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NEXUS BETWEEN URBAN MOBILITY AND THE TRANSMISSION OF INFECTIOUS DISEASES: EVIDENCE FROM EMPIRICAL REVIEW

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Abstract. The transportation of human beings from one location to the other could play a crucial role in the transmission of infectious diseases which could result in a major epidemic such as Tuberculosis, Ebola, Covid-19, and others that are currently invading the nations of the world. Concerning the high poverty level, much concentration on livestock farming, open grazing, rising urbanization, and globalization, the human being is exposed to more infectious diseases that can be transited and transmitted. The transmission of infectious diseases can be in the form of a chain; some are imported from high-risk countries and contacted by friends and families which will later spread into the larger society. It can also be contacted through imported livestock which will later spread among other animals and be contacted by a human. Importation of infectious diseases is not only applicable to humans but animals. Findings from the empirical studies reviewed show that a close nexus between urban mobility and the transmission of infectious diseases. To ensure adequate health safety, it is recommended that regional as well as international complementarity of trade should be checked such that high-risk countries should be banned from participating in trade with other low-risk countries; preventive measures should be enforced without any form of sentiment, human being should minimize or reduce traveling.

Keywords: urban mobility; transportation; transmission; infectious diseases

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1. Introduction

Just as the significance of mobility cannot be far-fetched from or beyond economic purposes, social integration and spatial interaction for people, goods, and services, so also is the significance of health for the users of mobility. Thus, maintaining quality health enhances the liveliness of mobility. One of the urgent issues in health

care is infectious diseases, they are disorders usually caused by micro-organisms. Examples of micro-organisms are viruses, bacteria, nematodes, fungi, or another form of parasites which subsist both inside and outside of human bodies. Some of these infectious diseases are usually transmitted or communicated from one person to another. Apart from the person-to-person transmission, some are transmitted by insects to human beings, animals to human beings, insects to animals, and animals to animals. The role of mobility in the spread of infectious diseases cannot be overemphasized as it is evident since ancient times.

Castelli and Sulis (2017) revealed that the mobility of humans, in addition to the transportation of animals, has been long linked with the spread and transmission of infectious diseases. Domestic infections are transmitted and spread among human beings and animals in the same geographical area. When those diseases are transmitted to foreigners, they are imported into another country and will later spread. For instance, influenza, smallpox, and AIDS were imported into Mexico during the Hajj operation in the year 1918 and later become a pandemic (Morens, Folkers and Fauci, 2004; Gayer, Legros and Formenty, 2007). Migrant populations are most suspicious to introduce infectious diseases into naive populations. Also, a high level of mobility may increase the probability of transmitting existing and new infectious diseases.

Infectious diseases are diseases that have recently increased in occurrence, incidence, and geographical spread (Metcalf and Lessler, 2017). This is more evident since the end of the 20th century and its occurrence has become a major pandemic to global health (Fauci and Morens, 2012). These diseases are evident in recent times because of the following reasons:

- a) The presence of new-fangled agents such as Severe Acute Respiratory Syndrome CoronaVirus-SARS-CoV- (2003), HIV-1, avian influenza virus H5N1(2005), H1N1 (2009), poliovirus (2014), Ebola virus (2014);
- b) The level of geographical spread such as Dengue, West Nile, Zika viruses, and Chikungunya;
- c) Acquisition of resistance such as Extended-spectrum beta-lactamases -ESBL- or carbapenemase-producing Enterobacteriaceae and multidrug-resistant-MDR- tuberculosis
- d) The rising trend of infectious diseases such as tuberculosis, HIV, and other plagues;
- e) Modification of virulence such as Neisseria meningitides.

It is pertinent to note that there is a fear among Nigerians that infectious diseases are being imported from abroad. This is similar to the Black Death in the Republic of Venice, Europe in the fifteenth century which led to the implementation of the 'quarantine' strategy. The flow of travelers into Nigeria mainly from high-risk countries and the level of political insensitivity have raised more fears that the typical epidemiological dynamics of infectious diseases could be impacted. In different countries of the world, infectious diseases have been linked with spread through human mobility. Based on the literature search, there seems to be scanty literature available to support this fact.

