TOPIC 12: A RETROSPECTIVE ANALYSIS OF THE 2003 SARS EPIDEMIC

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EVOLUTION OF SARS 2003 EPIDEMIC

The first reported case of an atypical pneumonia was noted on November 16, 2002 in the Guangdong region of China in Foshan City (CDC, 2013). According to the WHO, the next update of information was an email sent to the WHO office in Beijing on February 10, 2003, detailing a “strange contagious disease” which at that time had accumulated over 100 deaths in the Guangdong province in a one week period (Knobler et al, 2004). Two days after this email was sent, the Chinese Ministry of Health reported to the WHO of an acute respiratory outbreak, totalling 305 reported cases and 5 deaths since the first report in November 16^{th} 2002 (Knobler et al, 2004). On February 14^{th}, the Chinese Ministry of Health concluded the reports were all consistent with atypical pneumonia and that the outbreak was said to be “coming under control” (WHO, 2021). Surveillance is a continuous system that relies on the networks of people and agencies across countries observing, recognizing, and reporting diseases (CDC, 2003). By downplaying the true nature of the situation, the virus was able to spread to densely populated cities like Hong Kong and Singapore before WHO could establish networks and cooperative efforts, like the Global Outbreak Alert and Response Network (GORN), to aid in the research and to facilitate communication between Hong Kong’s Department of health and the WHO (Hung et al, 2018).

It was on March 12, 2003 when the WHO issued a global alert for a “severe form of pneumonia of unknown origin in persons from China, Vietnam, and Hong Kong” (CDC, 2013). Following the global alert, new reports were sent to the WHO from a hospital in Vietnam that had 26 staff with symptoms of either pneumonia or an acute respiratory syndrome, as well as a growing numbers of nurses and other health care workers infected who were in close contact with the victims of the mysterious respiratory disease (CDC, 2013). Retrospective analysis of a case definition of SARS developed by the WHO revealed that most cases were amongst close contact individuals, this included people who cared for or lived with someone carrying the virus (Wu et al, 2004).

On March 15, 2003, the first travel advisory was issued as it had been declared that SARS is airborne (WHO, 2021). The discovery was found when a 32 year old physician in Singapore, who treated these atypical pneumonia cases, boarded a flight and reported symptoms which then resulted in the quarantine of his relatives and himself, subsequently becoming the first SARS cases in Germany (WHO, 2021). Following the reports and the global alert, the mysterious illness was named SARS (severe acute respiratory syndrome) by the WHO after its symptoms.

