SARS

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Introduction (Written by entire team, Eric Wang)

SARS, severe acute respiratory syndrome, was a pneumonia-like illness that spread globally in 2003. After making its first appearance in the Guangdong province of southern China, SARS then rapidly spread to both neighboring and distant countries in the months that followed. As a result, many cities implemented strict health measures to combat the spread and contain the virus. Due to the travel restrictions advised by the WHO and temporary sanctions placed on China, the economy diminished noticeably in the latter half of 2003 and early 2004. Intense backlash was directed towards the Chinese government for its censorship and suppression of information regarding the initial spread of the virus. Many others criticized the World Health Organization for not declaring an emergency early enough in the beginning of 2003.

Origin of SARS (Valerie Ng)

The SARS virus was first identified in the Guangdong province of southern China in 2002. On January 2, 2003, two pneumonia-like cases in the city of Heyuan were transmitted to several healthcare workers at the Guangzhou Chest Hospital (Meirion, 2004). This then led to an investigation by the Guangdong Provincial Center for Disease Control and Prevention, where they found more cases in six other cities (Foshan, Jiangmen, Zhongshan, Guangzhou, Shenzhen, and Zhaoqing) from November 2002 to mid-January 2003. The SARS infection spread rapidly from China to other Asian countries. Several cases were also recorded in four European countries and a severe outbreak began in Toronto, Canada.

There are many theories on the origin of SARS. According to the National Health Services (NHS), there were additional smaller SARS outbreaks linked to a medical laboratory in China in 2004. Public suspicions were raised due to the fact that the virus was being tested early on in a laboratory without the citizens being properly informed. Some theorized that a Chinese scientist had come into direct contact with a sample of the SARS virus; he then spread the virus to his fellow scientists and people in contact with him, thus starting chains of infections. Another dominant theory for the SARS epidemic was the "animal to animal" then "animal to human" transmission conjecture. Bats were believed to be the original vectors of SARS; they were brought to Southern Chinese wildlife markets where their feces would spread the virus to civet cats. When these civets were later slaughtered by humans, SARS would then enter the human bloodstream. After this original infection, the transmission of SARS-CoV was primarily from person to person. It was an airborne virus, so when an infected individual sneezed or coughed, viral particles were transmitted through small droplets of saliva (NHS, 2019). The virus was eventually contained through public health interventions such as isolating patients with the virus, quarantining thousands of people, and emphasizing the actions of "social distancing." There are a myriad of theories on the origins of SARS and still no definitive answers, making the origins of this global pandemic a mystery to this day.

Evolution of Medical Understanding (Ruilin Yang, Daniel Song)

Throughout history, major civilizations have always sought to increase their medical knowledge and understanding. The Ancient Egyptians first attempted to diagnose and treat about two hundred diseases, whereas the Ancient Greeks focused on identifying pathological features, such as inflammation, and began dissection practices. However, at the time, these symptoms were not tied to pathogens due to the dominant humoral theory, a flawed ideological system that

has affected medication for almost a millennium. Brought to light by Greek physician Hippocrates of Kos, known as "the father of medicine," the theory of humorism described four primary "humors" essential in keeping the body balanced: black bile, which is secreted by the spleen and supposedly causes depression; yellow bile, which can cause aggression when released in excess by the gallbladder; blood, which is released by the liver and causes positive and cheerful behavior; and phlegm, which is associated with the lungs and causes apathy or calmness. Scholars used this theory for many aspects in the observation and diagnosis of a patient.

Likewise, in Ancient China, the *qi* and *yin yang* theories were built on a belief of a couple of cardinal components used to explain natural occurrences. However, there were suspicions of invisible "seeds" of disease that would infect a person if inhaled or ingested. These seeds were thought to reinfect a person if they were still lurking within the body. However, the humoral theory overrode any push for acceptance of this primitive form of the later germ theory of disease. This "seed" concept gave way to the miasma theory, which implicated "bad air" in causing illness. The Renaissance and the Enlightenment brought about new observations and discoveries that dealt significant blows at the humoral and miasma theories. More scholars began to have a more profound understanding of the body. Physicians and biologists began using more advanced light microscopes to examine and discover organic tissue. Giovanni Battista Morgagni published two significant books in the 18th century, drastically changing the medical world through his written accounts and observations of autopsies that suggested that diseases originate in specific organs and tissues. By the 1800s, many physicians were more receptive to the fact that diseases could be transmitted through contact. Dr. Oliver Wendell Holmes published a research paper in 1843 suggesting that childbed fever could've been spread by doctors' unwashed hands. In 1860, Louis Pasteur proved the existence of germs and its role in diseases. The work of Pasteur and others, such as Robert Koch, formed the foundation of microbiology, which has come to save countless lives as humans finally started to unearth the secrets of pathogens and find ways to combat them.

