

Coronavirus: Should We Aim for Herd Immunity Like Sweden?

Tomas Pueyo, *medium*, June 9, 2020

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And What Can Countries like the US or Netherlands Learn from It?



Sweden has famously followed a different coronavirus strategy than most of the rest of the Developed world: Let the virus run loose, curb it enough to make sure it doesn't overwhelm the healthcare system like in Hubei, Italy or Spain, but don't try to eliminate it. They think stopping it completely is impossible. The natural consequence is that most citizens get infected, and that eventually slows down the epidemic. That's why, in short, people call that strategy "Herd Immunity".

The other strategy is the Hammer and the Dance: Aggressively attack the coronavirus by locking down the economy. Once curbed, jump into the Dance by replacing the aggressive lockdown with cheap and intelligent measures to control the virus.

Some countries and states, such as the Netherlands and the UK, or US states like Texas and Georgia, have implemented measures in between the two strategies. So which strategy is best?

Today, we're going to use a lot of data and charts to answer these questions:

1. What is happening in Sweden?
2. How bad is the virus, really? How many people does it infect? Hurt? Kill?
3. *Who* does it affect? Can we just protect the weak?
4. What's best for the economy?

Here's what you're going to learn:

- Sweden is suffering tremendously in cases and deaths. Yet few people have been infected yet. They are a long way from Herd Immunity.
- Between 0.5% to 1.5% of infected die from the coronavirus.
- Left uncontrolled, it can kill between 0.4% and 1% of the entire population.
- Many more suffer conditions we don't yet understand.
- Unfortunately, that death and sickness toll is far from having bought us Herd Immunity anywhere in the world.
- Only protecting those most at risk sounds great. It's a fantasy today.

- Even if Sweden's economy has remained mostly open, it has still suffered as much as others.
- From now on, it might start doing worse.
- Sweden now has regrets. But not enough. It can control the virus without a lockdown if it acknowledges its mistakes and takes the right measures.
- Other countries, like the US or the Netherlands, are toying with a Herd Immunity strategy. It will only cause more economic loss and death.

Alright, let's do this.

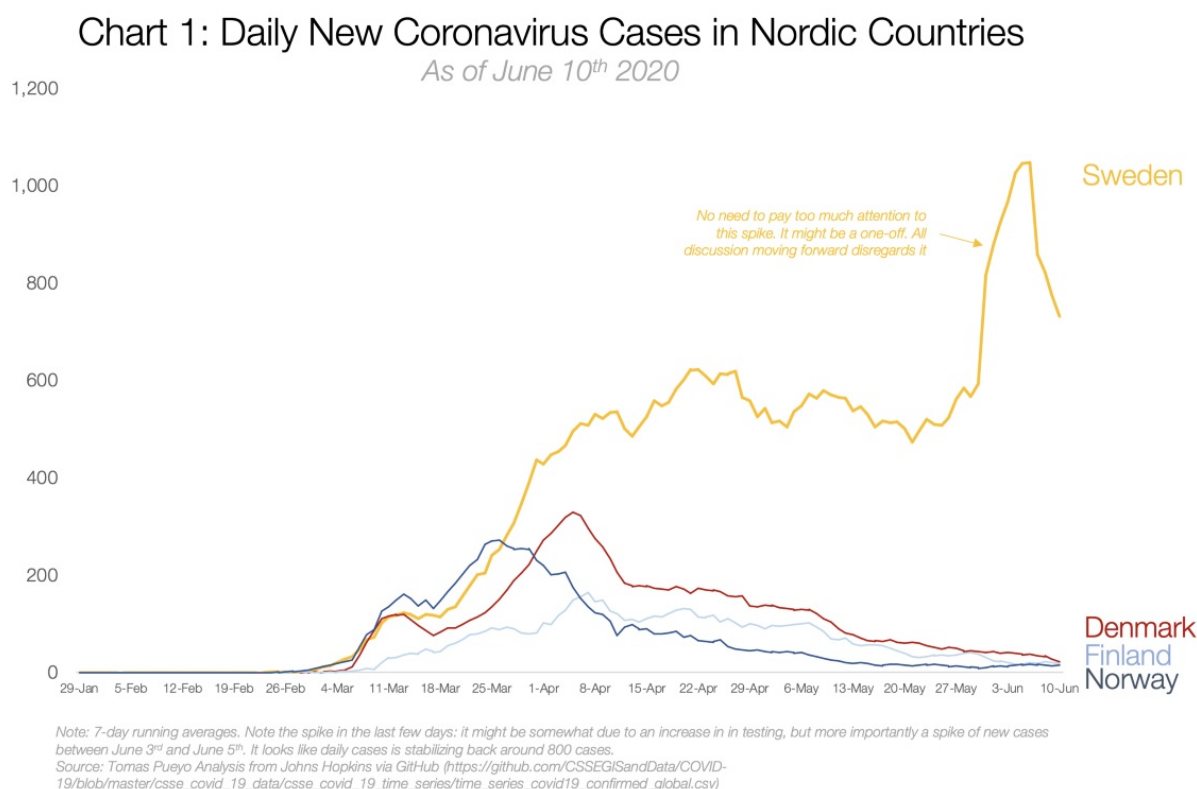
1. Sweden's Case

What's the Situation in Sweden?

People in Sweden haven't been locked down the way they have been in other countries.

Swedes have been free to walk around. Elementary and middle schools have remained open, as well as businesses like bars, clubs, gyms, or restaurants.

So what has been the result?

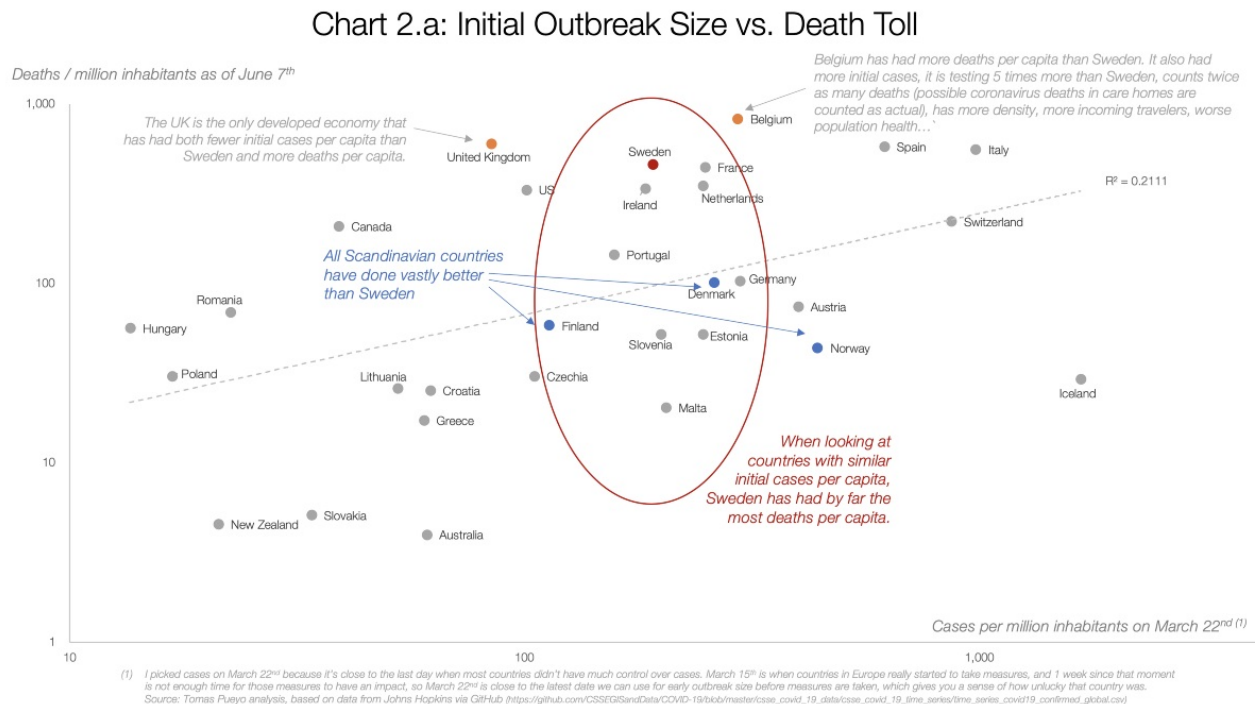


The best way to understand Sweden is by comparing it to the countries that look the most like it. Thankfully, we have nearly perfect comparisons: other Nordic countries. They share a similar culture, weather, behavior, economy, demographics, and received coronavirus cases at approximately the same time, as we can see in the first half of March. Other countries aren't as comparable, since they either suffered much earlier

outbreaks (such as Italy, Spain, France...), have a different density (such as the UK, Germany, France, Italy, Belgium...), or have different demographics (such as large households with kids and grand-parents in the Mediterranean), etc.

Some people will complain at this comparison. They will say: “*But Italy has more deaths per million inhabitants! And Spain! And Belgium!*” So let’s dig slightly deeper. What other countries can we compare Sweden to?

Who Should We Compare Sweden to?



On the horizontal axis, we have how many cases there were in that country initially. I picked cases per inhabitant, although you can pick total cases to measure the initial outbreak, and the correlation is even stronger, with $R^2 \sim 0.5$. I chose March 22nd because most developed countries only took measures after March 15th, and it took at least 2 weeks for them to have an impact on numbers, so the number of cases on March 22nd is close to the last time when cases were determined by luck and not by action. The vertical axis shows deaths per million inhabitants as of the beginning of June. This conveys the impact of the individual country strategy since March. Both axes are logarithmic.

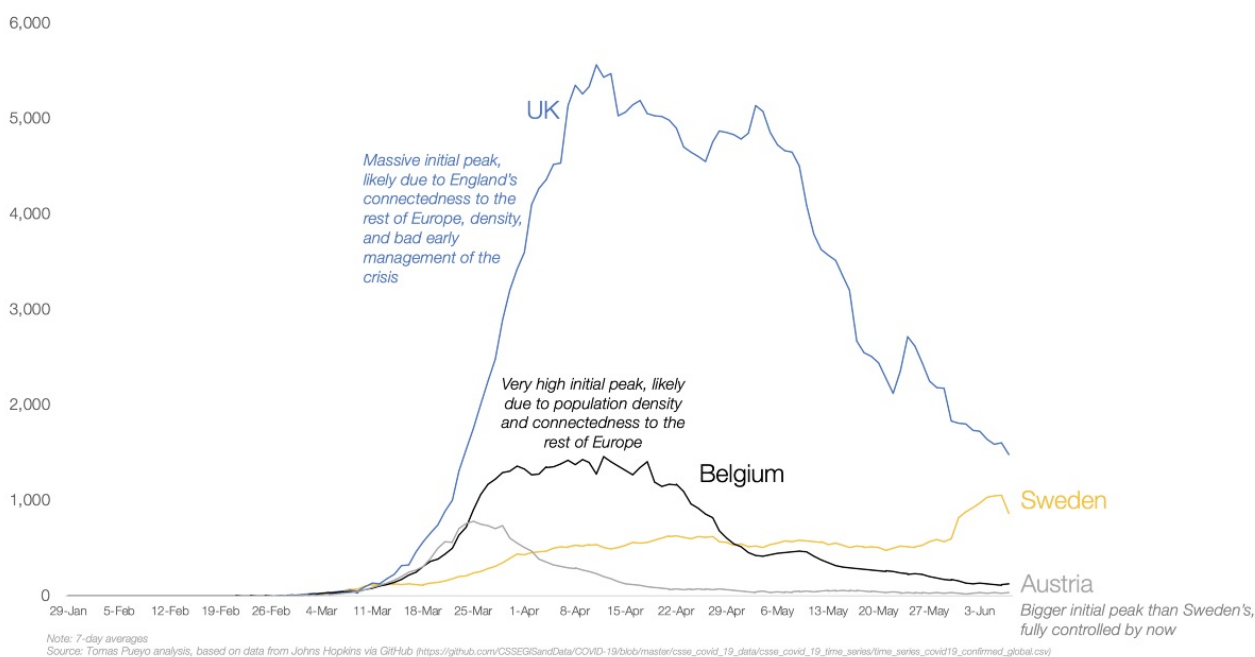
This graph has plenty of insights. The horizontal axis shows initial cases in mid March per million inhabitants, to give a sense of how unlucky that country was to get an early outbreak. The vertical axis tells you deaths per million inhabitants. We can see that the bigger the initial outbreak, the more deaths.

This tells you, for example, that you shouldn't compare Sweden to Spain or Italy, because these countries were unlucky enough to have many more initial cases. Same thing for countries like Canada, Lithuania or Slovakia: They had few initial cases. What we should compare here is countries in the same *vertical*, because that shows countries that had the same initial outbreak. Their management of that initial outbreak determined how many deaths they ended up with.

In that sense, Sweden is by far the worst of its group. It's done worse than France, Ireland, Netherlands, Portugal, Denmark, Norway, Austria, Germany, Czechia, Australia, Estonia, Slovenia, Malta, Finland... This group includes Denmark, Finland, and Norway, other Nordic countries, which is very convenient for our analysis.

The graph also shows why defenders of Sweden's strategy pick the UK or Belgium as comparisons: They are the only countries with more deaths per person and a similar number of initial cases per capita. However, this is not a fair comparison.

Chart 3: Daily Coronavirus Cases in Select European Countries



Both Belgium and the UK have had massive initial outbreaks in comparison to Sweden's. These are much harder to control. They are also much more connected internationally, with many more incoming infections. They have a much higher population density, worse population health, and more people per household.

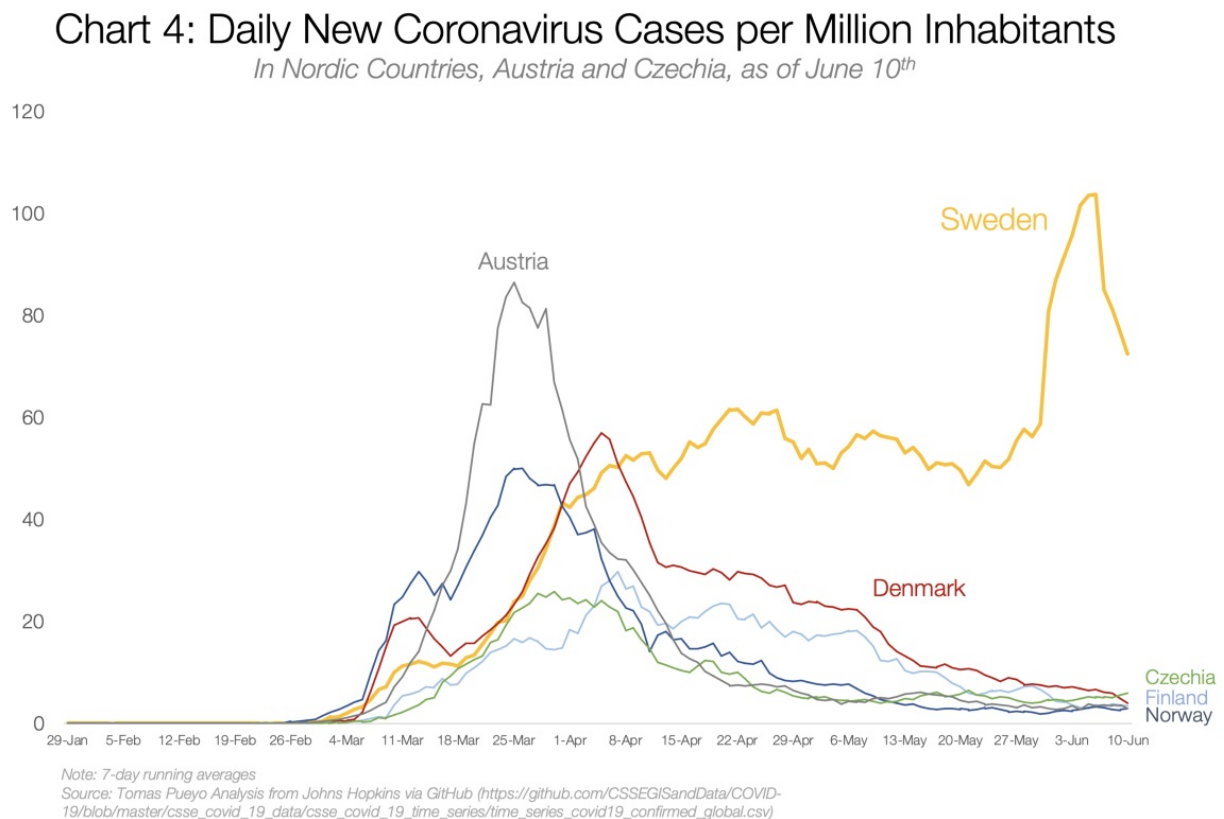
On top of that, the UK has been a leader of coronavirus mismanagement and bad luck: It took too long to impose a lockdown, the lockdown was not as strong as in other countries, sick patients were sent back into nursing homes...

