

Pandemics: The Invisible Enemy

Pandemics: The Invisible Enemy

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Publisher's Note

Thoughtfully curated, these 43 articles come from different titles across several of our imprints—Grey House Publishing, Salem Press, and H.W. Wilson. This collection starts with several articles specifically related to COVID-19, and continues with a section of general pandemic information, like causes and testing. The remaining content is arranged by century—from the late Middle Ages and the Black Death, to the Twenty-first Century and SARS, Zika and COVID-19.

Over the years of developing content for a variety of users, Grey House Publishing and the Salem Press collection of health-related and historical material is far ranging. In an effort to provide our users with easy access to material that provides not only valuable reading on the history of pandemics around the world, but helpful medical information in this time of anxiety and information overload, the "Current Topics" section of our Salem Press/Grey House Publishing platform presents a new collection of content—*Pandemics: The Invisible Enemy*. In addition, we have developed this content into a free PDF for you to download and share with students, library patrons, family and friends.

You will find historical accounts of everyday individuals and families dealing with disease, medical explanations and definitions, and public health issues, including the founding of national health organizations. You will read how disease was purposely used

as genocide in 1492, about children orphaned by the plague and influenza, the story of Typhoid Mary in 1901, about the development of the respirator in 1929, how the polio vaccine was created in the 1950s, how AIDS started and became a national crisis in the 1980s, and details about 21st century contagions from SARS to COVID-19.

This text is well-supported by top-matter information, like dates and definitions. Dozens of photos supplement the content and a good number of charts and tables offer valuable statistics and helpful information.

As we continue to grapple with the reality of COVID-19, the worst and most widespread pandemic in more than a century, that so far has claimed more than 130,000 deaths around the world, *Pandemics: The Invisible Enemy* provides solid content that can help us learn from the past, answer today's questions, and offer some guidance on how to maneuver the future.

COVID-19

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COVID-19 DISEASE

Anatomy or Systems Affected: Respiratory system

Also Known As: SARS-CoV-2, 2019-nCoV, novel betacoronavirus

DEFINITION

COVID-19 is a respiratory disease caused by a novel betacoronavirus that can produce illness ranging from mild, or even asymptomatic, to severe, life-threatening pneumonia. The virus is highly contagious and has spread worldwide causing a pandemic.

CAUSES

On December 31, 2019, China reported a cluster of pneumonia cases associated with the Huanan Seafood Market in the city of Wuhan. One week later it was announced that the infectious agent was a novel coronavirus. The Chinese market sold a variety of live animals, including bats; the virus is thought to have originated in bats with direct transfer to humans or indirect transfer to humans through an intermediate animal host. The virus is similar to another betacoronavirus – SARS – originating in Chinese live animal markets in 2003 causing severe respiratory distress syndrome. The first case of COVID-19 in the United States occurred on January 19, 2020, in Snohomish County, Washington state. The patient was a 35-year-old man who had just returned from visiting his family in Wuhan, China.

The COVID-19 virus can be spread by airborne droplets, contact with contaminated surfaces with entrance through mucous membranes, and possibly by fecal-oral routes as the virus has been shown to be shed in the feces of infected individuals. After exposure, the incubation period is usually about five days but may be up to two weeks.

RISK FACTORS

This is a new virus, so no one is immune to infection. Older age, immunocompromised status, underlying diseases, and smoking have all been associated with more severe disease. COVID-19 is highly transmissible, and close contact with an infected individual or contaminated surface should be avoided. Healthcare workers are at an increased risk and must wear gloves, gowns, and N-95 respirators to protect themselves from infection. Masks should be worn by infected or suspected patients to decrease the chance of

spreading infection. Wearing of regular masks by uninfected individuals does not reliably protect against infection as they are not occlusive against aerosols and leave the eyes unprotected.

SYMPTOMS

Some infected persons will have few or no symptoms. Children usually have mild disease with cold-like symptoms often with no fever. Adults will have fever, headache, sore throat, dry cough, and shortness of breath in more severe cases. There can also be a feeling of fatigue and general malaise with accompanying myalgia. Viral pneumonia occurs with severe disease and results in impaired oxygenation manifested by shortness of breath. Such patients need immediate medical care and hospitalization.

SCREENING AND DIAGNOSIS

During the current pandemic, any patient with new respiratory symptoms, especially if accompanied by fever, must be considered possibly infected with COVID-19. Additionally, any patient coming from a highly infected country, cruise ship, or area with a high prevalence of COVID-19 infection must be considered possibly infected even if they are asymptomatic. Screening may initially be done to rule out other respiratory pathogens such as influenza virus. Definitive testing for COVID-19 is accomplished by taking two swabs, one from the nose and one from the throat, which are then sent to a microbiology laboratory with the capability to perform specific polymerase chain reaction (PCR) testing. This test can identify viral genetic material. Because the genetic material (RNA) of this coronavirus is very large and capable of evolving mutations, the PCR probe has been designed to target two specific genetic areas to avoid missing cases. It is possible to have a negative PCR test very early in the COVID-19 infection when only small amounts of the virus are present.

Radiological examinations are also helpful in diagnosis. Computerized tomography (CT) scanning often reveals characteristic features in COVID-19 pneumonia patients. Sometimes the findings from these exams can provide a presumptive diagnosis while awaiting PCR test results.

TREATMENT AND THERAPY

For infections in patients with mild symptoms treatment can be initiated at home with zinc lozenges and mouth wash containing alcohol to reduce the amount of virus in the mouth and upper respiratory tract. Fever should be treated with acetaminophen. More severe cases require hospitalization to provide intravenous fluids and respiratory therapy with oxygen and mechanical ventilation, if necessary. Antiviral agents have been used with varying success. The antimalarials, quinine, chloroquine, and hydroxychloroquine, are also being investigated for effectiveness against the virus. Antibacterials are often used to prevent or treat secondary bacterial infection of the damaged lung tissue of COVID-19 pneumonia patients. Some severe cases seem to show improvement from the infection and then worsen. This late stage illness sometimes seen in severe cases are thought to be the result of continuing and overactive immune response to the infection that can lead to further damage to the lungs. Treatment with corticosteroids has been shown to be of benefit in some patients with this late stage deterioration of the pneumonia.

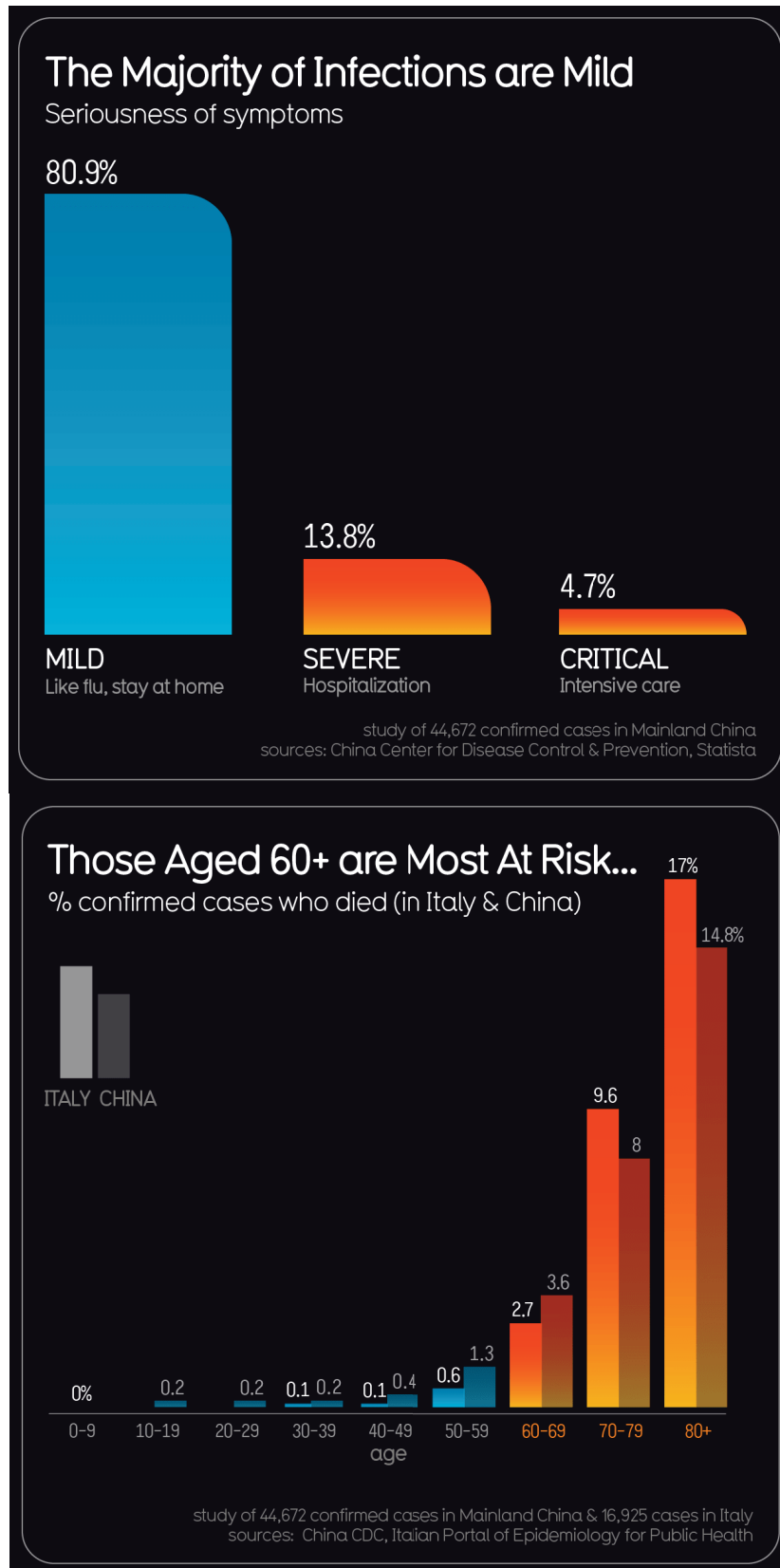
PREVENTION AND OUTCOMES

Prevention for the general population is being accomplished by social distancing and quarantine of infected patients or possibly infected patients. Movement of people from countries or areas of increased infection is being completely halted or restricted. A two-week period of quarantine is necessary for infected or possibly infected patients, as well as individuals exposed to an infected patient. Travelers from a country with a high incidence of COVID-19 and cruise ship passengers are also required to self-quarantine for two weeks. Frequent hand washing

with soap and water for at least twenty seconds or use of hand sanitizer is strongly recommended. COVID-19 can be inactivated on surfaces by disinfection with 70% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite for one minute. Infected or possibly infected patients should wear masks when seeking medical diagnosis or treatment to lessen the chance of spreading disease. Healthcare workers need to wear gloves, gowns, and N-95 respirators when providing care to infected or possibly infected patients. This protective equipment is also necessary for healthcare workers obtaining nasal and throat swabs for diagnostic testing. Both federal researchers and pharmaceutical companies are developing and testing vaccines to prevent COVID-19, but even with accelerated programs it will likely be 1-2 years before a safe and effective vaccine is available to the public.

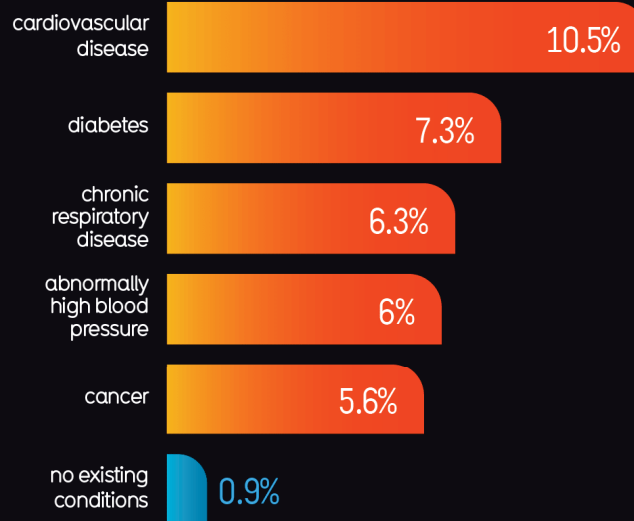
Children generally have mild disease; the rare cases of severe disease in children are almost never fatal. Adults have increasing risks of severe disease with older age, underlying diseases, and smoking. The overall adult mortality rate worldwide has ranged from less than 1% to 3%. For elderly patients, the mortality rate is much higher and may exceed 10%. Individuals can completely recover even from severe disease, but some patients recovering from severe disease may shed virus for several weeks and may require longer quarantine. Hospitalized patients should test negative for the virus before being removed from quarantine after discharge from the hospital.

—H. Bradford Hawley, MD



Especially Those with Existing Conditions

% with other **serious ailments** who die

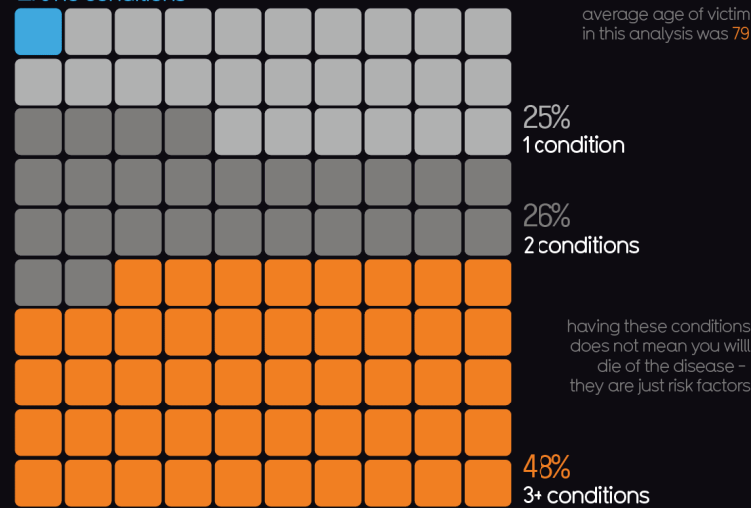


study of 44,672 confirmed cases in Mainland China
sources: China Center for Disease Control & Prevention, Statista

Multiple Conditions Increase Risk

Serious conditions present in those who have died

1% **no conditions**

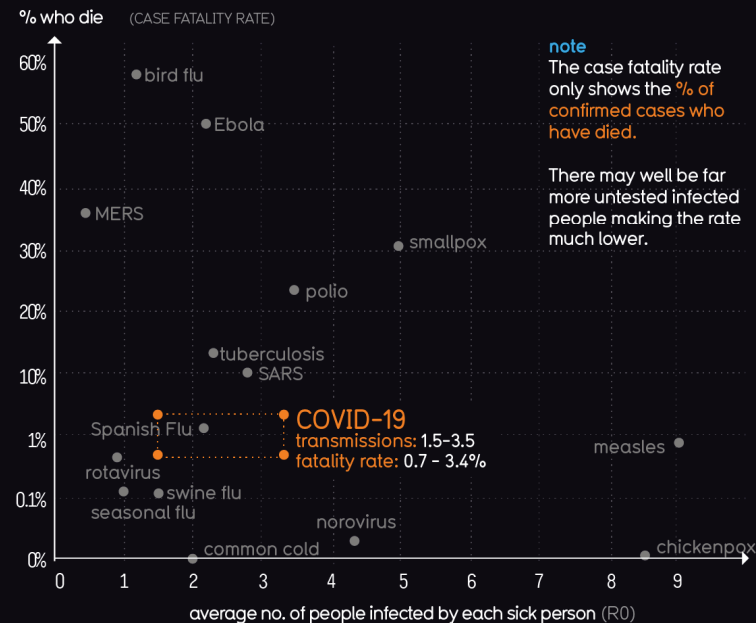


Active cancer, Atrial fibrillation, Chronic Obstructive Pulmonary Disease (COPD)
Dementia, Diabetes, Heart disease, Hypertension, Liver disease (chronic),
Renal failure (chronic), Stroke

study of 355 deaths from 16,925 confirmed cases in Italy
source: Italian Portal of Epidemiology for Public Health

How Contagious & Deadly is It?

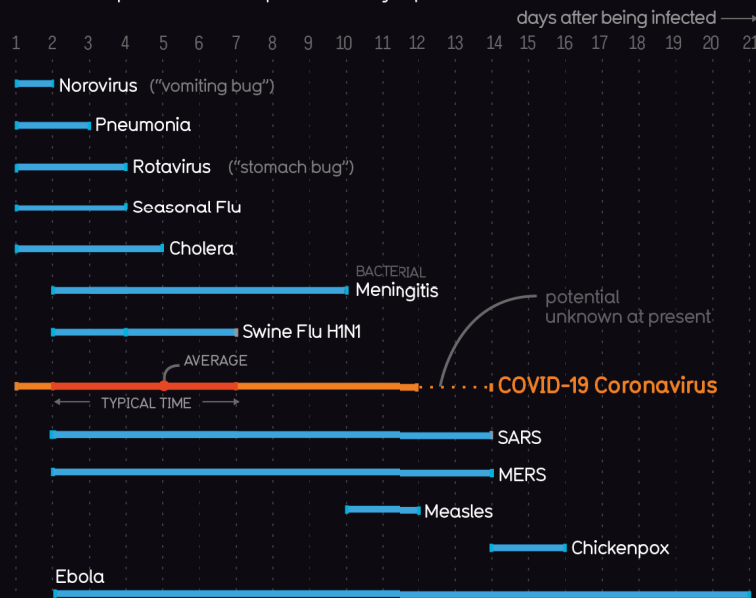
We don't fully know yet but it's in **this range**



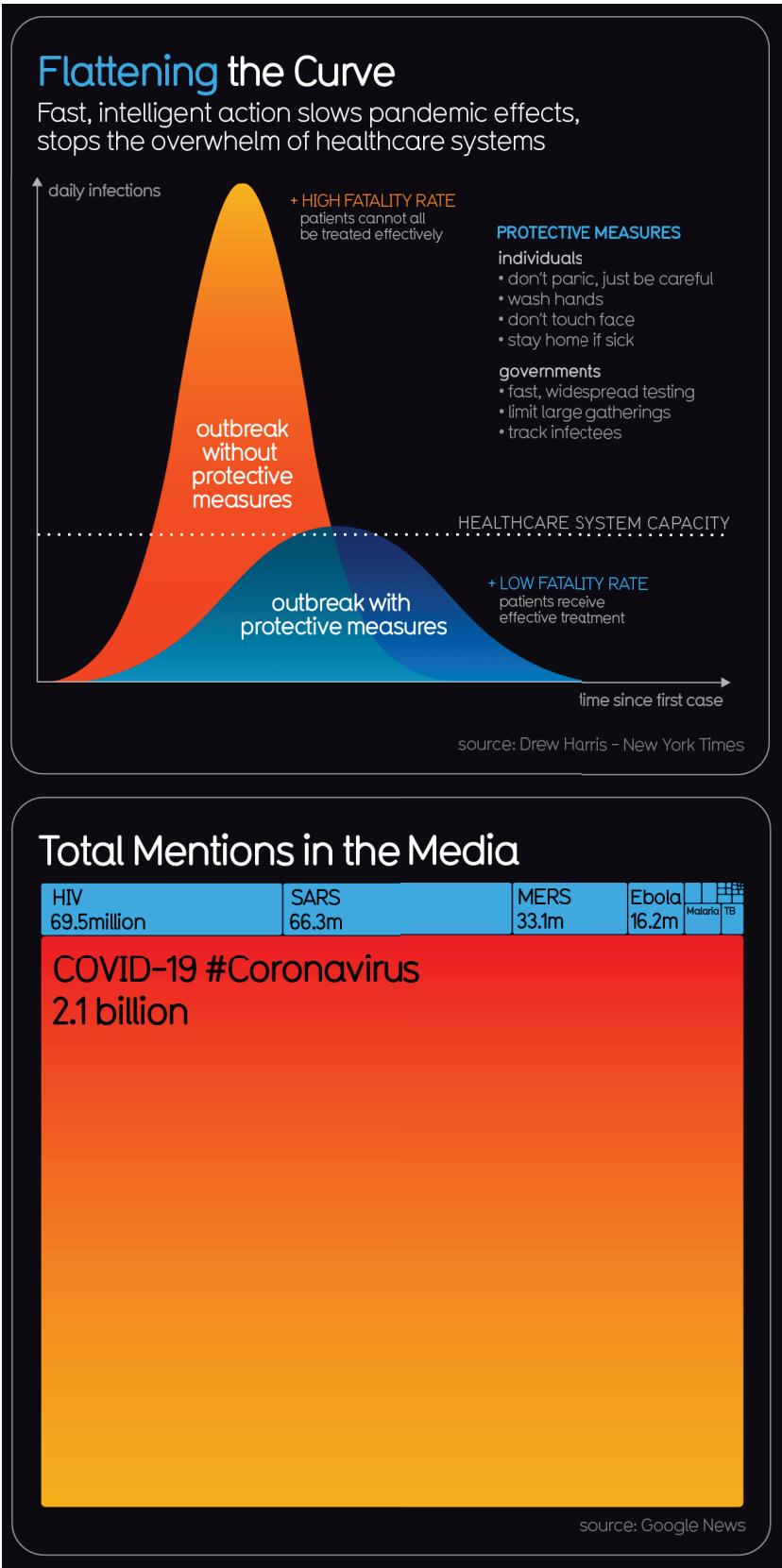
sources: US Centers for Disease Control & Prevention, WHO, New York Times

Incubation Periods

Range of time after infection but before showing symptoms, when a person can potentially spread a disease



sources: US Centers for Disease Control & Prevention, WHO, Lauer et al (2020)



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WEB SITES

Centers for Disease Control and Prevention
www.cdc.gov

Infectious Diseases Society of America
www.idsociety.org

The Society for Healthcare Epidemiology of America
www.shea-online.org

United States Environmental Protection Agency
www.epa.gov/pesticide-registration/

"TIME FOR PHYSICIANS TO CREATE HISTORY TOGETHER"

by Patrice A. Harris

Delivered on June 11, 2019, to the American Medical Association Annual Meeting, Chicago, IL. © American Medical Association. All rights reserved/Courtesy of AMA Archives.

Patrice Harris became the first African American woman and the 174th president of the American Medical Association in June 2019. She the chair of the Opioid Task Force and she is a psychiatrist. Harris has a bachelor's degree in psychology, a master's degree in counseling psychology, and a medical degree from West Virginia University.

Good evening. Tonight is very special for me and I honored that each of you is here to share it. The poet Maya Angelou once said if one is lucky a solitary fantasy, and I would add dream, can totally transform 1 million realities. Now you didn't think you'd sit through an address from a psychiatrist and not hear something about fantasies and dreams, did you?

But the great thing about psychiatrists is that we can talk about dreams as well as the hippocampus and the cytochrome p 450 system. It's truly a dream come true to stand before you tonight, a dream my ancestors, parents, my extended family and supported before it even entered my imagination. A dream my West Virginia Georgia psychiatry and AMA helped me achieve and I know in my heart tonight that I am my ancestors' wildest dreams.

I would like to thank my parents Barbara and Titus Harris, my fierce protector Anthony, the Harrison Smith families, the Baron Singley Williams families and Clark Brody family, my sorority sisters of Alpha Kappa Alpha Sorority, my WVU and West Virginia friends, my 80 aliens and Georgians who are here tonight and all my management and staff. Please join me in thanking.

I'd also like to recognize two other who broke barriers in our organization: Dr. Lonnie Bristow, the first African American to lead the AMA, and Dr. Nancy Dickey, the first woman to lead the AMA.

So if you'd hadn't guessed already I've chosen as the theme of my inauguration from many families, one now each of our families, whether composed of relatives, friends, or colleagues has something to teach us and mine have been no different. A common thread of my lessons is the importance of standing together. From my Aunt Betty who when confronted with a challenging situation would remind me we Harris's stick together. From my Georgia family who taught me that physicians are at our best in advocacy

when we work together, and you, my AMA family, remind me daily that there is strength in our collective voice.

Now my personal journey has also taught me many valuable lessons. First, medicine involves a community. I learned this from Marcus Welby MD—I know the younger folks are gonna have to google that but a fictional television doctor from the 1970s who actually inspired me to become a physician doctor. Welby not only cared for his patients inside the exam room but he cared about their lives, their families, and their communities. Another lesson, medicine relies on teamwork, I learned this as a medical student in the emergency department holding a woman's hand in my heart, holding a woman's heart in my hand as a member of the on-call trauma team and we were working to keep her heart beating after a motor vehicle accident.

Medicine needs a broad perspective. From my work with patients who've been abused, neglected, diagnosed with a mental illness, subjected to childhood trauma, my patients who are homeless or unemployed, I learned that I often overlooked health determinants that have an effect on one's health over a lifetime.

Medicine needs allies. I've learned the critical importance of partnerships with legislators, community-based organizations and the business community, and the impact of those partnerships on patient health. And finally, medicine's future needs leadership. It needs us, the AMA, to lead the way. Last month I gave the commencement address at the Morehouse School of Medicine, and there I saw the future. I saw our brilliant and highly motivated future colleagues who cannot wait to stand where we are and who are counting on us to lead before we pass the baton.

Our personal journeys inform the people we become, and just as I am the sum of my parts—an African American, a psychiatrist, a child from the heart of coal country—so each of you is the sum of your parts, where you came from, your specialty, and your experiences. Our diversity is the source of our strength as we face medicine's most daunting challenges. From geography to age and gender, our uniquely lived experiences shape who we are as people and as physicians. Now while we have many differences at the AMA we have this common goal through this great organization: we believe we can uplift our profession, we believe we can improve care for all of our 300-plus million fellow Americans and we believe we can stand as leaders in health care across the globe.

So lead we must, and lead we will. But our core values—access to health care for all, diversity and inclusion, the primacy of the patient-physician relationship, the advancement of science and public health—these core values will not be a part of a healthcare landscape unless ensure that they are. Over our 172-year history as an organization we have faced many challenges and we are all too well aware of what we face today.

While the Affordable Care Act brought coverage to millions of Americans, millions still lack coverage and we know there are those who want to roll back the gains we've made. Far too many people—one in two adults—struggle with chronic conditions like diabetes and heart disease. Though we've made progress the face of medicine still fails to match the faces of our patients. People living in rural areas too often have to drive hundreds of miles to the nearest physician or hospital. Overdoses continue to outpace other causes of premature death and wreak havoc on our communities. Our young people are subject to the dangers of e-cigarette use at epidemic levels and pharmaceutical prices continue to soar. But I see these not as intractable problems but as intractable opportunities. Opportunities that we as physicians fully embrace because we don't run away from problems.

Physicians run towards them, and that is our role, our responsibility and our AMA mission. We can make a difference and we do make a difference. Our formula for success? Community, teamwork, a broad perspective, professional allies, and a willingness to lead. Well, as Barbara said, a year is not a long time. Like all who came before me, I too hope to leave a

mark on the AMA, both as a child and a lesson psychiatrist and as the first African American woman to hold this position. And so when I look back on my time as president I hope to say we turned the promise of parity for mental health into reality.

We moved the needle on health equity. We reformed prior authorization so that more patients could get the right care at the right time. And we saw the end to the opioid epidemic on the horizon and furthered alliances in Washington and across every state to remove barriers treatment for those diagnosed with substance use disorders.

One of my favorite poems about leadership was written by Mary Lou Anderson and she wrote leaders are called to stand in that lonely place between the no longer and the not yet and intentionally make decisions that will bind, forge, move, and create history. When it comes to health equity, to mental health and too many other issues, medicine is in that lonely place between the no longer and the not yet, and we must act intentionally to move forward. We are no longer at a place where those with mental illness and addiction are hidden and ignored but we are not yet at a place where mental disorders are viewed without stigma and truly integrated into healthcare. We are no longer at a place where we can tolerate the disparities that plague communities of colored women and the LGBTQ community but we are not yet at a place where health equity is achieved in those communities and not yet at a place where women can live with confidence that we are firmly in charge of our own medical decisions. We are no longer at a place where underrepresented groups are unwelcome in medicine but we are not yet at a place where African American men are entering or graduating from medical schools at the rates of their peers. We are no longer at a place where we can tolerate bureaucratic government and PARE requirements that add to the cost of care without increasing value but not yet at a place where we have eliminated unnecessary regulations and can truly focus on care. We are no longer at a place where we can turn a blind eye to the chronic conditions that plague half of American adults but not yet at a place where everyone has access to affordable health care.

So colleagues, as medicine's leaders we all need to stand in those sometimes lonely places and make decisions now that will move us forward to a future we helped create. So I asked you to join me in taking the

next step of leadership and intentionally make decisions that will bind, forge, move, and create history. The AMA has led the way on numerous public health advances throughout our history. So let us commit tonight to move medicine forward again this year. And we state emphatically that health in all its dimensions is a basic human right.

AMA family, friends, colleagues, partners, we can do this because when we all join together bringing our differing perspectives, backgrounds, experiences, and resources to bear, that's when we can truly

move medicine forward for the good of our patients, the nation and the world.

So I'll close with one more quote from Maya Angelou, who said life is not measured by the number of breaths we take but by the moments that take our breath away. And for me tonight is one of those moments. I am honored that each of you is here to share it with me and by the trust you have placed in me. I can promise you that the legacy of the AMA will be in good hands as we work together to transform 1 million realities.

CORONAVIRUS INFECTIONS

Anatomy or system affected: Gastrointestinal system, lungs, respiratory system

Also known as: Common cold, SARS, viral bronchitis, viral pneumonia

DEFINITION

Exposure to the coronavirus results in a variety of infections, including approximately one-third of all cases of the common cold. The virus also may be responsible for viral bronchitis, pneumonia, and SARS (severe acute respiratory syndrome), especially in persons with weakened immune systems. The coronavirus is the largest positive-strand ribonucleic acid (RNA) virus; it is part of the Coronaviridae family.

CAUSES

Coronavirus is the underlying cause of a variety of illnesses that affect the respiratory system, the gastrointestinal system, and, in rare cases, the neurological system. Infections with the virus are often seasonal in nature, with more occurring in winter. Contact with contaminated droplets from sneezing and coughing and direct contact by touching contaminated objects, such as surfaces and tissues, may transmit the virus from person to person.

The virus may live six to nine hours, and the live virus has been found in the stool of people diagnosed with SARS. It is highly contagious, and reinfection may occur. The virus can affect humans, cattle, pigs, rodents, cats, dogs, and birds, but there is no evidence of animal and bird variations infecting humans.

RISK FACTORS

Risk factors for coronavirus infection are exposure to an infected person through kissing and sharing living spaces and contact with droplets or contaminated surfaces containing the virus. The severity of the infection increases if a person is immunocompromised (less able to fight infections because of a weakened immune system).

SYMPTOMS

Coronavirus infection that leads to the common cold comes with symptoms of fatigue, a scratchy throat, sneezing, nasal congestion, and a runny nose. Fever rarely occurs with a cold, except in children. A more serious infection, such as pneumonia or SARS, may

be occurring if symptoms include fever, chills, muscle aches, an acute cough, a headache, dizziness, or diarrhea.

SCREENING AND DIAGNOSIS

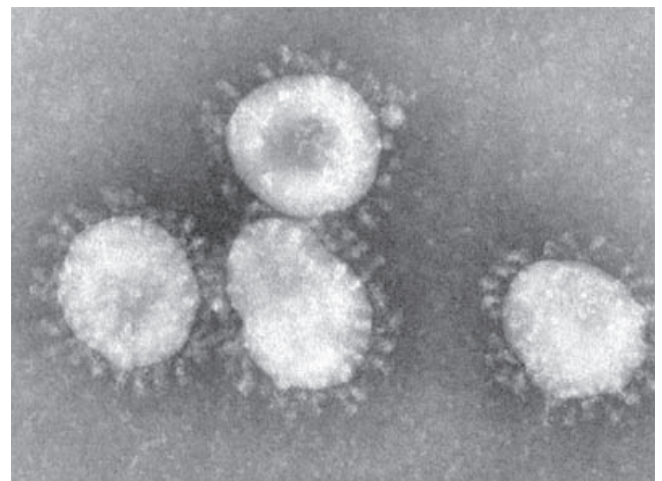
A physical examination including listening to lung sounds, reviewing symptoms, chest X rays, and blood work may be used to determine if a person has a cold or has developed pneumonia or SARS. Blood work may include blood chemistries and a complete blood count to determine if white blood cell counts, lymphocytes, and platelets are low. Specific tests for SARS may be ordered too.

TREATMENT AND THERAPY

In the absence of fever, symptoms may be treated with over-the-counter medications, plenty of fluids, and rest. If symptoms worsen or if a fever develops, one should seek medical care. Antibiotics, antiviral medications, and high doses of steroids to decrease lung inflammation may be prescribed. In severe cases, the patient may need oxygen, breathing support with a respirator, and hospitalization.

PREVENTION AND OUTCOMES

The best prevention against coronavirus infection is to limit contact with infected persons. Hand hygiene, including handwashing or cleaning hands with an alcohol-based hand sanitizer, is an important part of prevention. Infected persons should cough or sneeze



Coronaviruses with classic halo-like appearance. Image courtesy of the CDC. Photo by Dr. Fred Murphy via Wikimedia Commons.

into tissue or into the arm to minimize droplets and airborne particles. Because coronavirus is contagious, one should not share food and drink, utensils, or personal supplies. Household areas, including door knobs, counter tops, and other surfaces, should be cleaned with disinfectant.

FURTHER READING

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WEB SITES OF INTEREST

American Lung Association

<http://www.lungusa.org>

American Public Health Association

<http://www.apha.org>

Centers for Disease Control and Prevention

<http://www.cdc.gov>

Clean Hands Coalition

<http://www.cleanhandscoalition.org>

WILL THE CORONAVIRUS END GLOBALIZATION AS WE KNOW IT?

The Pandemic Is Exposing Market Vulnerabilities No One Knew Existed

by Henry Farrell and Abraham Newman, *Foreign Affairs*, March 16, 2020

The new coronavirus is shaping up to be an enormous stress test for globalization. As critical supply chains break down, and nations hoard medical supplies and rush to limit travel, the crisis is forcing a major reevaluation of the interconnected global economy. Not only has globalization allowed for the rapid spread of contagious disease but it has fostered deep interdependence between firms and nations that makes them more vulnerable to unexpected shocks. Now, firms and nations alike are discovering just how vulnerable they are.

But the lesson of the new coronavirus is not that globalization failed. The lesson is that globalization is fragile, despite or even because of its benefits. For decades, individual firms' relentless efforts to eliminate redundancy generated unprecedented wealth. But these efforts also reduced the amount of unused resources—what economists refer to as “slack”—in the global economy as a whole. In normal times, firms often see slack as a measure of idle, or even squandered, productive capacity. But too little slack makes the broader system brittle in times of crisis, eliminating critical fail-safes.

Lack of fail-safe manufacturing alternatives can cause supply chains to break down, as they have in some medical and health-related sectors as a result of the new coronavirus. Producers of vital medical supplies have been overwhelmed by a surge in global demand, pitting countries against one another in a competition for resources. The outcome has been a shift in power dynamics among major world economies, with those that are well prepared to combat the new virus either hoarding resources for themselves or assisting those that are not—and expanding their influence on the global stage as a result.

FRAGILE EFFICIENCY

The conventional wisdom about globalization is that it created a thriving international marketplace, allowing manufacturers to build flexible supply chains by substituting one supplier or component for another as needed. Adam Smith's *The Wealth of*

Nations became the wealth of the world as businesses took advantage of a globalized division of labor. Specialization produced greater efficiency, which in turn led to growth.

But globalization also created a complex system of interdependence. Companies embraced global supply chains, giving rise to a tangled web of production networks that wove the world economy together. The components of a given product could now be made in dozens of countries. This drive toward specialization sometimes made substitution difficult, especially for unusual skills or products. And as production went global, countries also became more interdependent, because no country could possibly control all the goods and components its economy needed. National economies were subsumed into a vast global network of suppliers.

The pandemic is exposing the fragility of the globalized system.

The pandemic of the disease caused by the new coronavirus, COVID-19, is exposing the fragility of this globalized system. Some economic sectors—particularly those with a high degree of redundancy and in which production is spread across multiple countries—could weather the crisis relatively well. Others could be pushed close to collapse if the pandemic prevents a single supplier in a single country from producing a critical and widely used component. For example, car manufacturers across western Europe worry about shortages of small electronics because a single manufacturer, MTA Advanced Automotive Solutions, has been forced to suspend production at one of its plants in Italy.

In an earlier age, manufacturers might have built up stockpiles of supplies to protect themselves in a moment like this. But in the age of globalization, many businesses subscribe to Apple CEO Tim Cook's famous dictum that inventory is “fundamentally evil.” Instead of paying to warehouse the parts that they need to manufacture a given product, these

companies rely on “just-in-time” supply chains that function as the name suggests. But in the midst of a global pandemic, just-in-time can easily become too late. Partly as a result of supply chain problems, global production of laptops fell by as much as 50 percent in February, and production of smartphones could fall by 12 percent this coming quarter. Both products are built with components produced by specialized Asian manufacturers.

CRITICAL SHORTAGES

Production bottlenecks like the ones in electronics manufacturing are also hampering the fight against the new coronavirus. Critical medical supplies such as reagents, a key component of the test kits that laboratories use to detect viral RNA, are either running low or out of stock in many countries. Two companies dominate the production of the necessary reagents: the Dutch company Qiagen (recently purchased by the U.S. giant Thermo Fisher Scientific) and Roche laboratories, which is based in Switzerland. Both have been unable to keep up with the extraordinary surge in demand for their products. The shortfall has delayed the production of test kits in the United States, which finds itself having to get in line behind other countries to buy the chemicals it needs.

As the new virus spreads, some governments are giving in to their worst instincts. Even before the COVID-19 outbreak began, Chinese manufacturers made half of the world’s medical masks. These manufacturers ramped up production as a result of the crisis, but the Chinese government effectively bought up the country’s entire supply of masks, while also importing large quantities of masks and respirators from abroad. China certainly needed them, but the result of its buying spree was a supply crunch that hobbled other countries’ response to the disease.

As the new virus spreads, some governments are giving in to their worst instincts.

European countries didn’t behave much better. Russia and Turkey prohibited the export of medical masks and respirators. Germany did the same, even though it is a member of the European Union, which is supposed to have a “single market” with unrestricted free trade among its member states. The French government took the simpler step of seizing all available masks. EU officials complained that such

actions undermined solidarity and prevented the EU from adopting a common approach to combating the new virus, but they were simply ignored.

These beggar-thy-neighbor dynamics threaten to escalate as the crisis deepens, choking off global supply chains for urgent medical supplies. The problem is dire for the United States, which has been late to adopt a coherent response to the pandemic and is short on many of the supplies it will need. The United States has a national stockpile of masks, but it hasn’t been replenished since 2009 and contains only a fraction of the number that could be required. Unsurprisingly, President Donald Trump’s trade adviser, Peter Navarro, has used this and other shortages to threaten allies and to justify a further withdrawal from global trade, arguing that the United States needs to “bring home its manufacturing capabilities and supply chains for essential medicines.” As a result, Germany is reportedly worried that the Trump administration will make the aggressive move of completely buying out a new vaccine under development by a German company in order to use it in the United States. Berlin is now considering whether to make a counterbid on the vaccine or ban the U.S. transaction.

VIRAL INFLUENCE

Whereas the Trump administration has used the pandemic to pull back on global integration, China is using the crisis to showcase its willingness to lead. As the first country hit by the new coronavirus, China suffered grievously over the last three months. But now it is beginning to recover, just as the rest of the world is succumbing to the disease. That poses a problem for Chinese manufacturers, many of which are now up and running again but facing weak demand from countries in crisis. But it also gives China an enormous short-term opportunity to influence the behavior of other states. Despite early mistakes that likely cost the lives of thousands of people, Beijing has learned how to fight the new virus, and it has stockpiles of equipment. These are valuable assets—and Beijing has deployed them with skill.

In early March, Italy called on other EU countries to provide emergency medical equipment as critical shortages forced its doctors to make heartbreaking decisions about which patients to try to save and which to let die. None of them responded. But China

did, offering to sell ventilators, masks, protective suits, and swabs. As the China experts Rush Doshi and Julian Gewirtz have argued, Beijing seeks to portray itself as the leader of the global fight against the new coronavirus in order to promote goodwill and expand its influence.

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This is awkward for the Trump administration, which has been slow to respond to the new virus (and which thinks banning travelers from Europe is the best defense against a disease that is already spreading rapidly on its soil). Far from serving as a global provider of public goods, the United States has few resources that it can offer to other states. To add insult to injury, the United States may soon find itself receiving Chinese charity: the billionaire cofounder of Alibaba, Jack Ma, has offered to donate 500,000 test kits and one million masks.

THE NEW GEOPOLITICS OF GLOBALIZATION

As policymakers around the world struggle to deal with the new coronavirus and its aftermath, they will have to confront the fact that the global

economy doesn't work as they thought it did. Globalization calls for an ever-increasing specialization of labor across countries, a model that creates extraordinary efficiencies but also extraordinary vulnerabilities. Shocks such as the COVID-19 pandemic reveal these vulnerabilities. Single-source providers, or regions of the world that specialize in one particular product, can create unexpected fragility in moments of crisis, causing supply chains to break down. In the coming months, many more of these vulnerabilities will be exposed.

The result may be a shift in global politics. With the health and safety of their citizens at stake, countries may decide to block exports or seize critical supplies, even if doing so hurts their allies and neighbors. Such a retreat from globalization would make generosity an even more powerful tool of influence for states that can afford it. So far, the United States has not been a leader in the global response to the new coronavirus, and it has ceded at least some of that role to China. This pandemic is reshaping the geopolitics of globalization, but the United States isn't adapting. Instead, it's sick and hiding under the covers.

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EPIDEMICS AND PANDEMICS: HISTORY

DEFINITION

Although the definitions of the terms “epidemic” and “pandemic” remain inexact, authorities mostly agree that the difference between the two words is subtle and hinges on the geographical scale of the disease and the number of populations afflicted. Generally, an epidemic is a frequent, severe, and widespread outbreak of a specific disease, whereas a pandemic is a recurring epidemic that affects a very large area of the world.

EPIDEMICS BEFORE THE SEVENTEENTH CENTURY

Civilization’s earliest written records periodically include accounts of devastating epidemics of unknown origin, epidemics that killed huge numbers of people and left behind disruption and despair. In 430 b.c.e., the city of Athens, Greece, was faced with a four-year epidemic known as the plague of Athens that appeared during the Peloponnesian War and reduced the Athenian population by 30 to 35 percent. Greek historian Thucydides, afflicted by a then-unknown disease, described its effects upon people, suggesting that it was not bubonic plague but, more likely, smallpox. Thought to have originated in Africa, smallpox was unknown to Athenians; consequently, Athens was likely a virgin-soil area.

Although by the fifth century b.c.e. in ancient Rome, malaria was endemic to certain low lying areas, reaching epidemic proportions during late summer and fall, no evidence suggests how it affected the population. However, a series of epidemics swept through the Roman Empire, one of the most deadly being the plague of the Antonines, which struck Rome in 166 c.e. and lasted about fifteen years. The famous Greco-Roman physician Galen, who lived during this time, recorded descriptions of those stricken that imply the disease was smallpox. Estimates of this disaster (from nineteenth and early twentieth century writings) insist that one-half the Roman Empire population died, but later research suggests a loss of 10 percent of the population.

In the eighth century, smallpox epidemics ravaged Japan, and attacks of leprosy (Hansen’s disease) in Europe between 1000 and about 1350 led to the construction of institutions for isolating lepers. Thought by medieval Christians to be divine punishment for

sin, and by physicians to reflect an imbalance in the four humours (blood, phlegm, yellow bile, and black bile) that are believed to inhabit the body, ideas about leprosy were influenced by medieval attitudes. People of the time believed that epidemics resulted from God’s anger, especially the deadly epidemic known as French disease, or syphilis, which was spread through Europe by soldiers. Pustules appeared on infected bodies, which soon seemed to rot. Response to this disease included the first prepared and marketed remedy: mercuric ointment.

The encroachment of French disease into virgin-soil areas of Europe also was similar to the vast sixteenth century American epidemics originating with Spanish explorers and slaves who unwittingly spread microorganisms among the indigenous peoples (who had no previous exposure). Spreading from the Caribbean region to Mexico, in about 1520, smallpox took a huge toll on the Aztecs, on the peoples of Panama, and on the Incas in South America, therefore reducing the indigenous resistance to the Spanish conquerors. The later part of the century saw renewed outbreaks of smallpox, measles, and typhus.

EPIDEMICS: SEVENTEENTH TO TWENTY-FIRST CENTURIES

Few methods of disease exposure were more effective than war, particularly the Thirty Years’ War, which involved vast numbers of people in a large area of central Europe. Most battles raged through the Germanic areas, with many areas losing one-half their populations between 1618 and 1648. This century’s battles illustrated the interaction between war and epidemic disease that characterized armies in centuries to come. Wars carried diseases of influenza, typhus, and plague, yet, war’s chaos prevented any response to the diseases.

Also in the seventeenth century, a sequence of disasters, including famines, floods, and epidemics that may have involved several different diseases (such as typhus, typhoid fever, malaria, dysentery, and bubonic and pneumonic plague), ravaged China between 1635 and 1644. Much conjecture pertains to the political implications of the losses of populations in certain areas and to whether the crop failures

associated with disasters contributed to dietary deficiencies in a population more likely to succumb to disease.

In its devastation of huge areas of the world, smallpox attacked Iceland between 1707 and 1709, claiming the lives of one-quarter of the population. In 1721, Boston fell victim to a smallpox epidemic, leading to controversy between religion and science with regard to inoculation. The argument concerning inoculation continued during the eighteenth century smallpox rampage through European cities, with children being the most susceptible to the disease.

A severe late-eighteenth century epidemic of yellow fever thwarted the efforts of British soldiers trying to take over Saint Domingue (now Haiti) and ultimately facilitated the island's bid for independence by its former slaves. Another yellow fever epidemic farther north afflicted Philadelphia and was possibly caused by fleeing Haitian refugees. As the capital of the new United States, Philadelphia's wrestling with a deadly epidemic led to limitless political speculation. In 1853, yellow fever struck New Orleans, a site of frequent outbreaks, with its worst epidemic, leading to one-half of the recorded deaths in that city in 1853.

In 1916, the United States sustained the world's first major poliomyelitis epidemic, in the environs of New York City, striking mostly young children. Twenty-seven thousand Americans were afflicted by poliomyelitis and six thousand died from the disease. This epidemic initiated hysteria about poliomyelitis, whose numbers rose drastically between 1945 and 1955, and then declined spectacularly. In the 1980's, the number of diagnosed AIDS (acquired immunodeficiency syndrome) cases in the United States reached more than 160,000, soon declining significantly. Tuberculosis, sometimes connected with AIDS, is one of the most prevalent diseases in the world, as is malaria, whose death toll in the twentieth century varies between one and two million cases, most of these in Africa.