SARS differed from earlier plagues in that it was one of the first epidemics in this new era of global economic development and the strengthened scientific power. With growing insights of microbiology, the medical community was able to quickly identify the SARS virus, determine its viral genome sequences, establish epidemiological models, and develop diagnostic technologies. This enabled them to accelerate drug and vaccine research, advancing protective measures against the virus. Identifying SARS infection in a person requires a polymerase chain reaction (PCR) test that detects the viral RNA within human cells. Laboratories follow strict standard criteria to confirm positive or negative results. Though some PCR-kits are commercially available, a laboratory test is recommended due to its improved accuracy. The sensitivity of PCR tests can easily be influenced by the specimen or even the time at which the patient is being tested. To increase sensitivity accuracy, multiple samples or parts of the body should be examined in the test. On the other hand, to check whether someone has antibodies for SARS, ELISA or IFA tests would be used. During this SARS prevention and control period, the infrared thermometer was invented by a high tech company in Shenzhen, China to detect fever or body temperature without requiring close contact with a patient's mucous membranes. The expeditious development of technologies and microbiology accelerated the process of controlling pestilences.

The field of public health has made rapid progress since SARS. It was clear that the health system needed to be improved to prevent the outbreak of plagues. Feng Zijian, Deputy Director-General of the Chinese Center for Disease Control and Prevention, said that: "SARS allowed Chinese medical and health system to vigorously expand" (China CDCP). From 2003 to 2006, China invested 25.7 billion yuan (equivalent to $3,704,557,854) to improve the public health system's response to potential future disease outbreaks. In 2006, the Chinese Ministry of Health announced the establishment of a new disease prevention and control system, with a disease communication and notification system that covers over 95% of the country's population. In the two decades that followed, countries strived to improve their defenses against viral attacks, while doctors and scientific researchers continued to improve medical standards. There are lessons to be learned from every epidemic. In order to keep societies safe and healthy, researchers and scientists began to develop medications to control bacteria and viruses in the body. By the early 20th century, antibiotics had been invented to suppress the risk of bacterial infection and vaccines were invented to combat viral diseases. From the epidemic and all its associated consequences, experience was gathered to learn how to better protect society against viruses.

Information and Disinformation (Olivia)

While previous epidemics like the Black Death rampaged through towns and cities with no centralized means of sharing information, the SARS epidemic struck modern cities that should've had constant readily accessible updates about the virus on the internet. Yet, residents of China found themselves in the dark. Despite the various digital modes of communication at the government's disposal, the lack of information sharing in modern China in 2003 meant the SARS epidemic ended up paralleling plague societies in the fourteenth century.

On January 2, 2003, health experts sent to Heyuan diagnosed the unknown illness presented and reported it to the provincial government and the Ministry of Health, who sent another team of experts to Heyuan. The report that the second team sent back to the provincial health bureau failed to mention that the disease showed significant contagiousness and didn't call for strict preventative measures (Huang, 2004). This same obscurity of the lethality of the disease was prevalent during the onslaught of the Black Death as well. Without understanding what the plague was, people were unable to protect themselves appropriately. Only top health officials were allowed access to the report; after they discussed the potential contagiousness, a bulletin was distributed to hospitals across the province. Unfortunately, because many healthcare workers were celebrating Chinese New Year at the time, few received the warning, and the incident of the disease was classified as a state secret, barring any reports on it with threat of persecution (Huang, 2004). This secrecy is just one example of the Chinese government's dangerous media censorship. The disease's risk was also severely downplayed, and reports on the virus were paused for over a month when the media began questioning the government's handling of the outbreak. This concealment of information was an attempt by the Chinese government to maintain economic stability and prevent public panic, but this silence accomplished neither goal and only allowed the virus to spread for months before proper action was taken. Even within the government, there was a lot of disinformation. Lower-level government officials warped figures as they reported to higher-level officials, out of the fear that pessimistic numbers from their jurisdictions would prevent them from receiving promotions (Huang, 2004). Conversely, during the Black Death, mortality figures were actually recorded as accurately as possible and were

made available to the public through bills of mortality. This stark contrast in clarity explains why a nation with modern technology still experienced so much confusion amidst an epidemic.

