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**Situation Report Regarding the 2019 Novel
Coronavirus Outbreak**

U-Link Business Solution
Shanghai, China

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Dear Evaluators,

This report, entitled "Situation Report Regarding the 2019 Novel Coronavirus Outbreak", was prepared as my 2A Work Term Report for U-Link Business Solution in Shanghai, China.

U-Link Business Solution is a consulting company for biotechnology, pharmaceutical, and medical companies. The Department of Medicine, which is the department that I was employed, is supervised by Manna Ma. I worked as a Medical Editor. I translated medical documents and journals that were sent by the clients, picked out important points from these files, and compiled these key points into presentations or briefing reports for clients to use.

This is my first work term report. The purpose of this report is to provide the individuals at U-Link Business Solution some key information regarding the current outbreak of the 2019 Novel Coronavirus (COVID-19) in China. These pieces of information include but are not limited to the methods of spreading, the characteristics of the high-risk population, and the proactive measures that can be taken in order to prevent the spread of the virus within the company. The information included in this report is very important for employees to understand, because as the outbreak is happening in China, fear has grown within the company, which has greatly affected the employees' productivity and mental health. Therefore, only through understanding the situation of the outbreak and the nature of the virus, people can regain confidence, restore their mental health, and be productive again.

This report was written entirely by me and has not received any previous academic credit at this or any other institution. I would like to thank Ms. Ma for suggesting the topic, as well as my other coworkers in the department who provided me with some highly beneficial academic journals that can be used as references in the report. I received no other assistance. I have checked the report for spelling and grammar to the best of my ability.

Stay safe and healthy.

Sincerely,

Richard (Zhi Fei) Dong 20775623

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Summary

The 2019 Novel Coronavirus (COVID-19) outbreak in China has been a major concern for many of the employees at U-Link Business Solution. This presents a big problem for the company, since when the employees are concerned but not informed about the situation, their ability to work effectively is greatly reduced. Therefore, this research report is prepared for everyone in the company for the purpose of educating the employees about the situation and preventing the spread of the virus within the company. By gathering the newest researches on the virus from various credible sources, this report covers the information about the basic biology of the virus, the clinical characteristics, the epidemiological characteristics, and the current treatment plans. Then, analysis of the data is made in order to answer the four most frequently asked questions by the employees: what causes the symptoms, who are more likely to be infected, how scary is the virus, and what will the situation be like in the future. From the analysis, it is concluded that the COVID-19 is a more contagious, especially for those with chronic diseases or are elder, yet less deadly virus when compared to SARS. In addition, the situation has become better in Shanghai as the number of new cases has been decreasing in the past several days. Hence, it is concluded that the risks of being infected within the city of Shanghai are very low, and employees should not be very worried about being infected by the virus themselves. However, it is still recommended for the company to take some proactive measures, such as allowing people to work remotely, setting up temperature checks and handing out hand sanitizers at the entrance, and encouraging the use of surgical masks, in order to prevent the circulation of the virus within the company.

Introduction

The mysterious 2019 Novel Coronavirus (COVID-19) is a type of coronavirus that is first reported in the city of Wuhan, Hubei, China on December 31st, 2019 (WHO, 2020). This virus is reported to cause symptoms such as fever, coughing, and/or difficulty of breathing (WHO, 2020). When it becomes severe, it can cause a build-up of fluid in the lungs or even respiratory failure (WHO, 2020). As of February 15th, 2020, there are 68,589 confirmed cases across 26 countries, with 1,666 deaths and 9,629 cured globally (WHO, 2020). As the spread of the virus continues, there is a growth of fear and uncertainty within the Shanghai office. A survey conducted within the company (n=24) has shown that on a scale of 1 to 10, on average, the employees rated 7 (“Very Concerned”) for the question of “How worried do you feel about the outbreak”. As a result of the concern, numerous sources, including some non-credible ones with eye-catching titles, are checked every day by many people within the company. The false news has greatly damaged some employees’ mental health, as they become more scared about the situation than what they actually need to be. Furthermore, it has also reduced the company’s productivity level, as people are distracted by the false information during their jobs. Therefore, as a response to this, this report is prepared to serve as a guide for every individual within the company in order to educate everyone about the current situation. In addition, this report also recommends some measures that can be implemented by the company to prevent the further spread of the virus amongst the employees. It is hoped that this report can help everyone survive through this epidemic crisis at a minimal disruption to his/her health and the company’s normal daily activity.

