

The Impact of Global Migration on Infectious Diseases

Dr. Surajit Let

Assistant Professor,

Krishna Chandra College, Hetampur, Birbhum, West Bengal, India

surajitgeo@gmail.com

Abstract:

According to WHO 'Infectious diseases are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another. Zoonotic diseases are infectious diseases of animals that can cause disease when transmitted to humans' (https://www.who.int/topics/infectious_diseases/en/). As all the infectious diseases have some point of origin and spread through some agent such as man and animals from one region to another region. So movement of people is strongly associated with the spread of infectious diseases. Geographically movement of people from one place to another is known as Migration. When this migration happened in a global scale then migration act like a fluid in spreading of infection.⁷

Key words: Infectious diseases, Globalization, Global migration, Pandemic, Epidemic

Introduction:

Few million years ago before the forming societies man was like today's chimpanzees and was living isolated from one another or nomadic in nature. Their lifestyle was a natural barrier for spreading of infectious diseases. At that time they were depended on raw food which they collect by hunting, gathering or collected as carrion. These types of food are the source of various parasites and infectious diseases. Besides there are many infectious diseases which had transmitted to human body from animals is known as zoonotic disease. So some infectious diseases transformed from their ancestor body. When human started to cluster in one place for permanent settlement these infectious diseases became lethal foes of humanity.

'Over the past two centuries, the average distance and speed of human travel have increased a thousand-fold, but incubation times for infectious diseases have remained the same. What historically may have been only a small, localized outbreak can now develop in a matter of days into a large, worldwide epidemic. Not only have the speed and distance of human travel accelerated and expanded, but unprecedented numbers of people are also on the move. Thirty years ago there were only about 200 million international tourist arrivals annually, compared with an expected 900 million or more by 2010. The global spread of HIV/AIDS is only one, albeit the most devastating, example of the impact of this tremendous human mobility on infectious disease' (**Workshop Summary on 'The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities**, 2006, p.7).

About Infectious Diseases:

An infection can be defined as a state in which microorganisms, bacteria, viruses, fungi and parasites survive and reproduce in the host's tissues. In many instances no noticeable changes (symptoms) are apparent. When the organism produces sufficient tissue damage through many different mechanisms, the definition of infectious disease then applies (**Introduction to infectious disease, PKIDs 2004-2008, p.5**). The enormous array of pathogens that infect humans and other animals may be conveniently divided on epidemiological grounds into microparasites and macro parasites (**Anderson and May 1979, May and Anderson 1979**). Microparasites include the viruses, bacteria, proto- zoa, and fungi; they are characterized by their ability to reproduce directly within individual hosts, their small size, their relatively short duration of infection, and the production of an immune response in infected and recovered individuals. Mathematical models examining the dynamics of these pathogens divide the host population into susceptible, infected, and recovered classes. In contrast, macroparasites (the parasitic worms, ticks, and fleas) do not multiply directly within an infected individual but instead produce infective stages that usually pass out of the host before transmission to another host. Macroparasites tend to produce a limited immune response in infected hosts, are relatively long lived, and are usually visible to the naked eye. Mathematical models of the population dynamics of macroparasites have to consider the statistical distribution of parasites within the host population (**Anderson and May 1979,1991, Dobson 1988**).

Vectorborne and Zoonotic diseases (VBZD)

Vectorborne and zoonotic diseases are infectious diseases whose transmission involves animal hosts or vectors. Vectorborne diseases, such as malaria, are those in which an organism, typically insects, ticks, or mites, carry a pathogen from one host to another, generally with increased harmfulness (virulence) of the pathogen in the vector. Zoonoses, such as Avian Flu, are diseases that can be transmitted from animals to humans by either contact with the animals or through vectors that carry zoonotic pathogens to from animals to humans. While many VBZD, such as malaria, yellow fever, dengue, and murine typhus, are rarely seen in the United States, we are directly susceptible to VBZD that are found in warmer climates and vulnerable due to global trade and travel. Many VBZD are climate sensitive and ecological shifts associated with climate change are expected to impact the distribution and incidences of these diseases (www.niehs.nih.gov).

