We need a way to separate hysteria, propaganda and conspiracy theory from reality so we can gain a pragmatic perspective on the current COVID-19 pandemic caused by the SARS-CoV-2 virus...

This paper was originally written in early May 2020 and has been updated many times over a period of many months. Although the basics have changed very little, the accumulated statistics have continued to climb as you would expect. Thus the referenced numbers are associated with the date they were valid for.

A good place to start is with a little education in virology. Columbia University offers a FREE introduction to virology – covered in 26 lectures. The course is very good and I highly recommend it. The class slides are provided on the class web site along with links to the lectures on YouTube. Here is the link to the course:

https://www.virology.ws/course/

Even if you only understand 5% of what the class covered, it would be well worth your time to sit through the class. So turn off the TV and give the social media sites a rest – take the course – watch the lectures.

And you should take a look at the major historic pandemics – I will use the CDC's data:

https://www.cdc.gov/flu/pandemic-resources/basics/past-pandemics.html

The big recent pandemics were:

1918: H1N1 – killing an estimated 675 thousand people out of a US population of 105 million, killing roughly 0.64% of the US population. Scaled to the current US population (330 million), we would have to kill 2.1 million people to match the same death percentage.

1957: H2N2 – killing an estimated 116 thousand people out of a US population of 172 million, killing roughly 0.07% of the US population. Scaled to the current US population, we would have to kill 222 thousand people to match the same death percentage. We crossed that line around October 19, 2020.

1968: H3N2 – killing an estimated 100 thousand people out of a US population of 206 million, killing roughly 0.05% of the US population. Scaled to the current US population, we would have to kill 160 thousand people to match the same death percentage. We crossed that line around August 6, 2020.
These are not the only significant epidemics around the world. There were many other serious epidemics such as Ebola and HIV/Aids. The three pandemics cited above just escalated to pandemic status, killed a lot of people and then receded into the background after a sufficient percentage of the population had recovered from the disease.

Note that the killed percentage given above is for the entire population. However, not everyone in the population got the disease. Most estimates are that only 50% of the population got each disease. Thus, the percentage that died from the disease is estimated as roughly twice the percentage provided.

I was too young to remember the 1957 pandemic. However, I was in junior high school during the 1968 pandemic. There was no hysteria. The pandemic was only occasionally covered in the news. No one was very concerned. Parents and school officials did not even ask us to wash our hands more often. When people got sick, they mostly stayed home.

To be fair, COVID-19 (Coronavirus Disease of 2019) is not the flu. Flu infections tend to be seasonal – peaking in the winter months and being subdued during the summer months. Thus, if a flu pandemic spans multiple years, you expect to see multiple peaks. COVID-19 has shown no signs of being seasonal so how well the public follows appropriate hygiene practices will be the controlling factor for where and how high the peaks are.

The SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) virus is covered with proteins that give the virus a spiked appearance under high magnification. Viruses of this type are commonly called corona viruses due to that appearance – corona translates to crown.

The SARS-CoV-2 virus infects a cell through a process called endocytosis. The SARS-CoV-2 virus protein spikes attach to ACE2 cell receptors. ACE2 is often pronounced Ace Two. After a virus protein spike attaches to an ACE2 receptor – think lock and key, the cell brings the virus particle into the cell – at which point the viral replication process can begin.

Although the upper respiratory system has a large concentration of environmentally exposed ACE2 cell receptors, many other organs around the body also have ACE2 receptors. Thus it is possible for a viral infection to start in the respiratory system and then move to other organs of the body. It is also possible for an infection to start in the GI track and spread from there. This is why COVID-19 patients exhibit such a wide range of symptoms. The extent of symptoms and damage to body systems can vary widely from one patient to the next.

R₀ (capital R, little zero) is the measure of how infectious a virus is – i.e., how easily the infection can spread. The R₀ for SARS-CoV-2 virus (which causes COVID-19, the
disease) is currently believed to be between 2 and 3. That means you need to infect 50% to 70% of the population before the virus stops spreading on its own. Thus, if we take the lower infectivity percentage, you have a roughly 50% chance of acquiring COVID-19 over the next 12 to 24 months. There’s no need to get depressed – I’m just being pragmatic here.