Meanwhile, Belgium is counting approximately twice as many deaths as most other countries: Half of the country's deaths are in care homes, but of those only 5% have been tested. 95% have simply been assumed to be caused by the coronavirus. It also suffered from a massive initial peak that has since been controlled.

Sweden vs. Other Nordic Countries

Based on all of the above, to clearly get a sense of the Herd Immunity strategy vs. the Hammer and the Dance, the best way is to compare Sweden to other Nordic countries: Denmark, Norway, and Finland. Also, for contrast, I included Austria and Czechia, as

other countries East European countries with a similar size (~10 million inhabitants) and a comparable initial outbreak.

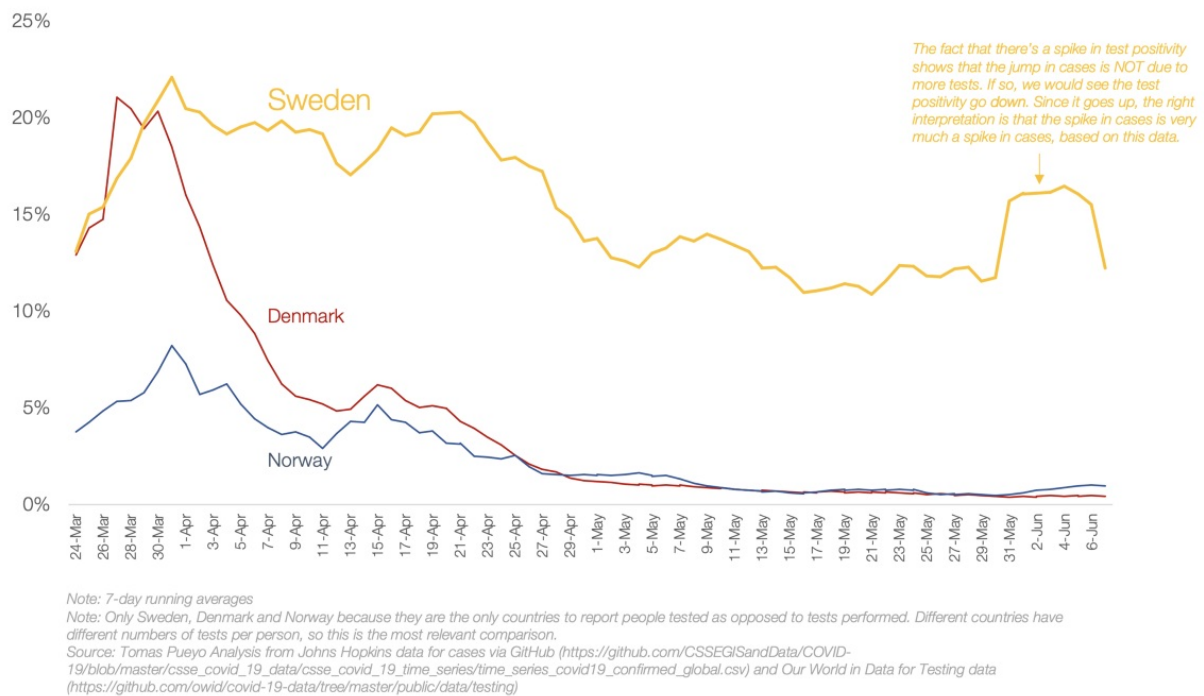


As of June 10th, Sweden had more daily cases than all of its Scandinavian neighbors combined, and this trend is only getting worse. In fact, if you add up the cases of the 21 EU countries with the least cases last week, Sweden still has more cases than all of them combined.

In the graph above, we can see that Sweden started off much better than its neighbors Denmark and Norway, as well as Austria, and similar to Czechia and Finland. However, all these other countries applied a Hammer in the second half of March. Two weeks later, at the beginning of April, we could see their cases go down together while Sweden's kept going up.

This is despite the fact that Sweden does not exhaustively count its coronavirus cases:

Chart 5: Test Positivity Rate in Scandinavia

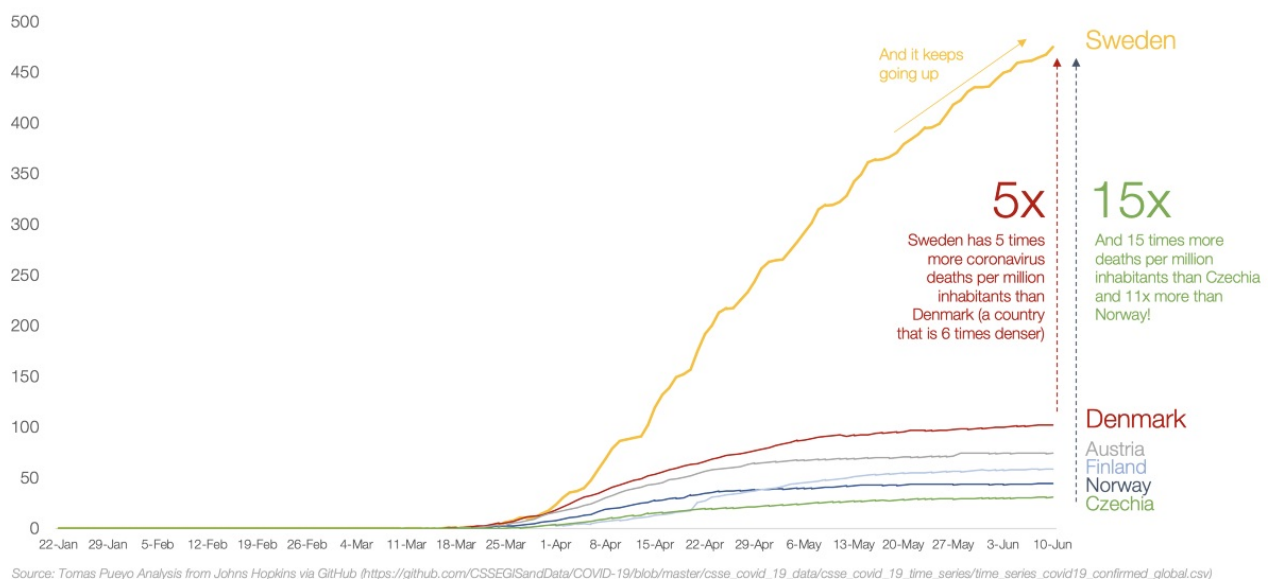


This shows the percentage of tests that turn out positive. The lower that percentage, the more confident you are that you're counting all cases. Sweden is testing 10 times less than its neighbors, because it doesn't really care about total cases, since it's not trying to eliminate the epidemic. As a result, they're undercounting cases.

Even then, cases are only as good as the official records. A more reliable data point is deaths.

So what about deaths?

Chart 6: Coronavirus Deaths per Million Inhabitants



While coronavirus deaths have stopped growing in Scandinavian countries and other

comparable ones, they're still piling up in Sweden. To understand why, we need to understand Sweden's strategy to fight the coronavirus.

The Swedish Strategy

Sweden never went into lockdown. Instead, the country closed its high schools and colleges, forbade gatherings above 50 people on March 27th, and encouraged its citizens to stay home and avoid unnecessary travel. Visitors were banned from nursing homes on March 30th. But beyond that, the government just asked people to work from home as much as possible and to practice social distancing. And it's *obligatory* for kids to go to school. Why?

Nordic countries' restrictions on daily life

How the countries' handling of coronavirus has differed.
Some of the restrictions listed below have since been lifted.

● Open ● Some closed ● Closed/banned

Sweden	Denmark	Norway	Finland
 Schools			
 Restaurants/bars			
 Hair salons			
 Large events			



Last updated: April 28, 2020 at 6:00 a.m. ET.
Sources: National authorities
Graphic: Sarah-Grace Mankarious and Henrik Pettersson, CNN

Source

This is how Sweden's official epidemiologists summarized their strategy:

"It's impossible to stop the coronavirus. Only Herd Immunity will make that happen. Lockdowns won't. So let's flatten the curve to avoid the collapse of the healthcare system, but that's it. If we lock down the economy, it will be costly and will only

postpone the inevitable. Meanwhile, let's protect older people, since they are the ones dying. The virus is not that bad anyways."

Some people call this a *mitigation* strategy, because it reduces the cases so that they don't overwhelm the healthcare system, but doesn't go beyond that to completely eliminate most cases. Others label this strategy *Herd Immunity*, because of the side effect: The belief is that the epidemic will only stop once enough people have been infected and develop immunity against it. For the coronavirus, it is assumed that the moment arrives when around 65% of people have been infected.

Swedish officials don't like the Herd Immunity label, but it's useful since it's memorable, everybody calls it that way, and it does not hide the nasty end result. So I'll use that.

There are many statements in the description of the strategy from above. Some are true. For example, the measures it declared (banning large gatherings, asking people to work from home, closing high-schools and universities) were enough to flatten the curve. The government also increased the capacity of the healthcare system, which contributed to keeping it working despite the weight of coronavirus cases.

Here are the statements that deserve scrutiny:

1. The coronavirus is unstoppable.
2. The virus is not that bad.
3. We can protect the elderly from it.
4. It's better for the economy to just flatten the curve while the virus spreads through the population than it is to implement the Hammer and the Dance strategy, a heavy lockdown followed by a reopening of the economy.

Let's look at each one.

2. Is the Coronavirus Unstoppable?

Does the Hammer Work?

Anders Tegnell, Sweden's head epidemiologist, had stated that there is not enough scientific evidence that lockdowns work, a statement that has been echoed by other Swedish government epidemiologists.

"Closedown, lockdown, closing borders — nothing has a historical scientific basis, in my view. We have looked at a number of European Union countries to see whether they have published any analysis of the effects of these measures before they were started and we saw almost none."—Anders Tegnell, Sweden's head epidemiologist.

If I were a Swedish politician and I heard that, I would have instantly started worrying. First, the evidence of that analysis has not been shared, as far as I could find. More importantly, this shows the scientists don't understand what it's like to manage in the real world.

Were the scientists waiting for a peer-reviewed scientific study unequivocally proving that lockdowns work? This is not a lab. That doesn't exist. It was impossible to have a clean analysis with a completely new virus.

Decisions shouldn't be measured by their outcome, but whether they were the right ones based on the evidence at that time.

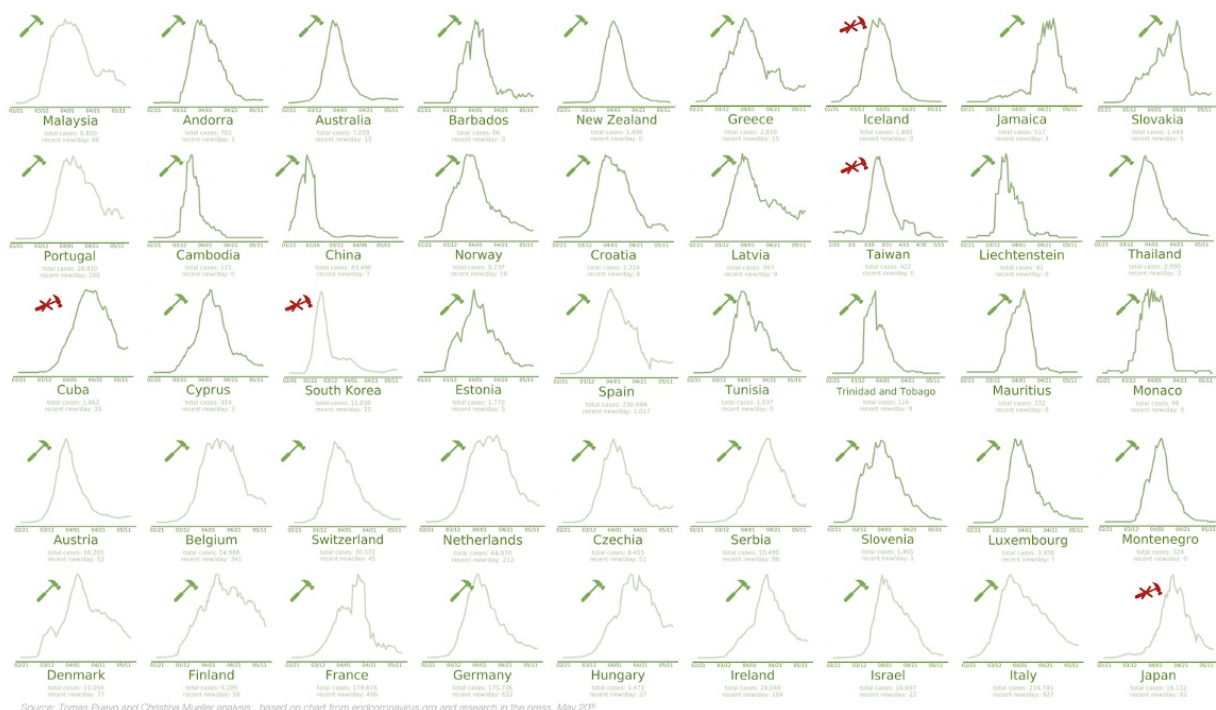
The world is messy. Data is imperfect. Are politicians supposed to wait until all evidence is perfect? No. That's too late. They need to piece together all the data they have and take action, even if it's not perfect. Because perfect is too late and gets you killed.

Perfect is the enemy of good.

And yet... There *was* evidence, based on everything that had happened in Wuhan, South Korea, Taiwan, Italy...

Since then, plenty of countries have acted on that evidence, and their performance is accumulating. So what did the available evidence indicate?

Chart 7: Countries that Beat the Coronavirus



Details on how each country applied the Hammer (or not): [How 45 countries beat the coronavirus](#)

Dozens of countries have crushed the virus. Out of this sample, 40 applied a Hammer to stop its spread. The remaining five countries (Cuba, Japan, Taiwan, Iceland and South Korea) are all islands (South Korea is de facto an island since its only ground border is

with North Korea and it's sealed) and all five had advanced methods to deal with the virus. Taiwan and South Korea took all the right preventative measures, as did Cuba. Japan had massive mask wearing and a strong healthcare network with contact tracing experience. Iceland went straight into dancing, testing a massive share of the population (around 17%) and isolating all the positive cases.

