COVID-19

THE PANDEMIC THAT NEVER SHOULD HAVE HAPPENED AND HOW TO STOP THE NEXT ONE

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For James, Jessica and Rebecca, who make everything possible.
And in grateful recognition of the scientists and journalists who do their best to find out what's going on and try to save us from it.

PREFACE

In November 2019, a coronavirus from a common little bat jumped, somehow, to a human, or maybe a few of them. It just happened that the virus could spread easily among people already, or it evolved fast, as these viruses can. By December, a cluster of people were hospitalized with severe pneumonia in Wuhan, China, and it wasn't the flu.

Not enough was done to contain this new virus until January 20th, when China told the world it was contagious. By then there were already so many cases in Wuhan, the city had to be locked down three days later to control the epidemic—but it had long since spread all over China and to other countries. The virus was named SARS-CoV-2 because it was so similar to another one we had barely managed to beat back in 2003. As you know, the disease it causes was named Covid-19: "co" for corona, "vi" for virus, "d" for disease," and 19 for the year it appeared. A lot of people just call it the coronavirus.

Three months after Wuhan was locked down, some two billion people worldwide were also in some form of lockdown, and everyone, everywhere faced infection with the virus, with few effective treatments and no prospect of a vaccine anytime soon.

Covid-19 has infected the entire human world. This pandemic has been like a big dog, picking up our fragile, complex society in its teeth and shaking it. Lots of us have died. Lots of us will continue to die, either from the virus itself or from the long-term poverty, political and economic dislocation, and overloaded medical systems that will be the pandemic's legacy. Some aspects of our society will change for the worse, some maybe for the better —but, either way, for good.

And through it all, we have been deluged with reams of news reports and instant analyses, heartbreaking frontline accounts, revised government instructions, and new medical advice, plus probably the most staggering global outpouring of instant

scientific research in history, all trying to predict what's coming next and figure out how to mitigate this disease disaster.

But you know all that.

And still there is the question: How could this happen? This is the 21st century. In much of the world, we have wonder drugs and flush toilets and computers and international cooperation. We don't die of pestilence anymore.

Sadly, as we all know now, yes, we do. But what is especially sad for a science journalist like me who writes about disease for a living is that this pandemic has not exactly been a surprise. Scientists have been warning for decades, with mounting urgency, that this was going to happen. And journalists like me have been relaying their warnings that a pandemic is coming and that we aren't prepared.

How did we find ourselves in this situation? In short, there are more and more people, and too many of them have had to put ever-increasing pressure on natural systems to get the food and jobs and living space they need. That means pushing into wilderness that harbors new infections and intensifying food production in ways that can breed disease. Covid-19, Ebola, and worse come from destroying forests. Worrying flu strains and antibiotic-resistant bacteria come from livestock. Yet we have neglected to invest in the things that discourage infectious disease: public health, decent jobs and housing, education, sanitation.

Then the impact of the new pathogens we unearth is magnified by our ever-increasing global connectedness, as we crowd into cities and trade and travel in an ever-denser global network of contact. So once public health fails and contagion appears anywhere, it goes everywhere. We know so much about beating disease, yet fragmented governing structures, lack of global accountability, and persistent poverty in so many places ensure that those failures happen and disease propagates.

Despite all that, we know what we need: much better understanding of potentially pandemic infections, fast detection of new outbreaks, and ways to respond to them quickly. I'll be looking at that in this book. So far, we haven't been able to do that effectively, where it is most needed.

In 2013, two labs—one Chinese, one American—investigated a

tribe of bat viruses that are almost certainly the source of Covid-19. They immediately recognized the threat. One lab called them "pre-pandemic" and a "threat for future emergence in human populations." The other wrote that they "remain a substantial global threat to public health."

Nothing was done. We could have learned more about them, designed some vaccines, looked into tests and treatment, studied ways these viruses might infect human populations—and shut those down. None of that happened. It was no one's job to take on those tasks with this kind of threat, even when it materialized.

Yet we needed so much to be in place if one of these viruses went global—which one did. You don't need to be told. Testing. Ventilators. Drugs. Vaccines. Protective gear for doctors and nurses. A plan for using old-fashioned quarantine and isolation to stop this kind of virus from spreading. A plan for dealing with the economic impact. Measures to contain the virus so we might not even need those things. Experts and governments have been talking intensively about pandemic preparation for nearly two decades, and still we weren't prepared.

