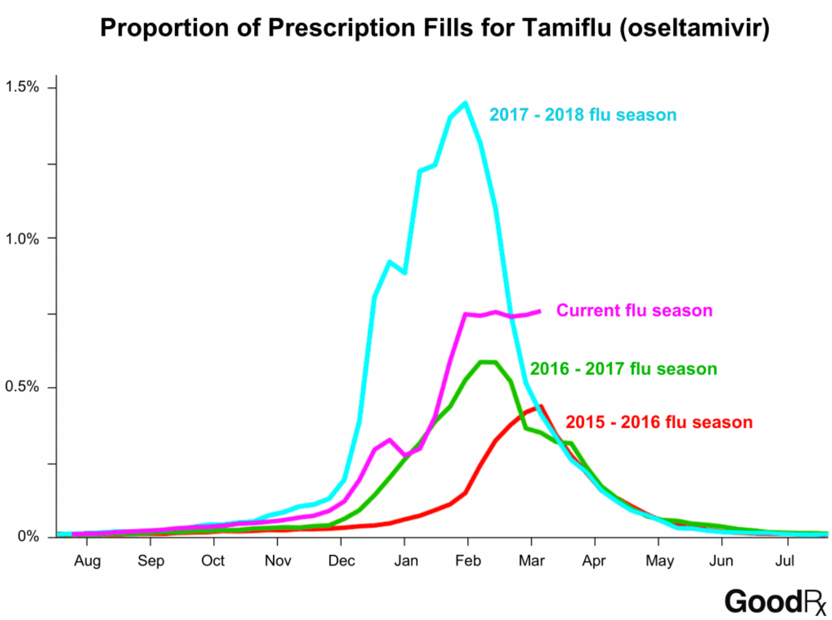
Will April save us from the Corona pandemic?

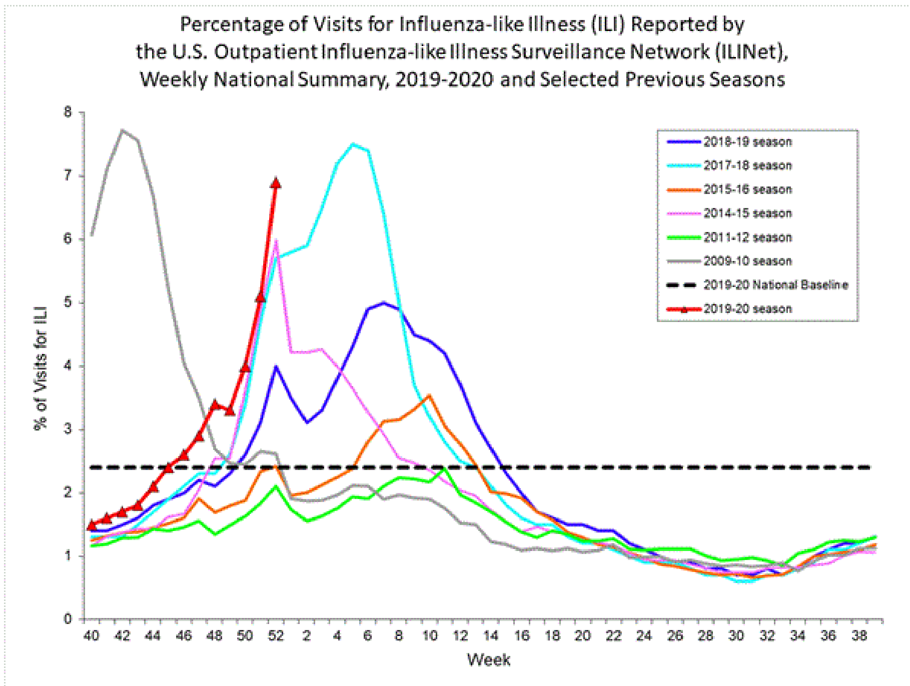
It is now known that the incubation period for COVID-19 is about 5 days from exposure and that those that die, succumb on average 15 days after symptoms begin. Even those that recover have a long disease course. Since this disease has such a long duration, patients may need hospitalization for fairly long periods. This can overwhelm the hospitals, resulting in care being denied to not just others with this disease, but to all the people that need to be hospitalized or otherwise treated for all the diseases that kept the hospitals busy before this outbreak. Half the deaths caused by a pandemic can result from the lack of available medical care to treats other conditions. Additionally, patients for example with chest pain, may stay away from the emergency, afraid of being exposed to the viral disease, may decide the risk for what might just be indigestion is not worth the risk the long lines and possible exposure to COVID-19 in the hospital, and stay home with a heart attack.