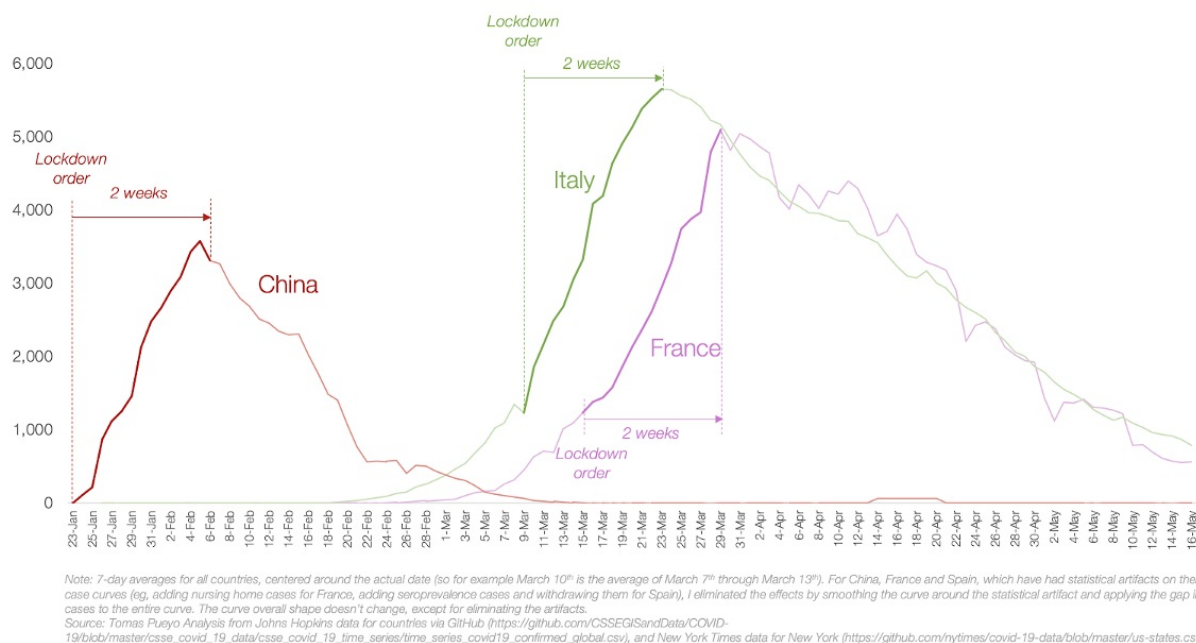
These 45 countries show that the Hammer can be applied successfully, especially in developed countries, and in many developing countries too.

“This is not a disease that can be stopped or eradicated, at least until a working vaccine is produced.” *Anders Tegnell, Sweden's head epidemiologist*

What other pieces of evidence can we use to assess whether Hammers work?

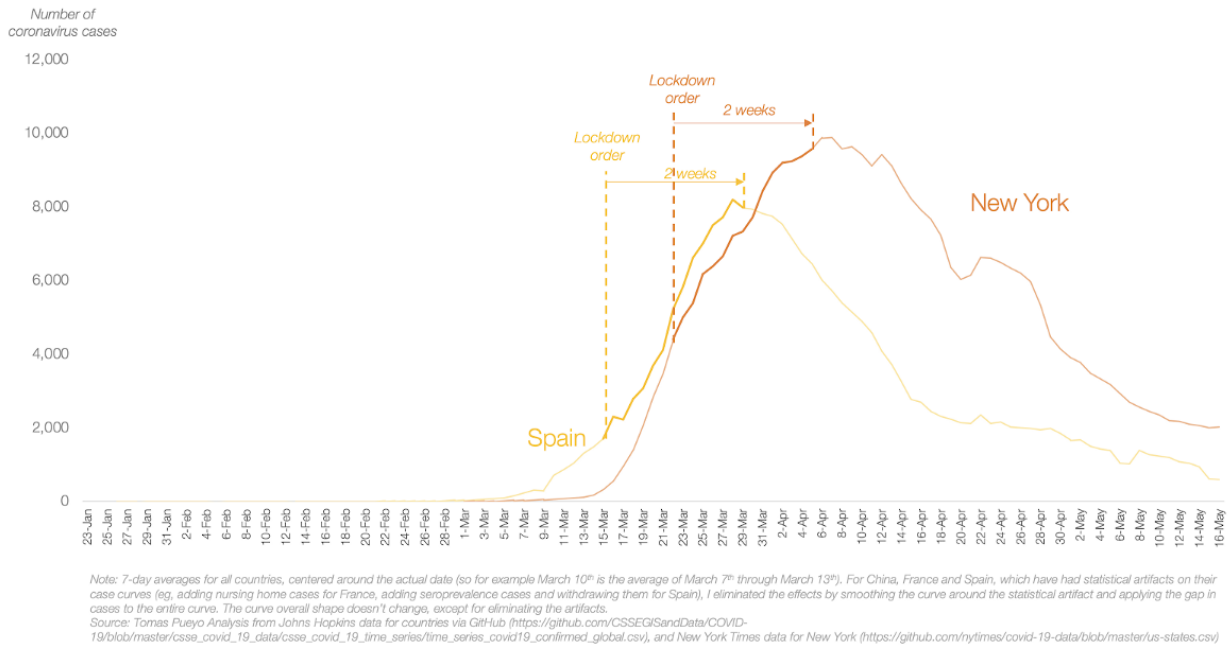
Let's look at the reduction in daily cases. For countries that applied very heavy Hammers, their case growth stops around two weeks after the Hammer.

Chart 7.a: Days Between Heavy Lockdown and Peak of Coronavirus Cases



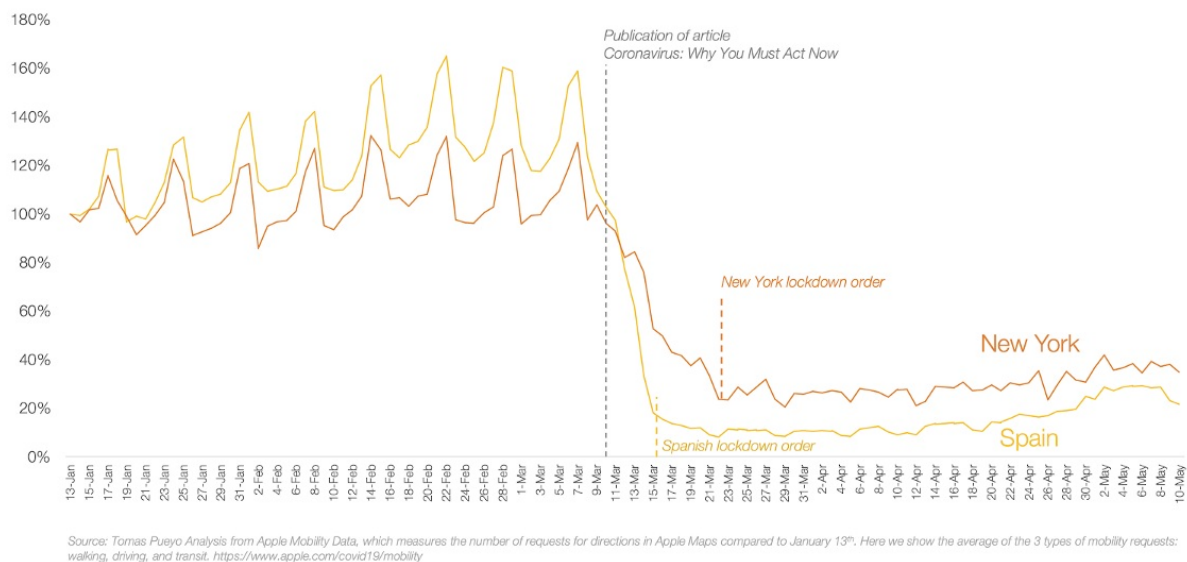
For the above graph we chose countries that applied heavy Hammers, so that the impact of these Hammers overpowers any other factor. The cases of Spain and New York are especially interesting:

Chart 7.b: Days Between Heavy Lockdown and Peak of Coronavirus Cases



New York was narrowly trailing Spain in cases. But it took seven more days (March 22nd) for the NY government to order the Hammer than the Spanish government (March 15th). As a result, the New York curve blew past Spain's, and Spain ended up with 235k cases by May 20th vs 360k for New York. This is despite the fact that citizens had already started limiting their movement in both places:

Chart 8: Mobility Changes in New York City and Spain



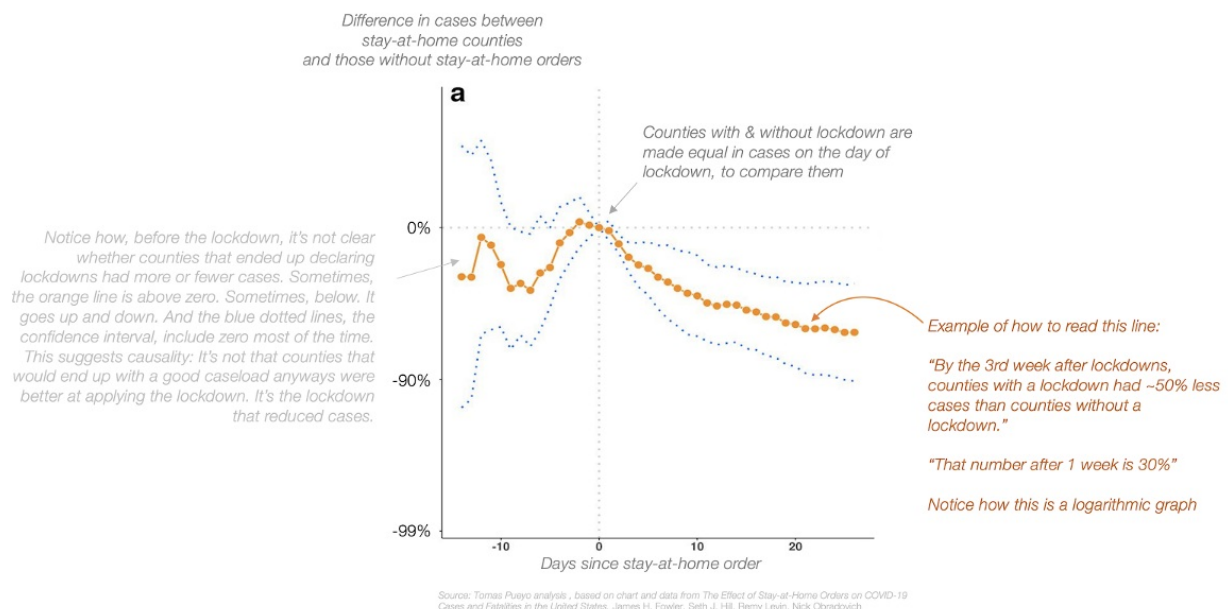
We can see the number of requests for directions on Apple Maps, compared to the baseline of January 13th. There are usually peaks during the weekend: During the week, people usually commute, so they have less of a need to ask for directions. We can also see that people started reducing their requests for directions several days before the lockdowns were ordered. In fact, it looks like the lockdowns trail public opinion rather than lead it. This mobility is not true mobility. It shows requests to Apple Maps for directions, which are likely more for new visits than habitual visits like commuting.

This chart is telling us two things:

1. Citizens and businesses follow the news and take some actions independently from government requests. These actions can affect the transmission rate of the virus.
2. That is not enough. Spain and NY lowered their mobility around the same time, but that was only partially reflected in the curve. The application of Hammers from governments came later, and the reduction in cases came two weeks after the Hammer like clockwork.

The US is a near-perfect place to study the impact of lockdowns, because there was no decision to lock the country down at a federal level, and both states and counties had to make that decision. That leaves thousands of counties to compare lockdowns vs. no lockdowns. What can we learn from that?

Chart 10: How Coronavirus Cases Compare between US Counties that Ordered Lockdowns vs. No Lockdown Ordered



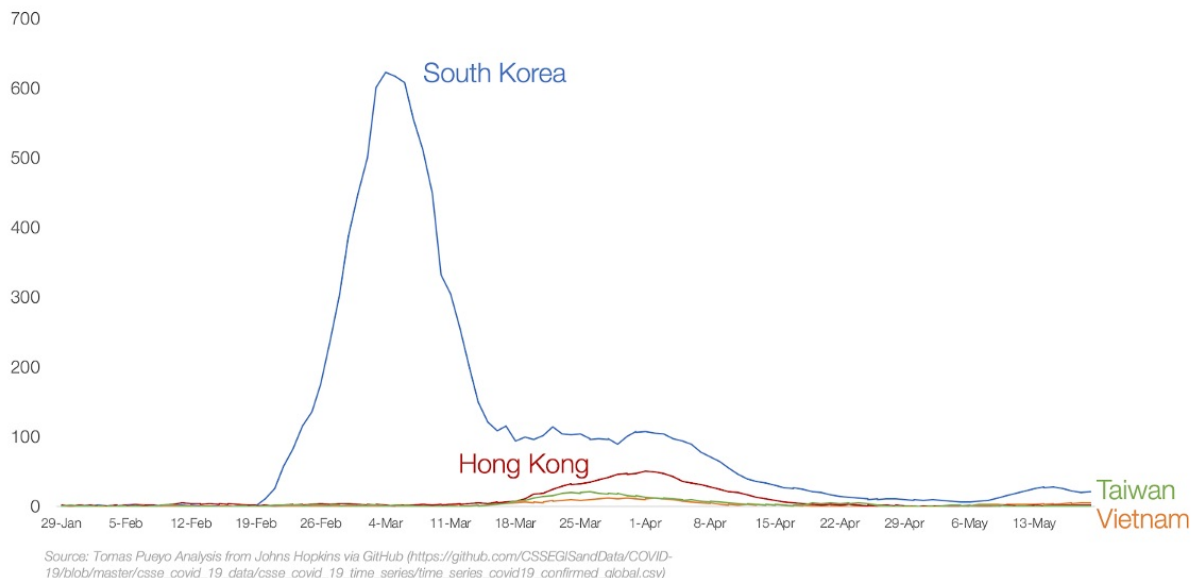
The graph is pasted from its original paper. I only annotated it.

The orange line shows how the cases evolved in counties that ordered a lockdown vs. those that didn't compared to counties with no lockdown. At day zero, they're made equal. Before that, it's a bit all over the place. But after the lockdown, the counties with lockdowns start having fewer and fewer cases compared to counties that did not lock down. By the 1st week, the number of cases is down by 30%. After two weeks, it's 40%. After three weeks, it's 49%.

So now we've seen that many different places have applied Hammers successfully. I assume that Swedish epidemiologists agree with this. Maybe their concern is not the Hammer, but the Dance? They might think it's impossible to contain the virus while the economy reopens. And if you can't Dance successfully, the Hammer is expensive and worthless. So... Can you Dance successfully?

Does the Dance Work?