PANDEMICS: PLAGUE AND CHOLERA

The first plague pandemic began spreading from obscure origins in 540 b.c.e., moving through the Roman Empire into Asia in waves of disease for two hundred years. Although modern estimates of mortality vary widely, descriptions of those afflicted verify

that the disease was bubonic plague. Thought to be sent by a vengeful God, the plague prompted changes in populations hitherto discussed only speculatively; however, recent archaeological discoveries have suggested more indirect answers.

The second plague pandemic began with the Black Death that originated in 1346 in southern Russia and spread, following trade routes, to the most densely populated areas in Europe, destroying more than one-third of its population by 1353. As the Black Death began to wane, other random but widespread outbreaks occurred in the next four hundred years, targeting Italian cities in the 1630's, London in 1665, Marseilles in 1721-1722, and Moscow in 1771; it remained in northern Africa until 1844. Before the second plague pandemic was extinguished in Asia, another disease site took hold in China that would expand into the third plague pandemic. This third plague pandemic continued in Asia and then into Africa and the United States in the twentieth century. An estimated thirteen million people perished in the third plague pandemic, with most deaths between 1894 and 1912.

All seven cholera pandemics that afflicted vast areas of the world began in Bengal, India, in the Ganges River delta, where cholera had long been endemic. The first pandemic began in Calcutta in 1817 and spread into Thailand, the Philippines, Asia, Japan, the Persian Gulf, Syria, and Persia; by 1823, it had spread to the Russian Empire. The second cholera pandemic spread from Bengal in 1827 into Russia and continued westward to, for the first time, Europe and North America in 1832. Americans were suspicious of the immigrant poor, while many Parisians believed the cholera pandemic was an elitist plot to rid Paris of the poor. In 1839, the third cholera pandemic began in paths that moved from Bengal to other parts of the world, some of which had never seen cholera. The disease reappeared in Europe and North America, spreading widely into areas of the Caribbean and South America, where a shocking number of deaths occurred in Brazil and in Latin America. These deaths initiated inquiries about the connection between cholera and race.

The fourth cholera pandemic, beginning in 1863, traveled around the world and convinced many that cholera moved with "human traffic." The fifth pandemic, beginning in 1881, extended across the Mediterranean to Italy, France, and Spain,

then across the world to Argentina, Japan, and the Philippines. During this pandemic, Robert Koch, a German microbiologist, discovered a germ that is primarily in water (and in some food) and was responsible for cholera; but, as doubts and uncertainties reigned, positive response to his findings was slow in coming. The sixth cholera pandemic (1899) made less progress because of the growing insistence upon clean water supplies; and, the seventh cholera pandemic (1961), attacking Europe, Africa, Latin and Central America, and Mexico, left cholera endemic to some parts of the world.

PANDEMICS: INFLUENZA AND AIDS

In 1781-1782, a massive pandemic of influenza spread from Russia into Europe and afflicted an estimated three-fourths of the population of Europe. Despite its high morbidity rate (the number of ill persons), the mortality rate was relatively low, as the disease proved fatal mostly to the elderly. A second influenza pandemic (1889-1890), also beginning in Russia, extended worldwide by way of steamship and railroad travel. Morbidity was uncommonly high, calculated to be between one-third and one-half the world's population. Historian David Patterson has estimated that this pandemic killed between 270,000 and 360,000 people in Europe.

The third influenza pandemic (1918-1919) became the most extensive disease event in recorded history, with an estimated death toll of fifty million people. The pandemic traveled in three waves. The first one began in March of 1918 in Fort Riley, Kansas, and, following U.S. troops to battle in World War I, appeared in western Europe in April. It then moved to China, India, Australia, and Southeast Asia. The second wave of the influenza pandemic, experiencing a resurgence in France and crossing the Atlantic, entered Boston in October of 1918 and moved westward to the Pacific Coast. Mortality rates in the United States were estimated at 5.2 per 1,000 persons. Another surge of the second wave progressed from France, to the Mediterranean areas, and to Scandinavia, Great Britain, Germany, eastern Europe, and Russia. The second wave, far more lethal than the first, was especially harsh for young adults between the ages of eighteen and thirty-five years. Also, the populations in Asia, Africa, and India were at greater risk of death, suffering disastrous mortality rates that were twelve times greater than those of



Dr. Jordan Tappero, CDC, gets help with his face mask from a colleague with Médecins Sans Frontières/Doctors Without Borders. Safety precautions like these suits and goggles are necessary to guard the treatment team against highly infectious agents. Image courtesy of CDC Global via Wikimedia Commons.

Europe and North America. The pandemic's third wave was milder than the second, raising the number of cases moderately as the disease was in decline.

After becoming known in the United States in 1981, AIDS began to spread worldwide within ten years, and by the end of the century, more than 25 million people had died in the pandemic. The region most affected by AIDS was Africa, with Zimbabwe, Zambia, and Malawi exceeding 500 cases per 100,000 persons. The number of persons in South Africa who are infected with the human immunodeficiency virus (HIV) reached 5.3 million by 2004. Since 2003, Asia has posted higher numbers of new infections than those of Africa, and India's 5.1 million HIV cases comes near to South Africa's total. In many African states, life expectancy has fallen below age forty years, as the disease strikes age groups between fifteen and forty-five years, and has increased the death rate of orphaned children. Also, the economic aspects are dire because the targeted age group is the most productive group of the African population.

IMPACT

Knowledge of major epidemics and pandemics from the beginning of recorded history provides insight into the beliefs and mind-sets peculiar to times that were unable to combat catastrophic diseases. With the gradual realization that epidemics demand responses from the medical community, world societies began to understand the need for clean water,

antibiotics, vaccines, and quarantines. This knowledge also raises serious questions about the future of epidemics and pandemics from the standpoint of population shifts and growth, primarily in dense urban populations in warm climates, and about mass migration and the aging or younger populations who are especially at risk. Other serious considerations include the cost of public health measures, the effect of certain political imperatives, and the possibilities that those without money would be disregarded.

—*Mary Hurd, M.A.*

FURTHER READING

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- Behrman, Greg. *The Invisible People: How the U.S. Has Slept Through the Global AIDS Pandemic, the Greatest Humanitarian Catastrophe of Our Time*. New York: Free Press, 2004. Addresses the effect of the AIDS pandemic on social and economic conditions both in the United States and in other regions of the world.
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- Trifonov, Vladimir, Hossein Khiabani, and Raul Rabadan. "Geographic Dependence, Surveillance, and Origins of the 2009 Influenza A (H1N1) Virus." *New England Journal of Medicine* 361 (2009): 115-119. This journal article discusses the various genetic origins of the 2009 H1N1 influenza virus.
- Tucker, Jonathan B. *Scourge. The Once and Future Threat of Smallpox*. New York: Atlantic Monthly Press, 2001. A detailed account of the history of smallpox, the eradication of the disease from the earth, and the controversy surrounding whether or not the remaining smallpox stocks should be destroyed. The potential of smallpox as a biological weapon is also addressed.

WEB SITES OF INTEREST

AIDSGov

<http://www.aids.gov>

Centers for Disease Control and Prevention

<http://www.cdc.gov>

Emerging and Reemerging Infectious Diseases Resource Center

<http://www.medscape.com/resource/infections>

World Health Organization

<http://www.who.int>

EPIDEMICS AND PANDEMICS: CAUSES AND MANAGEMENT

DEFINITIONS

An epidemic is a contagious, infectious, or viral disease affecting a disproportionate number of persons in a community, region, or population at the same time. A pandemic is a contagious, infectious, or viral disease occurring over a large geographical area or affecting a high proportion of a certain population.

Although both the terms “epidemic” and “pandemic” refer to a disease spreading through a population, a pandemic usually indicates either a larger geographical area or a higher number of people affected, or sometimes both. For example, a disease, such as influenza, may occur in a limited geographical area in many more people than would be expected. However, if the disease never spreads widely (perhaps only a few other cases appear nationwide), this situation would be an epidemic. However, if the disease spreads into a larger geographical area, for example, nationwide, with many more people contracting the disease than would be expected, this episode would then be termed a pandemic.

Another use of the term “pandemic” occurs when the disease affects an inordinate amount of people in a localized population. For example, in some areas of Africa, nearly 100 percent of the population is infected with the human immunodeficiency virus (HIV), making the situation a pandemic. Generally, a pandemic starts as an epidemic that, because of poor management, negligence, or ignorance, spreads into a larger area or affects a larger percentage of a population.

The application of the words “epidemic” and “pandemic” also depends on what is expected or what has been experienced in the past. For example, the common cold is a virus that is experienced worldwide; however, it is expected and it is known, from experience, that many people contract the virus that leads to the common cold. Even though the cold is a widespread illness, it is not a pandemic, or even an epidemic. However, hantavirus infection, being very rare and neither expected nor experienced by many, becomes epidemic when a few people do become infected.

The words “epidemic” and “pandemic” are often used in connection with a disease or condition, such as diabetes or obesity, that is not infectious. In their

true scientific senses, epidemic and pandemic refer only to conditions that are contagious or transmissible from one person to another.

CAUSES

Disease epidemics have been recorded since at least the time of the pharaohs in ancient Egypt, and there are biblical references to plagues and diseases that spread rapidly and decimated human populations. Some of the most striking examples of past epidemics include the Black Death, or bubonic plague, which spread through Europe in the fourteenth century; the smallpox epidemic that affected Native Americans at first contact with Europeans in the New World; and the Spanish flu, a form of influenza that spread around the world in 1918, killing millions of people in just eighteen months.

Epidemics can be spread by many different means, including by an infectious carrier, contamination, mutation of an infectious agent, human behavior, and environmental change.

Infectious carrier. Sometimes animals carry disease that can spread rapidly through a population. For example, the bubonic plague, which killed an estimated 1 of every 4 people in Europe and 1 of every 2 people in Venice alone in 1347-1348, is thought to have been spread by rats carrying fleas infected with the disease. These fleas easily made the transition from being carried by rats to being carried by people, and through their bites, the fleas spread this disease. Other examples of vectors (organisms that carry disease) are the ticks that carry Lyme disease.

It is also possible for a person to be a vector, to carry a disease without becoming or being infected. These carriers can infect others unknowingly. For example, in the early twentieth century case of Mary Mallon (also known as Typhoid Mary), who worked as a cook, Mallon infected more than forty people with typhoid fever. She was immune to typhoid, even though she carried the disease.

Contamination. Contamination of water or food can also be a source of epidemics, such as cholera, which is transmitted through contaminated water. Strange cases of outbreaks can be tied to contamination. For example, an outbreak of cases involving *Salmonella* bacteria in Minnesota in 1994 was traced

back to a particular brand of ice cream. However, *Salmonella* can be found only in poultry and eggs. Because the ice cream contained neither, the outbreak was puzzling. Further investigation revealed that the ice cream was created with a mix that had been carried by trucks that had previously carried unpasteurized eggs. Another factor was inadequate cleaning, which had contaminated the ice cream mix.

Mutation of an infectious agent. Even when the infectious agent is known, as are the *Plasmodium* microbes that cause malaria, an agent's ability to quickly mutate to survive can foil attempts to prevent the spread of disease. These microbes reproduce so rapidly and change genetic material so often that it is difficult for malarial medicine to keep up with the changes. Another problem that continues the spread of malaria is that involving the mosquitos that carry the disease; they too can quickly mutate and thus survive the application of pesticides, making it difficult to control the population of the infected vectors.

Human behavior. Social and political issues also affect how disease is spread. For example, even though many studies have shown that the best way to prevent the spreading of disease is frequent handwashing, other studies show that people do not always comply with handwashing recommendations. Another example is the refusal by some parents to vaccinate their children against diseases, even though the benefits of vaccination far outweigh the risks. Also, sexual contact can transmit infectious diseases; some people refuse to practice safer sex, even though doing so has been proven to reduce sexually transmitted infections. Lack of education and access to medications are other issues that allow disease to spread.

Another factor in the spread of disease is the introduction of new diseases by nonindigenous populations. Early Native Americans had contact with settling Europeans, who had gained immunity to but still carried infectious agents, causing Native Americans, who had never been exposed to the smallpox virus and thus had no opportunity to develop immunity to it, to contract severe and oftentimes fatal infections from their first exposure. This type of disease transmission still occurs today. With more people traveling the globe, diseases are spread more quickly among populations; for example, severe acute respiratory syndrome (SARS) spread rapidly throughout the world in early 2003 because of the high number of

international travelers who were infected.

Political issues also interfere with disease control. U.S. president Woodrow Wilson was roundly criticized for his policies during the influenza outbreak of 1918. Even though many people were dying from influenza, he refused to move resources focused on fighting in World War I to fighting the disease, thus possibly contributing to the spread of the disease and to many more deaths.

Environmental change. A short-term or long-term change in environmental conditions can contribute to the spread of a disease. An example of environmental change contributing to an epidemic is that of the hantavirus. This virus mysteriously appeared in Native Americans in the American Southwest in 1993, infecting three healthy people and rapidly killing them. The virus then spread through the population. Through a series of investigations, epidemiologists discovered that after years of drought, a snowy winter and wet spring had led to an increase in pinion nuts in the area, which, in turn, led to an increase in mice that ate these nuts. The hantavirus can be carried in the feces and urine of these mice. Infection occurred when people cleaned up the mouse droppings, inhaled the virus that was in the contaminated dust, and then passed the virus to other humans. Because of the change in weather, the mice, who had always been in the area, increased in numbers. This led to greater contact with the human population.

Environmental change contributed to the spread of disease among the people of the Lyme, Connecticut, area. People began building homes farther into the woods, which led to more contact with deer that were native to the area. These deer carried ticks that, in turn, carried the bacterium *Borrelia burgdorferi*. When the ticks began to leave their deer hosts and to infect humans with this bacterium, humans contracted what came to be called Lyme disease.

MANAGEMENT

Seventeenth century Dutch scientist Antoni van Leeuwenhoek first looked into his microscope and saw "little animals," thus inspiring scientists such as Robert Koch and Louis Pasteur to study and understand that microbes can cause diseases that can be transmitted from one person to another. Scientists still work at creating antibacterials, antivirals, and vaccines that will prevent people from getting or

spreading disease.

However, even with all the medications that are available, there are other hurdles to overcome in managing diseases. Often, medications are too expensive, or, as in cases of war or other civil disruptions, medications do not get to those who need them. Also, a decline in sanitary conditions can lead to outbreaks of disease. Vaccination programs can fail to reach a critical mass of people to keep infectious diseases under control.

Public health agencies also have a role to play in managing disease. John Snow had been credited with the first public health action in managing the spread of disease after he investigated the London cholera outbreak in 1854. Cholera was raging through the city, and many still believed that disease was caused by bad air or humours. Snow, however, plotted the cholera outbreak by using a map to pinpoint the cases of the disease. He noticed that many of the people with the disease were getting water from the Thames River through a pump; the river, at the time, was severely polluted with human waste. Even though he made his findings public, some people refused to believe that the polluted water was causing their illnesses. The Reverend Harry Whitehead found Snow's evidence compelling and worked with Snow to convince city officials to remove the handle of the pump, rendering it unusable. This public health intervention led to a rapid decline in the cases of cholera in the area and to an overhaul and general cleanup of London water sources.

These types of outbreaks still occur, and public health officials resort to seemingly drastic measures to try to control the spread of disease. For example, during a cryptosporidium outbreak in 2007, public health officials in Utah intervened to ensure public safety by asking that children younger than age five years, persons wearing a diaper, and persons with diarrhea avoid using public swimming pools. Even after the outbreak subsided, small children were required to wear a swim diaper and plastic pants to help curb the disease.

IMPACT

Epidemics have raged through populations since the beginning of human existence, and the future will be no different. The ability of infectious agents to propagate and mutate far outstrips the human immune system's ability to adapt to and fight contagious diseases.

However, fear and ignorance of how disease is transmitted have a huge societal and economic impact. For example, misunderstandings of how a particular disease is transmitted led to fear of touching persons with AIDS at the beginning of that pandemic. More recently, misunderstandings of how the H1N1 virus is transmitted led to the slaughter of pigs in certain countries. Neither of these actions impacted the infection rates of these diseases.

The keys to preventing epidemics and pandemics include understanding how a particular disease is transmitted and spread through a population; using public health pathways to provide and act upon scientifically proven information, both in controlling a disease and preventing it in the first place; and educating the public on good health practices, both socially and physically.

—Marianne M. Madsen, M.S.

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WEB SITES OF INTEREST

Centers for Disease Control and Prevention
<http://www.cdc.gov>

World Health Organization: Global Alert and Response
<http://www.who.int/csr>

OUTBREAKS OF INFECTIOUS DISEASE

DEFINITION

The term “outbreak” denotes a larger-than-expected occurrence of a specific disease or infection during a particular time and in a certain place. In other words, an outbreak is present when disease levels are greater than what would be typical or expected in a given community. Such a community could be as small as a school or restaurant or as large as a nation or continent. Outbreaks also can occur globally.

CLASSIFICATION

Although some variation exists on the precise definition of “outbreak” and its patterns of occurrence, the following is a general guide to the various types of outbreaks.

Endemic. An outbreak is considered to be endemic when there is continual presence of a disease or infection within a specific geographic area or among a particular subpopulation. For example, malaria is endemic to certain parts of Africa.

Epidemic. An epidemic is the sudden and severe occurrence of a disease or infection within a particular region or subpopulation. Epidemics usually spread very rapidly. An example of an epidemic is acquired immune deficiency syndrome (AIDS) among users of intravenous drugs.

Pandemic. As with an epidemic, a pandemic involves the sudden and severe occurrence of a disease or infection that spreads rapidly. However, a pandemic affects a much larger geographic area (several countries or more) and a sizable proportion of the population. Although a pandemic is the most serious type of outbreak, it is relatively uncommon, having occurred just three or four times per century. Examples include the great influenza (Spanish flu), the Hong Kong flu, and influenza A (H1N1).

DETERMINING THE EXISTENCE OF AN OUTBREAK

To establish whether or not an outbreak truly exists, it is essential to know the expected number of cases for a particular area during a given period of time. This may be done by comparing the current number of cases with the incidence rates in recent months or years. Sources of such information include health department surveillance records, disease registries, and hospital discharge records.

Even if the current number of cases appears to exceed the expected number, the excess may not necessarily indicate an outbreak. Variations in reporting procedures can impact these numbers, as can sudden changes in population size. Such factors must be considered when determining whether the increased number of cases would constitute an outbreak.

IMPLEMENTING MEASURES OF CONTROL AND PREVENTION

Once an outbreak has been confirmed, measures of control and prevention should be implemented immediately. Control methods can be undertaken quickly if the source of the outbreak is known. For instance, if an outbreak is food-borne, a control technique would be to destroy or recall the contaminated products.

Control measures also can be directed at interrupting disease transmission and minimizing exposure to causative agents. Immunizations are helpful for reducing the susceptibility to disease. However, it can take time to develop effective vaccines. Regardless of the methods used, educating the public is a major component of controlling and preventing outbreaks.

RECENT OUTBREAKS

Listed here are examples of recent outbreaks, mostly in the Western Hemisphere.

Cholera in Haiti (October, 2010). Before this outbreak, cholera had not occurred in Haiti for several decades.

Salmonella (August, 2010). Millions of eggs were recalled after thousands of people in the United States became ill from *Salmonella enteritidis*.

Escherichia coli (July, 2009). This outbreak, involving *E. coli* infection and beef products, occurred in the United States.

E. coli (June, 2009). This outbreak of *E. coli* infection in the United States was linked to the consumption of raw, refrigerated, and prepackaged cookie dough.

H1N1 influenza (April, 2009). Cases of the H1N1 flu were confirmed in the United States and internationally.

IMPACT

The overall impact of a disease outbreak is enormous. In addition to the negative effects on people's health and well being, and its causing death, outbreaks pose tremendous burdens for health care facilities and systems, often draining their resources. Control, prevention, and education must be further developed and implemented. Such efforts require substantial time, energy, financial resources, and collaboration among policymakers and other community groups. Outbreaks can impact productivity in schools and the workplace too, and they create extreme burdens for society as a whole.

—Lynda A. Seminara, B.A.

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<http://www.knowledgeisinfectious.org>
- Centers for Disease Control and Prevention, Emergency Preparedness and Response
<http://emergency.cdc.gov>
- Emerging and Reemerging Infectious Diseases Resource Center
<http://www.medscape.com/resource/infections>
- World Health Organization: Global Alert and Response
<http://www.who.int/csr/don>

PUBLIC HEALTH

DEFINITION

Public health is a practice that focuses on the promotion of physical, mental, and social health and well-being and on the prevention of disease and disability among groups of people. It differs from the practice of medicine because it focuses on prevention rather than cures and addresses the needs of people as a whole rather than as individual persons.

Public health is an evidence-based practice, which means that its professionals collect and analyze data to determine the health needs and risks of a population and then design programs to deliver services that will effectively address these needs and reduce risks.

AREAS OF SPECIALIZATION

Public health encompasses many specialized fields of study, including epidemiology, maternal and child care, environmental health, injury prevention and control, addiction, health education and promotion, and health program management and administration. These specialties evolved as the correlations between health and sanitation, safety, and behavior were better understood. Each specialization addresses the specific needs of a community.

EPIDEMIOLOGY

Epidemiology is the study of the relationship between causative agents and morbidity and mortality. This relationship may not be one of direct cause and effect, but the risk factors for a given illness are more likely to be identified. By determining the distribution of a public health concern, such as an infectious disease, within a population, commonalities may emerge that may then be tested for significance.

A classic example of epidemiology is the investigational work of John Snow, who looked into the source of a cholera outbreak in 1854 in central London. He began mapping the cases of cholera and found clusters in two areas. He interviewed the residents of these neighborhoods and found that they all had used the public water pump on one street. Direct examination of the water was inconclusive, but Snow's logic had convinced officials to remove the pump's handle, rendering it inoperable. Snow argued that the water company, Southwark and Vauxhall

Waterworks, was delivering polluted water from the Thames River to this public well, which served areas that showed a high incidence of cholera. The cholera epidemic began to wane, although it could not be proven whether this occurred because of the pump's water supply being discontinued or because people had already left the area to escape the disease.

Snow used statistics and surveys to determine the distribution of the disease and to identify common factors, suggested a plausible causative agent, and proposed an effective solution. Similar, refined methods are used today in epidemiology. For example, when the incidence of hantavirus infection suddenly increased in the western and southwestern United States between 1993 and 2007, epidemiologists used morbidity and mortality statistics to identify the trend and the geographical distribution. They looked for common factors and found weather patterns, vegetation, and rodents. Hantavirus was known to be transmitted when humans came in contact with the urine, feces, or saliva of infected rodents. The reason, however, for the sudden increase was not yet clear. When researchers began to study the relationships among common factors, they discovered that climate change (hotter, moister summers and warmer autumns) had nurtured increased vegetation, providing an increased food source (more seeds) for rodents. The rodents then had a greater survival rate in the winter months and multiplied at an accelerated rate. This increased rodent population propagated the hantavirus and shed it in greater quantities.

MATERNAL AND CHILD CARE

The primary goals of public health programs in maternal and child care are to reduce infant mortality, reduce the prevalence of child abuse and neglect, and extend the life expectancy of children. Studies indicate that for the first time, children in the United States may not live as long as their parents, primarily because of lifestyle choices and resultant chronic diseases rather than infectious diseases. According to the Centers for Disease Control and Prevention (CDC), the percentage of children between the ages of six and eleven who are obese had increased to 18 percent by 2012 because of poor nutrition, excessive eating, and a lack of physical activity. Obesity can lead



Public health campaigns can cover a wide range of topics, from basic hygiene to smoking cessation. This public service announcement was created by the Alberta Department of Public Health in 1959. Image courtesy of the Provincial Archives of Alberta via Wikimedia Commons.

to diabetes and heart disease, both of which reduce a person's life expectancy.

Maternal and child health care begins with education in the schools about teenage pregnancy and providing access to prenatal care for all women. Although death during childbirth rarely occurs in the United States (14 deaths per 100,000 live births in 2015, according to the Central Intelligence Agency), women should have a safe, clean place in which to deliver with professional assistance. The rate of infant mortality is higher (5.87 deaths per 1,000 live births in 2015). Following birth, newborns need screening for diseases, disorders, and conditions so they can receive prompt and appropriate treatment and support. Newborns also benefit from breast-feeding and vaccinations. New mothers should also be screened for postpartum depression. Because mothers are still the primary caregivers, they must be taught about nutrition and healthy lifestyle choices for their children. In addition, they must have resources to care for children with special needs, such as autism, epilepsy, sickle cell disease, and hemophilia. Public health programs address these aspects of maternal and child health care, targeting at-risk populations such as teenagers, immigrants, and isolated rural residents.

ENVIRONMENTAL HEALTH

Environmental health involves the study of the human relationship with the surrounding world, or environment. Areas of study include outdoor air quality, water quality, waste management, agriculture, and chemical exposure. Environmental health professionals also inspect buildings for health hazards such as sick house syndrome, mold, radon, and infestations. They monitor climate changes because temperature and precipitation affect the spread of waterborne and food-borne diseases caused by bacteria, viruses, and parasites. Children are more sensitive than adults to their environment, so professionals also study allergies, asthma, chemical sensitivities, and secondhand smoke to improve pediatric health.

Environmental health specialists also influence a community's infrastructure. They determine access to public transportation for subsequent access to health care and similar resources; help create bike paths, hiking trails, and outdoor recreation areas for public exercise; and work on systems for emergency preparedness and response. Such emergencies

include major collisions and explosions that result in mass casualties, chemical spills, radiation leaks, natural disasters and severe weather, and infectious disease outbreaks.

INJURY PREVENTION AND CONTROL

Injuries, which contribute to disability and death, are public health concerns. Injuries are like diseases because they have underlying causative factors, they have identifiable risk factors that increase their likelihood, and they have factors that make them preventable. Injuries may be divided into two categories: unintentional injuries and injuries caused by violence.

Unintentional injuries include motor vehicle collisions, falls, drowning, sports collisions (with other players or with equipment), burns and electrical injuries, and exposure to toxic chemicals. Public health addresses traffic safety (drinking and texting while driving and wearing seatbelts when driving), the regular use of protective equipment (motorcycle helmets, bicycle helmets, and athletic mouthguards), chemical safety (medication interactions, binge drinking, and child-proofing home medicine cabinets), and identification of potential hazards in the home and workplace. The prevention of unintentional injuries reduces the expense of medical care, lowers the incidence and cost of long-term disability, and decreases the number of deaths from unnatural causes.

Violence is the intentional infliction of pain and injury and may result in death. Although it is usually perpetrated by one person against another, it may be carried out by a group of people or it may be self-inflicted. Public health programs address issues such as street gangs, domestic violence, child abuse, teen suicide, and self-mutilation. These can become epidemics depending on a community's socioeconomic status and access to professional resources with healthier alternatives.

SUBSTANCE USE, ABUSE, AND DEPENDENCY

Public health professionals are concerned with the use of substances that have detrimental health effects. These substances include tobacco, alcohol, and a variety of drugs. According to a 2015 report by the United Nations, in 2013, twenty-seven million people worldwide were classified as problem drug users. Nicotine addiction significantly contributes to heart disease and lung disease, making it the foremost

lifestyle-related cause of death worldwide.

One goal of public health agencies is to educate people about the dangers of substance use, misuse, abuse, and dependency. Use is the habitual ingestion of and misuse is the use of a substance for which it was not intended, such as inhaling aerosol propellants to get intoxicated (or high). Substance abuse involves dangerous actions and continued use in the face of negative consequences. Dependency has a strong psychological component and physiological need.

Another goal of public health agencies is to promote substance abuse and dependency as diseases. Agencies seek to foster understanding from families and communities that will encourage users to seek treatment. Cessation programs begin with withdrawal or detoxification and continue with behavior modification therapy on an inpatient or outpatient basis.

Public health agencies may also seek to ameliorate the effects of substance abuse. For example, methadone clinics may be established to help people who are otherwise unable to give up illegal drugs. Clean needles may be distributed to reduce the spread of infectious diseases from sharing needles among intravenous drug users. Because sex is often “traded” for drugs, condoms may be distributed to reduce the spread of sexually transmitted diseases.

HEALTH EDUCATION AND PROMOTION

The first goal of health education and promotion is to improve the health of persons and families by providing accurate, timely, and understandable health information. According to the analysis by the National Center for Education Statistics of the National Assessment of Adult Literacy, which was conducted in 2003 and included a section specifically targeting health literacy, most adults (53 percent) have intermediate health literacy, meaning they can comprehend and apply some of the health information they read, but 14 percent have below-basic health literacy, meaning they can comprehend very little and apply almost none of the health information they read. Health information may be presented through brochures, posters, newspaper and magazine articles, and radio and television programs, and on websites. Many presentations are bilingual, depending, especially, on the region.

The second goal of health education and promotion is to create resources within the community to encourage and sustain a healthy lifestyle. These

resources include school-based health centers; workplace programs such as stress management and smoking cessation (in support of a smoke-free environment); health fairs that showcase wellness resources such as yoga classes, massage therapists, and organic food shops; and community clinics for family planning, blood pressure monitoring, and flu shots.

The third goal of health education and promotion is to advocate for the public health needs of communities by educating politicians on the health issues that are affecting their constituents. Using the evidence-based approach, public health officials can statistically define a community's needs, propose well-established strategies for meeting those needs, outline the resources necessary to implement the strategies, and offer quantitative measures of the outcome. The desired results of such advocacy are effective legislation, such as health care reform acts, and appropriated funding for national, state, and local public health programs.

HEALTH PROGRAM MANAGEMENT AND ADMINISTRATION

Public health departments are found at the federal, state, and local levels. They maintain databases that include information on morbidity and mortality, births and deaths, and records of inspection of public places, such as restaurants and swimming pools. The departments operate laboratories for testing air, water, and soil samples and for investigating microorganisms. They conduct epidemiological surveillance and investigations into communicable diseases to prevent epidemics. They often work with other agencies, such as clinics, schools, businesses, and other government agencies.

Professionals in health program management and administration are frequently responsible for grant writing and reporting and for overseeing budgets and managing resources. Successful health programs depend on appropriate planning and design that are based on an accurate assessment of community needs. Measurable goals and objectives must directly arise from these data. The programs also depend upon timely implementation with adequate attendance by the target population. Finally, the programs depend on quantitative evaluation and plans for sustaining the results. Effective public health efforts must also consider the social, economic, and cultural characteristics of the communities they serve.

IMPACT

At the end of 2010, the US Department of Health and Human Services released its Healthy People 2020 program, which includes national health goals and objectives through 2020. Several hundred objectives cover twenty-eight priority areas of public health. The focus of this program is not simply to reduce disease and death rates; its goal is to improve quality of life and increase the years of healthy living. Morbidity and mortality rates are easy to collect for specific populations and to analyze by cause. Life expectancy in the United States, however, has increased significantly since 1979, so these rates are less relevant than are reduced disability, premature death, and improvements in pain control and functional capacity.

A second focus of this program is to eliminate or, at minimum, greatly reduce health disparities for racial and ethnic minority groups, people with physical or mental disabilities, socioeconomically disadvantaged people, and the elderly. Disparities are pronounced in infant mortality, cardiovascular disease, diabetes, and human immunodeficiency virus (HIV) infection. Public health professionals believe that all members of a community should have access to health education, disease prevention information, and medical care, based on the ideal of social justice.

An executive report released in 2014 stated that progress had been made on four significant objectives: fewer adults were smoking cigarettes, fewer children were exposed to secondhand smoke, more adults were meeting physical activity targets, and fewer adolescents were using alcohol or illegal drugs.

The effectiveness of public health initiatives has led to a shift in the major cause of death: from infectious diseases to chronic diseases. Although some future initiatives will continue to aim for the reduction of the incidence of infectious diseases, others will address lifestyle-related choices, such as obesity and cigarette smoking, which are controllable risk factors for chronic diseases.

— *Bethany Thivierge, M.P.H.*

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American Public Health Association
<http://www.apha.org>

Association of Schools of Public Health
<http://www.asph.org>

Centers for Disease Control and Prevention
<http://www.cdc.gov>

Partners in Information: Access for the Public Health Workforce
<http://phpartners.org>

Society for Public Health Education
<http://www.sophe.org>

U.S. Department of Health and Human Services
<http://www.hhs.gov>

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INVASION OF THE BLACK DEATH IN EUROPE

The invasion of the Black Death, or plague, created physical and psychological devastation, but also brought an end to Church domination in the Middle Ages and ushered in numerous social and economic reforms.

Date: 1347-1352

Locale: Western and central Europe

SUMMARY OF EVENT

Apparently originating near Delhi in the 1330's, the plague spread to southern Asia by 1346 and to the cities of Kaffa and probably Constantinople by the end of the following year. Merchants traveling from Kaffa and probably from Constantinople effectively transmitted the plague to the ports of Genoa and Venice in northern Italy, to Messina in Sicily, and to Marseilles in southern France. The pandemic spread through Spain and France in 1348, arriving in England in the autumn of that year and eventually reaching Scandinavia and northern central Europe in 1349. Northern Russia first suffered its effects in 1352, after the plague had declined in Western Europe. China experienced the disease between 1352 and 1369; Iceland and Cyprus were totally depopulated.

An increase in both maritime and overland trade facilitated the movement of the plague bacillus, and the southern European seaports were devastated first. Boats were loaded with two commodities: spices and disease-ridden rats. The "king of terrors" ravaged populated areas so severely that at least one-fourth of Europe's inhabitants had died by 1350. Sometimes entire villages were depopulated by death, since 60 percent to 80 percent of those infected failed to survive. Half of Florence's ninety thousand people vanished; some two-thirds of the population of Siena and Hamburg died.

French physician Guy de Chauliac encouraged rational and professional courtesy in the face of the disease and also understood some of the demographics and social conditions that encouraged its persistence. The biological spread of the plague bacillus (*Yersinia pestis*) was facilitated when engorged, bacilli-infested fleas would leave their original animal hosts in search of new hosts, usually humans. The bite of the flea produced oval swellings called buboes. These chestnut-sized lumps appeared commonly near an area of lymph nodes, usually in the groin, the armpit, or the neck. The blackened color of these buboes

gave the disease its common name—the Black Death. It appears that three types of plague existed. The first was the simple bubonic plague. The second and the most common type was pneumonic plague, which occurred when the bacillus invaded the lungs or was transmitted through exposure to a coughing plague victim. The third type was the always fatal septicemic plague, which occurred when the bacillus fully invaded the bloodstream and overwhelmed the nervous system before producing pustules.

Europe experienced great physical and mental anguish as whole families vanished. The plague created an even greater sense of demoralization, anomie, and relative deprivation, exacerbated by numerous viral epidemics, including measles, smallpox, influenza, dysentery, typhus, tuberculosis, and whooping cough. Medical treatment was invariably irrational, even dangerous to the patient, as were numerous preventive procedures.

The practice of "sewage pharmacology" became widespread as people turned to unusual treatments



This wood engraving, from a fifteenth century German book in the Rosenwald collection (Library of Congress) depicts a plague victim pointing out his boils to three physicians. (Library of Congress)

**SEARCHING FOR SCAPEGOATS: JEAN
DE VENETTE ON THE PLAGUE AND
ANTI-SEMITISM**

Some said that this pestilence was caused by infection of the air and waters, since there was at this time no famine nor lack of food supplies, but on the contrary great abundance. As a result of this theory of infected water and air as the source of the plague, the Jews were suddenly and violently charged with infecting wells and water and corrupting the air. The whole world rose up against them cruelly on this account. In Germany and other parts of the world where Jews lived, they were massacred and slaughtered by Christians, and many thousands were burned everywhere, indiscriminately. The unshaken...constancy of the [Jewish] men and their wives was remarkable. For mothers hurled their children first into the fire that they might not be baptized and then leaped in after them to burn with their husbands and children. It is said that many bad Christians were found who in a like manner put poison into wells. But in truth, such poisonings, granted that they actually were perpetrated, could not have caused so great a plague nor have infected so many people. There were other causes; for example, the will of God and the corrupt humors and evil inherent in air and earth.

Source: Jean de Venette, *A Chronicle of Jean de Venette*, translated by Jean Birdsall and edited by Richard A. Newhall (New York: Columbia University Press, 1953), pp. 48-51.

in the hope of preventing the disease. Believing that strong odors could prevent transmission of the disease, some people would bathe daily in urine and even drank urine; others smeared human excrement on their clothing. Attempts were made to bottle flatulation; others allowed male goats to live in their houses, filling rooms with the malodorous smell of their urine. It was also the practice for people to hover over open latrines and inhale the stench. One witness reported "many were so courageous that they swallowed the pus from the mature boils in spoonfuls." Boils were incised, dried, and powdered for inhalation or administered orally in a drink. Geoffrey Chaucer's *The Canterbury Tales* (1387-1400) describes such psychological and behavioral responses to the plague.

Attempts at prevention assumed other procedures

as when walls, furniture, and even a person's face and hands were washed in rose-water or vinegar. It was not an uncommon sight to see people with garlands, wearing nosegays, and even cloth masks with large noses stuffed with flowers, which were believed to act as a filter against miasma. Further evidence of this belief is revealed in the nursery rhyme "Ring Around the Rosey, Pocket Full of Posies," which signified the rose-colored swelling "ring" on the skin as an early stage of plague. Even the wearing of pointed shoes was avoided because such shoes were thought to resemble Satan's cloven hoof.

In keeping with Galenic medicine and the concept of humors, people were advised to avoid any excesses in eating, drinking, exercise, and even sexual relations. At the same time, many people felt doomed and frequently indulged in extreme forms of debauchery and antisocial behavior. Individuals and groups roamed streets robbing people or entering houses to rape and plunder. In Spain, the Tarrantella dance (bite of the tarantula spider) was forbidden.

Mass hysteria became endemic to much of Europe. Various social movements became the focus of the people's frustration. Italian writer Giovanni Boccaccio, in his work *Decameron*: O, Principe Galeotto (1349-1351; *The Decameron*, 1620), presented a series of graphic biographies explaining social dysfunction and class structure during the plague. In one such display of social dysfunction, pilgrimages of the Brethren of the Cross or the Brotherhood of the Flagellants would go from village to village whipping themselves and others with metal-tipped leather thongs as penitence for presumed wrongs. This form of mortification of the flesh was actually based on an earlier concept of exorcism, one that the Church later came to despise. The Flagellants roamed throughout much of Europe, releasing criminals and patients from insane asylums. Carmelite friar Jean de Venette made a number of astute observations and descriptions of flagellantism.

A similar social movement was the so-called charis-
sant mania, whereby hundreds, sometimes thou-
sands, would dance and sing uncontrollably in village
or city streets. The sinister aspect of this mania was
that some would dance themselves to death through
exhaustion or trample others to death while per-
forming awkward and erratic dances. Yet for some,
the dance of death was not a psychological disorder
but rather represented a later stage of plague, when

the subcutaneous hemorrhaging created black blotches on the victim's skin. Eventually, the victim's central nervous system deteriorated, creating bizarre and painful neurological dysfunction and disorientation.

Unfortunately, another antisocial movement, also documented by Jean de Venette, was the rise of anti-Semitism, particularly later in Germany and central Europe, although the first instances of widespread persecution were in Marseilles in 1348 when thousands of Jews were burned to death. The notion of anti-Semitism probably developed as early as the First Crusade (1095-1099), when the Catholic Church contended that Jews represented demons of Satan, poisoning the wells of plagued communities. By 1349, the number of persecutions had begun to decline, perhaps because the populace realized that Jews were also victims of the plague. With the decline of the Black Death in 1351, the persecution of the Jews waned.

SIGNIFICANCE

The Black Death resulted in many lasting changes: better medical literature, programs of public sanitation, decline of feudalism and the manorial systems, the beginning of the end of the medieval period, and almost complete control of all ecclesiastical matters by the Catholic Church. For example, certain city governments imposed programs to prevent contagion and improved sanitation. Florence and Venice established commissions for public health in 1348; in the same year, the Italian city of Pistoia issued regulations on burial, clothing, and food to counter the spread of plague.

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THE BLACK DEATH: TWO READINGS

Date: 1348

Locale: Modern France

SUMMARY OVERVIEW

These documents illustrate the devastation and existential fatalism caused by the plague of 1348, which ultimately killed up to 25 million people, or one-third of the population, in Europe. The plague's cause was unknown but its effects destroyed the confidence of much of Europe in religious and social structures. The suddenness of the onset of disease inspired a fatalistic worldview that can be seen in the art and literature of the time. Doctors were unable to explain it, and those who saw their families and towns destroyed tried to justify their suffering by blaming the plague on foreign powers, heretics and the faithless, or the malice of non-Christians. Many communities placed the blame for the outbreak on the Jewish population; they extracted confessions under torture and punished thousands of Jews with exile, imprisonment, and death. These excerpts illustrate victims of the plague attempting to come to terms with the destruction of their way of life, whether by appealing to religion or finding scapegoats.

DEFINING MOMENT

Trade in Europe at the beginning of the fourteenth century was thriving; merchants brought west goods from Asia by land and sea routes, but the rise of globalization spread disease as well as prosperity. The disease that caused the bubonic plague, also known as the Black Death, seems to have originated in central and western Asia, carried by the fleas living on rodents. Merchants and armies facilitated the spread of these rodents along the Silk Road from Asia, as did merchant sailors coming into port cities of Italy and southern Europe.

The unhygienic conditions of early Renaissance towns allowed the disease to thrive in Europe. From Italy, the disease spread northwest to France, Spain, and England in 1348; it then spread east through Germany until 1350. By 1353, it had killed up to 100 million people worldwide and may have caused the death of approximately 30 percent of Europe's population. The plague's symptoms began with the appearance of buboes, or swellings that secreted blood and pus; once these afflicted a patient, death

was considered certain. Fever, vomiting, and rash followed shortly, and death came within a week (often much less).

Desperately seeking an explanation for their suffering, people turned to religion, astrology, magic, and fanaticism. Many considered the plague a demonstration of God's anger and became resigned to their fate. Some tried to escape by retreating from public life. The universality of the disease, which struck without regard to wealth or status, prompted many artistic depictions of death as an unstoppable and inevitable force. Social structures began to break down as the population decreased—literary accounts of the plague report increases in lawlessness, violence, and general fatalism.

Jewish communities often fell victim to Christians looking for scapegoats. By the fall 1348, when the plague had already taken hold, a rumor spread that the plague deaths were due to an international conspiracy of Jewry to poison Christendom. It was reported that the leaders in the Jewish metropolis of Toledo had initiated the plot and that conspirators had sent poisoners to France, Switzerland, and Italy. Though based only in fear, these rumors had almost immediate effect. Communities around Europe ostracized their Jews or arrested, tortured, imprisoned, and killed them on the suspicion of having poisoned water supplies.

AUTHOR BIOGRAPHY

Jean de Venette was a French friar who chronicled the years 1340 to 1368. His history is notable for its focus on, and sympathy for, the peasant classes and those outside of the normal power structures of the time. Though the facts of his history are often disputed, he offers a valuable perspective on his time period.

The second account is a translation from the Latin of a confession made under torture by Agimet, a Jew, who was arrested at Chatel, on Lake Geneva (between modern France and Switzerland). It is typical of the confessions extorted and forwarded to other towns. These confessions, based on the cultural reputation of Jews as outsiders and underhanded merchants, helped to spread the persecution of Jewish communities throughout Europe.

HISTORICAL DOCUMENT

1. The Chronicle of Jean de Venette

In A.D. 1348, the people of Florence and of almost the whole world were struck by a blow other than war. For in addition to the famine...and to the wars...pestilence and its attendant tribulations appeared again in various parts of the world. In the month of August, 1348, after Vespers when the sun was beginning to set, a big and very bright star appeared above Paris, toward the west. It did not seem, as stars usually do, to be very high above our hemisphere but rather very near. As the sun set and night came on, this star did not seem to me or to many other friars who were watching it to move from one place. At length, when night had come, this big star, to the amazement of all of us who were watching, broke into many different rays and, as it shed these rays over Paris toward the east, totally disappeared and was completely annihilated. Whether it was a comet or not, whether it was composed of airy exhalations and was finally resolved into vapor, I leave to the decision of astronomers. It is, however, possible that it was a presage of the amazing pestilence to come, which, in fact, followed very shortly in Paris and throughout France and elsewhere, as I shall tell. All this year and the next, the mortality of men and women, of the young even more than of the old, in Paris and in the kingdom of France, and also, it is said, in other parts of the world, was so great that it was almost impossible to bury the dead. People lay ill little more than two or three days and died suddenly, as it were in full health. He who was well one day was dead the next and being carried to his grave. Swellings appeared suddenly in the armpit or in the groin -- in many cases both -- and they were infallible signs of death. This sickness or pestilence was called an epidemic by the doctors. Nothing like the great numbers who died in the years 1348 and 1349 has been heard of or seen of in times past. This plague and disease came from ymaginatione or association and contagion, for if a well man visited the sick he only rarely evaded the risk of death. Wherefore in many towns timid priests withdrew, leaving the exercise of their ministry to such of the religious as were more daring. In many places not two out of twenty remained alive. So high was the mortality at the Hôtel-Dieu in Paris that for a long time, more than five hundred dead were carried daily with great devotion in carts to the cemetery of the Holy Innocents in Paris for burial. A very great number of the saintly sisters of the Hôtel-Dieu who, not fearing to die, nursed the sick in all sweetness and humility, with no thought of honor, a number too often renewed by death, rest in peace with Christ, as we may piously believe.

This plague, it is said, began among the unbelievers, came to Italy, and then crossing the Alps reached Avignon, where it attacked several cardinals and took from them their whole household. Then it spread, unforeseen, to France, through Gascony and Spain, little by little, from town to town, from village to village, from house to house, and finally from person to person. It even crossed over to Germany, though it was not so bad there as with us. During the epidemic, God of His accustomed goodness deigned to grant this grace, that however suddenly men died, almost all awaited death joyfully. Nor was there anyone who died without confessing his sins and receiving the holy viaticum. ...

