

Epidemic Cycle

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Abstract

This article explains the natural progression of a typical viral epidemic. Epidemics historically go through a progressive cycle because once a person is victimized normally there is an immune and non-infectious period of one or more years. At this time both immunity and infectiousness has not been scientifically verified for the Covid-19 virus. However, likely the Covid-19 virus will progress the way of other past virus epidemics. At present there is much untested and possibly unreliable information regarding the Covid-19 epidemic. This article shows the most likely way the Covid-19 epidemic will progress over time.

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Received: April 12, 2020; **Accepted:** April 21, 2020; **Published:** April 25, 2020

Keywords: Non-infectious, Covid-19 virus, N95 mask, Nanometers, Microns, Vitamin C

Introduction

The first myth to eliminate is the one that masks other than n95 masks give protection to one's self and others. Such masks are either of paper or cloth and have porosity that allows a virus to go both in and out of this non-n95 type mask. And the n95 masks only are 95 percent effective. Because of the current shortage of such masks it is wrong for anyone who is not in a medical position to have the right to buy a n-95 mask. Those who have already owned an N95 mask prior to the Covid-19 epidemic surely have a right to have and use their N95 mask. Because of the porosity of paper and cloth non-n95 masks one should treat people wearing one of these porous masks as just as much threat as those who do not wear one. A false sense of security endangers those who do not understand the limitations of wearing a non-n95 mask.

We need to be aware that viruses operate at the nanometer level. The Covid-19 virus is about 125 nanometers in size. On the other hand, a paper or cloth non-n95 mask has porosity that measures in Microns. One micron is one million times larger than one nanometer. Therefore, it is clear that a paper or cloth mask is all but totally ineffective to prevent the virus from going through a non n95 paper or cloth mask. The danger in using a paper or cloth mask is that it may give others a false sense of security. In general, one is much better off keeping a safe distance of 6 feet or more from others rather than depending on protection from a porous cloth or paper mask.

Generally, microscopic particles are measured in nanometer, micron, or millimeter. The nanometer is one billionth the size of a meter. The micron is one millionth the size of a meter. And the millimeter is one thousandth the size of a

meter. Viruses generally are measured in nanometers varying from 20 nanometers to 450 nanometers but some very large viruses measure 1000 nanometers. There are viruses that are actually larger than bacteria. Porosity of paper and cloth measure using the micron scale. Clearly, the virus operates at a much smaller range of measurement than the porosity of paper and cloth masks that operate in the range of a micron scale. The net outcome of this situation is that the non-95 paper and cloth masks are all but totally ineffective. And it does not take a big dose of a virus to infect others. Because of the false sense of security often felt by those wearing masks they represent more of a threat than someone who does not wear one. The best advice anyone should follow is to stay 6 feet or more away from others when exposed to gatherings of others whether masked or not.

Life Cycle of a Virus Epidemic

Over the years countless epidemics have occurred on planet Earth. This latest one with the Covid-19 is especially virulent. In 1918 a flu epidemic caused much loss of life just as Covid-19 is doing now. Such epidemics gradually regress as more and more people acquire immunity from experiencing a new viral infection. The tragedy is that some people simply do not have a strong enough immune system to survive. Clearly included in this group are people of all ages and genders. The Covid-19 virus can swiftly cause death when it invades lung tissue. Only intensive care can help those afflicted with the pneumonia caused by the Covid-19. But many survive using ventilators and respirators. The Covid-19 virus does not affect everyone equally and sometimes people carry the virus with no symptoms. Others have mild reactions to the virus assumed to be minor allergy reaction or a minor cold. Very likely many have been infected by the Covid-19 without knowing it. And many more believe they just experienced a minor infection or allergy.

Prior to the USA public knowing about the epidemic many were infected and passed it off as just another minor ailment. That is what happened to the author of this article. He had no idea that he had been infected and just assumed he had his first major cold in over 40 years. In fact, the author finally realized after he survived that he had in fact had eleven of ten symptoms of the Covid-19. He had one that was not listed in the internet. He had a horrible earache that lasted 24 hours of pain. It was perhaps the last blow struck by Covid-19. After that earache the author progressively got better enough to return to jogging and running 2 miles per day.