We have a great risk of having this virus overwhelm the health care system. But if we can flatten the curve of the outbreak, slowing the number of new cases appearing each day, we can avoid overwhelming the hospitals and treat everybody, but spread over a longer period of time. We can also develop more resources and have more time to find better treatments and eventually develop a vaccine. Slowing the spread and flattening the curve is the goal of increasing social distancing.

A colleague pointed out to me that all of the seven known human corona viruses spread during the winter and spring and abate in the summer months. Thus, transmission of the viruses behaves much like influenza. While viruses are active all year, respiratory viruses including influenza, rhinoviruses which cause the common cold, and other respiratory viruses generally peak in the winter months and peak most often in February. I expect that COVID-19 will slow its spread in April or May.

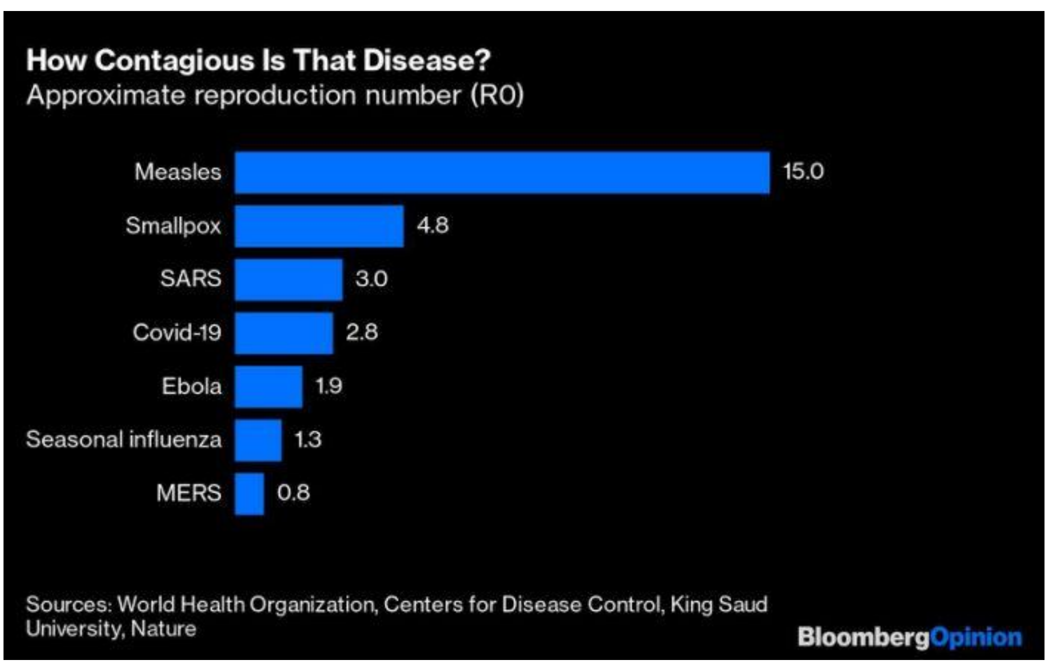
Peak month of Flu Activity 1982 to 2018





Week zero begins on January 1 each year. Here it can be seen that the 2009 -10 flu season (H1N1 Swine flu) behaved differently.

There are several possible reasons that respiratory virus infections peak in winter, and especially in February, but a definitive reason is not clearly defined.



The R_0 is the reproductive rate of a disease – the average number of persons infected by each disease case. If the average R_0 is two, then in twenty cycles, a million people will be infected. If the average incubation period is about 4 days, it will take about 80 days to get to a million cases.

If the R_0 is one, then one person will only infect one other person and the number of cases will be steady at a number around the length of the disease duration divided by the incubation period in days. If it is less than one, the disease will die out.

The R_0 for influenza falls in the spring causing the disease to nearly (but not completely) disappear. The question is why does the R_0 for influenza fall? How does summer help?