Chart 9: Daily New Coronavirus Cases in East Asia



Many countries have exited the Hammer, and many are Dancing. But few have had time to prove they can Dance for a long period of time. However, there are examples. Besides China, four great ones are South Korea, Hong Kong, Taiwan and Vietnam. They have been dancing for three to five months. South Korea had a minor outbreak, and it was able to control it without a Hammer. It's hard to say there's no evidence that lockdowns work when you can apply them successfully, and several countries have been able to Dance well for months.

| *Several countries have been Dancing successfully for months.*

Many more have been dancing successfully for many weeks, such as New Zealand, Australia, Iceland, or Austria.

The Silent Spreader

Both the Hammer and the Dance can work.

Yet some people have claimed that the peak and drop of coronavirus cases were not due to the Hammer. They say it doesn't have any effect. Instead, they argue that outbreaks happen in all countries sooner or later and that, like clockwork, the epidemic dies down after a few weeks, whether there were lockdowns or not. In science, if you want to prove a theory, you make predictions based on it and you see if they turn out to be true. Here are some predictions from this theory:

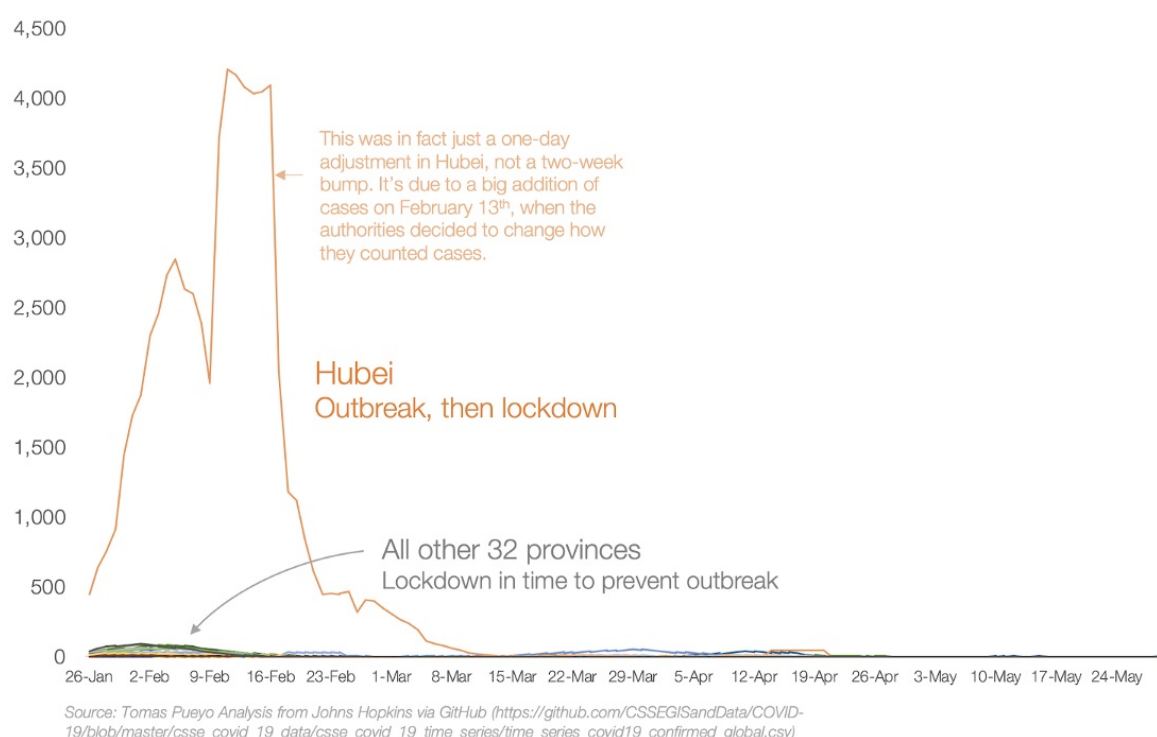
1. Since all countries have a similar case curve going up and down independent from any Hammer, there should be an outbreak in all countries. Countries without a heavy outbreak are impossible.

2. Conversely, since all countries have a similar case curve going up and down independent from any Hammer, all countries should be seeing their caseload go down.
3. Countries with similar initial conditions should see similar outbreaks, regardless of whether they applied Hammers.
4. Conversely, countries with different initial situations should see different outbreaks, regardless of whether they applied Hammers.

The first prediction is false. Not all countries have had an outbreak. Under that reasoning, Taiwan, Hong Kong or Vietnam are not possible: They didn't suffer any outbreak. The countries that were prepared — the ones that knew how to dance right away — did not have outbreaks.

Not only that, but this was known back in March, since only one Chinese region really suffered an outbreak:

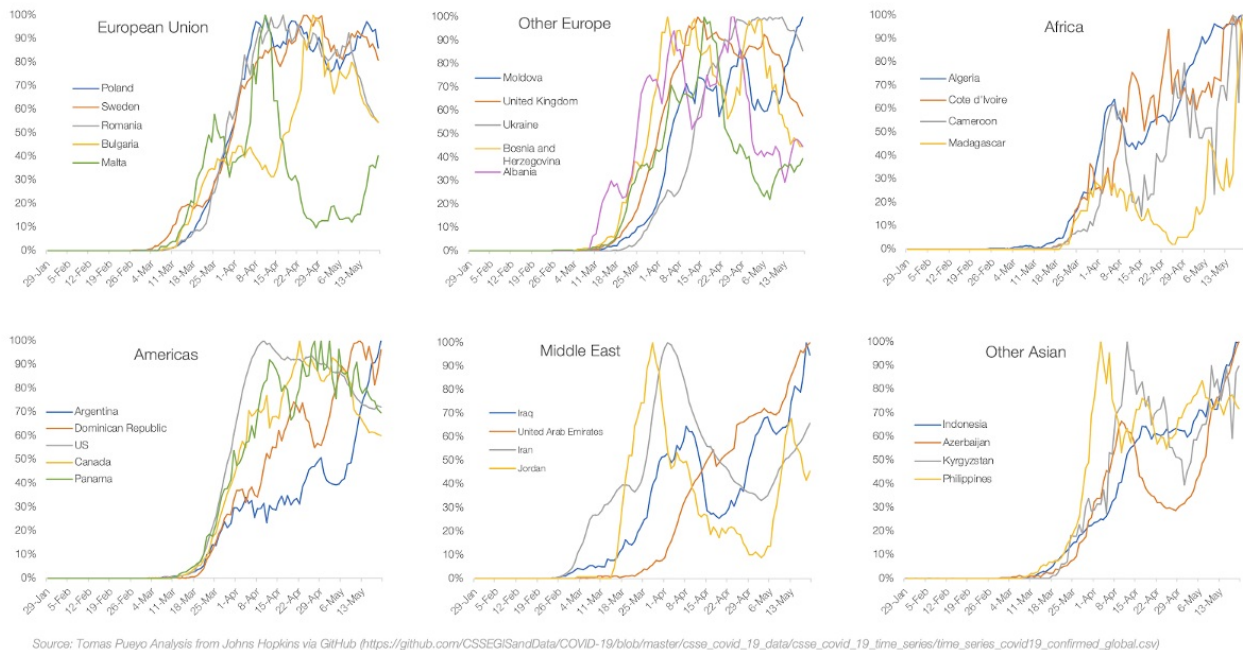
Chart 11: Daily Coronavirus cases in Different Chinese Provinces



If lockdowns don't matter, how come all the Chinese provinces that locked down early, alerted by the Hubei situation, were able to dodge an outbreak? How come the only region that had an outbreak is the one that couldn't lock down on time?

The second prediction—"All countries that have had outbreaks should have been back to normal by now"—is false. We saw that hasn't happened in Sweden. We can easily find other countries in all continents:

Chart 12: Shape of the Curve of Coronavirus Cases in Countries that Didn't Apply a Successful Hammer



We previously saw many countries that have successfully applied the Hammer. Within 2–3 weeks they start flattening the curve, and with a few more weeks, they get it close to 0. But we can also find dozens of countries across continents where that is not the case: The number of daily coronavirus infections continues at a high and stable level for weeks (like in Sweden or the US), keeps growing (like in Moldova, Algeria, Argentina or Russia), or goes down before going back up (like in Azerbaijan, Jordan, Iran or Malta). If the curve was independent from the measures, you'd see all countries going down. That doesn't happen.

The third prediction—"Countries with similar initial conditions should have similar case curves, independent from the Hammers they applied"—is false. We saw that Norway, Denmark, Austria, Finland and Czechia started similar to Sweden, and yet went through different paths. We also saw how New York and Spain were very close in initial cases, so their curves should have gone down at the same time. But that's not what we saw. New York's case curve took longer and went higher. Same thing for US counties.

The fourth prediction — "Countries with different initial conditions should have different case curves, independent from the Hammers they applied" — is false. There should be some variability across countries in the bending of the curve, but daily cases nearly always go down two weeks after the Hammer is applied, as we saw for places like China, France, Italy, Spain or New York.

The coronavirus is not unstoppable. There's a clear way to stop it for many countries: the Hammer and the Dance.

So what was Sweden's official stance throughout all of this? On April 30th, the country released the results of a test that found that 2.5% of Swedes had been infected by April 3rd. An official Swedish model projected that 26% of the population would be infected one month later, by May 1st. Prof. Johan Giesecke, an advisor to the government and

former head epidemiologist of the country, thought mass testing would find 50% of the country infected. A key modeler for the country, Tom Britton, agreed. That would have been good news: It would have proven that the Herd Immunity approach works.

What actually happened? On May 20th, the country released the update to the survey. Instead of 26% of the population having been infected, the rate was just...5.4% (7.3% in Stockholm. National average of 5.4% found crossing age-based prevalence with Sweden's age distribution.)

These numbers likely reflect the immunity of around April 20th, since it takes some time for antibodies to develop. However, about half of the 5.4% are likely false positives. It could be that true positives by April 20th were only 2.3%. Regardless, let's be very generous and assume that, by end of April, the prevalence was ~7%.

This was critical: Swedish epidemiologists thought the country's sacrifices would have gotten them halfway to Herd Immunity. This showed they were 10% of the way there, and the death toll would need to multiply by up to 10 before getting to Herd Immunity. Or more, since the elderly had been less infected than the rest of the population (2.7% for people above 65 years old).

“This means either that the statistical calculations made by the Public Health Authority and myself are quite properly wrong. [...] Or it is a larger part that has been infected than that developed antibodies.” — *Tom Britton, professor of mathematics at Stockholm University and advisor to the Swedish government, via Dagens Nyheter*.

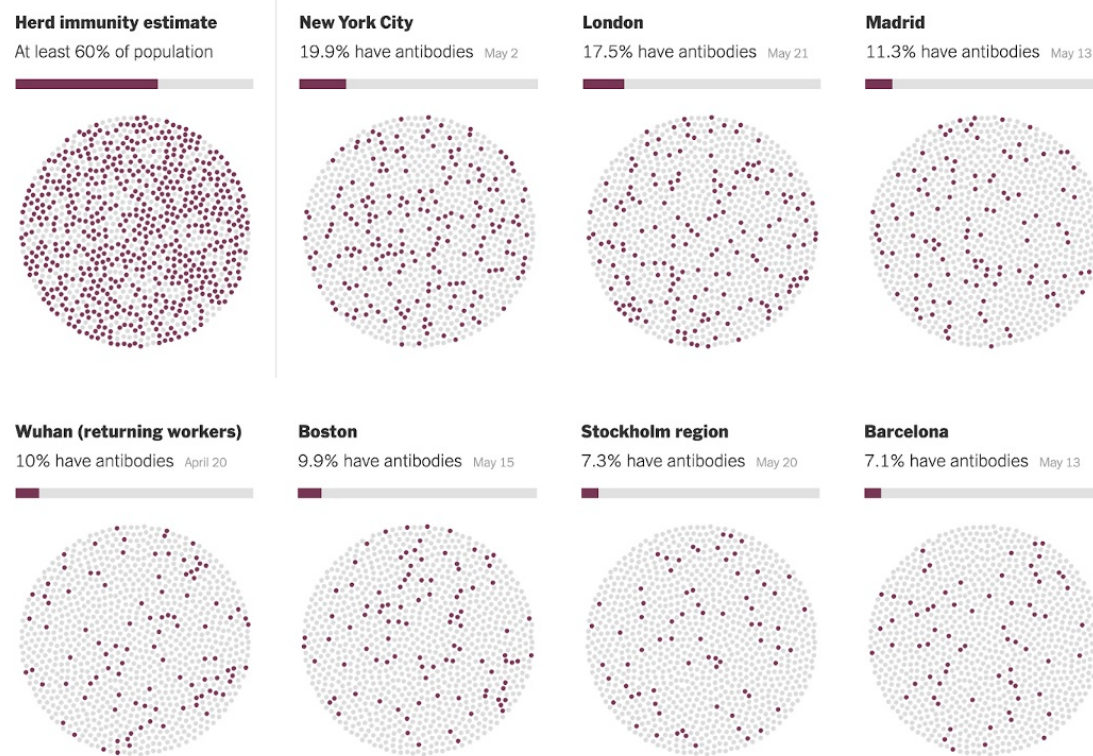
With ~10 million Swedes, 7% means around 700k had been infected at some point, and ~9 times more would need to be infected before Herd Immunity. Since deaths take around 3 weeks to happen, this should be comparable to the number of deaths around the end of May, so around 4,000.

With ~700k infected and ~4,000 deaths, the infection fatality rate (IFR) would be 0.57%. The Swedish government thought it would be 0.1%, nearly six times lower than it already is.

“I think [the fatality rate] will be like a severe influenza season, which might be on the order of... 0.1% maybe.” *Prof. Johan Giesecke, advisor to the Swedish government and former head of the dept now headed by Tegnell, via Unherd*.

Letting the virus run through the entire population would multiply deaths by an order of magnitude, bringing the death toll to ~30,000–40,000 people.

This, by the way, is not unique to Sweden. Even in areas with massive outbreaks, a low percentage of the population has been infected.



Note: Studies represent best current estimates, but are inexact and may overestimate immunity where coronavirus infections are low. Reported dates reflect when study results were publicly released. The study from Wuhan, China, evaluated immunity only among people returning to work, not in the general population. Broader estimates from the city are unavailable. Sources: [New York State](#); [Public Health England](#); [Carlos III Health Institute](#); [Wu et al., Journal of Medical Virology](#); [City of Boston](#); [The Public Health Agency of Sweden](#)

Source

Not only that, but this makes another huge assumption: that people with antibodies against the coronavirus are actually immune. We don't know that.

It could be, for example, that some people appear to have immunity but in fact they have antibodies for another type of coronavirus. They might also have developed a few antibodies from a small exposure to the virus, but a bigger exposure might overwhelm their system. If situations like these were true, in a country like Sweden, the percentage of the population that is currently immune could be even lower than 6.7%, and reaching Herd Immunity could be even farther off.

3. Is the Coronavirus Like the Flu?

In 2019, around 700 Swedes died from the flu. That would mean the coronavirus kills 50 times more people than the flu.

Contrast that with Prof. Giesecke's assumption:

“The number of deaths from coronavirus might be double as much [as influenza deaths] but it won't be 10 times as much.”

It is unlikely that the coronavirus is 50 times worse than the flu. But it's not like the flu.

How bad is it, really?