Airborne diseases :

Airborne infection occurs when pathogenic bacteria or viruses are inhaled and penetrate the alveoli (van Leuken et al., 2016). Airborne transmission occurs by dissemination of either airborne droplet nuclei or small particles in the respirable size range containing infectious agents that remain infective over time and distance (**Siegel JD, Rhinehart E, Jackson M, & Chiarello**

L, p. 19, 2019) . Airborne diseases include any that are caused via transmission through the air. The relevant pathogens may be viruses, bacteria, or fungi, and they may be spread through breathing, talking, coughing, sneezing, raising of dust, spraying of liquids, toilet flushing or any activities which generate aerosol particles or droplets. Airborne infections usually occur by the respiratory route, with the agent present in aerosols (infectious particles <5 µm in diameter) (**Wikipedia**).

Food- and waterborne diseases:

Waterborne diseases are conditions caused by pathogenic micro-organisms that are transmitted in water. These diseases can be spread while bathing, washing, drinking water, or by eating food exposed to contaminated water. While diarrhea and vomiting are the most commonly reported symptoms of waterborne illness, other symptoms can include skin, ear, respiratory, or eye problems (**Wikipedia**). According to the World Health Organization, waterborne diseases account for an estimated 3.6% of the total DALY (disability- adjusted life year) global burden of disease, and cause about 1.5 million human deaths annually.

Importance of Migration:

No country of the world is untouched by Migration. Migration is a truly global phenomenon, with movements both within nations and internationally across borders. The world has an estimated 244 million international migrants (UN DESA, 2016) and 763 million internal migrants (UN DESA, 2013). In other words, migrants make up more than 1 billion people, or one-seventh of the world's population. In 2015, migrants contributed \$6.4-6.9 trillion, or 9.4% of global gross domestic product, from 2000 to 2015, annual migration growth of 2.4% significantly outpaced annual population growth of 1.2% and more than 60% of global migration consists of people moving to neighbouring countries or to countries in the same part of the world. In an analysis of international survey data collected by the International Organization for Migration (IOM) from the Gallup World Poll for the period 2010–2015, 1.3% of the global adult population, or 66 million people, were planning to migrate permanently within the next 12 months (**Migration and Its Impact on Cities, WEC, 2017, p.14-16**). The world wide spread of capitalism and the open market is the main driving force of globalization.

Globalization and Migration

Globalization is like a tidal wave which affects the all sectors of world. 'Globalization is by no means a new phenomenon; transcontinental trade and the movement of people date back at least 2,000 years, to the era of the ancient Silk Road trade route. The global spread of infectious disease has followed a parallel course. Indeed, the emergence and spread of infectious disease are, in a sense, the epitome of globalization' (**Workshop Summary on 'The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities**, 2006, p.2). Migration is the latent manifestation of Globalization. It transformed the nature of migration especially international migration.

The movement of people and the increased mobility of disease vectors are major consequences of globalization, which both exacerbate the risk of infectious disease spread. According to several studies, three million people travel every day across borders, with one million of them crossing from developing countries to developed countries (**Cobo . Fernando. , 2014**).

‘The number of international migrants worldwide has continued to grow over the past seventeen years, reaching 258 million in 2017, up from 248 million in 2015, 220 million in 2010, 191 million in 2005 and 173 million in 2000. Between 2000 and 2005, the international migrant stock grew by an average of 2 per cent per year. During the period 2005-2010, the annual growth rate accelerated, reaching 2.9 per cent. Since then, however, it has slowed, falling to around 2.4 per cent per year during the period 2010-2015 and to 2.0 per cent per year during the period 2015-2017’ (**International Migration Report- 2017, p.4**).

More than 60 per cent of all international migrants worldwide live in Asia or Europe. In 2017, 80 million international migrants were residing in Asia, compared to 78 million in Europe. Northern America hosted the third largest number of international migrants (58 million), followed by Africa (25 million), Latin America and the Caribbean (10 million), and Oceania (8 million). Most of the world’s migrants live in a relatively small number of countries. In 2017, more than 50 per cent of all international migrants in the world were living in just ten countries or areas, while only twenty countries or areas hosted 67 per cent of the global number of international migrants. The largest number of international migrants resided in the United States of America: 50 million, equal to 19 per cent of the world’s total (figure 3). Saudi Arabia, Germany and the Russian Federation hosted the second, third and fourth largest numbers of migrants worldwide (around 12 million each), followed by the United Kingdom of Great Britain and Northern Ireland (nearly 9 million), and the United Arab Emirates (8 million). Of the twenty largest countries of destination of international migrants worldwide, nine are located in Asia, seven in Europe, two in Northern America, and one each in Africa and Oceania (**International Migration Report- 2017, p.5-6**).

