The Role of Migration in Health, Zoonoses and One- Health Concept

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Abstract

Migration, also termed the seasonal movement of birds, animals and people from one location to another, has a major impact in population dynamics. This can have an impact in spreading of zoonotic diseases, integrating the One-Health idea in the dissemination of illnesses across animals, people, and the environment. This study conducted a systematic literature review using databases of PubMed, Cochrane, Medline and a popular web search engine, Google Scholar, to access peer reviewed journals related to migration, its role in health, zoonoses and one-health. The keywords searched for were migration, zoonoses and one-health. The search reviewed articles from 2011 to 2023. Search results showed that migration was interposed in humans, animals and the environment. Many viral diseases, including Ebola virus disease (EVD) and Coronavirus disease have been traced back to animals. One Health aims to shed more light on understanding better, variables that contribute to the transfer of disease-carrying pathogens between animals and people, including creating solutions to prevent and control these diseases at their sources. Migration therefore, is an integral aspect of population dynamics, the propagation of diseases that are zoonotic and the concept of One Health.

Keywords: *Health, Migration, One-health, Zoonoses*

Introduction

Migration is a global phenomenon. It is the seasonal migration of individuals, animals, and birds from one area to another location. Researchers have been studying the reasons why people migrate for decades. Many reasons such as demographics, economic, politics, economic, social, cultural and ecological factors can be adduced as key migratory drivers[1]. There has always been movement of people looking for a better life, and in some instances, just to survive. Nearly one billion individuals today reside far from their places of birth, with roughly 270 million (about 3.5% of the population worldwide) travelling across international borders.[2] The growth in population has resulted in an increased demand for the resources available, including an unprecedented surge in industry and technology. Also, the many occurrences of wars in addition to ethno-political conflicts, have led to people moving from one area to another to seek jobs, escape from conflicts and persecution, environmental and climatic changes.[3,4]

Based on the above factors, migration can be classified as:

1) **International migration**: The United Nation proposes a definition of migration to other countries with a focus on residency and time.[2] In this regard, the definition of a migrant is 'a person who moves from a country in which they reside in regularly, for a minimum period of 12 months.' Migration is a driver of urbanisation[5](IOM, 2015), and urban migration (both national and international) is a 21st-century trend.[5]

   Crossing international borders can also be termed international migration. It might include labour migration (seeking better employment possibilities), family reunification, refugees and asylum seekers (escaping violence or persecution), and irregular migration (movement without legal authorisation).

[1]Castelli Francesco (2018). Drivers of migration: Why do people move. J Travel Med 1: 25(1).
[2] United Nations (1998). Recommendations on statistics of international migration. Series M, No 58, Rev 1.
[3] Wennersten JR and Robbins D. (2017). Rising tides: climate refugees in the twenty-first century. Bloomington: Indiana University Press. p. 118–21. In depth examination of climate migration with key case studies.
[4] Berchin II. Climate change and forced migrations: an effort towards recognising climate refugees. Geoforum. 2017. 84:147–50.
[5] International Organisation for Migration IOM (2015). World migration report – migrants and cities: New partnerships to manage mobility. Geneva.

2) **Internal migration**: Internal migration from rural locations to urban regions accounts for about 40% of all urban growth in Asia, Africa, and Latin America. Between 2014 and 2050, the number of people living in cities is expected to rise in Asia, from 48% to 64% and in Africa, from 40% to 56%, owing largely to the influx of people moving from rural regions.

3) **Labour migration**: According to Scott[6], the influx of migrant labour is also a reaction to shifting industrial systems. Migrating labourers are more productive at least, in three ways. First of all, migrants are appealing because they constitute a versatile work force. Second, they are structurally disempowered. This manifest in their informal labour arrangements, a lack of language skills, little union participation that reduces their ability to negotiate salary, working conditions, and even to resist a downward review of both salary and working conditions. Third, migrants' 'dual frame of reference' makes poor pay and working conditions in the host country bearable, if not appealing.[6]

4) **Forced migration**: Forced migration is the movement of individuals that are compelled to leave their homes and relocate due to circumstances that are beyond their control. These issues frequently involve threats to their safety, well-being, or fundamental human rights. Forced migration can occur within a country's borders (internal displacement) or across international borders (cross-border displacement). It is frequently motivated by conflict, persecution, human rights violations, natural catastrophes, and other crises that imperil people's lives and livelihoods.

[6] Scott, S. (2015). Making the case for temporary migrant worker programmes: evidence from the UK's rural guest worker ('SAWS') scheme. Journal of Rural Studies 40 pp. 1–11.

The migration of humans and animals within their environment is crucial in the infectious diseases' transmission. In recent times, newly emerging diseases in humans originated from animals. Zoonotic diseases are highly infectious diseases naturally transmitted from animals to people, or from humans to animals. Nearly 60% of disease-causing bacteria, viruses or microorganisms in humans is zoonotic in nature. Zoonotic diseases, a major public health hazard, and the causative agents include a wide range of pathogens, ranging from bacterial, viral, parasitic, fungal to mycoplasma. Birds have also been known to contribute globally to the dissemination of developing infectious disease, in a way comparable to humans flying in planes.

This review is therefore important in order to provide more information regarding how humans, animals and birds are implicated in the propagation of diseases, and how the concept of One Health addresses global health by considering the intersections of human health, animal health and their environment.

Objective

The goal of this systematic review is to examine how migration affects human health, animals and the ecosystem and the implications in the growth and spread of zoonotic diseases.

Materials and Methods

The information gathered for this review was obtained using a popular web search engine, Google scholar, besides gathering data from databases of PubMed, Medline and Cochrane review, in order to access peer reviewed journals. PubMed is known for citations of biomedical literature from Medline and life science journals. Cochrane review involves a comprehensive review of health-care-related research and policy.

The journals reviewed were from the year 2011 to 2023. The authors were acknowledged for their write-up. Keywords used in the search were migration, zoonoses and One Health concept.