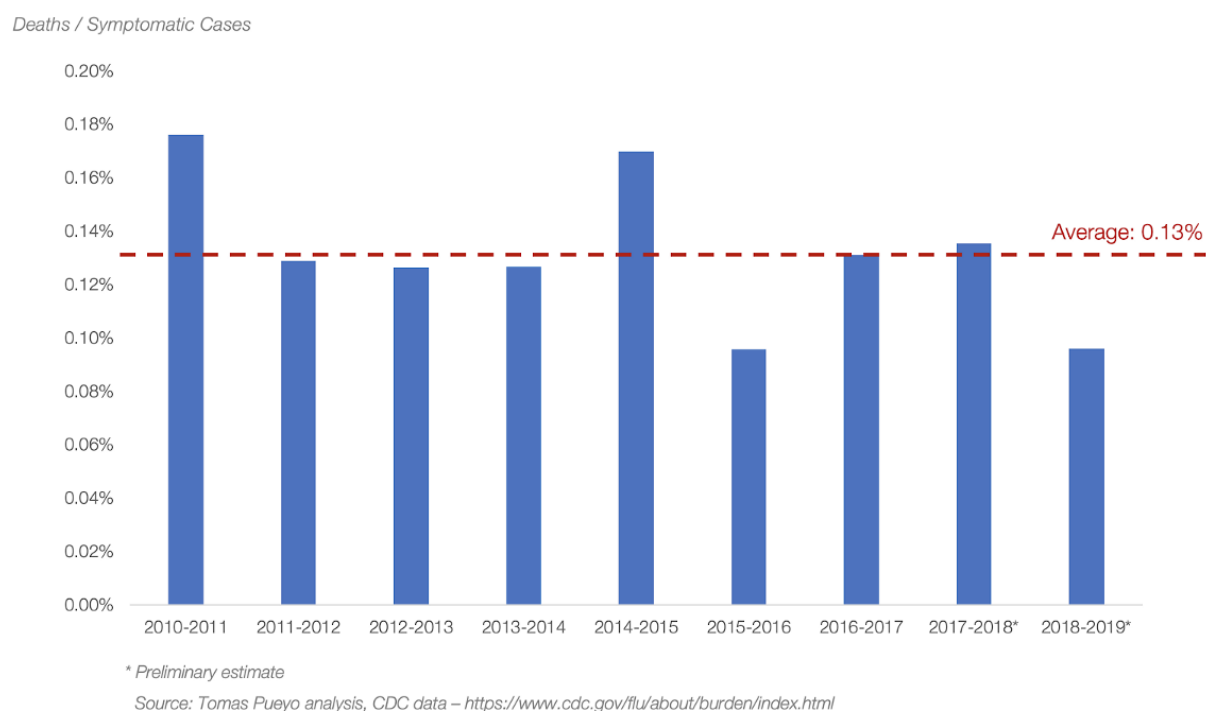
To assess that, we need to understand the difference between case fatality rate (CFR) and infection fatality rate (IFR).

Case Fatality Rate

The CFR only looks at people who were confirmed to have the virus and died. If 100 people test positive and 2 of them die, the CFR is 2%.

What is the CFR of the flu and the coronavirus? In the US, the flu CFR is ~0.13%.

Chart 13: Case Fatality Rate of the Flu in the US



So far, the CFR for the coronavirus in the US is 6%. That's 46 times worse. In South Korea, Taiwan, and the Diamond Princess cruise ship, three places with very thorough testing and where cases have had time to convert in deaths since the biggest outbreaks are long past, the CFR ended up around 2%-2.5%.

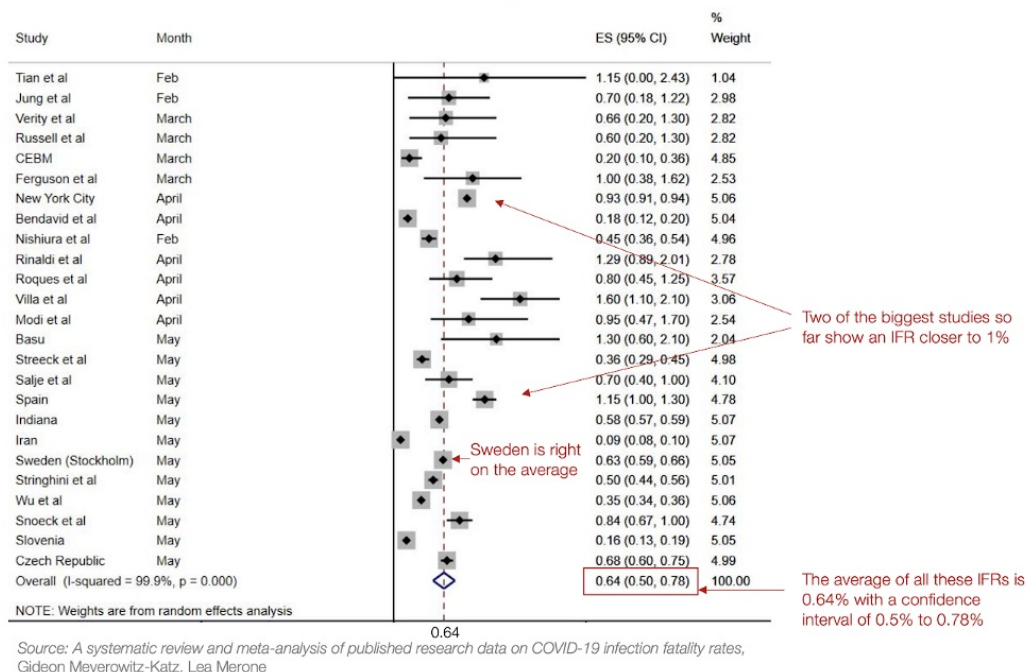
The 0.13% CFR of the flu in the US is probably an overestimate. The true CFR is probably lower, because most people that have the flu don't get tested. If there are 100,000 people with the flu, only 10,000 of them get tested, and 13 of them die, it will look like the fatality rate is 0.13%, when in fact it's 0.013%. However, for the coronavirus, many more people get tested than for the flu, because everybody has heard about it and wants to be treated. That makes the CFR of the coronavirus lower than it is in comparison to the flu's.

No matter how you look at it, the CFR for the coronavirus is orders of magnitude higher than for the flu.

Infection Fatality Rate

What about IFRs for the coronavirus? We saw that the current number for Sweden is likely ~0.57%. The best summary of all the research on IFRs is [this paper](#) (pre-print), which has looked at hundreds of analyses and has found an IFR so far of 0.64%

Chart 14: Infection Fatality Rate According to Different Studies



Source. This is by far the most exhaustive meta-analysis available today. The author has also taken on other meta-analyses, such as [the one from Prof. Ioannidis](#), debunking his low estimate.

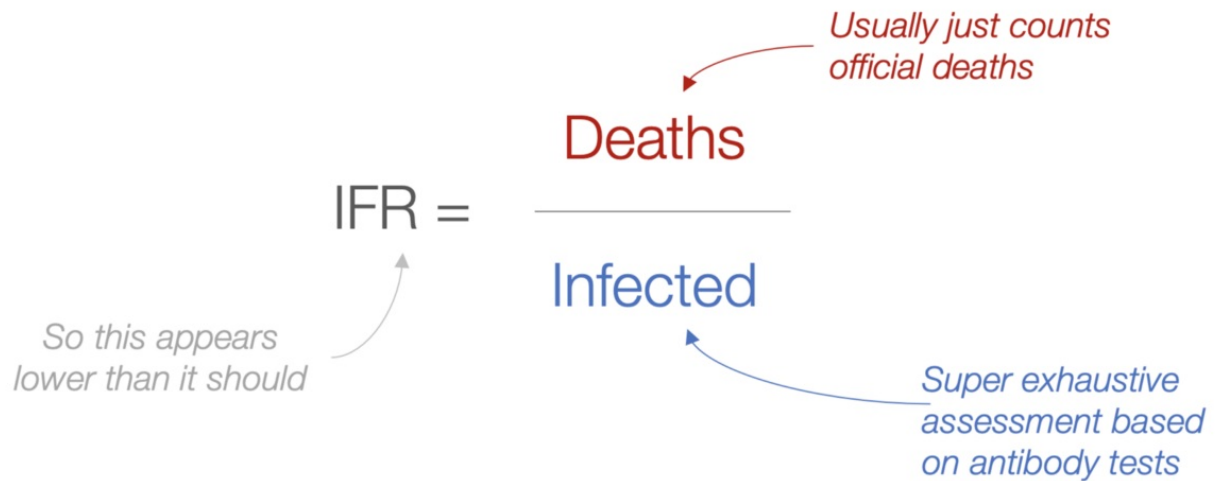
As we get more data, we can narrow down the IFR. It looks like it's converging between 0.5% and 1.5%, hopefully closer to 0.5%. If it is, it's fantastic news that it's much lower than the feared 2% CFR. Yet it is still way, way worse than the flu.

| This virus is nasty.

Any IFR in the range we're seeing is a big deal. If 65% of the population contracts the virus, between 0.4% and 1% of a country's entire population will die before reaching Herd Immunity. Countries must decide whether they're ok with that—transparently debating it with their citizens.

In a country like Sweden, that would be between 40,000 and 100,000 deaths (they have ~4,800 official deaths as of June 10th). In a country like the US, that would be between one and three million deaths.

These numbers of IFRs and coronavirus deaths might be too optimistic for two reasons: We're undercounting deaths and assuming immunity.



First, these studies try to count all the infected, but they seldom try to count all the dead. There is a severe undercount of deaths across the world. Even in developed countries, the total death toll of coronavirus could be twice as high as we think.

Second, all of this is making the huge assumption that those with antibodies are immune. That might not be true. They might have only been partially exposed to the virus, and their immune system might not be ready to fight a bigger infection.

With more deaths and less immunity, it might be possible that way more than 0.4%-0.7% of the population might die from the virus if left unabated.

Collateral Damage

Section of Heart from Coronavirus Autopsy



Section of a heart from a coronavirus patient's autopsy. The portion of the heart on the left of the image is the right ventricle. It's normal for the right ventricle to be crescent-shaped in cross-section rather than round like the left ventricle. The salient change is the enlargement of the right ventricle and resulting flattening of the wall of the left ventricle which abuts it. Image description by James Mitchell. Source.

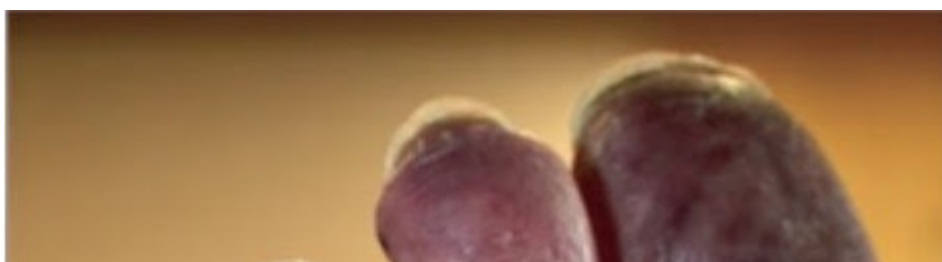
When countries make the decision of whether to pursue Herd Immunity or control the virus, they should also look into collateral damage, side effects, and chronic conditions that the coronavirus might cause. We now know it affects the lungs, the kidneys, the intestines, the immune system, the blood, the heart, the brain...

Doctors keep discovering new ways the coronavirus attacks the body

Deborah Coughlin was neither short of breath nor coughing. In those first days after she became infected by the novel...

www.washingtonpost.com

The virus can damage the body directly, but also indirectly through cytokine storms that make the immune system attack the body, through blood clots, through lack of oxygen, or through the side-effects of the treatment.

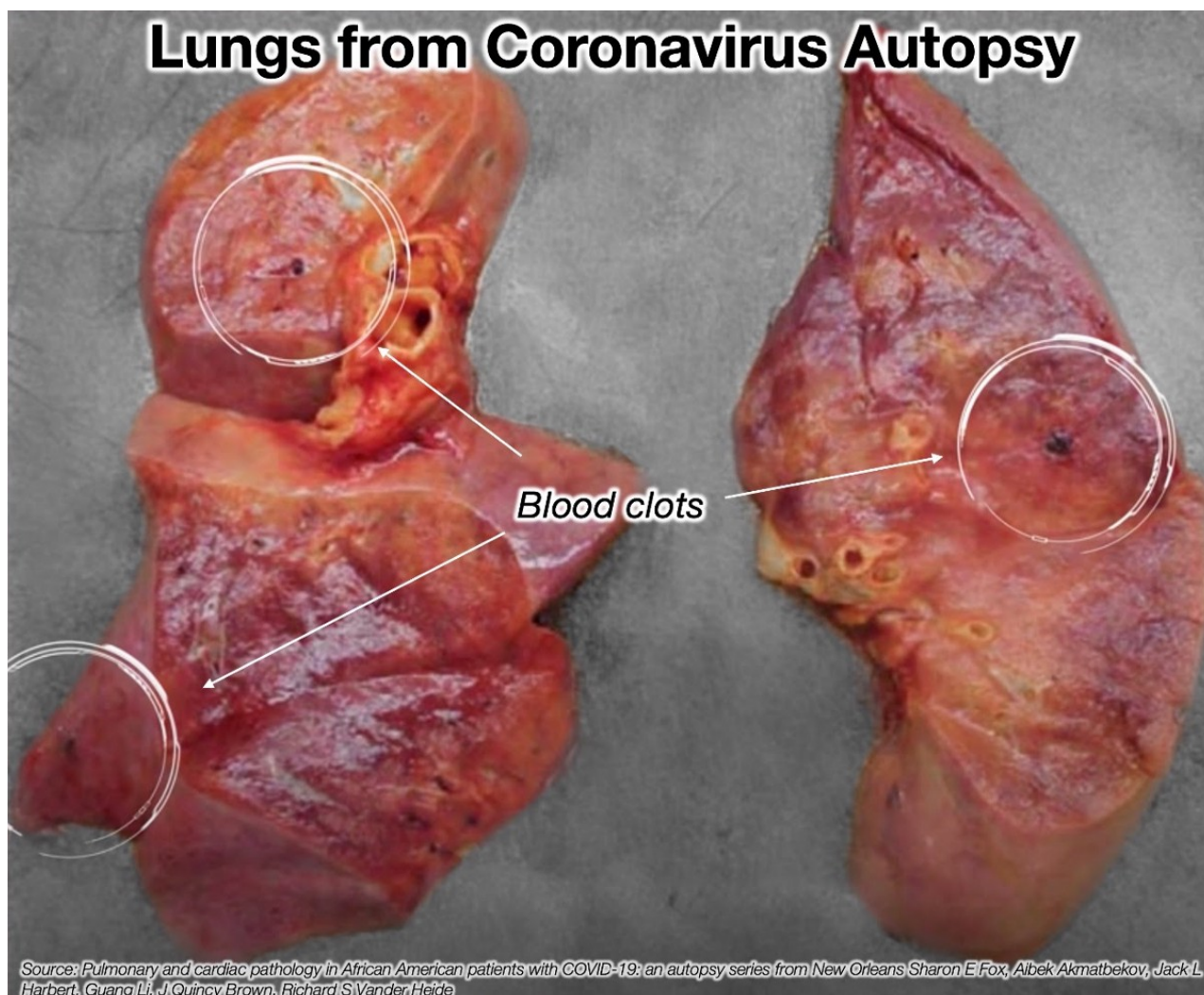




COVID Toes

Toes from a coronavirus patient that developed gangrene.[Source.](#)

These secondary effects can provoke strokes, seizures, heart attacks, kidney failures, ARDS (acute respiratory distress syndrome), skin changes, kawasaki syndrome, gangrene, pulmonary fibrosis or thrombosis. Lung damage has even been found in people who showed no noticeable symptoms.



