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【特別寄稿】

Infectious Diseases: COVID-19 versus the World

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1. Introduction

In this world, infectious viruses are everywhere—in stations, buses, local areas and any public spaces. In the history of public health, we have attempted to prevent and combat fatal diseases such as tuberculosis (TB), malaria, SARS, MERS, AIDS, H1N1 flu, Ebola and other infectious diseases through global human cooperation.

According to the United Nations (UN), the three main infectious diseases are malaria, TB and AIDS, which cause more than 5 million deaths annually, and our human society, countries and international organisations are trying to reduce the numbers through many efforts, which are described in later parts. In the world of infectious diseases, annually, HIV, TB and malaria infect 810.5 million people and kill 5 million of them. These diseases are preventable and treatable, so it is not impossible to help people who are infected. In 2014, Ebola got more attention to killing 8,000 people in total. However, 4 million people have died from AIDS, TB and malaria (Scott, 2020).

1.1 Definition

An infectious disease is caused by a contagious virus that can spread out

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and infect living organisms, in which its virus has come in contact with humans. These diseases include Ebola, malaria *(Plasmodium falciparum)*, SARS, MERS, AIDS, H1N1 flu, TB *(Mycobacterium tuberculosis)*, and the current novel coronavirus, COVID-19. In epidemiology, such diseases can lead to endemics and pandemics, which include several stages of transmission that could impact humans in our society.

1.2 The importance of infectious diseases and the issues

The issue of infectious disease has become very important to societies around the world because it affects our lifestyles tremendously in such a way that it advances our knowledge about infectious diseases according to history. The World Health Organization (WHO) and several other international organisations have been working on this troublesome issue.

On 12th March 2020, Dr Tedros, the Director-General of WHO, stated that the novel coronavirus (also called SARS-CoV-2 and COVID-19) and its epidemics can be defined as a pandemic, which is the last stage of an epidemic. According to epidemiology, epidemics could impact human populations by infecting a massive group (cluster) of people in a country (endemic) or by affecting the majority of the population in the world (pandemic), which could eventually become fatal to those who are infected. The current situation is the worst stage of transmission, what we will call a global pandemic, which has had several epicentres throughout the world.

Regarding this issue, this report would hope to research the specific causes and symptoms of COVID-19. This will involve inquiring how the disease started as well as how it can become a serious condition for human beings. I would like to bring in some research on how this disease has been impacting the human lifestyle globally from the perspectives of multi-disciplinary research in the areas of epidemiology, immunology, virology and preventative

medical science.

Indeed, this issue of COVID-19 is linked to Unuted Nations' Sustainable Development Goal 3: Good Health and Well-being. That means this report should discuss how and in what ways human beings are able to attain this goal, using research as well as local and global actions (Bloom, 2019: 13).

1.3 The structure of this report

This report has six sections that explore infectious diseases through case studies.

It describes the causes and impacts of infectious diseases on our human society and the world by following three Research Lines of Inquiry: causation, function and perspective. This report will also discuss effective strategies to prevent infectious diseases and cure patients, as well as various views of infectious diseases and related issues.

For those diseases for which there are no effective vaccines currently available, this information report will discuss how researchers, microbiologists, and immunologists sequence the genome and achieve the development of a new vaccine.

On the other hand, I would also like to understand what actions governments have taken and how the global community—including the WHO—could create an initiative to prevent a global pandemic and find cures for new diseases like SARS-CoV-2 and COVID-19 (Watkins, J. 2020).

These ongoing battles between human beings and infectious diseases certainly raise questions of public health. They also make us consider in what ways we can advance our humanity in the 21st century, which promises further uncertainties. The real issue is if the people of the world can cooperate to build a bright future by achieving the SDGs and other essential targets.

2. Causes and Effects of COVID-19: Causation

There are specific ways in which communicable diseases can impact the human population—for example, by infecting massive groups, clusters, of people in a country or continent, an epidemic, or by affecting the majority of the world's population, a pandemic. Examples of these diseases are Ebola, Malaria, SARS, MERS, AIDS, and the novel Coronavirus (COVID-19).

This section about causation connects with the First Research Line of Inquiry. The reason for this is because it explains the effects of our human population, such as gradually decreasing the human population number, and the severe impacts on the world population. This section will be followed up later by Section 4: Case Studies: Malaria, Tuberculosis (TB), and AIDS.

According to Epidemiology, infectious diseases sometimes have epidemiological impacts on human society, which could then turn into an endemic or pandemic. In addition, a certain level of a pandemic may intensify the death tolls, depending on the **Transmission Risks and Rates,** by the diseases spreading from one person to another. There is another ratio, called the **Case Fatality Ratio (CFR),** from which we can estimate the total number of deaths. Another is the **Effective Reproductive Number** (R-nought), which shows the number of cases to which one case can lead (Imperial College London, 2020).

The COVID-19's CFR is estimated to be around 2.2-3.4%, which is actually 82% genetically linked to SARS, with a CFR of around 10%, and MERS, with a CFR of around 34%, because they are both a type of coronavirus. It is thought that bats are the main causation of these diseases because bats' blood contains viruses, and bats are eaten in Wuhan in mainland China (Ferguson, 2020).

The First Research Line of Inquiry questions were primarily answered

Epidemiological Comparison of Respiratory Viral Infections

Disease	Flu	COVID-19	SARS	MERS
Disease Causing Pathogen	 Influenza virus	 SARS-CoV-2	 SARS-CoV	 MERS-CoV
R_0 Basic Reproductive Number	1.3	2.0 - 2.5 *	3	0.3 - 0.8
CFR Case Fatality Rate	0.05 - 0.1%	~3.4% *	9.6 - 11%	34.4%
Incubation Time	1 - 4 days	4 - 14 days *	2 - 7 days	6 days
Hospitalization Rate	2%	~19% *	Most cases	Most cases
Community Attack Rate	10 - 20%	30 - 40% *	10 - 60%	4 - 13%
Annual Infected (global)	~ 1 billion	N/A (ongoing)	8098 (in 2003)	420
Annual Infected (US)	10 - 45 million	N/A (ongoing)	8 (in 2003)	2 (in 2014)
Annual Deaths (US)	10,000 - 61,000	N/A (ongoing)	None (since 2003)	None (since 2014)

* COVID-19 data as of March 2020.

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in my interview with Dr. Ogawa; the questions and answers are as follows:

1) How does our immune system work against infectious diseases?

'There cells called Macrophages. If they find bacteria and viruses that have entered the body, they inform the T cells that there are intruders which have entered, then the T cells give specific signals to two other cells in the immune system. One commands the Killer T cells to destroy the intruding cells. The other informs the B cells to make antibodies to help the other cells fight the bacteria or viruses. This method occasionally works, and when it does, the immune system memorises this fight and remembers the ways to kill that specific virus or bacteria. However, this method could fail, depending on what the situation is'.

2) What is the difference between highly infectious and low infectious diseases?

'High or low infectivity is determined mainly by three factors: (1) the nature of the pathogen (bacteria and viruses), (2) the inherent immunity of the infected person, and (3) environmental factors (traffic and human density) and public health environment (whether hands can be washed and disinfected properly, whether people can act properly, etc.)'.

'What people [mistakenly believe is that] the higher the spreading rate, the higher risk. However, this is not true. For example, measles has had a spreading rate that is 12–18 people, and it is 1.5–2.5 people for Ebola, but Ebola has a much higher lethality rate than the spreading rate.'

3) What does an electronic microscope do?

'Electronic microscopes, unlike optical microscopes, allow you to see smaller sized cells and distinguish them. By using this, the nature of the pathogen can be analysed, so it could be possible to find effective treatment methods quicker and efficiently.'

n.b. The author's interview recorded on 23 March 2020.

2.1 What is SARS-CoV-2 (COVID-19)?

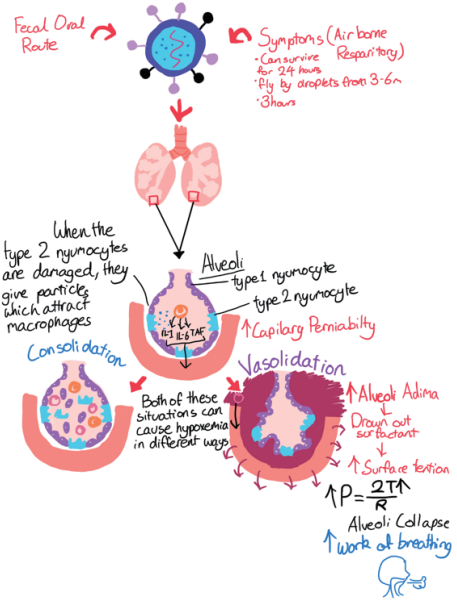
Pathophysiology and Diagnostics

Figure 1 shows the structure that infection is caused via the fecal–oral route or by symptoms along the airborne respiratory route which can survive for 24 hours, such as fly-by droplets that travel about 3–6 metres in less than one second.

The SARS-CoV-2 virus usually travels to the alveoli in the lungs. It then damages the type I pneumocytes, causes it to spread particles and damages it, and this can lead to consolidation or vasodilation. This, then, could cause hypoxemia. These outcomes could then harm even some of the vital organs such as the heart, the kidneys and so on.

This harms the infected person's vital organs. People who have mild

Figure 1: Pathophysiology and Diagnostics



n.b. Produced from the author's research notes

symptoms can recover and could become immune to it and develop antibodies against the SARS-CoV-2 virus.

Virology

The virus is called SARS-CoV-2 and causes the disease COVID-19. It is 80% genetically related to SARS and MERS. There are spike proteins (the main part of the virus), hemagglutinin esterase protein, and some others. COVID-19 has two types: The S type and the L type. The S type comprises 30% of infections while the L type comprises 70%, and there are differences in symptoms.

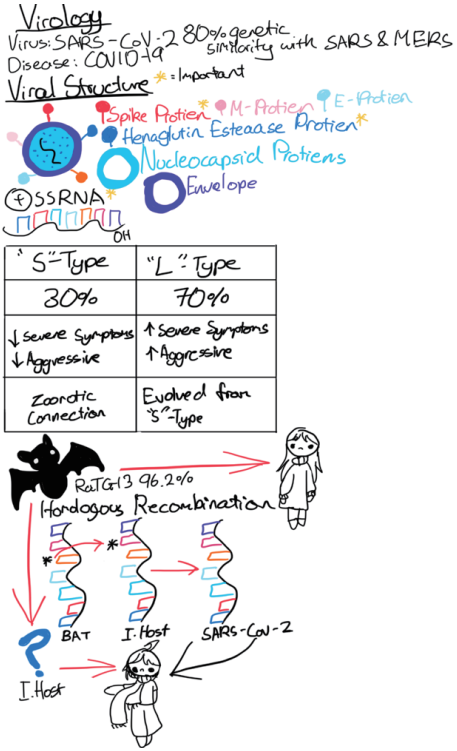


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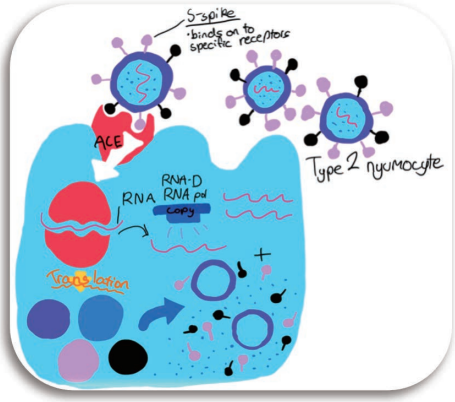
Figure 3 shows a novel coronavirus (SARS- CoV-2), which is a recently discovered coronavirus of medical significance, an enveloped, positive-sense single-stranded RNA virus. It belongs to the *Orthocoronavirinae* subfamily. As described by the name, it has 'crown-like' spikes on their surfaces'.