Results

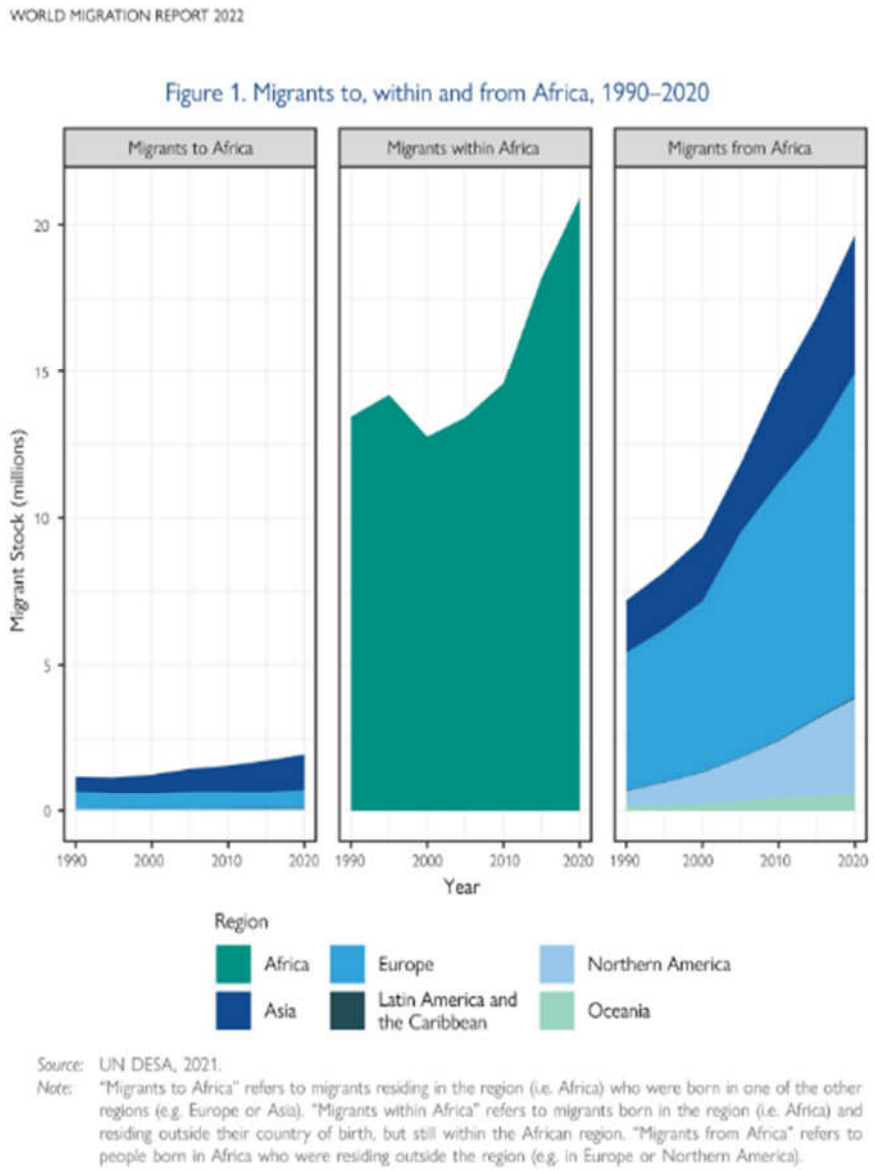

Fig. 1: Migrants to, within and from Africa 1990 - 2020
Source: World Population Report 20

Migratory species can be found all over the world, in aerial, terrestrial, and aquatic environments, and in every major vertebrate (birds, fish, mammals, reptiles, amphibians)[7]. Insects are the most commonly prevalent of terrestrial travelers, but have gotten less attention than migratory mammals because of their tiny size.[8]

Bird migration is motivated by the requirement to gather seasonal food resources for fueling behaviours like molting and mating, while avoiding adverse situations such as poor weather and decreased food supply. Approximately a fifth of the entire species of bird travel seasonally, rotating between non-breeding and breeding regions[9]. Migratory birds, particularly ducks, are recognized for being natural reservoirs for the virus responsible for avian influenza. They transport and exchange various virus strains throughout their migratory paths, causing viral reassortment and the creation of novel HPAI viruses.

Birds are reservoirs of zoonotic enteropathogens. Birds that migrate over national and international boundaries can eventually lead to being long-range vectors for any virus, parasites, bacteria or drug-resistant organism that they possess. Salmonella typhimurium is the most often reported gastrointestinal pathogen of wild birds. Humans have been known to contract salmonellosis from wild birds after coming in touch with infected bird feeders. Furthermore, it is been postulated that sparrows and other nestling birds close to farm buildings may act as a reservoir for infection for poultry and other business enterprises.

[7] Shaw, A. K. (2016). Drivers of animal migration and implications in changing environments. Evolutionary Ecology. 30(6): 991–1007.
[8] Chapman J.W., Reynolds D. R. and Wilson, K. (2015). Long-range seasonal migration in insects: mechanisms, evolutionary drivers and ecological consequences. Ecol Lett 18:287.
[9] Kirby, J.S., Stattersfield, A.J., Butchart, S.H.M., Evans, M.I., Grimmett, R.F.A., Jones, V.R. *et al.* (2008). Key conservation issues for migratory land- and waterbird species on the world's major flyways. Bird Conservation International 18: S49–S7.

Discussion

Migration and Its Effects on Health

The World Health Organisation (WHO) defines health as a condition of total physical, mental, and social welfare, rather than only the absence of sickness or infirmity**"**[10]**.** Furthermore, the World Health Organisation (WHO)[11] and the International Organisation for Migration (IOM)[12] prefer socioeconomic factors of health (SDH) approaches,[13] which emphasize that definitions of health must incorporate the larger social components that support it, such as work, education, and family status.[11,12,14]

Migration has a major impact on health, both within migrant communities, alongside native populations in host nations.[15] This impact varies significantly among various migrant groups, depending on factors that include pre-existing health issues, experience during the migration route, or gender.[15]

Migration is increasingly becoming accepted as a health factor[14]. There are numerous levels of social determinants of health, ranging from the general socioeconomic, environmental, legal, cultural, as well as physical settings to individual characteristics such as age, lifestyle, genetics, and behavioural variables that affect the health of migrants. However, health determinant strategies have been criticized for emphasizing on financial position to the detriment of other characteristics such as race, gender, and legal status.[16]

