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The effect of advances in transportation on the spread of the coronavirus disease: The last is Africa and endemic

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Significance for Public Health
Based on the history of infectious diseases and previous studies related to the coronavirus, the transmission of COVID-19 is closely related to transportation. And it is likely to be indigenous in Africa. Finally, COVID-19 will be one of the biggest challenges for public health in Africa.

Abstract
For a long time in the future, transportation will be used only by limited systems that are quarantine friendly. Besides, depending on the circumstances, international or inter-regional travel may be restricted. However, the African continent comprises mostly of developing countries with poor healthcare systems and low health literacy. As a result, it is highly likely that Africa could suffer greater damage than any other region once an outbreak occurs. The fact that countries in Africa must be most concerned about is that COVID-19 may become endemic, and the outbreak may continue for a very long time.

Introduction

After the Chinese government reported cases of pneumonia of an unknown cause in Wuhan, Hubei province, in December 2019, the World Health Organization (WHO) officially defined the causative virus of that disease as "severe acute respiratory syndrome coronavirus 2" on February 11, 2020.[1)]This disease, which is technically known as the coronavirus disease (COVID-19), is currently called COVID-19 for convenience. After the initial report, COVID-19 began to spread to all parts of the world, and on February 24, 2020, the WHO announced that “for the moment, we are not witnessing the uncontained global spread of this virus”.[2] However, on March 11, 2020, just 23 days after that announcement, the WHO declared the COVID-19 outbreak a global pandemic.[3] The COVID-19 pandemic has become the worst global pandemic in the 21st century. COVID-19 is an infectious disease with potent infectivity and a high fatality rate. It presents with flu-like symptoms, such as fever or chills, cough, fatigue, sore throat, runny nose, muscle pain, and headache.[4] The fatality rate of COVID-19 is known to be approximately 2%, but the exact rate varies widely between countries, with fatality rates ranging from 0.1% to 25% of confirmed cases.[5] In other words, although COVID-19 presents with flu-like symptoms, it has much higher infectivity and mortality rates than the flu. For this reason, many countries have closed their borders or placed restrictions on inter-regional travel since the start of the COVID-19 pandemic to prevent/control the spread of the disease. However, are forced travel restrictions and regional closures appropriate methods for protecting the public from COVID-19? If so, are they effective? The objective of this review was to evaluate the historical events related to advances in transportation and the spread of infectious diseases to help address these questions, and to rationally assess and present the progress on COVID-19, transportation, and population movement to date.

ADVANCES IN TRANSPORTATION AND THE GLOBAL SPREAD OF INFECTIOUS DISEASES

Historical cases

Throughout much of history, humans have been confined to regionally isolated lives. However, a wide range of contacts between humans and animals have taken place in relatively recent years. Moreover, modern advances in transportation have made it easier for people to be affected by variants of existing diseases or completely new diseases.[6] Transmission of an infectious disease can be divided into transmission by a carrier and transmission by humans, *i.e.*, transmission from an infected person. As a result of climate change and increased international travel via ships and airplanes, yellow fever and dengue fever have been spread by *Aedes aegypti*, Japanese encephalitis by *Aedes japonicus*, and malaria by the Anopheles mosquito, indicating that physical distance is no longer a major barrier for disease-carrying vectors.[6,7]

However, the spread of infectious diseases by vectors and by humans is increasing. The primary vectors responsible for the plague, which occurred in the early 20th century and mostly in port cities, were humans, not rats.[8] This indicates what the primary mode of transportation was at the time while also alluding to how the disease may have been introduced to that region (center of transportation).[6] The acquired immunodeficiency syndrome (AIDS) epidemic is suspected to have begun during the 1970s or 1980s, with travel or the sexual activities of

individuals, including immigrants, drug addicts, travelers, truck drivers, soldiers, and sailors, contributing to its worldwide spread.[9] Advances in transportation during the 20th century, including aviation and shipping, led to global outbreaks of influenza.[10] There have been global outbreaks of novel coronavirus diseases similar to COVID-19, such as the severe acute respiratory syndrome in 2002 and the Middle East respiratory syndrome in 2012. The outbreaks of these diseases demonstrate how the movement of a population could lead to the worldwide spread of an infectious disease.[11,12] The route of influenza infection has become more diverse due to advances in air and ocean transportation, leading to a global epidemic. Moreover, influenza could be mutated so that the human immune system cannot properly respond to it. Interestingly, it was predicted in 2005 that millions of people could die if outbreaks of influenza, mutated to be ignored by the immune system, occur via various routes, and there are no response measures in place.[13] The number of COVID-19-related deaths surpassed 900,000 as of mid-September 2020, whereas the number of deaths, including unofficial deaths, is expected to continue increasing for the time being.[14]

Transportation and spread of the COVID-19

Historically, transportation has had a significant impact on the spread of infectious diseases. Furthermore, before the 20th century, it was slow and difficult for infectious diseases to spread worldwide. The 1918 flu pandemic (Spanish Flu) spread rapidly, and it is estimated that 500 million people were infected, and nearly 100 million died. This is one of the first examples to show that infectious diseases are spreading faster and more widely through modern transportation.[15] It is obvious that transportation also has an impact on the worldwide spread of COVID-19. The advent of commercial flight has allowed infectious diseases to spread much faster and more widely than ever before. The number of people who use commercial flights per year is over 3 billion.[6] Since an airplane is an enclosed space and air travel would require an infected person to be in the same place for a relatively long time, a commercial flight could become a catalyst for spreading infection inside an airplane, causing even more people to become infected.[12] This mode of transmission applies to COVID-19 as well,[16] and not only for airplanes but also with all modes of transportation that utilize similar environments. It has already been identified that high transmission of COVID-19 occurs between passengers of cruise ships due to the enclosed environment on cruise ships and the high population densities of such cruises.[17] Moreover, the fact that cruise ships travel from country to country impacts the spread of COVID-19 between countries.[18] For these reasons, European countries such as France, Switzerland, and Austria,[19] in addition to South Asian countries, closed their borders to stop the spread between countries.[20]

