead in developing and implementing their emergency response plans, it does not appear to address federal coordination of multiple states’ emergency response activities.

Two Category 5 hurricanes occurred after the FRP and NRP were approved: Hurricane Katrina of August 2005, which destroyed parts of New Orleans and southern Louisiana, killing 1,800 people, and Hurricane Maria, which struck Puerto Rico during September 2017, more than 3,000 people. During both disasters, state governors requested the president’s federal assistance. The federal response was widely criticized as “too little and too late.” Something serious had happened to the implementation of federal response to assist the states during emergencies. Numerous changes were made to the Federal Response Plan and its siblings (the National Response Plan and National Response Framework) between 2004 and 2008, and perhaps even later, along with changes in leadership, possibly resulting in the federal government’s inability to effectively respond to regional disasters and assist the states during emergencies and recovery.

Currently, we are struggling to contain the Covid-19 pandemic across our states. A handful of other countries, including South Korea, Hong Kong, Vietnam, Taiwan, and New Zealand, are reported to have effectively responded to the Covid-19 pandemic during early January, when these nations first became aware of the pending health crisis. These countries experienced firsthand the deadly SARS pandemic of 2003-2004 and were already well prepared to respond to the Covid-19 emergency by issuing and implementing public directives to wear masks and gloves, maintain safety distances from one another, shelter-in-place, quarantining entire cities and regions known to contain mass infections (hot spots), testing and quarantining people arriving at airports and ports, testing most of their citizens, locate-test-quarantining others who may have interacted with infected people, and closing down non-essential businesses until the rates of new infections and deaths were significantly reduced. Most of the citizens of these countries clearly understood the risks of widespread deadly infections and promptly complied with safety directives.

We should question what factors caused some countries to be better prepared to respond to the Covid-19 pandemic than others, including Spain, Italy and our country, which are the countries that had/have the highest rates *per capita* for infections and deaths. On the other hand, Germany South Korea, Singapore, Taiwan, Hong Kong, China and New Zealand, countries which experienced and responded to the SARS pandemic of 2002-2004, were prepared for the Covid-19 pandemic. When the health authorities in these countries initially heard about the Covid-19 outbreak in China and cases began to appear within their countries, they did not hesitate to inform their citizens about the outbreak and to shelter-in-place, wear masks and wash hands. They began testing suspected persons to determine if they were infected, conducted contact tracing of others who possibly were exposed to infections. It helped that the

people in these countries followed their governments' guidance and directives. Their medical staff was well prepared and equipped with personal protective equipment (PPEs), medical equipment and hospital beds.

Several factors put our country more at risk for higher rates of infections and death *per capita* than other countries, including the following: there was failure to respond early to the pandemic; states' health and safety directives in combating this infective disease were fragmented and inconsistent, not fully coordinated by a central health authority; a large percentage of the citizenry was not likely to comply with health directives; in a highly mobile nation, numerous people from all corners of the world arrived at our ports and airports and were not tested or quarantined; federal stockpiles did not contain sufficient quantities of PPEs and vital emergency room medical equipment such as ventilators; and U.S. medical device companies currently manufacture most of their products overseas, thus not readily available in case of emergencies.

Covid-19 is a highly lethal global pandemic that is rapidly spreading to all corners of the earth. Preparation for epidemics and pandemics includes planning and training, and maintenance of stockpiles of critical supplies for medical emergency response operations should already exist. Our collective emergency response operations require effective guidance, communication, cooperation, and coordination at all levels of political leadership, governmental agencies, and NGOs. The following elements should be considered minimal requirements to implement during the pandemic:

- ✓ **International Leadership.** Since Covid-19 is a pandemic affecting every nation on earth, we must collectively combat it together. The best means in defeating the Covid-19 pandemic is for all countries to work together until we resolve the pandemic, guided by the United Nations leadership and the World Health Organization's top scientists. It was the WHO that successfully defeated polio and smallpox viral infections around the world by providing vaccinations to all countries. The WHO's team of experts include physicians, epidemiologists, virologists, engineers, economists, and technologists from around the world, working together as Task Force, and/or Emergency Operation Center (EOC). The EOC role is to develop standardized procedures and strategies for quarantining areas where reports of outbreaks are occurring, develop effective testing and reporting strategies and plans, and work with other countries' national health agencies to determine sources and transmission of the disease and location of "hot spots. The WHO should assess whether all regions and countries have enough medical personnel and emergency supplies available and how best to conduct contact tracking. The WHO will compile factual data on infection and mortality rates/per capita

worldwide and can coordinate global research towards the development of preventative prophylactic pharmaceuticals and vaccines.