[10]World Health Organisation (WHO) (1946). Constitution of the World Health Organisation. http://apps.who.int/gb/bd/PDF/bd47/EN/ constitution-en.
[11]World Health Organisation WHO (2011). Rio Political Declaration on Social Determinants of Health. https://www.who.int/ sdhconference/declaration/Rio_political_declaration.
[12]International Organisation for Migration. IOM. (2011). National Consultation on Migration Health,Kenya.https://www.iom.int/jahia/webdav/shared/shared/mainsite/activities/health/promotion /National-Consultationon-Migration-Health-Kenya
[13]Braveman P, Egerter S, Williams DR. The social determinants of health: coming of age. Annu Rev Public Health 2011. 32:381-98
[14]Wallace, S.P., Young, M.-E. D. T., Rodríguez, M. A., and Brindis, C. D. (2018). A social determinants framework identifying state-level immigrant policies and their influence on health. SSM - Population Health, 7. https:// doi.org/10.1016/j.ssmph.2018.10.016
[15]Chung, R.Y., and Griffiths, S. M. (2018). Migration and health in the world: A global public health perspective. Public Health. 158:64–65.
[16]Ingleby, D., Dias, S., Magnus, J., Nordström, C., and Kumar, B. (2019). Joint Action Health Equity Europe, Work Package 7—Migration and Health, Deliverable 7.1—Policy Framework for Actin. **https://jahee.iss.it/wpcontent/uploads/2020/12/D7.1-WP7-PFA**

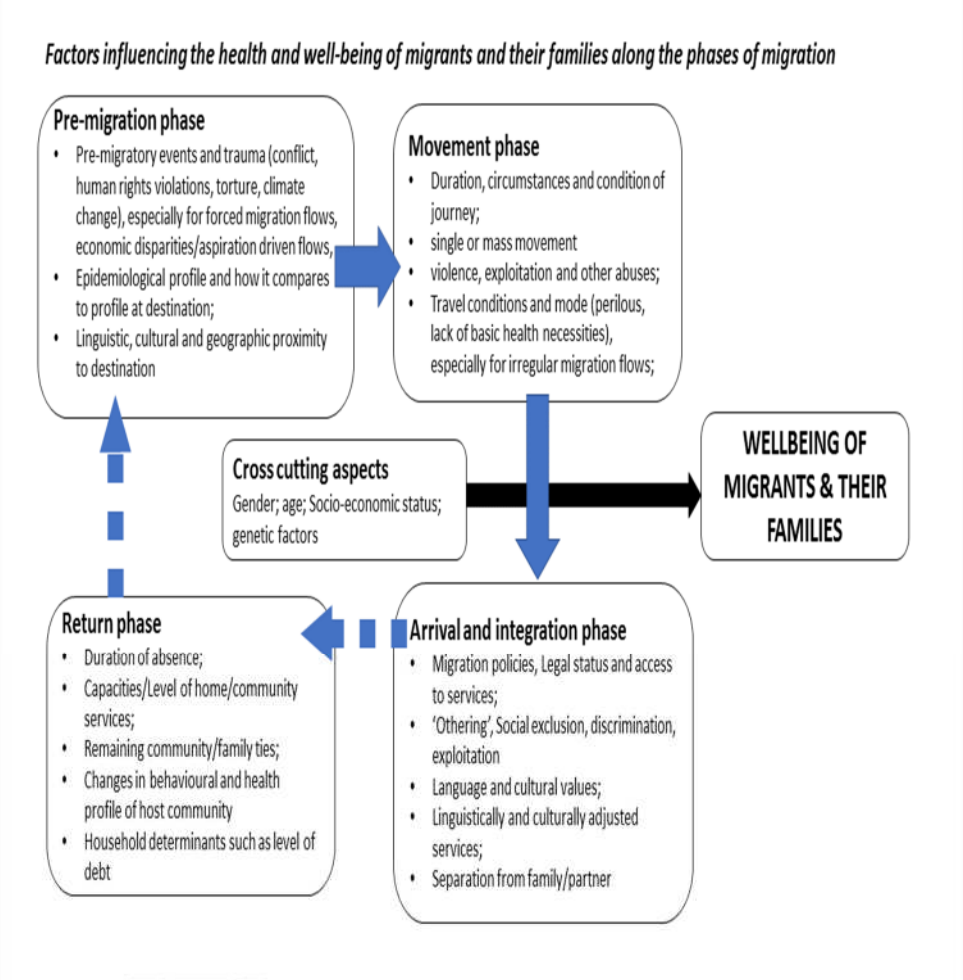

Fig. 2: Health and the well-being of migrants
Source: https://www.migrationdataportal.org

Health of the Migrant Population

As mentioned above, the pre-existing health conditions of migrants' population is important. Individuals are placed in situations that could have an impact on their physical and mental well-being due to the movement from one location to another. The conditions of the process of migration process can render migrants more predisposed to ill health outcomes. This is particularly true especially for persons fleeing catastrophes or violence and migrating for low-skilled occupations. The unskilled are likely to reside in deplorable conditions, devoid of basic necessities and as a result,

endanger their health.[17] Many vectors breed in these areas, and their poor living conditions leave them vulnerable to a wide range of illnesses, including behavioural risk factors including the using cigarette, intake of alcohol, drug abuse and unsafe sexual behaviours.[18-20]

Studies have revealed that migration to cities has been linked to a rise in obesity, which has resulted in other health concerns[21] such as increased hypertension and fasting blood glucose[17, 22]. Malaria is also widespread among construction site migrants.[17.] Inadequate techniques in controlling vectors, in addition to poor living circumstances have contributed to building sites acting as breeding places.[17]The result is an increased man-mosquito interaction, and increased malaria infection.[17]Population mobility is therefore, a significant source of infection.[17]

Animals, Birds and Migration

Migration influences disease transmission patterns, as migrating animals frequently carry illnesses that may be transmitted from animals to people, thus resulting in public health implications. Migrating birds are carriers of the causative bacterium of Lyme disease in humans, and in most cases, are not entirely cleared by the animals upon recovery. They remain latent until a stressful event, such as migration, causes a reactivation. Reactivating latent infections can make up for animals that die in the process of migration, thereby resulting in an increase in the number of infected animals throughout the year.[17.]

[17]Kusuma, Y.S. and Babu, B.V. (2018). Migration and health: A systematic review on health and health care of internal migrants in India. Int J Health Plann Mgmt.1–19

[18] Somasundaram, K.V. and Bangal, V. B. (2012). Living and health conditions of migratory sugarcane harvest workers of Ahmednagar district in Maharashtra. Int J Biomed Adv Res.;3:70-76.

