

[Will a pandemic bring down civilisation?](#)

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FOR years we have been warned that a pandemic is coming. It could be flu, it could be something else. We know that lots of people will die. As terrible as this will be, on an [ever more crowded planet](#), you can't help wondering whether the survivors might be better off in some ways. Wouldn't it be easier to rebuild modern society into something more sustainable if, perish the thought, there were fewer of us.

Yet would life ever return to something resembling normal after a devastating pandemic? Virologists sometimes talk about their nightmare scenarios - a plague like ebola or smallpox - as "civilisation ending". Surely they are exaggerating. Aren't they?

Many people dismiss any talk of collapse as akin to the street-corner prophet warning that the end is nigh. In the past couple of centuries, humanity has innovated its way past so many predicted plagues, famines and wars - from Malthus to Dr Strangelove - that anyone who takes such ideas seriously tends to be labeled a doom-monger.

There is a widespread belief that our society has achieved a scale, complexity and level of innovation that make it immune from collapse. "It's an argument so ingrained both in our subconscious and in public discourse that it has assumed the status of objective reality," [writes](#) biologist and geographer [Jared Diamond](#) of the University of California, Los Angeles, author of the 2005 book *Collapse*. "We think we are different."

Ever more vulnerable

A growing number of researchers, however, are coming to the conclusion that far from becoming ever more resilient, our society is becoming ever more vulnerable (see page 30). In a severe pandemic, the disease might only be the start of our problems.

No scientific study has looked at whether a pandemic with a high mortality could cause social collapse - at least none that has been made public. The vast majority of [plans](#) for weathering a pandemic all fail even to acknowledge that crucial systems might collapse, let alone take it into account.

There have been many pandemics before, of course. In 1348, the Black Death killed about a third of Europe's population. Its impact was huge, but European civilisation did not collapse. After the Roman empire was hit by a plague with a similar death rate around AD 170, however, the empire tipped into a downward spiral towards collapse. Why the difference? In a word: complexity.

In the 14th century, Europe was a feudal hierarchy in which more than 80 per cent of the population were peasant farmers. Each death removed a food producer, but also a consumer, so there was little net effect. "In a hierarchy, no one is so vital that they can't be easily replaced," says Yaneer Bar-Yam, head of the New England Complex Systems Institute in Cambridge, Massachusetts. "Monarchs died, but life went on."

Individuals matter

The Roman empire was also a hierarchy, but with a difference: it had a huge urban population - not equalled in Europe until modern times - which depended on peasants for grain, taxes and soldiers. "Population decline affected agriculture, which affected the empire's ability to pay for the military, which made the empire less able to keep invaders out," says anthropologist and historian Joseph Tainter at Utah State University in Logan. "Invaders in turn further weakened peasants and agriculture."

A high-mortality pandemic could trigger a similar result now, Tainter says. "Fewer consumers mean the economy would contract, meaning fewer jobs, meaning even fewer consumers. Loss of personnel in key industries would hurt too."

Bar-Yam thinks the loss of key people would be crucial. "Losing pieces indiscriminately from a highly complex system is very dangerous," he says. "One of the most profound results of complex systems research is that when systems are highly complex, individuals matter."

The same conclusion has emerged from a completely different source: tabletop "simulations" in which political and economic leaders work through what would happen as a hypothetical flu pandemic plays out. "One of the big 'Aha!' moments is always when company leaders realise how much they need key people," says Paula Scalingi, who runs pandemic simulations for the Pacific Northwest economic region of the US. "People are the critical infrastructure."

Vital hubs

Especially vital are "hubs" - the people whose actions link all the rest. Take truck drivers. When [a strike blocked petrol deliveries from the UK's oil refineries](#) for 10 days in 2000, nearly a third of motorists ran out of fuel, some train and bus services were cancelled, shops began to run out of food, hospitals were reduced to running minimal services, hazardous waste piled up, and bodies went unburied. Afterwards, [a study](#) by Alan McKinnon of Heriot-Watt University in Edinburgh, UK, predicted huge economic losses and a rapid deterioration in living conditions if all road haulage in the UK shut down for just a week.

What would happen in a pandemic when many truckers are sick, dead or too scared to work? Even if a pandemic is relatively mild, many might have to stay home to care for sick family or look after children whose schools are closed. Even a small impact on road haulage would quickly have severe knock-on effects.

One reason is just-in-time delivery. Over the past few decades, people who use or sell commodities from coal to aspirin have stopped keeping large stocks, because to do so is expensive. They rely instead on frequent small deliveries.

Cities typically have only three days' worth of food, and the old saying about civilisations being just three or four meals away from anarchy is taken seriously by [security agencies such as MI5 in the UK](#). In the US, [plans for dealing with a pandemic](#) call for people to keep three weeks' worth of food and water stockpiled. [Some planners](#) think everyone should have at least 10 weeks' worth. How long would your stocks last if shops emptied and your water supply dried up? Even if everyone were willing, US officials warn that many people might not be able to afford to stockpile enough food.

Two-day supply

Hospitals rely on daily deliveries of drugs, blood and gases. "Hospital pandemic plans fixate

on having enough ventilators," says public health specialist Michael Osterholm at the University of Minnesota in Minneapolis, who has been calling for broader preparation for a pandemic. "But they'll run out of oxygen to put through them first. No hospital has more than a two-day supply." Equally critical is chlorine for water purification plants.

It's not only absentee truck drivers that could cripple the transport system; new drivers can be drafted in and trained fairly quickly, after all. Trucks need fuel, too. What if staff at the refineries that produce it don't show up for work?

"We think that if we can make people feel safe about coming to work, we'll have about 25 per cent staff absences if we get a flu pandemic like the one in 1918," says Jon Lay, head of global emergency preparedness for ExxonMobil. If that happens, then by postponing non-essential tasks, and making sure crucial suppliers also hang tough, "we can maintain the supply of products that are critical to society".