History of Some Infectious Diseases - Outbreak due to the Migration:

Epidemics infectious diseases have been documented throughout the history. In ancient Greece and Egypt account describe epidemics of smallpox, leprosy, tuberculosis, meningococcal infections and diphtheria (**Watts. S , 1997**).

From the ancient period politics, society, culture etc. effected by the infectious diseases and infectious disease diffused from their place of origin through migration. In epidemics, none were spared. Smallpox likely disfigured and killed Ramses V in 1157 BCE, although his mummy has a significant head wound as well (**Ruffer , MA. , & Ferguson, AR., 1911**).

In the 2nd year of the Peloponnesian War, 430 BCE, an outbreak of plague erupted in Athens which killed the one third of the population. The origin of the epidemic occurred in sub-Saharan Africa just south of Ethiopia. The disease swept north and west through Egypt and

Libya across the Mediterranean Sea into Persia and Greece. The plague entered Athens through the city's port of Piraeus. The Greek historian Thucydides recorded the outbreak in his monumental work on the Peloponnesian war (431-404 BCE) between Athens and Sparta [**Thucydides (trans. B.Jowett). *History of the Peloponnesian War*. Clarendon Press, Oxford, 1900, 2.42-2.462.55-2]** .

By Roman times, world trade routes had effectively joined Europe, Asia, and North America into one giant breeding ground for microbes. Millions of Roman citizens were killed between 165 and 180 AD when smallpox finally reached Rome during the Plague of Antoninus. Three centuries later, the bubonic plague hit Europe for the first time (542–543 AD) as the Plague of Justinian. It returned in full force as the Black Death in the fourteenth century, when a new route for overland trade with China provided rapid transit for flea- infested furs from plague-ridden Central Asia (**Workshop Summary on ‘The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities, 2006, pp.3-4**).

The ‘**Antonine Plague**’ of 165 to 180 AD, was once viewed as a decisive event in Roman history. This pandemic brought to the Roman Empire by troops who were returning from campaigns in the Near East. Lucius Verus died in 169 CE, and Marcus Aurelius died in 180 CE. It has been speculated that both deaths were caused by the disease (**Littman R. J. & Littman M. L., 1973, p-243**).

The first indubitable report of the plague is the ‘**plague of Justinian**’ named after the roman emperor of that time. It possibly originated around the year 532 in northern Africa (Ethiopia or Egypt) and spread through the Middle East and Mediterranean basin in the following years. Probably the commercial city of Pelusium in the mouth of the Nile in Egypt served as an important centre from which the infection was distributed (**Zietz Bjorn P. & Dunkelberg Hartmut 2004, p.166**).

“In contrast to earlier epidemics the great medieval plague is well documented by many authors and documents (Haeser, 1882, p. 97ff). Forexample, the plague epidemic of Florence in the year 1348 is described by Giovanni Boccaccio (1313 to1375) in his famous book ‘Decamerone’. The plague began spreading again probably from the Himalayas westward along three major trade routes from the years 1332 to 1346. The introduction into Europe in the year 1347 resulted in the start of the first epidemic of the second pandemic that was active until the year 1352. This epidemic again encompassed all of the ‘known world’ at that time and later became known as the Black Death. Even the island of Greenland in the North Atlantic was effected (Haeser, 1882, p. 97f; Sticker, 1908, p. 42f). Upon the arrival in the eastern Mediterranean the disease quickly spread especially by sea traffic to Italy, Greece and France, and later throughout Europe by land” (**Zietz Bjorn P. & Dunkelberg Hartmut ., 2004, p.168**).

On 1492, influenza, smallpox, tuberculosis and gonorrhoea began when Columbus went to the Caribbean. The inhabitants did not have immunity to these endemic European infections, and as

a consequence, the 8 million people on the island of Hispaniola (where Columbus first set foot in the New World) died. Replacement of the population by African slaves introduced African infectious diseases such as malaria and yellow fever into the Caribbean and Americas, which in turn, killed many European settlers (**Introduction to infectious disease, Instructor's Background Text, PKIDs' infectious disease Workshop, 2004-2008, p.7**).