Some said that this pestilence was caused by infection of the air and waters, since there was at this time no famine nor lack of food supplies, but on the contrary great abundance. As a result of this theory of infected water and air as the source of the plague the Jews were suddenly and violently charged with infecting wells and water and corrupting the air. The whole world rose up against them cruelly on this account. In Germany and other parts of the world where Jews lived, they were massacred and slaughtered by Christians, and many thousands were burned everywhere, indiscriminately. The unshaken, if fatuous, constancy of the men and their wives was remarkable. For mothers hurled their children first into the fire that they might not be baptized and then leaped in after them to burn with their husbands and children. It is said that many bad Christians were found who in like manner put poison into wells. But in truth, such poisonings, granted that they actually were perpetrated, could not have caused so great a plague nor have infected so many people. There were other causes; for example, the will of God and the corrupt humors and evil inherent in air and earth. Perhaps the poisonings, if they actually took place in some localities, reinforced these causes. The plague lasted in France for the greater part of the years 1348 and 1349 and then ceased. Many country villages and many houses in good towns remained empty and deserted. Many houses, including some splendid dwellings, very soon fell into ruins. Even in Paris several houses were thus ruined, though fewer here than elsewhere.

After this cessation of the epidemic, pestilence, or plague, the men and women who survived married each other. There was no sterility among the women, but on the contrary fertility beyond the ordinary. Pregnant women were seen on every side....But woe is me! the world was not changed for the better but for the worse by this renewal of population. For men were more avaricious and grasping than before, even though they had far greater possessions. They were more covetous and disturbed each other more frequently with suits, brawls, disputes, and pleas. Nor by the mortality resulting from this terrible

plague inflicted by God was peace between kings and lords established. On the contrary, the enemies of the king of France and of the Church or stronger and wickeder than before and stirred up wars on sea and on land. Greater evils than before [swarmed] everywhere in the world. And this fact was very remarkable. Although there was an abundance of all goods, yet everything was twice as dear, whether it were utensils, victuals, or merchandise, hired helpers or peasants and serfs, except for some hereditary domains which remained abundantly stocked with everything. Charity began to cool, and iniquity with ignorance and stand to abound, for a few could be found in the good towns and castles who knew how or were willing to instruct children in the rudiments of grammar.

2. The Confession of Agimet of Geneva

The year of our Lord 1348.

On Friday, the 10th of the month of October, at Châtel, in the castle thereof, there occurred the judicial inquiry which was made by order of the court of the illustrious Prince, our lord, Amadeus, Count of Savoy, and his subjects against the Jews of both sexes who were there imprisoned, each one separately. [Jews were sometimes imprisoned separately to prevent suicide.] This was done after public rumor had become current and a strong clamor had arisen because of the poison put by them into the wells, springs, and other things which the Christians use-demanding that they die, that they are able to be found guilty and, therefore, that they should be punished. Hence this their confession made in the presence of a great many trustworthy persons.

Agimet the Jew, who lived at Geneva and was arrested at Châtel, was there put to the torture a little and then he was released from it. And after a long time, having been subjected again to torture a little, he confessed in the presence of a great many trustworthy persons, who are later mentioned. To begin with it is clear that at the Lent just passed Pultus Clesis de Ranz had sent this very Jew to Venice to buy silks and other things for him. When this came to the notice of Rabbi Peyret, a Jew of Chambry who was a teacher of their law, he sent for this Agimet, for whom he had searched, and when he had come before him he said: "We have been informed that you are going to Venice to buy silk and other wares. Here I am giving you a little package of half a span in size which contains some prepared poison and venom in a thin, sewed leather-bag. Distribute it among the wells, cisterns, and springs about Venice and the other places to which you go, in order to poison the people who use the water of the aforesaid wells that will have been poisoned by you, namely, the wells in which the poison will have been placed."

Agimet took this package full of poison and carried it with him to Venice, and when he came there he threw and scattered a portion of it into the well or cistern of fresh water which was there near the German House, in order to poison the people who use the water of that cistern. And he says that this is the only cistern of sweet water in the city. He also says that the mentioned Rabbi Peyret promised to give him whatever he wanted for his troubles in this business. Of his own accord Agimet confessed further that after this had been done he left at once in order that he should not be captured by the citizens or others, and that he went personally to Calabria and Apulia and threw the above mentioned poison into many wells. He confesses also that he put some of this same poison in the well of the streets of the city of Ballet.

He confesses further that he put some of this poison into the public fountain of the city of Toulouse and in the wells that are near the [Mediterranean] sea. Asked if at the time that he scattered the venom and poisoned the wells, above mentioned, any people had died, he said that he did not know inasmuch as he had left everyone of the above mentioned places in a hurry. Asked if any of the Jews of those places were guilty in the above mentioned matter, he answered that he did not know. And now by all that which is contained in the five books of Moses and the scroll of the Jews, he declared that this was true, and that he was in no wise lying, no matter what might happen to him.

Glossary

cistern: a well of drinking water

deigned: condescend, agree

infallible: certain

iniquity: sin, wrongdoing

span: distance from tip of little finger to thumb

tribulations: difficulties, trials

viaticum: the Eucharist, given to someone about to die

DOCUMENT ANALYSIS

These two documents present contrasting attempts by those who lived through the plague years to come to terms with the suffering they witnessed and experienced. Both Jean de Venette and the author of the confession of Agimet seek to assign causes and reasons for the plague, and both reach for supernatural and religious explanations for the disease. At the same time, both are concerned with the effect of the plague on normal people and with the ways communities respond. The resulting documents chronicle a human response to adversity: people attempt to explain the unexplainable but simultaneously interpret and react to it in ways that reflect the values and priorities of their times.

De Venette's chronicle presents the story of the plague logically, in a way that offers a reason and a cohesive narrative for the awful events. His story begins before the affliction struck with a comet that, in retrospect, seemed to foreshadow the disease. This warning comet presents a contrast to the sudden, unforeseeable deaths of the plague victims—as de Venette says, he who was “well one day was dead the next”. At the same time, de Venette distances himself from the astronomers who try to offer a rational or scientific explanation for the comet. Throughout this passage, the author acknowledges the difficulty of assigning a single cause to the disease and the fallibility of human attempts at complete knowledge. De Venette is skeptical not just of astronomers but of those who blamed the plague on the malice of Jews. He recognizes that a single cause would be insufficient to explain the devastation.

Rather than attempting to explain the disease fully, de Venette focuses on the reactions of individuals. He reserves his highest praise for those who understood the dangers of their actions but helped others despite the risk. The priests who stayed in their plague-stricken towns to tend to the living, the nuns who died nursing the sick, and even the Jews who stayed true to their religion during the persecution all deserve the historian's praise. In sharp contrast to those who died in service of others are those who lived through the epidemic; the survivors became more selfish and violent than ever before. This narrative is one of humanity's fall from an age of relative peace and selflessness to one of evil and ignorance.

The desire of survivors to impose reason on terrible events is also evident in the account of Agimet's

torture and confession. The author acknowledges that “public rumor” is what led to the general suspicion of Jews as poisoners, and he states twice that Agimet's confession was made under torture, but he appeals to “the presence of a great many trustworthy persons” to strengthen the authority of the account. The confession is full of elements of the fantastic—it takes place around Easter; the shadowy, omniscient figure of Rabbi Peyret directs the plot; the poison is described almost as a magical object, a tiny package powerful enough to kill thousands. Throughout the passage, the inquisitors demand information that will permit them to lay the blame for the plague on a conspiracy larger than themselves, directed by members of a persecuted minority. Though Agimet's confession is unlikely to the point of impossibility, it was extracted in an attempt to put responsibility for their suffering onto a group that had little recourse to law or justice at the hands of the dominant society.

ESSENTIAL THEMES

The quest for a cause behind the plague, or the fruitlessness of such a quest, is a major theme of both passages. Jean de Venette reports that many people sought to explain the plague through science or by accusing Jews and non-Christians of poison; in the second account, Agimet's torturers try to explain their suffering by blaming him as an agent of a mysterious Jewish plot. The two authors vary in their tolerance of uncertainty. De Venette is willing to accept that the plague's origin may be beyond his ability to understand (whether it is divine will or the work of human hands) and focuses instead on its effects on humanity. The author of Agimet's account insists on laying blame at the hands of Jewish communities, even at the cost of extracting a forced and irrational confession from a prisoner.

A second theme of the passages is the effect of the plague on religious communities and their attempts to cope with it. Both authors speak of an opposition between Christians and non-Christians. De Venette recognizes the humanity and suffering of Jewish communities, as well as their bravery in the face of persecution; he also praises certain Christian groups for their service, and blames others for acting in unchristian ways. The author of Agimet's confession is less willing to consider Jewish communities as anything other than monolithic, sinister groups intent on destruction. In both readings, authors define

individuals based on their religion, but take different approaches to evaluating their status within society.

—*Hannah Rich, MA*

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DECAMERON

Date: 1350-1353

Locale: Italy

SUMMARY OVERVIEW

A collection of one hundred novellas, Giovanni Boccaccio's *Decameron* is a collection of stories told by ten narrators who have fled the city of Florence in an attempt to escape the plague of 1348. As they hide in the countryside, they tell each other stories to pass the time.

The *Decameron* is a fundamental book in the development of Western prose. Written toward the end of the Middle Ages, it has deeply influenced various writers from later historical periods, among them Niccoló Machiavelli, Geoffrey Chaucer, and the English Romantics. The title derives from the Greek for "ten days," referring to the time employed by the narrators (seven women and three men) to tell the one hundred stories. These narratives are framed by the tragic events of the plague, which Boccaccio witnessed. In the introduction to the first day excerpted here, the author directly reports the tragic situation created by the plague. In a following section, he also explains how the ten narrators of the collection fled the city, where death and chaos reigned, to go to the countryside. There, accompanied by their servants, they lead an idyllic life and, each day, elect a "king" or a "queen," who sets the general theme of their tales.

DEFINING MOMENT

Italy in the mid-fourteenth century was politically divided, dominated by the Catholic Church, and richly connected to both European and Asian countries by international trade routes. The plague that swept through Italy and Europe in the 1340s posed an existential threat to this vibrant society. The disease that caused the plague seems to have come from Asia; carried by fleas, it spread to Europe along trade routes and exploded in the crowded and dirty cities of Italy. The epidemic, which came to be known as the Black Death, began in Europe in 1348 and eventually killed up to 100 million people by its end in 1350, as much as a third of Europe's population.

The disease struck quickly and felled even individuals who seemed to be in good health. It struck without regard to age or gender; its trademark symptoms were the sores (called *gavoccioli* by Boccaccio)

that promised quick and near-certain death.

The plague had a huge cultural impact. Many became fatalistic in the face of certain and unexplainable death, and motifs of mortality and decay are common to visual arts of the time. Historians and philosophers tend to emphasize the effect of the plague on society by pointing out the decline of public feelings of piety, charity, and empathy; some considered it an effect, rather than a cause, of irreligious behavior.

Boccaccio's *Decameron* was written shortly after the plague years at a time when society was recovering from the epidemic's effects and social institutions underwent great change. One such change was a linguistic shift. Latin was the language of formal writing and high literature while formulaic romances and popular literature was written in vernacular Italian. In the fourteenth century, however, this balance shifted: Petrarch popularized the sonnet, for instance, and written Italian was becoming more widespread. Boccaccio's works cannot easily be categorized. His *Decameron* is a mix of all genres, held together by a frame tale about the plague; he also wrote Latin bucolic poems, Italian love poetry, and genealogies of famous men and women. He was notable for his attention to subjects that were neglected or considered unworthy by his contemporaries; his most famous work after the *Decameron* is likely his "On Famous Women", a collection of biographies of women that ranges from mythological and ancient times to the present day.

Boccaccio's willingness to write literature about subjects unusual for his time ties into his use of the vernacular language rather than Latin. In addition, his dialogue is innovative: rather than having his characters speak in elevated diction, they use the everyday language spoken by Boccaccio's contemporaries.

AUTHOR BIOGRAPHY

Giovanni Boccaccio was an Italian writer of the fourteenth century. His works, along with those of his contemporaries Dante and Petrarch, helped to usher in a new age of humanism and interest in the relationship between the classical tradition and modern ways of life. He was born in Florence in about 1313 and trained as a banker, but eventually transitioned into a career as a poet. He travelled Italy as a scholar

and diplomat and became deeply involved with the humanist movement when he met Petrarch in 1350. They remained friends and wrote frequent letters to each other, and Petrarch was instrumental in ensuring the survival of Boccaccio's works and library. Boccaccio wrote love poems, biographies, love poems and lyric poems (including a collection on the death

of Petrarch), and an encyclopedic compilation of the Greek and Roman gods that remained a standard reference work for centuries. He is most famous for the *Decameron*, a collection of stories that take place during the great plague of 1348-1350. He died in 1375 in Florence.

HISTORICAL DOCUMENT

First Day

As often, most gracious ladies, as I bethink me, how compassionate you are by nature one and all, I do not disguise from myself that the present work must seem to you to have but a heavy and distressful prelude, in that it bears upon its very front what must needs revive the sorrowful memory of the late mortal pestilence, the course whereof was grievous not merely to eyewitnesses but to all who in any other wise had cognisance of it. But I would have you know, that you need not therefore be fearful to read further, as if your reading were ever to be accompanied by sighs and tears. This horrid beginning will be to you even such as to wayfarers is a steep and rugged mountain, beyond which stretches a plain most fair and delectable, which the toil of the ascent and descent does but serve to render more agreeable to them; for, as the last degree of joy brings with it sorrow, so misery has ever its sequel of happiness. To this brief exordium of woe—brief, I say, inasmuch as it can be put within the compass of a few letters—succeed forthwith the sweets and delights which I have promised you, and which, perhaps, had I not done so, were not to have been expected from it. In truth, had it been honestly possible to guide you whither I would bring you by a road less rough than this will be, I would gladly have so done. But, because without this review of the past, it would not be in my power to shew how the matters, of which you will hereafter read, came to pass, I am almost bound of necessity to enter upon it, if I would write of them at all.

I say, then, that the years of the beatific incarnation of the Son of God had reached the tale of one thousand three hundred and forty-eight, when in the illustrious city of Florence, the fairest of all the cities of Italy, there made its appearance that deadly pestilence, which, whether disseminated by the influence of the celestial bodies, or sent upon us mortals by God in His just wrath by way of retribution for our iniquities, had had its origin some years before in the East, whence, after destroying an innumerable multitude of living beings, it had propagated itself without respite from place to place, and so, calamitously, had spread into the West.

In Florence, despite all that human wisdom and forethought could devise to avert it, as the cleansing of the city from many impurities by officials appointed for the purpose, the refusal of entrance to all sick folk, and the adoption of many precautions for the preservation of health; despite also humble supplications addressed to God, and often repeated both in public procession and otherwise, by the devout; towards the beginning of the spring of the said year the doleful effects of the pestilence began to be horribly apparent by symptoms that shewed as if miraculous.

Not such were they as in the East, where an issue of blood from the nose was a manifest sign of inevitable death; but in men and women alike it first betrayed itself by the emergence of certain tumours in the groin or the armpits, some of which grew as large as a common apple, others as an egg, some more, some less, which the common folk called gavoccioli. From the two said parts of the body this deadly gavocciolo soon began to propagate and spread itself in all directions indifferently; after which the form of the malady began to change, black spots or livid making their appearance in many cases on the arm or the thigh or elsewhere, now few and large, now minute and numerous. And as the gavocciolo had been and still was an infallible token of approaching death, such also were these spots on whomsoever they shewed themselves. Which maladies seemed to set entirely at naught both the art of the physician and the virtues of physic; indeed, whether it was that the disorder was of a nature to defy such treatment, or that the physicians were at fault—besides the qualified there was now a multitude both of men and of women who practised without having received the slightest tincture of medical science—and, being in ignorance of its source, failed to apply the proper remedies; in either case, not merely were those that recovered few, but almost all within three days from the appearance of the said symptoms, sooner or later, died, and in most cases without any fever or other attendant malady.

Moreover, the virulence of the pest was the greater by reason that intercourse was apt to convey it from the sick to the whole, just as fire devours things dry or greasy when they are brought close to it. Nay, the evil went yet further, for not merely by speech or association with the sick was the malady communicated to the healthy with consequent peril of common death; but any that touched the clothes of the sick or aught else that had been touched or used by them, seemed thereby to contract the disease.

So marvellous sounds that which I have now to relate, that, had not many, and I among them, observed it with their own eyes, I had hardly dared to credit it, much less to set it down in writing, though I had had it from the lips of a credible witness.

I say, then, that such was the energy of the contagion of the said pestilence, that it was not merely propagated from man to man, but, what is much more startling, it was frequently observed, that things which had belonged to one sick or dead of the disease, if touched by some other living creature, not of the human species, were the occasion, not merely of sickening, but of an almost instantaneous death. Whereof my own eyes (as I said a little before) had cognisance, one day among others, by the following experience. The rags of a poor man who had died of the disease being strewn about the open street, two hogs came thither, and after, as is their wont, no little trifling with their snouts, took the rags between their teeth and tossed them to and fro about their chaps; whereupon, almost immediately, they gave a few turns, and fell down dead, as if by poison, upon the rags which in an evil hour they had disturbed.

In which circumstances, not to speak of many others of a similar or even graver complexion, divers apprehensions and imaginations were engendered in the minds of such as were left alive, inclining almost all of them to the same harsh resolution, to wit, to shun and abhor all contact with the sick and all that belonged to them, thinking thereby to make each his own health secure. Among whom there were those who thought that to live temperately and avoid all excess would count for much as a preservative against seizures of this kind. Wherefore they banded together, and, dissociating themselves from all others, formed communities in houses where there were no sick, and lived a separate and secluded life, which they regulated with the utmost care, avoiding every kind of luxury, but eating and drinking very moderately of the most delicate viands and the finest wines, holding converse with none but one another, lest tidings of sickness or death should reach them, and diverting their minds with music and such other delights as they could devise. Others, the bias of whose minds was in the opposite direction, maintained, that to drink freely, frequent places of public resort, and take their pleasure with song and revel, sparing to satisfy no appetite, and to laugh and mock at no event, was the sovereign remedy for so great an evil: and that which they affirmed they also put in practice, so far as they were able, resorting day and night, now to this tavern, now to that, drinking with an entire disregard of rule or measure, and by preference making the houses of others, as it were, their inns, if they but saw in them aught that was particularly to their taste or liking; which they were readily able to do, because the owners, seeing death imminent, had become as reckless of their property as of their lives; so that most of the houses were open to all comers, and no distinction was observed between the stranger who presented himself and the rightful lord. Thus, adhering ever to their inhuman determination to shun the sick, as far as possible, they ordered their life. In this extremity of our city's suffering and tribulation the venerable authority of laws, human and divine, was abased and all but totally dissolved, for lack of those who should have administered and enforced them, most of whom, like the rest of the citizens, were either dead or sick, or so hard bested for servants that they were unable to execute any office; whereby every man was free to do what was right in his own eyes.

Not a few there were who belonged to neither of the two said parties, but kept a middle course between them, neither laying the same restraint upon their diet as the former, nor allowing themselves the same license in drinking and other dissipations as the latter, but living with a degree of freedom sufficient to satisfy their appetites, and not as recluses. They therefore walked abroad, carrying in their hands flowers or fragrant herbs or divers sorts of spices, which they frequently raised to their noses, deeming it an excellent thing thus to comfort the brain with such perfumes, because the air seemed to be everywhere laden and reeking with the stench emitted by the dead and the dying, and the odours of drugs.

Some again, the most sound, perhaps, in judgment, as they were also the most harsh in temper, of all, affirmed that there was no medicine for the disease superior or equal in efficacy to flight; following which prescription a multitude of men and women, negligent of all but themselves, deserted their city, their houses, their estates, their kinsfolk, their goods, and went into voluntary exile, or migrated to the country parts, as if God in visiting men with this pestilence in requital of their iniquities would not pursue them with His wrath wherever they might be, but intended the destruction of such alone as remained within the circuit of the walls of the city; or deeming, perchance, that it was now time for all to flee from it, and that its last hour was come.

Of the adherents of these divers opinions not all died, neither did all escape; but rather there were, of each sort and in every place, many that sickened, and by those who retained their health were treated after the example which they themselves, while whole, had set, being everywhere left to languish in almost total neglect. Tedious were it to recount, how citizen avoided

citizen, how among neighbours was scarce found any that shewed fellow-feeling for another, how kinsfolk held aloof, and never met, or but rarely; enough that this sore affliction entered so deep into the minds of men and women, that in the horror thereof brother was forsaken by brother, nephew by uncle, brother by sister, and oftentimes husband by wife; nay, what is more, and scarcely to be believed, fathers and mothers were found to abandon their own children, untended, unvisited, to their fate, as if they had been strangers. Wherefore the sick of both sexes, whose number could not be estimated, were left without resource but in the charity of friends (and few such there were), or the interest of servants, who were hardly to be had at high rates and on unseemly terms, and being, moreover, one and all, men and women of gross understanding, and for the most part unused to such offices, concerned themselves no further than to supply the immediate and expressed wants of the sick, and to watch them die; in which service they themselves not seldom perished with their gains. In consequence of which dearth of servants and dereliction of the sick by neighbours, kinsfolk and friends, it came to pass—a thing, perhaps, never before heard of—that no woman, however dainty, fair or well-born she might be, shrank, when stricken with the disease, from the ministrations of a man, no matter whether he were young or no, or scrupled to expose to him every part of her body, with no more shame than if he had been a woman, submitting of necessity to that which her malady required; wherefrom, perchance, there resulted in after time some loss of modesty in such as recovered. Besides which many succumbed, who with proper attendance, would, perhaps, have escaped death; so that, what with the virulence of the plague and the lack of due tendance of the sick, the multitude of the deaths, that daily and nightly took place in the city, was such that those who heard the tale—not to say witnessed the fact—were struck dumb with amazement. Whereby, practices contrary to the former habits of the citizens could hardly fail to grow up among the survivors.

It had been, as to-day it still is, the custom for the women that were neighbours and of kin to the deceased to gather in his house with the women that were most closely connected with him, to wail with them in common, while on the other hand his male kinsfolk and neighbours, with not a few of the other citizens, and a due proportion of the clergy according to his quality, assembled without, in front of the house, to receive the corpse; and so the dead man was borne on the shoulders of his peers, with funeral pomp of taper and dirge, to the church selected by him before his death. Which rites, as the pestilence waxed in fury, were either in whole or in great part disused, and gave way to others of a novel order. For not only did no crowd of women surround the bed of the dying, but many passed from this life unregarded, and few indeed were they to whom were accorded the lamentations and bitter tears of sorrowing relations; nay, for the most part, their place was taken by the laugh, the jest, the festal gathering; observances which the women, domestic piety in large measure set aside, had adopted with very great advantage to their health. Few also there were whose bodies were attended to the church by more than ten or twelve of their neighbours, and those not the honourable and respected citizens; but a sort of corpse-carriers drawn from the baser ranks, who called themselves *becchini* and performed such offices for hire, would shoulder the bier, and with hurried steps carry it, not to the church of the dead man's choice, but to that which was nearest at hand, with four or six priests in front and a candle or two, or, perhaps, none; nor did the priests distress themselves with too long and solemn an office, but with the aid of the *becchini* hastily consigned the corpse to the first tomb which they found untenanted. The condition of the lower, and, perhaps, in great measure of the middle ranks, of the people shewed even worse and more deplorable; for, deluded by hope or constrained by poverty, they stayed in their quarters, in their houses, where they sickened by thousands a day, and, being without service or help of any kind, were, so to speak, irredeemably devoted to the death which overtook them. Many died daily or nightly in the public streets; of many others, who died at home, the departure was hardly observed by their neighbours, until the stench of their putrefying bodies carried the tidings; and what with their corpses and the corpses of others who died on every hand the whole place was a sepulchre.

It was the common practice of most of the neighbours, moved no less by fear of contamination by the putrefying bodies than by charity towards the deceased, to drag the corpses out of the houses with their own hands, aided, perhaps, by a porter, if a porter was to be had, and to lay them in front of the doors, where any one who made the round might have seen, especially in the morning, more of them than he could count; afterwards they would have biers brought up, or, in default, planks, whereon they laid them. Nor was it once or twice only that one and the same bier carried two or three corpses at once; but quite a considerable number of such cases occurred, one bier sufficing for husband and wife, two or three brothers, father and son, and so forth. And times without number it happened, that, as two priests, bearing the cross, were on their way to perform the last office for some one, three or four biers were brought up by the porters in rear of them, so that, whereas the priests supposed that they had but one corpse to bury, they discovered that there were six or eight, or sometimes more. Nor, for all their number, were their obsequies honoured by either tears or lights or crowds of mourners; rather, it was come to this, that a dead man was then of no more account than a dead goat would be to-day. From all which it is abundantly manifest, that that lesson of patient resignation, which the sages were never able to learn from the slight and infrequent mishaps which occur in the natural course of

events, was now brought home even to the minds of the simple by the magnitude of their disasters, so that they became indifferent to them.

As consecrated ground there was not in extent sufficient to provide tombs for the vast multitude of corpses which day and night, and almost every hour, were brought in eager haste to the churches for interment, least of all, if ancient custom were to be observed and a separate resting-place assigned to each, they dug, for each graveyard, as soon as it was full, a huge trench, in which they laid the corpses as they arrived by hundreds at a time, piling them up as merchandise is stowed in the hold of a ship, tier upon tier, each covered with a little earth, until the trench would hold no more. But I spare to rehearse with minute particularity each of the woes that came upon our city, and say in brief, that, harsh as was the tenor of her fortunes, the surrounding country knew no mitigation; for there—not to speak of the castles, each, as it were, a little city in itself—in sequestered village, or on the open champaign, by the wayside, on the farm, in the homestead, the poor hapless husbandmen and their families, forlorn of physicians' care or servants' tendance, perished day and night alike, not as men, but rather as beasts. Wherefore, they too, like the citizens, abandoned all rule of life, all habit of industry, all counsel of prudence; nay, one and all, as if expecting each day to be their last, not merely ceased to aid Nature to yield her fruit in due season of their beasts and their lands and their past labours, but left no means unused, which ingenuity could devise, to waste their accumulated store; denying shelter to their oxen, asses, sheep, goats, pigs, fowls, nay, even to their dogs, man's most faithful companions, and driving them out into the fields to roam at large amid the unsheaved, nay, unreaped corn. Many of which, as if endowed with reason, took their fill during the day, and returned home at night without any guidance of herdsman. But enough of the country! What need we add, but (reverting to the city) that such and so grievous was the harshness of heaven, and perhaps in some degree of man, that, what with the fury of the pestilence, the panic of those whom it spared, and their consequent neglect or desertion of not a few of the stricken in their need, it is believed without any manner of doubt, that between March and the ensuing July upwards of a hundred thousand human beings lost their lives within the walls of the city of Florence, which before the deadly visitation would not have been supposed to contain so many people! How many grand palaces, how many stately homes, how many splendid residences, once full of retainers, of lords, of ladies, were now left desolate of all, even to the meanest servant! How many families of historic fame, of vast ancestral domains, and wealth proverbial, found now no scion to continue the succession! How many brave men, how many fair ladies, how many gallant youths, whom any physician, were he Galen, Hippocrates, or Aesculapius himself, would have pronounced in the soundest of health, broke fast with their kinsfolk, comrades and friends in the morning, and when evening came, supped with their forefathers in the other world!

Glossary

beatific: blessed

bier: couch on which a dead body is carried

champaign: field, countryside

cognisance: recognition, understanding, realization

divers: various

doleful: grievous, misery-causing

exordium: prologue, preface, beginning

festal: festival, merry

imminent: immediate

iniquities: sins, wrongdoings

malady: sickness, illness

manifest: obvious, clear

naught: nothing

obsequies: rites, rituals

requital: revenge, recompense

scion: heir, descendant

sepulchre: tomb

sequestered: secluded, hidden, out-of-the-way

sufficing: being sufficient, being enough

tincture: trace

untenanted: unoccupied

venerable: respected

DOCUMENT ANALYSIS

The excerpted document is the introduction to the first of the ten days that compose the Decameron. It constitutes the realistic narrative frame that encloses the narrators' tales and makes their escape from the city a plausible event. The tragedy of the plague creates a society that has lost all solidarity and civic sense among its members; it is represented as a force that permits people to transgress the common rules on which society is based. Throughout the text, Boccaccio lists the most significant of these transgressions: the decline of the sense of ownership and private property, the challenge to the authority of laws and the reliance on individual strength, the disruption of family ties and moral codes, the degradation of customs and rites usually connected to social status (as exemplified by funerals and burials).

In the introduction to his work, Boccaccio sets up a contrast between the world that the narrators have left and the world they will create through their stories. In the real world, morality and social norms have ceased to exist. Boccaccio lists examples of this from all phases of life—business ties, family rituals, sexual habits, and religious rites are equally affected by the plague. Just as it struck all areas of human life, the plague struck all people without regard to social class, wealth, or moral character. Furthermore, by showing the many ways in which the plague caused a change in ancient social customs, Boccaccio paints it as an agent of social change. It is a terrifying and disruptive force that requires an entirely new way of looking at the world, and not even the most time-honored customs can provide a sense of stability.

By beginning with emphasis on the universal toll of the plague, Boccaccio also destabilizes the reader's expectations about the genre of his work. His introduction covers people from all walks of life and levels of society, and his work tells stories in every imaginable genre and with narrators from many social stations.

ESSENTIAL THEMES

The themes of freedom and choice are introduced in this introduction to frame the tales that the narrators

tell in an attempt to escape the plague. The narrators have left the city, where the plague seems most dangerous, for the country; their decision to leave is an attempt to regain the freedom and autonomy that the plague has destroyed. The narrators' choice of the country over the city is one of many possible reactions to the pestilence that Boccaccio lists: some begin to lead a secluded and sober life, while others give free rein to their most basic instincts and make excess the norm. Between these two extremes are those who keep to "a middle course" and those who go into voluntary exile. There is a dark message beneath this depiction of choice. Though the epidemic is portrayed as freeing individuals from all social constraints, this freedom is far from liberating, as the plague devastates everyone no matter where they try to hide.

The narrators' search for freedom and normalcy, and the challenges they face, can be seen in the structure of the tales. Boccaccio's authorial voice enters the narration of the poem, the introductions to the first and fourth days, and the conclusion, but he otherwise hands over control of the stories to the individual narrators. The variety of styles and topics that the tales cover can be seen to mirror the narrators' attempts to recreate social bonds from the ruins and devastation caused by the plague. Significantly, the theme of the tenth and final day concerns acts of generosity and honesty, thus providing a clear improvement on the dark beginning devoted to the tragic effects of the plague. The early tales reflect the multifaceted and disjointed society that the plague produced, and by the end of the tales, the narrators are ready to begin the process of rebuilding and recovery.

—Luca Prono, PhD and Hannah Rich, MA

FURTHER READING

Battaglia Ricci, Lucia. Boccaccio. Rome: Salerno Editrice, 2000.

Bergin, Thomas G. Boccaccio. New York: Viking, 1981.

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FLORENTINE CHRONICLE

Date: 1375–1385

Geographic region: Italy

SUMMARY OVERVIEW

In the fourteenth century, the Bubonic Plague swept west engulfing the Mediterranean Basin and Europe. Florence, an up and coming city-state in Northern Italy, was struck as hard as the surrounding lands. Baldassarre Bonaiuti lived during this time and in the last several years of his life wrote a chronicle detailing the economic and political history of contemporary Florence. This chronicle is best known for these excerpts which include the depiction of Florence amidst the outbreak of the plague. Bonaiuti begins by quickly outlining the symptoms and physical effects of the bacterial infection. Most of his account, however, focuses on the drastic social and economic disruptions brought upon by the plague and the legislative responses of Florence's government. The plague was a manifest reminder of the fragility of both human life and social structures, and Bonaiuti's account emphasizes the upheaval and chaos that reigned in Florence in 1348.

DEFINING MOMENT

The Bubonic Plague, a bacterial infection, causes flu-like symptoms, swollen lymph nodes known as buboes, and, commonly, death. The pestilence is thought to have arisen in China or the steppes of Central Asia in the early fourteenth century. From there it moved East with help from the Silk Road and recent Mongol expansion. It reached Crimea, on the North shore of the Black Sea, by 1343. Carried by fleas which lived on rats which, in turn, resided on cargo the ships, the plague quickly spread across the Black Sea, the Mediterranean Sea, and Europe.

By the time the plague hit in 1348, the city of Florence had been on the rise. Formerly part of Tuscany, the city became an independent republic

towards the beginning of the twelfth century. Growing and flourishing, it became a banking powerhouse. (Baldassarre Bonaiuti, the author of this document, and his family were bankers.) It was also a hub for cutting-edge architecture and literature. The writers Dante, Petrarch, and Boccaccio were all born in Florence in the thirteenth and fourteenth centuries. Beginning in 1348, the plague ravaged Florence, as Bonaiuti details in this document. Another blow was struck to the city in 1378 by the Ciompi revolt, an uprising of wool worker who made up a large proportion of the Florentine population. Despite these challenges, the city bounced back as strong as ever. The end of the fourteenth century saw the rise of the Medici, Florence's most famous politicians and art patrons.

AUTHOR BIOGRAPHY

Baldassarre Bonaiuti was born in Florence in 1336. He is commonly known as Marchionne di Coppo Stefani due to his preference of Marchionne over his given name of Baldassarre as well as an early publisher misrepresenting his family name. Bonaiuti was born into an elite Florentine family to Coppo Stefani de Buonaiuti and Gemma di Dante di Rinaldo. Though his parents died while he was still a teenager, Bonaiuti followed his father's footsteps as a Florentine banker and politician. He visited Naples and Rome on behalf of the Florentine state and served as the city's ambassador to Bologna and Bohemia. His only known literary work is *The Florentine Chronicle*, a first hand account from which the excerpts that comprise this document are taken. These excerpts concerning the Bubonic Plague in Florence are what the chronicle is most known for; however, it is, in fact, a wide ranging political and economic history of contemporary Florence. He wrote this work in the final years of his life, before dying sometime between 1375 and 1385.

HISTORICAL DOCUMENT

Rubric 643: Concerning a Mortality in the City of Florence in Which Many People Died

In the year of the Lord 1348 there was a very great pestilence in the city and district of Florence. It was of such a fury and so tempestuous that in houses in which it took hold previously healthy servants who took care of the ill died of the same illness. Almost none of the ill survived past the fourth day. Neither physicians nor medicines were effective. Whether because these illnesses were previously unknown or because physicians had not previously studied them, there seemed to be no cure. There was such a fear that no one seemed to know what to do. When it took hold in a house it often happened that no one remained who had not died. And it was not just that men and women died, but even sentient animals died. Dogs, cats, chickens, oxen, donkeys sheep showed the same symptoms and died of the same disease. And almost none, or very few, who showed these symptoms, were cured. The symptoms were the following: a bubo in the groin, where the thigh meets the trunk; or a small swelling under the armpit; sudden fever; spitting blood and saliva (and no one who spit blood survived it). It was such a frightful thing that when it got into a house, as was said, no one remained. Frightened people abandoned the house and fled to another. Those in town fled to villages. Physicians could not be found because they had died like the others. And those who could be found wanted vast sums in hand before they entered the house. And when they did enter, they checked the pulse with face turned away. They inspected the urine from a distance and with something odoriferous under their nose. Child abandoned the father, husband the wife, wife the husband, one brother the other, one sister the other. In all the city there was nothing to do but to carry the dead to a burial. And those who died had neither confessor nor other sacraments. And many died with no one looking after them. And many died of hunger because when someone took to bed sick, another in the house, terrified, said to him: "I'm going for the doctor." Calmly walking out the door, the other left and did not return again. Abandoned by people, without food, but accompanied by fever, they weakened. There were many who pleaded with their relatives not to abandon them when night fell. But [the relatives] said to the sick person, "So that during the night you did not have to awaken those who serve you and who work hard day and night, take some sweetmeats, wine or water. They are here on the bedstead by your head; here are some blankets." And when the sick person had fallen asleep, they left and did not return. If it happened that he was strengthened by the food during the night he might be alive and strong enough to get to the window. If the street was not a major one, he might stand there a half hour before anyone came by. And if someone did pass by, and if he was strong enough that he could be heard when he called out to them, sometimes there might be a response and sometimes not, but there was no help. No one, or few, wished to enter a house where anyone was sick, nor did they even want to deal with those healthy people who came out of a sick person's house. And they said to them: "He is stupefied, do not speak to him!" saying further: "He has it because there is a bubo in his house." They call the swelling a bubo. Many died unseen. So they remained in their beds until they stank. And the neighbors, if there were any, having smelled the stench, placed them in a shroud and sent them for burial. The house remained open and yet there was no one daring enough to touch anything because it seemed that things remained poisoned and that whoever used them picked up the illness.

At every church, or at most of them, they dug deep trenches, down to the waterline, wide and deep, depending on how large the parish was. And those who were responsible for the dead carried them on their backs in the night in which they died and threw them into the ditch, or else they paid a high price to those who would do it for them. The next morning, if there were many [bodies] in the trench, they covered them over with dirt. And then more bodies were put on top of them, with a little more dirt over those; they put layer on layer just like one puts layers of cheese in a lasagna.

The beccamorti [literally, vultures] who provided their service, were paid such a high price that many were enriched by it. Many died from [carrying away the dead], some rich, some after earning just a little, but high prices continued. Servants, or those who took care of the ill, charged from one to three florins per day and the cost of things grew. The things that the sick ate, sweetmeats and sugar, seemed priceless. Sugar cost from three to eight florins per pound. And other confections cost similarly. Capons and other poultry were very expensive and eggs cost between twelve and twenty-four pence each; and he was blessed who could find three per day even if he searched the entire city. Finding wax was miraculous. A pound of wax would have gone up more than a florin if there had not been a stop put [by the communal government] to the vain ostentation that the Florentines always make [over funerals]. Thus it was ordered that no more than two large candles could be carried [in any funeral]. Churches had no more than a single bier which usually was not sufficient. Spice dealers and beccamorti sold biers, burial palls, and cushions at very high prices. Dressing in expensive woolen cloth as is customary in [mourning] the dead, that is in a long cloak, with mantle and veil that used to cost women three florins climbed in price to thirty florins and would have climbed to 100 florins had the custom of dressing in expensive cloth not been changed. The rich dressed in modest woolens, those not rich

sewed [clothes] in linen. Benches on which the dead were placed cost like the heavens and still the benches were only a hundredth of those needed. Priests were not able to ring bells as they would have liked. Concerning that [the government] issued ordinances discouraging the sounding of bells, sale of burial benches, and limiting expenses. They could not sound bells, sell benches, nor cry out announcements because the sick hated to hear of this and it discouraged the healthy as well. Priests and friars went [to serve] the rich in great multitudes and they were paid such high prices that they all got rich. And therefore [the authorities] ordered that one could not have more than a prescribed number [of clerics] of the local parish church. And the prescribed number of friars was six. All fruits with a nut at the center, like unripe plums and unhusked almonds, fresh broadbeans, figs and every useless and unhealthy fruit, were forbidden entrance into the city. Many processions, including those with relics and the painted tablet of Santa Maria Inpruneta, went through the city crying out “Mercy” and praying and then they came to a stop in the piazza of the Priors. There they made peace concerning important controversies, injuries and deaths. This [pestilence] was a matter of such great discouragement and fear that men gathered together in order to take some comfort in dining together. And each evening one of them provided dinner to ten companions and the next evening they planned to eat with one of the others. And sometimes if they planned to eat with a certain one he had no meal prepared because he was sick. Or if the host had made dinner for the ten, two or three were missing. Some fled to villas, others to villages in order to get a change of air. Where there had been no [pestilence], there they carried it; if it was already there, they caused it to increase. None of the guilds in Florence was working. All the shops were shut, taverns closed; only the apothecaries and the churches remained open. If you went outside, you found almost no one. And many good and rich men were carried from home to church on a pall by four beccamorti and one tonsured clerk who carried the cross. Each of them wanted a florin. This mortality enriched apothecaries, doctors, poultry vendors, beccamorti, and greengrocers who sold of poultices of mallow, nettles, mercury and other herbs necessary to draw off the infirmity. And it was those who made these poultices who made a lot of money. Woolworkers and vendors of remnants of cloth who found themselves in possession of cloths [after the death of the entrepreneur for whom they were working] sold it to whoever asked for it. When the mortality ended, those who found themselves with cloth of any kind or with raw materials for making cloth were enriched. But many found [who actually owned cloths being processed by workers] found it to be moth-eaten, ruined or lost by the weavers. Large quantities of raw and processed wool were lost throughout the city and countryside.

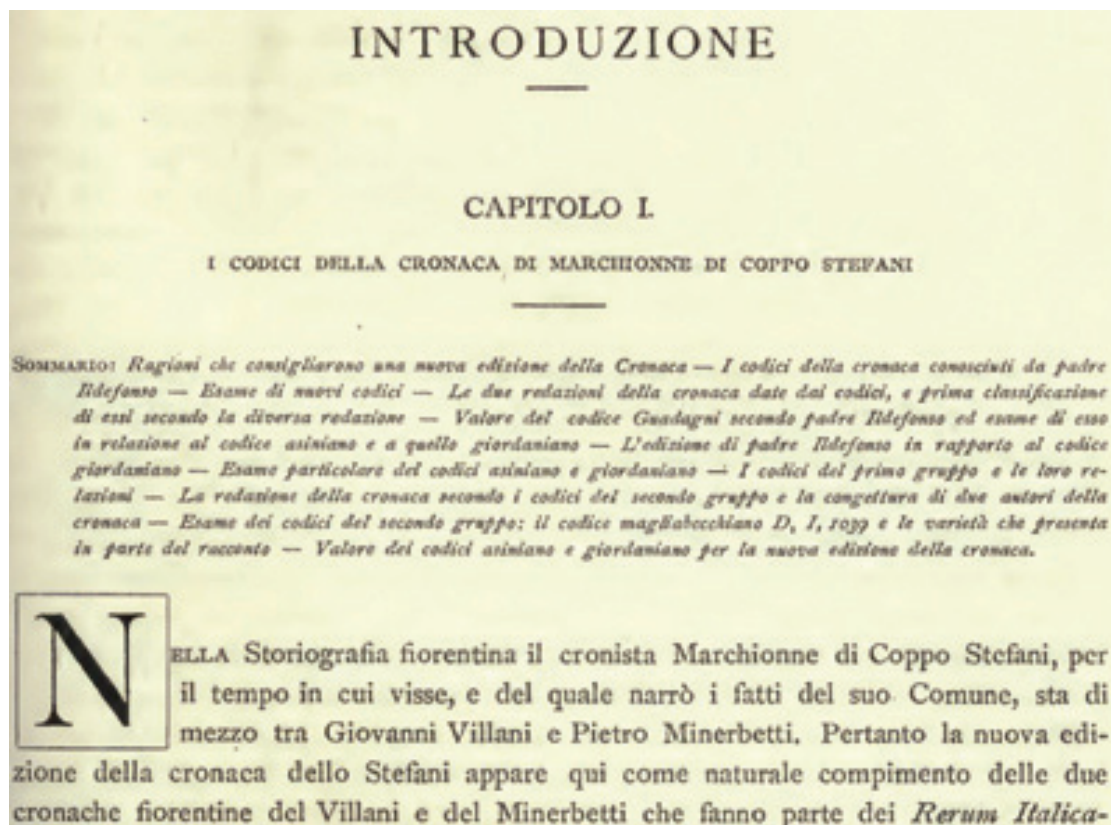
This pestilence began in March, as was said, and ended in September 1348. And people began to return to look after their houses and possessions. And there were so many houses full of goods without a master that it was stupefying. Then those who would inherit these goods began to appear. And such it was that those who had nothing found themselves rich with what did not seem to be theirs and they were unseemly because of it. Women and men began to dress ostentatiously

Rubric 635: How Many of the Dead Died Because of the Mortality of the Year of Christ 1348

Now it was ordered by the bishop and the Lords [of the city government] that they should formally inquire as to how many died in Florence. When it was seen at the beginning of October that no more persons were dying of the pestilence, they found that among males, females, children and adults, 96,000 died between March and October

Rubric 636: How They Passed Ordinances Concerning Many Things in Florence

In the said year, when the mortality stopped, women and men in Florence were unmindful of [traditional modesty concerning] their dress. And ordinances were passed concerning this giving authority to the Judge of the Grascia to enforce these ordinances. The tailors made such boundless demands for payment that they could not be satisfied. Authority was granted [to the judge] that he should handle all matters himself. Servants were so unhappy about the very high prices [they paid] that it was necessary to make great efforts to restrain [the price rises]. The workers on the land in the countryside wanted rent contracts such that you could say that all they harvested would be theirs. And they learned to demand oxen from the landlord but at the landlord's risk [and liability for any harm done to the animal]. And then they helped others for pay by the job or by the day. And they also learned to deny [liability for] loans and [rental] payments. Concerning this serious ordinances were instituted; and [hiring] laborers became much more expensive. You could say that the farms were theirs; and they wanted the oxen, seed, loans quickly and on good terms. It was necessary to put a brake on weddings as well because when they gathered for the betrothal each party brought too many people in order to increase the pomp. And thus the wedding was made up of so many trappings. How many days were necessary and how many women took part in a woman's wedding. And they passed many other ordinances concerning [these issues].



DOCUMENT ANALYSIS

In these excerpts, Bonaiuti describes the havoc which the Bubonic Plague wreaked upon the city of Florence in 1348. He begins with a physical description of the pestilence and its symptoms. Yet Bonaiuti does not play medical observer for very long. After several sentences, he quickly moves onto the changes that the outbreak wrought on Florentine society. He looks at a wide range of changes, social, legislative, and economic.

Throughout his depiction of social changes, Bonaiuti focuses on the theme of upheaval. This concept will be examined in greater depth in the Essential Themes section below. Bonaiuti begins with social upheaval at the family level and expands from there. He writes that “Child abandoned the father, husband the wife, wife the husband, one brother the other, one

sister the other.” The juxtaposition of the concept of abandonment and close family ties establishes the sense of disruption that the pestilence brings to the social fabric. The extensive list of different family ties showcases the extent of the disruption. From families, Bonaiuti moves to more general social mores. At the end of Rubric 643, he states: “Women and men began to dress ostentatiously.” This idea also appears at the beginning of Rubric 636: “In the said year, when the mortality stopped, women and men in Florence were unmindful of [traditional modesty concerning] their dress.” With a manifest example of the fragility of life, the residents of Florence were less interested in modesty. The problems in the health of individuals led to a breakdown of social norms at all levels of society.

The legislative changes are a direct result of the social changes, as the city government attempted to deal with disruptions in social norms. As Bonaiuti details, these legislative changes come in the form of ordinances passed. Rubric 636 devolves into a list of these various ordinances. In response to the ostentatious display of dress: "Ordinances were passed concerning this giving authority to the Judge of the Grascia to enforce these ordinances." A labor crisis arose in the countryside and "Concerning this serious ordinances were instituted." Finally, pomp exhibiting during weddings was on the rise. Similar to the changes in dress, this can be attributed to residents of Florence putting less stock in modesty. As one might imagine, "They passed many other ordinances concerning [these issues]." The quick succession of legislation can be viewed as a direct effect of the sudden social changes.