[19]Kusuma, Y.S., Pandav, C.S. and Babu, B.V. (2014).Socio-demographic profile of socioeconomically disadvantaged internal migrants in Delhi, India. J Identity Migr Stud.;8:37-50.

[20]Babu, B.V., Kusuma Y. S., Muthusamy S., et al. (2017). Living conditions of internal migrants: A nationwide study of 13 Indian cities. Int J Migr Border Stud. 3(4):328-351.

[21]Ebrahim S., Kinra S., Bowen. L., et al. (2010). The effect of rural-to-urban migration on obesity and diabetes in India: A cross-sectional study. PLoS Med. 2010; 27:7e1000268.

[22].Bailey, P. K., Tomson, C.R., Kinra, S., et al. (2013). The effect of rural-to-urban migration on renal function in an Indian population: Cross-sectional data from the Hyderabad arm of the Indian Migration Study. BMC Nephrol. 14(1):240.

[23]Muralidhar, M.K., and Wantamutte, A.S. (2007). Malaria among migrants in a rural area of Belgaum. Ind J Community Med. 32(2):153.

The migration of animals has the ability to affect infectious disease transmission through a wide range of methods. Migration might expose hosts to a greater number of infectious illnesses since it covers a broader region and visits more habitats than locals. However, because long-distance mobility requires a lot of energy, migration can have a culling impact on infected hosts, lowering the probability of infection.

The migration of birds is motivated by the requirement for birds to obtain seasonally accessible food supplies to provide energy for activities as molting and mating, while avoiding stressful conditions such as restricted food supply and bad weather.[24]. The way birds spread these emerging diseases globally can be likened to humans travelling on an aircraft.

Migrant birds, particularly ducks, serve as natural reservoirs for the virus causing avian influenza. They carry and interchange various virus strains along their migratory pathways, resulting in antigenic drift and antigenic shift**,** and the formation of new Avian Influenza viruses (HPAI viruses) that are highly pathogenic. HPAI viruses are mostly composed of the H5 and the H7 types, and infection with these viruses can cause 100% mortality in sensitive poultry species.

While the AI (LPAI) viruses that are low in pathogenicity may cause asymptomatic illness or mild respiratory symptoms in poultry, infection with the H7N9 LPAI strain can result in severe sickness and even death in people.

Every spring, millions of birds migrate from Africa's wintering habitats across the Mediterranean Sea to their breeding sites in the Palearctic area. This is one of the world's greatest bird migration movements, with Capri, Italy, Antikythira and Greece, providing significant stopping points for birds arriving from Africa after traversing the Sahara Desert and the Mediterranean Sea.

[24]Somveille M., A. S. Rodrigues and A. Manica (2015). Why do birds migrate? A macroecological perspective. Global Ecology and Biogeography. 24: 664-674

Wild birds migrate seasonally, and this process is one of nature's most spectacular phenomena**.** Each fall, approximately five billion birds move from North America to Central and South America, with a comparable number traveling from Eastern Europe to Africa.

Although not much is understood about why certain species of bird migrate and others do not, one significant benefit of migration is being able to take advantage of seasonal changes in nesting habitat and availability of food.

These birds get these infectious infections by their food or parasites that feed on them. Untreated sewage, garbage dumps, manure, and other sources of enteric pathogens attract a large number of bird species, including crows and gulls.

It is not a surprise that the intestines from wild birds have revealed a wide range of enteropathogens, including the very virulent serovar DT 104 Salmonella spp and Campylobacter spp such as Camphylobacter jejuni, Campylobacter coli. Wild birds have been infected with a number of agents, including arboviruses including the virus responsible for West Nile (WNV), Borrelia burgdorferi, the virus responsible for Influenza A, enteric bacterial infections, and certain drug-resistant bacteria.

	**Flying foxes** (*Pteropus spp.*)	Unknown maximum migratory distances for many species; can range between 50-1000 km across Southeast Asia and Australia	Paramyxoviruses such as Nipah virus and Hendra virus	Loss of feeding grounds through deforestation; Habitat loss through land conversion
	**Green darner** (*Anax junius*)	Exact distances unknown, but adults travel 700 km or more annually from southern Canada and northern U.S. to Central America	Eugregarine protozoan (*Geneiorhynchus* sp.)	Unknown; possibly destruction of freshwater breeding habitats
	**Wildebeest** (*Connochaaetes taurinus*)	In the Serengeti, animals move between wet and dry seasons across an area of 30,000 km^2	Rinderpest (*Morbillivirus* sp.); Brucellosis (*Brucella*); Foot-and-mouth disease (*Aphtae epizooticae*)	Landcover change (reduction in tree cover); Fire frequency; Exposure to infected domestic livestock
	**Swainson's thrush** (*Catharus ustulatus*)	Migrate up to 10,000 km annually between breeding grounds in Canada/northern U.S. to overwintering sites in Central and South America	West Nile virus; Lyme disease; Blood parasites (*Haemoproteus* and *Plasmodium*)	Habitat loss on breeding and wintering grounds; Building strikes during migration
	**Gray whale** (*Eschrichtius robustus*)	Annual migrations of over 18,000 km from feeding sites in the Bering Sea to winter breeding grounds along the coast of Baja California	Whale lice (cyamid amphipods, *Cyamus* spp.); Barnacles (*Crytolepas*); Multiple endoparasitic worms	Industrial activity near calving lagoons; Oil exploration along migration routes; Vessel harassment

Fig. 3a: Representative migratory species, including migration distances and routes, known parasites and pathogens, and major threats to species persistence. Infectious diseases have been examined in the context of migration for some, but not all, of these species. Supporting references and photo credits are provided in the supporting online material (SOM) text.
Source: Altizer et al. (2011).

[25]Altizer, S., Bartel, R., & Han, B. A. (2011). *Animal Migration and Infectious Disease Risk. Science.* 331(6015):296–302.