All the data included in this report is accurate and up to date to February 15th, 2020, the day that this report is finished on. As the situation continues to evolve and more researches are

done about the virus, some information is subjected to change. Therefore, it is still recommended for everyone to keep monitoring the situation through credible sources.

Methods of Research

Numerous data of the COVID-19 outbreak was researched using credible sources and put together in order to identify some trends and characteristics of the virus. This would allow the discussion of some potential preventative plans that can be put into place within the company. In addition, data from other coronavirus outbreaks (primarily the Severe Acute Respiratory Syndrome, SARS, from 2003) was also gathered and put alongside with the data from the COVID-19. This would allow some comparisons and predictions to be made regarding the stages of the current outbreak, and as a result, helping people to establish confidence in combating the virus.

Results and Analysis

1. The Biology of the Virus

The COVID-19 is classified as a beta-coronavirus, which is a type of enveloped and RNA based virus (Xu et al., 2020). A genomic sequencing was done on the virus, which revealed that the genetic sequence of the COVID-19 is very similar to that of the SARS (Xu et al., 2020). Major differences between the two viruses are found in their sequences of the S-Protein in the RBD domain, which is the part that is responsible for attaching onto the human cells via an integral membrane protein named ACE-2 (Xu et al., 2020). Even though four out of five of the major amino acids in the COVID-19's S-Protein are different from that of the SARS, the overall structure of the protein remains the same (Xu et al., 2020). Studies have also found that the

binding free energy between COVID-19's S-Protein and ACE-2 is about -56 kcal/mol, compared to that of the SARS, which is about -78.6 kcal/mol (Xu et al., 2020).

2. Clinical Characteristics

According to a study on the first 99 reported cases of the COVID-19 patients in Wuhan, the most common symptoms reported at admission are fever (83%), cough (82%), shortness of breath (31%), and muscle ache (11%) (Chen et al., 2020). 90% of the first 99 patients presented with one or more symptoms, with the combination of fever, cough, and shortness of breath accounted for 15% of the patients (Chen et al., 2020). CT scans also revealed that about 75% of these patients presented with bilateral pneumonia, and the other 25% presented with unilateral pneumonia (Chen et al., 2020).

Another study on the clinical characteristics of the COVID-19 reveals that symptoms can appear as few as 1 day after the infection, or as long as 24 days, with a mean of 3 days (Guan et al., 2020).

3. Epidemiological Characteristics

Amongst the first 99 cases, 49 patients (49%) had a history of direct exposure to the Huanan Seafood Market in Wuhan, with 47 of them having a long term exposure (working in the market), and 2 having a short term exposure (shopping in the market) (Chen et al., 2020). Human to human transmission is also evident, as 15 medical workers who were involved in the treatment of the first several infected patients were also tested positive for the virus (Chen et al., 2020). In addition, 50 patients (51%) had chronic diseases, such as cardiovascular and cerebrovascular diseases (40 patients) and/or digestive diseases (11 patients), prior to having the infection.

The same study also found that the mean age for the patients is 55.5 years of age, with a standard deviation of 13.1 years of age (Chen et al., 2020). The following plot represents the age group distribution of the first 99 confirmed cases:

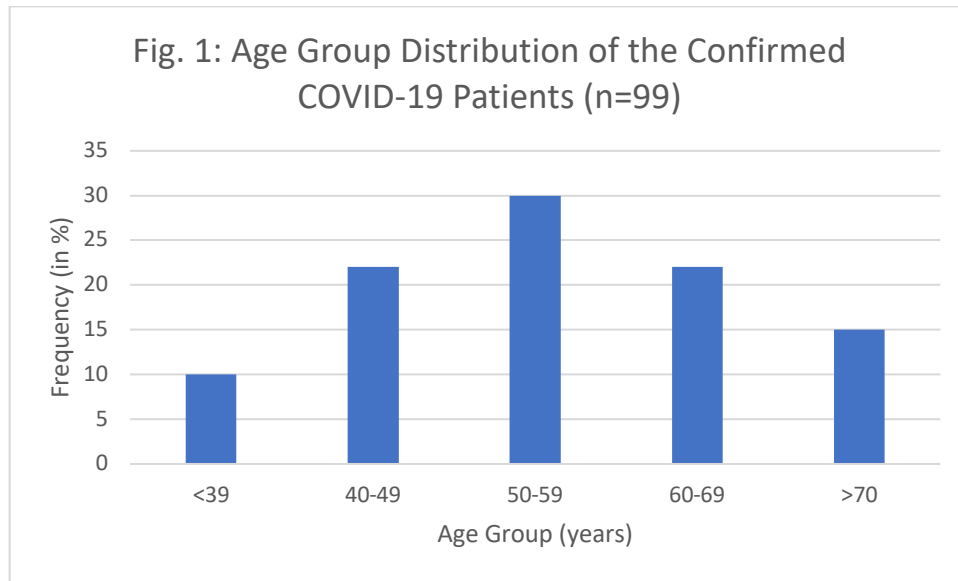


Fig. 1: Age Group Distribution of the Confirmed COVID-19 Patients (n=99). It shows the number of COVID-19 patients from each age group in the study. Data from Chen, N. et al. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The Lancet*; published online Jan. 29. DOI: 10.1016/S0140-6736(20)30211-7.

As of February 15th, 2020, there are a total of 68,589 confirmed cases of COVID-19 worldwide (WHO, 2020). The majority of these cases, 56,249 cases or 82%, are concentrated in Hubei, China (WHO, 2020). The following comparison graph is prepared by Peeri et al., which shows the total number of the reported cases of COVID-19, SARS, and MERS as of February 15th, 2020:

Fig. 2: Comparison of the Reported Cases of COVID-19, SARS, and MERS

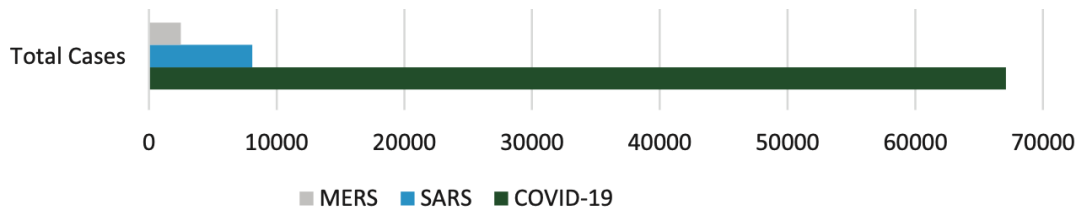


Fig. 2: Comparison of the Reported Cases of COVID-19, SARS, and MERS. It compares total reported cases of COVID-19, SARS, and MERS up until February 15th, 2020. Adapted from Peeri, N. C., Shrestha, N., Rahman, M. S., et al. (2020). The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned? *International Journal of Epidemiology*. doi: 10.1093/ije/dyaa033

As of February 15th, 2020, there are a total of 328 reported cases of the COVID-19 in Shanghai, with 1 death 140 cured (WHO, 2020). The total number of confirmed cases of the virus by days in the city of Shanghai (Fig. 3), as well as the number of new cases by days in the city of Shanghai (Fig. 4), are plotted below to provide a better idea of the current situation within the city:

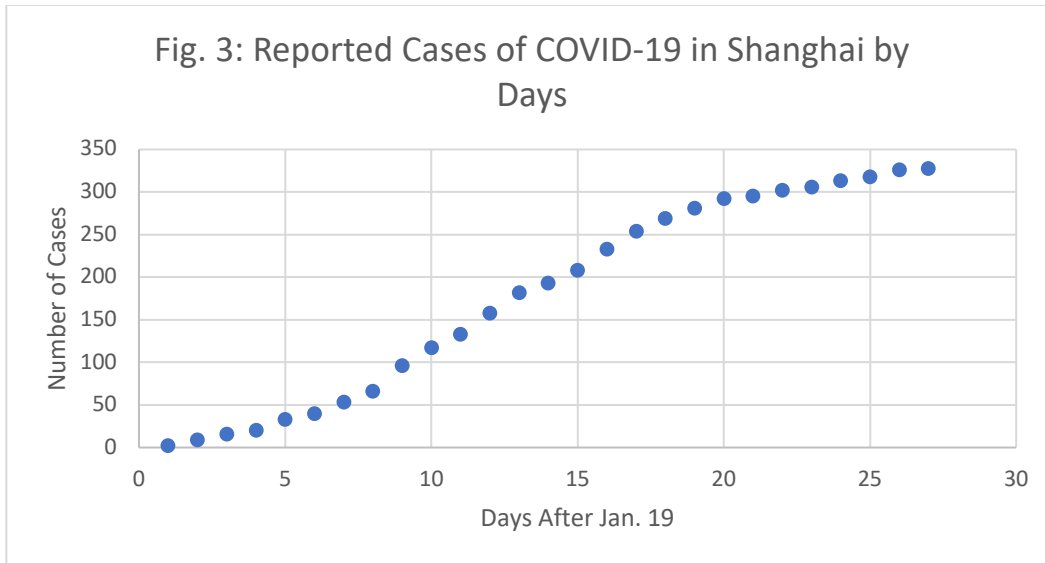


Fig. 3: Reported Cases of COVID-19 in Shanghai By Days. This graph shows the total number of reported cases of COVID-19 in Shanghai, China by days. Data from the World Health Organization. (2020, February 16). *Novel Coronavirus (COVID-19) Situation Report 27*. Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200216-sitrep-27-covid-19.pdf?sfvrsn=78c0eb78_2.

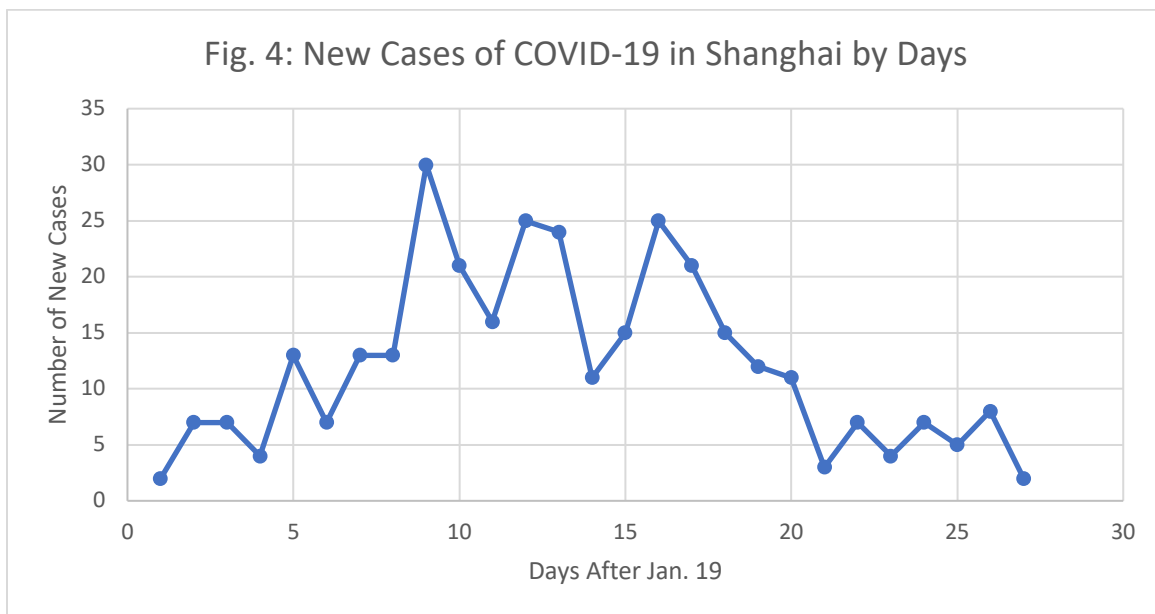


Fig. 4: New Cases of COVID-19 in Shanghai By Days. This graph shows how many more cases are reported every day in Shanghai, China. Data from the World Health Organization. (2020, February 16). *Novel Coronavirus (COVID-19) Situation Report 27*. Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200216-sitrep-27-covid-19.pdf?sfvrsn=78c0eb78_2.