1. Host susceptibility: People's vitamin D levels fall during the winter as the sun is low in the sky and most people spend more time indoors. Also, in winter, most indoor environments have lower humidity which may make the respiratory mucosa more susceptible. Immunity may be lower in the winter. This may be associated with diet, perhaps less fruits and vegetables. It could also be shorter days and changes in sleep cycle. It could be less vigorous exercise. The immune system is single minded and dedicates itself to fights only one type of problem at a time. If your body is fighting a bacterial infection, parasites, or allergy, it will not be able to fight a virus at the same time.

2. The corona virus can survive long on surfaces for days. At room temperature and 50% humidity, the half-life of the viruses on surfaces was found to be 67 hours (almost 3 days). At cool temperatures and high humidity the half-life was 86 hours (4½ days).[1] Thus there are still plenty of virus particles after several days, just half as many viable ones, and likely enough to cause infection. The flu virus also survives longer on surfaces indoors and in cool weather.

3. Influenza, like COVID-19 can be spread by aerosol/droplets and by direct contact. Influenza is a seasonal virus in the temperate regions, but not in the tropics. Influenza does spread in the tropics, but without large seasonal fluctuations. This appears to occur as a result of a lack of aerosol transmission in hot weather, however, with year-round transmission by direct personal contact. In an experiment with guinea pigs (they actually used guinea pigs as guinea pigs) aerosol transmission of influenza was efficient at 20° C (68° F) but was blocked at 30°C (86° F), while direct contact transmission did not change with temperature.[2] Aerosol transmission is most efficient in cool temperatures. Salts and proteins in respiratory droplets aid in the survival of the viruses in low humidity.[3] In hot climates, higher indoor humidity is thought to help decrease the time that droplets are suspended in the air, while the droplets can remain in the air longer in dryer air that allows them to be lighter and thus suspended longer or of sizes that are more likely to be deposited in the airway. In either warm or cold environments, humidity appears to increase the survival of viruses on surfaces.[4]

Human corona viruses can survive on indoor surfaces for up to 9 days. Limited data for temperature inactivation for corona viruses found that the viruses could remain infectious at 4° C for more than 28 days, at room temperature (20° C) for 3 – 28 days, and at 40° for 4 – 96 hours.[5] SARS-CoV-2 infectious airborne droplets stay aloft and infectious in room air for quite some time. *The half-life of infections SARS-CoV-2 aerosols is from about ¾ hours to 2 ½ hours, with an average half-life of about 70 minutes. That means it takes around 8 hours to clear 99 percent of the infectious aerosols from a room.*[6] Temperature and humidity affect how long the aerosols remain aloft. In warmer and dryer temperatures they settle more quickly.

Out of doors they disperse quickly, and landing on the ground or leaves, they are not much of a problem, as UV light in sunlight should inactivate the virus particles quickly.

Additionally doors and windows are closed more and there is less circulation of the air, and thus a higher concentration of virus droplets may be present and suspended in the air. Viruses that do not follow the winter epidemic pattern are more likely to rely on direct contact rather than airborne spread.

Nevertheless, Florida and even Hawaii have a winter flu seasons, but this may be influenced by contagion from travelers from cooler areas.

4. During the winter months, people tend to gather and are in closer contact with each other, putting more droplets into the room air and making it easier for the disease to spread person to person. Christmas holiday gatherings and travel help spread the disease from one area to another. People stay inside more in the winter months, in school, and in social gatherings. Higher numbers of people travel on holiday peaks, Thanksgiving and Christmas.

5. School and children with less immunity to influenza. Children are typically efficient disease vectors for respiratory infections. They have less history of various infections and thus more susceptibility to get and spread the infection. They are slimy little creatures that spread pathogenic snot, touching everything including the faces of other people, and rarely washing their hands well enough to make a difference. Schools are excellent places for spreading influenza. They usually have air venting systems well designed to spread disease. (Typically blowing air around and mixing the air from one classroom to another.) They use communal bathrooms at schools that are humid and contaminated with excrement particulates.

One reason for a fall in influenza cases in the Spring is social distancing that occurs when school is out. Closing schools helps slow the spread of respiratory infections by "social distancing". China shut itself down for about a month – to increase social distancing to control COVID-19. Spring break helps.

6. The decline in respiratory infections in the spring may also be the result of fewer children and other people remaining that have not yet been exposed. Over the winter months as more people have been exposed, herd immunity lowers the R_0 to less than 1.0, and the disease fail to spread any further or cases fall to very low levels. This can be seen in the graphs above, where the epidemic general tails off before April Fool's day, before the weather gets warm. Herd immunity is likely an important contributor to why flu abates in the Spring.