These lungs are inflamed and show black dots, which are thromboses. Source.

If you're interested in more details, you can watch this video:

Summarizing:

- Between 0.5% and 1.5% of infected die from the coronavirus
- Many more become very sick
- All of that might turn out to be worse if those with antibodies are not safe from the virus, or if it mutates

This virus is nasty. Letting it run loose exposes people not just to possible death, but to all the complications that might emerge from infection. We could be creating a wounded generation.

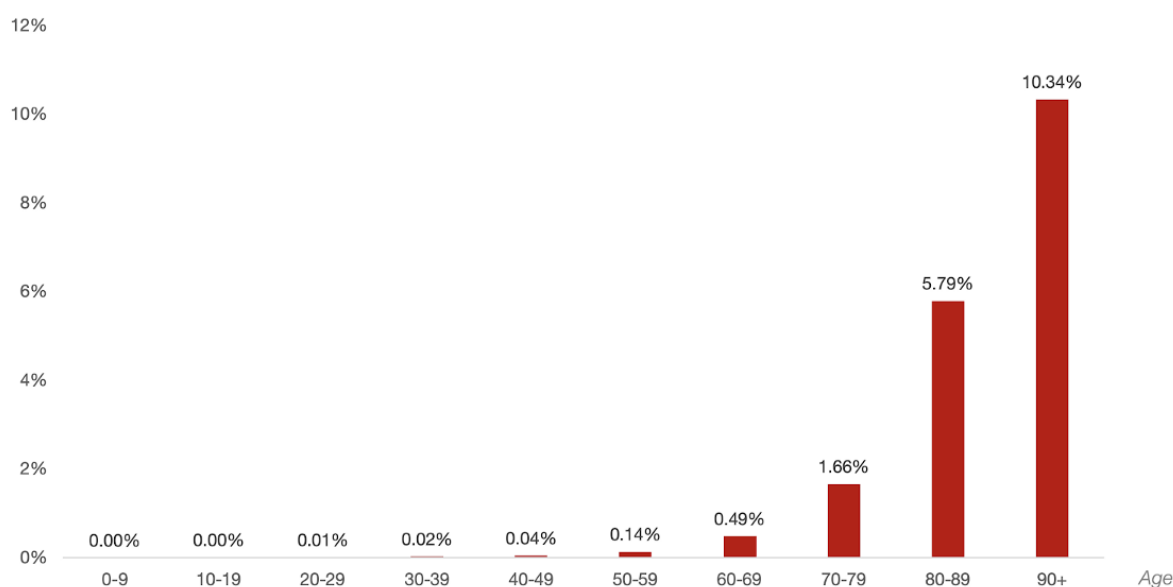
However, this virus doesn't affect everybody equally. It is much worse for some people than others. Maybe the Herd Immunity strategy is viable if we can protect the most vulnerable?

3. Can We Protect Those at Risk?

One thing you might have noticed is how different the IFR is in the different studies I showed above. That makes sense: There's not one single IFR. It depends on things like how many old people live in a country, how many have pre-existing conditions like obesity, whether the healthcare system collapsed, or how close people live with each other (which might increase the viral load of household contagions).

This is the IFR by age in Spain (one of the most exhaustive antibody tests in the world):

Chart 15: Coronavirus Infected Fatality Rate per Age Range in Spain



Source: Tomas Pueyo analysis, based on data from Spanish seroprevalence study processed by @gummibear737

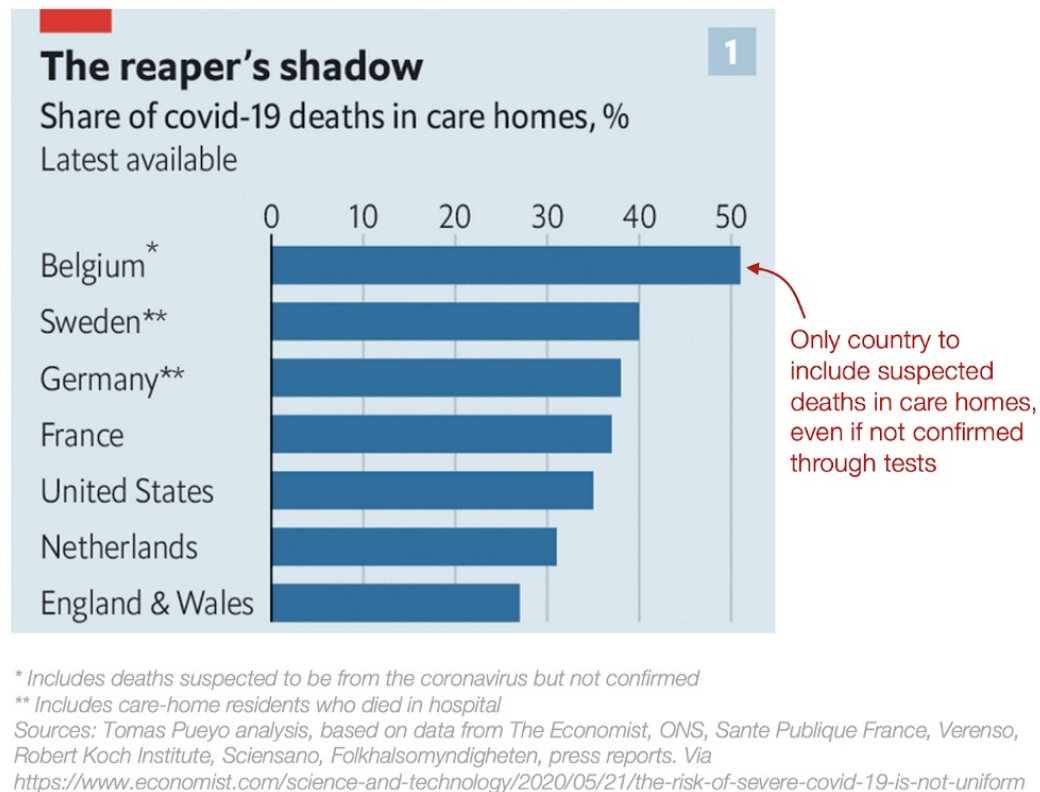
Looking at that, a very sensible strategy comes to mind: Can we free young people, let them catch the coronavirus, seclude older people during that process, and once all the young people are infected and there's Herd Immunity, let older people free too?

Protecting the Elderly

This is what the Swedish government attempted. They banned care home visits on April 1st and encouraged people above 70 to stay home.

Yet 40% of deaths have come from care homes.

Chart 16: Coronavirus Deaths in Care Homes



This is among the highest in the world, in a country that had special protections for them. Only Belgium has a higher share of care home deaths, and that's because they are one of the few countries that also count suspected deaths from coronavirus in care homes as official cases.

Sweden's lead epidemiologist said this was not a failure of the overall strategy, but rather a failure of protecting the elderly.

When asked if a Hammer and Dance strategy would have fared better, this was his response:

‘We have a hard time understanding how a lockdown would stop the introduction of the disease into the elderly homes.’ *Anders Tegnell*.

This shows a deadly lack of imagination. This is how a lockdown would have stopped the introduction of the disease in care homes:

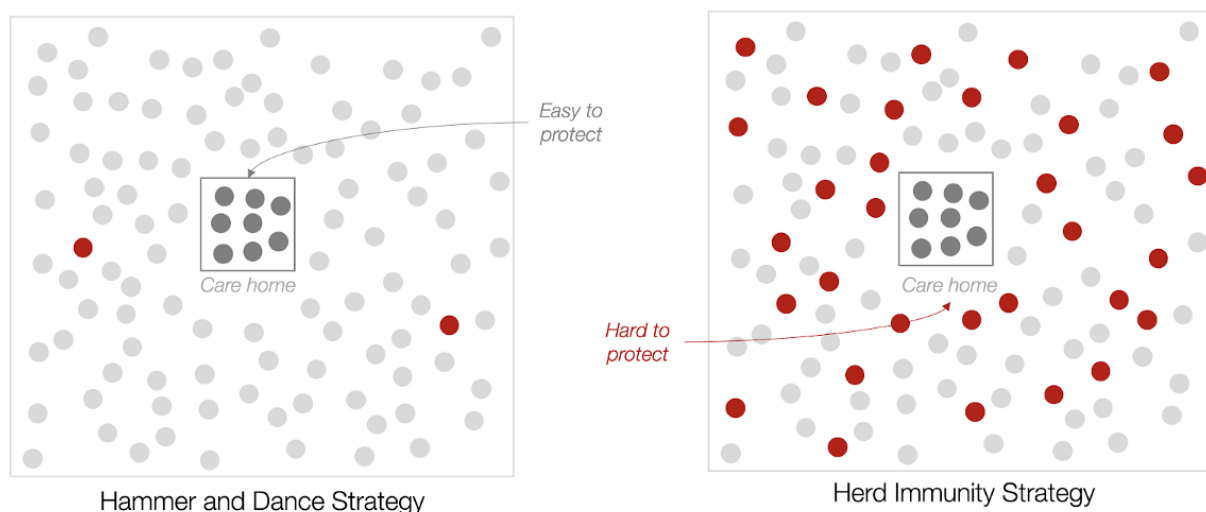
First, he should have looked around. Deaths in care homes in East Asia were very low. Maybe that was an indication that controlling the virus in the broad population meant controlling it also for older people.

This is completely intuitive: If nobody has the virus, older people don't either.

The additional point Sweden's top epidemiologists are making is that the lockdown has to open up eventually, and then infections in care homes would happen. Again, same thing, in East Asia that doesn't happen. If the virus doesn't run around, it doesn't infect old people.

Conversely, if it's running wild, it's very hard to prevent care home residents from getting infected.

Chart 17: Protecting Elderly Care Homes in Hammer and Dance vs. Herd Immunity Strategies



Source: Tomas Pueyo

The first measure Sweden took to protect care homes was to forbid visits. That type of measure limits contagion. Under a Herd Immunity strategy, these limits would need to last for years until there's a treatment or vaccine — instead of a few weeks during a Hammer. That's because even when many people have already overcome their infections, the virus is still present. During all this time, as soon as one single person is infected in a care home, the virus spreads like wildfire inside. So no visits for years.

The elderly still need workers to take care of them. What will happen with these workers, called shielders? Will they also be quarantined? For years? What about their partners, will they also be quarantined? Will they have to lose their jobs? What about their kids, should they also be quarantined? Stop going to school? If not, what about other kids and their parents? Should they be quarantined instead? All of that's impossible, so we must assume many care home workers will get infected. How to protect the elderly from them?

In a Herd Immunity strategy, shielders would have to start wearing personal protective equipment such as masks, face shields or gowns. For years, until a treatment or vaccine is available. Without letting a single infection through.

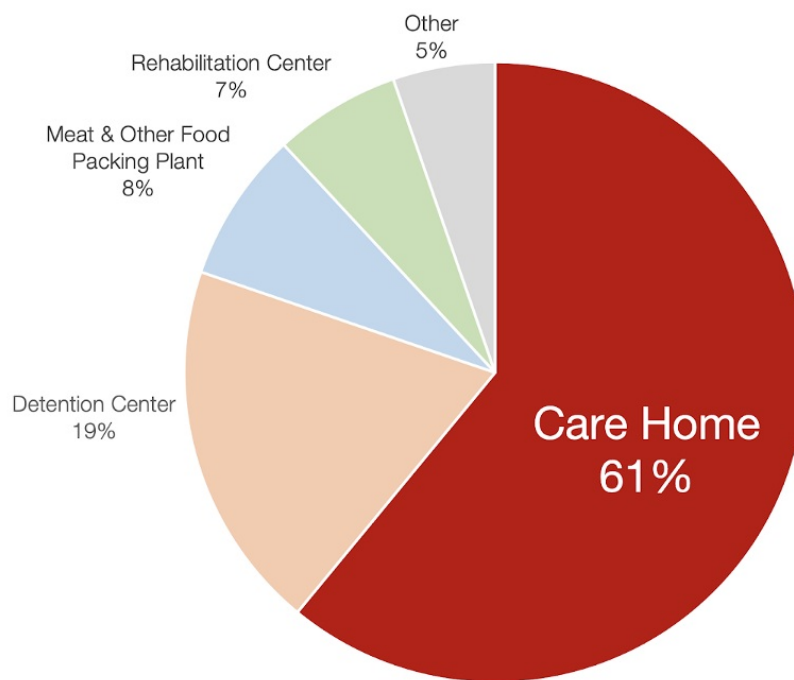


Imagine this, but with gull gowns and face screen, changing it several times a day for years Source

Care home workers are not usually specialists with the levels of training of doctors or nurses.

The idea of protecting those at risk sounded good in theory, but in practice it hasn't worked so far anywhere in the world. There have been outbreaks in nursing homes all over the world. In the US, around 60% of the top ~1,000 outbreaks have been in nursing homes.

Chart 18: Top 866 Outbreaks in the US by Type of Cluster



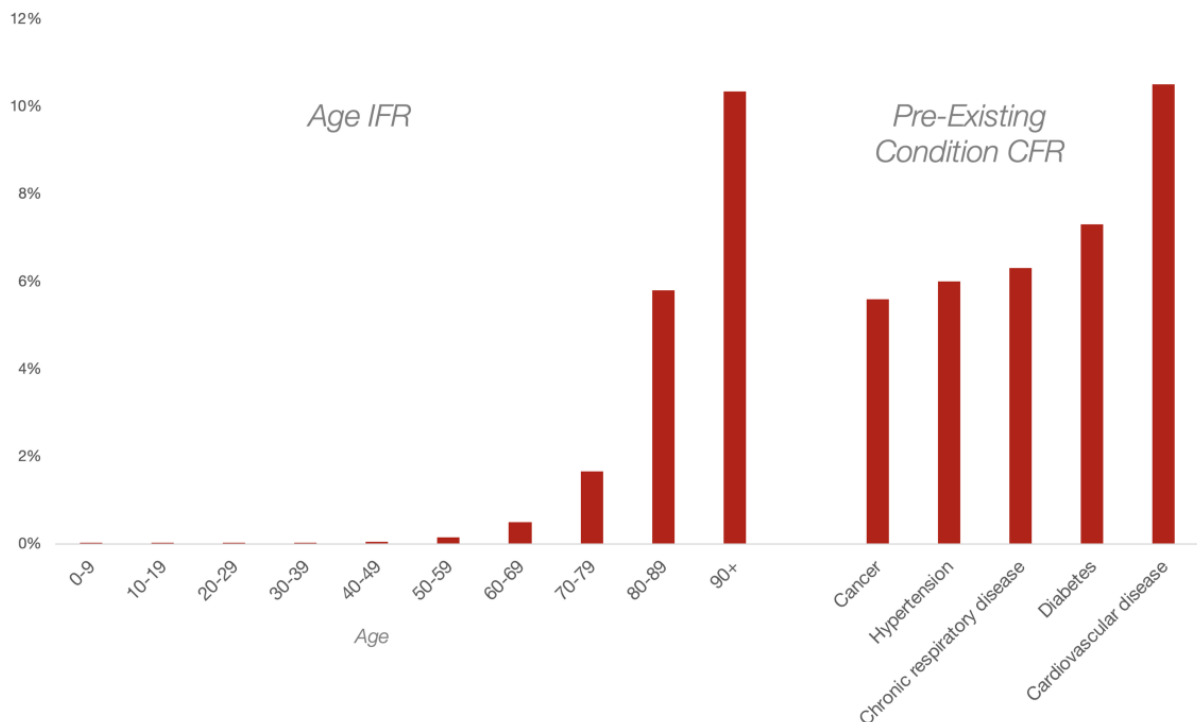
Source: Tomas Pueyo Analysis from New York Times data (<https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html#clusters>)

In the future, we might get better at protecting them, but if we take the time to learn, there might not be many guests in care homes left to protect.