'The exact origin, location, and natural reservoir of the 2019-nCoV remain unclear, although it is believed that the virus is zoonotic, and bats may be the culprits because of sequence identity to the bat-CoV'.

There are various causes of increasing zoonotic emergence—the

Figure 3:



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transmission of disease from animals to humans—but the following factors are the principal causes:

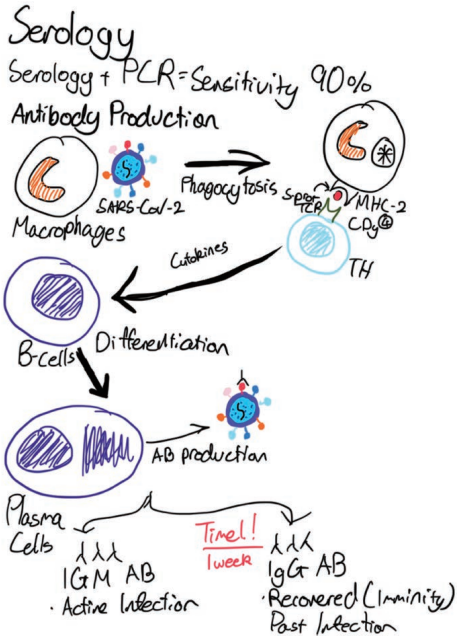
1) Deforestation and other land use
2) Antimicrobial resistance (AMR),
3) Intensified agriculture and livestock production
4) Illegal and poorly regulated wildlife trade
5) Climate change

Source: UNDESA, 2020

Serology

Figure 4 shows that, with serology and PCR together, there is a 90% sensitivity. For antibody production, macrophages consume the COVID-19 virus and go to a T h cell. They then give the S-Protein of the virus. They then send the S-Protein to the B cell, which turns into plasma cells to produce antibodies against the COVID-19 virus. However, this process takes time, so you cannot get the antibodies immediately.

Figure 4:



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2.2 Clinical Course

Xu et al (2020) states, 'COVID-19 has a mean incubation period of 5.2 days (95% confidence interval, 4.1–7.0). The infection is acute without any carrier status. Symptoms usually begin with nonspecific syndromes, including fever, dry cough, and fatigue. Multiple systems may be involved, including respiratory (cough, shortness of breath, sore throat, rhinorrhoea, haemoptysis, and chest pain), gastrointestinal (diarrhoea, nausea, and vomiting), musculoskeletal (muscle ache), and neurologic (headache or confusion). More common signs and symptoms are fever (83%–98%), cough

(76%–82%), and shortness of breath (31%–55%). There were about 15% with fever, cough, and shortness of breath. After onset of illness, the symptoms are somehow mild and the median time to first hospital admission is 7.0 days (4.0–8.0). But the disease progresses to short of breath (~8 days), acute respiratory distress syndrome (ARDS) (~9 days), and to mechanical ventilation (~10.5 days) in about 39% patients. Patients with fatal disease develop ARDS and worsened in a short period of time and died of multiple organ failure. The mortality rate in the early series of hospitalized patients was 11%–15%, but the later statistics was 2%–3%.' (See **Figure 5**: Pathogenicity and Transmissibility Characteristics of Recently Emerged Viruses)

He also mentions that 'The SARS-CoV-2 virus may enter the host through respiratory tract or mucosal surfaces (such as conjunctiva). Oral-fecal transmission has not been confirmed. The virus has a preferential tropism to human airway epithelial cells and the cellular receptor, like SARS, is ACE2. However, the pathological changes of the disease and its pathogenesis in human is not clearly elucidated. Theoretically lungs are the major involved organ. We do not know if the virus replicate in other part of the body is not clear'

2.3 Diagnosis

According to Zhang, Y. (2020) and Rusell, T. et al (2020) say, 'The COVID-19 usually presents as an acute viral respiratory tract infection and many differential diagnoses related to common viral pneumonia should be considered, such as influenza, parainfluenza, adenovirus infection, respiratory syncytial virus infection, metapneumovirus infection, and atypical pathogens, such as *Mycoplasma pneumoniae* and *Chlamydophila pneumoniae* infections etc. Therefore, it is crucial to trace the travel and

Table 1: Pathogenicity and Transmissibility Characteristics of Recently Emerged Viruses

Pathogenicity and Transmissibility Characteristics of Recently Emerged Viruses in Relation to Outbreak Containment.

Virus	Case Fatality Rate (%)	Pandemic	Contained	Remarks
2019-nCoV	Unknown*	Unknown	No, efforts ongoing	
pH1N1	0.02–0.4	Yes	No, postpandemic circulation and establishment in human population	
H7N9	39	No	No, eradication efforts in poultry reservoir ongoing	
NL63	Unknown	Unknown	No, endemic in human population	
SARS-CoV	9.5	Yes	Yes, eradicated from intermediate animal reservoir	58% of cases result from nosocomial transmission
MERS-CoV	34.4	No	No, continuous circulation in animal reservoir and zoonotic spillover	70% of cases result from nosocomial transmission
Ebola virus (West Africa)	63	No	Yes	

* Number will most likely continue to change until all infected persons recover.

Source: Xu. Z (2020). *Pathological findings of COVID-19 associated with acute respiratory distress syndrome*, *The Lancet*

exposure history when approaching a suspected patient who has returned from an epidemic area. In addition, commercial respiratory syndromic diagnostic kits that detect multiple etiological agents may help with timely differential diagnosis.'

In general, COVID-19 is an acute respiratory disease, but it can also be deadly, with a 2%-20% case fatality rate according to various circumstances. **Table 1** shows the pathogenicity and transmissibility characteristics of recently emerged viruses.

2.4 Impacts of COVID-19 on the Sustainable Development Goals

The United Nations Department of Economic and Social Affairs (2020) predicts that there are many and various impacts on SDGs. The following are a summary of 17 goals, of which Goal 3, Good Health and Well-being, has already been devasted. The following goals have positive and negative

effects. The negative effects are highlighted in red, and the positive effects are highlighted in blue:

1. No poverty: Loss of income, causing families in vulnerable segments of society to fall below the poverty line.

2. Zero hunger: Food production and distribution could be disrupted.

3. Good health and well-being: Devastating effect on health conditions

3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases, and combat hepatitis, water-borne diseases and other communicable diseases

3.a Achieve universal health coverage, including financial risk protection, access to quality protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all

3.b Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines.

3.c Strengthen the capacity of all countries—in particular, developing countries—for early warning, risk reduction, and management of national and global health risks.

4. Quality education: Many schools are closed; remote learning is less effective and not accessible for some children

5. Gender equality: Women's economic gains are at risk, and levels

of violence against women increase; women account for the majority of healthcare and social care workers who are more exposed to COVID-19

6. Clean water: Supply disruptions and inadequate access to clean handwashing facilities, which is one of the most important COVID-19 prevention measures

7. Affordable and clean energy: Supply and personnel shortages lead to disrupted access to electricity, further weakening health system responses and capacity

8. Decent work and economic growth: Economic activities suspended, leading to lower income, less work time, and unemployment for certain occupations

11. Sustainable cities and communities: Populations living in slums face a higher risk of exposure to COVID-19 due to high population density and poor sanitation conditions

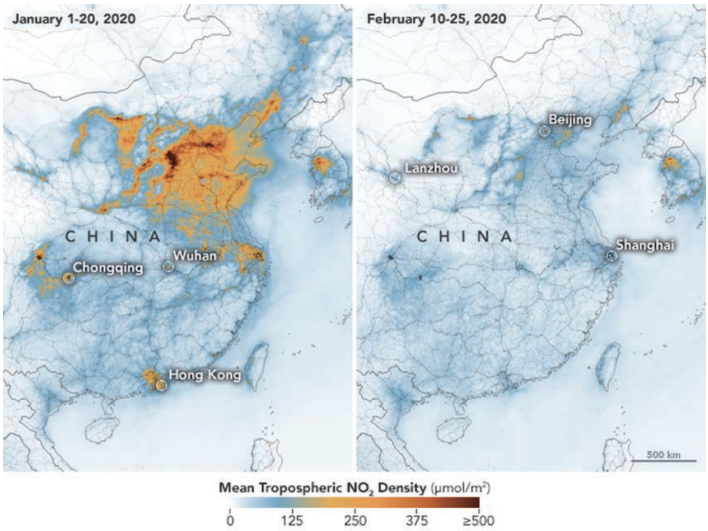
13. Climate action: Reduced commitment to climate action, but **fewer environmental footprints due to a decrease in production and transportation**

16. Peace, justice, and strong institutions: Conflicts prevent effective measures for fighting COVID-19; those in conflict areas are most at risk of suffering devastating loss from COVID-19

17. Partnerships for the Goals: Refute backlash against globalization, and also highlight the importance of international cooperation on public health

Due to COVID-19, it is likely that the targets in SDGs need revisions for policy implementations. However, Lomborg (2018) states that some of the SDGs are not achievable since the goals had not specified achievable targets in implementation. However, goal 13, climate action, is extremely important

Figure 6: Mean Tropospheric NO2 Density (umol/m2)



Source: Monks, P. (2020) *Coronavirus: lockdown's effect on air pollution provides rare glimpse of low-carbon future, The Conversation – Academic rigour, journalistic flair.*

to the environment since lockdowns by many countries have brought about a positive effect on air pollution. The World Health Organisation (WHO) estimates that 'about 3 million people die each year from ailments caused by air pollution, and that more than 80% of people living in urban areas are exposed to air quality levels that exceed safe limits. The situation is worse in low-income countries, where 98% of cities fail to meet WHO air quality standards. **Figure 6** shows the air quality in China. During late January and early February 2020, levels of nitrogen dioxide (NO2) over cities and industrial areas in Asia and Europe were lower than they were in the same period in 2019 by as much as 40%.

Monks, P. (2020) argued that 'most NO_2 comes from road transport and

power plants, and it can exacerbate respiratory illnesses such as asthma. It also makes symptoms worse for those suffering from lung or heart conditions. NO_2 emissions have been a particularly thorny problem for Europe.' According to Monks, China emits over 50% of all the nitrogen dioxide in Asia. Each tonne of NO_2 that is not emitted as a result of the pandemic is the equivalent of removing 62 cars per year from the road.

3. Effective Strategies used for Prevention and Cure for COVID-19: Function

As described earlier, infectious diseases can become fatal, and people try to protect others, e.g. children, family members, co-workers or friends, in an effective way. Once failed, it may be disastrous to our human society with many death tolls.

The Second Research Line of Inquiry is primarily answered by my interview to Dr Ogawa as follows:

1) How can we find a cure for infectious diseases?

'In order to make an effective treatment, you will need to know what the pathogen is, and what its properties are, which are analysed by an electronic microscope mentioned before and various other tests to create an effective medicine for infectious diseases.'