Nations in the world adopted different strategies for preventing and controlling infectious diseases (Rai, Lambert, and Ward, 2017; Beyrer, 2007) which are impacted by the existence or nonexistence of apposite prevention mechanisms, and human mobility (McGrath, Eaton, Newell, and Hosegood, 2015). Among the strategies are technical strategy and targets for each disease; subscribing to global vaccine action plan; follow-up strategies; provision of foreign aids for developing countries; free of charge for elderly healthcare; provision of bed netting and medicines to prevent parasites from causing infection when bitten by a vector; the use of animal control regulations and vaccination for domestic animals; immunity or quarantine of infected animals for up to six months; regulate and control of food mobility; identifying the contacts of infected individuals and establishing contact tracing to provide with treatment; and others.

Incident cases of infectious diseases such as Covid-19 in Nigeria have been condensed to a minimal level through advancements in testing, funding, international collaborations and interventions, deployment of technologies, and

implementation of policies and preventive measures. Despite all these efforts towards reducing the rate of Covid-19 and some other infectious diseases in the country, the incidence seems to be high in the last quarter of 2020. Based on the foregoing, the study examines the nexus between mobility and the transmission of infectious diseases with evidence on empirical review. It is believed that this study will explore different studies and establish fact based on previous findings on the impact of mobility on the transmission of infectious diseases.

2. Review of Relevant Literature

Infectious diseases are a threat to public health, they are caused by the rising level of commercial activities which is enhanced by regional or international complementarity of trade, intervening opportunities, and transferring of goods on a geographical space at a global scale. Apart from commercial activities in global space, it is also caused by human and freight mobility both from urban-to-urban, urban-to-rural, and vice versa and rural-to-rural and coupled with the muddling of ecosystems.

Nicolas and Olivier (2018) conducted a study on travel, migration, and emerging infectious diseases in France. The study revealed that infectious diseases have resulted in significant cooperation between countries. As a result of this cooperation, the first international conference on epidemic response was held in 1851 and in 1948 which gave back to the World Health Organization (WHO). Also, it was revealed that travelers play a significant role in the importation of infectious diseases which could spread to be a major epidemic.

Globalization and move within space through the mode of transportation are principal factors that enhance the spread of infectious diseases (Pybus, Tatem, and Lemey, 2015; Brockmann and Helbing, 2013; Komatsu and Sawada, 2007). Human mobility upholds the movement and transmission of infectious diseases to the extent of becoming an epidemic among the susceptible populations, resulting in major outbreaks (Soto, 2009; Komatsu and Sawada, 2007). Regarding the HIV epidemic, human mobility is a major driver that enhances the transmission of the HIV epidemic within a particular nation (Vasylyeva, Liulchuk, Friedman, Sazonova, Faria, Katzourakis, Babii, Scherbinska, Theze, and Pybus, 2018; Faria, Vidal, Lourenco, Raghwani, Sigaloff, Tatem, van de Vijver, Pineda-Pena, Rose and Wallis, 2019); such is well enhanced by the mobility that involves intercity movement and across the nations of the world (Beyrer, 2007; Faria, Vidal, Lourenco, Raghwani, Sigaloff, Tatem, van de Vijver, Pineda-Pena, Rose and Wallis, 2019).

According to Nicolas and Olivier (2018); Steffen, Amitirigala, and Mutsch (2008), traveling is a global phenomenon. Steffen, Amitirigala, and Mutsch (2008) conducted a study on health risks among travelers in Bangkok, Thailand, and found out that the exposure of travelers to infectious diseases in a high-risk zone was estimated at 1 percent for one month of travel. This was also affirmed in the study of Zimmerman, Kiss, and Hossain (2011). The process of human mobility affects the health condition of an individual traveler when accumulated, and the traveler is exposed to a higher risk of infectious diseases such as malaria, HIV, tuberculosis, hepatitis B, and schistosomiasis (Zimmerman, Kiss, and Hossain, 2011; Simon, Kiss, Laszewska and Mayer, 2015; De Vito, deWare, Specchia and Ricciardi, 2015).