I will be using the lower $R_0$ (infectivity) value of 2 throughout this article and thus the corresponding requirement to infect 50% of the population before the virus stops spreading on its own. If we use the higher value of 3, that corresponds to a requirement to infect 70% of the population before the virus stops spreading on its own. Notice that the higher infectivity results in 40% more people being infected. As a result, we would expect any associated death count to also increase by 40% because the death rate is assumed to be constant. It is left as an exercise for the reader to appropriately scale any death counts to the higher value.

Data indicates that COVID-19 has an exponentially increasing risk of hospitalization and death with age. From around age 20, the risk doubles every 16 years – about 4.5% per year. And men have a risk that is roughly 50% higher compared to woman. This exponential increase in risk with age and higher male risk is common for many other diseases.

There were no vaccines to inoculate the population during the three prior pandemics and thus those pandemics ran their course through the population unhindered. The three prior pandemics died out on their own when a sufficiently high percentage of the population had become infected and recovered from the disease. There is no reason to believe this pandemic will be any different. It’s the way infections work. This is how Nature develops “herd immunity.” That which does not kill you makes you stronger...

Although medical technology has come a long way, there is no evidence that it is possible to develop, test and deploy a new vaccine for COVID-19 in 12 months – or even 18 months. Thus, the scenario with the highest probability is that this pandemic will run its course through the population.

It is important to emphasize that the viruses that caused the three prior pandemics are still out there – in one form or another. Kids continue to be born and those kids present a new opportunity for those viruses to spread. And people travel from place to place and take their viruses with them. It is entirely possible one of these viruses will find the right conditions and the virus will flare up as an outbreak and then recede into the background. SARS-CoV-2 will join the list after this pandemic.

So where are we in the current pandemic? It’s a moving target. A common place to start is with the John Hopkins data:

https://www.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6 (copy/paste entire URL, remove extra space after first line)
The CDC (United States Centers for Disease Control and Prevention) weekly death data along with detailed information on the limitations of that data can be found here:

https://www.cdc.gov/nchs/nvss/vsrr/COVID19/index.htm

And if you want the Arizona data, you can go here:


If you want to know what is currently happening and the trends, use the daily or weekly rates. But as is explained in detail by the CDC, these numbers need to age. By the time the numbers are many weeks old, they should be relatively close to where they are likely to end up. That means the data will become more stable and less likely to change dramatically. That does not mean the data is accurate – as will be discussed later – it just means the data is stabilizing around its likely final value.

There were 1.6 million “confirmed” COVID-19 cases by May 24, 2020. There were also 97 thousand “COVID-19 deaths.” The data behind these numbers are suspect, but it represents the best data published on that day – so that is the data I will use.

It is important to keep in mind that testing around May 2020 was generally restricted to people who were sick and showing COVID-19-like symptoms. Of those tested, you would typically see a positive result for only 6% to 8% of tested people. Later in the year, testing was expanded to also allow exposed people without symptoms. The positive rate rose to 10% to 12% by June and July 2020 during the summer peak and then dropped again before heading back up in the fall. These are the “confirmed” cases.

If you are sick with relatively mild symptoms and stay home instead of going to the doctor, you will not be tested. Even if you are sick and try to see the doctor, you may not be tested. Thus, it was guesstimated in the May 2020 timeframe that there were 10 times more actual cases than “confirmed” cases – so we will use that 10 times expansion to account for under testing. Therefore, let's just assume – for the sake of this discussion – that there are closer to 16 million cases. This is a very rough guesstimate at best.

The time between getting a test and receiving results has been an ongoing problem. The longer it takes to receive a result, the less useful the result will be. By the time the result is delayed by a week, the result is nearly useless because the decision about what to do was made long ago without any consideration for the test results.

The problem with testing accuracy has been an on-going problem. False positives and false negatives have been all too common. There have been some spectacular
high profile failures showing false positive rates in the 80% range. Suffice it to say that the quality control on many test kits and the processing of those kits was lacking.

The problems with published data have continued as the pandemic has worn on. On September 20, 2020, Arizona was reporting 214,018 cases but only 178,000 positive test results. That is a discrepancy of roughly 36,000 cases – ignoring the practice of testing the same person multiple times. Nothing on the dashboard page tries to explain the discrepancy. We are using the larger reported case number for consistency.

