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SEASONALITY OF INFECTIOUS DISEASES

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Introduction

Although it is not a sole determinant, seasonality plays an important role in predicting future disease outbreaks, epidemics, and pandemics. To call an infectious disease seasonal, it needs to have a repetitive, and predictive pattern within a year. Many of us know about seasonal flu, but it is not just the flu that's seasonal. Many infectious diseases have a seasonal component starting from childhood infections, water- and food-borne illnesses, vector-borne diseases such as malaria and dengue, and even sexually transmitted diseases like gonorrhea. Now, scientists say that all infectious disease has a seasonal component.

Complex interconnected relationship between all living and non-living things in our ecosystem plays the main role in seasonality. Abiotic factors (e.g. wind, rain, temperature, humidity, water) found in the ecosystem influence living things in multiple ways. Within fields of infectious disease in ecology, a seasonal variation in the transmission is called season forcing. If seasonality is determined by environmental factors we call it environmentally forced disease dynamics.

Aim

To provide a better understanding of the dynamics and drivers of seasonality. To determine the importance of seasonality in public health.

Material and methods

A theoretical analysis of literature sources and synthesis of scientific literature from 2015–2018. By far we can broadly classify seasonal drivers into 4 main groups, they are: environmental factors, host behaviour, host phenology, and exogenous biotic factors.

Environmental factors especially climatic conditions (temperature, rainfall, and humidity), influence a variety of infectious diseases (e.g. African sleeping sickness Tsetse fly distribution expands during the rainy season. Bacterial pneumonia peaks in midwinter associated with influenza, chickenpox cases peak in spring, and viral meningitis in summer). Other examples include seasonal non-climatic abiotic environmental conditions such as water salinity that may impact water-borne pathogens. Furthermore, environmental factors can influence pathogen survival, the host susceptibility to infection, and also vector population dynamics. One such example is humidity, which is the concentration of water vapour present in the air. Low humid levels (below 20 %) predispose to viral and bacterial respiratory tract infection and high humid levels (above 60 %) predisposes to fungal infections.

Host behaviour Transmission seasonality is sometimes due to seasonal host behaviour, (e.g. rituals made by men, like festivals). The most well-expressed example is the elevation in measles transmission rate during school term due to aggregation of children in classes, or the increase in transmission of infections due to aggregation of people indoors during wintertime.

Seasonal host behaviour not only include contact rate in human but also in animal hosts (domestic and wildlife). The seasonal interface created between humans and wildlife in remote places poses a unique challenge and threat in zoonotic infections in humans (e.g. Ebola in wildlife peak in the dry season, exposure to livestock seasonally can lead to Echinococcosis).

Host phenology Life history of the host (Migration and hibernation), physiological changes that happen endogenously due to seasonal changes(seasonal restructuring of immunity), cycles of metabolism, and seasonal changes in reproduction (e.g. sexually transmitted infections like gonorrhoea and syphilis peaks in summer due to high sexual activity and partner changing during summer vacations) all affect the transmission of infectious diseases. Unlike the environmental drivers and host behaviour, phenology can drive seasonality by other mechanisms using the SIR model, (susceptibility, infectiousness, disease and natural induced mortality and symptomatology).

Exogenous biotic factors interactions that take place within the host (e.g. parasite-parasite interaction, bacterial pneumonia followed by viral influenza) or interactions within the ecological community, (the multi-host disease system in Lyme disease).

Seasonality of respiratory viruses in the human population. To date, at least 9 distinct viruses have been identified as common causative agents for respiratory tract infection. According to the epidemiological studies in the temperate regions, most of the viruses have oscillations of a seasonal outbreak. Respiratory syncytial virus, Influenza virus, human coronavirus clearly show peak incidences in winter months, which lead them to be called winter viruses. Some enterovirus cases peak during summer (summer viruses), other viruses like human metapneumovirus, human bocavirus, and adenovirus are detected throughout the year (all-year viruses). Human parainfluenza viruses are type-specific. HPIV-2 cases peak in the fall of each year and HPIV-3 usually occur in the spring and early summer months each year.

Effects of environmental factors on host airway defence system seasonal fluctuation of temperature and humidity of inhaled air have a direct effect on the mucosal surface defence. Low levels of humidity below 20 % in the air make the air we breathe dry and dehydrated. This dehydration caused by dry breathing air leads to increased viscoelasticity of the mucous layer and immobilizes cilia and reduces its height due to the dehydrated periciliary layer. An experimental study using guinea pigs demonstrated immediate airway epithelial loss, and detachment of epithelial cells with inflammation of trachea due to inhalation of dry air. Another study done with humans, in ambient temperature showed that mucociliary beating begins to decline below 20’C and is no longer observed at 5’C. Studies with Siberian hamsters with a short exposure of daylight decreased phagocytic activity and reactive oxygen species which plays an important role in the nonspecific immune response. Lastly, Vitamin D deficiency during winter causes immunosuppression by impairing macrophage maturation.

Seasonality and transmission of vector-borne diseases which includes virus, protozoa, and filarial nematodes. Among these, parasites are most likely to vary with environmental conditions. In warmer regions, seasonal rainfall can increase the number of mosquitoes and other vectors. Furthermore, mosquitoes reach sexual maturity earlier and feed more frequently at warmer temperatures. Replication rate of mosquito-transmitted dengue viruses and malarial parasite increase at a warmer temperature and in contrast during cooler climatic conditions parasites might not mature quite easily before they turn to adult mosquitoes and die. Longer winters and colder temperatures reduce the number of host-seeking nymphs that transmit Lyme disease and other tick-borne infections.