A study published in *The New England Journal of Medicine* has also found that asymptomatic transmission is possible, with one case found in a child (Li et al., 2020). Another study published in the *International Journal of Infectious Diseases* has estimated the reproductive number (Ro) for the virus to be 3.6 to 4.0 (Zhao et al., 2020).

4. Current Treatment Plans

Currently, there is no effective medication or vaccination for the virus (Chen et al., 2020). In the first 99 patients admitted to the hospitals, supportive cares, such as oxygen therapy (used on 75 patients or 76%) and mechanical ventilation (used on 17 patients or 17%), are the primary methods of care (Chen et al., 2020). As of February 15th, 2020, there are currently 11,272 patients in critical conditions, 1,666 deaths, and 9,629 patients being discharged (WHO, 2020).

Discussion

In this part of the report, some common questions that are asked by the employees regarding the virus and the current situation will be answered, with supporting data from the *Results* section.

1. What causes the symptoms?

Data from the *Results* section has revealed that the virus attacks the ACE-2 proteins on the human cells in order to enter its reproduction cycles. ACE-2 proteins are mainly expressed in endothelium and the lungs (Donoghue et al., 2000), which explains why the major symptoms shown are all related to the respiratory system. Fever is a result of the immune response from the body, as the body tries to elevate its temperature to cease the reproduction of the virus (Evans et

al., 2015). Since there are currently no medications or vaccines for the virus, all the treatment effort is dedicated to supporting the immune system to allow it to combat the virus effectively. This explains the reasons of supportive cares, such as oxygen therapy and mechanical ventilation, being mainly used in the treatment, as it helps to reduce the stress of the body from maintaining its normal everyday activity.

2. Who is more likely to be infected?

It is evident that the majority (67%) of the patients is over 50 years old (Fig. 1). This is not a surprise, since the ability of the human immune system to combat diseases is drastically reduced starting the sixth decades of a human's life (Weyand and Goronzy, 2016). As a result, the virus has a higher chance to attack the body of an elder person, compared to that of a young person. This also explains why a lot of people with chronic diseases are infected with the virus, as their immune system is compromised by the diseases and is less likely to win the battle of the virus.

The exact methods that the virus is spread are still unknown at this time (United Nations, 2020). However, in general, respiratory diseases are spread through body fluids and/or by direct contact (United Nations, 2020). This includes coughing, sneezing, or touching the surface that the carriers have just touched (United Nations, 2020). Asymptomatic transmissions are possible, yet very rare, as there is only one confirmed case worldwide. Therefore, most transmissions occur when one is near or/and having direct contact with an infected and symptom showing person.

3. How scary is the virus?

Using the data from the *Results* section, currently, the death rate (the number of deaths divided by the total number of cases) of the COVID-19 is at 2.4%, with 2.8% in Hubei and 0.5% for the rest of the world. This should come as no surprise, as the majority of the cases are concentrated in Hubei, which makes the hospital understaffed and unable to accompany the number of patients coming in. Yet it is worth noting that the death rate of the COVID-19, even in Hubei, is much lower compared to other major outbreaks in the past, such as SARS (at 10%) and MERS (at 37%) (Huang et al., 2020).

Even though the COVID-19 outbreak is not as deadly as many other diseases, it is evident that the COVID-19 spreads much faster and reaches many more people than SARS (Fig. 2). The primary reason for this may lie in the biology of the virus, particularly in their free binding energies. In general, the lower the value of free binding energy, the more likely the binding will occur for the virus to enter the cells (Du et al., 2016). As a result, the lower free binding energy found in SARS may result in it having a shorter range of incubation period (anywhere between 2 to 10 days) than that of the COVID-19 (anywhere from 1 to 24 days), as immediate symptoms can occur much quicker (CDC, 2005). Even though the COVID-19 might be less likely to bind, the longer range of the incubation period does mean that more infected people with minimal or mild symptoms will have the opportunity to spread the virus without knowing they are doing that. This, as a result, makes COVID-19 a more contagious yet less deadly virus than the SARS.