On July 15, 2020, the Arizona data showed that 1.8% of the Arizona population had tested positive for COVID-19. If we assume the same 10x expansion to account for under testing noted above, we can guesstimate that 18% of the Arizona population has been infected. If we assume roughly 50% of the population has to get infected for the spread to stop on its own, we can guesstimate that we are one-third the way through the pandemic as far as Arizona is concerned. The figures rose to 2.9% and 29% respectively by September 20, 2020. By November 15, 2020, the number had risen to 3.7% and 37% respectively.

It is important to keep in mind that not all “COVID-19 deaths” are “confirmed” cases. It will be argued for quite some time how many of the deaths involving COVID-19-like symptoms were actually involving COVID-19. Keep in mind the wide discrepancy between tested and confirmed cases previously covered – not to mention all of the untested cases. And those with underlying medical conditions may be dying from the underlying conditions as opposed to COVID-19 – even if they test positive. All of this leads to a legitimate disagreement as to how to classify any given death. So COVID-19 deaths are a rough guesstimate at best.

The bottom line is this: how many people are going to die from this pandemic? What will be the eventual death count from the COVID-19 pandemic?

Using 16 million guesstimated cases and the published 97 thousand death count from May 24, 2020 produces a guesstimated death percentage of 0.6%. If you assume 50% of the US population gets COVID-19 and this death percentage stays the same, we can guesstimate the pandemic will kill almost 1 million people – half the number of the 1918 pandemic when scaled to the current US population.

If we use the October 18, 2020 numbers – 8.1 million confirmed cases and 220 thousand deaths, we get a death rate of 2.7%. If we again use the same 10:1 guess to scale for under testing, this drops to 0.27%. This suggests the death rate has fallen by half compared to the May 24, 2020 figures and thus only half a million people may die from this pandemic.
Sounds dreadful, doesn’t it? However, the data and assumptions used to generate these figures are quite suspect and thus the guesstimate may be way off – high or low.

The real death percentage can shift dramatically as the pandemic continues. As the pandemic moves through new segments of the population, those new segments may be more or less likely to die compared to previous segments of the population. As the treatment of critical care patients improves with experience, you expect the percentage of critical care patients surviving to improve. And the data shows the survival rate of critically ill COVID-19 patients has at least doubled over the last many months and is now similar to other comparable illnesses.

Guessing is still guessing, no matter how many decimal places you use. Or put a different way, extrapolating suspect data into fanciful results is a fool’s errand.

Let’s take a look at a second method to guess at the eventual death count. For this method, we start with a monthly death count. The April 2020 COVID-19 death count as reported on May 29, 2020 by the CDC was roughly 50 thousand COVID-19 deaths. The data was at least a month old at the time so the data should have been sufficiently stable. Now extrapolate that for 12 months with the same monthly death count. This yields 600 thousand deaths in the US.

Note that we have assumed the pandemic will run continuously at the same level for 12 months. As of mid November, the monthly death rate has averaged roughly half the April death rate. So one of our assumptions for the second method guess is clearly wrong. Are the other assumptions any better? We just don’t know. If you want the answer today, you must predict the future – which is notoriously unreliable.

If you compare “COVID-19 deaths” to “Pneumonia and COVID-19”, the death rate drops by half. That would lower the guess to only 300 thousand deaths using this method. Given the primary cause of death from COVID-19 is from pneumonia related issues, this may well be a better number.

On July 15, 2020, the Arizona data showed that 0.034% of the Arizona population had died from COVID-19. If we assume the pandemic is one-third over based on our earlier calculations and assume other things remain the same, we can guesstimate there will be three times the deaths before the pandemic ends. From that, we can guesstimate that 0.1% of the population will die in Arizona from this pandemic. Given Arizona’s population of 7.4 million people, we would expect 7,400 Arizona deaths. Applying the same death rate to the US population of 330 million, we would expect 330 thousand deaths. But again, this is just a guesstimate.

On September 22, 2020, the Arizona data showed 5,498 total COVID-19 deaths – 0.074% of the Arizona population. The death count rose to 6302 by November 15, 2020 – 0.085% of the Arizona population. Arizona reported a case fatality rate of
2.25% on November 18, 2020 – 0.225% if you apply the 10 times scaling for under testing – the actual infection fatality rate is unknown.