- ✓ **Global Cooperation.** Economic embargos and sanctions of certain countries should be lifted temporarily or permanently to assure those countries currently unable to receive critical medical supplies and resources, can receive these resources as soon as possible to effectively combat the pandemic and save the lives of ordinary citizens.
- ✓ **Establish National Emergency Operation Centers.** Nations, including the U.S., should establish national emergency operations centers or task forces that include their renowned physicians, epidemiologists, virologists, scientists, engineers, demographers, economists, and technologists to work with their counterparts at the WHO, and with tribal and indigenous communities and states.
- ✓ **The U.S. Emergency Operation Centers/Task Force.** The U.S. EOC should include the Surgeon General and knowledgeable members from key federal agencies such as the Department of Health and Human Services, Center for Disease Control, National Institute of Health, Public Health Service, Food and Drug Administration, Department of Agriculture, Environmental Protection Agency, American Medical Association and others as needed.
- ✓ **Universal Health Care.** Countries that have established universal health care can assure most of their citizens and noncitizens alike will receive testing for infectious diseases and health care without additional personal costs for testing and/or hospitalization. Diagnostic testing for infectious diseases during epidemics and pandemics should be freely available to everyone.
- ✓ **Establish Sites for Quarantining Travelers.** Nations should establish plans to quarantine and test potentially infected people arriving at their borders by ship, airplane, train, or otherwise for a specified period to determine whether they are infected and/or need medical care. One of the functions of the U.S. Public Health Service was to quarantine immigrants to the U.S. at selected sites (Ellis Island at New York City and Angel Island at San Francisco Bay) for a specified time to assure diseases such as TB were not reintroduced into the U.S.
- ✓ **Production and Stockpiling of Medical Equipment.** The Public Health Service established 5 National Strategic (Pharmaceutical) Stockpiles for emergency purposes around the U.S following the “9/11” terrorist attack. Other industrial countries should maintain critical medical device manufacturing plants and pharmaceutical stockpiles, enough to provide for their citizens and those in adjacent or nearby less developed nations. Governmental agencies must assure manufacturers are qualified to produce vital and critical pharmaceuticals and medical equipment. Critical medical devices and pharmaceuticals should include gloves, masks, personal protective equipment (PPEs), breathable oxygen and medical gases in cylinders, devices to sterilize or sanitize large

and small medical instruments and equipment, wound care materials, hospital beds and tents, well-equipped vehicles to transport patients, etc. Medical devices, including in vitro diagnostic test kits, reagents and applicators, and PPEs, must be manufactured by pre-approved manufacturers and certified to comply with safety and effectiveness standards. There should be a means in place to assure counterfeit medical devices and pharmaceuticals are not imported or stockpiled. Test kits should include adequate instructions and statements of accuracy (percentages of false-negative and/or false-positive results).

- ✓ **Establish Local Emergency Operations Centers.** Local health agencies should conduct diagnostic testing and retesting of as many people as required by their lead health authorities. The local agencies should conduct contact tracing to assure persons that were likely exposed to infection are sheltered-in-place or quarantined to prevent infecting others.
- ✓ **Identify Existing Sites to Serve as Potential Medical Emergency Facilities.** Local health agencies should maintain a list of potential sites where emergency medical facilities can be quickly erected. Mass transportation systems (airplanes, trains, buses, ships) should transport only essential personnel and supplies as needed.
- ✓ **Identify and Monitor Sites Where Infectious Disease Is Likely to be Transmitted to Others.** These sites should be pre-identified and listed in local health agency emergency preparedness plans: high-density residential areas; areas with a high percentage of senior citizens, convalescent and nursing homes; anywhere likely to have high concentration of people including restaurants, shopping malls, sports arenas, jails, prisons and detention centers; conveyances such as cruise ships, airlines, trains, and buses; meat and fish processing plants; communities that have large percentages of minorities, including Native American and indigenous people and homeless people; and schools and colleges.
- ✓ **Provide Accurate Up-to-Date Data to Health Authorities and to the Public.** It has been reported by various media sources that the actual number of cases and deaths worldwide due to Covid-19 is much higher than the official numbers of cases and deaths. This discrepancy in numbers is partly due to many reasons, including the following: diagnostic test kits being used here and abroad provide certain percentages of false negative and false positive results; some infected people do not display symptoms of the disease; and some people who died at home from Covid-19 were not reported. It is important to assure accurate information about the pandemic is reported including locations of cases to identify “hot spots”: numbers of cases, patients cured, and deaths per location (totals, per capita and percentage rates); available medical resources (physicians, nurses, medical equipment, hospital beds, etc.); and lists of governmental and private hospitals; and governmental and NGO agencies

available to provide medical services in managing the pandemic, etc. This information will help health agencies and governmental bodies to effectively facilitate their emergency response operations, and allocate resources and funding as needed. Open both hyperlinks to view updated Covid-19 cases and deaths in the U.S and around the world: <https://covidgraph.com/> and <https://www.cdc.gov/nchs/nvss/vsrr/covid19/index.htm> .

- ✓ **The Public Health and Medical Science Community and Public Sharing Information and Trust.** The health science community including virologists, epidemiologists, microbiologist, researchers and physicians have an incredible task to perform in responding to a pandemic and saving lives. They must identify root causes of the disease, vectors, hosts and means of detecting the disease, providing health and safety guidance to the public, treat patients and eradicate the disease. The public should trust the health and safety guidance their public health and medical community provides to them.
- ✓ **Identify and Inform Public About Similar Diseases That Mimic the Pandemic Disease.** There were issues in our community during early March when flu cases and hay fever symptoms appeared when the pollen count in air was high, making it difficult to determine whether a person had a Covid-19 infection or something else.
- ✓ **Monitor Impacts to the Economies.** There will be negative impacts to local, national, and international economies due to combating or not combating this pandemic. Our governmental leaders must weigh the risks and benefits for whatever course of action they decide, hopefully with success and not with failure.