'The first cholera pandemic, known as "Asiatic cholera", occurred in the Bengal region of India in 1817 and lasted until 1823. By the early 1820s, colonization, migration, and trade had carried the disease from India to Southeast Asia, China, Japan, the Middle East, and southern Russia. The most affected cities during the first cholera pandemic were Muscat, Tehran, and Baghdad. About 6000 British troops were estimated to have died from the disease in India during this pandemic, as were 10 000 Indonesians' (**Barua D., 1972, Quoted in Cholera, Migration, and Global Health – A Critical Review, by Niyi Awofeso & Kefah Aldabk in International Journal of Travel Medicine and Global Health, p.93**)

'In 1829, the second cholera pandemic started in India and subsequently spread to Russia and then to Poland, Germany, Sweden, Austria, and England in 1831, and further to China and the United States. The pandemic lasted until 1835' (**Niyi, Awofeso & Kefah, Aldabk., 2018, p.93**).

'The fifth cholera pandemic (1881–1896) originated in the Bengal region of India and swept through Asia, Africa, South America, and parts of France. Between 1883 and 1887, the epidemic cost 250 000 lives in Europe and at least 50 000 in the Americas. In 1892, cholera claimed 267 890 lives in Russia, 120 000 in Spain, 90 000 in Japan, and over 60 000 in Persia, 24 in Egypt, cholera claimed more than 58 000 lives. The 1892 outbreak in Hamburg killed 8600 people' (**GHDI., Cholera Epidemic in Hamburg -1892, Quoted in Cholera, Migration, and Global Health – A Critical Review, by Niyi Awofeso & Kefah Aldabk in International Journal of Travel Medicine and Global Health, p.93**).

'The influenza pandemic of 1918 was exceptional in both breadth and depth. Outbreaks of the disease not only swept North America and Europe, but also spread as far as the Alaskan wilderness and the most remote islands of the Pacific. It has been estimated that one-third of the world's population (500 million people) may have been clinically infected during the pandemic' (**Burnet and Clark, 1942, Frost 1920 Quoted in, The Origin and Virulence of the 1918 "Spanish" Influenza Virus by Taubenberger, Jeffery K. 2006**). This influenza pandemic is considered one of the deadliest disease outbreaks in recorded history during World War I. It is called "The Spanish Flu" because Spain had remained neutral during the war and freely reported news of flu activity.

The Asian influenza pandemic of 1957-58 was the second of three twentieth century influenza pandemics. It was far milder than its predecessor, the catastrophic Spanish influenza of 1918-19, but claimed more lives than the Hong Kong influenza of 1968-69 (**US Department of Health and Human Services, 2008**). Asian flu was a pandemic which was originated in China in 1956

and lasted until 1958. In this two years duration, it was traveled from the Chinese province of Guizhou to Singapore, Hong Kong, and the United States (**Kelly Elaine, 2009, p.5**).

Infectious diseases like ancient plagues to the COVID-19 pandemic of today are playing a great role in human civilization. Globally, as of 11:09am CEST, 31 May 2020, there have been 5,891,182 confirmed cases of COVID-19, including 365,966 deaths, reported to WHO [**WHO Coronavirus Disease (COVID-19) Dashboard**]. The recent outbreak began in Wuhan, a city in the Hubei province of China. Reports of the first COVID-19 cases started in December 2019. Finally it spreads to the various parts of the world from china. More than 213 countries and territories around the world have affected by the COVID-19. The global spread of this infection happened due to the international migration.

There have also many infectious diseases which have taken its epidemic or pandemic forms due to the migration of peoples from one region to another region such as H1N1 Swine Flu pandemic (2009), Setbacks in Global Polio eradication efforts (2014), outbreak of Zika virus(2016), Western African Ebola Virus epidemic(2013-16), etc..

From the above discussion it is clear that there have so many historical evidences about the outbreak of infectious diseases due to the global migration from the place of origin to other region.