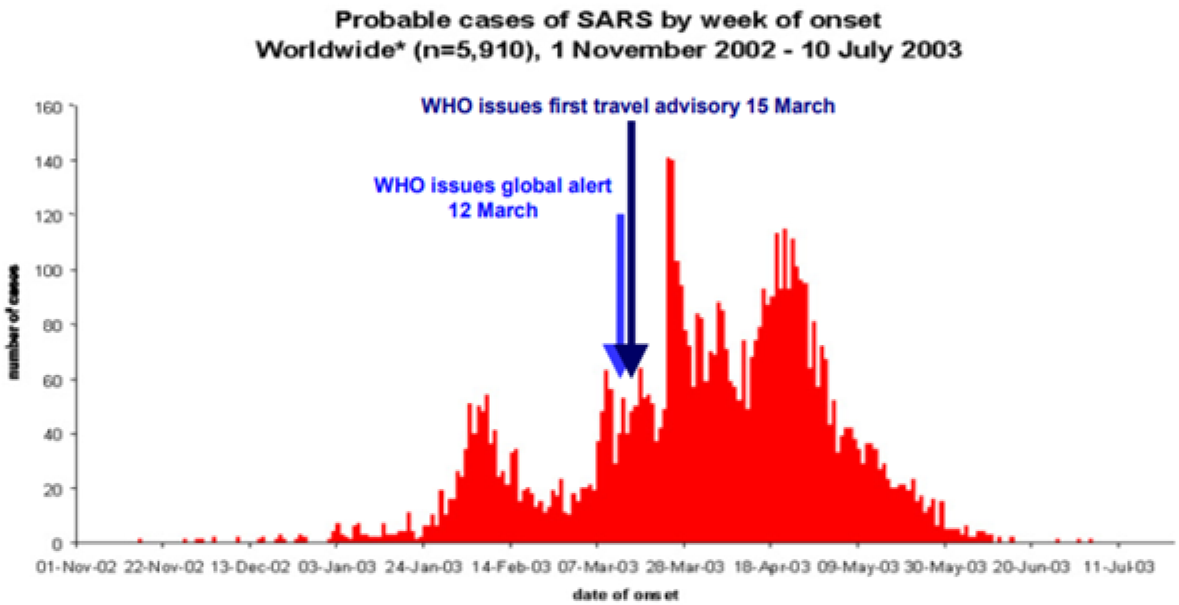

Figure 1: Graph of Probable cases of SARS by week of onset conducted by WHO (WHO, 2021). A week after the global alert and travel advisory, the number of probable cases nearly doubled after more countries came to a consensus about monitoring and surveillance practices of symptomatic patients.

OVERVIEW AND ORIGIN

The SARS epidemic, which is most often cited as the first pandemic of the 21st century, occurred during the period of 2002-2004 for a duration of two years and had devastating economic and health consequences (CDC, 2013). SARS, which stands for severe acute respiratory syndrome comes from the virus family called coronavirus and this strand of the virus (SARS) was identified as a novel strand (Luo et al, 2013, p. 1). The symptoms of this illness are very similar to the common cold as those infected by this illness experience fever, muscle aches, chills and headaches (CDC, 2017). This deadly illness has an average incubation period of 4 days, however incubation periods of over 10 days were also witnessed which was a contributing factor to what made it so contagious (CDC, 2017).

While the origins of this virus are still disputed, it is speculated that this virus was transmitted from a certain group of animals to humans, specifically the animals found within animal markets

(CDC, 2013). Initially it was presumed that this virus had been transmitted from civets to humans, however after additional research and inquiry, further arguments were presented that this virus had instead originated in bats (Luo et al, 2013, p. 1). Due to the reason being that the SARS virus found within civets was more homologous to the virus found within humans, it was assumed that civets were the natural host that the virus had begun in (Luo et al, 2013, p. 1). However, certain groups of scientists argued that it seems much more apparent that the SARS virus most likely began in bats, then mutated before it was passed on to civets, and then passed on to humans; which could be a strong explanation of why there is much more similarities between the viral strains found in the civet and human hosts than there are in the bat hosts (Luo et al, 2013, p. 1).

The type of diffusion modelled by the SAR epidemic was a mixture of all three; relocation, hierarchical, and expansion diffusion (Liu, 2009, p.1). The disease started out in China, then spread to Vietnam, after which it reached Hong Kong, and then to Canada in the region of Toronto (CDC, 2013). Hierarchical diffusion is defined as the spread of a disease in which illness is spread through a class of places as can be seen in the way SARS has travelled (Schærström, 2009, p. 1). It started in one place in the province of China, after which it quickly moved through and spread to other countries in the East Asian hemisphere (Liu, 2009, p.1). In summary the way SARS spread can be modelled by relocation, hierarchical, and expansion diffusion (Liu, 2009, p.1).

As mentioned prior, the SARS strain comes from the family of coronavirus (CoV); a family of single stranded RNA viruses which have been identified to cause up to 30% of common colds experienced by humans (Wu et al, 2020, p,1). The encapsulated SARS virus interacts with and enters host cells via spike proteins on the actual virus which go on to interact with host cells to ensure infection (Wu et al, 2020, p,1). The first subunit of this protein functions to bind with the receptors of the host cell and the second subunit of this protein functions to ensure that the virus and host cells' membrane fuses together (Wu et al, 2020, p,1). This fusion results in the virus releasing its genetic machinery within the host cell so it can express its own genetic material within the host cell by using the host cell's machinery; thus making infection successful (Wu et al, 2020, p,1).

The demographic affected by this virus was mostly people from East Asian countries such as China, Vietnam, Taiwan, and also people from Canada (Wu et al, 2020, p,1). Although these areas were the major hotspots of the SARS virus, in total 29 countries in total were affected which resulted in 8000 cases and almost 800 deaths (Wu et al, 2020, p,1). Interestingly, the majority of the cases affected women as there were 53% of females infected and 47% of males infected (Wu et al, 2020, p.1). The global case fatality rate was 11% at the end of the SARS 2003 epidemic (WHO, 2003). In Canada the median age of death from SARS was 75 years with diabetes and comorbidities being associated with mortality (WHO, 2003). In China, and Hong Kong, the case-fatality ratio was also highest at the age of 70 and above but with males suffering a more severe illness from SARS than females (WHO, 2003).