Looking at the per capita death rates for early July 2020, Belgium was the highest with 86 per 100 thousand. The USA was at 41 per 100 thousand. If we were to assume the eventual per capita death rate will be 100 per 100 thousand, we might guess that the pandemic is mostly over for Belgium and not quite half over for the USA. But remember, 0.1% is just a guesstimate and it could be way off. The per capita death rates reported as of September 16, 2020 were 86.9 per 100,000 for Belgium and 59.7 per 100,000 for the USA. By November 13, 2020, this had increased to 120.9 per 100,000 for Belgium and 73.5 per 100,000 for the USA.

Finally, consider the weekly graph of all deaths against the averaged historic data of weekly deaths. Weekly numbers above the average numbers represent excess deaths that are presumably caused by some current phenomenon – such as the current pandemic. This method may do a better job of separating the folks that were going to die anyway from the folks that died primarily from COVID-19. Here is a link to the CDC data on excess deaths associated with COVID-19:

https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm

You will notice there was a large spike that peaked on the week ending April 11, 2020. After that, there was a rapid fall heading back toward the threshold for excess deaths line. You will notice that by the week ending June 6, 2020, excess deaths were approaching the threshold line. We ignored the last month of data – which was well below the threshold line – due to the likelihood that data is incomplete. As it turned out, this was to be just a low point in the graph that was followed by a significant broad peak when many more months of data had become available. This particular graph combined with the early July 2020 death count (130 thousand deaths) might lead you to guest that perhaps 200 to 300 thousand people will die from the current pandemic. But again, it is just a guesstimate. Note that the 200 thousand mark was passed on September 21, 2020 and by November 18, 2020 the death count had already reached 249 thousand so this estimate is clearly low.

The John Hopkins reported deaths for the US had reached 200,786 on September 22, 2020, just in time for the fall equinox. But the CDC weekly excess deaths showed 246,377 deaths. That is a rather large discrepancy. Both data sets should have similar reporting lags – death counts always lag behind actual deaths by many weeks. Some – if not all – of this difference can be explained by the fact that the CDC data includes non-COVID-19 deaths that are in excess of the expected average. Isolating just the COVID-19 deaths from the total data is a lot more difficult as there are no summary figures. However, spot-checking suggests it is likely to account for the 25% higher CDC value.

But this just begs a different question. Where did all of those non-COVID-19 excess deaths come from? Is it because the medical system is so focused on COVID-19 that
they are ignoring the common fatal disease states such as cardiovascular diseases and cancer that kill a lot of people each year? How about trauma injuries? Or are people now afraid to go to their doctors? Or are people no longer able to get to their doctors for treatment? Or are people so stressed out by losing their jobs and/or being isolated that they are committing suicide or dying from excessive self-medication while trying to cope?

You may find it interesting to look at the excess deaths relative to the cause of death. Circulatory diseases and Alzheimers/dementia show the larger peaks above the historic data. But be careful about drawing any particular conclusions based only on the graphed data – there are many possible explanations.

You should also consider long-term disability caused by COVID-19. Just because you don’t die from the disease does not mean you will fully recover from the disease. Remember the ACE2 receptors all around the interior of your body? You may be left with damaged organs. That damage may remain for months, years or the rest of your life. There is currently little published data to help assess this issue.

Let’s return to the infectivity rate discussed earlier. We will again assume 50% of the population has to be infected to stop the infectious spread. Wouldn’t it be nice to know what percentage of the population has been infected with COVID-19 and is now part of the immune herd? Or put another way, what percentage of the population remains to be infected before the pandemic runs its course and quits?

By the beginning of October 2020, the WHO (World Health Organization) estimated that 10% of the world population had been infected. That’s 760 million out of 7.6 billion. That figure is for the world population and is only a guesstimate. The John Hopkins data for the same date shows 35 million confirmed cases. That works out to roughly 21 times more infections than confirmed cases. I have been using 10 times scaling to account for under testing. Given the amount of testing available by October 2020, 10x is probably a better guess for the US population.

We have assumed an eventual death rate of 100 per 100 thousand persons the US population. That’s 0.1% of the general population. Or put another way, one person out of every 1000 people will die from COVID-19. But that is not the rate of death for infected people – it is the rate of death for the general US population. If we assume that 50% of the US population gets COVID-19, then the death rate for infected persons is actually 0.2%. Using the WHO estimate of infections, that yields a death rate for infected persons of 0.13% - not that far from the previously derived guesstimate of 0.2%.