Trend of Migration and Infectious diseases:

An epidemic is the rapid spread of infectious disease to a large number of people in a given population within a short period of time (**Managing epidemics Key facts about major deadly diseases, WHO, 2018. p.34**). According to WHO 'New and more intense factors amplify the transmission of diseases, either because they increase contacts between people, or between animals and people. In an era of rapid global change, many of these factors are almost inevitable. Among them are the fast and intense mobility of people, with increased transport and international travel, and greater inter-connectivity between megacities which are major transport hubs for aircraft, trains, road vehicles and ships' (**Managing epidemics Key facts about major deadly diseases, WHO, 2018. p.25**).

In this technocratic civilization several factors triggering the global migration which includes global trades and trade agreements, reduction of travel cost and times, economic instability etc.. Now government opened up their countries for foreign investment. Due to the moving of unprecedented numbers of people from one country to another country accelerating the speed for spreading infectious diseases. Every year million of peoples are leaving their homelands for better opportunity. Among these migrant peoples refugees are the most vulnerable for emerging infectious diseases. Following table (table no-) is showing the percentage of increasing trend of international migrants. As the people global movement is increasing day by day so the probability for spreading infectious diseases also increasing.

Table-1 : International migrants, 1970–2019

Year	Number of migrants	Migrants as a % of the world's population
1970	84,460,125	2.3%
1975	90,368,010	2.2%
1980	101,983,149	2.3%
1985	113,206,691	2.3%
1990	153,011,473	2.9%
1995	161,316,895	2.8%
2000	173,588,441	2.8%
2005	191,615,574	2.9%
2010	220,781,909	3.2%
2015	248,861,296	3.4%
2019	271,642,105	3.5%

Source: UNDESA, 2008, 2019a, 2019b, World Migration Report 2020, p.21.

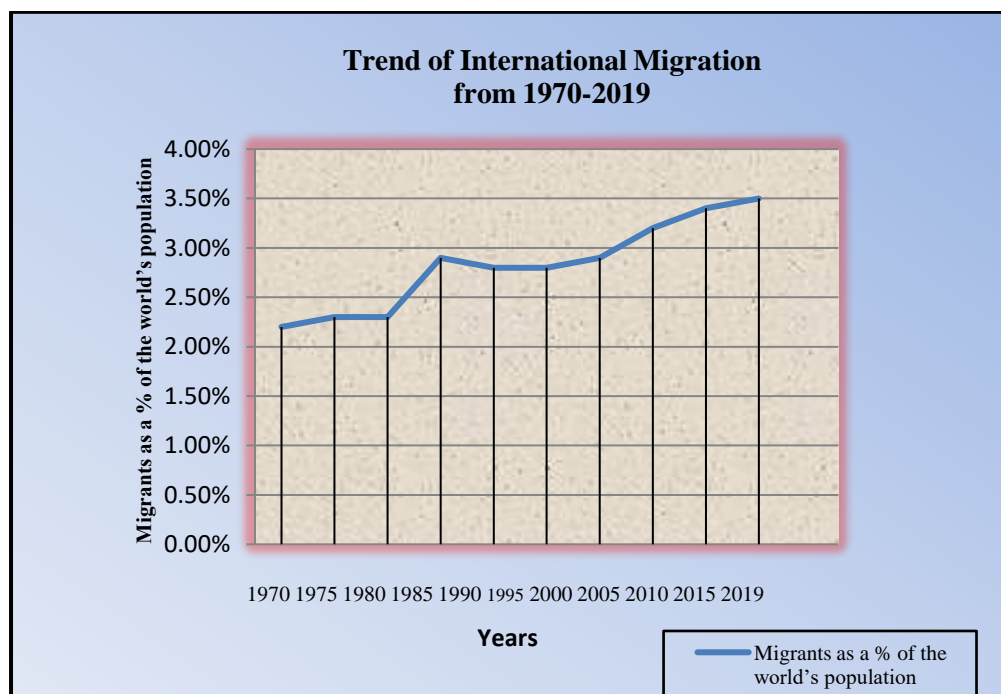
**Fig. 1. Trend of International Migration**

Table -2: Epidemic events globally, 2011 – 2017: A total of 1,307 epidemic events
Number of epidemic events by disease and year