2) At what stage of infection can a vaccine be made?

'Generally, a vaccine will be made when it is transmitted from person to person or when it is considered to have a significant impact on society. Note that some vaccines have not been made yet.'

3) What actions should we take, and when should we take the actions?

'This is a classical issue to us, the best way one to prevent it is as early as possible by washing your hands, disinfection, keeping away from infected people. In addition to the above, it is important to do larger prevention

measures of physical distance, such as prohibiting public transport.'

n.b. The author's interview recorded on 23rd March 2020.

As stated above, effective methods or strategies are still being searched for. This question of people's battle against viruses has a significant relationship with the Second Research Line of Inquiry, which shows the different ways to prevent the communicable disease, and it is called '**Containment Measures'** by Social Distancing (Physical Distance), banning people's movement in cities, locking down of cities (Wuhan in China) and in whole countries in Italy, Spain, France, Germany, the U.K., U.S., South Africa and India in addition to banning international travellers between the countries. So far, the strictest measures have been taken by most countries.

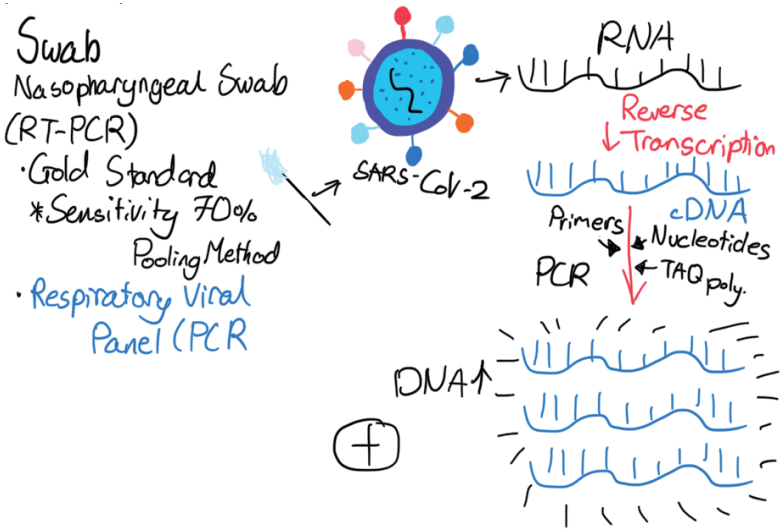
It is important that the COVID-19 is also a large threat with the three main diseases: HIV, malaria and tuberculosis (T.B.). People who are infected by the following are more likely to be affected by COVID-19. Weak health systems cannot contain an outbreak that is said to outflank even the most determined preventative strategies.

3.1 Tests

Whilst people expect that the COVID-19 the Polymerase Chain Reaction testing (RT-PCR) will become more available, infected patients who are healthy enough to be sent home are quarantined at home while home-based testing is coordinated. This system only works for patients who are well enough to be sent home, but not for severe illness patients. There is one way of those tested positive and go ho for self-isolation.

Figure 6 shows the structure of Swabs (PCR tests) when testing with nasal swabs (RT-PCR) you try to find the SARS-CoV-2 virus. Then turn RNA into DNA by using Reverse Transcription. After the Reverse Transcription process, if the PCR machine detects colour, then the result will be positive.

Figure 6: Swabs (RT-PCR)



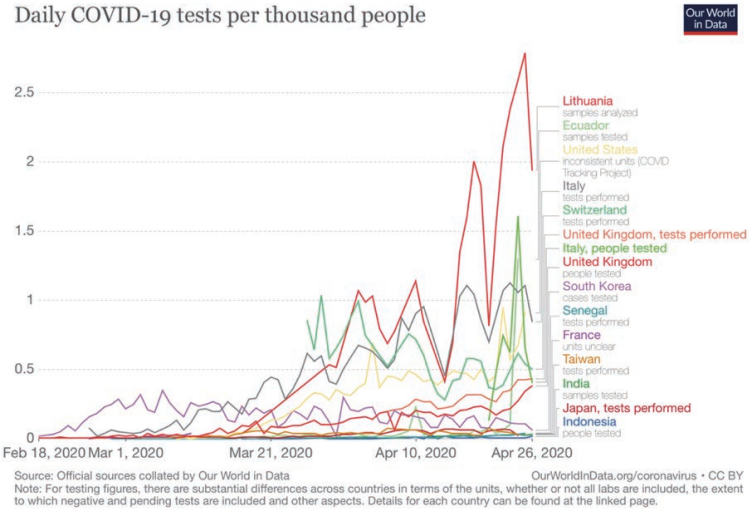
n.b. Produced from the author's research notes

Figure 7 shows the daily numbers of COVID-19 per thousand, and RT-PCR high-test rating brings in many positive cases. According to **Figure 7**, the number of Japanese RT-PCR test is 0.39 per 100,000, which is far lower than the European standard, and therefore, it is not appropriate to compare the test numbers each other. It is also not possible to confirm the total number in Japan in an accurate way since the Japanese government are adapting Contract Tracing (See the below).

Figure 8 shows the structure of Antibody and ELISA tests. There are different kinds of tests for COVID-19. Unlike the RT-PCR test, Antibody test tries to find someone who is immune to SARS- CoV-2, The Antigen tests are to find out if you have antibodies of the SARS-CoV-2 virus. The ELISA tests are for Epidemiological data (population data).

The COVID-19 usually presents as an acute viral respiratory tract infection

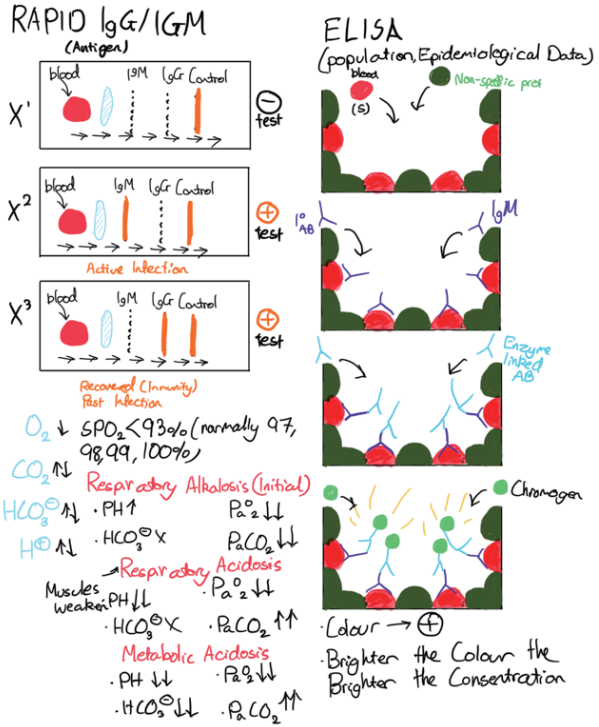
Figure 7: Daily COVID-19 RT-PCR tests per thousand people, as of 26th April 2020



Source: Official Sources collated by One World in Data

and many differential diagnoses related to common viral pneumonia should be considered, such as influenza parainfluenza, adenovirus infection, respiratory syncytial virus infection, metapneumovirus infection, and atypical pathogens, such as *Mycoplasma pneumoniae* and *Chlamydophila pneumonia* infections etc. Therefore, it is crucial to trace the travel and exposure history when approaching a suspected patient back from an epidemic area. In addition, commercial respiratory syndromic diagnostic kits that detect multiple etiological agents (such as Film array Respiratory Panel) may help timely differential diagnosis.

Figure 8: Antibody and ELISA tests



n.b. Produced from the author's research notes

3.2 Prevention

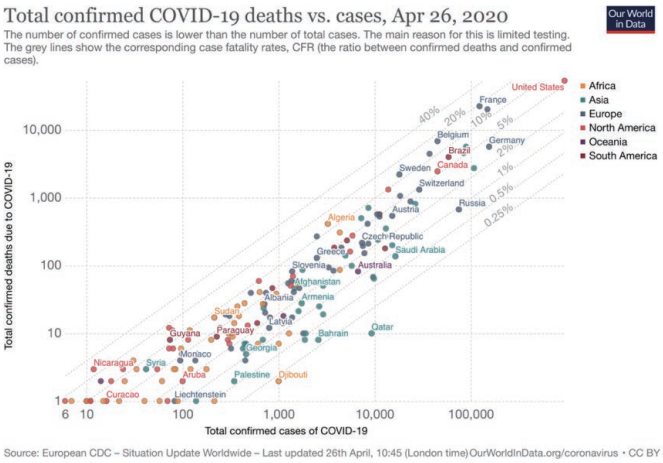
Since there are no standard treatments for COVID-19, it is vital to avoid infection or further spreading. Accoring to Xu et al (2020), he states, 'For the general population, travel to an epidemic area of COVID- 19, contact, or eating a wild animal is dissuaded. For those who had a history of travel from the epidemic area in recent 14 days, body temperature monitor and self-surveillance for 14 days should be performed. If compatible symptoms developed, designated transportation is recommended to prevent unprotected

exposure. For health- care workers, personal protective equipment should be put on and taken off properly while caring probable or confirmed patients. Stringent protection procedures should be conducted for high-risk procedures. Once exposed to blood or body fluids of the patient unprotected, the healthcare workers should flush the exposure site thoroughly by water or soap. Afterwards, body temperature should be monitored for 14 days. The confirmed case should be isolated (prefer a negative pressure isolation room or, alternatively, a single room with good ventilation). Under the circumstances of resolved symptoms for 24 hours and consecutive two negative results, isolation could be released. Corpses should be burned or buried deep'.

He also states, 'COVID-19 infection is a zoonotic disease with low to moderate mortality rate. Currently, there is no standard treatment for the disease, and supportive treatment was the only strategy. Although many experimental trials are on the way, the best we can do to prevent a rampant outbreak is stringent infection control operation. Clinicians should consider the possibility of SARS-CoV-2 virus infection in persons with travel or exposure history with compatible incubation period and presenting symptoms. First-line healthcare providers should be highly aware of appropriate infection prevention measures for suspected patients.'

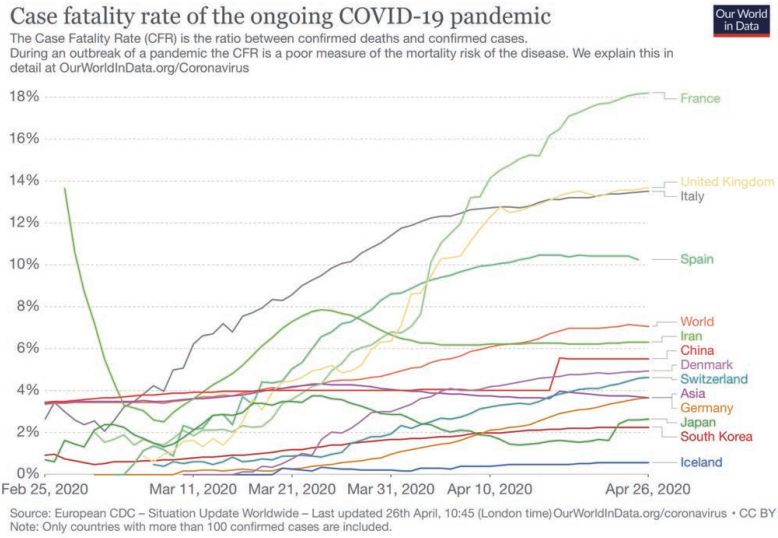
The following **Figure 9, 10, 11 and 12** compares the total confirmed cases and the confirmed deaths (COVID-19) with several colours representing their continent that are Africa, Asia, Europe, North America, Oceania and South America. This also illustrates what amount of people are confirmed or killed by COVID-19, the Case Fatality Ratio (CFR) is at for all the countries included which Italy, Spain, the U.K., the U.S., Belgium and France, which has the highest rate, 18% of the Case Fatality Rate.