How many infections or deaths could have been prevented if initial cases in China were reported honestly and efficiently? Factors that contribute to the emerging and reemerging of infectious diseases like the SARS outbreak include; complacency and the breakdown of public health infrastructure, as well as advances in technology, specifically international travel (Morse, 1995). April 16, 2003 is when the WHO accused the Chinese government of underreporting cases after SARS coronavirus had been identified (Knobler et al, 2004). Consequently, this led to the much needed analysis of the current microbial public health surveillance system as the existing methods did not seem adequate for rapidly identifying newly emerging diseases (Jamison et al, 2006). With the help of the Global Public Health Information Network (GPHIN) and ProMED mail, early outbreak detection became more reliable as disparate data from multiple surveillance systems across different countries could use information that, when observed as a whole, could trigger a threshold to alert public health professionals of a possible future outbreak (Knobler et al, 2004). Notably, the spread of the virus could no less be attributed to international traveling as Toronto became the first hot spot for SARS outside of the eastern sector of the world (Low, 2004). This rise in human advancements in international travel gave way for the dispersal and integration of pathogens and vectors across the globe (Keusch, et al., 2009). Other risk factors associated with potential increased SARS exposure included eating outside and using public transportation more than once per week (Wu, et al., 2004).

In addition to the obvious health impacts of this virus, there were also severe socioeconomic and mental health consequences of this epidemic occurring (Luo et al, 2013, p. 1). The prevention of travel during this period impacted regions in East Asia negatively as it resulted in a blow to their economy in addition to the suffering front line health care workers had to endure due to the lack of proactive action by governments and health organizations (Luo et al, 2013, p. 1).

The cornerstone of the attack on SARS was the world wide media attention as it became the headline in every newspaper and public health information outlet available. The US's response to SARS was to aid in providing information using their CDC website, satellite broadcasts of updates and public information, as well as hotlines for public and health care workers to report any signs and symptoms of the infectious disease (Knobler et al, 2004). The strategy imposed by the North American countries was to prioritize early detection methods of common symptomsung and immediate isolation of infectious individuals (Knobler et al, 2004). However, due to China's miscommunication about the truth of the outbreak, many cities and neighbouring countries implemented quarantine and isolation of travelers exposed to SARS carriers (Knobler et al, 2004). The use of masks also became widely used by the public to aid in decreasing rates of transmission in high risk countries such as China, Vietnam, Singapore (Wu, et al., 2004). Finally, on July 5, 2003 the WHO globally reported that all the transmissible chains of the SARS virus had been broken (WHO, 2021).

FUTURE IMPLICATIONS

The SARS epidemic taught everyone, especially the public health system, how to control an infectious disease on both a national and international level. Many new ideas and approaches were invented for future threats that might help reduce the impact of the disease and its transmission.

Lessons from SARS

After the SARS epidemic was over, emergent issues throughout the epidemic were taken into account as lessons that could better equip the public health system at handling the next microbial threat. Scientists and researchers were gathered at the workshop, *Learning from SARS: Preparing for the Next Disease Outbreak,* on the Forum on Microbial Threats, initiated by the

Institute of Medicine in 2003 (Knobler, et al., 2004). The workshop highlighted several key lessons to improve the public health community response (Knobler, et al., 2004).

The first topic discussed ways to improve early detection of outbreaks to ensure proper measures are taken at the appropriate time (Knobler, et al., 2004). The WHO noted that countries should revise their legal frameworks to support surveillance and cooperation of both private sectors and non-governmental organizations to help with early detection (Knobler, et al., 2004). For example, behaviour-based surveillance can detect rise in drug sales or changes in public behaviour such as the use of vinegar in China which was believed to fight SARS infection (Knobler, et al., 2004). Early detection of this will not only help catch the spread but also prevent the surge of false rumors that could potentially be harmful. Following accidents in Singaporean and Taiwanese research labs that lead to SARS infection in workers, the workshop members noted that along with lab surveillance, awareness of the risks associated with handling communicable diseases in the lab, and strict adherence to the laboratory procedures along with well-trained personnel must also be enforced (Knobler, et al., 2004).

