Crosstalk

COVID: Excess Mortalities Two Years Later

The death toll is increasingly comparable to that of the 1918–1920 flu

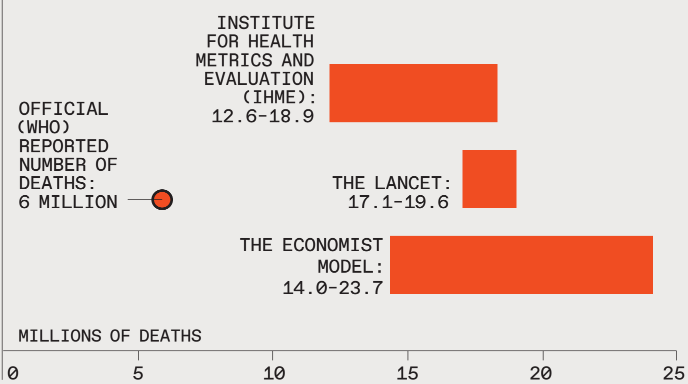
The World Health Organization (WHO) declared the outbreak of the COVID-19 pandemic on 11 March 2020. Two years later, it put the cumulative number of cases at about 452 million, more than 5 percent of the world's population, and the number of new infections was still averaging more than a million a day.

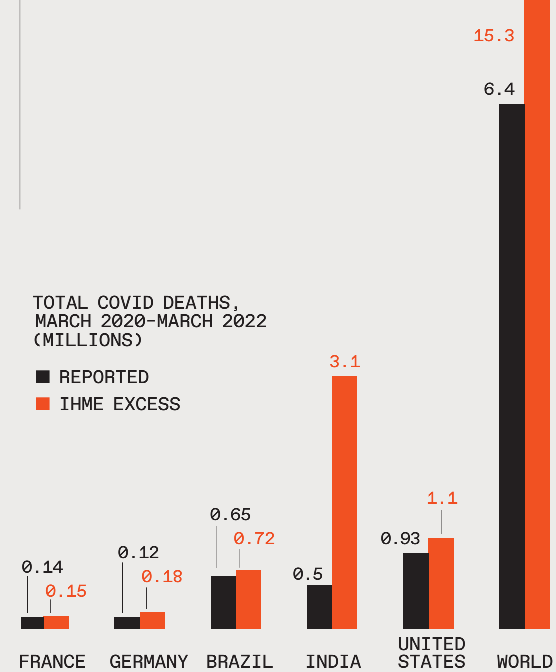
How many people have died? We can begin to model the problem by using the highest mortality estimates of the two previous major pandemics—138 deaths per 100,000 people in 1957–1958 and 111 per 100,000 in 1968–1969. A similarly virulent two-year event, adjusted for today's population of 7.9 billion, would then be expected to kill 8.8–10 million people. On 11 March 2022, the WHO's officially logged COVID death toll was about 6 million. Every epidemiologist knows that this must be a significant underestimate.

Estimates of actual global mortality attributable to COVID are at least two and up to four times as much as the officially reported total.

A better way to assess the death toll is to calculate excess mortality: that is, the difference between the total number of deaths during a crisis and the deaths that would be expected under normal conditions. Obviously, this approach will work only in those countries that collect near-impeccable mortality statistics. The WHO has assessed the health-information capacity of 133 countries, showing that the share of all deaths that are registered ranges from 100 percent in Japan and 98 percent in the European Union to 80 percent in China and only 10 percent in Africa. Given these realities, calculations of excess mortalities are revealing in France, inaccurate in China, and impossible in Nigeria.

And even in Japan, interpreting excess mortalities can be complicated. On one hand, COVID excess mortality includes not only the deaths directly attributable to the virus (due to inflammation of tissues or oxygen deprivation) but also the indirect effects caused when COVID aggravates preexisting conditions (heart disease, dementia) or induces the deterioration and disruption of normal health care (forgone diagnoses and treatments). But on the other





SOURCES: WHO, IHME, THE LANCET, THE ECONOMIST. THE NUMBERS FROM THE WHO ARE REPORTED DEATHS. ALL OTHERS ARE ESTIMATES.

hand, the spread of COVID appears to have largely preempted seasonal excess mortality caused by winter flu epidemics among the elderly, and lockdowns and economic slowdowns improved the quality of outdoor air.