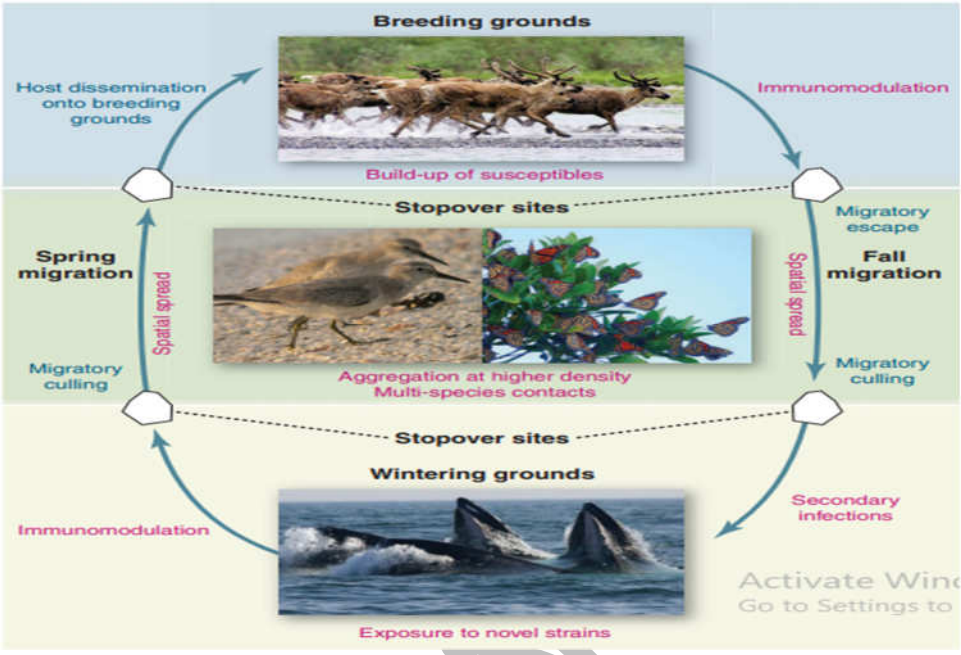

Fig. 3b: Points along a general annual migratory cycle where key processes can increase (red text) or decrease (blue text) pathogen exposure or transmission. Behavioural mechanisms such as migratory escape and migratory culling could reduce overall pathogen prevalence. As animals travel to distant geographic locations, the use of multiple habitat types including stopover sites, breeding areas, and wintering grounds can increase transmission as a result of host aggregations and exposure to multihost pathogens. This might be especially true for migratory staging areas where animals stop to rest and refuel. High energetic demands of spring and fall migration can also result in immunomodulation, possibly leading to immune suppression and secondary infections. [Photo credits (clockwise): J. Goldstein, B. McCord, A. Friedlaender, and R. Hall]
Source: Altizer et al., (2011).

[25]Altizer, S., Bartel, R., & Han, B. A. (2011). *Animal Migration and Infectious Disease Risk. Science.* 331(6015): 296–302.

One Health and Zoonoses

The concept of One Health established in the early 2000s, states that human and animal health are interdependent and linked to the health of the ecosystems in which they live.[26] The idea of One Health is important in addressing new zoonotic diseases and zoonoses that are re-emerging, thereby managing the effects of zoonotic infections on animals, people and the environment. This aims to make the globe free of zoonotic disease hazards. It is a successful strategy to zoonotic disease control in humans, animals, and the environment.

Zoonotic illnesses are infectious illnesses that are naturally transmissible from vertebrates to humans, according to the World Health Organisation (WHO). Thus, animals play a very crucial part in propagating zoonotic infections in nature. Examples of some zoonotic diseases include Rabies, Salmonella infection, Ebola, Avian influenza infection, Brucellosis, Anthrax, Mpox, Bovine tuberculosis to mention a few.

The World Health Organisation (WHO), the Food and Agriculture Organisation (FAO), and the World Organisation for Animal Health (OIE) have agreed to describe an emergent zoonosis as one that is freshly identified or newly developed, or previously happened but has showed a rise in incidence or geographic, host, or vector range expansion. There are around 200 identified varieties of zoonoses. Six out of ten human occurrences of infectious illness are brought on by animal transmission[27]. Disease transmission from animals may occur everywhere people dwell, in both urban and rural environments.

Recent particularly severe infections have highlighted the significance of zoonotic diseases to human health with every likelihood of becoming pandemic and having the potential for high death. Such occurrences include the 2005 H5/N1 avian influenza outbreak, the swine flu H1/N1 influenza pandemic that happened in 2009, the 2013–2016 West African Ebola outbreak, including the 2019-novel coronavirus that occurred in 2019 (2019-nCoV).

[26].McEwen, S. A., & Collignon, P. J. (2018). Antimicrobial Resistance: a One Health Perspective. Microbiology Spectrum. 6(2):23-26
[27].Centre for Disease Control. One Health. https://www.cdc.gov/onehealth
[28]Morand S, McIntyre KM, Baylis M. (2014). Domesticated animals and human infectious diseases 514 of zoonotic origins: domestication time matters. Infect Genet Evol. 24:76-81

Zoonotic diseases and One Health concept.

Fig. 4: The concept of One health concept and zoonoses
Source: Yasmeen et al. (2021)
Yasmeen N, Jabbar N, Taif S and Fang X. (2021). One health paradigm to confront zoonotic health threats: A Pakistan approach. Frontiers in Microbiology 12

The World Health Organisation (WHO), the Food and Agriculture Organisation (FAO), plus the World Organisation for Animal Health (OIE) have agreed that an emerging zoonosis is one that is newly acknowledged or recently evolved, or that has previously occurred but has shown an upsurge in the incidence or geographic, host, or vector range expansion. Emerging zoonoses are seen as a worldwide concern by the WHO, FAO, and OIE, with potentially significant human health and economic consequences. They noticed the current rising trend in these ailments and expect it will continue.

The coronavirus (SARS-CoV) is zoonotic. It spreads from civet cats to humans. Coronaviruses are encapsulated, single-stranded, positive-sense RNA viruses belonging to the family Coronaviridae.