Name of Epidemic Events years	2011	2012	2013	2014	2015	2016	2017	Total
Yellow fever	17	12	8	2	4	10	4	57
Chikungunya	8	10	3	29	27	14	4	95
Viral haemorrhagic fever						6	4	10
Ebola virus disease	1	2		11	4	3	1	22
Marburg virus disease		1		1			2	4
Crimean-Congo haemorrhagic fever	3	5	6	8	7	7	13	49
Rift Valley fever	1	1	1	1	1	4	5	14
Cholera	62	51	47	37	44	42	25	308
Typhoid fever	20	23	5	2	8	3	14	75
Shigellosis	25	24	28	29	4	2	1	113
Plague	8	7	6	10	7	6	3	47
Lassa fever	2	1	2	3	2	7	6	23
West Nile fever	11	15	15	11	11	18	10	91
Zika virus disease			5	7	19	54	52	137
Meningitis	14	20	19	19	19	23	23	137
MERS-CoV		3	10	17	12	7	8	57
Influenza A	5	6	7	9	10	5	9	51
Monkeypox					2	2	5	10
Nodding syndrome		1	1					2
Nipah virus infection	1	1	1	1	1			5

Source: 'Managing epidemics : Key facts about major deadly diseases', WHO, 2018(data reported to WHO and in media)

Table-3: Number of epidemic events by year

Years	2011	2012	2013	2014	2015	2016	2017	Total
No of epidemic events	178	183	164	197	182	213	188	1305

Source: 'Managing epidemics :Key facts about major deadly diseases', WHO, 2018

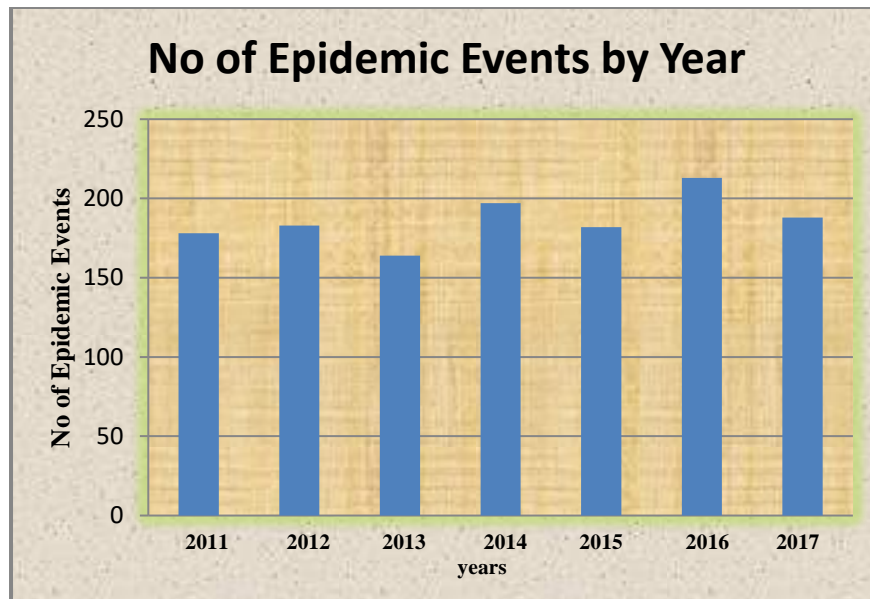


Fig. 2. Epidemic Events by Year

From the above data it is clear that both the global migration and numbers of epidemic events are increasing. It is also fact that global migration is one of the most responsible factors for spreading infectious disease. Both the migration and spreading of infectious disease are positively related. Now in running COVID- 19 situation it is also alarming about the global migration.

Recommendations:

In this era of globalization we cannot stop the movement of people and goods or we cannot able to finish all the infectious diseases at a time. So movement of people and disease both will remain, but now question how both will co-exist in parallel way. Because treatment of one disease must come but no one can tell that new disease will not come. So we should conscious about the situation of migration and take necessary steps for combating the situation, Such as-

a. Proper monitoring system :

Proper monitoring system of mobile populations has to be improved. The architecture of global migration governance should be built up for the surveillance system. Many countries want to overlook local outbreaks in fear of lose in foreign trade and political repercussion which also lead to increase huge outbreak of some infectious disease. So regional surveillance system should be developed through proper monitoring of international bodies of health organization.