And this kind of virus wasn't—and isn't—even the only viral threat out there, yet we're just as unprepared for the others. I wrote the following for *New Scientist* magazine in 2013, the year the Covid-like viruses were discovered, about a visit to the World Health Organization's then-shiny new situation room and what might happen if H7N9 bird flu, the virus causing concern at the time, went pandemic:

> As it stands, the World Health Organization's top brass will watch any H7N9 pandemic unfold from their strategic operations centre. Information will flood in; body counts will mount. Governments will be told that their demands for vaccines and drugs cannot be met. They will issue declarations, hold briefings, organise research, tell people to wash their hands and stay home. Mostly, though, they will just watch helplessly.

Sound familiar? Especially the part about washing your hands and staying home?

I don't claim to be prophetic: I'm not. Other journalists and

scientists have said as much and more. As far back as 1992, the top infectious disease scientists in the US warned about "emerging infections," declaring that the threat from "disease-causing microbes... will continue, and may even intensify in coming years."

If that sounds like unusually cautious language, even from scientists, it's because they were afraid any stronger language would trigger disbelief. That's almost all that has changed.

It's not that they weren't heard. In the years since then, we all started half-expecting a pandemic. Pandemics became part of the cultural background noise, reflected, with varying balances of science and entertainment (and zombies), in films like *Outbreak*, *Contagion*, and *I Am Legend*. There was some disease surveillance set up, new international rules written, a lot of virus research. A few countries had pandemic plans, on paper. Yet when the lockdowns began, in many places toilet paper was in more demand.

The only real surprise when Covid-19 finally hit was the sheer extent to which most governments simply had not listened to the warnings. We were unable as a planet to muster our considerable scientific understanding of disease in time to soften the blow, never mind preventing it in the first place. And, as I will explain in the coming pages, we could have—at least a lot more than we did. Science didn't actually fail us. The ability of governments to act on it, together, did.

Experts had warned about the lack of preparation in addition to the risk of a pandemic itself. The few countries with pandemic plans built them around a very different virus, flu, and regardless, many failed to stockpile or acquire the most basic essentials for making the plans work. I'm not sure their response would have been much more effective if this had been a flu pandemic. Which we will have at some point.

The World Health Organization (WHO) made it very clear how to contain Covid-19, but few countries followed their advice entirely. A few showed what should have been possible for all countries. The rest did pick-and-choose variations on the WHO's advice and/or that of their scientific or political advisers. Nearly all countries were more or less too late to limit the damage as much as they might have, and the pain of lockdowns and economic dislocation in some places seemed to rival the disease.

But you know that.

So, besides the question of how this could happen, the other big questions are: Can this happen again? And can we do better next time? The answer to both is yes. Some real pandemic planning is now in order, because the Covid-19 pandemic may not even be the worst we could see. And even Covid-19 could still have some tricks up its tiny sleeves.

First, let's look at the immediate future from the virus's perspective.

Eventually, after considerable death and disruption, most people in the world will have been exposed to or vaccinated against Covid-19 and will be, we hope, immune to further infection with the same virus as a result, at least temporarily. So, with fewer people around that it can still infect, new cases should slow to a trickle. The virus might even quietly die out, as its sister-virus SARS did in 2003 when we blocked enough chances for it to spread.

Or it might adapt to its new situation. RNA viruses like this one can evolve quickly, although the Covid-19 virus isn't quite as volatile as some. Like flu, it might mutate to evade the immune defenses our bodies will eventually learn to mount and start another global rampage, perhaps a bit less deadly this time—or perhaps a bit more. The comforting myth that viruses become more benign as they adapt to us is simply not true. It all depends on what works for the virus, and it can go either way. We will look at that later in the book.

Or it might circulate and surge sporadically, perhaps pouncing on new, susceptible humans, becoming yet another disease of childhood.

This pandemic has moved fast since it started. You may already know something about which of those scenarios is playing out. There aren't, broadly speaking, a lot of different things a disease can do, bound by the implacably quantitative laws of epidemiology, the science of epidemics.

Until then, horrific as it has sometimes been, we can be grateful it hasn't been worse. Covid-19 does not have a massive death rate—best guesses as I write this are that it's less deadly than we initially feared, but still maybe ten times more deadly than ordinary flu. SARS was ten times deadlier than that. Fortunately, it

never learned to spread like Covid-19—and, with luck, Covid-19 will never learn to kill like SARS. Think about what this pandemic would have been like with ten times the death rate.