This death rate is just a guess based on the stated assumptions. We need two important pieces of information to figure out the actual death rate. First, we need to know how many people died – the numerator. We have a usable approximation for the numerator – about 249 thousand on November 18, 2020. Second, we need to know how many people have been infected – the denominator. The reality is that
we have no clue how many people have been infected so picking a denominator is just a guess. Thus, the quotient – the result of the division – the infection fatality rate – is completely unknown.

What we do know is that as of November 15, 2020, the death rate from COVID-19 in the general US population was 0.075% and rising.

As you can see, there are a lot of unknowns. We don’t know how many people have already acquired the disease and recovered. We don’t know how many people remain to get the disease. We don’t know what percentage of otherwise healthy people who get the disease will die from the disease. We don’t know how much the treatments for the disease – or the side affects of the disease – will improve and thus how that will affect the number of very ill people who survive instead of dying. It will likely be well after the pandemic is over before we have an accurate estimate of what really happened.

Now let’s turn our attention to reducing our probability of catching COVID-19. Is there any magic or anything special we need to do? Not really. Just do the same old stuff that’s been taught for decades. Here’s a link to the CDC’s recommendations:


It should be emphasized that the following guidelines are good practice in general, especially during the annual flu season. We should have been doing this stuff all along.

The basic steps are very simple:

1. Get people to stay home when they feel sick
2. Wash your hands as needed
3. Don’t touch your face with dirty hands
4. Social distance when interacting with others – 6 to 7 feet (2 meters)
5. If you cannot social distance, use appropriate PPE (personal protective equipment) and procedures
6. Get people with underlying medical conditions – those conditions that make them particularly vulnerable – to take extra precautions

The SARS-CoV-2 virus spreads most easily directly from person to person and less easily indirectly via other surfaces. This is mostly due to the amount of viable virus that can be transmitted and this determines the likelihood of transmission. In microbiology, it is the concept of the minimum infectious load needed to transmit an infection. Note that the minimum infectious load has not been determined for COVID-19 but the current evidence suggests the infectivity is similar to colds and flu.

The virus quickly degrades outside the body and thus infectivity drops rapidly with time at normal room temperatures. For this reason, most surfaces will
decontaminate themselves and no disinfection is needed. In other words, the same level of cleaning used for colds and flu should suffice.

Having a good immune system is very important to fighting any infection. Your body’s immune system is very capable. The standard guidelines of good nutrition, regular exercise, enough sleep, low stress and social connectedness will keep your immune system in top shape. These very same guidelines also reduce the common comorbidities – i.e., things that increase the likelihood of worse outcomes - such as high blood pressure.

Some percentage of people with COVID-19 are asymptomatic – meaning that they do not feel sick and they do not show any signs of being sick – but they are still infectious. People can be asymptomatic prior to becoming symptomatic or they may never become symptomatic because they have a very mild case. And even after symptoms have abated, someone may return to being asymptomatic until the virus is finally cleared from their body. Such is life. If you treat everybody you meet as if they are asymptomatic, you are less likely to do the wrong thing by mistake and become infected.

Data now show that children are at very low risk from COVID-19. They rarely have complications requiring medical care unless they have an underlying medical condition – children have a very low rate of underlying medical conditions. Further, they pose a lower risk of passing on the infection as their viral loads tend to be much lower than that of an adult.

What about masks and respirators?

The spread of a virus through the air can take multiple forms. For instance, if you are coughing, sneezing or even just talking, you are expelling mucosal particles. The mucosal particles range in size from big enough to see to very small. In general, sneezing produces larger particles while coughing produces smaller particles.

The larger particles have a higher mass and travel in straighter lines, following a standard parabolic ballistic curve as they are slowed by air resistance and pulled down by gravity. These particles do not tend to travel very far before falling to the ground and are easy to catch using a course filter such as a multi-layer cloth mask.

Smaller particles have a lower mass and are more susceptible to air currents and less susceptible to gravity. The smallest of these particles are able to travel on air currents and require a finer filter to capture.

Add to this the relative humidity. In higher humidity conditions, mucosal particles retain their water and thus their size and weight. As the humidity drops, the evaporation rate goes up. Smaller particles have a higher surface area to volume ratio compared to larger particles. In other words, smaller particles shrink in size faster relative to larger particles due to evaporation. Thus, smaller particles can
completely desiccate under dryer conditions and become sufficiently small and light to drift on air currents.

