



## Pandemics and the World Economy

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*To the memory of Martin Mayer and William V. Shannon,  
beloved friends from whom I learned much.*

### 2. Cooperation

“Disease was a perverse, dissolute form of life,” Thomas Mann wrote a century ago in *The Magic Mountain* (1922), as the world recovered from the great flu pandemic that left some 100 million people dead, compared with the four million people killed so far by covid-19. “And life itself? Was it perhaps an infection, a sickening of matter?”

Not quite so. Human cooperation makes the difference, nourishing accumulation and spread of knowledge over time between generations, including codes of conduct and sharing of information found in most forms of life.

In the century between 1920 and 2020, the average human life span doubled, with large variations between countries, but rising nearly everywhere. In Brazil, life expectancy at birth rose from 27 years in 1870 to 75 years today, as in Mumbai and Delhi in India. Until the mid-18th Century, life expectancy stayed at around 30 years for



centuries and growth of population remained slow. Humanity multiplied with better food supplies, more scientific experimentation and data collection, new infrastructure and better codes of civic behavior. The pace of innovation in public health accelerated in the 18th Century and seems to have reached a climax in recent decades.

The surge in survival of populations began around 1750 with development by Edward Jenner of a vaccine to prevent smallpox, which killed both rich and poor. Still, the swelling of cities around the same time led to surges in mortality, especially among the crowded poor, as today, on a smaller scale, with

covid in New York, São Paulo, Lima, Delhi and other big cities, spreading then to more prosperous classes. The density of industrial cities then made infection from cow's milk more dangerous than before, until

Louis Pasteur in 1865 developed a technique for boiling milk, called pasteurization, which saved billions of lives worldwide since then.

Epidemics tend to strike suddenly, but no pandemic has stricken so many countries so quickly and on such a large scale as covid. But in face of this adversity, organized societies so far remain intact. In virtually all stricken countries, doctors, nurses other medical staff keep working long hours, as do gravediggers working overnight and creating new space to bury the surging inflow of corpses. At least 17,000 health workers died from covid during the first year of the pandemic, and many more since then, with promised levels of vaccination for them falling short. But people still tend to respect institutions, even though hospitals cannot accommodate the huge inflow of patients. There is no way that complex societies could have prepared for adversity of this magnitude.

### How many deaths?

According to a statistical analysis by *The Economist*, from seven to thirteen million people in the world died so far from covid-19 in 2020-21, double or triple conventional estimates of around 3.3 million deaths derived from official statistics, including recent surges among younger people. In Latin America and the Caribbean, 1.5-1.8 million additional deaths were estimated, against official counts of around 600,000. Recently deaths have been concentrated in developing countries, where covid vaccination is rare.

The civilized world struggles to overcome these adversities. “The number of infectious disease outbreaks has been accelerating,” warns a panel of scientists. But vaccines have been developed at unprecedented speed with tools never before available, including submicroscopic technologies. As of October 2020, 44 candidate vaccines were being tested clinically worldwide with another 151 in preclinical development. These efforts have multiplied enormously.

New and better vaccines are appearing fast, especially those based on RNA (ribonucleic acid), a genetic molecule that defines the specific character of all forms of life. A revolutionary second wave of RNA vaccines, developed recently in Germany, enables poorer countries to apply widely the new covid vaccine without needing the freezing technology demanded by earlier versions. RNA molecules also are becoming widely used in developing farm pesticides at falling costs, including in Brazil. The boss of a Kansas firm developing RNA-based pesticides observes that “a

gram of RNA cost \$100,000 when we started. By 2014 it was \$100 a gram. Now it’s a dollar a gram.”