Bonaiuti focuses on economic changes far more than social or legislative changes. This should come as no surprise given his background as a banker and the economic bent of the rest of his chronicle. The economic changes he details prove varied. He details how the price of some products increased exponentially: "The things that the sick ate, sweetmeats and sugar, seemed priceless...Capons and other poultry were very expensive and eggs cost between twelve and twenty-four pence each...mantle and veil that used to cost women three florins climbed in price to thirty florins and would have climbed to 100 florins had the custom of dressing in expensive cloth not been changed." This increase in prices meant bedlam for the average Florentine citizen. However, there were those that profited: "Priests and friars went [to serve] the rich in great multitudes and they were paid such high prices that they all got rich." And later Bonaiuti adds that "This mortality enriched apothecaries, doctors, poultry vendors, beccamorti, and greengrocers who sold of poultices of mallow, nettles, mercury and other herbs necessary to draw off the infirmity." Moreover, the quick reversal in the economic hierarchy created a stigma upon the new rich: "And such it was that those who had nothing found themselves rich with what did not seem to be theirs and they were unseemly because of it." Similar to the social changes and the legislative changes which they caused, the economic changes constituted sudden and violent disruptions from the status quo.

ESSENTIAL THEMES

The theme of upheaval courses through these excerpts. In this Bonaiuti echoes the ancient Greek historian Thucydides and his depiction of the great plague that hit Athens during the Peloponnesian War. Just as Thucydides does in that account, Bonaiuti shows how damage wrought on the health of individuals quickly translates to upheavals in morality and the social hierarchy. On the one hand, this course of events may be common for all devastating outbreaks, yet Bonaiuti's employs specific echoes to recall Thucydides' prose. One of the social upheavals that Thucydides focuses on is the disregard for the normally meticulous burial rites as corpses get heaped upon one another. Bonaiuti includes a similar description with a ghastly analogy: "And then more bodies were put on top of them, with a little more dirt over those; they put layer on layer just like one puts layers of cheese in a lasagna." Thucydides also addresses how the outbreak dissolved family ties. As seen in the Document Analysis section above, Bonaiuti writes: "Child abandoned the father, husband the wife, wife the husband, one brother the other, one sister the other."

Finally the theme of upheaval gets extended into the economic realm. The overturning of the economic hierarchy caused by the Athenian plague troubled the aristocratic Thucydides. Bonaiuti, likewise a member of the elite class, is similarly concerned with economic upheaval. While discussing the labor crisis in the countryside, he details how the laborers turned the tables on the landowners. They made so many unprecedented requests that Bonaiuti claims, "You could say that the farms were theirs." The transference of land, albeit metaphorical, from the elite to the laborer underscores the upheaval exhibited throughout these excerpts.

—Anthony Vivian, MA

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GENOCIDE OF AMERICAN INDIANS

The European discovery of the New World had devastating consequences for the native population. Within a century of Christopher Columbus's landing in 1492, the number of people living in the Americas had declined from 25 million to 1 million. Whole societies in Mexico and South America died within weeks of initial contact with Spanish explorers and adventurers. The major cause of the devastation was disease. Native Americans had lived in total isolation from the rest of the world since first arriving in the New World from Central Asia around 20,000 bce; hence, they had escaped the devastating epidemics and diseases, such as smallpox and the plague, that had afflicted the rest of humankind for generations. Such diseases normally required human carriers to pass them on to others, and such conditions did not exist in the New World until after 1492.

DEADLY CONTACT

Columbus and his crew made four separate voyages to the New World between 1492 and 1510, and on each of those voyages sailors brought new diseases with them. Even the common flu had devastating consequences for Native American babies and children. Other people of the world had built up immunities to these killers, but Native Americans had none, so they died in massive numbers. In the 1500s, most of the dying took place from Mexico south, since the Spanish appeared to be uninterested in colonizing North America. Only after the English settled Jamestown in 1607–8 and Plymouth in Massachusetts in 1620 did the epidemics affect Native Americans in that region.

The first major tribe to be exterminated in North America was the Massachusetts of New England, whose population died out completely between 1619 and 1633 from a smallpox epidemic. Yet other things besides disease were killing Native Americans. Most Europeans believed that the people they came across in their explorations were not human at all, but instead savage, inferior beings who had no law and order, no cities, no wealth, and no idea of God or progress. When they died from “white man’s diseases,” this offered further proof of the weakness and helplessness of the population. Europeans soon turned to Africa for their supply of slave laborers; Africans, who had had a much longer history of

contact with other peoples of the world, had built up immunities to the killing diseases. Native Americans were not so lucky.

NATIVE AMERICAN TRIBES THAT HAVE BEEN COMPLETELY EXTERMINATED

Conflict over Land

As time passed, immunities were built up by native peoples, and fewer tribes were extinguished by diseases. Warfare, however, continued to take its toll. Thousands of Native Americans died defending their homelands from American settlers in the aftermath of the War for Independence. Native Americans were not made citizens by the Constitution of 1787 but were legally defined as residents of foreign nations living in the United States. Wars and conflicts over territory devastated many tribes by 1830. In that year, president Andrew Jackson and Congress adopted a program, the Indian Removal Act, that they hoped would put an end to wars with the Native Americans. Under this new act, the American government would trade land west of the Mississippi River for land owned by the tribes in the east. Land in the west, acquired from France in 1803 as part of the Louisiana Purchase, was deemed unsuitable for farming by Europeans. Native Americans, on the other hand, would be able to survive on the Great Plains, called the “Great American Desert” by most whites, by hunting buffalo and other game.



A mass grave being dug for frozen bodies from the 1890 Wounded Knee Massacre, in which the US Army killed 150 Lakota people, marking the end of the American Indian Wars. By Northwestern Photo Co.

Congress authorized the president to exchange land beginning in 1831. Three years later, a permanent Indian Country was created in the West and settlement by whites was declared illegal. By 1840, Indian Removal was complete, though it took the Black Hawk War in Illinois, the Seminole Wars in Florida, and the terrible march forcing the Cherokee from Georgia to the Indian Territory, to complete the process. At least three thousand Native American women and children died at the hands of the US Army on the Cherokee Trail of Tears. Indian Removal meant death and disaster for many eastern tribes.

Conflict was reduced by the program only until whites began moving into the West in the 1860s. During the Civil War (1861–65), several Indian Wars were fought in Minnesota and Iowa, and the infamous Chivington Massacre took place in Colorado in 1864. In this incident, 450 Native Americans were slaughtered without warning in a predawn raid by the Colorado militia. To prevent massacres in the West, Congress enacted a “reservation policy,” setting aside several million acres of western lands for “permanent” Indian settlement. The Army had the job of keeping the tribes on their reservations. Frequent wars resulted as Great Plains tribes attempted to leave their reservations to hunt buffalo (bison) and the army drove them back.

Problems increased with the coming of railroads. The first transcontinental railroad began carrying passengers in 1869. Huge buffalo herds presented the railroads with a major problem, however, because they took hours and sometimes days to cross the tracks. To keep trains running on time, railroads hired hunters to kill the buffalo. By the late 1880s, they had nearly accomplished their goal of killing off all the herds. Buffalo had once numbered 100 million, but by 1888, there were fewer than 1,000. With

the destruction of the buffalo came the end of the Native American way of life. The final war was fought in 1890 in the Black Hills of South Dakota on the Pine Ridge Reservation. An Indian holy man claimed that the whites would disappear and the buffalo would return if Native Americans danced a Ghost Dance. Magical shirts were given to the dancers that were supposed to protect them from white men’s bullets. When the white Indian agent asked Washington for help to put down the Ghost Dancers, the Army responded by killing hundreds of the Native Americans, whose magical shirts did not work.

Native Americans did not become American citizens until 1924 and were required to live on reservations. Not until 1934 was self-government granted to the tribes, and by that time the reservations had become the poorest communities in the entire United States. It is only in recent decades, with the rise in Indian activism and legislation protecting Indian civil and tribal rights, that Native Americans have begun to recover.

—*Leslie V. Tischauser*

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MOHAWK TRIBESMAN EFFORTS HELP PREVENT SMALLPOX

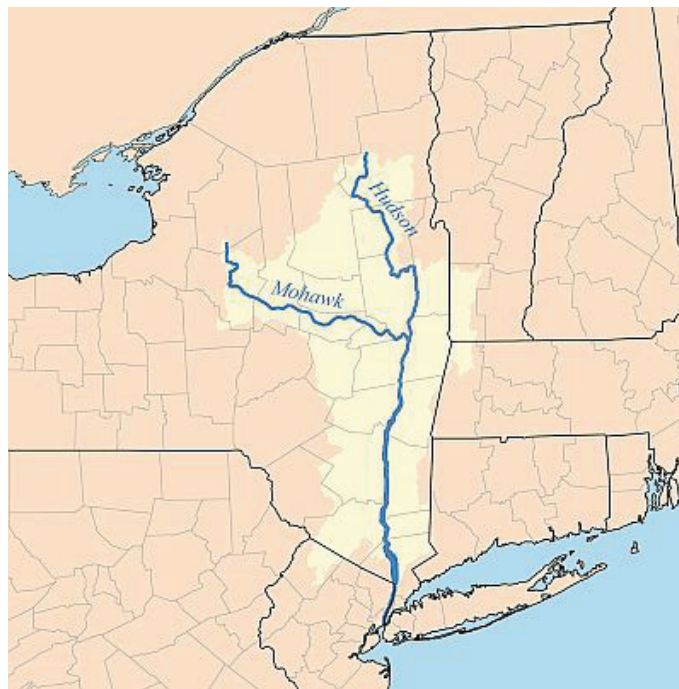
Rohahes was part of the Mohawk tribe that lived near present-day Albany, New York. After seeing the widespread and quick destruction caused by the small pox epidemic in surrounding areas, he advocated for ways to prevent the disease from devastating his village.

LIFE AT HOME

- Rohahes was born in 1610 near present day Albany, NY in a Mohawk village
- His mother, Ojista, was among the more respected women in his village. She was not a clan mother, one of the leaders of the matriarchal Mohawk society, but she was viewed as a very wise woman and people often sought her out for advice.
- His father, Kor, was a skilled hunter, who helped provide the village with deer and elk
- Rohahes had two younger sisters. He enjoyed playing with them around the village. He liked to tease them a lot and they often got fed up with his clowning, but overall they loved each other and would always seek out each other's company.
- Rohahes and his family lived in a longhouse which they shared with several other families. Mohawk society was communal and based as much on the clan as the family, but Rohahes preferred the company of his own family to that of the other clan members.
- From the time he was a young boy, Rohahes listened to his father's tales about his hunting expeditions. It was understood that these were exciting events and that Rohahes would one day join his father's occupation, but they failed to excite the boy.
- As a boy, Rohahes also listened to his parents talk about the Dutch and French settlers who were making inroads into their territory. There were mixed feelings in the village about these Europeans, but Rohahes' parents were wary of them.
- In 1614, when Rohahes was four, the Dutch established a trading post, known as Fort Nassau, just

several miles from his village. They began trading furs with the Mohawks.

- This brought a lot of prosperity to the village, but Ojista and Kor were not convinced that this was a positive development.
- When he was six, Rohahes saw a Dutch trader making a deal for furs with one of the most respected tribe members, a man named Ohserase. The Dutch trader yelled at Ohserase the entire time and once the deal was concluded, he spit rudely on the ground next to Ohserase. "That is disrespectful," thought Rohahes. "He didn't need to do that."
- When he was nine, Kor brought Rohahes along on his first hunting expedition. They went away for several days to a clearing that was rife with deer and elk which they hunted with bow and arrow.



The Mohawk lived in the upper Hudson and Mohawk Valley regions of present-day New York State.

- Rohahes hadn't realized how much of the expedition was taken up with waiting and he soon became bored. When it came time to actually hunt, Rohahes had fallen asleep and Kor had to wake him up.
- Kor very gently chided Rohahes—he was a kind father—but he realized that hunting wasn't going to be what his son would end up doing.
- Nonetheless, Rohahes could not avoid embarking on a military initiation. Although he had no particular inclination to go to battle, he had to embark on this rite into manhood when he was 13.
- He was given a warrior costume and embarked with a war party from the village to conduct a raid on a nearby Mahican village. The Mahicans were the Mohawks' rivals in the fur trade and the Mohawks were always looking to get the best of them.
- Although Rohahes was dreading the outing, as they approached the Mahican village, he found an inexplicable feeling of excitement mounting inside him. He had not felt this way during the hunting expedition and he was extremely surprised.
- When they entered the village, this feeling increased and, although he did nothing during the raid, he came away feeling that he wanted to become a great warrior.
- Over the next several years, Rohahes continued to go out on raiding parties, and his enthusiasm only increased. He killed several members of neighboring tribes and, although he didn't love the killing part, he accepted it as part of the experience. He quickly gained a reputation for bravery.
- In 1628, when Rohahes was 18, the Mohawks decided to consolidate their influence in the region and become the sole fur trading power. To do this, they realized that they had to push back the Mahicans and force them to retreat to a more distant locale.
- They launched an attack against their old rival



Rohahes was seriously injured by an axe during a raid on a Mahican village.

shortly after reaching this decision. They set upon the Mahican lands with their entire army.

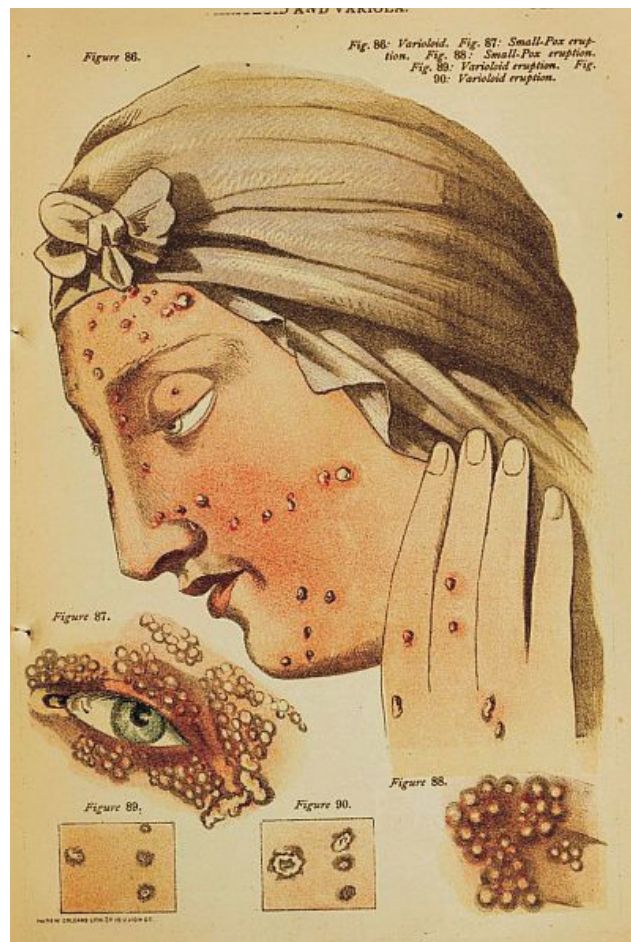
- Rohahes was right at the front of the charge. Upon reaching the battle field, Rohahes charged bravely but was soon met with an axe throw by a Mahican warrior. The axe landed in his right thigh and dropped him to the ground.
- Rohahes got up and tried to keep fighting but he couldn't. The Mohawks pushed the Mahicans backwards, but Rohahes stayed where he was.
- Left to himself, he thought he was going to die, but managed to pull the axe out of his leg, create a makeshift tourniquet, and limp to a safe camp.
- The mission proved successful, as the Mohawks pushed the Mohicans back into present-day Connecticut, and established the Mohawks as the only tribe to trade furs with the Dutch.
- Rohahes, however, was seriously wounded and he could not fight again. He walked with a pronounced limp for the rest of his life.
- Nonetheless, because of his bravery, Rohahes was considered a desirable marriage prospect, and soon after, he wed a beautiful young woman from the village named Skawennati, whose mother was a clan elder, and, per the custom of the tribe, moved in with her family in their longhouse.
- Now that the Mohawk had secured their trading monopoly, the Dutch were an even more constant presence in their village. Although relations seemed cordial and the trade proved lucrative,

Rohahes sensed that something wasn't right. He didn't like the way the Dutch lorded their superiority over the Mohawks.

- Soon, a couple of members of the tribe started getting sick with a mysterious illness. Rohahes had heard about other tribes falling prey to European illnesses but had never observed this with his own people. He didn't think these sick tribe members were anything to worry about, but he determined to keep a close watch on the proceedings.

LIFE AT WORK

- By 1634, more and more people were getting sick in the village. The illness affected the old and young, men and women alike. The victims would come down with a fever and nausea and a strange rash on their face and bodies.
- Rohahes decided to wander around neighboring villages and see what he could learn. He went over to his Oneida neighbors, fellow members of the Iroquois Confederacy, and asked them if they knew anything about this new illness. They replied that they did. They were suffering the same sickness.
- "It is called small pox," one of the village elders told him. "It is deadly, it comes from the Europeans, and there is nothing we can do about that." "We'll see about that," thought Rohahes and returned to his village.
- Although Rohahes's injury prevented him from hunting, fighting, or farming, he was still a respected member of the village because of his former military exploits. Therefore, when he approached the clan mothers and told him what he had learned, they listened to him. "We must do something," he told them. "That starts with limiting our exposure to the Dutch."
- Rohahes started advocating for breaking off relations with the Dutch. The clan mothers got together with the sachem from the village, the leader who represented them in the Grand Council of the Iroquois Confederacy.



Symptoms of smallpox included red pustules appearing on the face and body.

- Rohahes explained his position and the elders weighed the options. On the one hand, breaking with the Dutch would probably help prevent the spread of further disease. On the other hand, it would devastate the economy.
- "What does the economy matter if we are all dead?" Rohahes cried out in exasperation. But the sachem, Akwirente, did not feel that the illness was as serious as Rohahes did and he ultimately rejected Rohahes's proposal.
- Rohahes simmered in frustration. "What should I do now?" he asked Skawennati.
- Meanwhile, more and more people became infected with smallpox. It became clear that the disease was deadly with few people recovering



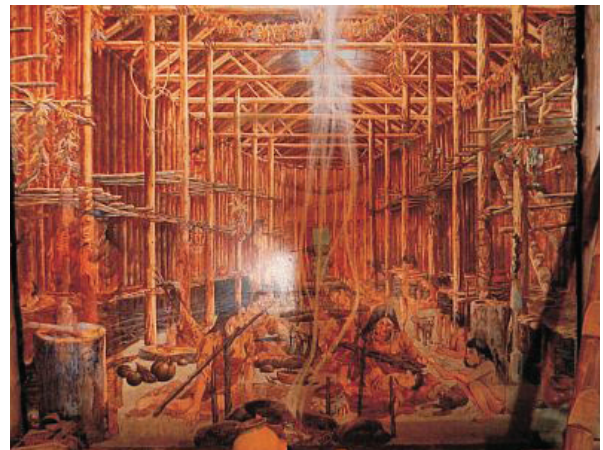
The exterior of a Mohawk longhouse was covered with bark.

once they caught it. By 1635, it had become an epidemic.

- Rohahes met again with Akwirente and the clan mothers. “See what has happened?” Rohahes scolded Akwirtente in frustration. “Yes, I see,” admitted Akwirtente. The sachem was due to attend a council meeting in a few days and he agreed to take Rohahes along with him.
- At the council meeting, the number one topic of discussion was the smallpox epidemic that was affecting all of Iroquois society.
- Although Rohahes was not a sachem, merely a guest, he spoke loudly and forcefully at the meeting. “We must immediately cut off contact with the Europeans in our midst,” he exclaimed.
- The proposal was met with reluctance, but everyone agreed to limit exposure as much as it was possible to do so.
- When Rohahes returned to his village, things were worse than ever. Hundreds of people had died in just the time he had been gone and many more were newly sick. “What is happening to us?” Rohahes thought. “Why has the Creator done this?” It felt to him like the end of the world.
- The Dutch kept away while everyone was dying, so Rohahes did not have to put his plan into effect. They watched from a distance and waited.
- By the end of the 1635, the population of the Mohawk people had been reduced by more than 60 percent. Rohahes himself never got sick but he was so grieved by the fate of his people that he did not even feel thankful that his life was spared.
- Nonetheless, the epidemic was winding down by the end of the 1635, and Rohahes was determined to lead his people on into the future. “We must regroup and start over,” he told Akwirente. “After all, we are Mohawks!”

LIFE IN THE COMMUNITY

- The village where Rohahes lived was one of four villages that comprised the Mohawk settlement in present day New York State. Rohahes’s village was located near present day Albany.
- The Mohawk People were one of the Five Nations who formed the Iroquois Confederacy, along with the Seneca, Oneida, Onondaga, and Cayuga tribes. They were later joined by the Tuscarora.
- The Mohawk’s were considered the Keepers of the Eastern Door because of their geographical location on the eastern part of the Iroquois Confederacy. They defended the Confederacy from attacks from the east.
- The Mohawk referred to themselves as being from Kanien’kehá:ka, which meant “flint stone place.” Even before contact with the Europeans, the Mohawk were a wealthy tribe because of trading.



Rohahes lived in a longhouse with many other Mohawk families.



Thayendanegea or Joseph Brant, War Chief of the Mohawks, painted by Gilbert Stuart in 1786.

In this case, it was the flint referred to in their name and which was abundant in their territory that allowed for their economic success. Other tribes needed it for their weapons.

- The Iroquois were considered among the most advanced Native civilizations. They had a modern government system, with a bicameral legislature, and were highly sophisticated in farming.

- The Iroquois farmed primarily corn, beans, and squash, known as the “three sisters”. Farming was mostly done by the women.
- The men were primarily hunters and warriors. They hunted mostly deer and elk, but also wild turkey, muskrat, and beaver.
- Mohawk society, like that of all of the Iroquois tribes, was matriarchal, with the woman given the power to preside over the land and to appoint sachems. Women were the holders of property and descent was passed through the women in a matrilineal system. When they married, a couple lived with the woman’s family in her longhouse.
- Before the onset of the smallpox epidemic, the population of the Mohawk peaked at 7,740. By 1635, it had reduced 63 percent to 2,830, despite the efforts of Rohahes.
- By 1642, the Mohawk people had reorganized into three villages (down from the previous four) and were ready to carry on their proud traditions. The new villages were established along the south side of the river that came to be known as the Mohawk.
- The Mohawks continued to trade with the Dutch and became important allies to each other, despite the Europeans’ condescending attitude.

GREAT PLAGUE IN LONDON

London suffered northwestern Europe's last major outbreak of bubonic plague, ending the second pandemic that began with the Black Death of 1347-1352. Despite the deaths of seventy thousand or more people, the city rapidly recovered, in large part because of the localized nature of the epidemic.

Date: Spring, 1665-Fall, 1666

Locale: London, England

SUMMARY OF EVENT

England had suffered outbreaks of plague every ten or fifteen years since the Black Death of 1347-1352. Though societal means of dealing with the pestilence, such as quarantines and boards of health, had developed since the fourteenth century, medical knowledge of the disease and its causes and vectors had not advanced. English society had learned to accept and even expect the plague, though especially heavy attacks could kill thousands and disrupt normal life for months. The year 1603 saw the greatest seventeenth century visitation, and 3,597 Londoners died in an outbreak in 1647. Between 1629 and 1636, the city lost an annual average of 1,500 people to plague, and the later 1640's saw an average of 1,072 plague deaths annually.

In the decade and a half leading up to 1665, however, plague deaths averaged only 14 per year in London, which housed nearly half a million people. Bills of Mortality—weekly publications that listed London deaths by cause—had been introduced in the 1520's and had long served as barometers that might predict heavy outbreaks. For the year 1664, they listed a mere five Londoners dead of the plague, at a time when nearby Amsterdam in the Netherlands was being ravaged by an epidemic. In 1663-1664, some thirty-five thousand Amsterdamers succumbed to the disease, but an embargo on Dutch shipping and an extremely cold winter in 1664-1665—the Thames River was frozen solid for two consecutive months—seemed to promise a safe new year in England.

Though virtually plague-free in the early 1660', Britons did suffer from malaria and other diseases that struck during the unusually warm summers. Despite the frigid winter, the spring of 1665 was also unseasonably warm, raising fears of plague brought from the Netherlands. The quarantine period for inbound ships was raised to forty days and mandated for twenty-eight port towns all around the island. *The Intelligencer*, a London newspaper, printed the plague

reports from the weekly Bills of Mortality in order to stem these fears. Before May 1, the periodical reported only three deaths attributable to plague, and it reported only forty-three in May itself.

Despite the tiny rise, many remained unconvinced by the data, since its collection was dependent on very unreliable people who could easily err in their diagnosis or be bribed. Since May, 1665, families with plague would by law be shut in until all members died or showed no more signs of the disease, Londoners had good reason to avoid being labeled as potential plague carriers. By mid-June, the number of reported plague dead rose to 112 per week. Both royal and civic authorities avoided formal acknowledgment of plague, since an official announcement would invite sudden flight from the city, disruption in local tax gathering and trade with other countries and regions, and interference with the preparations for war with the Dutch.

In June, reported plague deaths rose to 590, though all were limited to only five large suburban parishes. The gentry now began to abandon the city, and the royal family, including Charles II, left for Hampton Court. In Marylebone, a pest-house was constructed to house the diseased poor, and on June 21, local officials began to seal off the area most affected from the rest of the city in hopes of containing the epidemic. Officials shut down theaters on June 5, the Inns of Court in mid-month, and all London schools in July.

Despite these precautions, July saw the plague spread across all 130 of London's parishes, taking a total of 5,667 lives. Samuel Pepys, an administrator for the Royal Navy, sent his family away but, like other heads of households, remained in the city to continue working. He discussed the effects of the plague in his famous diary, remarking that the city seemed nearly deserted by late July. The four weeks of August saw reported plague death totals of 2,817; 3,880; 4,237; and 6,102. September saw these weekly numbers rise to 6,988; 6,544; and 7,165; and then fall again to 5,533, for a monthly total of 26,230.

Officials combated the epidemic by keeping bonfires in the streets stoked to dry out the supposedly pestilential damp air; houses where plague had visited were fumigated with gunpowder smoke, brimstone, or incense, and a multitude of cats, dogs, and birds that were suspected of somehow carrying the disease were destroyed. Thieves sacked abandoned homes, burial rites were curtailed, and bodies were dumped in mass graves. Individuals sought to avoid the disease by fleeing—a tactic of the well-to-do, including physicians like Thomas Sydenham—or by medicating themselves with tobacco, secret cures, and patent medicines developed during earlier plagues and wearing toad amulets. Preachers—those who remained—harangued their congregations for angering a God who was now justly punishing them. Quakers and other religious dissidents were treated as scapegoats by Anglicans and Puritans alike.

Monthly death tolls dropped from October through December to 1,050; 652; and 987, respectively, and London was repopulated in December and January. The year 1666 saw around 1,800 plague burials, bringing the total plague death toll in London to 68,596, about 70 percent of the total of 97,300 deaths from all causes in London for the period, according to the Bills of Mortality. Skeptics at the time distrusted the bills and claimed the figure to be much higher: The earl of Clarendon thought 160,000 plague deaths more likely. Historians who trust the bills claim 70,000 to 75,000 deaths, for a total loss of 15 percent of the city's population, compared to perhaps 50 percent loss in the late 1340'. Skeptical historians place the death toll rather higher, around 100,000, in the light of the insufficiencies of the bills.

SIGNIFICANCE

The Great Plague of 1665-1666 marked the last major outbreak of the disease in England. The economic recession and population loss were rapidly reversed, and London's total recovery was only suppressed by the Second Anglo-Dutch War and the Great Fire of 1666. Migration from across England reinforced the depleted population, which returned to its pre-plague level in 1668.

Culturally, the plague inspired novelist Daniel Defoe's *Journal of the Plague Year* (1722), which blends his own childhood recollections with the historical

record and fictional material. After fleeing London, poet John Dryden wrote several major works, including *Annus Mirabilis* (1667), and absentee London physician Sydenham penned his treatise on pestilential fevers in the plague's wake. It was while shunning plague-struck Cambridge in 1665 that Sir Isaac Newton made many of his key scientific discoveries, including formulating his theory of gravitation.

Plague also spread to other parts of England, as Pepys notes fearfully in his diary and as the example of the village of Eyam still commemorates. Plague struck Eyam in August, 1665, and the villagers imposed quarantine on themselves. By late 1666, 257 of perhaps 350 villagers had succumbed, with few if any surviving by flight. By the 1660's, plague had all but disappeared from many regions in Europe, though it would strike again mercilessly in the Mediterranean region, as at Lyon (1672 with some 60,000 victims) and Marseilles (1720-1722, killing perhaps 80,000).

—Joseph P. Byrne

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LAST MAJOR OUTBREAK OF PLAGUE

On May 20, 1720, a ship carrying victims of plague arrived at the French port of Marseilles. Several days later, an epidemic began in the city. By the time the disease ran its course, fifty thousand people in the city had died, as well as an equal number throughout the countryside. The epidemic represented the last major outbreak of the plague in Europe.

Date: May, 1720-December, 1721

Locale: Marseilles, France

SUMMARY OF EVENT

Bubonic plague, generally referred to as plague, is the result of infection by the bacterium *Yersinia pestis*. While most wild rodents may serve as reservoirs for the agent, it is most commonly carried by rats; transmission to humans results from bites by fleas carried by these animals.

The first appearance of the bubonic plague in the Mediterranean area is suspected to have occurred as early as the third century b.c.e., according to a description later produced by Rufus of Ephesus (fl. 98-117 c.e.), a Greek physician and writer. However, the first confirmed epidemic of plague in Europe was the Plague of Justinian (542-543). While precise mortality figures are unknown, as many as ten thousand persons per day may have died in Constantinople alone. The failure of Justinian to restore Roman rule across the Mediterranean was in large part a result of the outbreak. The epidemic reached Gaul (France) through the port of Marseilles in 543.

The most devastating outbreaks of the plague in Europe occurred during the fourteenth century, when approximately one-third of the population, some 25 million persons, fell victim to a series of epidemics that came to be known collectively as the Black Death, or Great Plague. The disease appeared in Marseilles in 1346, probably carried on a ship arriving from the Middle East, where the disease had been endemic.

After the 1346 epidemic, despite occasional local outbreaks, Western Europe, particularly France, was largely spared large-scale epidemics of the plague for nearly four centuries. However, on May 25, 1720, the *Grand St. Antoine*, a ship under the command of Captain Jean-Baptiste Chataud, arrived at Marseilles. The ship's voyage had originated at Saida, Syria, in January, at a time when an outbreak of plague was occurring in that city. Seven sailors had died en route from an illness that likely had been the plague. Refused entry at several ports prior to its arrival at

Marseilles, the *Grand St. Antoine* was placed in quarantine in a lazaretto near the port until the nature of the illness it carried could be determined.

The ship's cargo included textile goods, silk, wool, and cotton, which city merchants wanted for the medieval fair held at Beaucaire. As a result, the quarantine was prematurely lifted in mid-June. Among the first victims once the ship had docked were several of the porters who transported its merchandise to local warehouses. French physicians who examined the men noted the presence of "large tumors the size of hen's eggs" in the groin, the buboes typical in cases of the plague. The first cases within the general population appeared soon on the rue de l'Escale. The disease first caused the death of a young woman and, shortly afterward, her young daughter. By the end of the month, several people who had come in contact with the cloth carried on the *Grand St. Antoine* became ill with what local doctors had been calling "malignant fevers." By the end of July, the outbreak had spread beyond control.

A decree of the Parliament of Aix (August, 1720) placed the city itself under quarantine. The death penalty was threatened for anyone leaving Marseilles, and a "plague wall" was erected outside the city. Guard posts were placed at intervals behind the wall, portions of which still remain nearly three hundred years later, but by this time, thousands of people had already fled into the countryside, carrying the plague with them. The disease reached Aubagne on August 15 and Toulon the following week.

The resulting epidemic, spanning the period between 1720 and 1722, devastated southern France. Much of what is known is based upon the eyewitness accounts of Jean Baptiste Bertrand, one of the physicians who attended the victims in Marseilles. Bertrand himself contracted plague during the course of the epidemic, but he recovered. His wife and children were not as fortunate. Bertrand later recorded his observations in a lengthy treatise.

Between June, 1720, and December, 1721, nearly 95,000 persons in a provincial population of 250,000 died of plague. Of the 90,000 persons who lived in

Marseilles and its surroundings, 40,000 reportedly died. Nearly every police officer succumbed, as did most other public servants (doctors, surgeons, guards). Thousands of corpses were reported in the streets, as not only the corbeaux, special transporters for corpses, but also beggars hired for the same purpose all died. Some idea of the devastation may be discerned from numbers reported by Bertrand: Among one hundred master hatters, fifty-three died. More than 80 percent of master joiners died in the epidemic, while 370 of 400 cobblers survived. The disease was largely spent by the end of 1721, although another, smaller outbreak of the plague came again in May, 1722. This time the epidemic lasted only until August, with mortality significantly reduced when compared with the numbers from the previous two years.

The outbreak was particularly devastating to the poor of the city, as well as to those clerics who ministered to their needs. Among the Jesuits who ministered in the province of Provence, eighteen died. Forty-three Capuchin clerics died. Numerous individuals were singled out for their service despite the devastation, particularly the local bishop, Henri François Xavier de Belzunce. Belzunce was observed providing rites of burial to those dying of the plague, ignoring the danger to himself. He also mortgaged his own property to purchase relief for victims or their survivors.

Captain Chataud was subsequently arrested for his part in docking the ship at the city. Imprisoned in the Chateau d'If, he was later brought to trial. On July 8, 1723, his case was declared *nolo contendere*, but he was spared further punishment.

The main outbreak of the plague was essentially ended by December, 1721. Reasons for its disappearance remain obscure. Certainly, a significant factor was simply the lack of potential victims, as those susceptible had either died or remained immune. The presence of other, cross-reacting bacilli in the population, which would have produced immunity against the plague bacillus, has been proposed as another possible reason for the near-disappearance of the disease. Evidence remains lacking in support of that theory, however. More likely, the stricter enforcement

of quarantine measures, which prevented more plague-infested rats from entering Marseilles, accounts for the conclusion of the epidemic.

SIGNIFICANCE

Epidemics of plague in Europe had occurred periodically for much of the preceding one thousand years. However, the outbreak in Marseilles represented the last significant appearance of the disease in western Europe. Several reasons may account for this. First, the outbreak was, to an extent, self-limiting. While the role of the rat flea in spreading plague would not be determined for another hundred years, it was clear that spread of the disease was not necessarily the result of simple contagion between affected persons and the population at large. More important was the enforcement of quarantine carried out by European countries, in particular Great Britain. Quarantines had previously been maintained in theory, but their actual practice was often limited. A major outbreak had occurred in 1665 throughout England; the strict enforcement of the quarantine after 1720 resulted in no further appearance of the disease.

Other factors may also have contributed to the partial disappearance of the disease, including improved sanitary procedures that reduced exposure to infected rats and better shipping practices, which prevented infected animals from being transported by sea. The memories of plague epidemics remained within the collective populations, however, as commemorative events in places such as Marseilles continued into the twentieth century.

While western Europe was relatively free of the plague after 1722, portions of eastern Europe continued to suffer the ravages of that disease. In 1770, some 300,000 persons reportedly died from the plague in portions of the Ukraine and Transylvania. The epidemic apparently died out from lack of any further susceptible population.

—Richard Adler

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DOCUMENT 19: JOHN BARTRAM ON RECLAIMING FLORIDA'S WETLANDS (1767)

Traditionally, the marsh was a wild, evil place that was feared and had to be subdued. It was thought to be the home of murderous spirits and dangerous monsters such as Grendel, the huge moor-stalking subject of the tenth-century Anglo-Saxon epic poem "Beowulf" "who held the wasteland, fens, and marshes."

The colonists brought this view of wetlands with them to the new world. In the United States, until the latter part of the twentieth century, marshes and other wetlands were generally regarded as wastelands, evil places, and sources of diseases such as malaria; they were places to be avoided and, if technologically possible, to be done away with.

John Bartram, the first American-born naturalist, was a self-educated farmer. Although he never traveled to Europe, he knew all the major European naturalists of his day either personally—because, like Peter Kalm, they came to visit his acclaimed garden at his home outside Philadelphia—or through written correspondence. Eager to have contact with the greatest thinkers of his time, Bartram urged his friend and fellow Philadelphian Ben Franklin to organize a society of the “most ingenious and curious men”¹⁰ in America, and in 1692 Franklin formed the American Philosophical Society, the first scientific organization in America, to promote useful knowledge and encourage scientific agriculture.

When Bartram was in his sixties, he was appointed botanist to the king of England, and in this capacity he surveyed the newly acquired territory of Florida for the English Crown. Although he remarked upon the richness of the wetlands and recognized their function as a sanctuary for young fish, he nevertheless was the first of many people to recommend the reclamation of Florida's wetlands.

The pine-lands, as they are here called, contain a variety of soil, according to their different situations. . . The pine-land, by the help of dung and cultivation, will produce good corn, potatoes, and cotton; the

large palmetto declining ground, between the pines and swamps, are moist and seem rich, and perhaps will suit both corn and indigo; but the shelly bluffs seem to be the most fertile spots of high ground, and the Indians chief plantations for corn and pumkins: That which is called hammocky ground is generally full of large evergreens and water-oaks, mixed with red-bay and magnolia, and in many places the great palmetto or cabbage-tree: this is generally reckoned proper both for corn, cotton, and indigo: but the marshes and swamps (so extensive upon the river St. John's) are exceedingly rich, the last of which are full of large ash, maple, and elm, being of an unknown depth of rich mud; so are the marshes on the upper part of the river, which are covered with water-canes and reeds, as the lower marshes are with grass and weeds; all of which when they are drained dry, will produce, in all probability, great crops of corn and indigo, and without much or any draining, a fine increase of rice. . . .

St. John's river, by its near affinity to the sea, is well replenished with variety of excellent fish, as bass, sea-trout, sheep-head, drums, mullets, cats, garr, sturgeon, stingrays; and near its mouth, oysters, crabs, and shrimps, sharks and porpoises, which will doubtless continue. . . . Its shores, being generally shoal . . . afford a fine asylum to the young fry against their devouring enemies.

Source. William Stork, *A Description of East-Florida, with a Journal, Kept by John Bartram of Philadelphia, Botanist to His Majesty for the Floridas; upon a Journey from St. Augustines up the River St. John, as Far as the Lakes*, 4th ed. (London: Faden & Jefferys, 1774), p. 34.

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NATIONAL QUARANTINE ACT

Date: April 29, 1878
Genre: Act of Congress

SUMMARY OVERVIEW

In 1800 the average life expectancy was about 37 years. Infant mortality was especially heavy, with 21.7 percent not living past the age of four. In large part this was due to the spread of communicable diseases such as measles, cholera, malaria, whooping cough, tuberculosis, and yellow fever. By mid-century, attempts were beginning to address these deadly threats at the national level. Between 1857 and 1860 four national meetings were held, all of which discussed in one form or another the possibility of establishing a national quarantine policy that would not only apply to those infected with communicable diseases inside the country, but to those attempting to enter the country. Yet, despite these efforts authority for health services continued to be decentralized among the states and individual cities.

Efforts to create a national health policy organization were revitalized in the early 1870s, but were soon sidetracked by a conflict between two of the movement's leaders, Dr. John S. Billings and Dr. John M. Woodworth. Secretary of the Treasury George S. Boutwell attempted to appoint Billings, an army major who believed that public health policy ought to be under the purview of the individual states, as the head of a federal public health effort, but the move was blocked by a U.S. Senate committee. When this failed, Boutwell appointed Woolworth as the Supervising Surgeon of the new Marine Hospital Service. Woolworth advocated the screening of immigrants as they arrived as a preventive measure to halt the entry of diseases into the country. He also believed that the Constitution provided the basis for federal supremacy in the establishment of public health policies to "promote the general welfare." To this end, a meeting in 1875 discussed the possibility of forming a federal health department but failed to agree on a specific recommendation.

DEFINING MOMENT

The early 1870s saw a number of major epidemics that took the lives of thousands of people. Especially hard-hit were the southern states, but a yellow fever epidemic traced to ships arriving from Cuba spread

sickness and death throughout the eastern United States beginning in the summer of 1877. More than 27,000 were infected in New Orleans alone, with 4,000 succumbing to the illness. An estimated ten percent of the entire populations of Memphis and Vicksburg died. Panic spread, causing major population dislocations as people fled the infected regions. Trade and commerce suffered. The seriousness of the health crisis caused a public reaction in favor of government action.

President Rutherford B. Hayes appointed his former campaign manager, Senator John Sherman, as the new Secretary of the Treasury. Sherman was the brother of the famous Civil War general William Tecumseh Sherman whose personal medical officer during the March to the Sea was Dr. John M. Woodworth. Naturally, Woodworth's views on federal control of national health policy received official support. With this boost, a bill to address the issue, including protection against the arrival of infectious diseases in American ports, was introduced into the House of Representatives where Julian Hartridge, chair of the Committee on Interstate and Foreign Commerce, presented it for vote. In the Senate, Roscoe Conkling of New York introduced the same bill which became the National Quarantine Act when adopted on April 29, 1878.

AUTHOR BIOGRAPHY

Julian Hartridge was born in Beaufort, South Carolina, in 1829. He graduated from Brown University in 1848 and Harvard Law School in 1850, being admitted to the bar in Savannah, Georgia a year later. When the Civil War erupted he served for a year in the Southern army before being elected to represent Georgia in the Confederate Congress. Following the war he gained election to the U.S. Congress as a Democrat in 1874. He died in Washington, DC, in 1879.

A native of Albany, New York, where he was born in 1829, Roscoe Conkling grew up in a political family. After obtaining a basic education he passed up college to read law in Utica and was admitted to the bar in 1850, the same year the governor appointed him Oneida County District Attorney. Originally a Whig, he switched to the new Republican Party in time to campaign in the 1856 canvass. He was elected to the

U.S. House of Representatives, serving from 1859 to 1863, quickly becoming associated with the anti-slavery leader Thaddeus Stevens and supporting both emancipation and the Lincoln Administration's war effort. After acting as a Judge Advocate in the War Department, he was reelected to the House in 1864.

As a leading radical who supported civil rights for African Americans, he was elected to the Senate in 1867 where he helped draft the Fourteenth and Fifteenth Amendments and the Civil Rights Act of 1875. He died in New York in 1888.

HISTORICAL DOCUMENT

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That no vessel or vehicle coming from any foreign port or country where any contagious or infectious disease may exist, and no vessel or vehicle conveying any person or persons, merchandise or animals, affected with any infectious or contagious disease, shall enter any port of the United States or pass the boundary line between the United States and any foreign country, contrary to the quarantine laws of any one of said United States, into or through the jurisdiction of which said vessel or vehicle may pass, or to which it is destined, or except in the manner and subject to the regulations to be prescribed as hereinafter provided.

SEC. 2. That whenever any infectious or contagious disease shall appear in any foreign port or country, and whenever any vessel shall leave any infected foreign port, or, having on board goods or passengers coming from any place or district infected with cholera or yellow fever, shall leave any foreign port, bound for any port in the United States, the consular officer, or other representative of the United States at or nearest such foreign port shall immediately give information thereof to the Supervising Surgeon-General of the Marine Hospital Service, and shall report to him the name, the date of departure, and the port of destination of such vessel; and shall also make the same report to the health officer of the port of destination in the United States, and the consular officers of the United States shall make weekly reports to him of the sanitary condition of the ports at which they are respectively stationed; and the said Surgeon-General of the Marine-Hospital Service shall, under the direction of the Secretary of the Treasury, be charged with the execution of the provisions of this act, and shall frame all needful rules and regulations for that purpose, which rules and regulations, shall be subject to the approval of the President, but such rules and regulations shall not conflict with or impair any sanitary or quarantine laws or regulations of any State or municipal authorities now existing or which may hereafter be enacted.

SEC. 3. That it shall be the duty of the medical officers of the Marine Hospital Service and of customs-officers to aid in the enforcement of the national quarantine rules and regulations established under the preceding section; but no additional compensation shall be allowed said officers by reason of such services as they may be required to perform under this act, except actual and necessary traveling expenses.

SEC. 4. That the Surgeon-General of the Marine-Hospital Service shall, upon receipt of information of the departure of any vessel, goods, or passengers from infected places to any port in the United States, immediately notify the proper State or municipal and United States officer or officers at the threatened port of destination of the vessel, and shall prepare and transmit to the medical officers of the Marine Hospital Service, to collectors of customs, and to the State and municipal health authorities in the United States, weekly abstracts of the consular sanitary reports and other pertinent information received by him.

SEC. 5. That wherever, at any port of the United States, any State or municipal quarantine system may now, or may hereafter exist, the officers or agents of such system shall, upon the application of the respective State or municipal authorities, be authorized and empowered to act as officers or agents of the national quarantine system, and shall be clothed with all the powers of United States officers for quarantine purposes, but shall receive no pay or emoluments from the United States. At all other ports where, in the opinion of the Secretary of the Treasury, it shall be deemed necessary to establish quarantine, the medical officers or other agents of the Marine-Hospital Service shall perform such duties in the enforcement of the quarantine rules and regulations as may be assigned them by the Surgeon-General of that service under this act: Provided, That there shall be no interference in any manner with any quarantine laws or regulations as they now exist or may hereafter be adopted under State laws.

SEC. 6. That all acts or parts of acts inconsistent with this act be, and the same are hereby, repealed.

Glossary

Cholera: A sometimes fatal infection of the small intestine causing vomiting, diarrhea, and muscle cramps.

Marine: Something which relates to the sea. In the sense used in this document, it refers to shipping and seafaring.

Surgeon-General: The head of the U.S. Public Health Service.

Yellow fever: An acute and sometimes fatal viral disease characterized by alternating fever, chills, nausea, muscle pains, and loss of appetite.

EXPLANATION AND ANALYSIS OF THE DOCUMENT

In order to prevent contagious diseases from entering the United States, the National Quarantine Act required that no ship carrying passengers or animals inflicted with such a disease, and no ship arriving from any region infected with such diseases whether or not the diseases appeared among the passengers or animals at the time of arrival, could enter the United States. Any such ships or passengers were subject to exclusion not only under federal law, but under any existing state law as well. To assist in the enforcement of this, Section 2 required that consular officials or other designated representatives of the United States report the name of the ship, the date of departure, and the intended port of entry in the United States to both the Supervising Surgeon General of the Marine Hospital Service and the health officials in the anticipated port of arrival. Consular officials were further required to report the health status of the ports where they were located on a weekly basis, and charged the Surgeon General of the Marine Hospital Service with responsibility for enforcing the law. These provisions clearly placed oversight and enforcement of the public health laws as they applied to immigrants to federal rather than state officials, thus ending that era of state control.

