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Pandemic Preparedness: What Role for the Private Sector?

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Executive Summary

The severe effects of the Covid-19 pandemic on U.S. public health, economic activity, and public finances demonstrate that preparation for the next pandemic needs to be much improved. The neglect of pre-Covid warnings of a coming pandemic shows that better surveillance and monitoring and reporting of pandemic threats will not by themselves be sufficient.

To spur better preparedness actions, the federal government and private industry should first work to develop credible estimates of the probability of a pandemic of given severity by a given date. Such estimates could be developed through structured expert judgment methods, a new collection, synthesis, and analysis of big data on viruses in animal and avian species around the globe, and the development of robust prediction or event contract markets. In addition, Congress, the administration, and the Commodity Futures Trading Commission (CFTC), should examine and correct all regulatory and legal obstacles impeding the growth of prediction markets and pandemic-related catastrophe bonds, including measures to allow these bonds to be traded on secondary markets. Prediction markets for pandemics assessment and pandemic-related catastrophe bonds (cat bonds) will allow for improved private-sector management and sharing of pandemic-related risks.

ABOUT US

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Introduction

The severity of the Covid-19 pandemic should prompt a thorough review of preparedness for the next one.[1] As of September 2, the World Health Organization (WHO) reported more than 4.45 million deaths and 218 million confirmed cases globally,[2] and the Centers for Disease Control and Prevention (CDC) reported more than 640,000 deaths and nearly 39.5 million confirmed cases in the United States.[3] Yet these statistics may not capture the full scope of the damage. Total hospitalizations and symptomatic illness, according to CDC estimates, were 1.8 and 3.9 times higher, respectively, than official U.S. statistics because of underreporting.[4] Harvard economists David Cutler and Lawrence Summers offered preliminary estimates that long-term

disabilities related to lung function and mental illnesses from isolation and loneliness could amount to a quarter of the total economic cost of the pandemic.[5] Economic activity globally fell in 2020 to about 6.4% below pre-pandemic projections, according to a report in Statista.[6] Finally, the policy response has greatly increased federal debt, as Congress rushed relief and recovery funds to American families, businesses, and state and local governments. The new legislation is projected to raise federal debt by $5.3 trillion over the next decade,[7] with federal debt approaching 109% of GDP in fiscal year 2021.[8]

Preparing for the next outbreak is, however, not an easy task. One reason is that the Covid-19 pandemic may be atypical and thus a poor guide to average or expected pandemic-related losses. Many years can pass with no new infectious disease being reported; in other years, new diseases—such as Middle East Respiratory Syndrome (MERS)—which emerged in 2012 and is also caused by a new coronavirus, spread slowly and are controllable through traditional public health measures. A 2018 report in the *Bulletin of the World Health Organization* modeled the risks of influenza pandemics using global influenza data since the 1770s. It reported expected mortality for the world of 720,000 pandemic influenza deaths annually and expected annual economic losses of about a half-trillion dollars globally.[9] But estimates of risk based on such long-term data may be of limited use as a guide to the future because of changes in technology and human behavior. Thanks to inexpensive jet travel, people carry viruses or other pathogens across oceans and continents in a day. Moreover, adventure-seeking travelers and thrill-loving foodies eat wild game sourced from environments where animals harboring pathogens might once have been undisturbed.

Another complication is the multitude of viruses that may infect humans and the variety of animal species that can host them. A 2012 study published by the United Kingdom's Royal Society identified 219 virus species able to infect humans and reported that three or four new such species are found every year.[10] These viruses reside in a wide variety of warm-blooded animals, rendering surveillance and monitoring challenging. For example, a 2020 study in *Nature Reviews Microbiology* reported that bats—constituting some 22% of all named mammalian species—have been identified as natural reservoir hosts for several viruses that can induce severe disease in humans, including the Marburg, Hendra, and Nipah viruses.[11] Additionally, "accumulating evidence suggests that other emerging viruses, such as Ebola viruses, severe acute respiratory syndrome coronavirus (SARS-CoV), and Middle East respiratory coronavirus (MERS-CoV), also originated in bats," even if other hosts are proximate reservoirs for human infection.[12]

Small nocturnal flying mammals that defecate on other animals and food sources are not the only concern. Avian influenza A of subtype H5N1 infected both wild birds and poultry flocks and killed dozens of people annually in Asia beginning in 2004, without gaining the ability to easily jump from one person to another.[13] In 2013, a second bird flu (of type H7N9) appeared in several regions in China, although it also did not lead to sustained human-to-human spread.[14] In 2014 and 2015, some 44 million birds were culled from poultry flocks in the Midwest to prevent the spread of a "highly-pathogenic" bird flu of subtype H5N2, thought to originate in wild birds migrating from Alaska.[15] Economy-wide losses from H5N2 reached $3.5 billion, and several countries imposed import bans.