On an interesting note the author's wife acquired the virus

from him but had a very minor case experiencing only a small subset of the Covid-19 symptoms. Probably, most are aware that males are more endangered by the virus than females according to death statistics from the Covid-19. Both Dr. Joseph Brierly and his wife Barbara are 80. Older people and those with compromised immune systems are more endangered by the Covid-19 according to statistics. The author's wife is diabetic and experienced a heart attack some years ago. The author, on the other hand, uses no prescriptions and is in peak health for his age with ability to do all-out-wind sprints just like when he stole bases playing little league baseball at the age of 13.

Make no mistake about it. The author does not wish to minimize the danger of the virus. Generally, one should heed the voice of the experts in epidemiology. Keeping a safe distance from others is sound advice. Especially avoid masked folks who possibly believe they can prevent infection by their porous mask. Besides avoiding public events one should also be aware of positive actions that could help survival.

It is well-known that Vitamin C minimizes the symptoms and duration of a cold. Recommend that readers of this article review the research work of Linus Pauling on how Vitamin C shortens a cold's cycle and also helps terminal cancer patients to live longer. Very likely Vitamin C will do the same for Covid-19 infections as with other common colds. Presently, it is too early to have conclusive research on the value of vitamin C in saving lives of people experiencing Covid-19. But we have nothing to lose by using vitamin C that is known to aid our well-being. And Vitamin C is cheap and readily available in drug stores.

The author kept a supply of Vitamin C jelly candies on hand at all times when he was infected. Every time he had a coughing spell accompanied by soreness in the throat he chewed up one or more of the Vitamin C jelly candies. The sore throat and coughing always stopped when the Vitamin C jelly candy was taken immediately upon the onset of the coughing spell. The author's wife did the same. In general, anything one can do to build up resistance is good advice. The author has taken a number of vitamins, minerals, and supplements throughout his life since he was in his teens. He believes it is one reason he is a healthy octogenarian.

Mathematics of Epidemics

How does mathematics help to understand the life cycle of epidemics? One might think that a biological condition is not subject to the restrictions of mathematical equations.

The author intends to undo that fallacy. To that end one of the experts on the Covid-19 epidemic ventured to say that the virus could be handled by 'herd immunity'. This expert seemed almost embarrassed to explain what she meant. No doubt because of the massive number of people experiencing the Covid-19 virus causing the shortage of medical preparation for the onslaught on our medical community this expert did not want to seem oblivious to the pain and suffering of the large number of victims of the virus. But the expert was completely accurate in mentioning 'herd immunity'. No doubt many epidemics have quietly gone away due to 'herd immunity' over time. The salient fact is that once infected people acquire a degree of immunity and lack infectiousness after surviving the infection. Once a population experiencing the epidemic is saturated by persons who are now immune and not infectious the epidemic loses its steam and quietly goes on a back burner as just another cold or flu. The phenomenon of 'herd immunity' is at the heart of why epidemics obey a mathematical analysis. Integral and differential calculus is exactly the area of mathematics to prove how new viral epidemics normally have progressed.

Herd immunity can be deciphered in terms of a mathematical model. Epidemics are subject to mathematical truth that explains why an epidemic will eventually lose its ability to infect a population. The next sequence will show how mathematics explains why the epidemic quietly becomes minimized to the degree that it is largely ignored after herd immunity and vaccinations defuse the epidemic. Consider this. After a person survives the Covid-19 we expect that they normally acquire an immunity that is essentially vaccinating themselves with their own creation of antibodies through their immunity system. The best part of self-immunization is that the public does not have to wait for medical science to develop a vaccine. Vaccines normally are developed by creating a deadened form of the virus that causes a healthy person to create antibodies without having the full-blown viral ailment. So, we conclude that vaccinations and self-immunization are really quite alike in many ways. But vaccines can take 1 to 2 years to be developed and tested.