Once immigrants arrived, Section 3 specified that medical officers in each of the Marine Hospitals, assisted by the customs officers, were to be responsible for enforcement of the provisions of the National Quarantine Act. The Surgeon General of the Marine Hospital Service was to provide to state and local authorities advanced notice of the arrival of ships from infected areas, as well as “weekly abstracts of the consular sanitary reports and other pertinent information.” Section 5 provided for enforcement, stipulating that it must be done in accordance with federal and state laws. In the absence of an existing federal system, this allowed for enforcement by personal from other agencies.

ESSENTIAL THEMES

The National Quarantine Act was the result of a gradual movement to bring public health policy under federal control. The legislation settled the ongoing difference of opinion on whether public health policy ought to reside with the states or the federal government and paved the way for creation of the National Board of Health in 1879 with one of its responsibilities being the determination of when to enact a quarantine. Unfortunately for those supporting the active participation of the federal government in disease research and control, the National Board of Health authorization expired after only four years, on March 2, 1883. The National Quarantine Act did not change existing federal or state quarantine laws or procedures, but it did make the refusal of entry of an infected vessels, passengers, and animals a national policy that could be enforced by federal officials, policies that outlasted the existence of the short-lived National Board of Health.

At the same time the new law was also part of a natural progression in American immigration policy that was moving away from the virtual open admission policy established by the Naturalization Act of 1790 to more restrictive entry policies. This was the first stage in a series of Congressional actions linking health issues to immigration policies. The Immigration Act of 1891 denied entry into the United States of persons with “dangerous contagious disease” and medical examinations began on Ellis Island on January 1 of the following year. In 1893 another quarantine act required U.S. consular officers in foreign ports to verify that ships bound for the U.S. was free of disease. What these acts in effect did was to create an amalgam system of state and federal laws and enforcement mechanisms but backed by the authority and financial resources of the federal government.

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THIRTEEN-YEAR-OLD ORPHAN IN 1882

Ora McFadden and his two sisters had lost their parents and their middle-class life in 1878, when an epidemic of yellow fever swept through Memphis, Tennessee. For the past four years, the three children had lived in the Catholic Orphan Asylum.

LIFE AT HOME

- At night Ora often dreamed about the house he had lived in before he and his sisters, Iris and Rose, came to the orphanage.
- Ora had had a bedroom of his own—just up the stairs from the kitchen, from which good smells emanated.
- He had had a dog and friends and a mother who tucked him in at night and a father who loved to tell stories.
- Then the yellow fever epidemic hit Memphis, and everything changed.
- Yellow fever had already devastated Memphis four times in the 1800s, most recently in 1873, when approximately two thousand people died.
- That dreadful figure was eclipsed in 1878, when more than eight times as many people perished in Memphis of yellow fever.
- In 1878 a New Orleans steamboat deckhand was the first person to die.
- He was followed by Mrs. Kate Bionda, who operated a snack shop patronized by river men, and then by James McConnell, a policeman.
- More than 20,000 citizens—half the city—then fled Memphis in fear.
- The Public Ledger observed, “At no time within the history of our city has there been such a sudden or effective panic among the people of Memphis. Our community is in a state of great alarm, and all who can leave are doing so.”
- When the yellow fever outbreak began, Ora's father, a bank clerk, sent the family north while he stayed behind in Memphis to provide necessary travel funds to fleeing residents.
- The family took the Louisville & Nashville train north a hundred miles to the country home of Ora's aging grandmother; Ora noticed that many additional railroad cars had been added to accommodate all the extra passengers fleeing Memphis.
- Ora McFadden lost his parents during the yellow fever epidemic.
- It was a frightening time, and the three children clung tightly to their mother for most of the trip; no one felt the need to appear brave.
- The Daily Appeal said, “The ordinary courtesies of life were ignored; politeness gave way to selfishness and the desire for personal safety broke through the social amenities.”
- To further assist the citizens of Memphis, Ora's father joined the Citizen's Relief Committee, which had two white members and one black member from each of the city's ten wards.
- Space was set aside in the hospital for indigents; schools were converted to hospitals.
- Of the 40,000 original residents of Memphis, only 7,000 whites and 13,000 blacks stayed in the city.
- Most of the people who remained within the city's four square miles were volunteers or were already ill, or they stayed because they thought they were immune to the disease.
- It was generally believed that African Americans had a higher resistance to yellow fever than did whites.
- Once the epidemic began, the Howard Association of New Orleans, which had been founded specifically to combat yellow fever, employed 3,000 nurses to care for the sick, two-thirds

of whom were males from Memphis, both black and white.

- In addition, 500 nurses came from outside the city to help-volunteers from Catholic, Protestant, and Hebrew groups-along with many who were employed by fraternal organizations such as the Odd Fellows and the Masons.
- Hundreds of nurses died caring for patients.
- During the first week of September, the city government and Board of Health ceased to function.
- That same week, Ora's father became ill with yellow fever.
- He was immediately given the "Creole treatment," consisting of small doses of castor oil or calomel to keep the bowels open, sponge baths to reduce fever, adequate covering in the event of chills, and absolute rest of mind and body.
- When Ora's mother learned that her husband was sick, she and the children's grandmother returned to Memphis.
- During the next two weeks, they all caught yellow fever, and they died within days of each other.
- Suddenly, Ora, Iris, and Rose were orphans.
- After the fever passed, the city was full of wandering, homeless children.
- African American gravediggers labored day and night for two dollars a day, but they could not keep up with the mountain of coffins.
- When Ora and his sisters returned to Memphis, as instructed by the authorities, they were placed in a Catholic Orphan Asylum, where they had remained for the past four years.
- They had not forgotten how nice their mother smelled when she tucked them in at night.

LIFE AT SCHOOL AND THE ORPHANAGE

- Every evening while lying in his bed in the orphanage, Ora pulled out the ferrotype pictures taken when the family was still together.
- He remembered that the pictures had been taken on a Saturday afternoon; his father's barber had proudly set up a photography studio, complete with desks, chairs, and props.
- The McFaddens had been among his first customers.
- Ora's father and mother even got dressed up for the occasion, although the children did not.
- Pictures were taken of Ora, then aged eight, and of his sisters; there were also photographs of Ora's father, mother, and grandmother.
- It was a great afternoon of fun; Ora had been unsure that he could remain standing completely still for 30 seconds so the photograph would not be spoiled, but he managed to do it.
- Most of the photos of his mother and of his sister Iris were lost when the children were taken to the orphanage.
- Ora still liked nothing better than to look at the pictures, even when they made him sad; he was determined always to remember what his mother, father and grandmother looked like before they died.
- The orphanage was filled with other children who also lost their parents in the epidemic.
- As the oldest child, Ora had felt it was his duty to lead the children into the orphanage for the first time, although he was frightened beyond words.
- Everyone was very nice, but the house was extremely chaotic then.
- Too many children had come too quickly, and few Sisters remained to care for them.
- Later things improved, and everyone learned

what was expected of them as well as what they could themselves expect.

- Before coming to the orphanage, many of the children had been living on the streets for months, begging for food from house to house.
- Until the hard winter came in January, many of the street children did not want to stay at the orphanage because so many of the nuns had died of fever during the epidemic.
- Everyone in Memphis had thought that God would make the Sisters safe.
- Many of the nuns Ora knew at the orphanage had arrived since the fever.
- Most of them believed that if they could control the influences that made up a child's life and thoughts, the child wouldn't ever be a truant or disrespectful, or run with a gang.
- Ora's English lessons were taught from the textbook *Graded Lessons in English*; his younger sisters used the *McGuffey Reader*, which had many delightful pictures.
- First published in 1836, the *McGuffey Readers* had become the basic schoolbook in 37 states; more than two million copies were sold each year.
- Little Rose loved to repeat the alphabet as she learned it from the first reader—from “A is for axe” and “B is for box” all the way to “Y is for yoke” and “Z is for zoo.”
- The books were filled with pictures of boys with hoops, kites, and skates and girls happily playing with dolls, sleds, and jump-ropes.
- At the orphanage the children were also instructed in the French language.
- Girls were taught to sew, wash, iron and cook; sewing was taken in from city residents to support the institution and to encourage the industrial education of the children.
- About half of the girls were in the sewing department and half in the mending department.
- Boys were trained in breadmaking, farm work and blacksmithing.
- Ora had found great joy in the bakery, but he knew his destiny was to work on the docks, where he could make enough money to buy back his childhood home.
- The orphanage's chapel, fitted with seats of natural wood and decorated with walnut moldings, could accommodate 250 people.
- The nuns insisted that everyone attend chapel regularly; the boys were lectured on temperance and told to pledge that they would never use alcohol or tobacco.
- The cost of housing the children was generally \$5 per month.
- The Catholic churches of the area provided additional support; in 1881 the churches had provided \$116 for the sustenance of the 15 Sisters, while an additional \$423 was donated toward the upkeep of the 125 children.
- The dormitories were furnished with single iron beds and straw mattresses.
- Iris had learned to iron as well as how to sew; she liked to iron because it meant she got to be around the nuns; one Sister, she had told Ora, talked just like their mother.
- Under the mattress of her bed, the only place she considered private, Iris kept her collection of trading cards advertising Soapine soap products.
- She especially liked the cards decorated with a gold rim, which depicted little girls like her.
- Mr. Anderson at the corner store, a man who had known her father and mother well, saved them for her as a special reminder of home.
- On Sunday afternoons the Sisters read aloud to

the orphans, often from the newspaper, which carried features just for children, such as “How Yap Got the Slipper.”

- On some nights the three children climbed together to the orphanage roof and looked toward the Mississippi River.
- Ora then imagined the day he would go to work there.
- Some nights Ora pretended he could see his father walking from his station at the bank down to the Cotton Exchange, just as he had done every day.
- Ora's father, as a bank clerk, had been heavily involved in the city's cotton business, often serving as middleman between buyer and seller and handling the financial exchange of goods; the bank received a commission for such services.
- When he turned 14, Ora would have to leave the orphanage and support himself; the girls could remain there until they were 16.
- He believed that if he could raise the money to buy back his parents' home one day, by working on the cotton docks, he and his sisters could live there again and be happy.
- To improve conditions, the city ordered that unconfined goats and hogs in the city be impounded.
- New regulations were created concerning the dumping of dead animals and the proper ways of emptying privies.
- An extensive sewer construction effort was under way; 30 miles of lines had been built in 1880 and 1881.
- Worldwide more than \$4.5 million was donated to Southern cities hit by the fever; \$1 million was donated to Memphis alone, \$45,000 of which came from New York City.
- Additional contributions came from all across the United States, Europe, Asia, Australia, and South America.
- Still, the epidemic was the last economic straw for the struggling city—Memphis was bankrupt.
- When the yellow fever struck, more than a million dollars in back taxes were due, and most of it was now rendered uncollectible.
- Residents continued to leave the city, some because of their fear of a new outbreak of yellow fever, others simply because Memphis seemed to be a dying city that offered few opportunities.

LIFE IN THE COMMUNITY: MEMPHIS, TENNESSEE

- After the yellow fever epidemic of 1878, doctors throughout the city advocated better sanitation methods to prevent another outbreak.
- In fact, yellow fever returned the following year, although with less severity.
- Even in the best of neighborhoods, the streets contained animal droppings; most homes had backyard privies, windows were unscreened against flies and mosquitoes, and water often was contaminated.
- In addition, Memphis was battling a flood that had disrupted one of its key economic mainstays, the shipping of cotton on the Mississippi River.
- Since 1873 Memphis had operated a spot market for cotton through the Cotton Exchange; cotton was bought and sold on the spot.
- By contrast, in a futures market, cotton was purchased based on expectations of its value.

ROSS ESTABLISHES MALARIA'S TRANSMISSION VECTOR

Several days after allowing mosquitoes to feed on a patient with malaria, Ronald Ross observed the malarial parasite in the stomach of the insect. He observed the parasite migrate to the salivary gland of the insect, suggesting a mechanism of transmission from human to human. Ross subsequently demonstrated that the anopheles species of the mosquito was the specific vector for transmission of the disease.

Date: August 20, 1897

Locale: Secunderabad, India

SUMMARY OF EVENT

Malaria is an ancient disease whose records go back to the time of the ancient Greeks. Moreover, indirect evidence suggests that the disease goes back several thousand years earlier in the eastern Mediterranean region. The earliest known direct description of malaria is in the writings of Hippocrates (c. 460-c. 370 b.c.e.), who described an illness with intermittent fever that appeared every three to four days and was generally found in people living near areas of dampness or swamps. From Greece, the disease spread to Rome, where its name was coined as a result of the belief that *mala aria*, or bad air, could be the cause. In 1740, Horace Walpole translated the Latin name into the English “malaria.”

By the period of the eighteenth century, theories about the source of the infection began to center on contaminated water. The germ theory of disease, primarily the result of research by Robert Koch and Louis Pasteur, resulted in physicians addressing the possibility of malaria being caused by a germ. The involvement of mosquitoes had historically aroused suspicion. Indeed, a description in Sanskrit literature from fifteen hundred years earlier had suggested a connection between mosquitoes and the disease, but until the nineteenth century, it was not believed that insects served as vectors of disease.

The first demonstration of the role played by parasites other than bacteria in disease came in 1878. Sir Patrick Manson, medical adviser to the British colonial office, reported the presence of the filarial worm in the blood of patients with elephantiasis, a condition marked by significant enlargement of the limbs. At the time, Manson failed to observe the maturation and development of the parasites he had observed, nor did he link the worm with its ingestion and passage through mosquitoes. He mistakenly continued to believe it was the ingestion of contaminated water that spread the disease, not the insect. However, as a result of his extensive studies into such diseases,

Manson became known as the founder of tropical medicine, and later, more pejoratively, as Mosquito Manson.

Louis-Félix-Achille Kelsch reported the presence of dark staining inclusion bodies in both red and white blood cells of persons with malaria. The significance of his observation was not understood immediately. In 1880, Alphonse Laveran, a French army surgeon stationed in Algeria, observed a spherical parasite containing hairs, or flagella. This parasite was likely the male gametocyte of the malarial protozoan, now known by the genus name *Plasmodium*. Émile Roux, a pupil of Laveran while in military school, arranged for a demonstration of “Laveran’s bodies” to Roux’s skeptical associate, Louis Pasteur. The success of this work later resulted in a successful search for other plasmodia in birds. Several years later, Camillo Golgi, more renowned for his observation of cellular organelles, also confirmed the presence of “Laveran’s bodies.” In 1885, Golgi identified three distinct species of the parasite, which are now known as *Plasmodium vivax*, *Plasmodium falciparum*, and *Plasmodium malariae*.

Ronald Ross was the son of Sir Campbell Ross, a British general in the Indian Army. Born in India, the younger Ross was interested in music and the arts but entered the medical profession, following the wishes of his father. After graduation from medical school in 1879, he served as a surgeon on a series of British ships. Ross became interested in malaria following a London demonstration by Manson in the spring of 1894, at which Ross learned that parasites could be observed in the blood of patients with the disease. (Manson believed incorrectly,



Ronald Ross. (Library of Congress)

however, that the malarial parasite was acquired through drinking contaminated water.) Ross also became aware of Laveran's belief that these parasites were the actual cause of the disease. Ross's interests continued to lie, however, in the arts. During the summer of 1894, he and his wife lived with friends in Switzerland, and Ross spent the time writing two romance novels.

Returning to medicine in 1895, Ross became increasingly associated with Manson and his work in London on parasitic diseases. Manson taught techniques to Ross necessary for the observation of parasites in blood or tissue. Manson had read Laveran's reports as early as 1889, and he became intrigued by the perceived similarities between the filarial structures and the flagella found on plasmodia. Although his ideas with respect to similarities in lifestyle between the two types of parasites were inaccurate, Manson did correctly suggest that blood cells played a role in the metamorphosis, or life-cycle changes, of these agents. Manson suggested to Ross that he continue with this work upon his return to India.

Ross returned to India in 1895. While on board ship, he began to practice dissection of cockroaches, both to develop expertise in dissection of mosquitoes and to investigate the possibility that cockroaches might carry a parasite similar to those in mosquitoes. Much of his methodology was self-taught. Ross had minimal knowledge of bacteriology, and his expertise in microscopy was primarily learned while working with Manson. He had little knowledge of the life cycle and behavior of the mosquito itself. The initial months of 1895 were spent addressing these deficits.

On August 16, 1897, while Ross was working in Secunderabad, he allowed anopheline mosquitoes to feed on a patient with malaria. On August 20, four days later, he dissected the mosquitoes and found cysts in the stomach tissue containing the malarial parasite. Similar experiments were carried out with two other species of mosquito, *Culex* and *Aedes*, but the results were negative. Furthermore, volunteers who drank contaminated water did not, with one exception, contract malaria.

It remained to be proven only that the infection of a healthy human with the parasite would result in that person contracting malaria. Ironically, in completing the research necessary to confirm the role of the mosquito in malarial transmission, Ross was betrayed by his mentor, Manson. The Italian physician

Giovanni Grassi had been carrying out studies similar to those of Ross and represented Ross's primary competition in the field. Grassi collaborated in his final experiments with Manson, even using Manson's son as one of the subjects for the experiment. Using mosquitoes which had recently fed on a human with malaria, Grassi demonstrated that transmission of the parasite using the anopheles vector would result in the transmission of malaria as well.

Ross continued with his work, observing the life cycle of the parasite. Following the rupture of the cysts in the mosquito's stomach, organisms migrated from the stomach to the salivary glands of the mosquito. By 1898, Ross had reported the complete life cycle of the *Plasmodium* parasite, as well as demonstrating that only the single species of mosquito, anopheles, was involved in its transmission. In 1902, Ross was both knighted and honored with the Nobel Prize for his work. Laveran received a similar honor from the Nobel committee in 1907 for his discovery of the malarial parasite.

SIGNIFICANCE

While mosquitoes had been suspected prior to this period in the transmission of certain tropical diseases, most notably malaria and yellow fever, the work of Ross and others provided scientific evidence to confirm this suspicion. Furthermore, their work provided an explanation for the presence of these diseases primarily in damp, swampy areas, which were breeding grounds for the insects. In the absence of a treatment (other than quinine) or a vaccine preventive, the explanation also provided a means to address the problem: Breeding grounds for mosquitoes would need to be eliminated.

Wherever possible, swamps were drained, and standing water was treated to kill anopheline mosquitoes. The clearest result of these actions could be observed in Central America: Yellow fever and malaria had ravaged U.S. soldiers during the Spanish-American War, as well as French laborers working in Panama to build a canal across the Central American isthmus. Although treatment of water primarily addressed yellow fever, the elimination of mosquito breeding grounds helped control malaria as well.

—Richard Adler

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MARY MALLON

A healthy carrier of typhoid fever, Mary was the first individual to be thus publicly identified in the United States.

Date: 1900-1915

Locale: New York, New York

EARLY LIFE

Mary Mallon (MA-lon) was born on September 23, 1869, in County Tyrone, Ireland. She emigrated to the United States in 1883 and lived with her aunt in New York City. She later worked as a domestic servant, then became a cook for prominent New York families. Previously, Mallon had contracted a light case of typhoid fever. She probably never even knew she had it. Although she was asymptomatic and appeared healthy, she remained capable of spreading the disease to others.

DOMESTIC CAREER

Mallon worked as a cook for a number of prominent families in New York between 1900 and 1907, infecting twenty-two people during that time. After several members of one employer's household became infected, he hired George Soper, a sanitary engineer who had experience with typhoid outbreaks, to investigate. Soper proved that Mallon was the source of the infections. Mallon vehemently denied being sick or having typhoid and would not cooperate with authorities.

LEGAL ACTION AND OUTCOME

Mallon was taken into custody and quarantined for three years on North Brother Island in New York's East River. Upon her promise not to return to cooking or to work with food, she was released in 1910. Unable to make her way, she returned to cooking, the only skill she possessed by which she could earn a decent living. She then infected twenty-five people at Sloan Hospital, two of whom died. Mallon was seized again

in 1915 and quarantined for the rest of her life. She died of pneumonia in 1938. At the time of her death she was found still to be contagious with typhoid bacilli.

IMPACT

The phrase "Typhoid Mary" entered the vernacular as a name given to a carrier of a contagious disease who refuses to comply with authorities to protect the public health. Mary Mallon's case involves a dilemma that has continued in the more recent emergence of infectious diseases and highlights the issue of how far authorities may go to protect the healthy population when a carrier's personal liberty is involved. The case of Typhoid Mary illuminates the human and social dimensions and dilemmas of disease control.

—Martha Oehmke Loustaunau

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AN ARMY PHYSICIAN ON THE 1918 FLU PANDEMIC

Date: September 29, 1918

Genre: letter

SUMMARY OVERVIEW

During the late stages of World War I, a new threat to the global community emerged: an influenza pandemic. Arriving in the United States in the spring of 1918, the disease quickly spread throughout the country. At the overcrowded Camp Devens in Massachusetts, thousands of US soldiers suddenly became ill in a matter of days. Nearly one thousand men died at this site alone. In a letter to a friend and fellow physician, a camp doctor known only by his first name, Roy, describes the scene and conditions at Camp Devens, where an average of one hundred men were dying each day during the pandemic. He cites rapidly appearing symptoms, followed by severe pneumonia and a “horrible,” suffocating death.

DEFINING MOMENT

World War I (1914–18) was one of the most destructive conflicts in history. More than sixty-five million military personnel were mobilized by sixteen nations, including the United States, which mobilized nearly 4.4 million troops. More than twenty-one million soldiers, who were sent to the battlefield, were wounded, and more than eight million soldiers were killed. The battlefield was a harsh environment; in addition to gunfire and chemical attacks, troops were exposed to extremely unsanitary conditions in the cramped and damp foxholes and trenches.

When the Great War began to wind down, a new threat emerged from that environment: influenza. The disease was first reported in the United States in January 1918, cropping up mainly in military camps. Very little attention was paid to this first wave, as the US government was more focused on the ongoing war effort. In the fall of 1918, however, a second, more virulent wave of influenza could not be ignored. The widespread mobilization of troops across the world

facilitated the spread of the disease. Merchant and military ships carrying troops and military hardware also brought influenza to ports all across the United States.

This letter by an anonymous physician provides a fascinating snapshot of the effects of the influenza pandemic at one Massachusetts military installation. Camp Devens, located about thirty miles northwest of Boston, was one of the main military hospitals and training installations in the Northeast. The camp (later renamed Fort Devens) was built to house up to thirty-five thousand people. However, by the summer of 1918, it had exceeded this capacity by some ten thousand men. Soldiers slept in cramped, crowded quarters that further facilitated the transmission of the disease.

Influenza began its rapid spread through Camp Devens by mid-September 1918. On September 22 alone, more than fifteen hundred soldiers went to the camp infirmary complaining of flu-like symptoms. That infirmary was only supposed to house about twelve hundred patients. Due to the overcrowding, the camp’s barracks became makeshift hospitals as well. One barracks even became a morgue, as the staggering death toll from the pandemic filled the existing morgue beyond its capacity. The military quarantined the camp, but locking it off from traveling soldiers took a great deal of time; by the time the camp was contained, far too many soldiers had been exposed for the quarantine to be effective. Meanwhile, there was a lack of medical personnel to treat the ill—far too many physicians were overseas assisting the war effort, leaving medical students and volunteers to treat the sick. More than one thousand people at Camp Devens died from what one doctor described as a powerful form of pneumonia that ultimately asphyxiated them. Writing to a fellow physician, “Roy,” as he signed his letter, illustrated how influenza had affected those at Camp Devens.

HISTORICAL DOCUMENT

Camp Devens is near Boston, and has about 50,000 men, or did have before this epidemic broke loose... This epidemic started about four weeks ago, and has developed so rapidly that the camp is demoralized and all ordinary work is held up till it has passed. All assemblages of soldiers taboo. These men start with what appears to be an attack of *la grippe* or influenza, and when brought to the hospital they very rapidly develop the most viscous type of pneumonia that has ever been seen. Two hours after admission they have the mahogany spots over the cheek bones, and a few hours later you can begin to see the cyanosis extending from their ears and spreading all over the face, until it is hard to distinguish the coloured men from the white. It is only a matter of a few hours then until death comes, and it is simply a struggle for air until they suffocate. It is horrible. One can stand it to see one, two or twenty men die, but to see these poor devils dropping like flies sort of gets on your nerves. We have been averaging about 100 deaths per day, and still keeping it up...

The normal number of doctors here is about 25 and that has been increased to over 250... We have lost an outrageous number of nurses and doctors, and the little town of Ayer is a sight. It takes special trains to carry away the dead. For several days there were no coffins and the bodies piled up something fierce... It beats any sight they ever had in France after a battle. An extra long barracks has been vacated for the use of the morgue, and it would make any man sit up and take notice to walk down the long lines of dead soldiers all dressed up and laid out in double rows. We have no relief here; you get up in the morning at 5:30 and work steady till about 9:30 p.m., sleep, then go at it again.

Glossary

Cyanosis: A bluish discoloration of the skin and mucous membranes

Grippe: Flu, or, more specifically, Spanish flu

DOCUMENT ANALYSIS

Camp Devens, one of the US military's main training and hospital installations in the Northeast during the Great War, became a microcosm of the second wave of the 1918 influenza outbreak in the United States. Because of wartime censorship in the United States and Europe, little attention was paid to the first wave of influenza. In September 1918, however, the second wave was so powerful and devastating that it killed thousands within days. Troops died, as did civilians and even the health care workers assigned to treat them. In a letter to a friend named Burt, a doctor at Camp Devens described the scene—the deplorable conditions, the rapidity and intensity with which the contagion spread, and the horrific images of the dead being stored in and transported out of the camp.

According to Roy, the onset of the influenza pandemic at Camp Devens was extremely quick and more devastating than any weapon deployed on the battlefield. The doctor writes how he and his fellow physicians at the camp “used to go down to the morgue (which is just back of my ward) and look at the boys laid out in long rows. It beats any sight they ever had in France after a battle.” He tells his friend that there were nearly fifty thousand people at Camp Devens

prior to the outbreak; within a matter of weeks, that figure was significantly reduced. Soldiers arrived at the infirmary complaining of respiratory ailments. The symptoms resembled those of “*la grippe*” (otherwise known as “Spanish flu”). However, he says, the strain that afflicted countless men at Camp Devens overtook the afflicted with far greater speed than was expected.

As soon as the men came to the infirmary, Roy says, they fell victim to “the most viscous type of pneumonia” he had ever seen. Within hours, the patients’ inability to breathe would lead to cyanosis, a condition in which the skin becomes discolored (purple or blue) due to a lack of oxygen. The cases the doctor recalls witnessing were so severe that patients’ entire faces became discolored, making it “hard to distinguish the coloured men from the white.” After the appearance of cyanosis, “it is only a matter of a few hours then until death comes, and it is simply a struggle for air until they suffocate. It is horrible.” As a physician in the early twentieth century, Roy could be expected to see a handful of such cases from time to time, but at Camp Devens, he witnessed hundreds of agonizing deaths over four weeks.

The doctor says that the hospital was normally staffed by only about twenty-five doctors, but saw its

physician rolls increase to 250 during the epidemic. Nevertheless, these extra doctors and nurses were still overworked. He recalls how he worked sixteen-hour days, without rest, writing, “we have no relief here.” Such stressful demands continued for weeks.

He also offers a surreal picture of the nearby town of Ayer. The normally picturesque town, he says, became a central venue for the removal of the dead from Camp Devens. Bodies were not loaded onto trains in coffins, as there were none available. Instead, the bodies were simply piled one on top of the other, awaiting a special train to take them away from the area. Back in the camp, the morgue was completely full, as was an extra-long barracks that had been converted into a temporary morgue. The letter explains that such images were reminiscent of those on the battlefield, although he believed (rightly or wrongly) that what he witnessed at Devens was far more horrific than any scene at the front during the Great War.

ESSENTIAL THEMES

Unlike many Americans, the doctor who wrote this letter knew of the first wave of influenza that had occurred a few months earlier, beginning in January 1918. When the second wave of influenza arrived at Camp Devens and other military installations, the doctor had a relatively informed understanding of the fact that it was the flu. However, the virus’s virulence far exceeded his expectations as a physician, and he remained at a loss as to how to treat his patients. In his letter, he notes, “There is no doubt in my mind that there is a new mixed infection here, but what I don’t know.” The letter simultaneously reveals the tremendous efforts of the physicians who assisted infected patients, as well as the significant

limitations to their medical knowledge in containing and treating the influenza.

In his letter to a colleague, the doctor suggests that the strength and speed with which this form of influenza attacked the Devens population could not have been anticipated. Indeed, droves of men entered the hospital daily complaining of flu-like symptoms, only to be quickly overcome by cyanosis and die within hours of their admission. The doctor describes his efforts to identify the characteristic sign of the disease in his patients by listening to their breathing for rales, or abnormal breathing sounds, noting “they all mean but one thing here... and that means in about all cases death.” The high mortality rate he witnessed at Camp Devens was characteristic of the disease worldwide: Approximately ten to twenty percent of all persons who became infected with this strain of influenza died. In total, nearly one-third of the global population became infected and more than fifty million people died, making the influenza pandemic responsible for nearly as many deaths as the war itself.

—Michael P. Auerbach, MA

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INFLUENZA EPIDEMIC STRIKES

The influenza epidemic constituted a major medical disaster more severe than any witnessed since the fourteenth century. The outbreak spurred the discovery of influenza's viral agent and a vaccine against the disease.

Date: March, 1918-1919

Locale: Worldwide

SUMMARY OF EVENT

The influenza (or gripe) pandemic of 1918-1919 was deadlier than any war in history. Its global fatalities were estimated at more than twenty million, but they may have been as high as forty million. All told, about a billion of the total world population of two billion at the time are thought to have been exposed to the virus. In addition, this epidemic spread faster and more widely than any previous epidemic. A noted American epidemiologist, Edwin Oakes Jordan, eventually computed the estimated breakdown of mortality by continents as follows: North and Central America, about 1 million; Latin America, about 300,000; Europe, about 2.2 million; Asia, about 15.8 million; Australia and Oceania, about 1 million; Africa, about 1.4 million. In the United States alone, some 550,000 died from influenza or its frequent pneumonic complications.

One peculiarity of the 1918 version of the flu was that it especially affected young adults between the ages of twenty and forty. Uncharacteristically, older citizens above sixty years, normally the most vulnerable, were now least so. Accordingly, it is on the basis of substantial increases in young adult deaths that pandemic pathways around the globe could be traced.

The United States was hit as early as March of 1918, as were France, Japan, China, and other countries. This initial wave of the attack was fairly mild and attracted little notice. Indeed, in recent times influenza had appeared identifiably in 1627, 1729, 1788, 1830, 1847, 1872, and 1889-1892 but it was known to have existed for centuries, and the disease had ravaged communities frequently but irregularly. In the early days, influenza epidemics had been attributed by astrologers to the influence (hence influenza) of the heavenly bodies. Only when the second, much more lethal, wave broke out in August-September, 1918, did the world witness an unprecedented flu epidemic.

The added virulence of this newer onslaught was subsequently explained as having been caused synergistically by a fairly mild flu virus acting in conjunction with an equally benign Pfeiffer bacillus. In combination, these two parasites produced a maverick killer that injured human lungs beyond their capacity to recover. During its peak in October-November, 1918, the influenza morbidity rate in the United States ranged from two hundred to four hundred per thousand; the mortality rate was about fifty, compared with the normal thirteen from all causes. Even though the pandemic visited all continents, this new strain of an old affliction was dubbed the "Spanish flu" because uncensored news of its devastation was coming out of that neutral country, Spain, during the world conflict.

Wartime conditions—individuals in their prime crowded in cities, in military camps, on vessels, in hospitals, and elsewhere and moving about in unprecedented numbers—contributed to the disease's rapid spread. On the western front in Europe, major offensives, first by the Germans and then by the Allies, were blunted in the summer and fall of 1918, partly because of the large number of troops victimized by the flu. The ailment recognized no regions, races, or categories other than age. The epidemic seems, however, to have found easy victims among people worn down by the deprivations of war and/or poverty in countries such as India. Important world leaders were not spared; the flu's victims included President Woodrow Wilson (who nearly died of influenza in April of 1919), Premier Georges Clemenceau of France, and Prime Minister David Lloyd George of Great Britain.

At the time, the specific cause of this highly contagious respiratory infection was unknown. Its symptoms, since its identification as the "English sweat" in the sixteenth century, were, however, familiar: sudden fever, inflammation of the mucous membranes, coughing, headache, acute perspiration, occasional nosebleed, muscular discomfort, prostration. Even though an attempt was made in 1951 to exhume the well-preserved bodies of Eskimo victims known to have died of influenza in the pandemic and

THE FLU EPIDEMIC'S TOLL

Because of the U.S. government's active role in Native American affairs, the influenza epidemic's effects on Native American populations were well documented. This letter of condolence from the superintendent of the Yakima Indian Agency to the mother of a child who died of influenza at an Indian boarding school in 1918 is typical of many letters written at the time.

October 29, 1918

My dear Mrs. Nye,

During the scourge of Spanish Influenza from which your daughter Cecilia died I was so extremely busy that it was impossible for me to tell the particulars in connection with the death of Cecilia.

The plague attacked this school on the 13th of October. It was brought here at first by new students coming in and it spread rapidly until we had about 250 cases. The entire school stopped its regular activities and devoted itself absolutely to the care and nurturing of the sick. Out of the 250 cases we lost a comparatively few. Among the number was your daughter. Absolutely everything possible was done in the way of medical care and nursing. The sick was never left alone for one minute, someone was administering to their needs and looking after them and I want you to feel that in this sickness that your daughter has had as good attention as she possibly could have had in any hospital or home. I have spared neither expense nor time nor trouble. Altogether I feel that we have done just as well as could be done. This disease which has taken thousands upon thousands throughout the country was no worse here than elsewhere. It was not due to Chemawa or its location. It was a general disease everywhere.

Now that the plague is over we have resumed our regular school work. All the students we have now are strong and getting along all right.

Trusting that Cecilia's body reached you in good shape and sympathizing with you, I am

Sincerely your friend,

Harwood Hall

Superintendent

Source: "The Deadly Virus: The Influenza Epidemic of 1918." National Archives and Records Administration.

buried in Alaska's permafrost, there was no trace of what was by then known conclusively to be the general cause of influenza: any of three distinct types of viruses, A, B, and C. These minute organisms mutate rapidly and resurface in several strains, or subtypes. Type A was identified in 1933 by Dr. Wilson Smith, Christopher Howard Andrewes, and Patrick Playfair Laidlaw as a filterable virus that was experimentally transmitted to animals and that the latter—not just hogs but also horses and birds among others—are suspected of harboring “underground” without causing outbreaks, except on occasion. One of these instances was in 1918-1919.

SIGNIFICANCE

The countermeasures taken in that epidemic, most vigorously in cities such as San Francisco, were generally gauze masks, at times medicated, worn on the face, and even some makeshift attempts at vaccination. Nevertheless, such countermeasures did not seem to be effective. Indeed, it was not until the

1930's that virology had advanced sufficiently to pinpoint the basic agent that had killed more in a year than World War I had done in four. Without a miracle drug or appropriate vaccine, rest, warmth, fresh air, and good nursing care were about the best that the medical profession could prescribe in 1918-1919, as immediate priorities at that time necessarily had to focus on symptoms and disease control rather than prevention.

Although individual survivors of the pandemic vividly recalled how the event affected them, surprisingly, this plague seems to have had little impact on the collective psyche. Mention of the epidemic by historians and writers describing the period has been generally casual, brief, or nonexistent. (Notable exceptions include authors Katherine Anne Porter, Thomas Wolfe, and Mary McCarthy, who were markedly affected by the event.) There may be at least two reasons for the lack of attention. First, influenza is usually an uncomplicated illness and a minor inconvenience. Second, because it recurs frequently,

the ailment is only too familiar. In short, it lacks the drama of other killers, such as tuberculosis.

Several influenza epidemics have taken place since that of 1918-1919, going by different names, including "swine flu," "Hong Kong flu," and "Asian flu." The reason is that most epidemics are caused by different strains of the Group A virus, and there are about a thousand of them. Samples of these are stored at the Influenza Center of the World Health Organization in London, but determining which particular subtype will hit in any particular flu season—essential to preparing an appropriate vaccination response in time—remained problematic. The variation of the virus is still not fully understood—though scientists have been able to piece together the 1918 virus's genetic sequence—and the world may again witness the visitation of the "Spanish Lady." In fact, in late 2005, researchers at the U.S. Centers for Disease Control and Prevention determined that the 1918-1919 epidemic was caused by genetic mutations that have a great deal in common with flu strains traditionally found mostly in birds, including the H5N1 strain from Southeast Asia, the strongest candidate for the next epidemic's cause. Although this strain's genes had much in common with the 1918 virus and H5N1 proved capable of transferring from animal to human, scientists were unsure whether it would mutate to a state that would allow it to transfer easily from human to human.

—Peter B. Heller

FURTHER READING

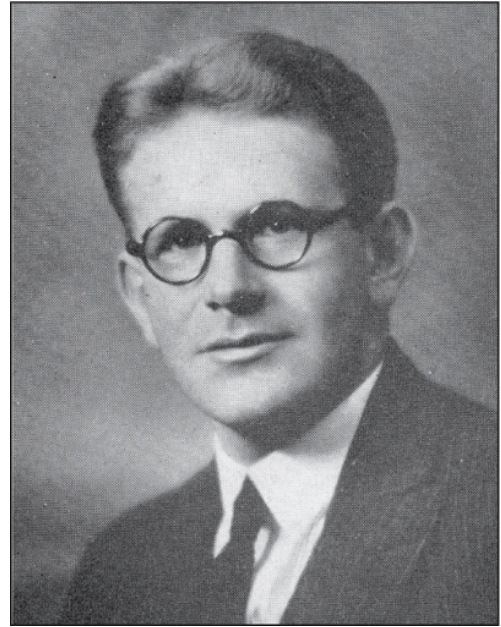
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HEALTH: PREVENTING ANOTHER INFLUENZA EPIDEMIC

Doctor Edwin Bernard, who always trusted in medicine, felt helpless and discouraged in trying to apply his knowledge to the influenza pandemic.

LIFE AT HOME

- This has been the most difficult year of 56-year-old Doctor Edwin Bernard's life.
- When the influenza epidemic hit his hometown of Richmond, Virginia, he never dreamed that hundreds would die within days of taking ill.
- In the last months of 1918, Dr. Bernard attended dozens of funerals of friends and patients for whom he could do little.
- He'd had to post hundreds of signs reading, INFLUENZA All Persons Excepting Physicians and Nurses Are Forbidden UNDER PENALTY OF LAW from Entering or Leaving This House, Without Written Permission from the BOARD OF HEALTH.
- In only four months, the epidemic left an indelible mark on the world.
- Even though Congress had approved a special \$1 million fund to enable the U.S. Public Health Service to recruit physicians and nurses to deal with the growing epidemic, nothing slowed the death toll.
- With World War I in full swing, the nation's medical corps were already strained before the epidemic swept through.
- Most frustrating of all, the influenza epidemic of 1918 affected the young and the healthy.
- In the past, the flu season had laid many low but killed only the very young, the very old, or the very sick.
- As health professional Victor Vaughan had said, "This infection, like war, kills the young, vigorous, robust adults.... The husky male either made a speedy and rather abrupt recovery or was likely to die."



Dr. Edwin Bernard did his best to control the influenza epidemic.

- For Dr. Bernard, the month of October was the saddest and most frightening of his life.
- Not only was he around disease-stricken patients every day, but his 19-year-old son was in the military, where the epidemic was most pronounced.
- It was in the middle of October that he made three decisions: never again to prate about the great achievements of medical science; to humbly admit his ignorance in this case; and finally, to find a way to be better prepared next time.
- Day after day, he visited the makeshift hospital configured at John Marshall High School, where he saw hundreds of sick.
- Every bed was full, but still more patients crowded in, their faces of a bluish hue, and their coughing yielding bloody sputum.
- On his watch, 555 people had died.
- An estimated 675,000 Americans died during the influenza pandemic—more than had died in the Great War.



Holidays were difficult for the hundreds of families affected by the epidemic.

- Worldwide, between 20 million and 40 million people died, making it the most devastating epidemic in recorded world history.
- Known as “Spanish Flu” or “La Grippe,” the influenza of 1918-1919 infected one-fifth of the world’s population and 28 percent of Americans.
- But in its earliest stages, influenza spreading among men living in close quarters did not particularly alarm public health officials, especially with the war going on.

LIFE AT WORK

- It was impossible to escape from the illness.
- Even President Woodrow Wilson suffered from the flu in early 1919 while negotiating the Treaty of Versailles to end World War I.
- Those lucky enough to avoid infection had to deal with the public health ordinances to restrain the spread of the disease: total cleanliness and the wearing of protective face masks, no coughing or spitting,

and no gathering in groups.

- Dr. Bernard was at the forefront of a campaign to distribute gauze masks to be worn in public.
- Despite the objections of his wife, he wore the mask even at home and in bed.
- He also sent boxes of the masks to his son, who was stationed at a military base on the West Coast.
- At Dr. Bernard’s insistence, Richmond’s stores did not hold sales, and funerals were limited to 15 minutes.
- The Virginia State Fair was ordered to close one day after opening.
- Pharmacies were encouraged to remain open at night.
- Even so, the month of October was the worst.
- Bodies piled up in hospitals, converted schools, and morgues.
- The horse-drawn ambulances were too slow and the automobile ambulances too few.
- Then Virginia was confronted with a shortage of coffins, morticians, and gravediggers.



John Marshall High School was converted to a makeshift hospital for 1,000 influenza patients.



Rapid spread of the influenza virus was blamed on the mass movement of men in armies and aboard ships in World War I.

- Lumber yard owners were persuaded to build wooden boxes which were stained black.
- Neighbors complained when the hammering from the lumber yards went on well past midnight.
- At the same time, everyone was looking to the doctors and scientists to create a magic shot capable of ridding the world of the terrible illness.
- During his first shift at the converted John Marshall High School, where 1,000 patients were housed, Dr. Bernard discovered that patients were being given whisky to make them feel better.
- He immediately put a stop to that foolishness.
- He knew that better solutions must be found before the next flu outbreak wiped out an entire generation of young people.
- The influenza pandemic circled the globe, in part because of the mass movements of men in armies and aboard ships in World War I.
- During the summer and fall of 1918, more than one million American soldiers crisscrossed the Atlantic ocean.
- Early health campaigns employed the rhetoric of war to fight the microscopic enemy.
- Health studies were made in certain localized regions, looking at the climate, the weather, and the racial composition of cities.
- Humidity was linked to more severe epidemics as it “fosters the dissemination of the bacteria.”
- Yet, the origins of the influenza variant were still unknown.
- Speculation was rampant and varied: American swine to Chinese immigrants, to calculated germ warfare perfected by the hated “Huns” of Germany.
- Dr. Bernard had determined that his job was to prevent the spread of the illness.

- He had drafted a city ordinance to outlaw the common drinking cups used in most factories, but more was needed.
 - His next target was the common towel used by dozens of workers each week.
 - Ventilation in public buildings also needed to be studied.
 - There were so many questions: Why were healthy young people the primary victims, and why did some die so quickly while others recovered?
 - Like medical scientists across the nation, Dr. Bernard wanted to understand what had caused the flu, how it had spread, and how to stop it if it happened again.
- LIFE IN THE COMMUNITY: RICHMOND, VIRGINIA**
- Lacking reliable medical defenses against influenza, Dr. Bernard spent the earliest phase of the outbreak looking for preventative measures.
 - Educating the public about an illness that was largely a mystery was a priority.
 - But communication was a problem; public gatherings were discouraged and face-to-face meetings avoided.
 - The telephone system was overwhelmed by too many distraught callers.
 - With the help of government officials, Dr. Bernard worked with the Red Cross, the Post Office, and the Federal Railroad Administration to adorn Virginia and the nation with posters.
 - U.S. Surgeon General Rupert Blue ordered the printing and distribution of pamphlets with titles like, "Spanish Influenza," "Three-Day-Fever," and "The Flu."
 - The Colgate company pitched in with advertisements that detailed 12 steps to prevent influenza; the recommendations included "chew food carefully and avoid tight clothes and shoes."
 - Physical exhaustion was discouraged.
 - The Committee of the American Public Health Association advocated legislation to prohibit public coughing and sneezing.



In some cases, only medical students were left to care for the sick.

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- Washing hands before every meal and paying special attention to general hygiene were encouraged, along with exposure to fresh air.
 - Physicians advised rinsing the mouth with everything from chlorinated soda to a mixture of sodium bicarbonate and boric acid.
 - Still, whole sectors of the population were left in the dark.
 - Rural farm families in southern Virginia relied on folk remedies to fend off or cure the flu.
 - These mothers insisted that their children stuff salt up their noses or wear goose grease poultices around their necks.
 - In other parts of the country, onions were a potential savior.
 - A four-year-old girl from Portland, Oregon, was said to have recovered fully from the flu after her mother dosed her with onion syrup and buried her from head-to-toe for three days in glistening raw onions.
 - Still others swore by a shovelful of hot coals sprinkled with sulfur or brown sugar, which filled every room with a noxious blue-green smoke.
 - In Sacramento, California, the streets were flushed with foul-smelling sheep dip.
 - Clearly, doing anything to fend off influenza was better than sitting idly by, waiting to become sick.
 - The influenza virus was profoundly virulent, with a mortality rate of 2.5 percent compared to that of the previous influenza epidemics, which was less than 0.1 percent.
 - Many people stricken with the illness died rapid deaths.
 - Four women were reported to have played bridge together late into the night; three of them died from influenza by morning.
 - Stories circulated of people on their way to work who suddenly developed the flu and died within hours.
 - One physician reported that patients with seemingly ordinary influenza would rapidly “develop the most vicious type of pneumonia that has ever been seen,” and later, when cyanosis appeared in the patients, it was “simply a struggle for air” until they suffocated.
 - The name Spanish Flu came from the early affliction and large mortalities in Spain, where it killed millions in May 1918.
 - It first arrived in Boston in September of 1918 through the port busy with war shipments of machinery and supplies.
 - The virus killed almost 2,000 in October of 1918 alone.
 - On November 11, 1918, Americans assembling to celebrate the end of the war triggered a resurgence.
 - Hospital facilities and staff were taxed to the limit caring for mustard gas victims and those otherwise wounded in the war.
 - In some cases, only the medical students were left to care for the sick; in Virginia, third- and fourth-year classes were closed and the students assigned jobs as interns or nurses.