Figure 9: COVID-10: Total confirmed cases vs deaths as of 26th April 2020



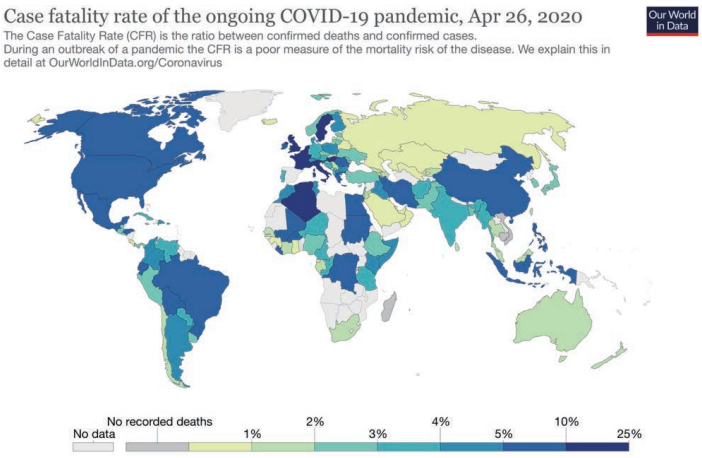
Source: European CDC – latest situation update worldwide

Figure 10: Case fatality rate of the ongoing COVID-19 pandemic, as of 26th April 2020



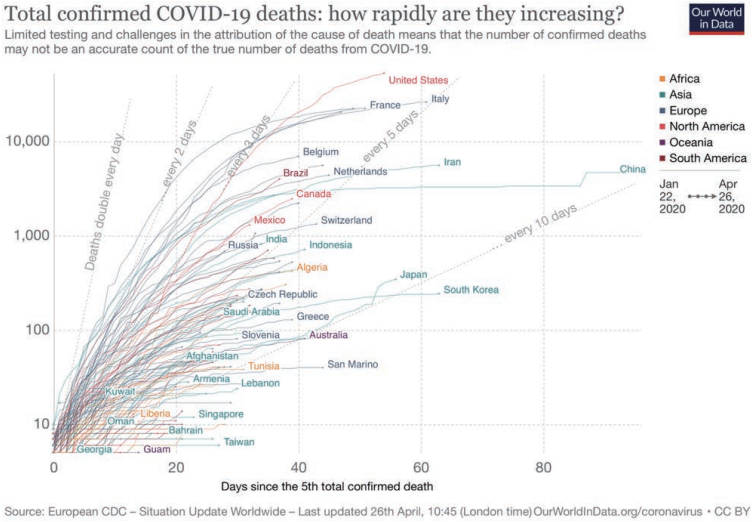
Source: European CDC – latest situation update worldwide

Figure 11: Case fatality rate of the ongoing COVID-19 pandemic, as of 26th April 2020



Source: European CDC – latest situation update worldwide

Figure 12: Total confirmed COVID-19 deaths, as of 26 April 2020



Source: European CDC – latest situation update worldwide

3.3 Treatments

In contrast to these preventive measures, an effective treatment for infectious diseases is **a vaccine**. Vaccines are injections that contain decoded molecules of the virus. However, vaccines can be expensive. If the symptoms are getting worse, the patient must be hospitalised. In some cases, clusters (infectious groups) can be immediately quarantined from non-infectious populations.

Currently, there is no validated treatment for COVID-19. The main strategies are symptomatic and supportive care—such as monitoring vital signs, maintaining oxygen saturation and blood pressure, and treating complications such as secondary infections or organ failure. Because of the potential mortality of COVID-19, many investigational treatments are underway (Oxford University Clinical Research Unit, 2020), as follows:

1. Remdesivir: The experimental drug is a novel nucleotide analogue prodrug in development by Gilead Sciences, Inc. It is an unapproved antiviral drug being developed for Ebola and SARS. In a report on the first case of COVID-2019 in the United States, administering remdesivir for compassionate use on day 11 of the illness resulted in decreasing viral loads in nasopharyngeal and oropharyngeal samples, and the patient's clinical condition improved. However, randomized controlled trials are needed to determine the safety and efficacy of this drug for the treatment of patients with 2019-nCoV infections.
2. onvalescent therapies (plasma from recovered COVID-19 patients): This strategy had been used to support passive immunization. Based on studies of MERS, the therapeutic agents with potential benefits include convalescent plasma, interferon-beta/ribavirin combination therapy, and lopinavir. However, these agents have not been used on COVID-19 before,

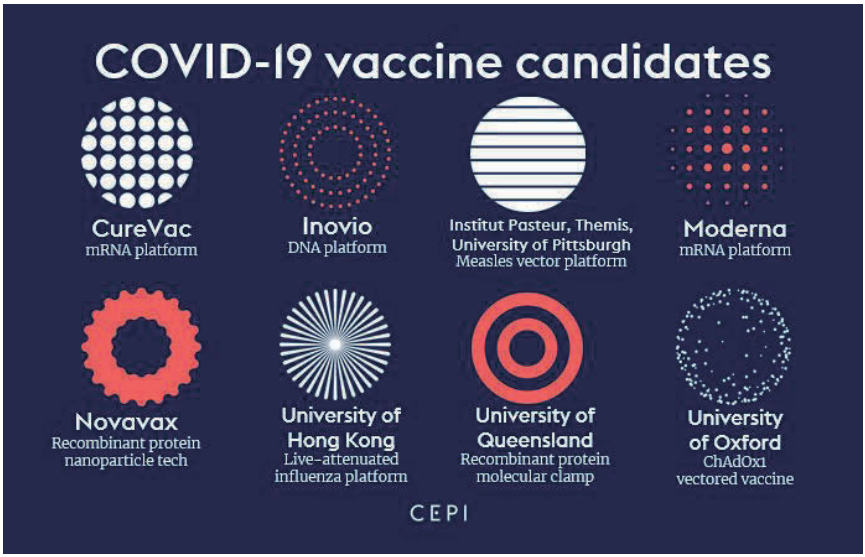
and there are no randomized controlled clinical trials for this management at present.

3. Antiviral drugs: **Lopinavir/ritonavir** and **ribavirin** had been used to attempt treatment of SARS patients with apparently favourable clinical responses. *In vitro* antiviral activity against the SARS- associated coronavirus at 48 hours for lopinavir and ribavirin was demonstrated at concentrations of 4 and 50 μg/mL, respectively. A recent report found an uncanny similarity between unique insertions in the 2019-nCoV spike protein and HIV-1 gp120 and Gag.

According to Fang, L. et al. (2020), important highlights include an asymptomatic COVID-19 disease patient with normal radiography throughout that appeared in this study. Secondly, lopinavir, which was originally developed to treat AIDS, has a positive effect on COVID-19 patients. Lastly, eosinophil counts presented themselves as potential predictors of the progression of the disease.

According to Cao et al. (2020), in hospitalized adult patients with severe COVID-19, no benefit was observed with lopinavir-ritonavir beyond standard care, so the results of the medication's effectiveness were varied.

4. Vaccines: There is currently no vaccine available for preventing COVID-19 infection. The spike protein may serve as a vaccine candidate, but its effect on humans requires further evaluation. There are eight COVID-19 vaccine candidates from the following universities and laboratories under the Coalition for Epidemic Preparedness Innovations (CEPI): CureVac, Inovio, Institut Pasteur, Themis, University of Pittsburgh, Moderna, Novavax, University of Hong Kong, University of Queensland, and University of Oxford.



Source: Oxford University Clinical Research Unit

4. The Variety of Views on COVID-19: Perspective

In recent decades, there has been a series of viruses that have spread worldwide, and an ongoing battle against infection. This section describes these virus infections and their transmission in many countries as well as the ways these countries have tackled the outbreaks. COVID-19 has impacted human society and the world enormously, spreading our fears about viruses. Various countries have taken various measures, and this section hopes to show some measures and scenarios for the future.

The third research line of inquiry is primarily answered in my interview with Dr Ogawa as follows:

1) What are the regional and global trends of infectious diseases?

'Endemic is an epidemic that occurs in regions, countries, or limited areas, such as Japan-only or Tokyo- only. A pandemic is an epidemic that occurs

simultaneously worldwide.'

2) How has the behaviour against new infectious diseases changed in human history?

'Prevention is based on our long history of experiences, preventive strategies and treatments have changed dramatically at that time. In the past, there were times when there was no disinfectant, so people feel grateful for their existence. I think there will be better and more detailed measures suitable for the time.'

3) Are there any more infectious diseases that threaten people?

'New infectious diseases can occur at any time in the future. Both infectivity and mortality are high, and it is especially dangerous if a new infection develops without appropriate treatment. We need to be aware of this and be prepared to deal with the worst situations. It is important to deepen your knowledge of infectious diseases and live on a daily basis to protect people.'

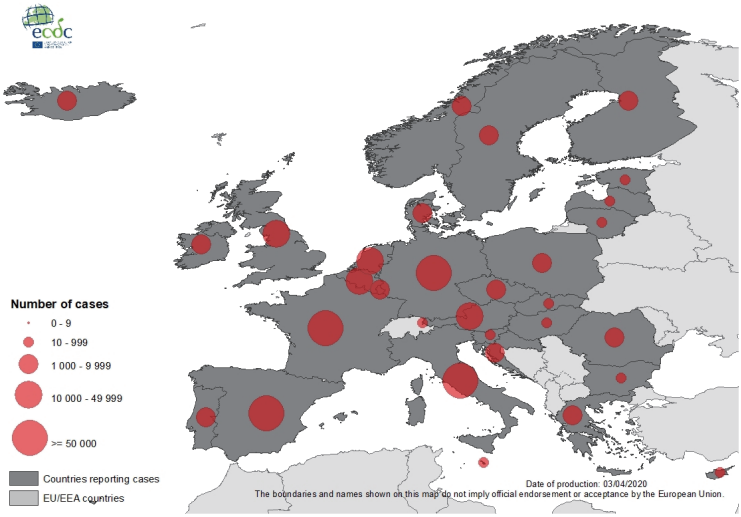
Source: The author's interview recorded 23 March 2020

According to Professor Bloom at Harvard, there will be an infectious disease threat in the twenty-first century. We need to cope with threats of known and unknown viruses, as well as the threat of antimicrobial resistance (AMR), at regional levels (i.e., local, national, regional and global) in order to strengthen the global response (Bloom, 2019).