A mask is designed to catch and stop mucosal particles along a direct path. These particles have enough mass that they are propelled directly from your mouth or nose into the mask material and captured. Even though masks are relatively course filters, they will catch and retain larger mucosal particles as well as most of the smaller mucosal particles. Thus, if you are infectious, you wear a mask and you don’t social distance, you can protect others from your mucosal particles.

Masks do very little good when it comes to short casual interactions between people that are socially distanced.

Masks are not sealed and are not fine filters and thus the smallest mucosal particles that ride on air currents will escape through the mask material or out the edges of the mask. Masks do slow and disperse the air stream from your mouth and nose, which will act to disburse any concentrated plume of virus. This is of concern if you do not social distance.

This takes us back to the concept of minimum infectious load. The more virus you are exposed to, the higher the probability you have of being infected. In general, it takes a minimum infectious load to transmit an infection. Anything less and the body can prevent the infection. Big mucosal particles can carry a much higher viral load compared to smaller particles.

RNA viruses such as SARS-CoV-2 degrade outside the body over a period of hours. Thus, a desiccated virus particle begins to deteriorate and over time loses its ability to cause a new infection. The data on how quickly this happens under different circumstances is lacking so it is not possible to make a clear definitive statement.

Masks work equally well in both directions. This is why medical people wear masks when seeing potentially infectious patients. The masks are to top splashed bodily fluids and mucosal particles expelled by the patient from entering the medical person’s mouth and nose along a direct path. They offer very little protection from air born viral particles.

Note that the protection from masks is only provided for someone directly in front of your face. If you are going to cough, sneeze or talk to someone while wearing a mask, face the other person so the mask can do its job. This is a very different reflex from turning away and coughing or sneezing into your elbow when you are not wearing a mask.

Respirators are very different from masks. A respirator is designed to protect the person wearing the respirator from air-borne contaminants in the environment. To provide this protection, the respirator must be properly fitted, sealed and the seal
must be tested. People have different face shapes and different respirators are designed to fit different face shapes. So you must find a respirator that is designed for your face shape. Then it takes training and practice to put on a respirator and validate a good seal. A respirator with a bad seal is no better than a mask and may be worse if it has an unfiltered front valve. As a result, respirators are not recommended for the general public.

Most respirators used in industry and for medical purposes are N-95 rated – meaning they stop 95% of all particles that are at least 0.3 microns (300nm) in size from being inhaled. N-95 respirators are not designed for use with tiny RNA viruses such as the SARS-CoV-2 virus that are roughly 0.1 microns (100 nm) in size. However, N-95 respirators will still reduce the inhaled viral load as these respirators tend to have better filter efficiencies than their rating.

Contact tracing is used to track down the origins of a disease and is commonly used to track many diseases. Properly implemented, contact tracing with treatment and isolation can theoretically stop the spread of most infectious diseases and even eliminate them from the general population.

The method is conceptually straightforward. When you discover a person with the target disease, you try to identify everybody the infected person has been in contact with over some period of time – that length of time could be the disease’s incubation period plus a few days. Then you go to all of the identified people and repeat the process. Each identified person is evaluated and treated for the disease or placed in quarantine. In this way, you find the infected people and isolate them from the general population or otherwise treat the disease and thus prevent further spread of the infection.

Note that the CDC’s definition of a contact for the purposes of COVID-19 is spending at least 15 minutes with someone at a distance of less than 6 feet without any personal protection equipment – such as a mask. This should give you a good idea of what it actually takes to transmit the disease. Casually passing someone on the street or stopping for a quick hello is not likely to transmit the disease.

There are factors that can reduce the effectiveness of contact tracing. For instance, if the disease can be spread asymptptomatically, there will not be any cause for an asymptomatic person to contact the health system and thus the health system will not be aware of the infectious person other than through the symptomatic people infected – think Typhoid Mary. Or, if the health system fails to make a good case to the public to encourage voluntary cooperation and/or fails to engender trust in the population, people may not cooperate with the health system and volunteer the required information.

It is important to ask if the illness justifies the considerable effort needed to contact trace. For illnesses that have a high ongoing cost to society, contact tracing may be a good option to reduce the cost of treating an illness in the general population or
preventing a high death rate. However, many illnesses – such as the common cold or flu – will see a relatively low return on investment so contact tracing is usually not done in these cases.