And as many of us have painfully learned, Covid-19 mostly kills older people. Speaking as one myself, I don't wish to be cavalier about this, but the brutal fact is that losing people in old age does not cause as much economic or social disruption as losing people of working and childbearing age. And even that will pass: in a year or three, with luck, we may have drugs and vaccines to protect everyone, including the elderly.

So why write a book about this when there's still a lot we don't know? Because we already know enough to say some important things, and we need to do that while memories of these hard times are raw enough for people to hear them.

The first thing to say is that this was predicted and could have been, to a large extent, prevented.

As for prediction, I am just one of many journalists who has been warning about the threat of a pandemic since the 1990s—and some were at it earlier. Since at least 2008 the US Director of National Intelligence has warned the president that a pandemic of a virulent, novel respiratory virus was the most serious threat the country faced. In 2014 the World Bank and the OECD, the club of rich nations, called a pandemic the top catastrophic risk, outweighing terrorism. Bill Gates has been warning that we aren't ready for a pandemic for years.

Second, this pandemic won't be the last one. There are simply too many potentially pandemic germs out there to predict which will emerge next. But before Covid-19 happened, we knew coronaviruses were among the leading possibilities: they were on a WHO watch list. Even with such warnings, we didn't do enough preparatory work on drugs and vaccines for coronaviruses like Covid-19 to allow us to easily adapt and produce them now—and we still haven't for many other viruses that pose a threat, including H7N9 and its kin. We need to do that now.

We also need to do some serious pandemic planning for when the next one happens. The Center for Health Security at the Johns Hopkins Bloomberg School of Public Health was among the institutions already trying to do that. Among other efforts, they

were running computer simulations of hypothetical pandemics as a training exercise for public officials. A month before the first cases appeared in Wuhan, they ran one called Event 201, starring a fictitious virus that was nearly a dead ringer for Covid-19. I can think of few better illustrations of how we knew this was coming.

Let me emphasize that this was a total coincidence: this was a "what if" scenario playing out in a computer model of US society, featuring a made-up virus. They chose a coronavirus for the simulation partly to show how disruptive even a relatively mild virus can be.

They succeeded. The result of the simulation was what we are living out now: overwhelmed health care, disrupted global supply chains, needless death, economic dislocation. And a table full of officials from government and industry sitting there saying, *If this were to happen, there's not much my sector/department/office could do*.

And the people who wrote that simulation were going easy on the officials—maybe so they'd sit through the entire afternoon and not be so horrified they'd quietly slip out at the coffee break, trying to forget what they'd seen. There are much worse viruses out there that could trigger a pandemic, that would kill more people, at younger ages.

It will not be much comfort to those who have lost or will lose loved ones to Covid-19, but so far, believe it or not, we've been lucky.

In addition, what almost no one realized before Covid-19 happened—I don't know how many realize it now—was what a pandemic could do to our complex, just-in-time society, and that economic domino effects would cascade through our tightly coupled global support networks.

What we need to remember, though, is that we *will* have another pandemic. And it could be worse.

So we have to do better—and we can. The hard-earned good news is that Covid-19 has shown us what we need to do. We cannot let a virus catch our interconnected global community this stupidly flat-footed again. We cannot let it break those interconnections either, at least not all of them. If this pandemic teaches us anything, it is that up against a contagious disease, we are all in this together. One big early lesson was that no country

can really seal off their borders anymore, or go it alone. Our society is global; our risk is global; our response and our cooperation must be global.

I can't think of a time when this pandemic will be "over" enough to provide a better vantage point for looking at these things. When the virus does grind to a halt, or we tame it with vaccines, it seems all too likely that we will drift back into a status quo of spending on wars and weapons—and on recovering from the economic damage Covid-19 is doing—not on preparing for the next virus. We will need to forget this nightmare, and to judge from past pandemics, we will.

Yet at this moment, the subject has our undivided attention. We can already say a bit about how this happened, and why, and what our options are to start doing better. Many scientists know this, and governments, we hope, will learn. But a lot of other people need to think about this too, whatever you do in life, in the kind of detail that will allow you to help make the changes we need.