Seasonality of Tuberculosis during the pre-antibiotic era tuberculosis mortality rate was higher in late winter and early spring in the northern hemisphere. Several researchers have suggested that environmental and social factors such as temperature, humidity, sunlight, as well as crowding, and person to person contact are a source of TB seasonality. But this applies to primary TB and not to reactivation of TB. Some researchers consider the main cause of TB seasonality as intrinsic. A possible explanation is that of vitamin deficiency and impaired host defence due to Mycobacterium.

Vaccination for seasonal infections. Vaccination is a very effective measure for providing immunity to many infectious diseases. The discovery of vaccines played a central part in the eradication of smallpox and helped significantly reduce the incidence of potentially severe diseases such as poliomyelitis and measles. In 1984 the Expanded programme immunization (EPI) created the first standardized vaccination schedule. In this first incarnation, the schedule recommended the following four vaccines against six diseases: Tuberculosis, Diphtheria, Pertussis and Tetanus (DPT), Measles and Poliomyelitis.

Then a list of vaccines that were added to the recommended schedule:

In 1988, a yellow fever vaccine was introduced to countries in which yellow fever is endemic. This vaccine is frequently given at the same time as the measles vaccine. According to WHO, a single dose of the yellow fever vaccine is sufficient for protective immunity against the yellow fever disease; a booster dose is not required.

In 1992, a vaccine against hepatitis B was added to the schedule, and by 1997, it was recommended as a vaccine in all countries. WHO recommends that all infants receive the hepatitis B vaccine as soon as possible after birth, which should be followed by 2 or 3 doses to complete the primary series. Many countries have not incorporated the birth dose of the hepatitis B vaccine into their national schedules, as a high proportion of births occur outside a health facility, making it difficult to reach newborns in time. The 3-dose primary series is often given at the same time as the DPT vaccine. No booster vaccinations are recommended for individuals who have completed the 3 dose vaccination schedule. When the Haemophilus influenza type b vaccine is administered with the DPT and hepatitis B vaccines, this is known as the pentavalent vaccine.

In 2001, WHO recommended the introduction of the mumps vaccine, to be administered with the vaccines for measles and rubella (MMR). There are two main types of polio vaccines: the oral polio vaccine (OPV) and the inactivated polio vaccine (IPV). OPV, which was included in the original EPI vaccination schedules, contains attenuated (weakened) polio viruses, which enable vaccinated individuals to become immune to the virus. Almost every country that has eradicated polio used OPV to stop person-to-person transmission of the virus.

In 2006, the rotavirus vaccine was added to the recommended vaccination schedules and in the same year the World Health Organization recommended a vaccine against Japanese encephalitis in all regions where the disease is a recognized public health problem. In 2007, the World Health Organization added the pneumococcal conjugate vaccine (PCV) to its recommended vaccination schedule in all countries. Diseases caused by Streptococcus pneumoniae (pneumococcus) include pneumonia, meningitis, febrile bacteraemia, otitis media, sinusitis, and bronchitis. In developing countries, the disease is most common in newborn infants and children under age 2. The vaccines, which are administered as injections, are designed to protect against the serotypes that are most commonly associated with severe pneumococcal diseases.

After all WHO categorizes recommendations for routine immunization into 4 groups as follows:

I. Recommendations for all immunization programmes include vaccines like BCG, Hepatitis B, Polio, DTP containing vaccine(DTPCV), Haemophilius influenza type b, Pneumococcal (Conjugate), Rotavirus, Measles, Rubella, HPV vaccines.

II. Recommendations for certain regions vaccines included were Japenese.

III. Recommendations for some high-risk populations Typhoid, Cholera, Meningococcal (MenA conjugate, MenC conjugate, Quadrivalent conjugate, Hepatitis A, Rabies, Dengue (CYD-TDV).

IV. Recommendations for immunization programmes with certain characteristics Mumps, Seasonal influenza (inactivated tri- and quadri-valent) and Varicella vaccines.

Strategic Advisory Group of Experts on Immunization (SAGE) was established to guide vaccination recommendations. SAGE meets twice a year to review information related to immunization and vaccine-related topics and to modify recommendations which are then reflected in the WHO vaccine position papers. Each country sets its own standards based on the Expanded Program on Immunization they are called as Country specific vaccination schedules.

Public health importance of seasonality. The emergence of SARS-associated coronavirus brought up questions about the mechanism that could drive pandemic influenza and the desire for improved tools for forecasting of infectious disease. Public health benefits can be expected if resources are devoted to the study of seasonality. The benefits of studying seasonality include an improved understanding of host and pathogen biology and ecology, enhances the accuracy of the surveillance system, and predict epidemics and pandemics. Plus it gives a better understanding of the long-term effects of global climate change in infectious disease control. Studying seasonality can also help in controlling disease burden and mortality rates.

Conclusion

Seasonality plays a very big role in infectious disease in terms of disease surveillance but yet it is poorly studied. Most communicable diseases have their seasonal oscillating patterns that help us understand the mechanism of transmission and improve prophylactic measures. It is important to know and find these patterns so that we can be more attentive during the seasonal spread of these disease. Which is why scientists are trying to find seasonality even in diseases that don't have on.

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ANTIFUNGAL EFFICACY OF SOME ORCHIDS FROM *COELOGYNE* LINDL. GENUS AGAINST *CANDIDA ALBICANS* STRAIN

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Introduction

Invasive fungal infections have increased greatly in recent years [1]. *Candida albicans* is the most important microorganism in the pathogenesis of candidiasis