4.1 European Situations: EU/EEA and the UK

As of 8 April 2020, overall large increases in COVID-19 cases and deaths continue to be reported from the EU/EEA countries and the UK. In addition, in recent weeks, the European all-cause mortality monitoring system showed excess all-cause mortality above the expected rate in Belgium, France, Italy, Malta, Spain, Switzerland and the UK, mainly in the age group of 65 years

Figure 13: Geographic distribution of laboratory-confirmed COVID-19 cases in the EU/EEA and the UK, as of 3 April 2020



Source: ECDC

old and above. **Figure 13** and **Figure 14** show the Geographic distribution in Confirmed Cases in the EU/EEA and the U.K.

According to ECDC (2020), 32% of the diagnosed cases have required hospitalisation and 2.4% have had severe illness requiring respiratory support and/or ventilation. The crude fatality rate was 1.5% among diagnosed cases and 11% among hospitalised cases. The likelihood of hospitalisation, severe illness and death increases in persons over 65 years of age and those with defined risk factors including hypertension, diabetes, cardiovascular disease, chronic disease, compromised immune status, cancer and obesity.

It is particularly observed that strain on health and social care systems and healthcare workers continues, with shortages reported in laboratory and testing capacity, personal protective equipment and healthcare capacity (including ICU ventilators and healthcare workforce capacity). In several

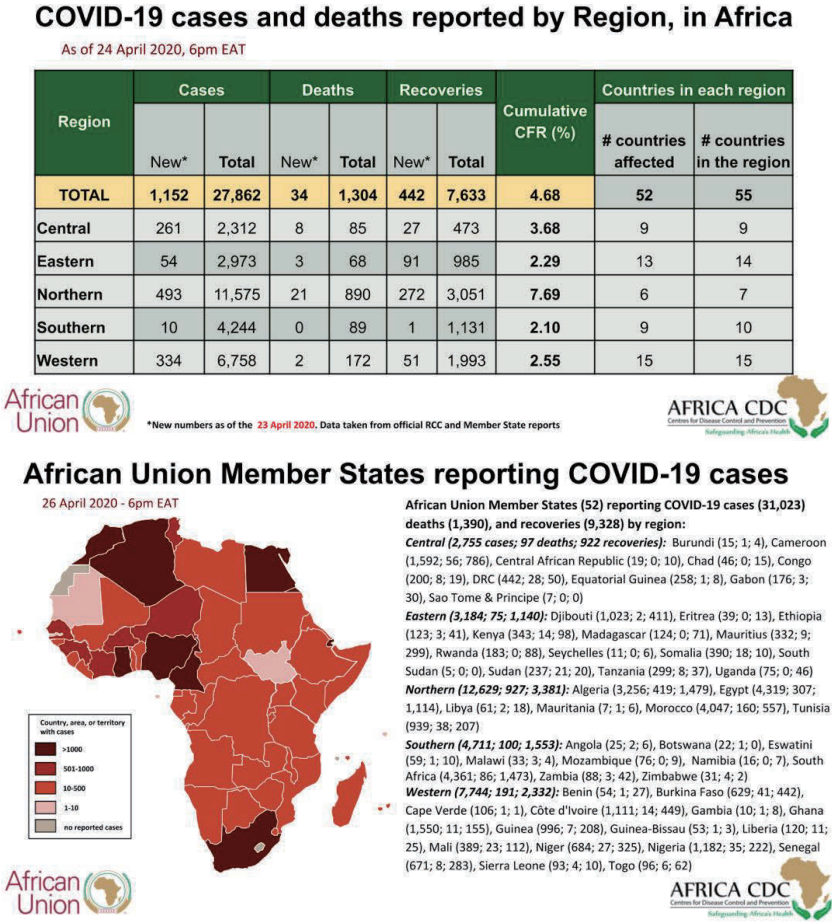
EU/EEA countries with available data, between 9% and 26% of all diagnosed COVID-19 cases are in healthcare workers. There are also increasing reports of COVID-19 outbreaks in nursing homes across Europe, highlighting the vulnerability of older people in long-term care settings and the importance of infection control measures to protect vulnerable populations.

4.2 African situations: African Union

Since the 14th of April 2020, 542,052 new confirmed Coronavirus disease 2019 (COVID-19) cases and 46,216 new deaths have been reported. This is a 31% increase in cases reported between 14-21 April 2020, compared to a 46% increase in cases reported between 7-14 April 2020. To date, a total of 2,316,039 COVID-19 cases and 157,896 (CFR: 7%) COVID-19-related deaths have been reported worldwide. This week, no new countries or territories have reported COVID-19 cases. This distribution of cumulative cases (proportion of global cases percentage) from the WHO reporting regions (excluding Africa) are as follows: Eastern Mediterranean Region 121,414 (5%), European Region 1,149,071 (50%), the Americas 858,631 (37%), Southeast Asia Region 29,576 (1%) and Western Pacific Region 133,150 (6%). For more detailed information on cases and deaths being reported outside of Africa, refer to the WHO daily situation reports.

Figure 14 shows, as of 9 a.m. EAT, 21 April 2020, a total of 23,505 COVID-19 cases and 1,158 (CFR: 5%) deaths have been reported in 52 African countries. Since the last brief, the number of COVID-19 cases has increased by 54% (8,221 cases). The five countries in Africa with the highest cumulative number of cases (proportion of reported cases in Africa) are Egypt (3,333; 14%), South Africa (3,300; 14%), Morocco (3,064; 13%), Algeria (2,718; 12%) and Cameron (1,163; 5%). When population is taken into account, Djibouti (85.6), Mauritius (25.8), Cabo Verde (12.1), Seychelles

Figure 14/15: COVID-19 cases and deaths reported by regions in Africa as of 24 April 2020



COVID-19 cases and deaths reported by Region, in Africa

As of 24 April 2020, 6pm EAT

Region	Cases		Deaths		Recoveries		Cumulative CFR (%)	Countries in each region	
	New*	Total	New*	Total	New*	Total		# countries affected	# countries in the region
TOTAL	**1,152**	**27,862**	**34**	**1,304**	**442**	**7,633**	**4.68**	**52**	**55**
Central	261	2,312	8	85	27	473	**3.68**	9	9
Eastern	54	2,973	3	68	91	985	**2.29**	13	14
Northern	493	11,575	21	890	272	3,051	**7.69**	6	7
Southern	10	4,244	0	89	1	1,131	**2.10**	9	10
Western	334	6,758	2	172	51	1,993	**2.55**	15	15

African Union

*New numbers as of the 23 April 2020. Data taken from official RCC and Member State reports

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African Union Member States reporting COVID-19 cases

26 April 2020 - 6pm EAT

African Union

African Union Member States (52) reporting COVID-19 cases (31,023) deaths (1,390), and recoveries (9,328) by region:

Central (2,755 cases; 97 deaths; 922 recoveries): Burundi (15; 1; 4), Cameroon (1,592; 56; 786), Central African Republic (19; 0; 10), Chad (46; 0; 15), Congo (200; 8; 19), DRC (442; 28; 50), Equatorial Guinea (258; 1; 8), Gabon (176; 3; 30), Sao Tome & Principe (7; 0; 0)

Eastern (3,184; 75; 1,140): Djibouti (1,023; 2; 411), Eritrea (39; 0; 13), Ethiopia (123; 3; 41), Kenya (343; 14; 98), Madagascar (124; 0; 71), Mauritius (332; 9; 299), Rwanda (183; 0; 88), Seychelles (11; 0; 6), Somalia (390; 18; 10), South Sudan (5; 0; 0), Sudan (237; 21; 20), Tanzania (299; 8; 37), Uganda (75; 0; 46)

Northern (12,629; 927; 3,381): Algeria (3,256; 419; 1,479), Egypt (4,319; 307; 1,114), Libya (61; 2; 18), Mauritania (7; 1; 6), Morocco (4,047; 160; 557), Tunisia (939; 38; 207)

Southern (4,711; 100; 1,553): Angola (25; 2; 6), Botswana (22; 1; 0), Eswatini (59; 1; 10), Malawi (33; 3; 4), Mozambique (76; 0; 9), Namibia (16; 0; 7), South Africa (4,361; 86; 1,473), Zambia (88; 3; 42), Zimbabwe (31; 4; 2)

Western (7,744; 191; 2,332): Benin (54; 1; 27), Burkina Faso (629; 41; 442), Cape Verde (106; 1; 1), Côte d'Ivoire (1,111; 14; 449), Gambia (10; 1; 8), Ghana (1,550; 11; 155), Guinea (996; 7; 208), Guinea-Bissau (53; 1; 3), Liberia (120; 11; 25), Mali (389; 23; 112), Niger (684; 27; 325), Nigeria (1,182; 35; 222), Senegal (671; 8; 283), Sierra Leone (93; 4; 10), Togo (96; 6; 62)

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Source: African Union and Africa CDC

(11.2), Morocco (8.3), Tunisia (7.4), Algeria (6.2), Equatorial Guinea (5.6) and South Africa (5.6) are reporting the most cases per 100,000 people in Africa. Thirteen countries report case fatality rates that are comparable to or higher

than the global cases fatality rate of 7%. Out of these, in countries with 100 cases or more, case fatality rates are highest in Algeria (14%), Sudan (11%), Egypt (8%), Democratic Republic of Congo (7%) and Burkina Faso (7%). See **Figure 15** for the full list of countries in Africa that report COVID-19 cases, deaths, and recoveries in addition to the epidemic phase in each country. Africa CDC is working with all affected countries and is mobilising laboratory, surveillance, and other response support where requested.

4.3 What has China done, and what can Great Britain do?

As is known, China has taken a strict measure to lock down all of Wuhan, which was effective in stopping the peak of viral transmission. Italy has also made similar measures. In Europe, Italy, France, Spain and Germany have locked down their whole countries. In China, it is believed that quarantine, social distancing, and isolation of infected populations could contain the epidemic. The Basic Reproductive Number (R0) is the mean number of secondary cases generated by one primary case. According to this paper, they calculate that approximately 60% of the population will become infected in the worst scenario. The Series Interval (SI) is estimated at 4.6 to 7.5 days, which is similar to that of SARS. The CFR is about 0.3 to 1%, and the incubation period is about 5 to 6 days (Source 12).

Utilising perspectives to combat COVID-19, here we use Great Britain as a case country to help determine what measures can be taken and what scenarios the country has in detail according to Ferguson's report: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand (published on 15 March 2020).

According to Ferguson et al. (2020), there are several scenarios for which Great Britain can take as actions by public health measures—so-called non-pharmaceutical interventions (NPI). This aims to reduce contact rates in the

population and to reduce the transmission of the virus. The team concludes that the effectiveness of any intervention is likely to be limited, requiring multiple interventions to be combined what the UK should take is for health care demands, such as the number of ICU beds, for example.