In some cases, the higher risk is caused by the poor socioeconomic situations of an individual, lack of fundamental rights to free treatment in some countries (Vazquez, Vargas, Jaramillo, Porthe, Lopez Fernandez, and Vargas, 2016; Derosé, Bahney, Lurie, and Escarce, 2009; Magalhaes, Carrasco and Gastaldo, 2010; Vignier, Degrees du Lou, Pannetier, Ravalihasy, Gosselin, and Lert, 2018). The risk of transmitting infectious diseases seemingly increases when travelers return home to visit relatives and friends (Khawaja, Kirveskari, Johansson, VaisanenDjupsjobacka, and Nevalainen, 2017).

In Denmark, the rate of transmitting tuberculosis in the 1990s is quite higher among travelers (Carballo and Nerukar, 2001). In France, the rate of transmitting tuberculosis is 10 times higher among travelers than among the

non-travelers (Hargreaves, Lonroth, Nellums, Olaru, Nathavitharana, and Norredam, 2017). In the America, Europe, and Australia, a review of measles conducted by Jost, Luzi, Metzler, MiranandMutsch (2015) found that all cases of measles were import-related. Charu (2017) found that the mobility of human, animate, and inanimate entities enhances the spatial transmission of influenza in the United States.

A study conducted by Hayes, Donnell, Floyd, Mandla, Bwalya, Sabapathy, Yang, Phiri, Schaap, and Eshleman (2019) on the Ebola outbreak in West Africa (Guinea, Sierra Leone, and Liberia) in 2014-2016 found that the disease was rapidly transmitted by human mobility between the rural and urban areas. In the study of Olsen, Chang, and Cheung (2003), the transmission of SARS among air passengers is evident during flight because airborne spread over a sizeable distance. The summary of the empirical review was shown in table 1 below.

Table 1. Empirical evidence of mobility and the transmission of infectious diseases

Author(s)	Year	Topic	Major Findings
Hayes, Donnell, Floyd, Mandla, Bwalya, Sabapathy, Yang, Phiri, Schaap, and Eshleman	2019	Effect of universal testing and treatment on HIV incidence-HPTN 071 (PopART)	Ebola outbreak in West Africa (Guinea, Sierra Leone, and Liberia) was rapidly transmitted by human mobility between the rural and urban areas
Faria, Vidal, Lourenco, Raghwani, Sigaloff, Tatem, van de Vijver, Pineda-Pena, Rose, and Wallis	2019	Distinct rates and patterns of spread of the major HIV-1 subtypes in Central and East Africa.	Human mobility is a major driver that enhances the transmission of the HIV epidemic within a particular nation
Vasylyeva, Liulchuk, Friedman, Sazonova, Faria, Katzourakis, Babii, Scherbinska, These, and Pybus	2018	Molecular epidemiology reveals the role of war in the spread of HIV in Ukraine	Human mobility is a major driver that enhances the transmission of HIV
Nicolas and Olivier	2018	Travel, migration, and emerging infectious diseases	Travelers play a significant role in the importation of infectious diseases which could spread to be a major epidemic
Khawaja, Kirveskari, Johansson, VaisanenDjupsjobacka, and Nevalainen	2017	Patients hospitalized abroad as importers of a multiresistant bacteria-a cross-sectional study	The risk of transmitting infectious diseases seemingly increases when travelers return home to visit relatives and friends
Pybus, Tatem, and Lemey	2015	Virus evolution and transmission in an ever more connected world	Globalization and transportation are principal factors that enhance the spread of infectious diseases
Jost, Luzi, Metzler, Miran, and Mutsch	2015	Measles associated with international travel in the region of the Americas, Australia and Europe, 2001–2013: A systematic review	All cases of measles in the Americas, Europe, and Australia were import-related
Zimmerman, Kiss, and Hossain	2011	Migration and health: a framework for 21 st -century policy-making	Travelers are exposed to infectious diseases in a high-risk zone
Brockmann and Helbing	2013	The hidden geometry of complex, network-driven contagion phenomena	Mobility enhances the spread of infectious diseases
Soto	2009	Human migration and infectious diseases	Human mobility upholds the movement and transmission of infectious diseases to the extent of becoming an epidemic among the susceptible populations, resulting in a major outbreak
Steffen, Amitirigala, and Mutsch	2008	Health risks among	Travelers are exposed to infectious diseases in a high-

Komatsu and Sawada	2007	travelers need regular updates The role of international migration in infectious diseases: The HIV epidemic and its trends in Japan	risk zone Human mobility enhances the spread of infectious diseases
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Source: Author's Survey (2021)

From the review of previous studies, most studies affirmed a close nexus between the mobility and the transmission of infectious diseases. The demand for mobility arises as a result of three major factors which are purposes to be fulfilled; the factors are economic factor, social integration, and spatial interaction. The economic factor is rooted on the following: regional complementarity, intervening opportunity, and spatial transferability. It is pertinent to note that mobility is not only meant for human, but for other animate and inanimate entities. Through the different phases of mobility, infectious diseases are been transmitted. The summary is illustrated in figure 1.