The rapid spread of an infectious disease can produce a large spike in medical cases that can exceed the capacity of available local medical resources – such as hospital beds, medical equipment or medical personal. You can prevent a large spike in cases – and thus prevent overwhelming the medical system – by “flatten the curve.” The curve (the graph of the number of cases over time) is flattened by slowing the rate of spread. The same number of people may still get sick and need medical attention, but now the illnesses are spread over a much longer period of time so the medical system capacity is not exceeded.

How do you flatten the curve? Simple. You lower the population’s probability of catching the disease over the period of interest. We already covered ways for individuals to accomplish this. To extend this to the whole population requires extensive public education and perhaps the expenditure of resources to implement the practices. You also need the public’s trust and cooperation. If most people participate, this should be enough.

It is important to realize that as long as the infectious disease continues to exist in the general population and as long as a large percentage of the population is vulnerable to the disease, the risk of rapid spread continues to exist. The threat of rapid spread will exist until a high enough percentage of the population has had the disease and the disease can no longer spread efficiently. In other words, until the population has developed herd immunity. The goal of good public health education is to popularize good hygiene habits and sufficient social distancing so as to lower the probability of transmitting the infectious disease.

Let’s revisit the question of stopping the spread of COVID-19. We have discussed how individuals as well as populations can lower the probability of contracting the disease. We have also discussed how contact tracing can be used to track down and isolate cases. This begs the question: is it practical to stop a disease like COVID-19 once it has entered the general population? Or is it better to just let the disease run its course through the population?

If you want to eradicate the disease, you must isolate every case and completely eliminate it from the population. If even one case remains to infect a vulnerable population, the pandemic will be off and running – again. The cost in terms of contact tracing and isolating will be high. The benefit will be the lives saved if you are successful. The risk of failing will be high because perfection is the only acceptable outcome. Remember, to be effective, you must eradicate the disease from all populations of the world at the same time.

If you let the pandemic run its course, some percentage of the world’s population will get sick and some percentage of the sick will die. The cost in terms of lives lost
will be high. The benefit will be great because you now have a population that is mostly immune to the disease (herd immunity) and thus future outbreaks will be limited – the strong survived. The risk will be low as there is a natural tendency for the disease to spread through the population and so the spread will not stop until herd immunity has been established.

That said, if you can keep the number of infections low for an extended period of time in a mostly unobtrusive way and if you assume you can eventually create a vaccine that the public will take, accepting a low long term infection rate might be a good option.

What about the case where you are never able to develop a vaccine? What is the optimum rate of disease spread through the population to get to herd immunity? Is there an unobtrusive way to accomplish this? And at what point in the pandemic does developing a vaccine become pointless? That is, at what point have so many people had the disease that it will be difficult to find the remaining people to give the vaccine to?

Now we turn to an interesting sociology question. What made this pandemic different from the last three pandemics?

A lot of things have changed over the last 50 to 100 years. Our population density has increased significantly. Our transportation infrastructure allows someone to travel between most population centers in a matter of hours. Social media allows truth and lies to spread at an alarming rate through the population. A large percentage of the public now has underlying medical conditions – creating a lot more comorbidities. Modern medical technology can keep people alive for months beyond when they would have ordinarily died. Globalization has pushed manufacturing to the cheaper international labor pools and has led to vulnerable supply chains. General technology is far more advanced, and with it, our expectations for controlling our destiny. Let’s not forget our changing society and the political climate. And finally, COVID-19 is not the flu.

In past pandemics, life mostly went on and people mostly went about their business. There was some social distancing and a few very large events got cancelled while other very large events took place. There was not much hysteria. People were not panicked even if they were fearful of the disease. People died and those deaths were accepted and mourned.

So many people died during the 1918 pandemic that they ran out of coffins but society generally kept going. Hospitals were filled to capacity and beyond but society soldered on. Medical technology to keep people alive for months on end was not available so very sick people just died – requiring fewer total beds for a similar volume of patients. A few large cities closed down entertainment establishments and even schools, but society mostly continued.
But then came COVID-19 followed by lock-downs and hysteria. Why did this happen? Why did governments choose to place their own healthy populations under house arrest instead of allowing their societies to continue functioning in a normal fashion as happened in prior pandemics? Historically, you isolate those who are sick – not the healthy.

Were lock-downs necessary to flatten the curve or were they counter productive? Would an honest, coordinated public health education program have accomplished the same thing without the hysteria and economic damage? Is it reasonable to think we can prevent the deaths that such a pandemic will bring without eradicating the disease through effective contact tracing or a vaccine?