At the international level, the WHO made revisions to the International Health Regulations (IHR) in 2005 (CDC, 2019). The IHR is signed by 196 countries and requires each country to: detect via surveillance any global health threats, to assess the situation by collaborating with other countries, to report their findings to the WHO and to respond to the threats with the means of limiting international travel if necessary (CDC, 2019).

Secondly, the use of quarantine can be better enforced by keeping the public well-informed and educated about the outbreak (Knobler, et al., 2004). This can be done by developing modelling tools that create accurate models based on previous epidemics to determine hospital capacities and the timing and nature of quarantine measures (Knobler, et al., 2004). These will help form realistic expectations of what rules and laws will need to be enforced, and for how long, and thus, it should increase public acceptance and cooperation (Knobler, et al., 2004). Likewise, using the media and the Internet can be effective methods to keep the public educated but should also be monitored for incorrect information being advertised (Knobler, et al., 2004).

Lastly, in several countries, the lack of ability to establish isolation areas within healthcare facilities contributed to the spread of SARS (Knobler, et al., 2004). The workshop members noted that developing a preparedness plan that identifies the facilities that can be used to treat epidemic cases as well as facilities that can be used for routine surgeries should be developed (Knobler, et al., 2004). For example, following the outbreak, China immediately created “SARS hospitals” as a way to contain the disease and avoid further transmission, which proved to be successful (Knobler, et al., 2004).

SARS and COVID-19

On a national level, after the 2003 SARS epidemic, Naylor and Canada’s top epidemic experts created a report titled, *Learning from SARS,* which outlined a range of recommendations for Canada's provincial, territorial and federal jurisdictions to follow in case of the next microbial threat (Webster, 2020). The protocol followed during the COVID-19 pandemic can be used to determine whether the SARS epidemic helped us prepare for the next infectious disease.

According to Naylor, a former dean of medicine and former president at the University of Toronto, the Government of Canada followed 80% of the recommendations they advised in the report (Webster, 2020). One of the most prominent outcomes being the creation of the Public Health Agency of Canada which has been a strong leader in the response to COVID-19 (Webster, 2020).

During the SARS epidemic, a key challenge was maintaining collaboration between the federal and provincial governments (Webster, 2020). However, through the recommendations, Canada revised some legislative laws and created new committees that enforced rules to allow collaboration between the two levels of government when managing any public health crisis (Webster, 2020). In addition, informing the public has also become more pronounced since the 2003 epidemic, as digital media usage has increased (Webster,. 2020). As such, public health officials can easily send out messages across the country keeping the public informed and to encourage their cooperation (Webster, 2020). To monitor the information being put out, the Government of Canada has also invested $3 million to catch false or misinformation surrounding COVID-19 (Government of Canada, 2021).

However, despite the lessons learned from the 2003 SARS epidemic, Canada has still struggled with using those recommendations to carry out the public health response (Webster, 2020). For example, from the SARS epidemic it was discovered that to keep the patients isolated in hospitals, but also avoid over-capacity, patients should be treated at home as much as possible (Webster, 2020). While this may have worked with SARS, with COVID-19 the cases are higher causing hospitals to over-fill much more quickly (Webster, 2020). In addition, the lack of effort to scale up virtual public health, where doctors can help infected patients digitally, has also become a contributing factor for creating over-capacity hospitals (Webster, 2020).

Furthermore, the idea to build an “infrastructure”, where epidemic surveillance is accounted for has yet to take place (Webster, 2020). Therefore, a digital system where COVID-19 testing, infections and treatment can be recorded by linking clinical information with public health is still to be produced (Webster, 2020).

Lastly, the call for an “enhanced national public health science capacity” in Naylor’s report has also not been taken to (Webster, 2020). Instead, funding for biomedical research has dropped with many epidemic researchers struggling to play their role in response to COVID-19 due to the lack of support from scientific investments (Webster, 2020).

Are we ready for the next crisis?

From the lessons learned from the 2003 SARS epidemic and the response to the COVID-19 pandemic, it's clear that while changes have been implemented for faster detection and reducing transmission, the lessons from the epidemic weren’t enough to account for a pandemic. The differences between the two viruses in terms of transmission rates, infection period, and type of spread is significant enough where COVID-19 requires more strict containment and surveillance measures (Wilder-Smith, et al., 2020). Therefore, the response to the COVID-19 pandemic has shown that the experiences from the SARS epidemic, while were useful in the beginning of the spread, have not been enough to tackle a global-sized crisis and continued developments to the public health system are needed.

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