Coronaviruses are enclosed, RNA viruses with a single strand and a positive sense belonging to the Coronaviridae family.[29] Six coronaviruses (CoVs) were previously recognised to be the cause of human ailments. In late December 2019, a newly discovered coronavirus, responsible for being the causative agent of the COVID-19 disease originally identified as 2019-novel coronavirus (2019-nCoV) and then recognised as SARS-CoV-2, which was reported from China. The outbreak was eventually classified as pandemic.[30] All seven identified human coronaviruses are known to be zoonotic in nature. The bat is the natural host of the majority of coronaviruses, with the exception of HCoV-OC43 and HCoV-HKU1, which originated in rodents. One possible transmission route to humans is through an intermediate host with whom humans have contact. Human-to-human transmission is straightforward since the viruses are mostly disseminated by respiratory droplets and fomites. Transmission via contact is an essential aspect in determining how these viruses propagate.

MERS-CoV which was transmitted from dromedary camels to humans is an emerging viral zoonotic disease. MERS first emerged in Saudi Arabia in 2012.[31] SARS-CoV, MERS-CoV, and SARS-CoV-2 were the most virulent of the seven viruses. MERS-CoV had the highest death rate. COVID-19 is a worldwide, public health challenge and is causing devastating effects on health, social life, and economy all over the world. The disease has been reported in more than 200 countries causing 25 million cases and 0.9 million deaths worldwide[32]. Also, fruit bats carry the fatal Ebola virus illness.

[29]Lee, J.; Chowell, G.; Jung, E. (2016). A dynamic compartmental model for the Middle East respiratory syndrome outbreak in the Republic of Korea: A retrospective analysis on control interventions and superspreading events. J. Theor. Biol. 408:118–126.
[30]Hui, D.S. (2017). Epidemic and emerging coronaviruses (severe acute respiratory syndrome and Middle East respiratory syndrome). Clin. Chest Med. **2017**. 38:71–86.
[31]Perlman, S. (2020). Another decade and another coronavirus. New England Journal of Medicine. 2020;382:760-762.
[32] World Health Organisation. Coronavirus Disease (COVID-19). Weekly Epidemiological Update and Weekly Operations Update. Available online at https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200831-weekly-epi-update-3.pdf?sfvrsn=d7032a2a_4. (Accessed July 2023).

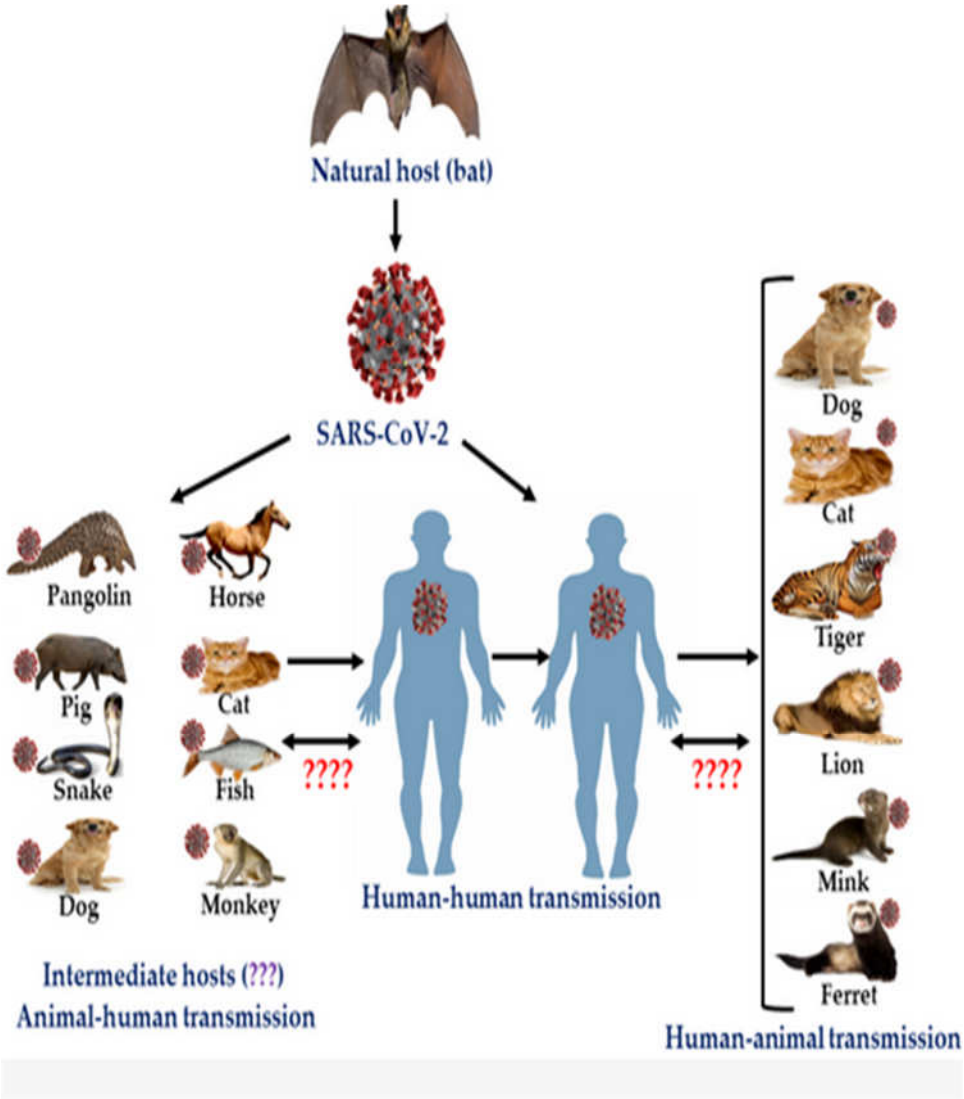

Fig. 5: Features of Zoonotic SARS-CoV-2 virus
Source: Rahman et al., (2020).

[33]Rahman, M. T., Sobur, M. A., Islam, M. S., Ievy, S., Hossain, M. J., El Zowalaty, M. E., Ashour, H. M. (2020). *Zoonotic Diseases: Etiology, Impact and Control. Microorganisms. 8(9): 1405.*

The Causative virus of Avian Influenza

Avian Influenza is among the most serious hazards to farm-raised chicken. An increase in commerce globally, increased production of chicken, a change in climate, the migration of birds, human transportation, including an increasing worldwide population have all led to the development and epidemics of the virus causing Avian Influenza.[34] Human H7N9 infections have grown increasingly severe since 2013.[35] Influenza epidemics on poultry farms generally result in the killing of the whole domestic bird population, thus resulting in substantial economic losses.