COLLEGE FRESHMAN FROM NORTH CAROLINA

After being pronounced dead last year during the Spanish flu epidemic, and then found alive by his father at the morgue, Arthur Ledbetter is now a freshman at North Carolina State University where he is studying animal husbandry.

LIFE AT HOME

- Less than a year after nearly dying during the great influenza epidemic, 20-year-old Arthur Ledbetter now attends North Carolina State University.
- When America sent its troops into the Great War, Arthur joined dozens of his friends to fight in the army.
- At Camp McClellan, an army boot camp in Alabama, he was overtaken by the flu epidemic sweeping the nation.
- When the flu struck, Arthur suffered a sudden onset of chills, severe headache, back pains, a general malaise, flushed face, some soreness of the throat and a roaring fever in excess of 104 degrees.
- This rapidly progressed into bronchitis, for which the treatment included bed rest, free movement of the bowels and a light diet.
- Within days of falling ill, he lapsed into unconsciousness, and in the confusion of the crisis, was pronounced dead.
- When his father arrived at the camp to claim the body of his oldest son, he was sent to the camp morgue where, while leaning over his son, he felt a breath—Arthur was alive!
- Subsequently revived and nursed back to health, he was discharged from the army and immediately entered North Carolina State University in Raleigh to major in his longstanding interest—animal husbandry.
- At home in Hendersonville, North Carolina, his father is worried; the economy is in a tailspin following the war's end and inflation is eating up his profits and hard-earned savings.
- He is determined to find enough money so his son can attend college, especially after he came so close to dying.
- To save money, the annual shopping trip to Charleston, South Carolina, has been cancelled; last year's fashions will have to do.
- For Thanksgiving dinner, the family is having cod because, as his mother says, even a king could not afford turkey this year.
- She is also planting a larger vegetable garden so that nearly all of the family's food can be homegrown.
- Her greatest fear is not inflation, but that one of her children will catch the flu again and die.
- Some days, when the air is heavy, she insists that the entire family wear masks—just in case the epidemic returns.
- The 1918 outbreak impacted many nations, including America, Europe, India, China and Australia.
- The Literary Digest said future generations would view the epidemic of 1918–19 in the same way previous generations had regarded the Great Plague of London in 1665.
- About 25 percent of all Americans caught the flu, and approximately 548,000 died.
- The name “Spanish influenza” was bestowed in the mistaken belief that the disease started in Spain, prominent medical journals now report.
- Arthur was one of many pronounced dead, but the only one awaiting burial to be found alive.
- He was born in South Carolina in 1899 to a mother enormously proud of her Huguenot background.



While in the military, Arthur contracted the flu and nearly died.

- The daughter of a state senator, she enjoyed a French governess and tutors as a child and many privileges growing up.
- A graduate of Mercer College in Macon, Georgia, Arthur's father is a tall, spare, beak-nosed man with one eye; the other one was shot out by a black sharecropper during a fight in which the latter was convinced Arthur's father was "having his way" with the sharecropper's wife.
- The family moved to Hendersonville, North Carolina, when Arthur was five, after doctors recommended the move to relieve his sister's severe asthma.
- Arthur and his younger brother attended the Blue Ridge School, a private institution in Hendersonville for both boarding and day students.
- The two boys were so strong-willed and competitive that their father was forced to construct a board down the middle of the bed they shared to keep them from fighting.
- Their sister currently attends a finishing school in Virginia.
- Her father's favorite picture of her was taken during a Methodist church play in which she was a daisy and her best friend played a fairy.

LIFE AT SCHOOL

- Having waited years for the chance to be away from home and free of supervision, Arthur loves being in college and afforded the chance to learn.
- His classes are in either Patterson Hall, the main agricultural building, or in the animal husbandry building.
- Patterson Hall is a buff brick structure with two stories and a basement; the lower floor is used as a dairy with washrooms and sterilization chamber, while the first floor provides room for the experimental station offices and classrooms for agronomy, horticulture, soils and agricultural experimentation.
- The second floor accommodates the departments of botany and plant pathology, physiology and veterinary medicine.
- There are also rooms for the poultry department and stock judging, as well as zoology and entomology.
- The centerpiece of North Carolina State's animal husbandry program is a dairy herd of over 80 head, a flock of sheep, and a number of hogs and Percheron horses.
- To earn extra money, Arthur spends weekends racing his Indian motorcycle at county fairs in the area, where he can sometimes make \$10 or more.
- The total cost for a freshman is calculated at \$325, including board, tuition, lodging, fuel and lights, fees and deposits, books, drawing instruments, laundry and a moderate allowance for incidentals.
- The college advises that "the allowances which parents make their sons for contingencies and spending money, it is suggested, should be kept small, for small allowances take away temptation to unwise living."
- His classes during his freshman year consist of botany, chemistry, agricultural drawing, mechanical engineering, shop, mathematics, zoology, animal husbandry and farm crops.

- In his sophomore year he will take dairying, organic chemistry, military art, English, soil geology, comparative physiology, veterinary medicine, plant propagation, horticulture and agricultural physics.
- During the school year he also has access to the college's machine shop, which has lathes, shapers, drill presses, grinders and planers.
- He used some discarded lumber to rebuild his dorm room bed, and has recently been recruited by a local theater to help build scenery for an upcoming play.
- It did not pass his notice that the play calls for nearly all of the actresses to be young and pretty, but he knows he must be careful in selecting his friends; he has been promised a gold watch if he neither drinks nor smokes before he is 21—a goal that is only one year away.
- He realizes, however, many young men—and women—do not share this goal, and has told his Pa these are not just city kids either; the boys from the farms also seem inclined toward easy pleasures.
- His dorm room has electric lights and steam heat; room assignments were made by the military department when he registered.
- Under the provisions of a 1916 act of Congress, a unit of the Reserve Officers' Training Corps was established at the college in 1917.
- As a member of the Corps, Arthur receives a government uniform and will spend four weeks in a training camp during the summer.
- During his freshman and sophomore years, three hours a week are devoted to military training; during his junior and senior years, the requirement is that no less than five hours a week be allotted to military training.
- In addition to his uniform allowance, Arthur receives \$100 per year for his participation in the Corps.

- After graduation, he will be placed on a list of reserve officers of the United States Army for 10 years.

LIFE IN THE COMMUNITY: HENDERSONVILLE, NORTH CAROLINA, AND NORTH CAROLINA STATE IN RALEIGH

- When Arthur's family moved to Hendersonville to alleviate his sister's asthma, few people in the community could afford an automobile except the tourists who arrived each summer from such diverse places as Chicago, Charleston and New Orleans.
- During the summer months, the St. John's Hotel in Hendersonville is often a blaze of lights as guests sit in the porch rocking chairs to watch a handful of cars and millions of fireflies go by.
- The neighboring communities of Black Mountain, Saluda, Montreat and Junaluska are all building a sound reputation as assembly grounds for religious services of all kinds—one of the reasons the state is placing a high priority on building roads, particularly hard surface roads.
- Of the 349 miles of road scheduled to be added or improved, 240 miles are to be built of gravel, sand and other materials, while 109 miles will be of hard-surface construction.
- The average North Carolina teacher's annual salary is \$284, below Mississippi's average by \$7 and South Carolina's by \$31; nationally, the average is \$635.
- According to the publication *School and Society*, most North Carolina teachers are paid less than it "costs to feed and house prisoners in the county jail."
- North Carolina still has 63,000 landless, tenant farmers.
- In Raleigh, where Arthur attends school, the college is an important institution.

- It was created by the North Carolina legislature in 1887 as a land grant for an agricultural and mechanical college, and opened two years later with 70 students taught by six full-time faculty and two assistants; the college roster for 1919 lists 651 freshmen—many of whom are WWI veterans who delayed college to fight in France—123 sophomores, 73 juniors, 41 seniors and eight graduate students.
- The college rests on 486 acres in the western suburbs of Raleigh, approximately one mile and a quarter from the state capital.
- The college library, open from 9 a.m. to 6 p.m., contains 8,000 volumes.

DRINKER AND SHAW DEVELOP A MECHANICAL RESPIRATOR

Philip Drinker and Louis Shaw developed the mechanical respirator known as the iron lung, a lifesaving device for victims of poliomyelitis that led to the development of other lifesaving respiratory care.

Date: July, 1929

Also known as: Iron lung

Locale: Harvard University, Massachusetts

SUMMARY OF EVENT

Poliomyelitis (polio, or infantile paralysis) is an infectious viral disease that damages the central nervous system, causing paralysis in many serious cases. Its effects result from the destruction of neurons (nerve cells) in the spinal cord. In many cases, the disease produces crippled limbs and the wasting of muscles. In others, “anterior” polio results in the fatal paralysis of the respiratory muscles. Since the 1950’s, use of the Salk and Sabin vaccines has virtually eradicated polio, but in the 1920’s, it was a terrifying disease. Its most feared, untreatable outcome was the paralysis of the respiratory muscles, which caused rapid death by suffocation, often only a few hours after the first signs of respiratory distress appeared.

In 1929, Philip Drinker and Louis Shaw, both of Harvard University, published an article in the *Journal of Clinical Investigation* in which they reported on their development of a mechanical respirator that would keep those afflicted with the disease alive for indefinite periods of time. This device, soon nicknamed the “iron lung,” provided essential life support for thousands of people who suffered from respiratory paralysis as a result of polio or other diseases. It was used for many years, but as John A. Meyer, a thoracic surgeon, noted in a 1990 article, iron lungs are now primarily “fascinating relics, reminders of high tech medicine of an earlier day.” This comment is corroborated by the fact that as of 1986, a survey found that only three hundred iron lungs remained in use in the United States.

Development of the iron lung arose after Drinker, then an assistant professor in Harvard’s Department of Industrial Hygiene, was appointed to a Rockefeller Institute commission formed to develop improved methods for resuscitating victims of electric shock and illuminating gas poisoning. The best-known use of the iron lung—treatment of polio—was a result of numerous epidemics of the disease that occurred

from 1898 until the 1920’s, each leaving thousands of Americans paralyzed. The concept of the mechanical respirator reportedly arose from Drinker’s observation of physiological experiments carried out by Shaw and Drinker’s brother, Cecil. Those experiments were components of an effort to design artificial respiration methods that would enhance a patient’s survival after surgery.

The experiments involved the placement of a cat inside an airtight box—a body plethysmograph—with the cat’s head protruding from an airtight collar. Shaw and Cecil Drinker then measured the volume changes in the plethysmograph to identify normal breathing parameters. Philip Drinker placed cats paralyzed by curare inside plethysmographs and showed that they could be kept breathing artificially by use of air from a hypodermic syringe connected to the device. Next, they proceeded to build a human-sized plethysmograph-like machine, using a five-hundred-dollar grant from the New York Consolidated Gas Company. The device’s construction was carried out by a tinsmith and the Harvard Medical School machine shop.

The prototype machine was tested on Drinker and Shaw, and after they made several modifications, a workable iron lung was available for clinical use. It consisted of a metal cylinder large enough to accommodate a patient. One end of the cylinder, which contained a rubber collar, slid out on casters along with a stretcher on which the patient reclined. Once the patient was in position and the collar was fitted around the patient’s neck, the stretcher was pushed back into the cylinder and louvers were secured to make the iron lung airtight. The iron lung then “breathed” for the patient by using an electric blower to remove and replace air alternately.

In the human chest, inhalation occurs when the diaphragm contracts and powerful muscles expand the rib cage. This lowers the air pressure in the lungs and allows inhalation to occur. In exhalation, the diaphragm and chest muscles relax, and air is expelled as the chest cavity reduces again in size. In a case of respiratory paralysis treated with an iron lung, intake

of air into and expulsion of air from the iron lung alternately compress the patient's chest, producing artificial exhalation, and allow it to expand so that it can fill with air. In this way, the iron lung "breathes" for the patient.

Careful examination of each patient was required to allow optimum adjustment of the rate of operation of the machine. The device also included a cooling system and ports for drainage lines, intravenous lines, and other apparatus needed to maintain a wide variety of patients.

The first person treated in an iron lung was an eight-year-old girl afflicted with respiratory paralysis resulting from polio. The iron lung kept her alive for five days. Unfortunately, she died from cardiac failure as a result of pneumonia. The next iron lung patient, a Harvard University student, was confined to the machine for several weeks and later recovered enough to resume a normal life. Use of the iron lung thereafter rapidly entered hospital practice. As Meyer described in 1990, "Treatment facilities tended to concentrate at university and city-county hospitals, each with its Respirator Center, where long lines of Drinker tank respirators were lined up side by side."

As James H. Maxwell pointed out in a 1986 article, one problem that limited maximum use of the iron lung came from physicians' fears that their patients would be "forever tethered to the lung." Such fears often led to inappropriate delays before patients were placed in the respirators, although in fact only a small percentage of patients became chronically dependent on the machines.

SIGNIFICANCE

Soon after the iron lung, also known as the Drinker respirator, came into use in 1929, the device came to be considered indispensable. Until the Salk vaccine became available in the 1950's, iron lungs saved the lives of countless victims of polio as well as other diseases. As Meyer noted in 1990, "no satisfactory mechanical respirator existed before" the iron lung, and for a quarter of a century it was the sole reliable machine of its kind, "a lifeline for thousands of patients afflicted with respiratory failure caused by poliomyelitis."

Drinker received a number of honors for his development of the iron lung, including Philadelphia's John Scott Medal (shared with Louis Shaw, in 1931), the Charles Chapin Memorial Award (1948), and

the Cummings Memorial Award of the American Industrial Hygiene Association in 1950. He was also made an honorary member of England's Royal Society of Health and the Finnish Industrial Medical Society. He was elected president of the American Industrial Hygiene Association in 1942, and he also became chairman of Harvard's Department of Industrial Hygiene.

It is generally acknowledged that the medical community's acceptance and use of the iron lung played a critical role in the development of modern respiratory care. For one thing, as Maxwell has noted, "use of the iron lung proved that large numbers of patients could actually be kept alive with mechanical support." Not all assessments are in agreement as to the device's importance, however. For example, H. H. Bendixen, an anesthesiologist, suggested in a 1982 article that the iron lung "must be called a technological detour, despite the fact that it has had life-saving clinical use." He also asserted that although the iron lung "became the mainstay of poliomyelitis treatment" until the 1950's, "the mortality rate remained high and was not significantly reduced" until combined intermittent positive pressure breathing was combined with the use of the iron lung.

—Sanford S. Singer

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ZINSSER DEVELOPS AN IMMUNIZATION AGAINST TYPHUS

Hans Zinsser demonstrated clinical differences in forms of typhus and developed an effective vaccine against the disease.

Date: 1930

Locale: Harvard University, Cambridge, Massachusetts

SUMMARY OF EVENT

As a bacteriologist and immunologist, Hans Zinsser was interested in the epidemiology of infectious diseases. During an outbreak of typhus in Serbia in 1915, he traveled with a Red Cross team in order to study the clinical and pathological aspects of the disease. He made subsequent trips to the Soviet Union in 1923, Mexico in 1931, and China in 1938. His observations supported the commonly held belief that typhus was caused by an organism, the rickettsia, isolated and named by Henrique da Rocha-Lima in 1916 for Howard T. Ricketts. The organism was known to be borne by a louse or a rat flea and transmitted to humans by way of a bite. The unsanitary living conditions resulting from poverty and overcrowding provided an atmosphere conducive for the spread of the disease.

The rickettsia are microorganisms whose shapes range from rod to sphere. Within the carrier's body, the rickettsia stimulate the cells of endothelial tissue to use phagocytosis (that is, to eat) so that the microorganism can enter and live in the cytoplasm of the endothelial cells, which line the gut of the insect. The rickettsia multiply within the tissue and pass from the insect body with the feces. Because the internal cells of the insect are destroyed, the insect dies within three weeks of becoming infected with the microorganisms.

As the flea or louse feeds on a human, it causes an itch; scratching of the itch may result in a break in the skin. This, in turn, provides an opportunity for the rickettsia-laden feces to enter the body. Dried, airborne feces can be inhaled. Once within the human host, the rickettsia invades endothelial cells associated with blood vessels and causes an inflammation of the blood vessels. The resulting cell death leads to tissue death. In a few days, the infected host exhibits symptoms such as a rash, severe and sudden headache, rise in temperature, photophobia (visual intolerance to light), vertigo, tinnitus (ringing in the

ears), deafness, and an altered mental state, which gives the disease its name, typhus (from the Greek meaning cloudy or misty). Left untreated, the patient dies within nine to eighteen days.

Typhus was first described in Europe in the fifteenth century. It is among the oldest diseases known to be caused by the rickettsia. Medical science now recognizes three clinical forms: the epidemic louse-borne form, the Brill-Zinsser form, and the murine, or rodent-related, form. The epidemic louse-borne or classical form is the severest manifestation of the disease. *Rickettsia prowazekii* is the causative agent and is carried by the human body louse *Pediculus humanus*. The Brill-Zinsser form presents symptoms similar to but milder than the epidemic type. It involves the reactivation of the organism within the host



Hans Zinsser. (National Academy of Sciences)

cells, indicating that the host had encountered the epidemic form earlier. The murine form is caused by *Rickettsia typhi* (previously called *Rickettsia mooseri*), which is borne by a rat flea. This variety also presents symptoms that are milder than the epidemic type. The pathology of murine typhus closely resembles that of Rocky Mountain spotted fever, which is caused by *Rickettsia rickettsii*.

When Zinsser began his work on typhus, the information that existed concerning the disease was in a chaotic state. Zinsser sought to organize the information and bring order to the study of the disease. Zinsser and his colleagues, including John Franklin Enders, Hermann Mooser, and M. Ruiz Castañeda, sought to establish the relation of one form of typhus to the others. In 1898, an endemic form of typhus prevalent among immigrants in New York City had been described. The endemic form was called Brill's disease. Mooser, in the late 1920's, proved that the causative agent of Brill's disease was *Rickettsia mooseri* and that the organism was carried by the rat flea. The endemic form became known as the murine form, and the causative agent was later renamed as *Rickettsia typhi*.

In the 1930's, Zinsser suggested that there were actually two forms of the disease being described by Brill: one that was associated with rodents (murine form) and another that had its own causative agent and was a reactivation of an organism picked up at an earlier time when the patient was exposed to the epidemic disease present in many European countries at that time. He demonstrated that *Rickettsia prowazekii* was the agent involved in both the European epidemic version and the reactivated version, which was known as Brill's disease. As a result of Zinsser's effort to distinguish the two types of typhus disease, it was renamed Brill-Zinsser disease.

Because he had analyzed the mechanism of the Weil-Felix diagnostic test for rickettsial diseases, Zinsser was aware that the disease-causing organism had an antigenic component, most likely a polysaccharide. In 1932, Zinsser and Castañeda identified agglutinins, or antibodies, in the blood serum of typhus-infected patients with the murine and the classical forms. Although earlier attempts at preventing typhus by means of passive immunity were not satisfactory, Zinsser saw immunity as a viable solution to the problem of typhus. He determined that a large number of dead microorganisms was necessary to

induce an immunity that would be effective. He and his colleagues set out to develop a method of growing organisms in large quantities by using tissue culture. The method started by infecting chick embryo yolk sac tissue with rickettsia. The infected tissue was used to inoculate large quantities of normal chick tissue. The infected tissue was then grown on the surface of agar in flasks. This provided Zinsser and his team with the quantities of microorganisms needed to produce the desired vaccine. The type of immunization Zinsser was proposing is known as passive immunity. The infecting organisms have markers on their cell surfaces known as antigens. The antigens are capable of eliciting an immune reaction regardless of whether the cell is living, weakened, or dead. The reaction involves recognition of the antigen by cells called macrophages and cells called B cells. The B cells produce antibodies that are capable of destroying the invading organism directly or attracting more macrophages to the area so that they can destroy the organism. B cells also produce "memory cells," which remain in the blood in order to trigger a rapid second response if there is a subsequent infection. Because the vaccine contains weakened or dead organisms, the person experiences a mild reaction to the vaccine but is not at risk of contracting the disease.

SIGNIFICANCE

Typhus is still prevalent in many areas of the world. Where it does persist, the disease is nurtured by poverty and overcrowded, unsanitary living conditions. Many countries that have experienced severe drought report high incidences of typhus. Epidemic typhus has not been reported in many countries for some time. The last report of the epidemic in the United States was in 1921. Endemic or murine typhus occurs more frequently. The incidence in the United States is low, with about fifty cases per year being reported. Because the organism is susceptible to antibiotics, such as tetracycline and chloramphenicol, reported cases can be treated; therefore, the mortality rate is low.

Zinsser's work on the treatment and prevention of the disease had important impacts. By creating an orderly classification of the typhus diseases and identifying causative agents and vectors, Zinsser and his coworkers contributed significantly to the understanding of the disease, which in turn enabled attempts to discover a cure and establish preventive

PITY THE POOR LOUSE

In his book *Rats, Lice, and History*, Hans Zinsser tells the story of his work against typhus. This excerpt illustrates why the book is considered a classic of popular science writing.

The louse is foremost among the many important and dignified things that are made the subjects of raucous humor by the ribald. Despite the immense influence of this not unattractive insect upon the history of mankind, it is given in the *Encyclopædia Britannica* two thirds of a column—half as much as is devoted to “Louth, a maritime county in the province of Loinster,” one fifth as much as is allowed for Louisville, Kentucky. This creature, which has carried the pestilence that has devastated cities, driven populations into exile, turned conquering armies into panic-stricken rabble is briefly dismissed as “a wingless insect, parasitic upon birds and mammals, and belonging, strictly speaking, to the order of Anoplura.”

The louse shares with us the misfortune of being prey to the typhus virus. If lice can dread, the nightmare of their lives is the fear of someday inhabiting an infected rat or human being. For the host may survive; but the ill-starred louse that sticks his haustellum through an infected skin, and imbibes the loathsome virus with his nourishment, is doomed beyond succor. In eight days, he sickens, in ten days he is in extremis, on the eleventh or twelfth his tiny body turns red with blood extravasated from his bowel, and he gives up his little ghost.

Man is too prone to look upon all nature through his egocentric eyes. To the louse, we are the dreaded emissaries of death. He leads a relatively harmless life—the result of centuries of adaptations; then, out of the blue, an epidemic occurs; his host sickens, and the only world he has ever known becomes pestilential and deadly; and if, as a result of circumstances not under his control, his stricken body is transferred to another host whom he, in turn, infects, he does so without guile, from the uncontrollable need for nourishment, with death already in his own entrails. If only for his fellowship with us in suffering, he should command a degree of sympathetic consideration.

The louse was not always the dependent, parasitic creature that cannot live away from its host. There were once free and liberty-loving lice, who could look other insects in their multifaceted eyes and bid them smile when they called them “louse.” But this was even longer ago than the Declaration of Independence, for it took the louse many centuries to yield up its individualism.

Source: *Hans Zinsser, Rats, Lice, and History* (Boston: Little, Brown, 1935).

measures. Louse and rodent control and improved sanitation helped to prevent the spread of the disease.

Zinsser’s idea to grow large quantities of the rickettsia to make a vaccine led him to investigate tissue culture as a quick and reliable method of securing a good yield of the desired microorganism. The attention focused on the tissue culture method and inspired researchers to modify and improve the technique so that now the use of tissue culture is a standard effective laboratory procedure.

Zinsser’s greatest contribution to medicine was the development of a vaccine for typhus. This disease has a place not only in the history of medicine but also in the history of the world. Battles and wars were lost because louse-infected armies fell victim to typhus. Invading armies carried the disease across national boundaries; Europe witnessed an uninterrupted series of epidemics throughout the eighteenth and nineteenth centuries. The vaccine that Zinsser and his team developed ensured that even if wars continued and armies were subjected to undesirable

living conditions, the possibility of contracting typhus would be greatly reduced. The vaccine also provided a safeguard for the poor in crowded cities. People who were forced by financial circumstances to live in densely packed housing, where they might easily become infected by lice or rat fleas, gained protection against typhus once the vaccine became available.

Because Zinsser looked to immunology for protection against typhus, he also had an impact on the growing science of immunology and its application to medicine. Vaccines have been developed against many pathogenic organisms, and their use has obliterated many diseases that were once commonplace. Zinsser was one of the pioneers in applying the principles of immunity to health care.

Zinsser was also an inspiring teacher whose students and associates appreciated his approach to science and his concern for the human condition. Unfortunately, he died before he had a chance to see all the benefits that accrued from the production of his vaccine against typhus. Today, the incidence of

typhus is negligible, although small outbreaks of Q fever have been reported in the United States and Australia, and Rocky Mountain spotted fever has been reported in the United States.

—Rosemary Scheirer

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TYPHUS IMMUNIZATION

Dates: 1930-1938

Locales: Vanderbilt University, Nashville, Tennessee;
Rocky Mountain Laboratory, Hamilton, Montana;
Harvard Medical School, Boston, Massachusetts

From the Middle Ages to the twentieth century, typhus was the bane of both military and civilian populations, particularly in Europe. The disease is transmitted by the human body louse, *Pediculus humanus*, as a result of poor hygiene. During and after World War I, typhus was estimated to have killed more than three million persons in Europe; in November, 1914, alone, typhus was estimated to have killed 200,000 Serbian soldiers on the eastern front of Europe. Consequently, the development of an effective vaccine against the disease during the 1930's was a major advance in medicine.

Epidemic typhus is a blood-borne disease caused by an intracellular bacterial parasite: *Rickettsia prowazekii*. The disease is transmitted by lice when they feed on human bodies. Although the etiological agent for the disease was isolated in 1916, and its means of transmission, the body louse, established by the 1920's, the inability to grow and study the organism in the laboratory made research into development of a vaccine difficult. Initial attempts to grow the organism in "lice farms" were carried out by Polish biologist Rudolf Weigl in 1930. Weigl injected living lice with the typhus organism, and after several days incubation, prepared a "paste" by grinding the midguts of the lice. The process proved impractical on a large scale. Ernest Goodpasture and Alice Woodruff and Eugene Woodruff at Vanderbilt University applied a method used for growing viruses to the cultivation of the typhus agent, inoculating fertilized chicken eggs with the agent. This enabled them to grow the quantities of the organism necessary for vaccine production.

In the 1930's, Hans Zinsser, who had spent the better portion of two decades researching typhus and is generally credited with developing the immunization against it, suggested that there were two forms of the disease: murine and another that was a reactivation of an organism picked up at an earlier time. Zinsser showed that *Rickettsia prowazekii* was the agent involved in both the European epidemic version and the reactivated version.

In 1932, Zinsser and his colleague M. Ruiz Castañeda identified antibodies in the blood serum of typhus-infected patients with the murine and the epidemic forms. Zinsser realized that a large number of dead microorganisms was necessary to create an effective immunity. Zinsser's method began with infecting chick-embryo yolk-sac tissue with rickettsia. In turn, this was applied in the inoculation of large quantities of uninfected chick tissue. Then, the infected tissue was grown on the surface of agar in flasks. Thus, Zinsser and his colleagues had the amount of microorganisms necessary to produce the desired vaccine.

A vaccine for a certain strain of typhus was developed by Harold Cox by 1938 at the Rocky Mountain Laboratory in Hamilton, Montana. Cox grew the organisms in eggs, purified the agent, and inactivated it using a mixture of formalin and phenol.

IMPACT

Immunization of American soldiers using the Cox vaccine began shortly after the entrance of the United States into World War II. The success of the program was immediate. During the North African campaign following the invasion in late 1942, an estimated sixty thousand native Algerians died from typhus. By contrast, among the 500,000 American soldiers serving in North America—all of whom had been inoculated against the disease—only eleven cases, all mild, were reported.

—Richard Adler

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CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

DEFINITION

The Centers for Disease Control and Prevention (CDC), a branch of the U.S., Department of Health and Human Services (DHHS), is the major agency in the United States for monitoring infectious diseases and other threats to public health and safety.

HISTORY AND ORGANIZATIONAL STRUCTURE

The CDC grew out of an organization called Malaria Control in War Areas (MCWA), which was formed in 1942 as a branch of the U.S. Public Health Service (PHS). Because malaria was common in southern states at the time, the MCWA's headquarters was in Atlanta. The organization's mission was to control malaria around military bases. Following World War II, under the leadership of Joseph W. Mountin, the MCWA was transformed on July 1, 1946, into the Communicable Disease Center, remaining as a division of the PHS. Most of the early activities of the CDC, as it came to be known, remained focused on mosquito control.

With the control and eradication of malaria in the United States, the CDC shifted focus and assumed responsibility for all communicable diseases in the United States, except sexually transmitted diseases, or STDs (formerly called venereal diseases, or VD), and tuberculosis, which were handled by other agencies.

Beginning in 1949 under the leadership of Alexander Langmuir, the CDC also became an important center for epidemiology. Additionally, in its attempt to control illness, the organization continued as a strong advocate of immunization programs. In 1955, careful surveillance work by the CDC allowed polio immunizations to be resumed after they had been stopped because of fears that the vaccine was causing the disease. Contamination was traced to a particular laboratory, the problem was corrected, and the program was resumed. The credibility of CDC was strengthened by this successful detective work, and in the following years, PHS oversight of STDs and tuberculosis was transferred to the CDC, in 1957 and 1960, respectively. In subsequent years, more programs were moved to the CDC, expanding the organization and bringing in knowledge

resources.

As the responsibility of the CDC increased over the years, the mission expanded from focusing only on communicable diseases to other types of illnesses, and even to nondisease threats to health. Among the programs transferred to the CDC was the National Institute for Occupational Safety and Health. In 1970, officials determined that the word "communicable" did not adequately describe the work of the CDC, and the name was changed to the Center for Disease Control, retaining the well-known initials "CDC." In 1981, with continued growth, the organization was reconfigured, and the name was changed again to reflect the new structure, changing "Center" to "Centers." Since 1992, the even-broader work of the CDC was acknowledged with another name change, this time to Centers for Disease Control and Prevention. The initials "CDC" were retained because of their familiarity.

The CDC is one of eleven operating divisions of the DHHS. The CDC itself is subdivided into an institute, centers, and offices. The major divisions are National Institute for Occupational Safety and Health; the National Center for Health Statistics; Offices of Surveillance, Epidemiology, Informatics, Laboratory Science, and Career Development; National Center on Birth Defects and Developmental Disabilities; National Center for Chronic Disease Prevention and Health Promotion; National Center for Environmental Health/Agency for Toxic Substances and Disease Registry; National Center for Injury Prevention and Control; National Center for Immunization and Respiratory Diseases; National Center for Emerging and Zoonotic Infectious Diseases; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention; and Center for Global Health.

The headquarters of the CDC remains Atlanta, on land acquired from Emory University. Other than the main headquarters, the CDC has locations in Anchorage, Alaska; Cincinnati, Ohio; Fort Collins, Colorado; Hyattsville, Maryland; Morgantown, West Virginia; Pittsburgh, Pennsylvania; Research Triangle Park, North Carolina; San Juan, Puerto Rico; Spokane, Washington; and Washington, D.C.

Researchers from the CDC will travel wherever a potential threat to health requires their expertise, including to many locations around the world.

The CDC also includes a separate foundation—the CDC Foundation—which is a nonprofit organization created by the U.S. Congress in 1995. The CDC Foundation is not part of the CDC, but it does coordinate nongovernmental resources with the CDC to aid a variety of CDC programs.

EPIDEMIOLOGY AND INFECTIOUS DISEASES

In 1951, Alexander Langmuir created a class to train physicians for the newly formed Epidemic Intelligence Service (EIS). That first course was taught by experts recruited by Langmuir to turn EIS officers into disease “detectives.” From the beginning, the course emphasized the use of statistics, which laid a quantitative, mathematical foundation under the epistemological work of the CDC. Because the EIS was formed during the Korean War out of fear of biological warfare, the original emphasis of epidemiological work was on infectious diseases. Later, as the CDC mission grew, other sections of the CDC began to use epidemiological investigations for noninfectious diseases as well, including chronic illnesses such as diabetes and heart disease.

From the first class of the EIS, Langmuir insisted that officers engage in “shoe leather” work, that is, going into the field to investigate and collect evidence anywhere there was evidence of a possible epidemic; EIS officers continue to fill this role. Epidemiology is so integral to the work of the CDC that many divisions have their own epidemiology branches. CDC investigators have helped to pinpoint the cause of new diseases, including Legionnaires’ disease and toxic shock syndrome. Among the cases handled by EIS officers have been investigations of H1N1 flu in various states, *Staphylococcus aureus* in West Virginia, rabies from a bat in Montana, *Salmonella* infections in various states, and monkeypox in the Democratic Republic of the Congo. In addition to work in the United States, epidemiologists from the CDC now travel the world to work with local health practitioners. Biological materials are sent back to CDC headquarters for

identification.

Since the 1960’s, the CDC has worked to control diseases in other countries, in part through disease surveillance and vaccination programs. One of the great successes of the CDC was to help develop techniques that led to the eradication of smallpox in 1977. CDC investigators working abroad have also helped to identify and treat Ebola, HIV/AIDS, Lassa fever, and other diseases.

Attempts to control three longstanding serious diseases illustrate the variety of approaches used by the CDC in dealing with infectious diseases. A great deal of attention has been given to HIV/AIDS since an article on the first diagnosis of what would later be termed “AIDS” was published in the CDC’s *Morbidity and Mortality Weekly Report* in 1981. As an example of the changing work of the CDC since its inception, part of its strategy for fighting AIDS is to promote prevention—to influence people to change their



Joseph W. Mountin founded the Centers for Disease Control and Prevention in 1946. Image courtesy of the CDC.

behaviors and not become infected. The CDC has a Division of HIV/AIDS Prevention, itself containing sections dealing with prevention, epidemiology and surveillance, intervention, and research. In addition, a number of other branches of the CDC have sections that deal with HIV/AIDS. These sections include the Global AIDS Program, which helps with prevention and treatment in other countries; the National Center for Infectious Diseases, which has a division to help control the spread of HIV in health care settings; the National Center for Chronic Disease Prevention and Health Promotion, which supports education programs for young people; and the National Center for Environmental Health, which supports quality assurance for laboratories that test the blood of newborns. Sections of the CDC also collect and analyze statistics to create more effective programs.

The HIV/AIDS pandemic's association with tuberculosis (TB) has increased attention given to TB, which had already been a concern of the CDC since 1960. Internationally, TB is one of the leading causes of death in people with HIV infection. CDC guidelines have been published with recommendations on avoiding exposure to TB and with information for travelers who may be exposed in high-risk settings overseas, such as in prisons or in homeless shelters. As with other diseases, TB rates are closely tracked in the United States. Through surveillance, the CDC notes that there are higher rates of TB among particular population groups or in certain settings, information that aids in attempts to control the disease by prevention. The Division of Tuberculosis Elimination has a laboratory branch that performs genotyping on samples sent in by local health departments. In addition, the division has established the Tuberculosis Epidemiologic Studies Consortium to coordinate efforts among many organizations and researchers.

Another infectious disease that has had great attention from the CDC is influenza (flu), in its various strains. One of the early surveillance successes of the CDC was tracking an influenza outbreak in 1957, helping lead to guidelines for using influenza vaccines. The CDC refers to the use of vaccines to reduce infectious diseases as "the greatest success story in public health," and in February, 2010, a CDC advisory committee even recommended that every person in the United States get a flu shot. The CDC also provides information specifically for vaccine makers. Patient information on the topic of flu vaccination

is considered important enough that it is made available on the CDC Web site in many languages, and special information is provided for people with diabetes, asthma, and cancer. Besides informing the public, the CDC addresses flu prevention and treatment by providing physicians and public-health workers with both information and training. As part of the epidemiological work of the CDC, close surveillance is conducted of viral types found around the United States, and of patient illness and mortality.

NONINFECTIOUS DISEASES AND THREATS TO HEALTH AND SAFETY

The CDC has gone far beyond its original focus on communicable diseases, and the agency now gives attention to any issue in the United States or the world that might pose a threat to health or safety. Within this broad view, issues receiving attention include those, such as gun violence, that are far removed from infectious diseases.

As an example of CDC interest in noninfectious diseases, the CDC created an arthritis program that worked with other agencies to write a National Arthritis Action Plan. According to the CDC, the plan was "a landmark document that put arthritis on the public health map." Other noninfectious diseases addressed by the CDC are heart disease and cancer. The Division for Heart Disease and Stroke Prevention works with and helps to fund several programs fighting heart disease. For cancer control, the Division of Cancer Prevention and Control engages in monitoring, research, and education. In addition, the CDC seeks to educate the public about changing behaviors, focusing on issues such as obesity and exercise.

While continuing its focus on health, the mission of the CDC also includes a focus on safety. General safety concerns include driving, boating, injuries at home, and domestic violence. In attending to workplace safety, the CDC looks at such factors as exposure to asbestos or carbon monoxide, danger from falls, and the environmental quality of the workplace. Food safety concerns include food contamination and the use of antibiotics in animals raised for food. Other examples of work done by the CDC not related to infectious diseases is the agency's recognition of the connection between aspirin use in young people and the development of Reye's syndrome; also the CDC recognized the dangers of lead in gasoline.

The concern for safety and well-being also has led the CDC to focus on a need for emergency preparedness at the national level and the local levels. Terrorism is a threat that can come in the form of biological attack (such as with anthrax or other biological agent). Other threats are industrial chemical accidents, radiation emergencies, natural disasters such as tornadoes and earthquakes, human-made disasters such as oil spills, and outbreaks of food poisoning. For each scenario, the CDC has prepared educational materials for the general public and for emergency responders.

IMPACT

The CDC has made achievements in areas of public health once deemed impossible to reach, including completely eradicating diseases. The CDC was instrumental in eradicating malaria in the United States by 1951, and it was a major partner in ridding the world of smallpox. Because of CDC efforts, other diseases, in the United States and abroad, have been identified. The CDC has also ensured that vaccination programs in the United States are now routine and widely accepted.

Given the size and extensive activities of the CDC, its impact too has been far-reaching. The organization is now recognized in the United States as the main provider of information on disease occurrence, and through the EIS, the CDC often leads the way in fighting diseases. The application of careful surveillance and epidemiological techniques to track diseases has proven effective, and the CDC has made these techniques a basic part of fighting disease. The work has been so effective that it is now applied to noninfectious diseases, such as heart disease.

The CDC's focus on disease prevention also affects the national approach to health care, an approach that has implemented measures to avoid infection and to influence public behavior. Part of the influence of the CDC comes from the strong voice it has among physicians and other health workers with its publication *Morbidity and Mortality Weekly Report*, which summarizes health data from around the United States.

The CDC will continue to have a major impact on health care through disease surveillance and through research. Also, the increasingly broad CDC concerns with health and safety have greatly influenced health and safety discourse in the United States. Future

national discussions about health care will likely include the topics of accidents, safety, and emergency preparedness for terrorist threats or natural disasters.

—David Hutto, Ph.D.

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- Institute of Medicine. *An Assessment of the CDC Anthrax Vaccine Safety and Efficacy Research Program*. Washington, D.C.: National Academy Press, 2003. This is a representative example of independently contracted evaluations of DHHS agency projects' effectiveness.
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Pendergrast, Mark. *Inside the Outbreaks: The Elite Medical Detectives of the Epidemic Intelligence Service*. Boston: Houghton Mifflin Harcourt, 2010. The story of the Epidemic Intelligence Service, founded in Atlanta in 1951 under the auspices of the Centers for Disease Control and Prevention to train disease “detectives” to address global epidemics.

Regis, Edward. *Virus Ground Zero: Stalking the Killer Viruses with the Centers for Disease Control*. New York: Pocket Books, 1996. Relates the CDC’s role in the containment of an outbreak of the Ebola virus in Kikwit, Zaire, in 1995.

Shroff, Sunil. “Update on Emerging Infections: News from the Centers for Disease Control and Prevention.” *Annals of Emergency Medicine* 55, no. 3 (2010): 280-282. Discusses the results of a CDC surveillance report for infections by body and head lice.

WEB SITES OF INTEREST

Association for Professionals in Infection Control and Epidemiology

<http://www.knowledgeisinfectious.org>

CDC Foundation

<http://www.cdcfoundation.org>

Centers for Disease Control and Prevention

<http://www.cdc.gov>

Clean Hands Coalition

<http://www.cleanhandscoalition.org>

Public Health Foundation

<http://www.phf.org>

WORLD HEALTH ORGANIZATION (WHO)

DEFINITION

The World Health Organization (WHO) is a unit of the United Nations that is devoted to global health issues. WHO coordinates and provides leadership and directions on health matters through health research programs, guidelines, and standards. The organization also provides technical support to governments to help them address global health problems and to improve the well-being of their respective populations.

The organization is governed by a constitution that has eighty-one articles or principles. The objective of WHO (described in chapter I, article 1) is “the attainment by all peoples of the highest possible level of health.”

The WHO constitution came into force on April 7, 1948. Soon thereafter, the first World Health Assembly (WHA), the highest WHO decision-making body, called for the creation of a World Health Day to mark the founding of the organization. Since 1950, World Health Day has been celebrated on April 7 annually around the world. A theme, which highlights a priority area of concern, is chosen each year to focus on key public health issues that affect the international community.

MEMBERSHIP

Any country that is a member of the United Nations may become a member of WHO by accepting the WHO constitution. Other countries may be admitted as members following the approval of their application by a simple majority vote of the WHA. Associate membership may be granted to territories not responsible for the conduct of their international relations when applications are made on their behalf by a member or other authority that is responsible for their international relations. There are 193 member states within WHO, and they are grouped according to regional location and offices.

STRUCTURE

WHA's main function is to determine WHO policies. The assembly meets yearly in May at its headquarters in Geneva, Switzerland, with delegates from member states. The WHA appoints a director-general, who supervises the financial policies of WHO and reviews

and approves the proposed program budget for a given year.

The executive board, whose members are elected to three-year terms, comprises members who have technical qualifications in health fields. The main function of the executive board is to facilitate the work of the WHA by approving their decisions and policies.

The secretariat of WHO is staffed by about eight thousand health and other experts and support staff on fixed-term appointments. The staff works at the headquarters in Geneva, in the six regional offices, and in member countries. WHO is headed by a director-general, who is appointed by WHA on the nomination of the executive board. Since the inception of WHO in 1948, eight directors-general have served. Brock Chisholm, from Canada, was the first director-general and served from 1948 through 1953. Director-general Margaret Chan, from the People's Republic of China, was appointed in November of 2006. The organization is financed by dues contributed by member states, by voluntary donations from private nongovernment organizations and foundations, and by partnership with research and pharmaceutical companies.

REGIONAL OFFICES

There are six WHO regional offices, each of which is headed by a regional director. The regional director manages a staff of health and other experts at the regional headquarters and in specialized centers within a given region.

The director is elected to a five-year term by a regional committee that consists of all heads of health departments in the governments of the member states within the given region. The tenure of the regional director is renewable once. The committee also implements the health policy guidelines that are outlined by WHA. The committee also monitors all WHO activities and operations within its respective region.

WHO regional offices represent Africa, the Americas, Southeast Asia, Europe, the eastern Mediterranean, and the western Pacific. The Regional Office for Africa (AFRO) is headquartered in Brazzaville, the Republic of Congo, and has

forty-six members, which includes most of the nations of Africa.

The Regional Office for the Americas (AMRO) is headquartered in Washington, D.C. The region has thirty-five member nations and was established before the founding of WHO as the Pan American Health Organization, the oldest international public health organization in the Western Hemisphere. The Regional Office for South East Asia (SEARO) is headquartered in New Delhi. This region consists of eleven member nations in Southeast Asia and includes North Korea. The Regional Office for Europe (EURO) is headquartered in Copenhagen. The region consists of fifty-three member nations in the European Union. The Regional Office for the Eastern Mediterranean (EMRO) is headquartered in Cairo. The region consists of twenty-one member nations, including the African nations of Egypt, Sudan, Tunisia, Libya, and Morocco, and the countries of the Middle East (except Israel).

The Regional Office for the Western Pacific (WPRO) is headquartered in Manila. The region consists of twenty-seven member nations, including the countries in Oceania and South Korea and Asian countries that are not served by SEARO or EMRO.

LIAISON AND COUNTRY OFFICES

In addition to the six WHO regional offices, the organization has country offices and liaison and specialist offices at critical international institutions. The country offices are usually located in a country's capital and may also involve the establishment of satellite offices. Country offices are headed by WHO representatives, who most often are trained physicians but are not citizens of the host country. These physicians typically hold diplomatic rank and are accorded diplomatic privileges and immunities similar to those of a nation's ambassador or high commissioner.

WHO country offices serve as the primary advisers on health and pharmaceutical policies to the host government. The international liaison offices have functions similar to country offices, but on a smaller scale; they are usually located in countries with an adequate health system but who nonetheless request the presence and cooperation of WHO.

There are nine liaison and specialists' offices in Africa, Japan, Europe, and North America, headed by liaison officers, who are citizens of the host country and who do not hold diplomatic rank. These offices

are the International Agency for Research on Cancer and the Office for National Epidemic Preparedness and Response, both in Lyon, France; the Centre for Health Development in Kobe, Japan; the Liaison Office and the Office at the World Bank and the International Monetary Fund, both in Washington, D.C.; the Mediterranean Centre for Vulnerability Reduction in Les Berges du Lac, Tunisia; the Office at the African Union and the Economic Commission for Africa in Addis Ababa, Ethiopia; the Office at the European Union in Brussels; the Office at the United Nations, New York; and WHO collaborating centers.

COLLABORATING CENTERS

WHO collaborating centers are institutions such as those conducting research that are designated by the WHO director-general to carry out activities in support of WHO programs at the country, regional, and global levels. The centers also participate in the strengthening of country resources according to WHO policy and its strategy of technical cooperation.

There are more than eight hundred WHO collaborating centers in more than eighty member states that are actively working in areas such as food safety and nutrition, nursing and midwifery, traditional medicine, injury and violence prevention, occupational health, health promotion, communicable diseases, nutrition, mental health, chronic diseases, and health technologies.

The second WHA, in 1949, adopted a policy that prevents WHO from establishing its own international research institutions but allows it to coordinate and make use of the activities of existing institutions to advance health research. A department or laboratory within an institution or a group of facilities for reference, research, or training that belongs to a different institution may be designated as a WHO collaborating center.

Designation as a collaborating center is made with the agreement of the head of the establishment to which the institution is attached or with the agreement of the director of the institution, if it is independent, and after consultation with the national government. An institution is designated initially for a term of four years; the designation may be renewed for the same or a shorter period. A WHO collaborating center may be jointly designated by WHO and by other competent and specialized international bodies. Networks, working groups, partnerships,

and programs, or nongovernmental organizations and similar bodies with a membership structure, including professional associations or foundations are not eligible for designation as WHO collaborating centers.