Unfortunately, seniors are not the only ones affected.

Protecting Those with Pre-Existing Conditions

Chart 19: Fatality Rates per Age Range and Pre-Existing Condition



Source: Tomas Pueyo analysis, based on data from Spanish seroprevalence study processed by @gummibear737, fatality rate for pre-existing conditions from Worldometers (<https://www.worldometers.info/coronavirus/coronavirus-age-sex-demographics/>)

Note that the age numbers are infected fatality rates because they're available by age. I have not found IFRs equivalents for pre-existing conditions, so I took CFRs.

Having a cardiovascular disease puts you in a similar risk as being 90 years old. Having cancer or diabetes might be as bad as being in your 80s.

How common are these risk factors? Sweden is a healthy country. People have fewer pre-existing conditions that worsen their outcomes. In the UK, adding people with pre-existing conditions, old people, and their shielders, we get to 40% of the population that needs to be protected.

In the US, it's even worse. 45% of the population has pre-existing conditions that increase their risk of death. That doesn't even include old people. More than half the population is at serious risk.

It's not sufficient to protect these people. All their contacts would need to be extremely careful not to catch the virus and pass it to their vulnerable loved ones. As a result, substantially more than half of the US population would need to be extremely careful for years. How are we going to keep more than half of the population safe from the rest?

Some people are already extra careful. Cancer patients undergoing treatment, for example, are immunosuppressed. Their immune system is weak, so they must be extremely careful to not catch anything. However, it's one thing to have a few people be very careful, but half the population is a much bigger task.

In summary

- A lot of old people are dying from the virus
- No country has been able to shield them so far
- People with pre-existing conditions also have a high risk of death
- If we decide to protect old people, people with pre-existing conditions, and their shielders, we would need to seclude a huge chunk of the population from the rest.

Are we sure it's doable to protect all these people from catching the virus for so long?
Are we sure this is better than the alternative of completely controlling the virus?

All of that could be worth it if at least the economy was better off with Herd Immunity.

4. What's Best for the Economy?

A few economic forecasts for 2020 have been made in May 2020:

Chart 20: 2020 GDP Forecasts for Select Developed Economies



Source: Tomas Pueyo analysis, based on data from European Commission for most countries (https://ec.europa.eu/info/sites/info/files/economy-finance/ecfin_forecast_spring_2020_statist_annex_en.pdf) and Bloomberg Economics for East Asia countries (https://www.bloomberg.com/news/features/2020-05-28/coronavirus-lockdown-crushed-economies-jobs-energy-and-shops?utm_source=pocket-newtab). The European Commission data is from early May and Bloomberg's is from late May, when the forecasts were more negative.

Note that East Asia countries like Japan, Singapore, South Korea, and China, all which have controlled the virus quickly and effectively, have had a much lower impact of the virus on their economies.

It looks like Sweden's economy is going to do as poorly in 2020 as most other comparable economies.

“It is too early to say that we would do better than others. In the end, we think Sweden will end up more or less the same.” *Christina Nyman, former official at Sweden's national bank*

This is at the time when Sweden's economy should be doing wildly better than anybody else's to compensate for a worse rest of the year. Remember: The entire point of the

strategy is to avoid an economic downturn *during* the lockdown. But the economy is tanking *regardless*.

That is very bad news for Sweden: During the Dance, all other economies are likely to work better than Sweden's. They will be at least as open as Sweden's, if not more. And without the virus running wild, people will be more willing to go out. Compare that to Sweden, which will need to keep the current level of closures to avoid a surge that overwhelms the healthcare system.

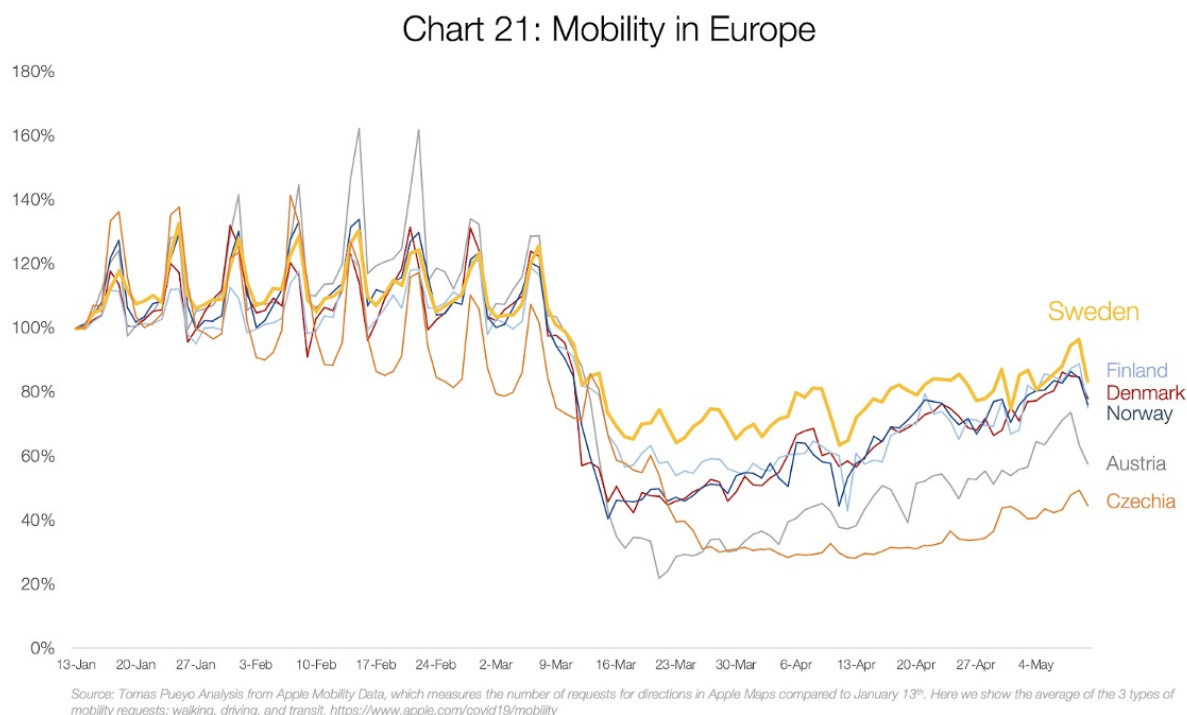
“There is much to suggest that the big fall will come in the second quarter. GDP could shrink by 10% this year and unemployment could rise to 13.5%” — *Magdalena Andersson, Sweden's finance minister, via [Politico](#) and [The Guardian](#).*

90,000 people had filed for unemployment in the last four to five weeks. — *Isabella Lövin, Sweden's deputy prime minister, via [The Guardian](#).*

And that's without considering other downsides, such as tourism: Other countries already ban tourists from Sweden. Many will follow. And few people might want to go visit Sweden.

It's unclear why Sweden's economy is doing as poorly as others, but there are a few hints.

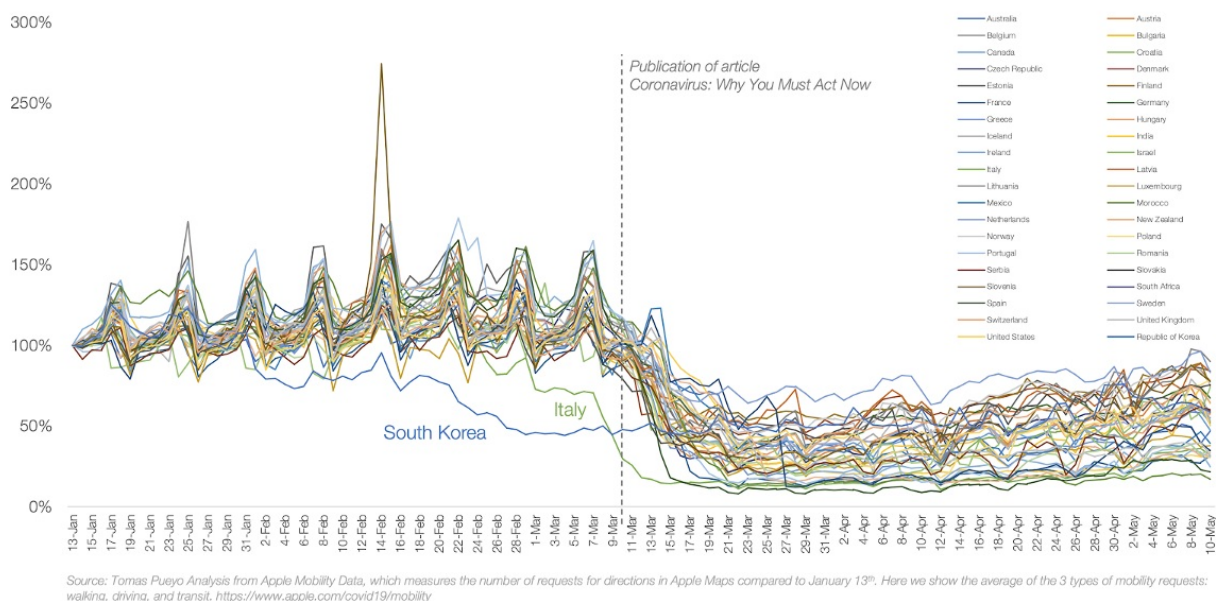
Why Has Sweden's Economy Tanked?



Sweden, like all its neighbors and comparable countries, went down in citizen mobility around the same time. The drop was not as steep, but it was close, and it has converged since.

The big drop in mobility happened around March 10th, when Coronavirus: Why You Must Act Now was published. This is true in fact of most countries around the world:

Chart 21.a: Mobility Changes in Select Developed Countries



Correlation is not causation

Of ~40 developed countries, only Italy and South Korea had an early reduction in mobility — because they were having bad coronavirus outbreaks. That was not enough to get the rest of countries to react, but starting on March 10th, people across the world suddenly started reducing their mobility. None of these countries escaped.

“There are just no customers. Everyone’s staying at home. Sales are down 80% compared to this month last year. It’s a really tough time.” *Mike Singh, clothing stall owner, Vällingby market, via Politico.*

This shows that a big part of the economic impact of the coronavirus is not just the measures that governments take, but simply the reaction of citizens. If they’re afraid of the virus, they won’t consume, and the economy will suffer.

Could It Have Been Predicted?

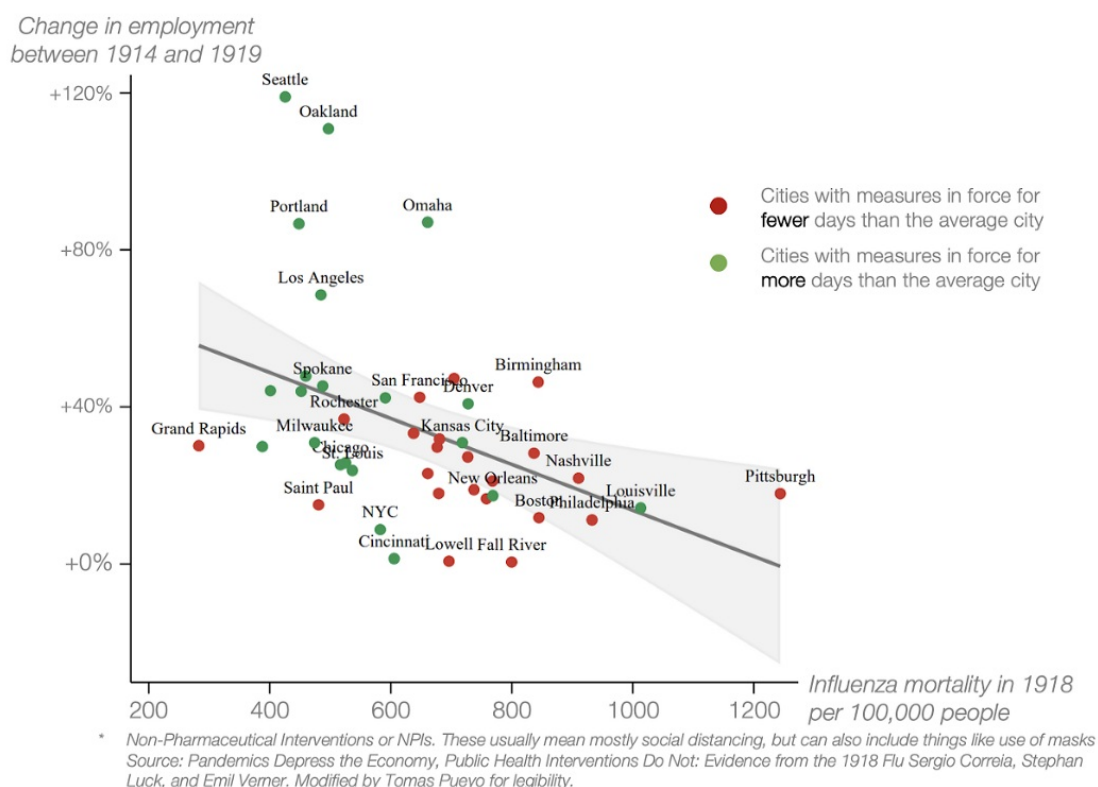
Apparently, all of this came as a surprise to Sweden’s government:

“Developments in April indicate that the covid-19 pandemic will hit the Swedish economy much harder than anticipated in the April 2020 Economic Report” — *Swedish National Institute of Economic Research, a government agency in Sweden responsible for economic analysis and forecasting.*

It shouldn’t have been a surprise.

When there's little data, we need to make guesses based on available evidence. Back in March, there was already evidence from China's stock market that a Hammer and a Dance was not too damaging to the economy. We also learned from the study of the 1918 pandemic that closing the economy was better than letting the virus run wild. This is one of many graphs showing that relationship from the article Coronavirus: Out of Many, One, published on April 1st.

Chart 17.b: How Measures* Impacted Mortality and Employment
in US Cities between 1914 and 1919



This is one of the more complex graphs in that article, so let's explain it a bit. Red dots are cities that had weaker social distancing measures than the average city. Green dots are cities that had stronger social distancing measures than the average. The line shows the trend: more mortality meant less employment after the pandemic. The grey area shows the confidence interval: the true trend is likely to be within that area, meaning that it's extremely likely that it was a downward trend. Because the virus hit the East Coast first, cities in the West had time to learn from cities in the East and take stronger, faster measures. That, however, generates a bias. There are more biases, such as that wealthier cities could manage the healthcare crisis better, but might be hit worse by the virus, or cities with more density could be hit more. So researchers controlled for factors such as density, wealth, population... Their controls were the 1910 agriculture employment share, 1910 manufacturing employment share, 1910 urban population share, 1910 income per capita, and log 1910 population.

Since then, all the information received has been reinforcing the idea that the economy goes back on track if the virus is contained. For example, China's economy has been going back to normal, including Wuhan's.