There are avian influenza (HPAI) strains that have a high pathogenicity. These may infect pigs and humans in addition to their primary avian host, posing a worldwide zoonotic and pandemic hazard. Several AI virus subtypes, particularly H5, H7, and H9, have demonstrated the capacity to transcend species barriers and infect mammals such as swine and humans.[35] As a result, avian influenza poses a significant public health risk.

Viral reassortment is the reason hazardous forms of the HPAI viruses are present. These forms may infect animals and adapt to their new hosts. It is still debated whether the famous 1918 Spanish flu pandemic was triggered by a reassortant strain developed in mammals or an exclusively avian-like virus that adapted to humans.

[34]Young, S., Carrel, M., Malanson, G., Ali, M., & Kayali, G. (2016). Predicting Avian Influenza Co-Infection with H5N1 and H9N2 in Northern Egypt. International Journal of Environmental Research and Public Health. 13(9): 886.

[35]Jessica A. Belser, Nicole Brock, Xiangjie Sun, Joyce Jones, Natosha Zanders, Erin Hodges, Joanna A. Pulit-Penaloza, David Wentworth, Terrence M. Tumpey, Todd Davis, and Taronna R. (2018). Mammalian Pathogenesis and Transmission of Avian Influenza A(H7N9) Viruses, Tennessee, USA. Emerg Infect Dis. 24(1): 149–152.

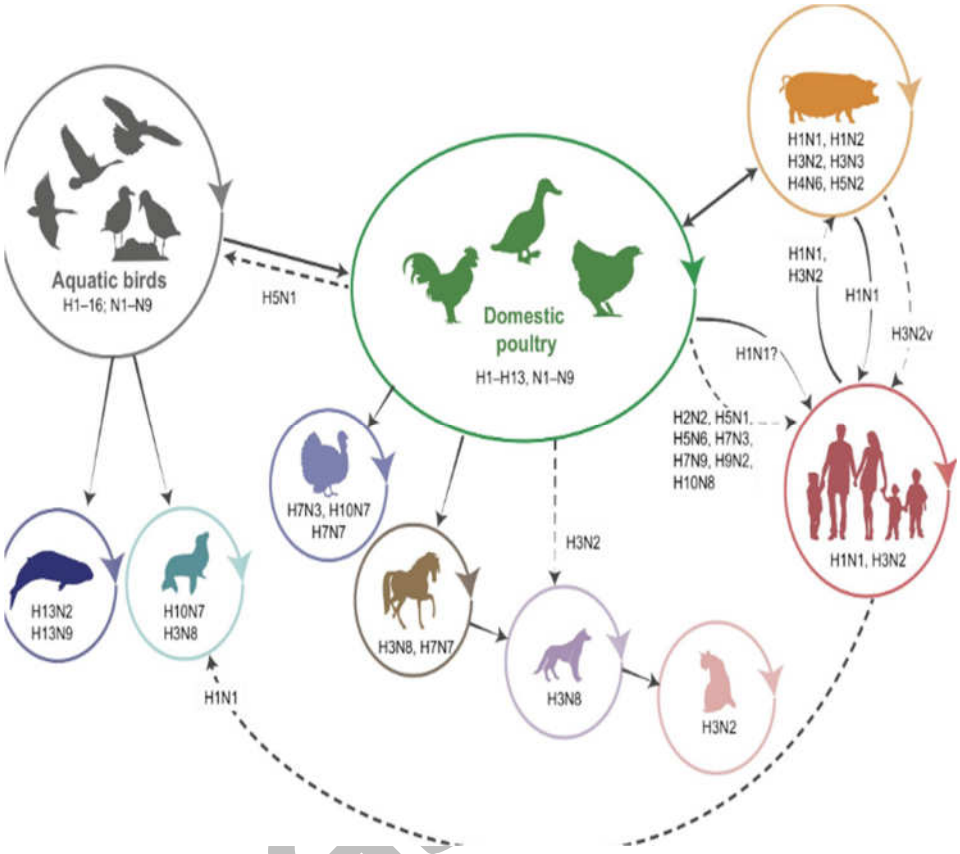

Fig. 6: Influenza A viruses (IAVs) spread widely across animals. Diagram depicting interspecies transmission events of IAVs and the subtypes involved. Solid arrows indicate direct transmission events that have been established in the host species. Dashed arrows indicate occasional or limited infection of subtypes in which persistent transmission in the new host has not been identified.

Source: Belser *et al*., (2018).

[35]Jessica A. Belser, Nicole Brock, Xiangjie Sun, Joyce Jones, Natosha Zanders, Erin Hodges, Joanna A. Pulit-Penaloza, David Wentworth, Terrence M. Tumpey, Todd Davis, and Taronna R. (2018). Mammalian Pathogenesis and Transmission of Avian Influenza A(H7N9) Viruses, Tennessee, USA. Emerg Infect Dis. 24(1): 149–152.

Conclusion and Recommendations

Migration is a worldwide issue that affects the health of people and populations. Zoonotic diseases such as bovine spongiform encephalitis, avian influenza, and anthrax have the possibility for disrupting diseases such as bovine spongiform encephalitis worldwide commerce in animals, animal products, and byproducts. Policies to safeguard migrants and public health will produce positive results, provided they cover all stages involving the process of migration.

Laws to prohibit cross-species breeding, enhancing the health of animals on farms by controlling stocking numbers, assuring high veterinarian care standards, and transitioning to plant-based diets. Improving preventative measures for efficiently controlling of avian flu viruses.

Environmental sanitation can help to reduce exposure to infectious agents by restricting contact with garbage or polluted media, including modifying hygiene and socio-cultural habits.

Conflict of Interest:
There is no conflict of interest.