Next is explained the mathematical nature of the progression of an epidemic. This section requires a mathematics background to understand because it applies calculus and elementary algebra to explain the progression of an epidemic. However, after formulating the mathematical explanation of the progression of an epidemic the ramifications of the mathematical explanation will be made clear for those who do not have adequate mathematical background.

Differential and Integral Calculus Epidemic Progression

First appears the symbols required to do the mathematics. Let p be the percent of those virus victims who survive the virus. Then it is clear that $1-p$ is the percent of those who do not survive. Let D be the population that does not survive the virus. Let T be the total population experiencing the epidemic. Then we can write the following relationship between these defined variables.

$$D = (T-pT)(1-p)=T(1-p)^2$$

Next we compute a derivative with respect to p .

$$\frac{\partial D}{\partial p} = 2T(p-1)$$

The derivative makes it obvious that there is no death rate when $p=1$ where the virus causes no deaths. Generally, values of p are a number less than 1 proving that a virus has a declining slope. A declining negative slope means deaths are decreasing.

Let $D(t)$ be the number of people who do not survive at time t and $T(t)$ be the people in population T who are still not affected by the virus. We can extend the previous derivative allowing for it to occur at any increment of time t . Thus, we have at time t

$$D(t)=T(t)(1-p)^2.$$

Assuming equal distribution of deaths per time t we have

$$T(t)=T/t$$

$$D(t)=(T/t)(1-p)^2$$

$$\frac{d(D(t))}{dt} = -T(1-p)^2 t^{-2}$$

This derivative is the death rate as time t progresses. As t increases towards infinity it is clear that the rate of deaths tend to zero. We conclude that the epidemic loses its virility over time. Eventually the epidemic is no longer enough of a threat to cause fear and the state of the public experiencing the epidemic no longer pays much attention to it. I.e. life goes back to normal. Economies rebound. Despite the fact that there may still be a few cases of the virus few regard it as a worthwhile threat at this time.

Differential calculus allows us to see why an epidemic loses its visible distress over time. We can now calculate the expected total number of deaths over times t by employing Integral calculus. The total number of deaths expected

conforms to the following integral whose solution behaves logarithmically. Let I symbolize total deaths for population T assuming a survival rate of p.

$$I = \int_1^t \frac{T}{t} ((1-p)) \ln(t) = T(1-p)^2 \ln(t)$$

From this integral we can compute the Total deaths for any time duration. For this article we will assume time length t=1 to 100 days for various values of p. Statistics on Covid-19 of hospitalized victims suggests that the percentage of people that do not survive ranges from .5 to 3 percent. It is very difficult to precisely assess the exact death rate by the statistics on those who submit to hospitalization because likely there are many more persons who had the virus but never submitted to hospitalization like the author. So, the best that can be done is to compute I for a wide range of values of p. The next chart gives death rates for 100 days for a range of values of p for a population of three hundred and fifty million approximately the population of the USA. We compute the following using standard tables for the Napierian log base Ln.

p=.005 I= 40,294 p=.01 I=161,175 p=.015 I= 362,643
p=.02 I=644,700

It is clear that total number of deaths over time t=100 behave logarithmically. Obviously from the table percent of deaths per day from the virus significantly affects total number of deaths for the next 100 days. Most of the experts believe that the number of deaths could easily go over 600,000. The author optimistically expects about 40 to 60 thousand deaths in the next hundred days from early April until early July of 2020. Without knowing for sure the exact death rate from the virus it is impossible to be sure of any prediction. That so many people will get the virus without ever requesting

medical help causes much of the uncertainty.

Conclusion

What should help the reader to understand the logarithmic progression of a virus epidemic is inherent in that as time goes by more and more people will become immune to the virus. When and if ever the number of people immune becomes close to 90 to 95 percent of the population then it is clear that if the death rate in any given time period is around 1 to 3 percent then the number of fatalities will be based on at most 3 percent of the 5 to 10 percent of the population that is still not immune. It is clear that herd immunity will eventually cause that to happen. Still before herd immunity can make a significant impact on the epidemic many people will have not survived. Everyone hopes the total number of deaths from the Covid-19 will be a very small number based on a small value of 1-p.

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