In any disease emergency, certainly in a pandemic, it is vitally important to tell everyone the whole truth—what we know and what we cannot know—and not hold back for fear of scaring people. That is a mistake that governments and other authorities make repeatedly with bad news stories like diseases.

What is happening might be scary, but saying so might galvanize people to take more effective action. Sometimes fear is necessary. That's why we have it.

But it shouldn't have to come to that. This is where you come in. Learning from this pandemic and preventing the next one will take political action of all kinds, from everyone.

The more people understand what we need to do, the more likely it is to be done. People vote. People march. People pressure. People decide to study virology or public health or nursing or vaccine engineering or communications. Public activism drove the development of HIV drugs and made them affordable. It drove the introduction of sanitation, the massive success of vaccination, the beginning of the end of smoking.

We can do it again. We have to.

To find out what is happening with Covid-19 right now, read

the news. For exposés and analyses of what this and that government or politician did wrong in dealing with it, also read the news and the stories that will pour out over the coming years. I know I will.

In this book, I'm going to give you the big picture. We'll take an in-depth look at what happened and whether we could have stopped it, before looking at the recent past to learn the natural history of some of the more amazing natural phenomena that make us deathly ill. We'll see how previous pandemics and threats of pandemics should have prepared us and learn the lessons we failed to apply before and after Covid-19 emerged. Then we can talk about what we need to do better before the next one hits.

I hope that, eventually, we will do more than talk.

A NOTE ON THE VIRUS

The WHO in its wisdom decreed that this disease would be known by the unlovely name Covid-19. Many people, and many languages, have just stuck with calling it the coronavirus. That is a much prettier word, but strictly speaking, it refers to a whole family of viruses, to which the one that causes Covid-19 belongs. I will be using the word *coronavirus* for that family.

The virus is officially called SARS-CoV-2, a name chosen by a committee of virologists expressly to underscore how novel it isn't and how similar it is to the virus that caused the disease SARS in 2003. That virus was renamed SARS-CoV-1. That makes the official name confusing, so I hope the virologists won't mind if I try and call it the virus that causes Covid-19, or even the Covid-19 virus, where at all possible. Because it is, and the word doesn't immediately hit the unspecialized eye as referring to another disease.

CHAPTER 1

Could We Have Stopped This Whole Thing at the Start?

> "Every disaster movie starts with someone ignoring a scientist."
>
> —Popular poster at the April 2017 March for Science.

So how did we end up with the Covid-19 pandemic? Could we have stopped it once it started? Could we have stopped it from starting at all?

If your house burns down, you ask two things. First, how did a fire get started in the house to begin with? Second, and most urgently, given that it did—and we saw it happen—why didn't we put it out before it spread? We'll look at the first question later in the book. Let's look at the second now. What happened to unleash a Covid-19 pandemic on the world?

The first inkling I, like many others, had of the gathering storm that became Covid-19 was a post on the online forum, ProMED. The machine-translated report from Finance Sina, a Chinese online news site, read:

> On the evening of [30 Dec 2019], an 'urgent notice on the treatment of pneumonia of unknown cause' was issued, which was widely distributed on the Internet by the red-headed document of the Medical Administration and Medical Administration of Wuhan Municipal Health Committee.

It was December 31st, and in our suburban French village, just over the border from Geneva, the sun was coming up. I had family

in for the holidays and had solemnly promised to stop working.

But, I told myself, that didn't mean I couldn't take a peek at ProMED, just to make sure I didn't miss anything important.

ProMED—the PROgram for Monitoring Emerging Diseases of the International Society for Infectious Diseases, a scientists' organization, formally called ProMED-Mail—is the world's leading online reporting system for new, or "emerging," infectious disease. Despite its importance, it's a non-profit run mostly by volunteer work, on a shoestring, with grants and donations. It was set up in 1994, as infectious disease specialists shaken by the emergence of AIDS in the 1980s uneasily realized that other new diseases might be out there, and that we needed an early warning system.

It consists of moderated daily reports of worrying medical events from contributors everywhere: doctors, vets, farmers, researchers, ordinary citizens, even agriculture labs (crops get diseases too). It's all in understated sans serif plain text—old-fashioned Helvetica, direct and to the point like the scientists who mostly read and contribute to it. Everything is classified by disease and place and date. The moderators, most of them veterans in their areas, tell you what they make of the reports, and I often cut straight to their comments. ProMED is one of the things humanity did right to prepare for disease emergencies like Covid-19.