b. Global health security :

To ensure the health protection of migrants' people essential health services should be provided which includes screening of migrant peoples and scientific quarantine facilities. So Border-health management system should be built up.

c. Adequate facilities:

To reduce health risk adequate, equitable health services and financial protection should be available for migrants. Systematic population screening is needed in regular basis for some sleeping sickness.

d. Identification of hotspot regions of infectious diseases:

All the countries of the world should provide actual and authentic data regarding the diseases to various international health organizations. From this organization all countries can collect the data and take necessary steps. So mapping of hotspot area of infectious diseases is necessary. It will help to predict the future spread and allocating resources for surveillance and containment strategies.

e. Transparency between the place of origin and place of destination:

There should be transparency between the place of origin and place of destination of migration in respect of health data supply. Then it will be possible to take preventive measures for destination countries where migrant people moves and they can take proper health check up and treatment facilities. It will also help to both countries for making common protocols and treatment schemes.

f. Health Card System:

Internationally all the countries should take decision regarding the making of health card those who wanted to go other countries for any purpose. All the information regarding their health will be available on this health card. So a system can be developed through international health organization for issuing the individual health card in various countries. So global co-operation have to be established among all the countries. On the basis of health card people can get their permission for international migration. After certain duration this card has to be renewed. In this card travel history of migrant people should be mention.

g. International coordination and collaboration:

Tuning with the increase rate of global migration there is a need for international coordination and collaboration between the international community which includes in surveillance system, training in field epidemiology, strengthening laboratory capacity, laboratory networks etc..

Few Other Steps :

- i. Along all the Public health infrastructure **public health education and training system** should be modified to accommodate the health care needs for the mobile population.
- ii. With the increasing human movement, **vector movement** also increasing via goods or peoples or transport vehicles which are also contributing the spread of infectious diseases.
- iii. **Refugee populations** are among the most responsible and vulnerable for emerging and reemerging infectious diseases.
- iv. **Economic and demographic gaps** between the countries also responsible for dramatic and unpredictable fast rate of global migration which leads to increase rapid spread of infectious diseases.
- v. Global community should also aware about the threat of **bioterrorism** which may executed by enemy countries through global migration.

So, **trade and transport related surveillance** is also necessary for control the situation. if left unchecked all the matters infectious diseases will change the shape of global landscape in unpredictable ways.

Conclusion:

Due to the huge global migration diversifications of infectious diseases happened and these diseases changed their basic character and became more deadly cocktail to human body. The human mobility is a key driver in the diffusion infectious diseases. In this new global landscape new global migration strategy is required to reduce the globalization of infectious diseases because migration health issue is an emerging unresolved health issue in worldwide. Every country should come together for protecting the health of migrants by sharing their experiences and best practices. Every country have to adopt national immunization plans to increase vaccination coverage for migrant communities.

Today a local outbreak spread silently and globally via migrant people from one country to another due to the development of global transportation system. Transcontinental movement of infectious disease vectors may be control to some extent through the monitoring of global migration. From ancient outbreak of plague to recent outbreak of COVID-19 all infectious disease changes their form and shape due to the unprecedented global migration. All the diffusion of infectious disease from their place of origin could be control through the restriction of global migration.

References :