Other center activities include collecting and disseminating information; standardizing terminology and nomenclature of technology, substances, methods, and procedures; participating in collaborative training and research training; and the coordination of activities carried out by affiliates' institutions.

The collaborating centers help to facilitate the fulfillment of WHO-mandated activities through using resources in the respective countries and regions. The exchange of information and research findings, for example, is enhanced by regular meetings and by a database that is accessible through the Internet. This database serves as the official source of information on the centers.

ANNUAL EVENTS

World Health Day is an annual WHO event. A theme is selected each year that focuses on a particular health issue or program. The theme for the 2010 World Health Day was urbanization and health, and its slogan was 1000 Cities-1000 Lives. Events were organized globally with a call on cities to open streets for health-related activities. In 2009, the theme was Save Lives—Make Hospitals Safe in Emergencies, which focused on the safety of health care facilities and on the readiness of health workers who handle emergencies.

WHO also observes a series of annual events that focus on specific health issues or themes. Events for 2010 included World Cancer Day on February 4, World Water Day on March 22, World TB Day on March 24, World Health Day on April 7, World No Tobacco Day on May 31, and World Blood Donor Day on June 14.

REPORTS AND PUBLICATIONS

Beginning in 1995, WHO began publishing its World Health Report, considered by many to be the organization's leading publication. Each report focuses on a specific subject and combines expert assessment of global health and informative statistics about member countries. The report provides countries, donor agencies, international organizations, and others with the information and data to help make

adequate policy and funding decisions. It is also a good source for researchers and journalists and for general readers with an interest in international health issues.

The World Health Report 2010: Health Systems Financing: The Path to Universal Coverage promotes the importance of good health to human welfare and to sustained economic and social development. The report maps out what countries can do to modify their financing systems to be able to move quickly toward the goal of universal health coverage while sustaining the progress that has been achieved.

The report also builds on new research and on lessons learned. It provides an agenda for countries at all stages of development and proposes ways that the international community can better support efforts in low income countries to achieve universal coverage and improve the health of their respective populations.

The first World Health Report, in 1995, with the theme of "Bridging the Gaps," focused on how poverty wields a destructive and often deadly influence at every stage of human life. The report describes WHO's efforts in helping to bridge the widening gaps between the rich and poor and between those with and without access to adequate health care.

INTERNATIONAL HEALTH REGULATIONS

WHO's International Health Regulations (IHR) 2005 is an international legal instrument that is binding on 194 countries across the globe, including WHO member states. The IHR came into force in June of 2007.

The aim of the IHR is to help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide. The IHR was developed in response to the exponential increase in international travel and trade and to the emergence and reemergence of disease threats and other health risks on a global scale.

The IHR calls for member countries to build up their capacity to prevent, protect against, and control disease outbreaks, and it defines the rights and obligations of countries to report to WHO certain disease outbreaks and public health events. The IHR also establishes a number of procedures that WHO must follow in helping to maintain global public health.

—*Oladayo Oyelola, Ph.D., SC(ASCP)*

FURTHER READING

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EPIDEMIC INTELLIGENCE SERVICE (EIS)

DEFINITION

The Epidemic Intelligence Service (EIS) is a U.S. government program that trains scientific professionals as public health investigators. The EIS is part of the Centers for Disease Control and Prevention (CDC).

CREATION AND PURPOSE

Cold War concerns regarding the potential of biological warfare motivated government scientists, including epidemiology expert Alexander Langmuir, to prepare effective medical defenses against epidemics infecting large populations. After World War II, Langmuir became chief epidemiologist at the Communicable Disease Center (now called the Centers for Disease Control and Prevention) in Atlanta. He emphasized surveillance techniques to evaluate the occurrence and distribution of diseases affecting groups. Seeking to train more epidemiologists to work for the CDC to document outbreaks, study pathogens, and reduce bioterrorism risks, Langmuir and colleagues created EIS in 1951.

Langmuir presented his goal for EIS in a March, 1952, article in the *American Journal of Public Health*, stressing the need for epidemiologists who can quickly respond to infectious disease crises. He reported that the initial EIS recruits began training in Atlanta in July, 1951, before conducting field work for the remainder of a two-year commitment to EIS. Langmuir stated that EIS officers provided an essential epidemiological resource if the United States faced a biological attack. In peacetime, EIS personnel would aid in the comprehension of how infectious diseases are transmitted and how they can be prevented and controlled.

SELECTION AND TRAINING

EIS retained its basic structure into the early twenty-first century, adapting to incorporate scientific and medical developments and address evolving infectious diseases concerns. Initially, EIS sought applicants who were physicians. By the late twentieth century, EIS recognized the importance of an interdisciplinary approach to its work, encouraging applicants with expertise in pharmacology, biostatistics, nutritional sciences, and other fields that complement public health work. EIS expects applicants to

have earned professional degrees in their specialties and to have secured relevant licenses. Because EIS investigations often occur in other countries, administrators consider qualified applicants from countries outside the United States who can gain a security clearance to access restricted information and laboratory materials.

Approximately seventy to ninety people are selected annually to join EIS. Several weeks of course work begin in Atlanta every year in July, in a program often compared with a hospital residency. Each EIS officer receives a position with health departments or CDC centers, such as the National Center for Emerging and Zoonotic Infectious Diseases, which focus on specific concerns. EIS officers perform various professional tasks, including writing scientific reports for the CDC's Morbidity and Mortality Weekly Report and attending the annual EIS conference, which is held each April.

EIS also offers a number of medical and veterinary medicine students the chance to participate in EIS epidemiology investigations for one to two months before they graduate from medical school. Some of those students are later selected for the main EIS program.

DISEASE RESPONSE

EIS officers respond to disease emergencies by traveling to infected areas, including disaster zones, immediately after learning of outbreaks. They collect specimens, interview patients, analyze causes and transmission of diseases, and immunize vulnerable or high-risk populations. EIS also sends representatives to areas affected by unidentified (and emerging) diseases.

Early EIS investigations frequently involved the diseases of histoplasmosis, rabies, and norovirus infection. EIS officers have also assisted in controlling diphtheria epidemics, in developing therapeutic oral hydration to treat cholera, and in identifying pathogens associated with Legionnaires' disease and acquired immune deficiency syndrome. They determined that West Nile virus is transmitted to humans by mosquitoes. EIS personnel also developed methods to counter lethal microbes, including Lassa, Ebola virus, and hantavirus. They have investigated



The Epidemic Intelligence Service can often be found on the front lines of disease outbreaks such as this one in Haiti, as technicians test for lymphatic filariasis and malaria. Image courtesy of the CDC. Photo by Elaine Kathryn Knipes, Ph.D. via Public Health Image Library.

SARS, H1N1 influenza, and the proliferation of antibiotic-resistant microbes that spread infectious diseases.

EIS officers were dispatched to New York City and Washington, D.C., after the September 11, 2001, terrorist attacks to survey sites around Ground Zero and the Pentagon for signs of biological warfare. EIS officers also investigated the distribution of anthrax spores through the U.S. mail. EIS officers now participate in bioterrorism exercises as part of their training to prepare as first responders in biological attacks.

IMPACT

By the early twenty-first century, the EIS had investigated more than ten thousand cases on six continents. A significant public health success attributed to EIS personnel includes eradicating smallpox.

Approximately three-fourths of the estimated

three thousand EIS graduates have pursued public health work after they completed their EIS service, extending the reach and influence of EIS. As of 2010, almost one-half of state epidemiologists and forty percent of state health officials have received EIS training. Four EIS alumni have served as directors of the CDC. Former EIS officers also have been leaders in organizations such as the Infectious Diseases Society of America, the National Foundation for Infectious Diseases, and the World Health Organization.

EIS representatives have assisted other countries in establishing epidemiological services such as the Field Epidemiology Training Program (FETP) and the Field Epidemiology and Laboratory Training Program (FELTP). By 2010, FETP and FELTP had been established in twenty-nine countries, many in Asia and Africa. EIS alumni also helped create the European Programme for Intervention Epidemiology Training, a program that serves

countries of the European Union.

—Elizabeth D. Schafer, Ph.D.

FURTHER READING

Altman, Lawrence K. "An Elite Team of Sleuths, Saving Lives in Obscurity." *The New York Times*, April 6, 2010, D-5. An EIS alumnus comments on Langmuir's sometimes controversial actions as EIS director, actions such as not releasing complete information regarding flawed polio vaccines and controlling publicity concerning infectious diseases.

Koo, Denise, and Stephen B. Thacker. "In Snow's Footsteps: Commentary on Shoe-Leather and Applied Epidemiology." *American Journal of Epidemiology* 172, no. 6 (2010): 736-739. Distinguishes between applied and academic epidemiology, providing a table outlining differences in personnel, training, benefits, and other areas.

Koplan, Jeffrey P., and Stephen B. Thacker. "Fifty Years of Epidemiology at the Centers for Disease Control and Prevention: Significant and Consequential." *American Journal of Epidemiology* 154, no. 11 (2001): 982-984. A CDC director and an epidemiology program office leader identify U.S. and international public health precedents that inspired Langmuir, stressing how EIS constantly adjusts to improve its services.

McKenna, Maryn. *Beating Back the Devil: On the Front Lines with the Disease Detectives of the Epidemic*

Intelligence Service. New York: Free Press, 2004. Atlanta-based journalist focuses on experiences of EIS officers from 2002 through 2003, preparing for bioterrorism and combating epidemics during wartime.

Pendergrast, Mark. *Inside the Outbreaks: The Elite Medical Detectives of the Epidemic Intelligence Service*. Boston: Houghton Mifflin Harcourt, 2010. Comprehensive chronological discussion of EIS, from the time of its founding into the early twenty-first century. Incorporates information from interviews with EIS and CDC personnel and from primary sources.

WEB SITES OF INTEREST

African Field Epidemiology Network
<http://www.afenet.net>

Epidemic Intelligence Service
<http://www.cdc.gov/eis>

European Programme for Intervention Epidemiology Training
<http://www.epiet.org>

Field Epidemiology Training Program
<http://www.cdc.gov/globalhealth/fetp>

Training Programs in Epidemiology and Public Health Interventions Network
<http://www.tephinet.org>

ON THE POLIO VACCINE SITUATION

Date: May 31, 1955

Author: Dwight D. Eisenhower

SUMMARY OVERVIEW

In 1955, President Dwight D. Eisenhower announced that the vaccine for poliomyelitis (“polio”) would soon become available for all citizens. Eisenhower said that the vaccine was produced under the strictest of regulatory frameworks in order to maximize public safety. He said that, although the vaccine was not 100 percent effective, its preventative benefits would be tremendous. Emphasizing the nationwide need for the vaccine, Eisenhower outlined a detailed plan by which distribution would occur. The first group of Americans who would receive the vaccine, he said, would be children, with all other Americans treated once the children were fully inoculated.

DEFINING MOMENT

Some of the most significant public-health emergencies in modern US history were polio epidemics. The first significant American outbreak—in Vermont—took place in 1894, afflicting 132 and killing eighteen. Polio epidemics began appearing each year and growing in size, spiking in historic epidemics such as the one in 1916, which began in New York City and spread nationwide, infecting 27,000 and killing 6,000. The largest on record was in 1952, when nearly 58,000 cases and more than 3,000 deaths were recorded; the lower death count in the larger epidemic was due in part to improved sanitation and early detection.

Most people infected with the polio virus never experience any symptoms; those who do fall into two broad categories, nonparalytic and paralytic polio. Nonparalytic polio is exemplified by flu-like symptoms, such as fever, fatigue, nausea, and sore throat, lasting as long as ten days. Paralytic polio is far more dangerous, involving entry of the virus into the central nervous system. Patients start out with symptoms similar to nonparalytic polio but then may develop a loss of reflexes, severe muscle pain, and paralysis. Victims of polio can experience symptoms decades after the polio virus has run its course.

Historians argue that one of the largest contributors to polio outbreaks was ignorance. Until the early 1900s, doctors did not know that polio was a virus,

spread when fecal particles enter the mouth in unsanitary environments. During some outbreaks, some communities sprayed the insecticide DDT to kill mosquitoes and flies, as the virus was sometimes found on the legs of these insects. People were afraid to sneeze or touch other people out of fear that they would contract the virus. What was clear to all Americans was that the disease was nondiscriminatory: people of all ages, races, and economic status could catch polio, including President Franklin D. Roosevelt, who contracted polio in 1921 and spent much of his life in a wheelchair as a result.

After World War II, the search for a polio vaccine began in earnest. Recruited by the University of Pittsburgh, Dr. Jonas Salk developed the first effective polio vaccine in 1952, using an inactivated (dead) virus. The next year, Salk and his associates began testing the vaccine. The tests were delayed, however, when California-based Cutter Laboratories—one of five pharmaceutical companies involved in the vaccine—accidentally gave test subjects a live virus, causing paralytic polio in more than fifty children, five of whom died.

The imperative for a vaccine was not tempered by this incident, however. In the Democratic Congress, there remained an open willingness to spend whatever was necessary to develop and administer the vaccine. In 1954, nearly two million children were test-vaccinated in a field program headed by famed epidemiologist and polio expert Dr. Thomas Francis Jr. On April 12, 1955 (ten years after Roosevelt's death), Francis announced the results of the field tests: the vaccine was safe, effective, and ready for nationwide distribution.

AUTHOR BIOGRAPHY

Dwight D. Eisenhower was born in Denison, Texas, in 1890, but was raised in Abilene, Kansas. A graduate of West Point, Eisenhower ascended the ranks before being selected by General George Marshall to command the Allied forces in North Africa in 1942, during World War II. In 1944, General Eisenhower served as supreme commander of Allied forces in the invasion of France (D-Day). After serving as president of Columbia University, Eisenhower returned to military service in 1951, overseeing the new forces of the North Atlantic Treaty Organization

(NATO). In 1952, Eisenhower successfully ran for president and served for two terms. Highlights of the Eisenhower administration included the armistice ending the Korean War, efforts to ease tensions between the United States and the Soviet Union, school

desegregation and the desegregation of the US military, and the establishment of the Interstate Highway System. At the end of his term in 1961, he retired to his farm in Gettysburg, Pennsylvania, where he died in 1969.

HISTORICAL DOCUMENT

I WOULD LIKE to issue the following statement about the polio vaccine situation. The last week has been both eventful and encouraging.

A committee of scientists is now screening polio vaccine before it is released for public use. The Surgeon General of the Public Health Service tells me that it is hoped to release some vaccine within a few days. Batches of vaccine must pass the most careful tests that scientists can devise and be as safe and effective as man can make the vaccine.

According to Dr. Francis' report on last year's field tests, the child who was vaccinated had a three times better chance of avoiding polio than the child who was not vaccinated.

There has been delay in the vaccination program. But remember—we are dealing in this field with the lives of our children and our grandchildren. Because of scientific work that was done during that delay science has learned new things about the way viruses behave in large scale manufacture and about the way we should make vaccine. Scientists have been able to design testing techniques of greater sensitivity and production techniques which build in a greater factor of safety and additional checks on the final product. So from that delay science has gained new knowledge, new safeguards.

I want to caution the people of our nation about two things:

First: No vaccination program can prevent all cases of the disease against which it is directed. Let us not forget that Dr. Francis reported the polio vaccine as used in the 1954 field trial was found to be 60 to 90 percent—not 100 percent—effective in the field trials last year.

Second: Although the manufacturers are now moving toward full scale production and distribution of this vaccine, it will take them varying periods of time to “retool” to meet the revised production standards. During the months immediately ahead we must be patient while our limited supply of vaccine is used first to help protect those who need it most.

Every parent and every child should be grateful to those scientists who have been working without rest and without relief during recent weeks to find answers to the problems that caused the delay. They have found these answers and another battle in the continuing fight against polio has been won.

DISTRIBUTION

Since April 12 the National Foundation for Infantile Paralysis has been furnishing free vaccine for children in the first and second grades, and for children in the third grade who participated in the field tests of vaccine last year. More than 58 million children have been vaccinated—including one of my grandchildren, a first grader. This free vaccination program is the initial method for getting the vaccine to our children. No vaccine is now being distributed in any other way.

Sufficient vaccine to complete the Foundation's program should be released within 60 days. Until it is finished all vaccine produced will go to the Foundation.

The fact that some children do not get their second injection promptly will not reduce the effectiveness of the first injection. Dr. Salk, himself, stated last week that the level of immunity developed by the first injection would last many months.

DISTRIBUTION WHEN THE FOUNDATION PROGRAM IS COMPLETED

As soon as the Foundation program is completed, distribution must continue to proceed in a fair and orderly manner. The Secretary of Health, Education and Welfare presented to me two weeks ago a sound plan for the distribution of the vaccine. I promptly endorsed that plan and made it public.

Briefly the voluntary control plan for distribution will work as follows:

1. Priorities. The vaccine must be used first for those most susceptible to polio. Not only is this just, but also by reducing the incidence of the disease among those most likely to get it we increase the protection for all of us. The National Advisory

Committee on Poliomyelitis Vaccine and the Secretary of Health, Education and Welfare have recommended that the vaccine be administered first to children of the ages of 5 to 9, inclusive.

I strongly endorse this recommendation and call upon our people to adhere strictly to the age 5 to 9 priority during the months ahead. No person not in the 5 to 9 age group should be vaccinated until the children of these age groups have received two vaccinations. The doctors of the country, through the American Medical Association, have pledged their support of these priorities.

The age group of second priority will be established and announced in due course.

2. Output of the Manufacturers. Each of the manufacturers of the vaccine has individually agreed to distribute his entire output of vaccine in accordance with this overall plan adopted by the Secretary of Health, Education and Welfare on the recommendation of the National Advisory Committee.

3. Allocation to States. The Secretary of Health, Education and Welfare will compile reports on the total output of the manufacturers and allocate the vaccine to each State on the basis of its population of unvaccinated children within the 5 through 9 age group, and subsequently, for other age groups.

4. State Responsibility. The States will advise the Secretary of Health, Education and Welfare as to their general plans for distribution of the vaccine and, specifically, their shipping instructions for manufacturers. This information then will be transmitted to the manufacturers.

5. Vaccination Programs. To assure that no child is denied vaccination by reason of its cost, some states and localities may operate mass free public vaccination programs for all children.

Other states may provide free vaccination only for children whose parents are unable to pay, through clinics, schools and preschool programs, or by furnishing free vaccine to private physicians. In those States, a portion of the State allocation of vaccine will flow into normal drug distribution channels for the exclusive use of children in the priority age brackets—to be administered by family doctors.

To assist the States in providing free vaccinations, I have recommended that the Congress enact legislation making \$28 million available to the States for the purchase of vaccine. This legislation is now being considered by the appropriate Committees of the Congress and I urge its immediate adoption.

6. Keeping of Records. Doctors, as well as all manufacturers and distributors of the vaccine, will keep records of the vaccine they handle. Cooperation to this end has been pledged by the doctors, the manufacturers and the distributors.

This plan for distribution of the vaccine can go into effect as soon as the free vaccination program of the National Foundation for Infantile Paralysis is completed. Under it, the Federal Government will assume responsibility for the equitable allocation of the vaccine among the States, and the States will assume responsibility for the direction of distribution within their borders.

The program will operate in a sure and orderly way, given the full cooperation of the State officials, the manufacturers, the distributors, the medical profession, and the people of the Nation. I am confident that the program will receive that support.

For these reasons I do not believe that regulatory legislation in this field is necessary.

We all hope that the dread disease of poliomyelitis can be eradicated from our society. With the combined efforts of all, the Salk vaccine will be made available for our children in a manner in keeping with our highest traditions of cooperative national action.

DOCUMENT ANALYSIS

President Eisenhower's comments on the polio vaccine are at once celebratory, cautionary, and pragmatic. He welcomes the announcement that the polio vaccine has been proven effective and safe in field trials. However, Eisenhower warns that the speed of the vaccine's distribution depends on the creation of safe techniques for its large-scale manufacture. Once all health concerns are satisfied, he says, the vaccine will be delivered to Americans in an orderly and prudent manner.

Eisenhower says he is encouraged by Dr. Thomas Francis Jr.'s report on the polio vaccine field tests, which indicated that a vaccinated child was three times less likely to get polio. He commends the vaccine project's scientists as well, for studying the roots of the virus and developing a drug that could block it, under tight safety parameters. Using the measured approach for which he was known, the president then notes that the vaccine is not 100 percent effective, but between 60 and 90 percent effective according to Francis's report. Eisenhower also says that the vaccine, despite clearing the hurdle of field tests, will not be immediately available, as the government needs to work with vaccine manufacturers to ensure that production is safe and effective. Finally, he says, the National Foundation for Infantile Paralysis (a nonprofit organization later renamed the March of Dimes) is still in the process of inoculating more than 58 million children as part of the field tests. No vaccines will be available until after all of the children in the program have been given the drug. In other words, Eisenhower cautions, it will be at least two months before the drug is available to all Americans.

Once the foundation completes its work, Eisenhower says, the vaccine will be distributed on a national scale. The distribution will be orderly and fair, he says. The first group to receive the vaccine will be those most susceptible to the disease: children aged five through nine. As the vaccine must be administered in two doses, Eisenhower says, no vaccines will be issued until all children of this age group have received the requisite two doses.

Eisenhower announces that the secretary of the Department of Health, Education and Welfare (HEW; later, the Department of Health and Human Services) has drawn up a plan for further administering the vaccine after the highest priority population is vaccinated. First, manufacturers are to

produce and make available the full quantity of vaccines to which they agreed with the federal government. Second, HEW will coordinate with states to determine the number of first and second priority citizens in need of vaccines. Third, the states will develop their own distribution plans and communicate with the manufacturers these plans. Finally, each state and locality will launch its own vaccination program. Such programs could be free of cost, Eisenhower says, if Congress provides the \$28 million he is recommending to fund free vaccination programs at schools, clinics, and other locales serving poorer residents.

Eisenhower stresses that, as long as each plan participant—manufacturers, government officials, doctors, distributors, and the citizens themselves—work together to adhere to the vaccination plan, Americans will soon be much better protected from polio. The objective, he says, is the total eradication of polio from American society—a goal Eisenhower sees as entirely reachable.

ESSENTIAL THEMES

Both as a military leader and a president, Eisenhower was notable for his moderate and pragmatic approach in even the most intense environments. This trait was manifest as he addressed the news that a vaccine for polio was finally available. Americans, he implied, were excited at the prospect of controlling the polio threat. His comments in this statement were positive, yet tempered. The vaccine might not help every American, he said, but it was safe and would benefit most people.

Eisenhower and his administration made sure that, even before the Francis report, a national distribution plan for nationwide vaccination was in place. The most vulnerable population were the youngest children, he said. Once the 58 million children receiving the first test doses were fully inoculated, every other child between the ages of five and nine would also be fully vaccinated. Thereafter, distribution would adhere to a complex plan involving the compliance of every stakeholder. HEW, state governments, the federal government, doctors, and health care workers—as well as private citizens receiving the vaccine—needed to work together to ensure that every American received the drug in order of priority. The vaccine, Eisenhower said, gave Americans a much better chance of avoiding the scourge of polio,

while scientists continued to work toward the eradication of this potentially deadly virus.

The results of polio vaccination in the United States and beyond were dramatic: the disease was declared eradicated in the United States by 1979 and throughout the Americas in 1994. A campaign began to eliminate the disease worldwide, and by the twenty-first century, only a handful of countries were still recording cases. In 2015, the World Health Organization recorded fewer than one hundred cases of polio worldwide.

—Michael P. Auerbach, MA

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SABIN DEVELOPS THE ORAL POLIO VACCINE

Albert Bruce Sabin developed a polio vaccine consisting of weakened strains of live polio virus, which, when ingested, caused a harmless infection in the gut and stimulated long-lasting immunity to poliomyelitis without causing the paralytic disease.

Date: 1957

Locale: Cincinnati, Ohio

SUMMARY OF EVENT

Almost a century ago, the first major poliomyelitis (polio) epidemic was recorded. Thereafter, epidemics of increasing frequency and severity struck the industrialized world. By the 1950's, as many as sixteen thousand individuals, most of them children, were being paralyzed by the disease each year.

Within twenty years of the first epidemic, scientists had shown that polio was caused by a virus and had discovered that deliberate injection of this virus into monkeys caused them to develop paralytic polio. This important discovery raised hopes that a vaccine would be developed quickly to control the disease. Unfortunately, although a means was now available to test the safety and effectiveness of potential vaccines in animals prior to use in humans, the choice of the monkey species was unfortunate because it fostered the mistaken belief that the virus infected humans as it did monkeys, namely, by inhalation through the nose.

It is now known that, in humans, poliovirus enters the body through ingestion by the mouth. It replicates in the throat and the intestines and establishes an infection that normally is harmless. From there, the virus can enter the bloodstream. Only in rare individuals does it make its way to the nervous system, where it attacks and destroys nerve cells crucial for muscle movement. The presence of antibodies in the bloodstream will prevent the virus from reaching the nervous system and causing paralysis. Thus, the goal of vaccination is to administer poliovirus that has been altered so that it cannot cause disease, but nevertheless will stimulate the production of antibodies. There are three types of poliovirus; a vaccine must stimulate antibodies against all three types in order to protect against disease.

Albert Bruce Sabin received his medical degree from New York University College of Medicine in 1931. Polio was epidemic in 1931, and Sabin's experience with the disease stimulated a lifelong interest in polio research. No other man, according to eminent

virologist John R. Paul, "contributed so much effective information—and so continuously over so many years—to so many aspects of poliomyelitis, as Sabin."

While working at the Rockefeller Institute, Sabin studied methods to grow the virus that did not depend on experimentally infected monkeys. In 1936, he and Peter Olinsky successfully grew poliovirus for the first time outside an animal using tissues cultured in vitro. They found that the virus would infect and replicate in brain tissue obtained from human fetuses but would not grow in tissues that were not of the nervous system. These results were promising because a method to provide a large amount of the virus was needed to produce a vaccine. The technique was limited, however, because it depended on the availability of human fetuses. Moreover, their results tended to strengthen the prevailing, but incorrect, idea that polioviruses attacked nerve cells only.

In 1949, Thomas H. Weller, John Franklin Enders, and Frederick Chapman Robbins provided the breakthrough that was so eagerly sought by successfully growing poliovirus in cultures of human and monkey nonnervous tissue. (For this feat, they received the 1954 Nobel Prize in Physiology or Medicine.) There is no ready explanation for why their experiments succeeded, whereas those of Sabin and Olinsky did not. Most likely, the discrepancy results from the use of different strains of poliovirus; Sabin and Olinsky used a strain that had been propagated repeatedly by injection directly into the brains of monkeys; this strain apparently lost its ability over time to infect other types of cells. In contrast, the Enders group used a strain that had been isolated directly from a human polio patient.

Tissue culture proved to be an excellent source of virus. Jonas Salk soon developed an inactive polio vaccine, consisting of virus grown from tissue culture that had been inactivated (killed) by chemical treatment. This vaccine became available for general use in 1955, almost fifty years after poliovirus had first been identified.

Sabin, however, was not convinced that an inactivated virus vaccine was adequate. He believed that such an inactive vaccine would provide only

temporary protection and that individuals would have to be vaccinated repeatedly in order to maintain protective levels of antibodies. Knowing that natural infection with poliovirus induced lifelong immunity, Sabin believed that a vaccine consisting of a living virus was necessary to produce long-lasting immunity. Also, unlike the inactive vaccine, which is injected, a living virus (weakened so that it would not cause disease) could be taken orally and would invade the body and replicate of its own accord. It would, therefore, more closely mimic natural infection and naturally induced immunity without causing disease.

Sabin was not alone in his beliefs. Hilary Koprowski and Harold Cox also favored a living virus vaccine and had, in fact, begun searching for weakened strains of poliovirus as early as 1946 by repeatedly growing virus in rodents. When Sabin began his search for weakened virus strains in 1953, a fiercely competitive contest to achieve an acceptable live virus vaccine ensued. About this time, Sabin completed a series of extremely important experiments comparing how well poliovirus multiplies in various tissues of monkeys and humans. These results formed the basis for his strategy to produce a living vaccine: He would search for strains of poliovirus that would multiply extensively in the human intestine, but not in the human nervous system.

Sabin's approach was based on the principle that, as viruses acquire the ability to replicate in a foreign species or tissue (for example, in mice), they become less able to replicate in humans and thereby to cause disease. Sabin used Enders's tissue culture technique to isolate those polioviruses that grew most rapidly in monkey kidney cells. He then employed a technique developed by Renato Dulbecco that allowed him to propagate and study the progeny of individual virus particles. The recovered virus then was injected directly into the brain or spinal cord of monkeys to identify those that did not damage the nervous system.

These meticulously performed experiments, which involved approximately nine thousand monkeys and more than one hundred chimpanzees, finally enabled Sabin to isolate rare mutant polioviruses that would replicate in the intestinal tract but not in the nervous system of chimpanzees, or, it was hoped, of humans. In addition, the weakened virus strains were shown to stimulate antibodies when they were fed to chimpanzees; this was a critical attribute

for a vaccine strain.

By 1957, Sabin had identified three strains of attenuated viruses that were ready for small experimental trials in humans. A small group of volunteers, including Sabin's own wife and children, were fed the vaccine with promising results. Sabin then gave his vaccine to virologists in the Soviet Union, Eastern Europe, Mexico, and Holland for further testing. Combined with smaller studies in the United States, these trials established the effectiveness and safety of his oral vaccine.

During this period, the strains developed by Cox and by Koprowski were being tested also in millions of persons in field trials around the world. In 1958, two laboratories independently compared the vaccine strains and concluded that the Sabin strains were superior. Nevertheless, amid Cold War tensions, doubts were voiced about the reliability of the Soviet studies and the effectiveness of Sabin's "communist vaccine." In 1959, an American microbiologist who was sent to the Soviet Union to evaluate the program returned with a favorable report. In 1962, after four years of deliberation by the United States Public Health Service, all three of Sabin's vaccine strains were licensed for general use.

SIGNIFICANCE

The development of polio vaccines ranks as one of the triumphs of modern medicine. Rarely has a serious disease been controlled so quickly and dramatically as was poliomyelitis in the developed areas of the world. During the high prevaccine rates of the early 1950's, paralytic polio struck 13,500 out of every 100 million Americans. Use of the Salk vaccine greatly reduced the incidence of polio, but outbreaks of paralytic disease continued to occur: Fifty-seven hundred cases were reported in 1959 and twenty-five hundred cases in 1960. In 1962, the oral Sabin vaccine became the vaccine of choice in the United States. Since its widespread use, the number of paralytic poliomyelitis cases in the United States has dropped precipitously, eventually averaging fewer than ten per year. Worldwide, the oral vaccine prevented an estimated 5 million cases of paralytic poliomyelitis between 1970 and 1990.

There were a number of reasons why the oral vaccine was favored over the inactive vaccine. The oral vaccine is cheaper and is easier to administer; therefore, it is more suitable for mass immunization

campaigns. Another advantage is that the live viruses of the oral vaccine multiply in the intestines of the vaccinated individual; some of the vaccine viruses may then be excreted and passed on to nonvaccinated individuals, inducing a protective immunity in them as well. As these viruses multiply, they raise antibodies in the intestines as well as in the bloodstream. These antibodies subsequently prevent wild (unweakened) viruses from infecting the intestines. Thus, wild viruses cannot spread through a population in which the majority of persons have received the oral vaccine. This form of “herd immunity” helps protect those individuals who have not been vaccinated.

The oral vaccine is not, however, without problems. Occasionally, the live virus mutates to a disease-causing (virulent) form as it multiplies in the vaccinated person. When this occurs, the person may develop paralytic poliomyelitis. Also, the mutated virus may be excreted and picked up by others, and cause disease in them. The inactive vaccine, in contrast, cannot mutate to a virulent form. The use of oral polio vaccine has reduced the incidence of polio in the United States to only a handful of cases each year. Ironically, nearly all of these cases are caused by the vaccine itself.

—Robin S. Treichel

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ASIAN FLU PANDEMIC KILLS MILLIONS WORLDWIDE

A new influenza virus emerged in China's southeastern Yunan Province, spreading rapidly to the rest of the world and causing the deaths of an estimated 2 million people. The pandemic, one of the three deadliest of the twentieth century, did not subside until the following year.

Date: February, 1957

Also known as: Asian strain flu; H2N2 virus; H2N2 pandemic

Locale: Yunan Province, China; worldwide

SUMMARY OF EVENT

Three major influenza pandemics appeared during the twentieth century. These global outbreaks, caused by subtypes of the influenza A virus, were responsible for the deaths of millions of people worldwide. The 1918-1919 pandemic, history's deadliest, was erroneously thought to have originated in Spain and was thus baptized the Spanish flu. Fifteen years later, British microbiologist Wilson Smith and his colleagues Christopher Howard Andrewes and Patrick Playfair Laidlaw identified the influenza virus — H1N1 influenza A—as the 1918-1919 pandemic's causative agent. The 1957-1958 and 1968 pandemics emerged on the Asian continent and are best known as the Asian and the Hong Kong flus, respectively. The H2N2 and H3N2 influenza viruses caused the Asian and Hong Kong flu pandemics.

Humans are not the only hosts for the influenza virus. Many nonhuman animals, including horses, pigs, sea mammals, and a variety of birds, also can harbor the virus. It is believed that in 1957, the simultaneous infection of a pig with both human and avian flu led to an exchange of genetic material between the two viruses, allowing the emergence of the H2N2 strain responsible for that year's Asian flu pandemic. The mixing of genetic material between two different flu viruses, known as antigenic shift, gives rise to a new flu virus. Because the majority of humans lack immunity to new subtypes, their rapid, worldwide spread will create a pandemic. Massive livestock farms such as those in rural China, which raise enormous quantities of birds and mammals, including pigs, create a milieu favorable to the birth of new influenza viruses.

The H2N2 virus emerged in China's southeast Yunan Province in late February of 1957. By mid-March the disease had reached epidemic proportions in that nation. Refugees from communist China

probably brought it to Hong Kong in early April. From there it spread rapidly to Singapore and then to Taiwan, Borneo, and Japan. At that time the international community, under the guidance of the World Health Organization (WHO), recognized the significance of the early influenza outbreaks and issued a global flu pandemic alert. The disease then spread to the Philippines, India, and Australia and to other Indonesian islands. June saw the arrival of the H2N2 virus in the Middle East, Europe, and North America. In July and August, it was found in South Africa, South America, New Zealand, the Pacific Islands, and parts of Africa, Eastern Europe, and the Caribbean. Within six months, the disease, spreading mainly by land and sea, had reached every corner of the world.

H2N2 arrived in the United States in June. The West Coast, more specifically California, appeared to have been one of the earliest entry ports for the virus. The flu spread from the coastal areas inland. During the early summer months, only sporadic outbreaks occurred, but in September, Louisiana reported epidemic conditions in more than 50 percent of its counties. By mid-October both New York and Maine reached epidemic conditions in 75 percent of their counties. H2N2 had the tendency to infect school-age children first. It then moved on from the preschool to the adult population. This trend was reflected by the high degree of absenteeism when schools restarted in the fall. An increase in mortality became apparent toward the end of September and reached its highest point during November.

In contrast to influenza pandemics, epidemics flare up yearly. Epidemics see an increase in mortality of the very old and very young, but pandemics are characterized by a marked increase in mortality of the younger population. This was particularly apparent at the time of the Spanish flu and was true, but less obvious, during subsequent pandemics. Almost 40 percent of all influenza-related deaths in the United States during the 1957-1958 Asian flu pandemic occurred in individuals less than 65 years of age.

While the Spanish flu claimed at least 50 million

deaths around the world, the 1957-1958 H2N2 pandemic is estimated to have led to 2 million deaths of people worldwide, including 80,000 people in the United States. Even though antibiotics were available at the time of this pandemic, the majority of people died of bacterial pneumonia. Health care costs and loss of productivity were enormous. The total costs of the 1957-1958 pandemic to the U.S. economy have been estimated at greater than \$4 billion (in 1958 dollars).

Before the Asian flu pandemic reached its peak in the United States, however, the virus already had been identified and information that was pertinent to the development of an effective vaccine was available. Within a month of the first outbreaks, the presence of the new H2N2 strain in the United States was confirmed through serologic testing. Public Health Services issued an alert in July and urged the U.S. government to launch a mass vaccination program. The Eisenhower administration left the responsibility of producing and distributing sufficient amounts of vaccine in the hands of private enterprise, but too little vaccine was produced and not enough was distributed in the crucial early months. At the height of the U.S. outbreak only 7 million people had been immunized. The 80,000 U.S. deaths attributed to the H2N2 virus reflect, in part, the failure of the pharmaceutical industry to adequately respond to the pandemic.

The Asian flu pandemic ended in 1958. Epidemic flare-ups with the H2N2 virus occurred until it was supplanted in 1968 by the newly emerged Hong Kong flu virus H3N2.

SIGNIFICANCE

The pandemics of 1918-1919 and 1957-1958 illustrate the inevitability that viral influenza mutation periodically leads to global influenza pandemics. The World Health Organization, which plays an essential role in global pandemic preparedness, has coordinated worldwide influenza surveillance since 1948 and heads an extensive network that includes more than eighty countries. The organization estimates that the next pandemic could kill between 2 and 8 million people worldwide. The impact on the United States will likely be tremendous, with 43 to 100 million people infected and with 89,000 to 207,000 anticipated deaths. The cost to the U.S. economy will probably range between \$71 billion and \$166 billion.

Vaccines have proven effective in combating human influenza. The Asian flu pandemic began during the early months of 1957 but did not reach pandemic proportions in the United States until the fall of that year. However, the era of jet travel has made it more likely that another pandemic will propagate more rapidly. Early detection of an emerging influenza virus and timely intervention will certainly demand a concerted global effort. The use of antiviral drugs has shown efficacy in the prevention and treatment of influenza. The distribution of such drugs, which would need to be readily available in large amounts at the beginning of an outbreak, could limit the progression of the infection until an ample supply of vaccine becomes available.

—Elisabeth Faase

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ASIAN FLU EPIDEMIC

The 1957 flu was a global pandemic of explosive proportions, the worst since 1918, with elevated death rates among the elderly and very young.

Date: Peaked between September and November, 1957, followed by a second wave in 1958

The Asian flu of 1957 sickened millions of people globally and was the most dramatic epidemiological event since the influenza pandemics of 1918 and 1889-1890. The 1957 flu variety was the most serious of three influenza epidemics affecting North America during the 1950's. A strain of influenza, which evolved by genetic drift, appeared in China in early 1957, and by late May, it had spread along transportation routes to Hong Kong, Japan, the Philippines, Malaysia, and Indonesia.

The virus entered the United States in June at the Naval Training Station in San Diego, California, as well as aboard a naval vessel deployed along the East Coast out of Newport, Rhode Island. It appeared in additional epicenters in Montana, Arizona, and Florida and by mid-summer was diffusing rapidly inland from the West, East, and Gulf coasts. The disease was geographically localized rather than frontal in its spread. Scientists believe that a small number of infected carriers known as "super-spreaders" may have unwittingly created multiple epicenters of disease throughout North America, especially in heavily populated urban areas.

The full pandemic exploded in both Canada and the United States from September through November; only isolated areas such as parts of Appalachia, interior Texas, the northern Plains, and lightly populated expanses of Canada escaped the worst of the disease. The Maritime Provinces were hardest hit in Canada, while Ontario and British Columbia fared much better, and the other provinces fell in between. The flu dissipated in North America by late autumn, but in the United States, the deadly siege in the fall was followed by another wave in early 1958. Except for the Ontario city of Montreal, Canada escaped the second onslaught. Overall, the flu epidemic in Canada was similar to the epidemic in the United States, with localized outbreaks, mostly from influxes of infected persons into population centers.

The 1957 influenza exhibited a normal age-mortality curve, with mortality the highest among the elderly. Death was normally a result of bacterial pulmonary complications and, in many cases, influenza may have hastened death to those with chronic cardiorespiratory ailments. Morbidity and mortality statistics were a reflection of the intertwining forces of viral strength and human vulnerability. The disease killed about eighty thousand persons in the United States, while Canada experienced a somewhat lower mortality rate.

IMPACT

The epidemic led to controversy over the feasibility and logistics of national inoculation programs. The federal governments did not mobilize to mass vaccinate the American and Canadian populations. A vaccine was developed, but there were diagnostic and distribution problems. This epidemiological event drew greater attention to disease surveillance and diagnosis, vaccine development, and research into the mechanisms of the type-A virus. Research showed its link to the Spanish flu of 1918, the most deadly epidemic in American history, and researchers continue their search for the genetic reservoirs and carriers of these strains. Birds, pigs, and human beings in South China intermingle in a viral breeding ground and have a suspected link to the 1957 flu.

—Ann M. Legreid

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EBOLA EPIDEMIC KILLS FIRST OF MANY IN AFRICA

First appearing in Zaire and Sudan in 1976, Ebola erupted several times thereafter, most notably in the mid-1990's, when the disease killed hundreds of people in Gabon, Zaire, and Sudan. Other outbreaks continued to occur, usually in equatorial Africa, with major epidemics occurring in 1995-1996 in Zaire, and one beginning in 2000 in Uganda. Other minor outbreaks have also occurred.

Date: September 8, 1976

Also known as: Viral (filoviral) hemorrhagic fever

Locale: Primarily equatorial Africa

SUMMARY OF EVENT

First appearing in Zaire and Sudan in 1976, Ebola erupted several times thereafter, most notably in the mid-1990's, when the disease killed hundreds of people in Gabon, Zaire (now the Democratic Republic of the Congo), and Sudan. By the early years of the twenty-first century, some two thousand cases of Ebola had been documented. Depending on the particular viral strain, 50-90 percent of those who contract the disease die from it.

The first recorded case of Ebola occurred in the mid-1970's. From August 10 to August 29, 1976, Mabalo Lokela, a Yambuku mission employee, traveled with six others into the rain forest north of Zaire. On returning home, Lokela, who was known as Antoine, complained of illness to the sisters at the mission. He believed his symptoms to be a flare-up of malaria and he was treated accordingly. Two days later, on August 28, another man came into the hospital with severe diarrhea. He was from the neighboring village of Yandongi. Both men had a viral infection that would later be named after a prominent river Antoine had crossed on an earlier trip. By September 5, Antoine was critically ill; he died on September 8.

Between July and September, 1976, in the region spanning from Nzara to Maradi in southern Sudan, an epidemic similar to the one in Zaire began in another tropical area devoted primarily to agriculture. Death rates from the disease in this area were also high.

The root of the epidemics in Zaire and Sudan was two similar strains of the same filovirus, whose looped images under an electron microscope resemble the hook of a staff or the number six. The Zaire epidemic had killed 103 people, a fatality rate of approximately 90 percent. In Sudan, the outbreak was less fatal, claiming 54 percent of its victims. Dr. Joseph B. McCormick of the Centers for Disease

Control (CDC) in Atlanta, Georgia, calculated that at the height of the outbreak in Yambuku, during September and October, 1976, a patient's chances of contracting Ebola from a contaminated, reused needle were more than 90 percent. It was later determined that the hospital there was spreading the disease: Of the 103 cases, 72 had been contracted through injections with contaminated needles.

When the first Ebola outbreaks began in the 1970's, the world was not yet familiar with the phenomenon of HIV/AIDS. Modern science had made great strides in eliminating agents involved in causing epidemics. Ebola, though horrific, was not widespread. Over time, careful laboratory research at various locations around the world, including the CDC, identified the four strains—or variants—of the Ebola virus: Ebola Zaire, Ebola Sudan, Ebola Côte d'Ivoire, and Ebola Reston. With the exception of Ebola Reston, which has only flulike effects, the disease produces startling symptoms.

Ebola is an RNA (ribonucleic acid) virus of the Filoviridae family, named so for its filamentous appearance. The incubation period for the virus is between two and twenty-one days. Ebola hemorrhagic fever begins with flulike symptoms: Fever, headache, joint and muscle aches, sore throat, and fatigue are followed by severe diarrhea, vomiting, and stomach pain. A rash, blood-red eyes, and hiccups give way to massive internal and external bleeding. The tissues and organs liquefy, and the patient finally bleeds to death.

Transmission of the disease is through physical contact, especially with contaminated blood. In isolated villages in Africa, the fever spread rapidly because families there traditionally care for their sick and dying and are therefore in close physical contact with them. In hospitals, the lack of sterile techniques magnified transmission. Dr. William T. Close, who treated patients during the 1970's Ebola outbreak, published a firsthand account of his experiences in 1995 titled *Ebola: A Documentary Novel of Its First Explosion*.



A nurse tends to victims of the Ebola virus in Yambuku, Zaire, in 1976. (Centers for Disease Control and Prevention)

SIGNIFICANCE

The virus's physical structure was investigated and its RNA sequenced. Immunological studies have shown that a large number of people in equatorial regions had filovirus antibodies, suggesting that hemorrhagic fevers such as Ebola are probably more common than was once thought. It was determined that those dying from Ebola failed to produce an immunological response to the virus. As of the early years of the twenty-first century, a cure for the virus was yet to be discovered.

—Lesa Dill

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AIDS EPIDEMIC

The appearance of rare opportunistic infections among populations of gay men and intravenous drug abusers led to the discovery of a previously unrecognized agent, now called HIV. By the end of the decade, thousands of Americans had been infected, and the disease itself, AIDS, had begun to spread throughout the world.

While the presence of a disease subsequently known as acquired immunodeficiency syndrome (AIDS) was initially recognized in 1981, the disease's etiological agent, the human immunodeficiency virus (HIV), had entered the human population several times during the previous decades. Computer-generated data measuring the rate of mutation of a simian virus to one in humans has supported the theory that penetration into the human population may have occurred as early as the 1930's.

Medical historian Jonathan Engel has suggested that between 1950 and 1972, infection may have occurred at least nineteen times. The oldest confirmed infections took place in 1959. Antibodies against HIV were found in blood collected in 1959 from a Bantu man in Leopoldville, Belgian Congo, who succumbed to an immunodeficiency disease. That same year, another man died in Manchester, England, exhibiting the same immunodeficiency defects. Retrospective analysis of his stored blood confirmed infection by HIV.

BEGINNING OF THE PANDEMIC

Recognition of an immunodeficiency syndrome was first reported in the June 5, 1981, issue of *Morbidity and Mortality Weekly Report*. The story, originating from the Centers for Disease Control (CDC) in Atlanta, described an unusual and rare parasitic lung infection, *Pneumocystis carinii* pneumonia (PCP), in five homosexual men in Los Angeles. The outbreak came to the attention of the CDC because the only known treatment, a drug called pentamidine isothionate, was available only from that agency.