Knowledge of transmission dynamics of covid is still evolving. Some scientists warn that “many characteristics of Sars-CoV-2 are not yet fully understood, such as levels of immunity and immune response, the full spectrum of disease and long-term sequels, the possibility of reinfection, and the potential of the virus to become endemic.” Uncertainties remain with proliferation of varieties of Sars-CoV-2, on whether the virus is an airborne threat and in the effectiveness of vaccines in this changing climate of proliferation. One of the most virulent of these emerged in Manaus, the Brazilian metropolis of the Amazon basin, with several new varieties, lowering protection from previous waves of vaccination.

In December 2020, only 11 months after Chinese scientists published the SARS-CoV-2 genetic code, the U.S. pharmaceutical giant Pfizer and its German partner BioNTech, followed by Moderna, won regulatory approval for new vaccines based on a new gene-based technology. The founders of BioNTech are a Turkish-born couple, Ozlem Tureci and Ugur Sahin, who worked for decades in Germany on new treatments for cancer by reprogramming the body’s immune system, then quickly applied their new technique to covid-19 as soon as China published its genetic code.

But they faced special conditions. These new vaccines had to be transported at sub-freezing temperatures (-80 degrees centigrade for Pfizer/BioNTech). Most required two injections, weeks apart, in a patient. It was hard to increase production volumes using these new gene-based technologies. But new versions are being developed to reduce the need for freezing, making it easier to send these vaccines to poorer and remote areas, with less special equipment for transport and storage. Other vaccines are being produced, with varied kinds of testing and delivery, and varying degrees of success in many countries, including China, Russia, Britain, the United States, Japan, India, Israel and France.

After a promising start, world covid vaccine production and distribution has fallen into confusion. In recent years India emerged as the world’s leading exporter of many vaccines, within a few months in 2019 generating half of global consumption of new covid vaccines. The privately owned Serum Institute of India, the world’s biggest producer, planned to export 2.2 billion doses this year, with one-third going to

developing countries under a World Health Organization (WHO) program.

But India in May suspended all covid vaccine exports to deal with a huge surge of cases at home. Because of scanty reporting of cases and deaths, independent professional estimates project between one third and half of India's 1.4 billion people infected by covid, leading to 1.6 million deaths, 20 times official counts of cases and five times the number of recorded deaths. "There is no way a democratic government under these circumstances would not take domestic political sensitivities into account," said Harsh Pant of New Delhi's Observer Research Foundation. "I don't think India would be in a position to come back to its original role as an exporter of vaccines. Perhaps it will dent India's image but no country comes out of this crisis unscathed."

China has made its vaccines as part of a commercial and diplomatic strategy in the covid pandemic, but denied giving clear answers on prices, delivery schedules or volumes. More than 60 countries approved them for use, with Brazil and many Asian and African nations highly dependent on applying them. Sinovac, the main brand, claimed a 79% efficiency rate, without releasing data, then reduced it to the 50% demanded by WHO. A phase-three trial in Brazil showed wide variations in efficacy, including 35% for asymptomatic cases. Gao Fu, head of the Chinese Center for Disease Control and Prevention, said that current vaccines "don't have very high rates of protection" and suggested that they could be mixed with other vaccines to improve efficiency.

The distribution process opened with a wide breach between technical capacity and institutional capacity. Distribution faltered due to confusion on scheduling of deliveries and shortages in trained staff, impaired by lack of funding. "We've taken the people with least amount of resources and capacity and asked them to do the hardest part of the vaccination –which is actually getting the vaccine into people's arms," said Dr. Ashish Jha, head of the Brown University School of Public Health.



Disorganization in deliveries to hospitals and in storage in freezers led to large-scale waste. U.S. President Joe Biden and his staff faced enormous challenges in overcoming the disorder and neglect left by his predecessor, Donald Trump, in dealing with the pandemic emergency. "We're backing you 100%," Trump told state governors in a conference call. "Also, though, respirators, ventilators, all the equipment –try getting it yourselves." State governors in Brazil faced the same challenge after President Jair Bolsonaro dismissed covid as "a little gripe." Dimas Covas, head of Brazil's largest vaccine manufacturer, quoted Bolsonaro as saying that staying at home to avoid covid "is a thing for queers," a phrase often repeated by the president. "He is playing the virus's game," Covas said. "He is doing social Darwinism, exposing people to the virus: those who resist survive, others die."