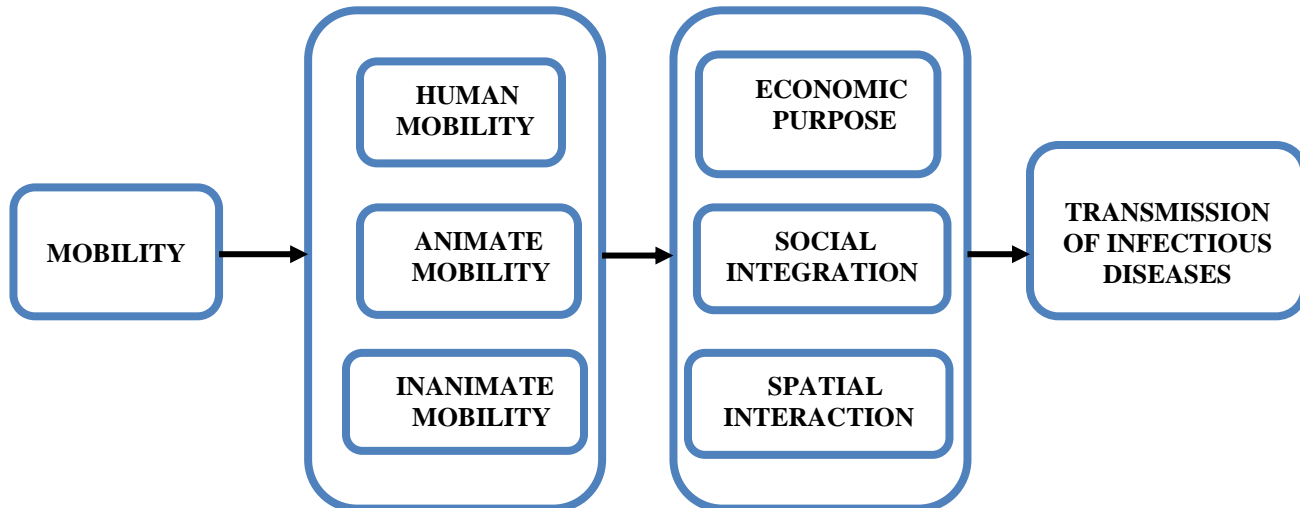


Figure 1. Connection between mobility and the transmission of infectious diseases

Source: Authors' study (2021)

The summary above is majorly applicable for human mobility and animate mobility, while inanimate mobility is mainly linked to economic purpose because it has no life, and the main essence of it mobility is to add economic value. Hence, the transmission of infectious diseases can be enhanced through surface contact.

3. Conclusion

This study examines the nexus between mobility and the transmission of infectious diseases with evidence of empirical review. The study concluded that there is a close nexus between the mobility and the transmission of infectious diseases. There are numerous ideas to address the issue of infectious diseases and mobility. However, to ensure adequate health safety of individual and nations, the following recommendations were suggested:

- a) Complementarity of trade from point of origin to the point of destination should be checked such that high-risk countries are banned from participating in trade with other low-risk countries;
- b) Preventive measures should be enforced during transactions; thereby reducing all forms of physical contact during trading;
- c) Vehicles involved in trading and public transport service should be thoroughly and periodically sanitized;
- d) Open grazing of livestock should be banned;
- e) Highly populated areas should be under strict control and monitoring;
- f) Immigration into various countries should be subjected to several medical tests before permitted to reside. This will allow early detection and ease of contact tracing;
- g) Setting up of diagnostic centers in all transport terminals across all modes to enhance rapid and timely diagnostics which will enhance ease of tracking travelers based on the record of contact information; and
- h) Human beings should consider traveling when primarily essential.

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