Rumors are often born from the unknown, as they were seen in both the bubonic plague and the SARS outbreak. The Hong Kong government had to send millions of text messages to residents when a teenager's hoax tricked many into thinking the city was going to be barricaded, prompting panic-buying (McCullagh, 2003). A rumor that bananas grown on a southern island contained viruses similar to SARS also pushed the Chinese Agriculture Ministry to debunk the lie (Reuters, 2007). These rumors heightened the rising panic already felt by Chinese citizens during the SARS outbreak.

Prevention methods and cures for both the bubonic plague and SARS were often littered with rumors and misconceptions as well. Doctors frequently used herbs and flowers during the spread of the Black Death as a way to ward off foul smells, which they believed would spread the plague according to the aforementioned miasma theory. Similarly, during the SARS outbreak, many people believed that several procedures (including blasting firecrackers, drinking mung bean soup at midnight, and disinfecting the air with vinegar) could protect them from the virus, even though there was absolutely no scientific backing (Tai and Sun, 2004).

Some rumors also fueled prejudice and scapegoating against certain ethnic groups. There was a notion that the plague was caused by Jews who had poisoned wells to kill Christians, leading to the persecution and killing of thousands of Jews. In reaction to SARS, racism toward Asian-Americans, particularly Chinese-Americans, was intensified and many Chinese saw themselves as heavily stigmatized. In both outbreaks, this widespread fear was the result of ignorance and pre-existing tensions. There was a hidden economic drive fueling the mass murdering of Jews, who were often competitors for merchants and traders that owed the Jews money. By persecuting their rivals, people were relieved of their debt and gained the redistributed wealth and possessions of Jews. Conflicting religious beliefs had also been a source of dispute between Christians and Jews for hundreds of years prior to the Black Death.

Similarly, Anti-Chinese sentiment had taken root in the United States long before the SARS outbreak. From Americans' fears of losing their jobs to cheap Chinese labor during the Industrial Revolution to the San Francisco plague of 1900-1904 that Chinese-Americans were blamed for, the fear of Chinese-Americans during the SARS outbreak was yet another display of xenophobia. A widespread rumor that a Vietnamese restaurant owner had died of SARS in New York City's Chinatown contributed to a plummet in business, with business owners in the area seeing 30-70% losses (Eichelberger, 2007). 14% of Americans admitted to avoiding Asian stores during the outbreak (Eichelberger, 2007). Although it never reported a single case of SARS, Chinatown was deemed a site of contagion (Eichelberger, 2007). Failure on the government's part of keeping the public informed amid crisis can lead to the dangerous spread of false information. This disinformation can cause unnecessary panic that builds off of preexisting bigotry, ultimately perpetuating fear toward specific groups.

Public Measure (Nelson Dong)

A crisis as significant as the SARS outbreak required the intervention of government services as well as the cooperation of the public to take control of the virus. Many public measures arose to prevent or mitigate the spread of the virus. The WHO, an international health organization, played one of the most prominent roles in combating the transmission of the virus and achieving the quick and successful containment. GOARN, the Global Outbreak Alert and

Response Network, and its 115 constituent partners worked with the WHO to create and execute a plan that effectively stopped SARS in less than four months after its initial recognition as a global health threat. With these programs, the general public was warned about the symptoms of this new illness and advised methods of prevention.Guidelines were created on many aspects of the outbreak, including case management, infection prevention and control, blood safety, traveling, mass gathering, etc. These detailed guidelines labeled the steps for citizens to take, adequately informing the public of the crisis at hand and advising smart action in nearly every situation regarding the virus. For instance, the guidelines in terms of traveling and mass gatherings state that "a person who has been in close contact or think he or she has been in close contact with a person suspected of SARS over the last 10 days, should not leave his/her country and should contact the national health authorities of his /her country" (WHO, 2003). In addition to giving direct support to the WHO, many GOARN partners also participated in other activities, such as: ensuring that marginalized areas of society received help, "addressing humanitarian aspects of the response and preparedness activities," (Mackenzie, 2004) and establishing surveillance networks to monitor the spread of the virus. These steps from the WHO helped healthy individuals remain safe, while isolating and reducing the transmission risk of patients already carrying SARS. This process was mainly implemented within hospitals and though it varied between countries, most followed similar procedures to ensure the safety of everyone in the hospital. An example of these infection-control measures was Toronto Public Health's combat against the nosocomial illness. Toronto, the site of the most substantial SARS infection in North America, was able to sharply drop its transmission rate, limiting the disease to those who were in close contact with hospitals or to the infected's household. Toronto Public Health's infection-control measures were based on the knowledge that SARS symptoms begin showing after approximately seven days due to the 2 to 7 day incubation period. With this in mind, they prepared patients for a ten-day quarantine period after confirming that they had the virus. From then on, they had an intensive follow-up period where the hospital had daily check-ups with the patients and searched for any cases of secondary infection among those who had made contact with the patients more than ten days after their last exposure. Through these efforts, the hospital was able to identify many positive and potential SARS cases, with a positive predictive value of 96.1% and less than a 8% misclassification rate of cases, according to the Toronto Public Health data (Svoboda, 2003). Toronto's effort in halting the spread of SARS epitomized fast and acute control. As the largest outbreak site in North America, Canada responded rapidly to halt the spread of the virus, implementing extensive measures to protect the non-infected and isolate and trace the infected.