By the end of 2020 the official worldwide COVID death toll was 1.91 million, but the WHO's preliminary evaluation estimated at least 3 million deaths. According to Seattle's Institute for Health Metrics and Evaluation (IHME), which counts only cases caused directly by the virus, not by the pandemic's disruption of health care, excess global mortality reached 15.34 million (that is, between 12.6 and 18.9 million) by 11 March 2022. That's the second anniversary of the beginning of the pandemic, according to the WHO's reckoning.

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A model run by *The Economist* relies on scores of national indicators correlating with data on excess death and thus it has produced a wide range of estimates. For the pandemic's two-year mark, the range is between 14 million (more than 2 times the official tally of 6 million) and 23.7 million (nearly 4 times the official number), with the central value at 20 million (3.3 times the official total). And on 10 March 2022, *The Lancet*, one of the world's leading medical journals, published its excess mortality estimate for 2020 and 2021: 18.2 (17.1 to 19.6) million, nearly 3.1 times the official two-year tally.

Even using a toll of around 15 million deaths is enough to put COVID-19 far ahead of the two major post-1945 pandemics on a per capita basis. And any number above 20 million would make it in absolute terms (but not in relation to population) an event on the same order of magnitude as the great 1918–1920 influenza pandemic. Will we ever know the real toll to within 10 percent, plus or minus? ■

MYTH AND MACHINE BY RODNEY BROOKS

How Networks Catalyze Civilization

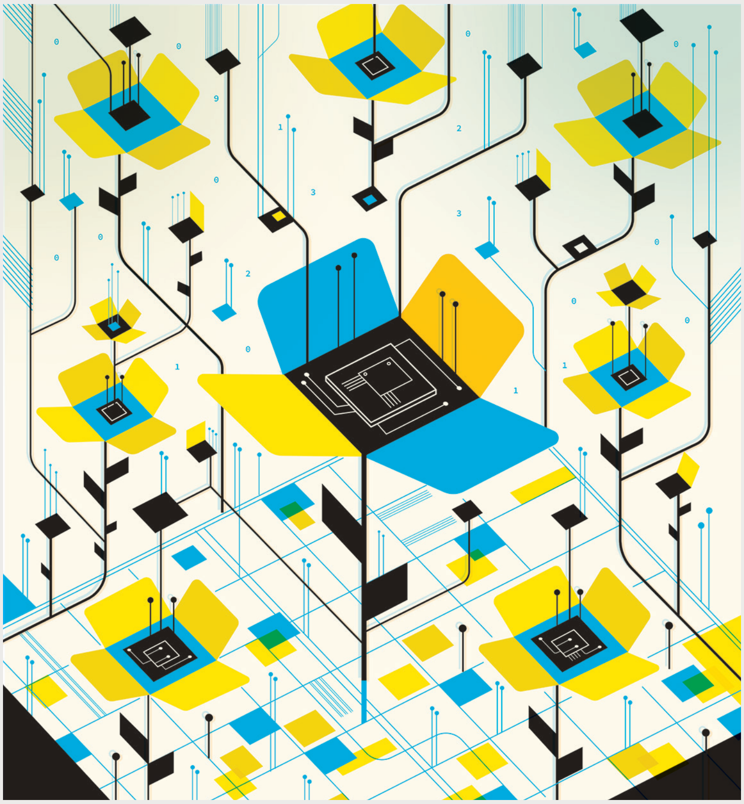
A minor miracle called autocatalysis sustains organisms and vast communications networks

PORTRAITS BY SERGIO ALBIAC

Thanks to the catalytic converter in their cars, most people have an idea of what catalysis is. It refers to a chemical reaction that is enabled, or greatly speeded up, by the presence of one or more other chemicals. A catalytic converter, for example, uses palladium, rhodium, and platinum to convert pollutants like carbon monoxide, nitric oxide, and nitrogen dioxide into water and carbon dioxide.