Sweden is an example of a society that bucked the lock-down and hysteria trend and chose the more traditional route. Sweden’s approach emphasized public education along with individual responsibility for social distancing and hygiene – the very things we have already discussed. Swedes were encouraged to work from home. Children under the age of 16 continued to go to school and as of June 15, 2020, older children have also returned to school. Anyone who felt ill and the elderly were asked to stay home. Restaurant tables were moved further apart. Congregating at the bar was discouraged. Gatherings of over 50 people were banned.

The Swedes understood the COVID-19 pandemic was a long-term event. The Swedes understood the pandemic was going to run its course, whether they liked it or not. The Swedish philosophy was to flatten the curve unobtrusively and ride it out.

To be fair, the Swedes have taken the position that very sick people should be allowed to die instead of keeping them alive for weeks to months on end using the latest life support systems. These people are provided regular end-of-life hospice services – including “comfort” medication – and allowed to die. This eliminates a huge burden on the hospital system and goes a long way to preventing COVID-19 cases from overwhelming the healthcare system.

The Swedish per capita death rate was listed as 43 per 100,000 people for June 2, 2020 – roughly halfway between the USA and Italy at the time. But, the pandemic is still young and all per capita numbers will continue to climb. Sweden’s per capita death rate rose to 57.4 per 100,000 by September 16, 2020 while the USA’s rate had risen to 59.7 per 100,000. As of November 13, 2020, the Swedish per capita death rate had risen to 59.5 per 100,000 while the USA’s rate had risen to 73.5 per 100,000. Until the pandemic is over and the final numbers have been tallied, there is no point in trying to compare the Swedish outcome to the outcomes of other nations. But early results indicate the Swedes may be on the right track. Time will tell the tale.

Studies published by mid November show that lockdowns are very destructive to the general population – both economically and socially, not to mention the issue of
destroyed civil rights. The recent CHARM (COVID-19 Health Action Response for Marines) study was published in the New England Journal of Medicine on November 11, 2020 (DOI: 10.1056/NEJMo2029717). The study used Marine recruits to provide a near homogeneous group that underwent supervised quarantine, distancing, masking and environmental decontamination with regular scheduled testing. The results showed that few infected recruits (9.8%) had symptoms before diagnosis of SARS-CoV-2 infection through testing, that transmission occurred in spite of implementing best-practice public health measures and that diagnoses were made only by continuous scheduled testing rather than by tests performed in response to symptoms.

It will be interesting to see what future research reveals when it looks back on the COVID-19 pandemic. What drove decisions? And what conclusions will history come to about those decisions? It will also be interesting to see what changes take place to the fabric of our society as a result of this pandemic.

Postscript

The original version of this article was written in early May 2020 in response to US Fish and Wildlife Services and USGS – along with other organizations – worrying about giving North American bats COVID-19. Why? The cavers, bat researchers and perhaps the general public were somehow going to give the North American bat population COVID-19. Then, somehow, those bats were going to spread COVID-19 to people – or other wildlife. Or perhaps COVID-19 was going to become the new WNS bat infection that would kill bats. There is no data to even suggest these scenarios are possible but that does not stop bureaucrats from speculating up a doomsday scenario. The human-to-human transmission vector is many orders of magnitude more efficient than any possible bat-to-human vector. The same holds true for vectors involving other wildlife. Not to mention a zoonotic change to the virus is probably required before any such transmission could take place.

This is the same lousy science displayed with White Nose Syndrome (WNS) – a Eurasian bat fungal disease that has killed a lot of North American bats. Cavers and even researchers were being excluded from caves because they would somehow infect bats with WNS. The bat-to-bat transmission vector is many orders of magnitude more efficient than any possible human-to-bat vector. The only documented human-to-bat transmissions of WNS involve a white lab coat, a swab and a spore loading of 100,000 to 300,000 – i.e., a scientist intentionally infecting a bat in the lab. That large spore loading is phenomenally high – but you cannot give a bat the disease without it. Bats are very social and groom each other so bat-to-bat contact can easily achieve the spore loading needed to pass on the infection to other bats.

Following the initial article oriented to the bat issues, the article was rewritten as a general article for a broad audience and has been expanded many times since. I hope you find it educational.