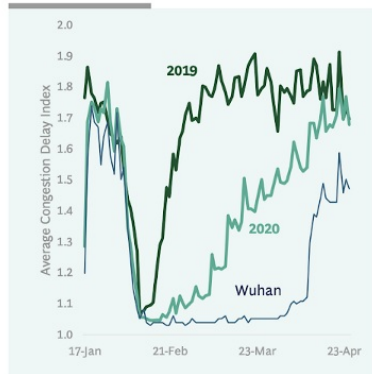
'Fight': China gives a first idea on what LEVEL of recovery the economy can achieve

SCENARIOS AND
ECONOMIC IMPACT

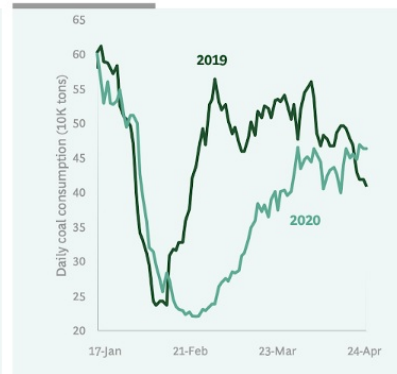
As of 24 April 2020

China

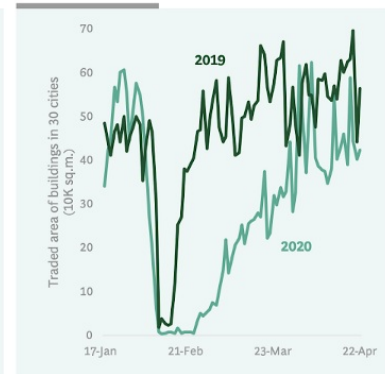
People and goods are
starting to move again



Coal consumption moving
higher



Property transactions are
restarting



Note: As of 24 April 2020; China data re-based for weekdays excl. weekends. Congestion delay index average include Beijing, Shanghai, Guangzhou, Shenzhen, and Wuhan; Daily coal consumption of major power plants = sum of daily average coal consumption of Jerdin Electric, Guangdong Yudean Group, Datang International Power Generation, and Huaneng Power International, Inc.; Source: www.cqcoal.com, and BCG Center for Macroeconomics

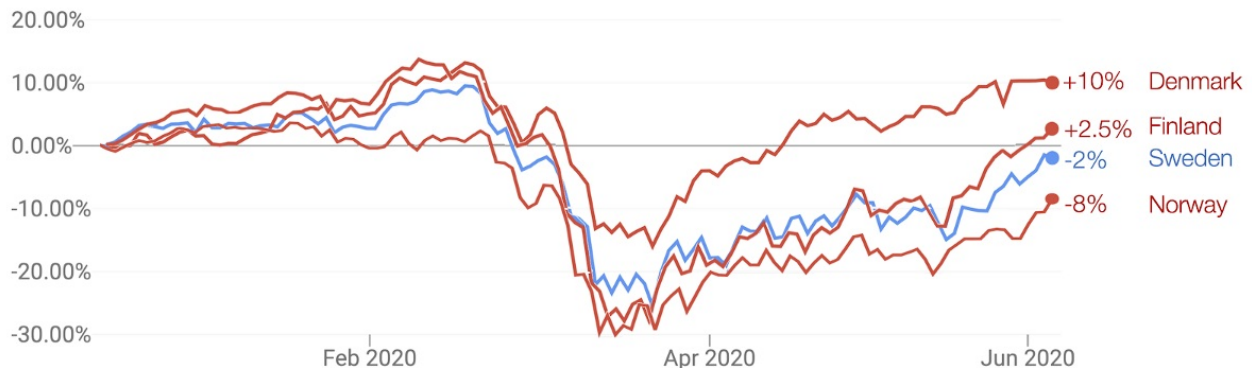
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Source

The stock market also predicted this:

Chart 22. : Stock Market in Sweden vs. Other Scandinavian Countries



Source: Tomas Pueyo Analysis based on data from Google Finance. Norway: OMX Oslo 20PI, Finland: OMX Helsinki 25, Denmark: OMX Copenhagen 20, Sweden: OMX Stockholm 30

As soon as March, an important Swedish index was not doing so well compared to its neighbors'. Now, both Denmark's and Finland's are doing better than Sweden's, and only Norway's is doing worse. Markets are not perfect, but they try to predict what will happen to an economy, so their signal should have been one more data point to consider that the Swedish strategy was not as good economically as some might have thought.

Lockdowns don't hurt the economy. The coronavirus does.

In summary:

- Sweden's economy has been impacted by the coronavirus as much as its neighbors'.
- Unfortunately, this is precisely the time when it should be doing better, since its goal was to avoid a lockdown. The next few months might turn out to be worse for the Swedish economy than for its peers'.
- This could have been predicted. The few signals suggested available in the past suggested that the economic impact of a Hammer and Dance would be better than for a Herd Immunity strategy.

What's the Lesson for Other Countries?

Many countries are opening up their economies. Some, like Spain, Austria, Germany, Italy or France, have worked hard to minimize the virus in their economies. But not all have.

The Netherlands, the UK and the US, among other countries, have all at some point either explored a Herd Immunity strategy, or are considering it now. For example, many US states are opening up, when nearly half of them have growing coronavirus caseloads.

As Sweden shows, this is a bad idea. It's worse for the lives, the health, and the economy of its citizens.

That doesn't mean countries like Sweden, the US, the UK or Netherlands need to go back to lockdowns. The Hammer and the Dance was meant for countries that were overwhelmed with cases and didn't know how to handle the situation, to limit the outbreak while figuring out what to do.

But now we *know* what to do. We can keep the economy open *and* reduce the caseload, the way South Korea, Taiwan, Vietnam or Hong Kong have been able to.

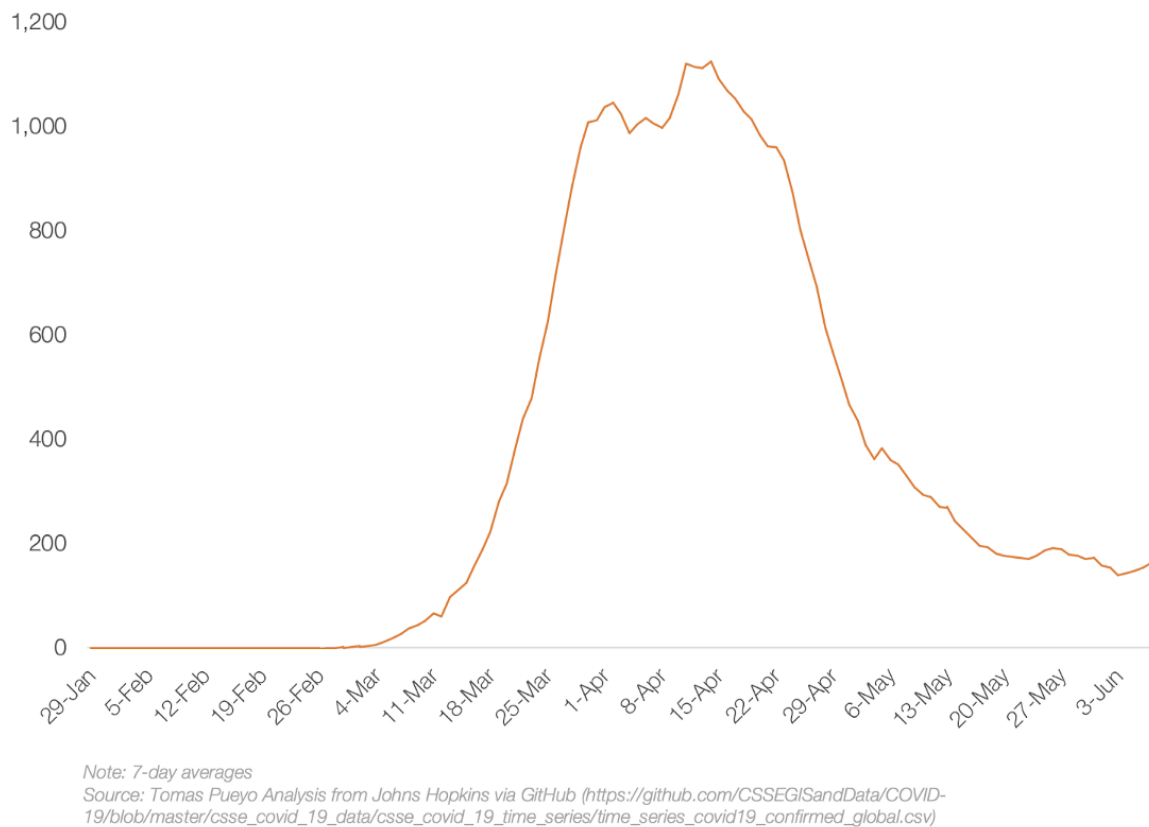
Many measures can be taken to stop the coronavirus, including testing, contact tracing, isolations, quarantines, universal masks, hygiene, physical distancing, public education, sewage testing, travel restrictions and crowds restrictions. All countries should apply these measures, since they're mostly proven, much cheaper, and can dramatically reduce the epidemic.

Whoever tells you it can't be done hasn't done their homework. Not taking these measures and letting the coronavirus run amok will only cause more sickness, more death, and a worse economy.

What Should the Netherlands Do Now?

The Netherlands is an especially interesting country, because it has nearly controlled the crisis despite toying with herd immunity.

Chart 23: New Daily Cases in the Netherlands

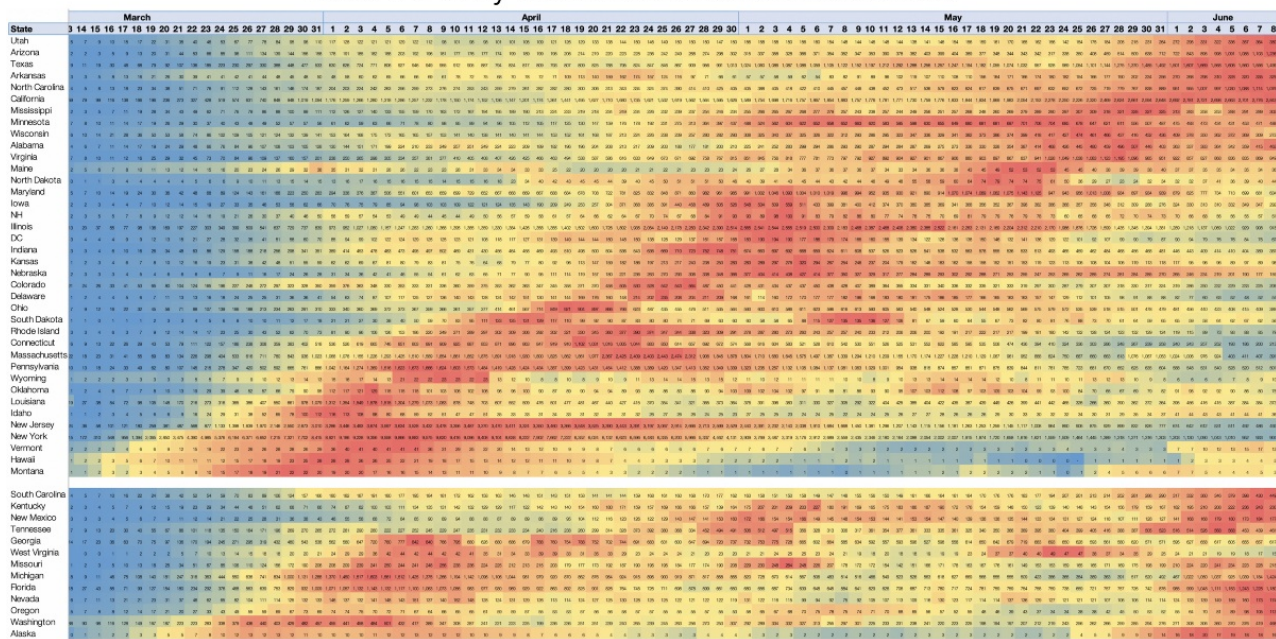


They are in a unique position in the world: It's the only country that *could* easily start Dancing, but is deciding not to. This makes no sense. They should simply apply the measures for Dancing that are proven elsewhere, and save their economy and thousands of lives.

What Should the US Do Now?

The US is in a different position. Its states are like 50 different countries, with half of them going up in cases.

Chart 24: Daily Coronavirus Cases in US States



Each line has been colored to show in blue the lowest number of daily cases in that state, and in red the maximum number of cases in that state over the period of time

Whether it's admitting it or not, the US is pursuing a Herd Immunity strategy. At this point, it's not realistic to apply new lockdowns everywhere. Thankfully, they're not needed: States can apply all the measures mentioned above. They're affordable and doable. Dozens of countries are doing it, many US states are doing it too.

If some states are going to continue in this Herd Immunity path, the only alternative for other states that want to save their citizens and are trying to Dance is to restrict travel from other states. Otherwise, they will carry all the costs of heavy lockdowns and dancing measures, and few of the benefit in the reduction of cases.

What Should Sweden Do Now?

Sweden has been slowly accepting its mistakes, from the government modeler who acknowledged their models were possibly wrong, to Tegnell's admission that there have been mistakes in managing deaths. This is not easy to do. I applaud them.

Some new precautions have been taken. A two-meter distance is required between people, and citizens have been asked to avoid public transportation. But this is not enough.

For example, the government has not yet realized that the coronavirus spreads through aerosols via droplet clouds. It continues to deny that masks work. That stance has been proven wrong by research across nearly 100 scientific papers, endorsed by over 100 experts — including two Nobel prize winners.

The Swedish government fears that people could have a false sense of security when using them and stop distancing socially. But East Asian countries have near universal mask wearing, and they've been dancing successfully for months. If improper mask wearing was so bad, they should have suffered massive outbreaks.

More examples:

- The virus mostly spreads in clusters, but the Swedish government says the country doesn't suffer from clusters anymore. The limit of 50 people in crowds is too high.
- The government is not testing because it's not tracing contacts. It needs to do both to keep people home when they're sick or might have been exposed.
- The government needs to acknowledge that nearly half of infections are pre-symptomatic or asymptomatic, and take measures accordingly. For example, if somebody in a family is sick, everybody in the family should quarantine, including those without symptoms. All should wear masks.
- The government should stop requiring all children to go to school, especially if they live with people with pre-existing conditions or with somebody infected.

One thing is to decide against a Hammer. That's fine. It happened. We can't change the past. A very different thing is to know you can Dance to reduce your epidemic dramatically and for quite cheap, but actively decide not to do it. The UK's government has acknowledged its mistakes and changed course. Pressure is mounting for Sweden to do the same. Tens of thousands of lives are at stake. If the government doesn't decide to acknowledge its mistakes and correct its course, bodies will keep piling up for nothing.

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If you want to translate this article, do it on a Medium post and leave me a private note here with your link.

Translations:

Spanish

This has been a massive team effort with the help of dozens of people who have provided research, sources, arguments, feedback on wording, challenged my arguments and assumptions, and disagreed with me. Special thanks to Galina Esther Shubina, Jana Bergholtz, Brian Meagher, Tom Cucuzza, Matt Bell, Carl Juneau, Genevieve Gee, Mike Mitzel, Christina Mueller, Elena Baillie, Pierre Djian, Yasemin Denari, Barthold Albrecht, Jorge Peñalva, and many more. This would have been impossible without all of you.

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