More than 90 percent of all industrial-chemical processes depend on catalysis. But for living systems, a more important phenomenon is autocatalysis, in which one of the chemical products of a reaction is itself a catalyst for that same reaction. Think of it as a feature that, under the right conditions, allows a chemical reaction to amplify itself.

It is a stunningly powerful mechanism. Life itself depends on autocatalytic chemical reactions—beneath our placid exteriors we are a seething mass of autocatalysis. Remarkably, this same concept, of a system giving rise to a factor that then synergistically enlarges or improves the system, can often be seen in the networks created by human beings. It's true of social networks, transportation networks, commercial networks, and, especially, communication networks.



In the 18th century, Great Britain built a network of canals that enabled, rather suddenly, the delivery of raw materials, coal for power, and access to ports for the finished goods. That, in turn, led to the invention of factories, which set the stage for the Industrial Revolution. Of course, the explosion of industrial activity that ensued was very, very good for the canal network. Here, the factories were the catalyst, spawned by the canal-network system that they then expanded and strengthened.

Fast-forward roughly 250 years, to the 1980s, in the United States. We have various electronic communication networks (the autocatalytic system) and some early personal computers (the catalyst). Personal computers are not yet ubiquitous, but then, in 1989, along comes the Internet, a second generation of a packet-data network that had started out as a communications network for the military and for sharing scarce computer resources in academia. Because the Internet was available to any customer who wanted to pay, the demand for network bandwidth surged and set the stage for the World Wide Web, an easy-to-use information network overlaid on the packet-data network. At last, people had a compelling reason to buy a computer.

The Web soon became a vehicle for commerce, and demand rose even more. Ultimately, we needed to build large data centers as the back end of that commerce system. Then a bunch of folks got the brilliant idea to offer businesses the computational resources, in addition to the storage, of those data centers. Thus, cloud computing was born.

Years later, cloud computing enabled the large-scale training needed for deep neural networks. The computational demands for this training are now so great that they are driving the growth of cloud-computing networks, which are fed by a worldwide network of mostly low-paid piece workers in the developing world who label data needed to keep the training going. They use the Web to move the data around, and to get paid.

Are we in the endgame for deep neural networks? Or will we manage to get past the very narrow capabilities of today's deep-learning networks to new AI technologies? And if we do, will there be new networks that arise and are autocatalytic with this new form of AI, whatever it might be?

Some researchers, engineers, and entrepreneurs are probably peering through the fog of the immediate and starting to see how new autocatalytic processes will interact. Some of them will start vastly successful companies. I don't know exactly what those companies will do; if I did, I would start one myself. But I have a couple of ideas.

COVID-19 quickened the pace of adoption of all kinds of home delivery. We have arrived at a tipping point where there is not enough labor for all the fulfillment centers now in existence, even as Amazon and other retailers are striving to achieve deliveries within a couple of hours of receiving an order.

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Amazon and others are already relying on robots to fetch and move purchased goods in these fulfillment centers, and even to pack items for shipping. There is an enormous incentive to make these robots more intelligent, more capable, and more pleasant for human workers to be around. These robots could be a catalyst for even more fulfillment centers, and for even better robots. Such capable robots would be used in manufacturing, so they might possibly prompt a return of manufacturing to technologically advanced countries that lost it decades ago to regions with lower-cost labor.

And there may be another big role for automation, too. The last-kilometer component of delivery will require faster, more automated solutions in our cities and suburbs. So we may yet see the transportation infrastructure needed to enable more robotic vehicles in these places. And that, in turn, could pave the way (as it were) for truly large-scale deployment of autonomous passenger vehicles.

It would be a revolution on a grand scale. But no more grand than others triggered by autocatalysis over the past couple of centuries. ■

Illustration by Harry Campbell