7. Another form of social distancing is going outside. Since the virus spreads in respiratory droplets, risk is lower outside where there is less chance of contact with these droplets. Sunlight should kill the virus fairly quickly, the spray from a cough dries more quickly, the droplets are more likely to blown away from other people, and the droplets are less likely to be on an object that will be touched by anyone before the virus dies. If infected people are outside 10 percent of the time, the Ro likely drops by 10 percent, and if non-infected persons are outdoors it additionally lowers contagion risk to them.

The decline in influenza that is typically seen in the spring, one way or another, is the result of a decline in the R_0. This occurs as a result of herd immunity, as fewer people are left that can become infected, social distancing, the environment that is less conductive to the survival of the virus, people are outdoors, and/or people are healthier and not being as successful at spreading the disease. It is a combination of all. The R_0 of a virus is in part, a function of the virus itself, but also a function of the culture and environment of society.

Therefore, public health measures, even if each intervention only lowers risk by several percentage points, factor and cumulatively lower the R_0. When the Ro falls below 1, the epidemic is halted.

Can we artificially make it Spring to lower respiratory viral disease spread? Each measure that lowers spread contributes to lowering the R_0. The goal is to get it to less than one.

Take vitamin D3, 400 - 800 IU daily, preferably at midday. It would likely slow the spread of respiratory viruses if all toddlers and school-aged children had a daily supplement of vitamin D3. A low dose of zinc (about 7.5 mg of zinc citrate) may also help.

Get plenty of sleep, and have a consistent bedtime. Avoid alcohol.

Open your windows to get an exchange of air. Run the fan in the air handler and use HEPA filters to remove aerosols and droplets. Humidify if living in a dry winter climate.

Social distancing: Avoid crowded rooms and airplanes during outbreaks. Avoid theaters, social events, and apparently, cruise ships.

Close schools. Children get the infection – but have very less severe disease. This does not mean that they do not spread it efficiently. In fact, most spread of the virus is from people with mild or pre-symptomatic infection.

Clean surfaces frequently. Wash hands or use sanitizers multiple times a day. Wear mask and safety glasses in situations where exposure is possible.

Avoid public restrooms.

Eat fruit and vegetables all year round. Prebiotics and probiotics lower risk of influenza, presumably by lowering T_H17 immune action, which distracts the body developing from T_H1 immune activity against viral disease.

Get some vigorous exercise most days of the week; outdoor exercise if possible. (But not if you are sick.)

Get bright light exposure daily if you tend to get SAD (seasonal affective disorder).

While April may quell the COVID-19 in a couple of months, that is unlikely to be the end of it.

The 1918 Spanish flu remitted in the spring of 1918, but it came back and killed even more people around the globe the next fall. If you look at the second graphic, you can see that influenza slows way down in summer, but never disappears, so it can easily come back. If this epidemic abates in April or May, it will likely reoccur in the fall of 2020. If we get this break, we should use the time to prepare for a possibly worse outbreak.

It is essential to understand that draconian measures limiting people's movements will not make this virus disappear. Shutting down the economy will make it harder to take care of people, and putting people out of work for long periods will not stop this disease. Social distancing and masks can reduce the R_0 to do that.

Slowing the spread, will give time to get ready, increase the availability of medications, protective equipment, train doctors on how to treat this disease, and develop cures and vaccines. Shutting the economy down will impede this.

The total average annual cost of influenza to the economy each year in the U.S. is about $80 billion, with 600,000 life-years lost, 3 million hospital days, $10 billion in hospital cost, 41,000 deaths and about $15 billion in lost earnings due to disease. This comes out to about $245 per person. The flu vaccine is usually about 60% effective, and thus if widely used, should bring the R_0 to below 1.0, and prevent epidemic spread of the disease. Vaccinating children may be an effective way to prevent epidemic spread, while vaccinating older adults can prevent a large number of hospitalizations and death. The commercial cost of the vaccine plus administration is about $25 for the uninsured. Thus government provided vaccines for all at no cost would likely decrease governmental spending on healthcare (Medicare, Medicaid, Veterans Benefits, etc.) and increase tax revenues otherwise lost from lost days of productivity.

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[6] https://www.medrxiv.org/content/10.1101/2020.03.09.20033217v2.full.pdf