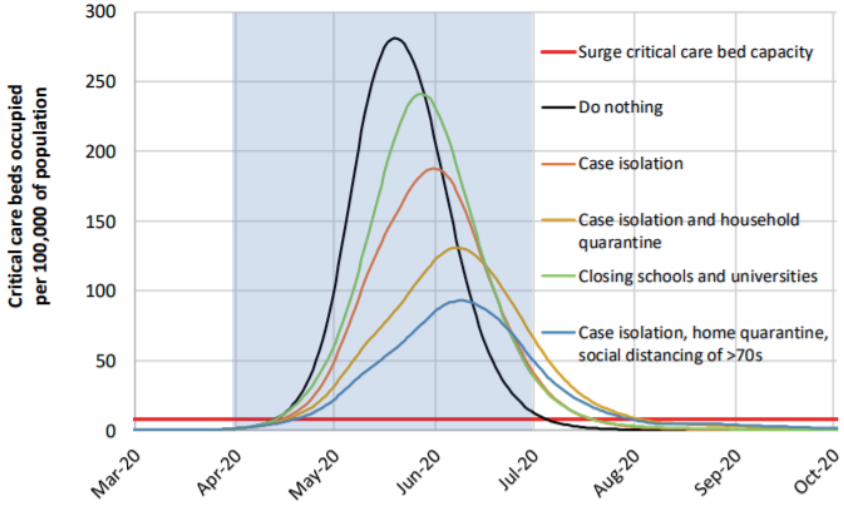
According to Ferguson's team (2020), 'Two fundamental strategies are possible: (a) mitigation, which focuses on slowing but not necessarily stopping epidemic spread – reducing peak healthcare demand while protecting those most at risk of severe disease from infection, and (b) suppression, which aims to reverse epidemic growth, reducing case numbers to low levels and maintaining that situation indefinitely'.

The goal of the COVID-19 pandemic is to keep the Basic Reproduction Number below one (R<1) when people are infecting fewer people on average. This goal will help slow down the spread of infectious diseases from person to person.

In **Figure 16**, there are six different-coloured lines that show different trends. The **black** line illustrates the unmitigated epidemic. The **green** line shows a suppression strategy that incorporates the closure of schools and universities. The **orange** line illustrates case isolation and household quarantine. The **red** line is the estimated surge ICU bed capacity in Great Britain. The **yellow** line is case isolation and household quarantine; lastly, the **blue** line is case isolation, home quarantine and social distancing of > the 70s. In the graph, there is a **light blue shaded area** which illustrates the 3-month period from April 2020 to July 2020, in which these interventions are assumed to remain in place.

The x-axis is the timeline from March to October 2020, and the y-axis is the number of critical care beds occupied per 100,000 people. The peaks of COVID-19 bed needs are coming by orders: 1) Do nothing, 2) Close schools and universities, 3) Case isolation, 4) Case isolation and household quarantine,

Figure 16: Mitigation strategy scenarios for Great Britain showing critical care (ICU) bed requirements

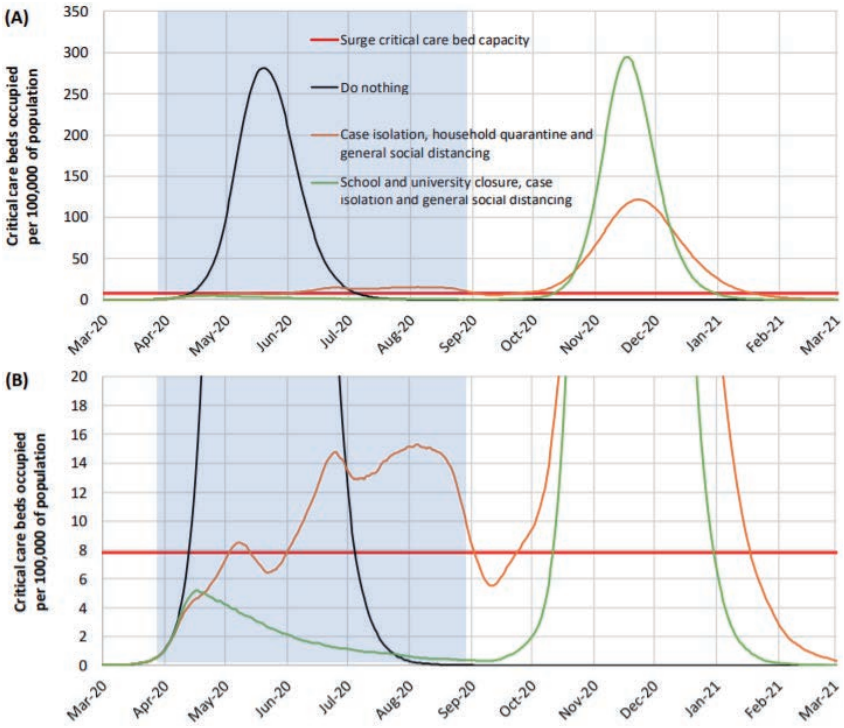


Source: Imperial College London

5) Case isolation, home quarantine and social distancing of >70s, and 6) Strict measure of public health measures. So, there were five scenarios Great Britain could take. For Great Britain, it was estimated that doing nothing rose up very high from May 2020 to the June and required about 275 beds per 100,000 people. As a policy decision, the British government started the lockdown on March 24.

In these graphs of **Figure 17**, there are four lines, which are used in many ways. In this case, the **black** line illustrates the unmitigated epidemic. The **green** line shows a suppression strategy that incorporates the closure of schools and universities, case isolation and population-wide social distancing starting in late March. The **orange** line illustrates a containment strategy incorporating case isolation, household quarantine and population-wide social distancing. Last, the **red** line is the estimated ICU bed surge capacity

Figure 17: Suppression strategy scenarios for Great Britain showing ICU bed requirements



Source: Imperial College London

in Great Britain. In the graph, there is a light blue shaded area which illustrates the five- month period from a few days before April until a few days before September, in which these interventions are assumed to remain in place. Graph B shows the same data as in panel A but zoomed in on the lower levels of the graph.

The x-axis of this graph is the timeline from March 2020 to March 2021, and the y-axis is the critical care occupied per 100,000 of population. Under the British National Health Service (NHS), it was estimated that there

are eight Intensive Care Unit (ICU) beds per 100,000 people. The peaks of COVID- 19 bed needs are coming by the following: 1) Do nothing, 2) Case isolation, household quarantine and general social distancing, and 3) School and university closure, case isolation and general social distancing. This suppression Strategy, if implemented for five months, has the potential to make the peak slow down and be lower and later. The strictest measure is the lockdown of entire countries.

4.4 Herd Immunity (Sweden), Lockdown (the UK) or City Lockdown (South Korea)?

What is the most effective way to stop viral transmission? According to immunology, herd immunity (HI) is the idea that if a certain proportion of people are immunized, they can protect others in the population from viral infection. Only Sweden is currently doing herd immunity. According to Professor Lipsitch at Harvard, a minimum percentage of her immunity is about sixty percent of the population. On the other hand, the UK had once tried to adopt this idea, but due to its unpopularity among people, the British Prime Minister Mr Boris Johnson changed the strategy from herd immunity to the whole country's lockdown.

Whilst the UK has been lock-downed and is currently seeking to lift restrictions. According to Professor Ferguson, 'Sweden is still seeing day-on-day increases in death and infection rates, whereas the UK's has fallen. The UK maintains the 0.8-0.9% infection-fatality rate. The lockdown strategy has been effective, but it is not sustainable in the long run. Lockdown has had a significant mental health and social impact on mortality in terms of not just isolating people, but in cancelled treatments. Health service capacity is a good guide for when to lift restrictions. There will have to be social distancing until a vaccine is developed, and we will not be a normal

society until then. The UK should employ the South Korean model, which has adapted city lockdown. On the other hand, Marcel Salathé and Nicky Case claim that contact tracing is an alternative to prevent long-term lockdowns or overwhelmed health systems (See also Appendix).

Lastly, unfortunately it is not clear as to what methods the Japanese government have been adapting since the government have not provided the people with the methods apart from social distancing clearly.

	Methods	Rules	Compensations (Social Security)	Social Distance
Sweden	Herd Immunity, Contact tracing with low PCR test rate	By law	No	No
The UK	Lockdown with low PCR test rate, and Antibody tests being introduced	By Law	Yes (80% of incomes)	Yes
South Korea	City lockdown with high PCR test rate	By Law	No	Yes
Japan	Search for clusters with low PCR test rate	Voluntary actions; Requests by the Government	No	Yes

n.b. Produced from the author's research notes

4.5 The Role of International Organisations

What can international organisations do?

On March 11, the World Health Organization (WHO) declared COVID-19

a global pandemic, which triggered a set of regulations and made resources available to nations to help them combat the virus. Can WHO provide a clear guidance to countries facing a health crisis? How effective is this arrangement? Who's WHO?

There are many reports of worldwide endemics, epidemics and pandemics published by WHO, CDC (U.S.), ECDC (EU), ACDC (AU), CEPI (International Non-Governmental Organisation), and UNICEF. Those reports include information about malaria, tuberculosis (TB), AIDS, SARS, MERS and so on.

However, WHO has been in the centre of attention. It has been predicted that there would be more new fatal contagious diseases than before, which makes it difficult to find an effective solution by preventive measures or treatments for the infected patients. There was a quote from the UN Secretary-General António Guterres on 25 March 2020, which was 'COVID-19 is menacing the whole of humanity – and so the whole of humanity must fight back'. However, some argue that the WHO has not been playing a major role in the COVID-19 issue. This claim has been made by most G7 member states (the U.S., Canada, Germany, the UK, France, Italy and Japan), and the U.S. President Donald Trump and the French President Macron have agreed to a reform plan to the WHO. In addition, the U.S. President Trump has been confrontational against China because of the virus' origin and China's lack of information about the situations in Wuhan city. The majority of G7 member states agreed to investigate a controversial laboratory, the Wuhan Institute of Virology, but the Chinese government declined the investigation immediately.

On the other hand, two international organisations, the United Nations International Children's Emergency Fund (UNICEF) and the United Nations Educational, Scientific and Cultural Organization (UNESCO),

are playing crucial roles in the child mortality issue and also concerned with school closures in the world since 1.37 billion students are now home. As COVID-19 school closures expand, ministers scale up multimedia approaches to ensure learning continuity and have recommended that students start online learning and courses. As a result, UNESCO has made more progress with digital and distance learning in the past 10 days than in the past 10 years. UNESCO has been taking several actions that mainly concern children who lack education. They are utilising social media tools to maintain the relationships between teachers and students and try to keep their motivation up. UNESCO is highly focused on making teachers responsible for the education process and offering virtual learning courses (UNESCO). With 1.37 billion students now home as school closures due to COVID-19 expand, school ministers scale up multimedia approaches to ensure learning continuity.

According to Professor Bloom (2018), 'there are several regional levels, which are local, national, regional and global.' These regional levels are used in a variety of ways. According to the academic journal Infectious Disease Threats, the world has created a global health system as a bulwark against known and unknown infectious virus threats, which consists of different organisations with various stakeholders.

It is crucial for us to fully understand the backgrounds of infectious diseases, their transmission, and how to control them. Recent history has certainly changed our view and knowledge of infectious diseases and their treatments and has progressed our history of controlling infections.