In both Brazil and the United States, negligence and confusion reigned at the highest levels of government. Bolsonaro, like President Trump, changed their tone as public fear and indignation spread and cases and deaths multiplied. Needles and syringes, as well as vaccines, became scarce on world markets, along with tubing, filters and biobags, the containers in which vaccines usually are made.

In the absence large amounts of effective vaccines as well as efficient distribution systems supplying their continental territories, citizens of both Brazil and the United States resisted basic precautions such as social distancing, wearing masks and frequent hand-washing. In Brazil, only one fifth of vaccine doses distributed to state governments were injected into citizens. Most neglected are small towns in the interior.

Receiving official approval of the vaccine, after Trump threatened to fire the head of the Federal Drug Administration if it did not authorize distribution that day, Pfizer began three days of emergency shipping of 2.9 million freeze-wrapped doses to hospitals and clinics in 636 cities nationwide, with airlines and delivery companies operating on 24-hour schedules.

Each specially designed container of frozen vaccines can be opened only twice daily for three minutes at a time to avoid spoilage, with each box monitored remotely for temperature and location. Made from carbon dioxide produced as waste from other industrial processes, dry ice became a hot commodity in the sprawling supply chain arising from the need to store and ship large volumes of vaccines at extremely low temperatures, in addition to other consumer demands such as delivery of food supplies to homes.

Vaccines are being developed at surprising speed, but the enormous task of distribution is slowed by logistical problems and confusion. In the United States, most states lacked plans to expand vaccine delivery systems, needing to identify and check thousands of new providers. Faulty reporting procedures confuse both suppliers and clinics. Many health systems were unsure of how much vaccines they would receive or when.

Old age homes have highest priority, but are swamped with vaccine doses in excess volumes they cannot use, while other institutions must cancel appointments because promised vaccines have not been delivered. Yet complex logistical operations are underway. Major pharmacy and supermarket chains now receive vaccines free for injection in local stores. One of the main channels of distribution is Walmart's supermarkets, with 5,000 outlets in the United States. Government priority has been given to poor and remote communities that are underserved medically, where most Walmart stores are located. Yet epidemiologists now believe that achieving herd immunity, protecting 80% of populations, is unlikely in the United States. But numbers of cases may be reduced gradually to more manageable levels despite refusal of many Americans to accept vaccination.

### **Small communities**

What about the institutional capacities of small outlying communities? Much vaccine has been wasted. The more demanding vaccines have been effective in Israel, with a small and compact population supported by an advanced medical and scientific infrastructure and a digitalized health system. But the fate of many communities elsewhere in this pandemic, with limited financial and institutional capacities, is a new feature of the polarization of the world economy.

The dedication and stoicism of doctors and nurses are widely publicized, but the unseen heroes of the surge in covid cases are the hospital laboratory

technicians whose workload expanded enormously, pressuring many of them to work 16-hour shifts to keep up with the flow of tests. Billions of lab tests for coronavirus have been done worldwide since the pandemic spread in the United States, straining technicians, equipment and chemical supplies, with many hard-to-replace older specialists retiring or quitting their jobs. Vaccination on a continental scale also must integrate the efforts of pilots, chemists, factory workers, truck drivers, data scientists, bureaucrats, pharmacists and health care employees.

Coordinated delivery must be made of ultra-cold freezers, dry ice, needles, masks, syringes and alcohol wipes. Huge shipments of dry ice must be kept at extremely low temperatures to prevent their degradation into poisonous gas. "Everything has to come together – the packaging, the dry ice, the vials, the material itself," said Yossi Sheffi of the MIT Center for Transportation and Logistics. "It all must come together to the same place and have enough of it and exactly the right people there ready to take it. Right now, there's no conductor for the symphony."