For disease researchers, public health people, and science reporters like me—as well as anyone fascinated by the daily reality show—ProMED is required reading. When I ducked into my office that day, hoping it was early enough that my family wouldn't notice, the giant Sina Corp's financial bulletin was reporting people with severe, undiagnosed pneumonia in the central Chinese city of Wuhan, in Hubei province.

Many had connections to a seafood market. There were already 27 cases.

A red-topped bulletin—rendered red-headed by the machine translation—must be an emergency alert, I guessed. The reporter from Finance Sina had verified it by calling the official hotline of Wuhan's Municipal Health Committee the next morning. It was true. The story went out.

And it was worrying enough to make someone send it to ProMED. It wasn't hard to see why.

Pneumonia is not a disease caused by a specific germ, like measles or flu. It just means any infection that inflames your deep lungs, the part with the air sacs, called alveoli. Those sacs are what your lungs are all about: you suck air into them, and oxygen pours across the alveoli membranes into the oxygen-starved blood on the other side. The carbon dioxide waste in that blood meanwhile pours into the alveoli, and you exhale it.

If those delicate membranes are damaged by an infection, they can start leaking fluid, and the sacs can fill up. That stops oxygen from getting to the membranes and entering your blood. If this gets bad enough, you effectively drown in your own fluids.

A respiratory infection—be it virus, bacteria, or fungi—may invade your nose, throat, or the deeper, bronchial air passages and give you a cold or a bad cough. But if it gets into the alveoli, that's pneumonia, and it can kill you.

The fact that this pneumonia was undiagnosed was the red flag that got ProMED's attention. Normally, white blood cells defend your alveoli from the bacteria that are always there, pulled in by the billion on every breath. Winter flu viruses knock out this key part of our immune system, and then the bacteria can grow, causing pneumonia. Therefore, most winter pneumonia is first treated with antibiotics, which kill bacteria. In Wuhan, this apparently wasn't working. Nor, presumably, were diagnostic tests for flu or the other usual suspects.

The Municipal Health Commission was holding a special meeting, said the report. But they made a point of saying they thought it wasn't the SARS virus. SARS emerged in China in 2002 and rampaged through 29 countries in 2003, causing severe pneumonia and killing 774 people.

Good, I remember thinking. SARS may not get talked about much anymore outside the countries that were affected, except by us disease buffs, but it was vicious, packing a 10 percent death rate. It was stamped out with an enormous international effort—and luck—with only the classic techniques of isolation and quarantine, mainly because it was clumsy at spreading among people. But if this new illness wasn't SARS, what was it?

The market connection was worrying. A seafood market in China is also a "wet" market that sells live animals, and many sell

that what they discovered made them immediately contact the Wuhan health authorities and warn them to take action. The virus was from the same family of bat viruses that had spawned SARS.

On January 7th, China announced a coronavirus was causing the pneumonia. But when no further action was taken, the Shanghai lab posted the sequence on a public database, the first sequence published for the virus. China CDC then posted its sequence. The Shanghai lab was shut by authorities the next day.

The sequences allowed other labs to design specific tests for the virus. Other countries started screening travelers from Wuhan —and finding infected people.

Neil Ferguson and his team at Imperial College London are among the world's most respected mathematical epidemiologists: they construct complex, mathematical computer models that describe how diseases are observed to behave and then use them to predict how new ones will spread. In January, they used a large database of airline passenger statistics to calculate how many people in the catchment area around Wuhan typically travel internationally.

It stood to reason that the percentage of travelers who were found to be infected should be the same as or less than the percentage of the population back home that was infected, as there was no reason to think people with the virus would be more likely to fly abroad than people without it. But in fact, the percentage of travelers who were infected was much higher.

So, they inferred, there must be more infected people in the Wuhan region than was being reported. Imperial crunched the numbers—it's more complicated than simple percentages—and reported on January 17th that there were probably 1,723 cases, give or take, in Wuhan. Wuhan was officially reporting 41.

There was no need to suspect underreporting. The most likely explanation was more straightforward: official numbers counted only people who had a positive test for the virus, and in the early days of the epidemic, the only people being tested were those sick enough to go to a hospital. Other countries, however, were testing every traveler with a fever who had just been in Wuhan, even if they were only mildly ill.