Bibliography

Altizer, S., Bartel, R., & Han, B. A. (2011). "Animal Migration and Infectious Disease Risk." *Science. 331(6015):296–302.*

Babu, B.V., Kusuma, Y.S., Muthusamy, S., *et al*. (2017). "Living conditions of internal migrants: A nationwide study of 13 Indian cities*." Int J. Migr Border Stud. 3(4):328-351.*

Bailey, P.K., Tomson, C.R., Kinra, S., *et al.* (2013). The effect of rural-to-urban migration on renal function in an Indian population: Cross-sectional data from the Hyderabad arm of the Indian Migration Study. *BMC Nephrol. 14(1):240.*

Berchin, II. (2017). "Climate change and forced migrations: An effort towards recognising climate refugees." *Geoforum. 2017; 84:147–50.*

Braveman P., Egerter S. & Williams D.R. "The social determinants of health: coming of age." *Annu Rev Public Health 2011. 32:381-98*

Castelli, Francesco (2018). Drivers of migration: Why do people move. J Travel Med 1: 25(1) Centre for Disease Control. One Health. https://www.cdc.gov/onehealth

Chapman, J. W., Reynolds, D.R. & Wilson, K. (2015). "Long-range seasonal migration in insects: mechanisms, evolutionary drivers and ecological consequences." *Ecol Lett 18:287*

Chung, R.Y., & Griffiths, S. M. (2018). "Migration and health in the world: A global public health perspective." *Public Health.* 158:64–65.

Ebrahim, S., Kinra, S., Bowen, L., et al. (2010). The effect of rural-to-urban migration on obesity and diabetes in India: A cross-sectional study. *PLoS Med. 27:7e1000268.*

Hui, D.S. (2017). "Epidemic and emerging coronaviruses (severe acute respiratory syndrome and Middle East respiratory syndrome)". *Clin. Chest Med. 38:71–86.*

Ingleby, D., Dias, S., Magnus, J., Nordström, C., & Kumar, B. (2019). Joint Action Health Equity Europe, Work Package 7—Migration and Health, Deliverable 7.1—Policy Framework for Actin. https://jahee.iss.it/wpcontent/uploads/2020/12/D7.1-WP7-PFA

International Organisation for Migration IOM (2015). *World migration report – migrants and cities: New partnerships to manage mobility*. Geneva.

International Organisation for Migration. IOM. (2011). National Consultation on Migration Health,Kenya.https://www.iom.int/jahia/webdav/shared/shared/mainsite/activities/health/promotion/National-Consultationon-Migration-Health-Kenya

Jessica A., Belser, Nicole Brock, Xiangjie Sun, Joyce Jones, Natosha Zanders, Erin Hodges, Joanna A. Pulit-Penaloza, David Wentworth, Terrence M. Tumpey, Todd Davis, and Taronna R. (2018). Mammalian Pathogenesis and Transmission of Avian Influenza A(H7N9) Viruses, Tennessee, USA. Emerg Infect Dis. 24(1): 149–152.

Kirby, J.S., Stattersfield, A.J., Butchart, S.H.M., Evans, M.I., Grimmett, R.F.A., Jones,V.R. (2008). Key conservation issues for migratory land- and waterbird species on the world's major flyways. *Bird Conservation International 18: S49–S73.*

Kusuma,Y. S, Pandav, C.S. & Babu, B.V.(2014).Socio-demographic profile of socioeconomically disadvantaged internal migrants in Delhi, India. *J Identity Migr. Stud. 8:37-50.*

Kusuma, Y.S. & Babu, B.V. (2018). Migration and health: A systematic review on health and health care of internal migrants in India. Int Journal Health Plan. Mgmt.1–19

Lee, J.; Chowell, G.; Jung, E. (2016). A dynamic compartmental model for the Middle East respiratory syndrome outbreak in the Republic of Korea: A retrospective analysis on control interventions and superspreading events. J. Theor. Biol. 408:118–126

McEwen, S. A., & Collignon, P. J. (2018). Antimicrobial Resistance: A One Health Perspective. *Microbiology Spectrum. 6(2): 23-26*

Morand S, McIntyre K. M. & Baylis M. (2014). Domesticated animals and human infectious diseases 514 of zoonotic origins: domestication time matters. *Infect Genet Evol. 24:76-81*

Muralidhar, M.K, & Wantamutte, A.S. (2007). Malaria among migrants in a rural area of Belgaum. *Ind J Community Med. 32(2):153.*

Perlman, S. (2020). "Another decade, another coronavirus." N. Engl. *J. Med. 382:760–762.*

Rahman, M. T., Sobur, M. A., Islam, M. S., Ievy, S., Hossain, M. J., El Zowalaty, M. E., & Ashour, H. M. (2020). *Zoonotic Diseases: Etiology, Impact, and Control. Microorganisms.8(9):1405.*

Scott, S. (2015) Making the case for temporary migrant worker programmes: evidence from the UK's rural guest worker ('SAWS') scheme. *Journal of Rural Studies 40 pp. 1–11*

Shaw, A.K. (2016). Drivers of animal migration and implications in changing environments. *Evolutionary Ecology*. 30(6): 991–1007

Somasundaram, K. V & Bangal, V.B. (2012). Living and health conditions of migratory sugarcane harvest workers of Ahmednagar district in Maharashtra. *Int J Biomed Adv Res*. 3:70-76.

Somveille M., Rodrigues, A. S. & Manica, A. (2015). Why do birds migrate? A macroecological perspective. *Global Ecology and Biogeography. 24: 664-674*

United Nations (1998). Recommendations on statistics of international migration. Series M, No 58, Rev 1

Wallace, S.P., Young, M.-E. D. T., Rodríguez, M. A., & Brindis, C. D. (2018). A social determinants framework identifying state-level immigrant policies and their influence on health. SSM - Population Health, 7

Wennersten, J.R. & Robbins D. (2017). *Rising tides: Climate refugees in the twenty-first century in: Depth examination of climate migration with key case studies*. Bloomington: Indiana University Press. p. 118–21

World Health Organisation W.H.O. (1946). Constitution of the World Health Organisation. http://apps.who.int/gb/bd/PDF/bd47/EN/ constitution-en.

World Health Organisation W.H.O (2011). Rio Political Declaration on Social Determinants of Health. https://www.who.int/ sdhconference/declaration/Rio_political_declaration.

World Health Organisation. Coronavirus disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. Available online: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200831-weekly-epi-update-3.pdf?sfvrsn=d7032a2a_4 (Accessed July 2023)

Yasmeen, N., Jabbar, N., Taif, S. & Fang, X. (2021). One health paradigm to confront zoonotic health threats: A Pakistan approach. *Frontiers in Microbiology. 12:40-44.*

Young, S., Carrel, M., Malanson, G., Ali, M., & Kayali, G. (2016). Predicting Avian Influenza Co-Infection with H5N1 and H9N2 in Northern Egypt. *International Journal of Environmental Research and Public Health.* 13(9):886.