Some models, however, suggest absenteeism sparked by a 1918-type pandemic could cut the workforce by half at the peak of a pandemic wave. "If we have 50 per cent absences, it's a different story," says Lay, who says his company has not modelled the impact of absence on that scale. And what if a pandemic is worse than 1918?

Critical infrastructure

All the companies that provide the critical infrastructure of modern society - energy, transport, food, water, telecoms - face similar problems if key workers fail to turn up. According to US industry sources, one electricity supplier in Texas is teaching its employees "virus avoidance techniques" in the hope that they will then "experience a lower rate of flu onset and mortality" than the general population.

The fact is that the best way for people to avoid the virus will be to stay home. But if everyone does this - or if too many people try to stockpile supplies after a crisis begins - the impact of even a relatively minor pandemic could quickly multiply.

Planners for pandemics tend to overlook the fact that modern societies are becoming ever more tightly connected, which means any disturbance can cascade rapidly through many sectors. For instance, many businesses - including *New Scientist's* parent company - have contingency plans that count on some people working online from home. Models show there won't be enough bandwidth to meet demand, says Scalingi.

And what if the power goes off? This is where the complex interdependencies could prove disastrous. Refineries make diesel fuel not only for trucks but also for the trains that deliver coal to electricity generators, which now usually have only 20 days' reserve supply, Osterholm notes. Coal-fired plants supply 30 per cent of the UK's electricity, 50 per cent of the US's and 85 per cent of Australia's.

Powerless

The coal mines need electricity to keep working. Pumping oil through pipelines and water through mains also requires electricity. Making electricity depends largely on coal; getting coal depends on electricity; they all need refineries and key people; the people need transport, food and clean water. If one part of the system starts to fail, the whole lot could go. Hydro and nuclear power are less vulnerable to disruptions in supply, but they still depend on highly trained staff.

With no electricity, shops will be unable to keep food refrigerated even if they get deliveries. Their tills won't work either. Many consumers won't be able to cook what food they do have. With no chlorine, water-borne diseases could strike just as it becomes hard to boil water. Communications could start to break down as radio and TV broadcasters, phone systems and the internet fall victim to power cuts and absent staff. This could cripple the global financial system, right down to local cash machines, and will greatly complicate attempts to maintain order and get systems up and running again.

Even if we manage to struggle through the first few weeks of a pandemic, long-term problems could build up without essential maintenance and supplies. Many of these problems could take years to work their way through the system. For instance, with no fuel and markets in disarray, how do farmers get the next harvest in and distributed?

Closing borders

As a plague takes hold, some countries may be tempted to close their borders. But quarantine is not an option any more. "These days, no country is self-sufficient for everything," says Lay. "The worst mistake governments could make is to isolate themselves." The port of Singapore, a crucial shipping hub, plans to close in a pandemic only as a last resort, he says. Yet action like this might not be enough to prevent international trade being paralysed as other ports close for fear of contagion or for lack of workers, as ships' crews sicken and exporters' assembly lines grind to a halt without their own staff, power, transport or fuel and supplies.

Osterholm warns that most medical equipment and 85 per cent of US pharmaceuticals are made abroad, and this is just the start. Consider food packaging. Milk might be delivered to dairies if the cows get milked and there is fuel for the trucks and power for refrigeration, but it will be of little use if milk carton factories have ground to a halt or the cartons are an ocean away.

"No one in pandemic planning thinks enough about supply chains," says Osterholm. "They are long and thin, and they can break." When Toronto was hit by SARS in 2003, the major surgical mask manufacturers sent everything they had, he says. "If it had gone on much longer they would have run out."

The trend is for supply chains to get ever longer, to take advantage of economies of scale and the availability of cheap labour. Big factories produce goods more cheaply than small ones, and they can do so even more cheaply in countries where labour is cheap.

Flawed assumptions

Lay points to recent hurricanes in the US and the 2005 fire at the Buncefield oil depot in the UK as examples of severe disruptions to the normal supply chain. In all of these instances, he points out, supplies from refineries were maintained. But those disasters were localised, and help could come from unaffected places nearby.

Disaster planners usually focus on single-point events of this kind: industrial accidents, hurricanes or even a nuclear attack. But a pandemic happens everywhere at the same time, rendering many such plans useless. "There are numerous assumptions behind our conclusions," Lay admits. "If they prove to be flawed, we could struggle."

The main assumption is how serious a pandemic could be. Many national plans are based on mortality rates from the mild 1957 and 1968 pandemics. "No government pandemic plans consider the possibility that the death rate might be higher than in 1918," says Tim Sly of Ryerson University in Toronto, Canada.

Even a rerun of 1918 could be bad enough. In a 2006 study, economist Warwick McKibbin of the Lowry Institute for International Policy in Sydney, Australia, and colleagues based their "worst-case" scenario on the same death rate as in 1918. The result, their model predicts, would be 142 million deaths worldwide, leading to a massive global economic slowdown that would wipe out 12.6 per cent of global GDP.

Death rate

This scenario assumes around 3 three per cent of those who fall ill die. Of all the people known to have caught H5N1 bird flu so far, 63 per cent have died. "It seems negligent to assume that H5N1, if it goes pandemic, will necessarily become less deadly," says Sly. And flu is far from the only viral threat we face.

The ultimate question is this: what if a pandemic does have huge knock-on effects? What if many key people die, and many global balancing acts are disrupted? Could we get things up and running again? "Much would depend on the extent of the population decline," says Tainter. "Possibilities range from little effect to a mild recession to a major depression to a collapse."

[Read the companion article about the complexity of civilisation](#)

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