We do not know how long protection will last for new vaccines. An editorial in the medical journal *The Lancet* warned in December 2020:

*Whether the vaccines prevent transmission of SARS-CoV-2 or mainly just protect against illness is largely unknown too. If the latter, achieving herd immunity becomes a difficult prospect. Pfizer and Moderna together project that there will be enough vaccine for 35 million individuals in 2020 and perhaps up to one billion in 2021. As a result, many millions of people at high risk of disease will not be immunized any time soon, necessitating the continued use of non-pharmaceutical interventions. There is a danger that the public might become complacent following the news of promising vaccines.... What will the long-term future look like? Will SARS-CoV-2 become endemic, in a post-pandemic phase? It is likely, but it is too early to be sure what form this endemicity will take. Vaccines will be just one determinant. Reinfections are another.*

Many specialists advocate producing vaccines not just for moments of crisis but as part of a long-term process, with huge political and financial challenges. Developing new vaccines is risky, slow and costly. Over the past two decades, scientists, public health specialists and philanthropists have been meeting to discuss the next pandemic. Scenarios like Operation Dark Winter (2001) and Atlantic Storm (2005) were discussed at international conferences and biosecurity think tanks in Europe and the United States. WHO sponsored the

Covid-19 Vaccines Global Access Facility (COVAX), a distribution scheme for poorer countries, which managed to distribute only 72 million doses, only 4% of the 1.7 billion covid doses shipped worldwide, thanks to concentration of production and consumption in rich nations and suspension of exports from India, the biggest producer, to face the huge covid outbreak there.

A group of academics proposed a long-term plan for developing and supporting a portfolio of vaccines to combat the world's most threatening infectious diseases. A megafund of \$35 billion would support 141 projects with an average cost of \$250 million each. The risks are daunting. Only one-third of new vaccines survive early evaluation to reach preclinical testing. Many vaccines are useful only during major epidemics, leaving behind wasted investments. Many of them are distributed to poor countries at prices far below cost and face challenges of storage and distribution, requiring billions of needles and syringes, hundreds of millions of glass vials and specialized "cold chain" transport. Combinations of governments, foundations, pharmaceutical companies and private investors in bond markets would be mobilized to share risks and benefits in different ways over several years, ranging from public financial and market guarantees to privileged access to new vaccines for companies and governments investing in their development.

The risks of epidemics multiply with growing populations crowding new environments as modern transportation systems ease traffic between distant regions of the world. One consequence of this crowding between the urban and the wild may be the role of the pangolin, a small creature wrapped in scales as protective armor. Pangolins and other wild animals are sold in the market in Wuhan, China, and elsewhere in Southeast Asia, for their meat and medicinal properties. Many scientists believe such creatures carried the coronavirus from the wild to human communities, starting its spread throughout the world in the covid-19 pandemic.

Other scientists disagree, after detailed examination of the thesis of wildlife origin of covid. They now find that covid originated in experiments at the Wuhan Institute of Virology, which for several years has conducted research on adaptation of coronaviruses to humans, with financial support from the U.S. government. Wuhan scientists became infected in field research on covid-bearing animals, then continued their experiments in laboratories without adequate

protection. Some lab workers were infected. The first known covid cases appeared in neighborhoods close to the Wuhan laboratory. China's government since has denied outside researchers access to laboratory personnel and data.

"We are now living through two concomitant massive pandemics that are the result of spillover from animal to human hosts, the H.I.V. and the covid pandemics," observed Wafaa El-Sadr, a tropical disease specialist at Columbia University who visited Wuhan. "Never in history has humanity experienced something along this scale and scope." Elsewhere, the animal spillover to humans led to covid outbreaks elsewhere, as in mink farms in the Netherlands, Spain and Denmark, leading to large-scale culling of the animals.

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