5. The Three Main Infectious Diseases and Medicine for COVID-19

5.1 Malaria

1) The main cause of malaria is usually infected female Anopheles mosquitos, which only appear in warm countries. Symptoms usually start after 10–15 days after the bite of the mosquito. The first few symptoms are fevers, headaches, and chills; however, they are mild and are difficult to recognize as malaria. If not treated within 24 hours after the bite, malaria could lead to severe illness, often leading to deaths (WHO, Malaria, 2020).
2) There is a type of medicine called **chloroquine,** which is used to treat malaria; it could also be a safe treatment for COVID-19. It is said that it has low-risk side effects when used as treatment. There are also other interventions used to prevent and cure malaria, such as vector control and insecticides; however, the Anopheles mosquito could become immune to the insecticides (WHO, Malaria, 2020).
3) There are five species of Plasmodium that can infect humans and cause illness. Those five species are Plasmodium falciparum (P. falciparum), Plasmodium malariae (P. malariae), Plasmodium vivax (P. vivax), Plasmodium ovale (P. ovale), and Plasmodium knowlesi (P. knowlesi).
4) Falciparum malaria is life-threatening. Patients with severe falciparum malaria could develop liver and kidney failure, convulsions, and coma. Although every now and then severe, infections with *P. vivax* and *P. ovale* in general cause less serious illnesses, but the parasites can remain asleep in the liver for several months, causing a reappearance of symptoms months or even years later.

5.2 TB

1) Tuberculosis is a deadly virus which remains the world's most fatal infectious disease, and it has been considered a global public health emergency for the past twenty-five years. Over 4,000 people are killed and around 30,000 people become ill from this preventable and curable infectious disease every day. It is often caused by a specific type of bacteria called *Mycobacterium tuberculosis* (Latin), which spreads similarly to the common cold or flu, but it is not as contagious. However, in some cases, children or people with TB that occurs outside the respiratory system do not spread the bacteria to others (*The Lancet*, Jennifer Furin, Helen Cox, Madhukar Pai, Tuberculosis: 2020).
2) In the past five years, with the introduction of two new drugs, **bedaquiline**, which is recommended by WHO as a core medicine in the treatment of rifampicin-resistant tuberculosis, and dexaminid, the treatment landscape for tuberculosis has dramatically changed. In previous studies, patients who received bedaquiline had a higher treatment success compared with those who received injectable agents, and a delay in bedaquiline initiation was significantly associated with mortality.
3) There are two types of TB conditions: latent TB infection and TB disease. These two types could develop when they become active. That would then cause the patient to become infectious and spread TB. However, at only several stages of TB will the infected person have symptoms, which could be mild or severe.

5.3 AIDS

1) The main causation of HIV is monkeys and great apes. Scientists have

made great progress in tracing the history of HIV utilizing advanced genetic and biochemical strategies. The people living with HIV tend to be most infectious in the first few months after being infected; many people are not aware of their status until the later stages. In the first few weeks after initial infection, people may experience no symptoms or an influenza-like illness that includes fever, headache, rash, or sore throat. This leads people to not recognise their infection as AIDS (Coursera: University of Michigan, AIDS: fear and hope. Week 1, Lesson 3, video 01.08-HIV, other viruses, other species, virus hunters).

2) There is a treatment used for HIV/AIDS, anti-retroviral drugs. They have made an enormous difference to people with HIV infection, and drug treatments help to reduce the HIV virus in the body while keeping the immune system as healthy as possible and decreasing the complications that may be developed (The Smartest Targets for the World (2015), 14. Infectious Diseases – Ebola Kills Fewer than AIDS, TB and Malaria. What Should We Prioritize, p. 71).
3) There are two forms of HIV, HIV-1 and HIV-2. HIV-1 has caused most of the AIDS cases around the world. HIV-2 infections have been limited to Africa. This is the reason why HIV-2 does not progress to AIDS as frequently as HIV-1. In addition, HIV-2 is less contagious than HIV-1. Genetically, there is significant divergence between HIV-1 and HIV-2 (Coursera: University of Michigan, AIDS: fear and hope, Week 1, Lesson 3, video 01.08-HIV, other viruses, other species, virus hunters).
4) There is a medicine currently utilised to treat HIV infection that could be effective for COVID-19. The medicine is a **combination of lopinavir and ritonavir**. It has a positive effect on those with mild symptoms, but it is not as effective in severe COVID-19 patients (The New England Journal of Medicine, B. Cao, Trial of Lopinavir & Ritonavir in Adults

Hospitalised with Severe Covid-19: 2020).

6. Conclusions

In conclusion, some medicines currently utilised to treat infectious diseases could be effective in the treatment of other viruses. However, it should be emphasised that antibiotics are not effective and cannot be used against COVID-19. This is related to how our immune systems fight against the virus. The use of antibiotics to treat COVID-19 could even cause much more severe impacts on some organs. The three biggest preventable and curable infectious diseases affecting humanity are HIV, tuberculosis (TB) and malaria. People infected with these diseases could be vulnerable to COVID-19 as well. Since most of the attention has been drawn to the novel coronavirus, prevention and treatment programmes for HIV, TB and malaria have been disrupted.

The current COVID-19 issues have had enormous effects on the population of the whole world. The death toll is increasing every day. However, it should also be noted that the death count caused by these three main infectious diseases is more than five million every year, and Sustainable Development Goals' Goal 3: Good Health and Well-being' has a very important role in achieving the SDGs. This also connects to the seventh target in Goal 3, which is 'Making people aware of global health risks. In my opinion, it seems that most people are now aware of the COVID-19 issue; however, they were unaware of the danger it had posed. In my perspective, the only way to help everyone is to break the chain of asymptomatic transmission.

Glossary:

Epidemiology- Population Health by statistical analysis

Immunology- An academic discipline of the immune system

Virology- An academic discipline of studies about viruses
WHO- World Health Organization
CDC- Centre for Disease Prevention and Control
ECDC- European Centre for Disease Prevention and Control
CEPI- Coalition for Epidemic Preparedness Innovations
UNICEF- United Nations International Children's Emergency Fund
UNESCO- United Nation Educational, Scientific and Cultural Organization

Bibliography:

Primary sources:

The author's interview to Dr Ogawa, MD, Ph.D. recorded on 23rd March 2020 (30 minutes)

Online courses (attended whole courses):

Imperial College London, *Science Matters: Let's talk about COVID-19*, *Coursera.*
Imperial College London, *Foundations of Public Health Practice: Health Protection*, *Coursera.*
London School of Hygiene and Tropical Medicine, *COVID-19*, *Futurelearn*.

Secondary sources (books, academic journal articles and journals of *the British Medical Journal, The Lancet, Nature, Nature Medicine, Science, the New England Journal of Medicine*):

Adepoju, P. (2020) Tuberculosis and HIV responses threatened by COVID-19, *The Lancet HIV*, April 8, 2020, pp.1-2.
Adhikari, S. et al (2020). Epidemiology, causes, clinical manifestation & diagnostics, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review, BMC.
Ahmed, F. (2020). Why inequality could spread COVID-19, *The Lancet Public Health* 2020 Published Online April 2, 2020.
Anderson, R. et al (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic?, *The Lancet*
Armocida, B. (2020). The Italian health system and the COVID019 challenge, *The Lancet Public Health* 2020 Published Online, March 25, 2020

Aronson, L. (2020). Age, Complexity, and Crisis – A Prescription for Progress in Pandemic, *the New England Journal of Medicine,* April 14, 2020, pp.1-3.

Atchison, C. et al (2020). Report 10: Public Response to UK Government Recommendations on COVID-19: Population Survey, 17-18 March 2020, Imperial College COVID-19 Response Team.

Atkinson, B. et al (2020). SARS-CoV-2 shedding and infectivity, *The Lancet.*

Becker, N. et al (2019). *Modeling to Inform Infectious Disease Control*, Chapman & Hall/CRC Biostatistics Series, CRC Press.

Bhatia. S et al (2020). *Report 6: Relative sensitivity of international surveillance*, Imperial College COVID-19 Response Team.

Blanco. J et al (2020). COVID-19 in patients with HIV: clinical case series, *The Lancet*

Bloom, E., et al (2018). New and resurgent infectious diseases can have far-reaching economic repercussions, *Epidemics*, pp.46-49.

Bloom. D et al (2019). Infectious Disease Threats in the Twenty First Century: Strengthening the Global Response, *Frontiers*.

Bozorgmehr, K. (2020) COVID and the Convergence of three crises in Europe, *The Lancet Public Health 2*020 Published Online April 3, 2020.

Bozorgmehr. K et al (2020). COVID and the convergence of three cities in Europe, *The Lancet*

Britton, T. (2020). *Basic estimation-prediction techniques for Covid-19, and a prediction for Stockholm*, Stockholm University.

European Commision (2020). *COVID-19: Commission sets out European coordinated response to counter the economic impact of the Coronavirus,* European Commission – Press release.

Cao. B et al (2020). Trial of Lopinavir & Ritonavir in Adults Hospitalised with Severe Covid-19, *The New England Journal of Medicine*.

Chan. Y (2020). The outbreak of COVID-19: An overview, 1, *EJCMA*.

Chen, Y. et al (202) Infants Born to Mothers With a New Coronavirus (COVID-19), *Frontiers in Paediatrics,* 16 March 2020, Vol. 8, Article 104, pp.1-5.

Coronavirus COVID-19 Global Cases by the CSSE at Johns Hopkins University (JHU) Corvetti, L. (2020) Deconstructing the Covid-19 Corona Virus, published

on March 2020.
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 2, Video: An introduction to vaccines, Online Course
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 2, Video: Vaccine preventable disease, Online Course
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 3, Video: Fukushima and the public health impacts, Online Course
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 3, Reading: Major incidents and emergency planning, Online Course
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 3, Video: Conclusions to the course, Online Course
Coursera: Imperial College London, Foundations of Public Health Practice: Health Protection, WEEK 3, Reading: Course 5: The Emerging Public Health Practitioner, Online Course
Coursera: Stanford University, Stories of Infection, WEEK 1, Alphabetical Glossary of All Term from the Course, Online Course
Coursera: Stanford University, Stories of Infection, WEEK 6 Other Infectious Pathogens, Video: Protozoa: Malaria, Online Course
Coursera: University of Geneva, Global Health: An Interdisciplinary Overview, WEEK 3, Lesson 3: Risk Communication in the context of Pandemics/Epidemics by Claudine Burton-Jeangros, Online Course
Coursera: University of Michigan, AIDS: fear and hope, WEEK 1, Lesson 3, Video 01.01: Mini intro (1) Terminology, Stigma, Online Course.
Coursera: University of Michigan, AIDS: fear and hope, WEEK 1, Lesson 3, Video 01.08: HIV, other viruses, other species, virus hunters, Online Course
Dhama, K. (2020). An Update on SAR_CoV-2/COVID-19 with Particular Reference on Its Clinical Pathology, Pathogenesis, Immunopathology and Mitigation Strategies – A Review, 23 March 2020.
Dhama, K. et al (2020). Coronavirus Disease 2019 – COVID-19, published on February 2020.

Dowd. J et al (2020). Demographic science aids in understanding the spread and fatality rates of COVID-19, PNAS

ECDC (2020) Contact tracing: Public health management of persons, including healthcare workers, having had contact with COVID-19 cases in the European Union – first update, ECDC, 31 March 2020.

ECDC (2020). Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK – eight update, 8 April 2020.

Ferguson, N. et al (2020), Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand, Imperial Collage COVID-19 Response Team report.

Furin J et al (2020). Tuberculosis, *The Lancet*.

Futurelearn, COVID-19 Week 1: Overview of the Coronavirus and COVID-19, LSHTH.