Social and Economic Consequences (Ethan Shan)

The SARS outbreak created a sense of danger and an impactful change in society that would later serve as an example of how such pandemics should be dealt with. The risk of infection led people to engage in practices such as quarantining, which profoundly affects the physical and mental health of the people and the nation's financial state (Qiu, W., Chu, C., Mao, A., & Wu, J., 2018).

SARS took a toll on the physical and mental health of those affected. China experienced widespread panic from the virus, since most of the information people received was through internet rumors rather than official government-advocated information. The Chinese government failed to release accurate information about the virus, forcing the public to stick to what they

heard through their friends and family. This panic led to mass buying of drugs and items such as *Radix isatidis* and vinegar, all widely believed to cure the virus. As more time passed and official information was still hidden from the public, more people found what they saw on social media groups and the internet to be factual. Soon enough, people were wearing masks in public and taking action. Some people criticized the health department for not releasing accurate information about the virus, attracting the attention of the international community (Qiu, W., Chu, C., Mao, A., & Wu, J., 2018). The 2003 SARS outbreak infected 8,098 people worldwide and killed 774 (CDC, 2017). Many had to cope with the loss of a loved one. Despite this devastation, this virus has undeniably shown that an emergency response with the quick spread of information and attention can quell the severity of the illness. SARS has managed to change the public and political opinion on diseases, as well as the dangers they can pose and how to better prepare for future outbreaks.

As the need for safety and resources grew, companies either got flooded with customers or lost business. To protect themselves and other countries, Asian countries closed off transportation in and out of its skies and ports. Tourism and its related businesses were severely affected, and the demand for hotels decreased by 60%. Travel to affected areas also saw a decrease of 50-70%. The need for food, clothing, transportation, and entertainment significantly decreased as well. Officers from the Agricultural and Health Departments in China have noted that "During SARS in Shanghai, there were not many people on the street and almost no people in entertainment clubs, restaurants and gymnasiums, which caused a very large impact on the whole social and economic life"(Qiu, W., Chu, C., Mao, A., & Wu, J., 2018). Such businesses that relied on the influx of customers saw severe losses as people stopped going outside in fear of the virus. The anxiety over contracting SARS decreased social exchanges and, in turn, reduced families' incomes. The demand for virus prevention products and healthcare also increased, putting further financial pressure on families.

From a broader perspective, many countries suffered impacts to their own national economy. Due to the risk of spreading the disease to other nations, countries such as China significantly reduced the amount of goods and trade that went between borders. Asia's most extensive manufacturing base, Dongguan, saw a decrease in the number of orders from Hong Kong by 33%. SARS also affected foreign investors who were looking to China for opportunities. The presence of the virus and the flawed response of the Chinese government caused foreign investors to become concerned about the quality of Chinese institutions and their future growth potential. Foreign investment flows into countries like China saw a significant decrease as investors lost their trust in the integrity of their original interests. Overall, China saw a 1% decrease in GDP as well as suffering a global macroeconomic loss of 30-100 billion USD.

Conclusion (Written by entire team, Valerie Ng)

The SARS virus led to tremendous adverse impacts on the global population’s health and economy. Since its original outbreak in 2003, China has established and strengthened a national surveillance system to prevent future outbreaks. They have also expanded their laboratory capacity for additional research to be done on pathogens, allowing them to study more effective prevention methods for the future.

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