4. Will Shanghai be the next Wuhan? What will happen in the future?

It is evident that the outbreak in Shanghai has been greatly contained, as the growth of the number of new cases slows down (Fig. 3). There are also very few reported new cases every day (fewer than 10 per day) after day 20 (Fig. 4). Using the data of Shanghai from the *Results* section, currently the death rate of the virus in Shanghai is 0.3% and the cure rate is 43%. Both of these numbers are much better than that of the world average (at 2.4% and 14%, respectively). For a city with a population of 27,058,000, the infection rate is only at 0.0012% (United Nations, 2019). Therefore, it is safe to say that the situation in Shanghai is very promising, and one should not be very concerned about being infected within the city. Yet one should still be alerted, as the outbreak is not over in Shanghai since there are still new reported cases every day.

The future of COVID-19 is yet unclear, as the numbers are still growing. With the current R_0 being 3.6 - 4.0, every infected individual will continue to infect another 3 to 4 people. As a result, it is likely that the outbreak will continue for another weeks or even months, especially in the Hubei province where the medical resources are overwhelmed by the number of admitted patients. According to a study published in *Nature*, in the worst case scenario, if all efforts that are put in place to stop the virus fails (which still remains as a possibility right now), the virus will continue to circulate and become an endemic (Lewis, 2020). This means that it is likely that humans will be seeing the virus returning every year until a cure or a vaccine is developed, just like the case of the influenza virus (Lewis, 2020).

Conclusion and Recommendations

The COVID-19 outbreak has been a serious challenge to many countries around the world and to the well beings of everyone in the affected areas. Studies have found elder people, especially those with chronic diseases, are at high risk of being infected by the virus. The most common symptoms are fever, coughing, shortness of breath, and muscle ache, with a very high possibility of presenting with more than one symptom. In general, this virus is more contagious yet less deadly compared to SARS in 2003 due to its lower likelihood of binding to human ACE-2 protein and its longer period of incubation. Human to human transmissions are possible, with the primary methods of transmission estimated to be through direct contact and body fluid. Asymptomatic transmissions are possible yet very rare.

The situation in Shanghai has been greatly improved over the past several weeks, with only a few number of new cases being reported every day, as well as some promising cured rates and death rates. Yet, with new cases still being reported, it is clear that the outbreak is not over yet, and the virus becoming an endemic is still a possibility. Therefore, based on the symptoms and possible methods of transmission discussed above, the following measures are recommended for the company to take in order to help both the company and the employees through this crisis:

1. Allow employees to work remotely from home whenever possible

Avoiding all unnecessary contacts with other people is the best way to avoid being infected, as human to human transmissions are possible. Since the work conducted in the work place by most employees could be done remotely from home, allowing that would make cross infection much less likely. This will benefit both the employees and the company, as if there are

cases being reported in the company, the company might need to be shut down for days for a full disinfection work.

2. Set up temperature checks and provide hand sanitizers at the entrance of the office

If it is necessary for the employees to come to the office during this period, body temperature checks should be conducted before he/she could enter the office, as one of the most common symptoms is fever. In addition, hand sanitizers should be provided to everyone upon entrance in order to eradicate the possibility of transmission through direct contacts.

3. Encourage the use of surgical masks when riding public transportations and/or visiting populous areas

The company should encourage the use of general surgical masks, as it helps to lower the possibility of transmission through body fluids from individuals nearby. This could be done by providing surgical masks directly or through subsidies to employees who are required to travel to and from work.

However, one should not be using professional medical masks, commonly known as the N95 masks, for normal daily activities. This is because that these masks are currently on a shortage, which is evident from their unusually high prices online, as well as the difficulty of buying one in the recent days. Therefore, one should kindly leave these professional masks for medical workers who are in need. General surgical masks are sufficient for normal daily uses.

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