On January 23, 2020, the Chinese government issued strict orders for quarantine and inter-regional travel bans for people living in Wuhan and 16 other cities;[21] this represented a quarantine order that involved 45 million people. However, by the time the travel restriction order was issued, China was already in the middle of the New Year holiday, and spring festivals had already begun two weeks earlier, meaning that several hundred million people had been moving around the country.[22] Consequently, it was determined that such extensive movement of the population significantly impacted the spread of COVID-19.[23] Moreover, travel

restrictions and quarantine policies delayed the spread of the epidemic from Wuhan to other mainland areas by only three to five days.[24] It was determined that the implementation of containment measures to close the areas affected by the outbreak of the disease was too late. Border closure or the containment of the area where the disease outbreak occurred means banning the movement of people from one region to another, and because modern society relies mostly on modes of transportation for such movement, this, in essence, means the restriction of transportation. A study by Lee[25] in South Korea reported that domestic automobile traffic influenced the spread of COVID-19, whereas a study by Zaho[26] in China indicated a correlation between domestic train transportation and the outbreak of COVID-19. Based on these findings, it is believed that the amount of traffic can influence the outbreak of COVID-19.

POST COVID-19

The human desire to be active

The 1994 plague in India demonstrated that many people were more concerned about economic damage than the deaths from the plague.[27] The current scenario of the COVID-19 pandemic is similar. People worry about dying from the disease, but they may have a greater fear of the global economic downturn, individual unemployment, and loss of income. The global economy has already taken a considerable downturn due to COVID-19.[28,29] The desire for economic activity and the desire to be safe from COVID-19 are conflicting. Consequently, each country worldwide will attempt to restart economic activities once the COVID-19 pandemic stabilizes, which would entail revitalizing domestic and international travel. However, this disease has a high infectivity rate, and new variants of the virus are continuously being identified.[30,31] This means that the number of confirmed COVID-19 cases may exhibit a cycle of increase and decrease over the next several years. Unless this pandemic comes to an end or an effective vaccine is developed, the threat from COVID-19 will continue.

Africa: Relatively late outbreak, long-term effects

COVID-19 arrived relatively late in Africa due to its warmer climate and limited international air traffic.[32,33] However, the African continent comprises mostly of developing countries with poor healthcare systems and low health literacy. As a result, it is highly likely that Africa could suffer greater damage than any other region once an outbreak occurs. The fact that countries in Africa must be most concerned about is that COVID-19 may become endemic, and the outbreak may continue for a very long time. AIDS became the biggest public health issue in Africa over the past decade;[34] 50-60% of all AIDS patients are living in Africa,[35] while the infection rate in Southeast Africa is estimated to be approximately 19% among persons aged 15-49 years.[36] Even if a vaccine or treatment option is developed, relatively few people in Africa will benefit from it. In other words, even if a vaccine or treatment for COVID-19 is developed, Africa is going to receive it at the latest. Therefore, COVID-19 may become endemic in Africa and developing countries and is highly likely to become a major issue in these regions until the outbreak comes to an end. Fortunately, several vaccines for COVID-19 have been developed, and vaccinations have begun. Nevertheless, global vaccine inequality is also a problem.[37] This is because, like most countries in Africa, developing countries lack the

funding to secure vaccines. In February 2021, the WHO and Gavi, the Vaccine Alliance and the Coalition for Epidemic Preparedness Innovations (CEPI) announced that it would supply the vaccine to Africa.[38] However, supply of vaccines is still insufficient. Moreover, it is also a big challenge for African countries to reach the people due to poor medical systems.

PERSPECTIVE ON TRAVEL MANAGEMENT AND SURVEILLANCE FOR COVID-19

Domestic and international travel has been restricted since the emergence of the COVID-19. Many countries are attempting to prevent the inflow of COVID-19 patients from other countries. The most definitive method of doing this is border closure; however, long-term border closure is very difficult to implement, except in finite circumstances. Considering this, how should foreign travel be managed amid such a pandemic? In the case of South Korea, everyone entering South Korea from a foreign country, including Korean nationals and foreigners, are placed under mandatory self-quarantine or quarantine in designated facilities for 14 days. Violation of such orders is subject to penalties, and foreigners may be deported. In addition, diagnostic tests are performed on symptomatic travelers upon entry regardless of their symptoms.[39] However, what should countries without such disease control and healthcare systems do? According to a recent study, reducing the time between presentation of symptoms to confirmation of diagnosis could drastically lower the number of imported infection cases.[23] In other words, if reducing or restricting international travel becomes difficult, the most realistic infection control method is to identify symptomatic patients during the customs inspection process or to establish a tracking system for inbound travelers. In addition, wearing a mask should be made mandatory for everyone traveling via airplanes or ships, and regular indoor disinfection of restrooms, aisles, and door handles should be implemented as well. Furthermore, the number of passengers traveling at a time should be limited, the method of seat assignment should be changed, and the boarding system should be modified to reduce waiting and crowding during boarding. And above all, global efforts are also needed to apply such a system to airports and borders of developing countries, including Africa. In conclusion, the global transportation system can be divided into the pre- and post-COVID-19 eras. Limitations and modifications of transportation help control the spread of infectious diseases and may be utilized by many systems for a long time. Depending on the circumstances, international or inter-regional travel may be restricted. Global collective immunity is required for freedom from this restriction of travel. Moreover, Africa, where vaccine inequalities are most severe, is likely to be the least free continent of international travel restrictions.

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