Later that summer, the CDC reported that an unusual epidemic among gay men was more widespread than had earlier been thought: More than 140 previously healthy young men had been diagnosed with either PCP or a rare form of cancer called Kaposi's sarcoma (KS). Generally only observed previously among Italian or Jewish men of Mediterranean origin, KS was unheard-of in the age population now being observed. Furthermore, the newly detected form of KS was much more aggressive than were

previously known instances. Because the disease had only been reported until then in homosexuals, it was initially referred to as gay-related immunodeficiency disorder (GRID).

Although the initial belief was that transmission of the disease, cause still unknown, was somehow related to homosexual behaviors, it soon became apparent that other means of transmission were also likely—most notably through contaminated blood. By the end of 1982, at which time more than six hundred cases had been reported, it was clear that intravenous (IV) drug abusers were at risk; cases were also observed in several hemophiliacs, whose only possible exposure had been through their use of Factor VIII (blood-clotting) products obtained from donated blood. The name of the illness was also changed, reflecting its more widespread nature, to acquired immunodeficiency syndrome, or AIDS. The range of opportunistic infections associated with the immune disorder was also widened to include illnesses such as fungal and other rare parasitic infections.

If there was any fortunate aspect associated with the outbreak at the time, it involved a growing understanding of the unknown etiological agent's method of transmission. While it clearly could be transmitted through sexual behaviors, as well as in contaminated blood, it was not transmitted through the air. Victims were classified by the CDC as falling into four specific categories, including homosexual or bisexual males (75 percent of known victims), IV drug abusers (13 percent), and hemophiliacs or transfusion recipients (around 0.3 percent). Since a number of Haitians who did not then appear to fall within the other categories had been diagnosed with the disorder, Haitians were included among the risk groups.

ISOLATION OF THE ETIOLOGICAL AGENT

Speculation within the general public, and even among some medical professionals, as to the cause of AIDS initially focused on homosexual behaviors, such as the use of amyl nitrate to enhance sexual pleasure or even the practice of anonymous sex with multiple partners. Among some evangelicals, the

AIDS Cases, Deaths, and Case-Fatality Rates in the United States Through December, 1989

<i>Interval</i>	<i>Adults/Adolescents</i>		<i>Children Under 13</i>	
	<i>Cases Diagnosed</i>	<i>Deaths</i>	<i>Cases Diagnosed</i>	<i>Deaths</i>
Before 1981	78	30	6	1
1981: Jan.-June	91	38	8	2
1981: July-Dec.	194	83	5	6
1982: Jan.-June	385	151	13	9
1982: July-Dec.	664	276	14	4
1983: Jan.-June	1,249	507	33	13
1983: July-Dec.	1,611	902	40	16
1984: Jan.-June	2,515	1,362	47	24
1984: July-Dec.	3,303	1,895	61	23
1985: Jan.-June	4,722	2,695	97	43
1985: July-Dec.	6,092	3,667	127	68
1986: Jan.-June	7,956	4,811	131	64
1986: July-Dec.	9,528	6,089	162	82
1987: Jan.-June	12,157	7,035	205	110
1987: July-Dec.	13,386	7,351	239	150
1988: Jan.-June	14,704	8,439	210	120
1988: July-Dec.	14,581	9,401	266	141
1989: Jan.-June	14,626	8,793	233	132
1989: July-Dec.	7,944	5,551	98	68
TOTAL*	115,786	69,233	1,995	1,080

*Death totals include 157 adults/adolescents and children known to have died but whose date of death is unknown.

Source: Centers for Disease Control and Prevention, *HIV/AIDS Surveillance Report*, January, 1990.

belief was that the disease represented a punishment from God. Since semen itself was felt to have some immunosuppressive properties, "sperm overload" was suggested as a possible cause. The demographics of the disease, however, did not fit. Increasing numbers of cases were observed among hemophiliacs, women, and even infants and young children, twenty-six of whom had been diagnosed with AIDS by late 1982. Furthermore, the specific cause of the immunodeficiency had become apparent, a loss of a class of lymphocytes called T cells, named for their site of maturation in the thymus. Researchers began to narrow their focus in the search for a cause, believing that it likely was a virus.

Suspicion by 1983 began to focus on a group of viruses known as human T-lymphotropic viruses (HTLVs), which had the ability to infect lymphocytes. HTLV-1 and HTLV-2, the two initial suspects, were in a group known as retroviruses. Retroviruses are viruses containing ribonucleic acid (RNA) that also carry an enzyme called reverse transcriptase, a protein that copies their RNA into deoxyribonucleic acid (DNA) following infection. Ultimately, two laboratories laid claim to isolation of the etiological agent associated with AIDS, one in Paris, the other in Bethesda, Maryland.

Among the leading researchers in this field was Robert Gallo at the National Institutes of Health. Gallo was already well known for his development of a method to grow lymphocytes in culture. In retrospect, the timing of this procedure turned out to be critical to the hunt for the cause of AIDS, since the ability to grow HIV in the laboratory and to develop an effective method for testing blood supplies was the result of Gallo's work.

In April, 1984, Gallo announced the isolation and identification of a virus that he felt was the cause of AIDS and that he named HTLV-3. However, the issue of priority quickly introduced politics into the science. In January, 1983, Luc Montagnier at the Pasteur Institute had also isolated a virus that he felt was the etiological agent of AIDS and that he called the lymphadenopathy associated virus (LAV). The two viruses were later shown to be identical. The issue of priority was never completely settled, though the evidence is that Montagnier was probably first, while Gallo is credited with developing the blood test for the virus's detection. To eliminate the confusion over names, the virus was given the name HIV. In 1985, a

second, similar virus was isolated in West Africa; the original virus was named HIV-1, while the newer isolate became HIV-2.

WIDENING EPIDEMIC

Though the initial features of the growing epidemic were focused primarily in the United States, it became clear by 1984 that the outbreak was taking place in much of the world. What had been known as "slim disease" in Africa was identified as AIDS and was seen in hundreds of patients there. By 1985, the disease had been found in more than fifty countries. More than seven thousand persons with AIDS were diagnosed in the United States, though likely many more were actually HIV-positive.

The impact of the disease on Americans was made particularly poignant by coverage of two high-profile cases. In 1984, a thirteen-year-old Indiana student named Ryan White acquired AIDS from a blood transfusion used to treat his hemophilia. Fear of transmission resulted in his being removed from the school system and forced him to be schooled at home. The issue was brought to court, which resulted in a ruling that he be allowed to return to school. Despite a five-year fight to educate the public on how AIDS can, and cannot, be transmitted, he was frequently harassed by other students and their parents and eventually moved to another town where he was accepted. In his last years, White frequently spoke to other students, explaining his illness and philosophy of life. White died in 1990. In his honor, the Ryan White Comprehensive AIDS Resources Emergency Act was passed by Congress in 1990 to provide health care for persons with AIDS who had no insurance coverage.

The second high-profile case was that of movie star Rock Hudson, who was diagnosed with AIDS in 1984, although the information was not released until the following year. Though it was an open secret in the movie community, the public was unaware that Hudson was gay. Despite a courageous fight, Hudson died in October, 1985. Another prominent person with AIDS was Liberace. A well-known entertainer, Liberace died from AIDS in 1987.

The response to the AIDS epidemic by the administration of President Ronald Reagan was largely neglect during the early years of the outbreak. Despite the fact that AIDS had clearly expanded far beyond the homosexual community, conservatives largely

ignored the problem or simply blamed a “choice” of lifestyle. The gay communities in larger cities did respond, attempting to close the bathhouses that often served in spreading the disease, as well as educating the gay community on how the disease could be avoided. The effort was successful, and new infections began to level off within the community. By the end of the decade, several events served to bring the problem of AIDS to the general public. In 1986, the National Council of Churches established an ecumenical task force, which shortly met with the U.S. surgeon general, C. Everett Koop. The group later produced a pamphlet that attempted to educate the public about the disease. Beginning in December, 1988, the first annual World AIDS Day was held, with the goal being to bring the issue to the attention of the world at large.

The first effective treatment for AIDS appeared in 1987. Azidothymidine (AZT), originally developed as an anti-cancer drug, was shown to be effective in inhibiting the replication of the virus. Although HIV would develop resistance to the drug, it did provide a means to extend the life of affected individuals.

IMPACT

When AIDS surfaced in Western countries in the early 1980's, it was treated primarily as limited to those exhibiting certain social behaviors. Scientists, medical professionals, activists, and other advocates struggled throughout the decade to educate the populace as to the epidemic's severity, HIV's ability to spread to anyone, and the specific, limited number of methods of transmission. By the end of the decade, AIDS was widely recognized as a problem of global significance requiring global resources to combat.

Indeed, AIDS went on to become a worldwide pandemic that would create particular havoc in developing nations. Lack of proper medical facilities in these countries, poor education in presenting the means to avoid the disease, and the difficulty of altering long-held sexual mores all contributed to the problem. As a result, the middle class in much of central and southern Africa was devastated, creating a generation of orphans and taxing the economy of these countries. Much the same scenario developed in portions of Asia as well. Debate continues as to whether the scope of this tragedy could have

been limited by a swifter, more decisive response on the part of the U.S. government and President Reagan, who refused to address the crisis in public until May, 1987.

—Richard Adler

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MENINGITIS OUTBREAK PROVES DEADLY IN WEST AFRICA

The largest meningococcal epidemic to date struck sub-Saharan Africa, affecting hundreds of thousands and killing tens of thousands. Local governments with the help of international aid organizations attempted to contain the epidemic, while preparing for future outbreaks.

Date: January-May, 1996

Locale: Meningitis Belt, from Senegal to Ethiopia

SUMMARY OF EVENT

Meningitis, or cerebrospinal meningitis (CSM), is an infection of the membranes that cover both the brain and spinal cord. Several bacteria cause CSM, but only *Neisseria meningitidis* (*N. meningitidis*, also known as meningococcus) gives rise to widespread epidemics. In the spring of 1805, Gaspard Vieusseux described the first meningococcal outbreak in Geneva, Switzerland. Meningococcal disease occurs worldwide, but Africa has been the continent most affected by recurrent, severe epidemics of meningitis.

Since the early twentieth century, numerous meningococcal epidemics have devastated sub-Saharan Africa and have recurred in a specific geographic location—a semiarid savanna between the fourth and sixteenth degrees north latitude. The area is characterized by minimal rainfall and by the harmattan—a dry, dusty wind originating in the Sahara. In 1963, Léon Lapeyssonnie appropriately named the area the African “Meningitis Belt.” The largest recorded meningitis outbreak struck this region in 1996-1997. It killed tens of thousands of people and affected hundreds of thousands of others.

Anton Weichselbaum cultured the meningococcus in 1887. Since then, twelve serogroups have been identified, of which A, B, C, and W135 have caused outbreaks of epidemic CSM. Characterization of the 1996-1997 bacterium has shown that *N. meningitidis* serogroup A clonal subgroup III-1 was at the origin of Africa’s largest epidemic. This strain first surfaced in Nepal in 1983-1984. It made its appearance again in India and Pakistan in 1985 and caused an epidemic during the 1987 pilgrimage to Mecca; returning pilgrims likely brought the strain to Africa.

In the two years preceding the 1996 epidemic, large meningococcal outbreaks occurred in Niger. In October of 1995, Nigeria saw a rise in meningococcal disease, and in the subsequent month the town of Jibia reached epidemic threshold, reporting more

than 15 cases per 100,000 inhabitants during two consecutive weeks.

Sahelian epidemics typically occur during the dry season, which begins in December and continues through June, and come to an abrupt end at the start of the rain season. True to this trend, the 1996 epidemic began in January of that year. CSM cases were on the rise in early February and peaked between mid-March and mid-April when temperatures soared to 42 degrees Celsius (about 107 degrees Fahrenheit), and relative humidity dropped to 10 percent. The disease struck the poor, who lived in overcrowded, poorly ventilated housing. The population most affected comprised children from five to fifteen years of age, but the disease did not spare other age groups. Mortality was high: 22 percent of those affected died during the first ten weeks of the epidemic, about 15 percent during the second ten weeks, and close to 5 percent toward the end of the epidemic. Hearing loss, paralysis, mental retardation, and loss of limbs occurred in probably 10 to 20 percent of the survivors. In 1996, nearly 95 percent of all cases and fatalities occurred in Mali, Burkina Faso, Niger, and Nigeria.

The countries most affected by the epidemic organized a massive response with the help of the World Health Organization (WHO), the United Nations Children’s Fund (UNICEF), Doctors Without Borders, and the International Federation of Red Cross and Red Crescent Societies. The first treatment centers opened in early March. They were operated by minimally trained health care personnel and were commonly located at the outskirts of villages. The constructions were simple, and patients frequently received treatment while lying on bare floors. Only health centers in large cities had access to skilled nursing care, and there was a paucity of physicians.

The treatment of choice during West African epidemics has been the antimicrobial oily chloramphenicol. A single injection of the drug effectively treats the disease. Even though international aid organizations donated vast amounts of oily chloramphenicol

during the 1996 outbreak, not enough was available, and many patients received ampicillin or penicillin, antibiotics that require frequent dosing over several days.

A massive immunization effort was launched in mid-March. After a minimal amount of training, health care workers were sent from village to village on horseback, bicycle, or motorcycle. Because of a limited supply of needles and syringes, vaccinators had to resort to the use of jet injectors. Incorrect use of the jet injector may also have led to the transmission of hepatitis and HIV between individuals. The impact of treatment and mass immunization became apparent by the second half of April, as fewer cases and fatalities were reported. The rain season started in early May and by the beginning of June, the 1996 outbreak ended.

The large-scale immunization efforts of 1996—Nigeria alone vaccinated 13.4 million people—had led to global depletion of meningococcal vaccine. It was feared that the epidemic would resurge in 1997, and this caused concern about the timely availability of sufficient quantities of vaccines and antibiotics. Under the auspices of the WHO, sixteen African nations met in October of 1996 in Ouagadougou, Burkina Faso, to discuss their anticipated needs. As a result of this meeting, the International Coordinating Group on Vaccine Provision for Epidemic Meningitis Control (ICG) was formed in January of 1997. The group's primary mission was to assess the needs of affected countries and to gather and distribute necessary supplies.

As anticipated, the epidemic resurged in 1997. With the help of the ICG, there was timely delivery of vaccines, antibiotics, and so-called autodestruct injection materials. In 1997, no cases were reported in Nigeria, but the disease was rampant in Burkina Faso, Ghana, and Mali. Eritrea, Gambia, Mauritania, and Senegal saw no cases of CSM in 1996 but noted the presence of the disease in their countries the following year. The total number of cases reported to the WHO in 1996 reached 152,693 and included 16,213 deaths; in 1997, 60,861 people fell ill and 6,027 died. There was likely substantial underreporting of cases. Some patients succumbed to the disease before reaching a treatment center; others were never taken to health centers out of fear or ignorance. Health officials discovered graves where people had secretly buried their dead. The true number of affected and killed people can therefore only be estimated.

SIGNIFICANCE

In the early years of the twenty-first century, meningococcal disease remained a significant public health problem in West Africa. A surveillance system for early detection of burgeoning epidemics had been put in place, however. Countries within the Meningitis Belt began to report their cases to the WHO weekly during the high-risk season and every other week during the remainder of the year. The enhanced epidemic surveillance system identified the emerging meningococcal serotypes and monitored the development of antibiotic resistance. Meningococcal polysaccharide vaccines have proven effective against *N. meningitidis* A and C. They do not provoke a protective immune response in children under the age of two, and the protection in older children lasts approximately three to five years. Mass immunization thus came to be used only when evidence arises of an impending epidemic.

The solution to recurring meningococcal epidemics in West Africa lies in preventive immunization of the at-risk population with a meningococcal vaccine that provides long-lasting protection in all age groups. Conjugate meningococcal vaccines have this ability. The Meningitis Vaccine Program (MVP), supported by the Bill and Melinda Gates Foundation, anticipates having a group A conjugate vaccine available for the Meningitis Belt by 2009. Mass vaccination of the high-risk population may soon bring an end to the feared sub-Saharan epidemics of meningococcal meningitis.

—Elisabeth Faase

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SARS EPIDEMIC RESULTS IN OVER 8,000 REPORTED CASES AND 774 KNOWN DEATHS

Severe acute respiratory syndrome (SARS) was the first major health crisis of the twenty-first century. SARS was one of the fastest spreading and most virulent diseases known. From November 27, 2002, to May 18, 2004, SARS infected 8,096 victims in 37 countries and caused 774 known deaths. In China alone, the source of the outbreak, there were 5,327 cases, with 336 people dying of the disease.

Locale: Worldwide

Key Figure: Carlo Urbani (1956-2003), Italian doctor and microbiologist who was the first to identify SARS

SUMMARY OF EVENT

On November 27, 2002, an occurrence of an atypical form of pneumonia was reported in the Chinese province of Guangdong, which borders on Hong Kong. Within four months, the previously unknown illness had infected 305 patients and resulted in at least 5 deaths. By February, 2003, the World Health Organization (WHO) was notified of this deadly respiratory illness. Initially, the outbreak of the illness remained localized around Guangdong, with the majority of victims being food handlers working in open-air markets or health professionals who dealt with infected patients. The epidemic seemed to reach its peak in early February, and then cases began to decline.

On February 21, 2003, however, this all changed when a physician from Guangdong traveled to Hong Kong and checked into the Metropole Hotel. The physician had been treating patients with SARS, and at the time of his arrival in Hong Kong he was already symptomatic of the infection. The physician fell ill and was taken to Prince of Wales Hospital, where he eventually died after infecting many of the hospital's staff and patients.

Within days, 12 guests staying on the same floor of the hotel as the physician were diagnosed with the Guangdong respiratory illness. One of the infected guests, an American businessman, traveled to Hanoi, carrying the disease with him to Vietnam.

On February 26, 2003, Johnny Chen, a Chinese-American businessman, was admitted to a Hanoi hospital and put under the care of Dr. Carlo Urbani, an Italian epidemiologist working with WHO in Hanoi. It was Urbani who first named the disease "severe acute respiratory syndrome." On March 15, 2003, WHO issued a statement that severe acute respiratory

syndrome was a global health threat because it was spreading so far and so quickly. Dr. Urbani himself became a victim of SARS and died on March 29, 2003. In memory of his research, WHO formally designated the disease "SARS" on April 16.

By this time, SARS had been identified in 14 countries around the globe, with more than 1,300 cases and 50 known deaths. A new outbreak of SARS was reported in Taiwan, where a misdiagnosis resulted in the disease spreading widely throughout regional health care facilities. Random cases continued to appear in China, but the second largest outbreak was in Toronto. The traveler landing in Vancouver from Hong Kong arrived showing signs of infection, was quickly isolated, and recovered without infecting others. In Toronto, the carrier from Hong Kong was able to infect family members and eventually a number of health care providers. By mid-March, Toronto public health officials alerted the public to the outbreak of an atypical pneumonia. Before the end of May, nearly 7,000 cases of voluntary quarantine were imposed on suspected patients or carriers to stop the outbreak in and around Toronto.

SARS is an infectious respiratory illness that is primarily caused by a particular strain of coronaviruses (which appear similar to a royal crown under an electronic microscope). In cases of SARS, not only is the respiratory system affected but other organs are involved in the infection as well, especially the liver. The onset of SARS is marked by a rapidly raising fever and dry cough, followed by shivering, dizziness, lethargy, muscle ache, vomiting, skin rashes, diarrhea, sore throat, and upper respiratory distress. In some patients, these symptoms may be followed by difficulty in breathing and rapidly progress to a severe form of pneumonia resulting in death when the heart and other organs fail from oxygen deprivation.

The SARS virus is spread by direct person-to-person contact or contact with aerosolized respiratory secretions from coughing, sneezing, or breathing. In addition, droplets or respiratory secretions that end up

on a victim's hands from rubbing the mouth or nose can also transfer the infection to touched objects. A vaccine for SARS is still in the experimental stage, but patients diagnosed and treated in the early stages of an infection usually recover. Treatment typically includes steroids and broad-spectrum antiviral drugs, and in some cases supplemental oxygen and assisted ventilation.

Coronaviruses and influenza are widespread in the environment and exist in a range of animal hosts, especially birds and pigs. Certain avian strains of influenza have demonstrated the ability to mutate and cross species barriers to infect humans. Southern China is home to massive commercial-scale poultry and pig industries and has a history of spawning new, highly virulent strains of influenza. In the last four decades of the twentieth century, at least four new strains of influenza spread globally from China. The huge number of poultry and pigs contained on these commercial farms provides an easy opportunity for any virus, mutated or otherwise, to find an available host and multiply readily. Animal handlers, cooks, and fresh food market vendors may all have first-line contact with an infected animal. If a cross-species mutation of an animal virus occurs, these people are the first to be exposed.

Throughout the world, stringent control measures were taken to stop the spread of SARS. Most important, airport and border guards began screening travelers for fever, and strict isolation and quarantine protocols were instituted in areas reporting SARS symptoms. Fortunately, the disease was discovered early and it appeared at a time when health authorities were ready to cooperate to stop the spread of the virus. By mid-May 2003, the number of new cases of SARS had significantly diminished, and by July 5, the WHO reported that all known chains of person-to-person transmission had been broken and that the epidemic had been contained. This did not mean, of course, that the SARS threat was completely eliminated. In China and elsewhere several hundred people were held under quarantine.

In late May 2003, researchers in Hong Kong discovered the genetic sequencing of a coronavirus found in masked palm civets to be 99 percent the same as the SARS virus. The Chinese government temporarily banned importing exotic meat from civets, a popular Guangdong Province delicacy. It appeared likely that the original human infection of SARS was a result of

preparing and eating civet meat. More than 10,000 masked palm civets were killed in China. Somewhat later, the Chinese Center for Disease Control and Prevention established a genetic linkage between the SARS coronavirus that appeared in both humans and civets. However, a later study concluded that bats, domesticated cats, and pigs were also involved in the transmission of the virus to humans.

During the the first five months of 2004, China reported twelve cases of SARS and the Philippines reported two possible cases. On April 19 and 23, two women in China died from SARS—thought to be the last mortalities of the epidemic. On May 2, China reported three new infections. That same day China released 189 people from quarantine. On May 19, 2004, WHO announced that there had been no cases reported in three weeks and that the disease appeared to have been contained. From that date until November 2016, there were no reports of any SARS infections

SIGNIFICANCE

After the SARS outbreak was contained, some public health officials and political leaders, especially in China, were accused of cover-ups and mismanaging the crisis to avoid economic disruption. Nevertheless, the campaign against SARS was amazingly successful. This is the story of a previously unknown virus that emerged suddenly; it caused terrible suffering by more than 8,000 persons in many different parts of the world; it killed at least 774 of those infected; and then, after only a year and a half, the virus appeared to have been defeated. The episode demonstrates what is sometimes possible when determined governments, physicians, and scientists cooperate with each other, using a combination of modern medical technology, modern communication, and old-fashioned quarantines. Nevertheless, on October 5, 2012, the Center for Disease Control (CDC) declared that SARS continued to have “the potential to pose a severe threat to public health and safety.”

Besides the human toll, SARS inflicted economic and political damage. During the months of outbreak, Asian countries saw an estimated financial loss of \$28 billion. For the first time in its history, WHO issued an advisory suggesting that travelers avoid parts of the world infected with a disease. Airlines cut 10 percent of their flights from North America to Asia, and some countries saw a drop of more than 60 percent

in tourism. In Canada, China, and the United States, sporting events, public gatherings, film productions, religious services, and parades were all canceled as a result of concerns about SARS.

An interesting footnote to the SARS legacy occurred in June, 2006, when Chinese researchers revealed that at least one of the reported SARS deaths in China during 2003 was actually the result of H5N1 avian influenza, raising the possibility that other cases attributed to SARS may have actually been human cases of H5N1 bird flu and that the Chinese government covered up the possibility that two pathogens were experiencing simultaneous outbreaks in China.

—Randall L. Milstein, Thomas T. Lewis

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SEVERE ACUTE RESPIRATORY SYNDROME (SARS)

Definition: A newly recognized type of pneumonia, caused by a novel coronavirus, that may progress to respiratory failure and death.

Key terms:

- *coronavirus*: a single-stranded ribonucleic acid (RNA) virus with a spherical shape and helical nucleocapsid surrounded by an envelope with a crown of glycoprotein spikes
- *electron microscopy*: an imaging technique in which magnetically directed electrons in a vacuum tube are absorbed and deflected by structures, thus forming an image on a screen with very high resolution
- *Koch's postulates*: criteria for judging whether given bacteria cause a given disease, including that the bacteria must be present in every case, that they must be isolated from the host and grown in pure culture, that the disease must be reproduced when the culture is inoculated into a healthy susceptible host, and that the bacteria must be recoverable from the experimentally infected host
- *tissue culture*: a diagnostic method in which cells from plant or animal tissues bathed in sustaining liquid solution form a monolayer on a container that can be inoculated and observed for deterioration or destruction by replicating viruses

CAUSES AND SYMPTOMS

SARS first received worldwide attention in February, 2003, after a Chinese physician from Guangdong Province and twelve other guests at a hotel in Hong Kong became ill. Subsequent investigation of cases traced the illness back to November, 2002, when a businessman from Guangdong Province developed the new disease and soon died. Using electron microscopy, molecular techniques, and tissue cultures, researchers have identified a coronavirus in a variety of specimens from patients with SARS. Glycoprotein spikes on the outside of the envelope surrounding the viral capsid give the appearance of a crown, or corona, and make possible the identification by electron microscopy. The virus was cultured from lung and kidney specimens obtained at autopsy of the Chinese physician using African green monkey kidney cells. Pure cultures of the coronavirus have been inoculated into monkeys, producing pneumonia. With Koch's postulates fulfilled, researchers

are confident that the coronavirus is the causative agent.

Human studies have revealed antibodies to this coronavirus only in SARS patients, suggesting that this is a new type of infection. Similar studies in animals have shown that SARS antibodies are present in wild animals, including the masked palm civet, raccoon dog, and ferret badger. While these animals have been found to host the SARS coronavirus, a 2006 study suggested that the natural reservoir host of SARS is likely the horseshoe bat. The crowded, unclean markets of Guangdong Province, which sell wild animals for human consumption, may have provided the opportunity for the virus to infect humans.

After an incubation period of two to sixteen days after exposure, patients develop fever, chills and rigors, myalgia (muscle pain), cough, headache, and dizziness. Less common symptoms are sputum production, sore throat, nausea and vomiting, and diarrhea. Radiographs and high-resolution computed tomography (CT) scans of the chest show ground-glass opacities and unilateral or bilateral air-space consolidation. Laboratory findings early in the illness often include lymphopenia, thrombocytopenia, and a variety of serum enzyme (lactate dehydrogenase, creatinine kinase, and alanine aminotransferase) elevations distinguishing SARS from pneumonia caused by usual bacterial pathogens.

SARS is often progressive in severity and is highly infective, especially for family members and health care workers. During the 2003 outbreak, the disease spread to many countries, with more than eight thousand cases and nine hundred deaths worldwide. The overall mortality rate was about 5 percent. Researchers wondered whether this respiratory illness would follow the seasonal pattern of similar viral illnesses, such as influenza. A SARS case diagnosed in Guangdong Province in January, 2004, led the Chinese government to order the mass slaughter of civets and rats in the hope of containing the disease.

Besides the livestock and human tolls, SARS inflicted economic and political damage. During the outbreak months in 2003, Asian countries saw a financial loss of roughly \$28 billion. For the first time, the World Health Organization (WHO) issued an advisory suggesting that travelers avoid parts of the world infected with SARS. North American-based airlines

**INFORMATION ON SEVERE ACUTE
RESPIRATORY SYNDROME (SARS)**

Causes: Coronavirus infection transmitted through contact with infected humans or animals

Symptoms: Severe pneumonia, with respiratory failure, fever, chills and rigors, muscle pain, coughing, headache, dizziness

Duration: Acute, sometimes fatal

Treatments: Supportive measures, corticosteroids, isolation

cut 10 percent of their flights to Asia, resulting in a 60 percent drop in tourism. In Canada, China, and the United States, sporting events, public gatherings, film productions, religious services, and parades were canceled because of fears concerning SARS. An interesting footnote to the SARS legacy occurred in June, 2006, when Chinese researchers revealed that at least one of the reported SARS deaths in China during April, 2003, was actually the result of H5N1 avian influenza; raising the possibility that other cases and deaths attributed to SARS may have actually been human cases of H5N1 bird flu and that the Chinese government covered up the possibility that two pathogens were creating simultaneous outbreaks in order to avoid further economic disruption.

TREATMENT AND THERAPY

No specific diagnostic test for SARS is available, hampering early diagnosis and treatment. SARS cases can be suspected but not reliably distinguished from other types of pneumonia. Thus far, no antiviral agent has been found to be active against the SARS virus, and initial empiric therapy with antibacterial and antiviral agents has been directed at other pathogens that cause pneumonia that is indistinguishable from SARS.

Supportive measures directed toward respiratory failure, often provided in an intensive care unit, are the mainstays of SARS therapy. In some cases of progressive pneumonia with respiratory failure, corticosteroid therapy has been used. Because of the alarming infectivity and spread of SARS, precautions against airborne droplets (respirators) and direct contact (gowns and gloves) are recommended. Despite such measures, spread has occurred, probably because of improper techniques used by

inadequately trained personnel.

PERSPECTIVE AND PROSPECTS

A coronavirus was first cultured from an adult patient with a common cold in 1965. It is now recognized that coronaviruses may cause up to 30 percent of common colds, but before SARS coronaviruses rarely produced pneumonia. These viruses also cause disease in a wide variety of animals, but usually in only one species. It is unclear how the SARS agent jumped from animals to humans. Furthermore, while some wild animals have been identified as having prior infection by the virus, the natural host remains uncertain. A more complete understanding of these issues will improve the chances of eliminating the disease from humans. Fortunately, only a few cases of SARS have been reported in the first few years of the twenty-first century, and these cases have been in laboratory workers or individuals directly exposed to civet cats. Since the 2002-2003 epidemic, human-to-human spread has ceased.

Extraordinarily rapid research has already produced sequencing of the SARS coronavirus genome. With this knowledge, molecular diagnostic techniques have been developed and should produce rapid and accurate diagnostic tests that will be widely available. Thousands of antiviral agents are being tested for activity against the virus, and new antivirals are being developed. Vaccines are available for some animal coronaviruses, and a SARS vaccine may be developed. In the meantime, there is hope that infection control and quarantine measures will be able to limit the spread of SARS.

—H. Bradford Hawley, M.D., Randall L. Milstein,
Ph.D.

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“THE EARLIER, THE BETTER: BUILDING IMMUNE DEFENSES AGAINST H1N1”

NewsUSA, June 12, 2009

(*NewsUSA*)—Recently, scientists discovered that the 2009 H1N1 Swine Flu virus is more like the H5N1 avian flu than the historic 1918 pandemic H1N1 Spanish flu strain, and that current mutations of the virus have rendered previous flu vaccines less effective.

In a teleconference with colleagues, Dr. Roger Mazlen, an internist in Roslyn Heights, NY, discussed the current Swine Flu outbreaks. Aside from traditional medical school, Dr. Mazlen received specialized training at the National Institute for Health (NIH) and is the former Clinical Research Director for Immunotec, Ltd. in Canada. He has practiced internal medicine and nutrition for more than 30 years.

Swine flu, or H1N1, was first isolated in a pig in 1930, according to the Centers for Disease Control and Prevention. The virus has demonstrated an ability to migrate from domestic pigs to humans. Dr. Mazlen said there are several factors contributing to the current swine flu outbreak, including environmental, cultural and economic issues. “The current recession, loss of retirement funds, compromised nutrition, reduced exercise, obesity and other factors produce immune depression. A depressed immune system cannot fight off the invasion of viral and other pathogens that attempt to find a home to set up infections in our bodies,” he says.

Dr. Mazlen suggests protection strategies for a potentially larger H1N1 outbreak during the 2009 through 2010 flu season. “Frequent hand washing is a start. Also, lots of daily water helps to hydrate the body and assist the immune system,” he said. Vitamin and mineral supplements add fortification, but Dr.

Mazlen suggested also adding fish oil because of its clinically-proven immune function support. Fish oil blends are available as gel capsules or in liquid form at health food stores, and several different brands are also available at www.puritan.com.

Dr. Mazlen said that Tamiflu, the currently recommended prescription medication used in flu and Swine flu, is most effective when used within a few hours of the first viral symptoms. But Swine Flu, as reported by the CDC, has an ability to mutate within hours. Tamiflu may be effective for Swine Flu in the morning, and may be ineffective by the end of the day because of viral mutation.

When asked whether the popular herbal remedy Echinacea could be effective, Dr. Mazlen explained that studies have proven the product has minimal effectiveness in stimulating the immune response. He said he prefers a natural immune-stimulating product that he has used with over 500 patients, including his family members. The product was originally developed in Russia but is now made in the U.S. Dr. Mazlen said he has had good results during the past years with patients fighting flu and other infections. The product, Del-Immune V, is available at www.delimmune.com.

Early measures to protect health might be the key to minimizing potentially serious infections this flu season. Dr. Mazlen closed the discussion by expressing his concern over whether it is Swine Flu H1N1 or a mutated form of the Swine Flu. “It is important to have an immune defense strategy this year—the earlier the better,” he said.

NEW STRAIN OF SWINE FLU DOES NOT KILL AS MANY PEOPLE AS ORIGINALLY FEARED

The spring of 2009 saw a new strain of the H1N1 swine flu virus, one that was similar to the 1918 strain of the H1N1 virus that had killed tens of millions of people. The initial concern was that the world might be faced with a similar catastrophe.

The 2009 pandemic killed 203,000 people.

Date: 2009

Locale: Global outbreak

SUMMARY OF EVENT

On March 18, 2009, infections of the H1N1 influenza virus were first identified in Mexico City. The virus was alarmingly similar to the virus associated with the 1918 outbreak (known as the Spanish flu) which resulted in an estimated fifty million deaths worldwide. The H1N1 virus had briefly reappeared during the late 1970s in Fort Dix, New Jersey, and in northern China, but was locally confined. The rapid spread in 2009 within the Mexican population and beyond gave rise to fears that a worldwide pandemic similar to that of 1918 might occur.

The first U.S. case of H1N1 was diagnosed on April 15, 2009. Within a week, the Centers for Disease Control and Prevention (CDC) was working to develop a vaccine for this new virus. Later that month, the World Health Organization (WHO) declared its first “public health emergency of international concern” (PHEIC). In June, the WHO and the CDC declared the outbreak of a pandemic.

The 2009 virus appears to have been the result of a triple recombinant of human, bird, and pig influenza viruses, hence the popular designation as the “swine flu.” Responses by health authorities were rapid, including recommendations to limit travel to Mexico or other areas in which the virus appeared. In some instances, the response by authorities to the swine flu bordered on panic; several countries banned the importation of pork products and Egypt ordered the slaughter of all domestic pigs.

The virus proved difficult to grow in the laboratory, so vaccines were in short supply during the first months of the outbreak. While the virus readily passed from human to human—by November an estimated 15 to 20 percent of the American population had been infected—it proved to be significantly less lethal than originally feared. By November, over 61 million vaccine doses were ready. But reports of swine flu gradually became less common in parts of

the country, which gave the medical community a chance to vaccinate more people. Eventually 80 million people were vaccinated against H1N1, which minimized the impact of the illness.

The demographics of severe infection from H1N1 were different from the other kinds of flu infections of previous years. The 2009 pandemic was largely confined to persons under the age of eighteen; few cases were reported among those over age sixty. Epidemiologists attributed these findings to significant immunity among older adults, the result of having been previously exposed. Since the young were considered at greater risk, among the recommendations was that any vaccination program should give priority to those under the age of eighteen.

Infections began to taper off by November 2009, and very few new cases were being reported by May 2010. The Director General of the WHO, Margaret Chan, announced the end of the pandemic on August 10, 2010.

SIGNIFICANCE

The outbreak of the H1N1 flu virus turned out to be much less serious than had been originally feared. The CDC estimated that 43 million to 89 million people in 74 countries were infected with the H1N1 virus between April 2009 and April 2010. They further estimated that the pandemic had caused about 9,000 H1N1 related deaths. Although these numbers appeared to be quite high, the incidence of deaths due to H1N1 was not significantly higher than the number during normal flu seasons. Fortunately, the 2009 H1N1 virus had been a hundred times less deadly than the strain of H1N1 that caused the deadly pandemic following World War I.

Critics charged that the WHO had exaggerated the danger and had frightened the public unnecessarily. The precise number of infections and deaths, however, was difficult to estimate because many people did not exhibit influenza-like symptoms and statistics were incomplete. Some researchers believed that the pandemic had actually killed as many as 500,000

people, because only fatalities confirmed by laboratory tests were included in the numbers announced in 2010. Many infected persons in the poorer countries of Africa and Southeast Africa did not have access to health facilities.

—Richard Adler

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OUTBREAKS OF THE ZIKA VIRUS SPREAD THROUGHOUT MUCH OF THE AMERICAS

The Zika epidemic of 2015–16 was the largest and most complex outbreak of the disease in recorded history. It affected primarily the Americas and was linked to severe neurological symptoms. Between November 1 and November 18, 2016, the World Health Organization classified the spread of Zika as a “Public Health Emergency of International Concern.”

Locale: The Americas and locations in the Pacific region

Key Institutions

World Health Organization (WHO), specialized agency of the United Nations

Pan-American Health Organization (PAHO), regional office for the WHO, serving the Americas

US Department of Health and Human Services (DHHS), cabinet-level department

Centers for Disease Control and Prevention (CDC), federal agency under the DHHS

SUMMARY OF EVENTS

Zika is a mosquito-borne disease caused by a virus in the flavi-virus genus (which includes dengue, Yellow fever, Japanese encephalitis and the West Nile viruses). Until the 2015–16 outbreak, known symptoms included fever, cutaneous rash, malaise and headache. These symptoms closely resemble some of the symptoms associated with influenza, which might have caused under-diagnosis of Zika during much of the twentieth century. There have also been documented asymptomatic cases of Zika.

The Zika virus was first identified in 1947 in the blood of a sentinel Rhesus monkey in the Zika forest of Uganda, by Lake Victoria. The following year, the virus was isolated from *Aedes africanus* mosquitos from the same forest. In 1952, the first cases of Zika in humans were registered in Uganda and Tanzania. Throughout the 1970s the virus was detected across Africa, with a predominance in Western Africa. In the late 1970s there were reported cases in Asia (Pakistan, Malaysia and Indonesia).

Until the mid-2000s, the number of reported Zika cases in humans was relatively small, with only 14 documented cases worldwide. In 2007, an outbreak took place in Micronesia, on the island of Yap. There were 49 confirmed cases, with serologic studies showing that 73% of Yap residents over the age of 3 had contracted the disease recently. Scientists admit the possibility of previous outbreaks in the region having gone undetected due to the mildness of symptoms

and clinical similarities with other viruses.

In 2012, scientists analyzing samples collected in Nigeria, Senegal, Uganda, Cambodia, Malaysia and Thailand identified two distinct lineages of the Zika virus (African and Asian). Between 2013 and 2014, a Zika outbreak of unknown origin started in French Polynesia and expanded to other islands in the South Pacific (Cook Islands, New Caledonia, Vanuatu, Solomon Islands and Easter Island). The virus was shown to belong to the Asian lineage. A potential connection between Zika and Guillain-Barré syndrome, a rare neurological disorder that may lead to paralysis, was first suggested during the outbreak, although not confirmed.

On March 2, 2015, Brazil notified the World Health Organization (WHO) of illness characterized by skin rash in four northeastern states (Pernambuco, Maranhão, Rio Grande do Norte and Bahia), with and without fever. At the time, Zika was not suspected and tests were run for other diseases (13% of 425 blood samples tested positive for dengue). It was not until May 7 that Brazil announced that the outbreak was due to the spread of the Zika virus (Asian lineage). That same day, the Pan-American Health Organization (PAHO) and the WHO issued an epidemiological alert, describing the disease and advising member states on how to leverage their surveillance systems.

Later phylogenetic studies determined that the strain present in the 2013–14 South Pacific outbreak was the most similar to the one that caused the outbreak in Brazil. There has been speculation that Zika may have been introduced to Brazil by visitors during either the soccer World Cup that was held in multiple Brazilian cities in 2014, or the Va'a World Sprint Race, a canoe competition that took place in Rio de Janeiro in mid-August 2014.

On July 17, 2015, Brazil reported detection of Guillain-Barré syndrome in 49 newborns, 47 of which tested positive for prior Zika, chikungunya or dengue infections. On October 30, Brazil reported an increase in microcephaly in newborns since August,

but a causal effect with Zika remained unproven. As the number of suspected, probable and confirmed cases continued to increase, Brazil declared a national public health emergency on November 11.

In the meantime, other countries began registering Zika cases. In early October 2015, health centers in the archipelago of Cape Verde began reporting cases of illness with skin rash, with and without fever. On October 21, Cape Verde confirmed that the country was facing a Zika outbreak. By December, the number of suspected, probable and confirmed cases was 4744. On October 8, Colombia reported findings of a retrospective review that had identified sporadic clinical cases of what was suspected to be Zika. Confirmation came in October, and by November, the number had escalated to 239.

The rapid propagation of the virus—associated with suspicions of a linkage between Zika and Guillain-Barré syndrome and between Zika and congenital microcephaly—led the WHO to declare a public health emergency of international concern on February 1, 2016.

In the United States, the first confirmed case of locally acquired Zika occurred in the territory of Puerto Rico on December 31, 2015. Two weeks later, the Hawaii Department of Health reported a local case of microcephaly involving the newborn of a woman who had spent time in Brazil during the early stages of pregnancy. On January 25, the United States reported the first case of locally acquired Zika infection in the Virgin Islands. On February 2, 2016, the United States reported the first case of sexual transmission of Zika infection, which took place in the state of Texas. The Centers for Disease Control and Prevention (CDC) in the United States estimated that the virus was being actively transmitted in 30 countries worldwide. The overwhelming majority of cases was being reported in the Americas. On February 8, President Obama asked Congress for USD \$1.8 billion to fight the outbreak. By this time, there were 50 confirmed cases in the United States.

Both the WHO and the CDC continued to add countries in Latin America to the list of areas with active outbreaks. In April 2016, the CDC list was expanded to include locations outside the Americas (certain regions of Micronesia). At the same time, the number of countries in Latin America with active outbreaks confirmed by the CDC continued to grow. By the end of April, the list included a total of

43 confirmed countries and territories. By the end of August, the number had reached 58 countries and territories worldwide.

On March 8, 2016, the WHO advised pregnant women to avoid areas affected by Zika and warned that sexual transmission of the virus was “relatively common.” On March 31, the WHO further stated that there was scientific consensus that Zika may be associated with both the Guillain-Barré syndrome and microcephaly. The organization cautioned that proof of the links was nonetheless likely to take months or years to establish.

In the United States, the CDC announced on April 13, 2016, that Zika infection in pregnant women could cause microcephaly in newborns, as well as other severe “brain abnormalities.” Puerto Rico reported the first Zika-related case. At this point, there were 683 suspected, probable and confirmed cases in the territory, and five suspected cases of Zika-related Guillain-Barre syndrome. Official confirmation of the first case of Zika-related microcephaly in Puerto Rico came on May 13.

On July 8, the CDC confirmed the death of a Utah resident. This was the first Zika-related death in the continental United States. In July, Florida health officials began investigating a case of Zika contracted through local mosquito bite. Later that month, Florida authorities reported the first local Zika transmission in the continental United States. On July 22, New York City reported the first newborn with birth defects caused by Zika. Three days later, the CDC updated recommendations for Zika prevention and testing.

On July 29, Florida governor Rick Scott announced four cases of locally-acquired Zika in the Miami-Dade and Broward counties. Soon thereafter, the CDC issued a travel warning for pregnant women to the Miami neighborhood of Wynwood. This was the first time the CDC issued a travel warning due to the outbreak of an infectious disease in continental United States.

On August 12, the Department of Health and Human Services (DHHS) declared a public health emergency in Puerto Rico, where there were at least 10,690 confirmed Zika cases. A month later, the DHHS reported 20,800 confirmed Zika cases in the United States and territories. Of these, 3,176 occurred in the states and District of Columbia. On September 19, Florida governor Rick Scott declared

the Miami neighborhood of Wynwood to be Zika-free. However, a travel warning for Miami Beach remained in place.

On November 18, 2016, WHO declared the end of the public health emergency of international concern, but warned that “robust longer-term technical mechanism” to manage Zika was now needed. By this time, there were 4,255 suspected, probable and confirmed cases in the continental United States and Hawaii. Worldwide, 69 countries and territories reported cases of mosquito-borne Zika infection. Removing the emergency designation placed Zika in a class with other serious diseases, such as encephalitis, that pose serious risks and require containing research to find better treatments and vaccines.

SIGNIFICANCE

For most of its history, the Zika virus had been endemic to equatorial Africa and Asia. During the 2015–2016 outbreak, it affected primarily the Americas, followed by the Pacific region. It has been determined that two different species of mosquitos are carriers of the Zika virus. The *Aedes aegypti* mosquito is the primary vector for the disease. The other vector is the *Aedes albopictus*, also known as Asian tiger mosquito. In the United States, the CDC has calculated that the range of both species of mosquitos can extend from the Northeast to the Midwest and into the southern part of the West Coast.

The Zika virus outbreak in the Americas demonstrated how a known disease that had not caused an outbreak for six decades could become a global health emergency. The 2015–2016 outbreak was the largest and most complex Zika outbreak ever recorded, shedding new light on the etiology and transmission of the disease. A change in character of the infection seems to also have occurred. Before, it was considered a vector-borne infection capable of causing only mild symptoms, comparable to influenza.

On February 18, 2016, following a visit to Latin America, Pope Francis said that “avoiding pregnancy is not an absolute evil” in circumstances such as the Zika virus epidemic. His comments sparked speculation that the use of contraceptives might be morally acceptable when used to prevent suffering from a devastating disease like Zika.

During the outbreak of the epidemic, some scientists continued to be skeptical about whether the virus was a cause for either microcephaly or the

Guillain-Barré syndrome. In late 2016, however, the CDC reported that there was a “scientific consensus that Zika virus is a cause of microcephaly,” although it was now known where a newborn who acquires the virus about the time of birth is likely develop microcephaly. A study in Brazil indicated that babies with microcephaly were 55 times more likely to have been infected with the virus in utero.

The evidence was not quite as strong in regard to a causative linkage between Zika and the onset of the Guillain-Barré syndrome. In October, 2016, nevertheless, researchers reported in the *New England Journal of Medicine* that they had found “a potential relationship” between the syndrome and Zika infection with previous exposure to the Dengue virus.

—Ana Santos Rutschman

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