- i. Anderson, RM. & May RM., 1979, Population biology of infectious diseases: Part I. Nature 280, pp.361-367.
----- 1982, Directly transmitted infectious diseases: control by vaccination. Science 215, 1053-1060.
----- 1991, Infectious diseases of humans: dynamics and control. Oxford (UK): Oxford University Press.
- ii. Awofeso, Niyi & Aldabk, Kefah ., 2018, Cholera, Migration, and Global Health – A Critical Review, International Journal of Travel Medicine and Global Health, Sep;6(3), pp. 92-99.
- iii. Barua D., Cholera. Pro Roy Soc Med., 1972, 65:11-16.
- iv. Burnet, F. & Clark, E., Influenza: A survey of the last 50 years in the light of modern work on the virus of epidemic influenza, Melbourne, MacMillan, 1942, p. 188.
- v. Cobo, Fernando., 2014, Imported infectious disease – the impact in developed countries, Woodhead Publishing series in biomedicine, Elsevier, First Edition, p. 27.
- vi. GHDI., Cholera Epidemic in Hamburg (1892), http://ghdi.ghi-dc.org/sub_image.cfm?image_id=1608, Accessed 27 January 2018.
- vii. Global Migration Data Analysis Centre, 2017, “Measuring Global Migration Potential, 2010-2015”. Issue No. 9. Available at: https://publications.iom.int/system/files/pdf/gmdac_data_briefng_series_issue_9.pdf.
- viii. Hirst, L. F., The conquest of plague. A study of the evolution of epidemiology. Oxford, Clarendon Press, 1953, pp.10ff, 97f.
- ix. https://en.wikipedia.org/wiki/Airborne_disease.
- x. https://www.niehs.nih.gov/research/programs/geh/climatechange/health_impacts/vect_orborne/index.cfm.
- xi. International Migration Report (2017), United Nations New York, 2017, Department of Economic and Social Affairs, pp.4-6.
- xii. Introduction to infectious disease , Instructor’s Background Text, PKIDs’ infectious disease Workshop, Vancouver, PKIDs 2004-2008, pp.5 & 7.1
- xiii. Kelly, Elaine., 2009, The Scourge of Asian Flu: in utero exposure to pandemic influenza and the development of a cohort of British children, IFS Working Paper W09/17, Economic and Social Research Council(E.S.R.C), University College London & Institute for Fiscal Studies,2009, September 21, p.5.
- xiv. Littman R. J. & Littman M. L, Galen and the Antonine Plague, The American Journal of Philology, Vol. 94, No. 3 (Autumn, 1973), The Johns Hopkins University Press , pp. 243-255.
- xv. Managing epidemics Key facts about major deadly diseases, WHO, 2018. p.23.

- xvi.** Migration and Its Impact on Cities, World Economic Forum, In collaboration with PwC, 2017 oct., pp. 14,
- xvii.** Ruffer, MA. & Ferguson, AR., 1911, Note on an eruption resembling that of variola in the skin of a mummy of the Twentieth Dynasty (1200 -1100 BC). *J Pathol Bacteriol*, 15:1-4.
- xviii.** Siegel, JD., Rhinehart, E., Jackson, M., & Chiarello, L., 2007, Healthcare Infection Control Practices Advisory Committee, " Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings" (PDF), *CDC.*, Retrieved 7 February, 2019, p. 19.
- xix.** Sticker, G., 1908, *Abhandlungen aus der Seuchengeschichte und Seuchenlehre. Band I: Die Pest. Teil I. Die Geschichte der Pest.* Gie°en, A. T^pelmann, pp. 24f, 42f.
- xx.** Taubenberger Jeffery K. , The Origin and Virulence of the 1918 "Spanish" Influenza Virus¹. *Proc Am Philos Soc.* 2006 March ; 150(1), pp.86–112 , (Author manuscript; available in PMC 2009 August 3).
- xxi.** Thucydides (trans. B.Jowett), *History of the Peloponnesian War.* Clarendon Press, Oxford, 1900, 2.42-2.462.55-2.
- xxii.** Van Leuken, J.P., Swart, A.N., Droogers, P., van Pul, A., Heederik, D., & Havelaar, A.H., (2016), Climate change effects on airborne pathogenic bioaerosol concentrations: a scenario analysis. *Aerobiologia* 32, 607–617.
- xxiii.** Watts, S., 1997, *Epidemics and History: Disease, Power and Imperialism.* New Haven, Conn: Yale University Press.
- xxiv.** Workshop Summary on 'The Impact of Globalization on Infectious Disease Emergence and Control : Exploring the Consequences and Opportunities' , Edited by tacey Knobler, Adel Mahmoud, Stanley Lemon & Leslie Pray , Forum on Microbial Threats, Board on Global Health , The National Academies Press, Washington, D.C. , 2006, pp. 2, 3,4,7.
- xxv.** World Migration Report 2020, International Organization for Migration, Geneva, Switzerland.
- xxvi.** Zietz Bjorn, P. & Dunkelberg, Hartmut., 2004, the History of the Plague and the research on the causative Agent *Yersinia Pestis*, *International Journal of Hygiene and Environmental Health*, pp. 165-178, (<http://www.elsevier-deutschland.de/intjhyg>).