The missing cases might simply have been not serious enough

to go to the hospital. They would not, after all, have excited suspicion: mild cases look like flu, and it was flu season.

Still, looking at Ferguson's numbers, that seemed like a lot of cases for a virus that wasn't transmitted person-to-person. Or as the Imperial team drily put it, "Past experience with SARS and MERS-CoV outbreaks of similar scale suggests currently self-sustaining human-to-human transmission should not be ruled out." MERS, a virus with an even higher kill rate than SARS—around 40 percent—jumped to humans in 2012 and is, like SARS, a close relative of Covid-19.

Yet the official word was still that human-to-human transmission was limited at best. On January 10th, researchers at the University of Hong Kong found a family over the border in Shenzhen that became infected when they traveled to Wuhan. As the team published later, one family member did not go to Wuhan but became infected after the others came home. And doctors in Wuhan had also seen the sickness spread in families.

The researchers must have shared this information. On January 15th, Japan reported a case in Kanazawa who had just been in China but had not visited a wet market. The report noted that, according to the WHO, "there are currently cases in which the possibility of limited human-to-human transmission of this disease, including among families, cannot be ruled out. However, there is no clear evidence of sustained human-to-human transmission." Sometimes, viruses new to people can jump to one or two more people, but get no farther: MERS does that.

On January 18th, the Wuhan neighborhood of Baibuting staged a potluck dinner with 40,000 people in honor of the kitchen god—and in a bid for a Guinness World Record for the number of dishes served. The mayor of Wuhan told a television interviewer later, after gatherings of people in Wuhan had been banned, that the party was allowed because they still thought that human-to-human spread was limited.

Then a local case turned up in Thailand. "Sticking my neck out to the chopping block, I suspect there may already be significant ongoing transmission of this novel coronavirus," Pollack wrote on ProMED. However, most cases were not being reported, because they were mild and unrecognized. About that, she wrote, "I

obviously hope I am correct here."

By January 20th, cases were being reported across China, Japan, Thailand, and South Korea. Pollack's gloves were off. "It is becoming more difficult to conclude," she wrote testily, "that there has been limited person-to-person transmission as the case numbers are climbing."

Chinese scientists were also losing patience. Also on January 20th, Yi Guan, a virologist at the University of Hong Kong who helped uncover the SARS virus, told the Chinese magazine *Caixin* that the Wuhan outbreak was behaving like SARS: it was spreading between people.

The same day, China's president Xi Jinping finally went public, telling people to take measures to stop the virus spreading during the coming Lunar New Year holiday. Zhong Nanshan, an epidemiologist called the "hero of SARS" for helping discover the SARS virus in 2003 (and then telling the public it was out of control, when Beijing said otherwise), was heading the government's investigation. After Xi spoke, Zhong told China Central Television that the virus spread from person to person.

There were more surprises: the *South China Morning Post* in Hong Kong later reported that, according to classified documents they saw, the earliest case developed symptoms on November 17th, not December 1st, as later reported. It had taken China a month and a half to spot a problem and tell the WHO. The doctors involved knew it was contagious: early patients were put in isolation, and Zhang Jixian, head of respiratory and critical care at Hubei Provincial Hospital, told reporters in February she knew on December 26th when three members of one family had pneumonia. She made staff wear N95 masks.

What happened next shows how bad things already were in Wuhan by late January. To understand that, we have to look at the main ways of fighting an epidemic when you don't have drugs and vaccines: containment and mitigation.

Containment is by far the most effective way to limit an epidemic, if you get to it before there is a large number of cases. The classic method of epidemic control used for centuries is to isolate people with symptoms and then quarantine their contacts

for the time it takes for them to incubate the infection and start showing symptoms. Maybe they won't have it—good. But if they do, the quarantine ensures they don't pass it on.

Nowadays, you can test people for the pathogen and only quarantine those who test positive—if you really trust your test not to produce false-negative results. In either case, the chain of transmission is broken. Do that enough, and you can snuff out a virus: that's how the world defeated SARS.

However, this won't entirely work if the virus can spread before people show symptoms, as neither the person infected nor the people they contact will suspect a problem. And it is hard to do if more than a few people are sick. You have to trace and quarantine all the people each case might have infected, which can add up quickly with a virus as easily transmitted as Covid-19. You won't get everyone, so some new cases will continue to crop up, meaning more people to trace.

