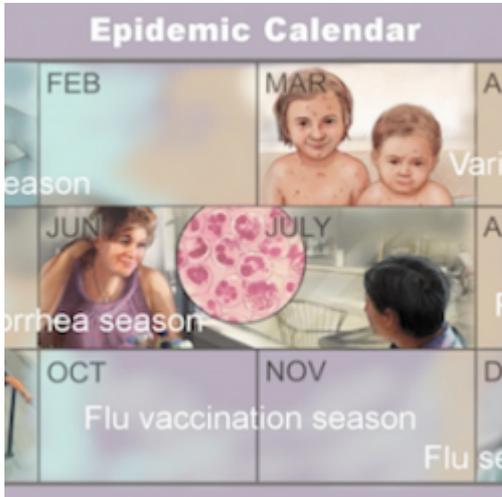


'Tis the Season for Infectious Disease



By *Chuck Dinerstein* — November 14, 2018



It is once again flu season, and yes, you should get a flu vaccination. But why is flu so seasonal; for that matter, why did polio strike more in the summer and what about acute flaccid myelitis? A recent review in *PLOS Pathogens* provides some background over what produces this natural rhythm.

The author reviews what we know about the forces affecting seasonal variation in infections termed seasonal forcing and spoiler alert our knowledge is incomplete at best. At its heart, there are four underlying forces, environmental factors, host behavior as well as our own annual rhythms, and exogenous forces.

Environmental factors

To the casual eye, these are the clear dominant forces, after all, as I said in the introduction, the annual flu season is upon us. But the underlying drivers can affect both host and invader; for example, temperature and rainfall influence the breeding of mosquitos, altering their numbers to create more or fewer sources of malaria. And seasonal weather may affect our immune response through the availability of food or exposure to very cold conditions.

Host behavior

For infectious diseases to be transmitted, there must be some form of contact, direct, through the air, in droplets. And once again our behavior, as well as that of our microbiologic invaders, has a seasonal component. For example, measles increases when school is in session, and susceptible hosts are gathered together; Lyme disease varies in relationship to an intermediary in the infectious chain, deer – our contact with deer is far more limited in the winter and fall than the spring and summer.

Host behavior may increase disease transmission, as with any sexually transmitted diseases or

decreased by washing our hands. Our increasing mobility is also a driver of infectious epidemics, witness the cases of measles in NY associated with people returning from Israel; or the heightened risk of cholera in human populations suddenly moved into new, confined areas with inadequate infrastructure. And these changes in the locality are not restricted just to human, animal vectors migrate and hibernate contributing their own rhythm to the calendar of diseases.

Phenology

The cycles and changes that make up the life of both host and vector also influence the seasonality of infection. For example, our circadian rhythms, our innate metronomes, influence our immune systems with cells counts rising and falling throughout the day. Or the seasonal variation in STDs in India, where school vacations increase the opportunity to "get busy" in more than one way.

Exogenous biotic factors

Interactions that take place within the "ecological community of hosts, reservoirs, and vectors," also play a role. The handiest example is the impact of antibiotics on the gut microbiome that increases populations of pathogenic bacteria, like *Clostridia* and reduces bacteria that suppress those more harmful actors.

Understanding seasonality

All members of the ecology have cycles, some easily perceptible like the lifespan of the fruit fly and others so long that we cannot see the alterations in our lifetimes, e.g., the rise and fall of mountain ranges. But they all influence, in subtle or profound ways, the multi-layered interactions that we perceive as the seasonal variation in infectious epidemics. We have made significant inroads in the management of these acute and chronic illnesses by focusing on easily identified, directly active "causes." We wash our hands; we have protected sex, we have developed vaccines. But by taking a more encompassing perspective, considering how multiple elements may interact we may also benefit; standing water and mosquito-borne disease go together, at least in the US, so measures to improve appropriate water management and run-off can be thought of as public health measures. Seasonality of disease is due to far more than the season in which it occurs. Carlo Rovelli, a physicist, put it best,

"...the dance of nature does not take place to the rhythm of the baton of a single conductor, at a single tempo, every process dances independently with its neighbors, to its own rhythm."

We are only now beginning to see how the independent "dances" of environment, host, and vector behavior together in the dance of nature that we call the seasonality of infectious epidemics.

Source: The calendar of epidemics: Seasonal cycles of infectious diseases. PLOS Pathogens
DOI:10.1371/journal.ppat.1007327

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Source URL: <https://www.acsh.org/news/2018/11/14/tis-season-infectious-disease-13596>