Gaythrope, K. et al (2020). Report 8: Symptom progression of COVID-19, Imperial College COVID- 19 Response Team

Ghinai, I. et al (2020). First known person-to-person transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the USA, *The Lancet*

Ghosh. S, Rahi. M et al (2020). Malaria elimination in India – The way forward, JVBD

Grein, J. et al (2020) Compassionate Use of Remdesivir for Patients with Severe Covid-19, *the New England Journal of Medicine*, pp.1-10.

Hollander, J. et al (2020). Virtually Perfect? Telemedicine for Covid-19, *The New England Journal of Medicine*.

Hu, Z. et al (2020). Infodemiological study on COVID-19 epidemic and COVID-19 infordemic, ResearchGate.

Imperial College London (2020). *Science Matters: Let's talk about COVID-19* Online course: *Coursera*.

Ingravallo, F. *(2020)* Death in the era of the COVID-19 pandemic, *The Lancet Public Health* 2020 Published Online April 2, 2020

Jiang, H. et al (2020). Maintaining HIV care during the COVID-19 Pandemic, *the Lancet HIV*, April 6, 2020, pp.1-2.

Jin, Z. et al (2020). Structure of M^{pro} from COVID-19 virus and discovery of its

inhibitors, *Nature*.

John Watkins (2020). Cardiff, UK, preventing a COVID-19 Pandemic We need to think beyond containment, BMJ.

Kissler *et al*., (2020). Projecting the transmission dynamics of SARS-CoV-2 through the post pandemic period *Science* 10.1126/*Science*. abb5793.

Kurian, N. (2020) Novel Conoravirus (COVID-19), published on 6th April 2020.

Lai, S. et al (2020). Effect of non-pharmaceutical interventions (NPIs) for containing the COVID-19 outbreak: on modelling study, Imperial College COVID-19 Response Team report.

Lai, S. et al (2020). Preliminary Risk analysis of 2019 Novel Coronavirus spread within and beyond China, University of Southampton.

Lan, J. et al (2020). Structure of the SARS-CoV-2 spike receptor-binder domain bound to the ACE 2 receptor, *Nature* accelerated article published on 30 March 2020.

Lancet Editorial (2020). Pandemic school closures: risks and opportunities. *The Lancet Child Adolescent Health* published on April 8, 2020.

Liu, F. et al (2020). Patients of COVID-19 may benefit from sustained lopinavir-combined regimen, *International Journal Infectious Diseases*.

Lomborg, B. et al (2015). *The Smartest Targets for the World*, Chapter 14: Infectious Diseases - Ebola Kills Fewer than AIDS, TB and Malaria. What Should we Prioritize, pp.71-79.

Lu, X. et al (2020). SARS-CoV-2 Infection in Children, *The New England Journal of Medicine*.

Lurie, N. (2020) Developing Covid-19 Vaccines at Pandemic Speed, *The New England of Medicine, published on April 2, 2020*.

Lurie, N. et al (2020). Developing Covid-19 Vaccines at Pandemic Speed, *The New England Journal of Medicine*.

Matamalas, J. et al (2020*).* Effective approach to epidemic containment using link equations in complex networks, *Science Advances*.

McCartney, M. et al (2020). The art of medicine Medicine: before COVID-19, and after, *The Lancet*

McCartney, M. (2020) The art of medicine: before COVID-19, and after, *The Lancet,*

Published Online March 31, 2020

Mitja, O. (2020). Experts request to the Spanish Government towards complete lockdown, *The Lancet, March 26, 2020, pp.1-2.*

Murphy, A. et al (2020). Economic sanctions and Iran's capacity to respond to COVID-19, *The Lancet Pubic Health*, April 6, 2020, pp.1-2.

Peacock, S. et al (2020). *PHE Infectious Diseases Strategy 2020-2025 Addressing urgent threats in the 21st century*, Public Health England.

Plotkin, S. et al (2020). *The New Coronavirus, the Current King of China*, Plokin Column

Ritchie, A. (2020) Immunosuppression for hyperinflammation in COVID-19: a double-edged sword?, *The Lancet*, Vol. 395, April 4, 2020.

Rodriguez-Morales et al (2020). COVID-19, an Emerging Coronavirus Infection: Current Scenario and Recent Developments – An Overview, *Pure Appl. Microbiology*., 14(1), March 2020, Article 6150, pp.1-8.

Rosenbaum, L. et al (2020). *F*acing Covid-19 in Italy – Ethics, Logistics, and Therapeutics on the Epidemic's Front Line, *The New England Journal of Medicine*.

Ruan, S. et al (2020). *Likehood of survival of coronavirus disease 2019*, *The Lancet*.

Russel, T. et al (2020). Estimating the infection and case fatality ratio for coronavirus disease (COVID-19) using age-adjusted data from the outbreak on the Diamond Princess cruise ship, February 2020, *European Surveillance*, 2020; 25(12): pii.

Sands, P. et al (2020). COVID-19 Threatens the Poor and Marginalized More than Anyone, *The Lancet*.

Sharma, H. et al (2020). *An Introduction to Sustainable Development Goals*, Goal 3: Good Health and Well-Being, 3.2 The targets to be achieved, pp: 30.

Sherlock, P. et al (2020). Bearing the brunt of covid-19: older people in low and middle income countries, *BMJ*.

Smith, P. et al (2020). Infection Control Through the Ages, Elseiveir.

Springer Nature Limited (2020). Pick of the coronavirus papers: vaccine from viral spikes holds promise, *Nature*.

Sutton, D. et al (2020) Universal Screening for SARS-CoV-2 in Women Admitted

for Delivery, *The Lancet*, April 14, 2020, pp.1-2.

Thompson, H. et al (2020). Report 7: Estimating infection prevalence in Wuhan City from repatriation flights, Imperial College COVID-19 Response Team report.

Thwaites, R. et al (2020). COVID-19: Lessons from SARS and MERS, ResearchGate.

Thwaites, R. et al (2020). COVID-19: Lessons from SARS and MARS, *European Journal of Immunology*, 2020.50:308-316.

UNESCO (2020). 1.37 billion students now home as COVID-19 school closures expand, ministers scale up multimedia approaches to ensure learning continuity, *UNESCO report.*

United Nations (2020). UN Chronicle, Scott. E, The Fight Against AIDS, Tuberculosis and Malaria – Past Progress and Hope for the Future, UN Report.

Velavan, T. et al (2020). The COVID-19 epidemic, *the Tropical Medicine and International Health*, Vol.25 No 3pp.278-280, March 2020.

Vynnycky, E. et al (2020). *An introduction to infectious disease modelling*, Chapter 1, Introduction The basics: infections, transmission and models, 1.2 Infections, 1.

Vynnycky, E. et al (2020). *An introduction to infectious disease modelling*, Chapter 1, Introduction The basics: infections, transmission and models, 1.2 Infections, **Table 1**.1 Summary of the different kinds of infectious agents, 2.

Vynnycky, E. et al (2020). *An introduction to infectious disease modelling*, Chapter 1, Introduction The basics: infections, transmission and models, 1.2 Infections, Fig 1.1, 3.

Walker, P. et al (2020). *The Global Impact of COVID-19 and Strategies for Mitigation and Suppression*, Imperial College COVID-19 Response Team.

Watkinson, J. (2020). Preventing a COVID-19 Pandemic We need to think beyond containment, *the British Medical Journal.*

Week 1: How Infectious is the Virus? By the London School of Hygiene and Tropical Medicine.

Weiss, T.G., Daws, S. (eds)(2007). The Oxford Handbook on the United Nations, Oxford: Oxford University Press.

Wenham, C. et al (2020). *COVID-19 the gendered impacts of the outbreak*, *The Lancet*

Willan, J. et al (2020). Care of haematology patients in a COVID-19 epidemic, *ResaerchGate*.

World Bank Group (2017). *Atlas of Sustainable Development Goals*, Sustainable Development Goals, Goal 3 Good Health and Well-Being Ensure healthy lives and promote well-being for all at all ages, 3b, 15

World Bank Group (2017). *Atlas of Sustainable Development Goals*, Sustainable Development Goals, Goal 3 Good Health and Well-Being Ensure healthy lives and promote well-being for all at all ages, 3c, 15

World Bank Group (2018). *Atlas of Sustainable Development Goals*, Sustainable Development Goals and Targets, Goal 3 Ensure healthy lives and promote well-being for all at all ages, 3.3, 70

World Bank Group (2018). *Atlas of Sustainable Development Goals*, Sustainable Development Goals and Targets, Goal 3 Ensure healthy lives and promote well-being for all at all ages, 3.8, 71

World Bank Group (2018). *Atlas of Sustainable Development Goals*, Sustainable Development Goals and Targets, Goal 3 Ensure healthy lives and promote well-being for all at all ages, 3.b, 71

World Bank Group (2018). *Atlas of Sustainable Development Goals*, Sustainable Development Goals and Targets, Goal 3 Ensure healthy lives and promote well-being for all at all ages, 3.d, 71

Wynants, L. et al (2020). Prediction models for diagnosis and prognosis of covid-19 infection: systematic review and critical appraisal, *BMJ*.

Xiong, N. Wang. T, Lin. Z et al (2020). *Invisible spread of SARS-CoV-2*, *The Lancet*.

Xu, B. et al (2020) Epidemiological data from the COVID-19 outbreak, real-time case information, *The Nature Scientific Data*, (2020) 7_106., pp.1-6.

Xu, S. et al (2020) Beware of the second wave of COVID-19, *The Lancet* April 8, 2020, pp.1-2.

Xu, Z. et al (2020). Pathological findings of COVID-19 associated with acute respiratory distress syndrome, *The Lancet*.

Yamey, G. (2020). Ensuring global access to COVID-19 vaccines, *The Lancet*, Published Online March 31, 2020

Zhang, Y. (2020) Ninety days in: A Comprehensive Review of the Ongoing

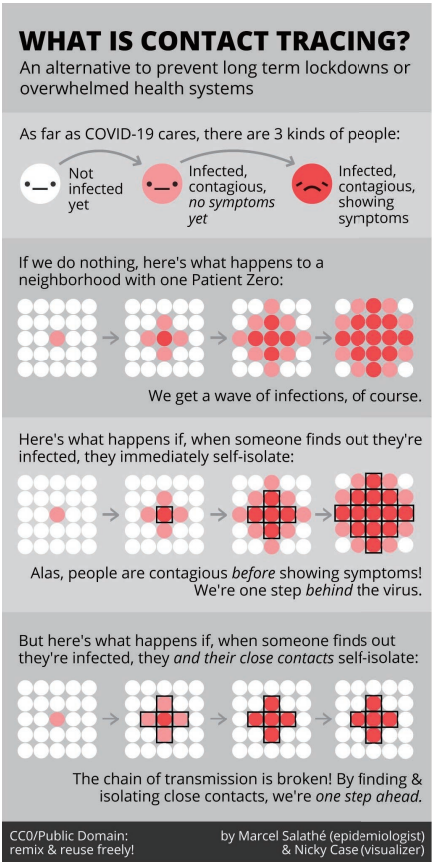
COVID-19 outbreak, *Health Science Journal* Vol. 14, No. 2: 706., pp.1-13.

Zhou, F. et al (2020). SARS-CoV-2 shedding and infectivity, *The Lancet*, April 15, 2020.

Zlojutro, A. et al (2020). A decision-support framework to optimize border control for global mitigation,

Scientific Reports.

APPENDIX:



Source: Marcel Salathé and Nicky Case