It's hard work. As it wrestled the Covid-19 epidemic to a halt in spring 2020, China eventually used six-person teams for each case to track contacts. The European Centre for Disease Prevention and Control estimates it takes a hundred person-hours to track one case's contacts. If you can break all the chains of infection from every case, the disease can be contained.

But you have to start early, before there are too many cases to track. If a disease is spreading generally—"in the community"—it becomes impossible: not only are there probably too many cases, but people might have no idea who they caught the virus from. That person could still be out there, spreading the virus, no matter how many known contacts of that case you quarantine.

At that point, the classic approach is to switch to mitigation. A lot of us know about that now because, with a few notable exceptions, most countries outside China didn't act in time to contain the virus and ended up mitigating: you ban large gatherings, close schools and workplaces, and generally reduce interaction between people to slow the spread of the disease, a set of measures known as social distancing.

At the extreme, as so many of us now know, you lock down and keep people inside. You don't entirely stop the spread of the virus, but at least it doesn't happen so fast that the sick overwhelm your

hospitals. That means the number of cases you get per day or per week does not rise as high or as fast—the now-famous "flattening the curve." And even though you are in theory only slowing the spread, you also save lives, as more people who need intensive care can get it.

In the course of the Covid-19 epidemic, China discovered that outside Wuhan and Hubei province, a mix of mitigation and containment actually worked best: first contact tracing and quarantine to break chains of infection and then, if necessary, varying levels of mitigation to slow the spread of the virus, which, because fewer people were catching the virus from each person who had it, also made containment more feasible.

But on January 22nd, Wuhan was already at the point where lockdown was deemed necessary. To get to that point, there must have been considerable person-to-person spread. But with the official story being that the virus did not spread from person to person, officials could not make any visible efforts to isolate cases and trace contacts, back when it might have been possible to contain the virus. Now it wasn't.

As a result, China imposed a *cordon sanitaire* around Wuhan, a term from pre-vaccine days meaning "health barrier." They were invented for cities with the plague, so no one would enter—or escape, carrying the disease. English uses the French term because in 1821, France revived the concept, by sending 30,000 troops to seal the Spanish border to keep out the yellow fever raging in Barcelona.

No one could enter or leave Wuhan, a city of 11 million, without special permission, beginning 10:00 AM local time on January 23rd. That was extended to all of Hubei province a day later. Transport within the city was shut down.

But there was a huge problem: Lunar New Year was only three days away. This is China's biggest yearly celebration, when 400 million people travel to family celebrations all over the country—the biggest human migration on earth. Moreover, Wuhan is a hub for travel within China. Mass travel had already begun, and at news of the impending shutdown, people flooded into train stations and airports.

Authorities later announced that five million people had left


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not
available

and epidemiologists would have run for their labs and models and started furiously posting results, as indeed they did a few weeks later once the news was out.

The world's developers of vaccines and drugs and diagnostic tests would have got to work. Other countries could have started testing people who had traveled to Wuhan earlier. As more cases appeared, China might have been able to impose the social distancing that would have made the difference, perhaps before five million people carried the virus out of Wuhan.

Those things happened anyway, but an earlier warning would have given everyone a few weeks' head start. We've all seen now what exponential looks like. A short time, at the right time, matters.

There is no question that when China finally did act, it was awesomely effective, if socially and economically painful. Dye's team found that, normally, 6.7 million people travel out of Wuhan in the month after New Year's. This year, there was almost no movement. That bought other cities, and the world, time to prepare.

Eventually, 136 Chinese cities also shut down their public transport and 220 banned mass gatherings. Dye's team found that cities that did those things sooner rather than later had a third fewer cases during the first week of their outbreak: curves were flattened, and the number of cases each person infected was slashed. Their models showed that the Wuhan travel ban alone or the shutdowns in other cities alone would not have reversed the climbing epidemic curve, but both together did—and cut the cases China would otherwise have had by 96 percent.

Wuhan required people to report their temperature daily, and in some cities that were not locked down, stores took people's temperatures before allowing them in. Anyone with a fever could go to a "fever clinic" for testing. People with cases too mild for hospitalization were isolated in repurposed stadiums and conference centers. Contacts of infected people were traced and quarantined.

An international team led by the WHO went to study China's response to the epidemic in late February. They reported that