Viruses that can threaten public health can originate in several wild and domesticated species of mammals and birds and can involve reassortment (a genetic mixing) of various virus species in ways that are hard to predict or monitor. In 2009, a flu pandemic of subtype H1N1, also called a swine flu, killed more than 10,000 Americans.[16] That subtype emerged from pigs in Mexico, but it was later shown to result from a reassortment of two types of swine virus. One was itself a reassortment of swine, avian, and human virus that had been latent for years.[17] Finally, Human Immunodeficiency Virus (HIV) reminds us that zoonotic viruses can lead to devastating pandemics even without transmission through respiratory passages.

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President Biden stressed pandemic preparedness in one of his first executive actions. On January 20, 2021, he signed Executive Order 13987, which required, within 180 days, a review of emerging domestic and global biological risks and national bio-preparedness policies. It directed the review to incorporate lessons from the Covid-19 pandemic.

The White House instead released on September 3 a new report, "American Pandemic Preparedness: Transforming Our Capabilities."[18] The report announced that the administration is engaged in a whole-of-government review and update of U.S. national biopreparedness policies. The work will culminate in the release later this year of the Administration's "strategy on biodefense and pandemic readiness."

The new report is big on new budget needs—$65 billion over 7-10 years, including some $15 billion already pitched to Congress—but short on analysis, consisting of four sections: introduction, goals, summary of goals and funding. President Biden's E.O. 13987 appropriately stated that the 180-day review and recommended actions "shall incorporate lessons from the COVID-19 pandemic." Regarding lessons learned from Covid, the new report declared to the contrary, "While there are important lessons to be learned from COVID-19, we must not fall into the trap of preparing for yesterday's war."

One lesson of Covid overlooked to date was that it has flourished not because people were unaware of the threat, but because they lacked actionable information necessary to justify appropriate investments in safety. However, there is no mention of crucial subjects such as using insurance-linked securities or other private-sector contracts to help reduce pandemic-related financial risks.

The neglect of these areas is troubling. First, most risks, both natural and those associated with engineered systems, entail financial losses that can be reduced by strategies involving insurance policies or specialized financial instruments. Insurance for fires, motor vehicle accidents, floods, crop loss, and loss of life all serve to mitigate losses to families and businesses. To the extent that the prices of such insurance are driven by risk, insurance can drive private risk-reduction efforts. The challenge—which, this paper will argue, is not insurmountable—is that financial losses from infectious disease have generally been seen as uninsurable, leaving families and businesses exposed to these risks.[19]

Second, the performance of federal actors in the fight against the pandemic has been disappointing. Despite an abundance of high-tech capabilities and a national strategic stockpile[20] of medical products to support preparedness for public health emergencies, the U.S. has experienced Covid cases and deaths well beyond its share of the global population.[21] Federal agencies were slow to develop, authorize, and deploy effective diagnostic tests,[22] a failure that experts have since identified as a crucial misstep in the national response.[23] CDC, the agency created to control and prevent disease, seemed to fail at multiple tasks essential to its core mission. Indeed, the agency's deployment of a faulty diagnostic test hobbled local detection efforts at a key moment in the spread of Covid. CDC also was late in acknowledging that Covid-19 spreads through aerosols that linger in the air and do not fall to the ground within six feet—facts essential to understanding the value of meeting outdoors and improved ventilation.[24]

Third, without new mechanisms for private-sector risk-sharing, another pandemic would likely lead to an unacceptable worsening of federal indebtedness. In its annual Long-Term Budget Outlook, the Congressional Budget Office (CBO) found that the growing debt burden could increase the risk of a fiscal crisis and higher inflation.[25] The Congressional Research Service reported in March: "The current and projected size of deficits and the rising debt-to-GDP (Gross Domestic Product) ratio are a topic of concern for many economists and policymakers given that FY2020 deficits and debt as a share of GDP were the largest on record since World War II."[26] CBO's March forecast did not include the $1.9 trillion American Rescue Plan signed by

President Biden on March 12, which represents about 9% of gross domestic product.[27] The forecast also did not reflect pending federal spending on infrastructure. Some private-sector alternatives to large-scale federal relief and support may reduce pressures for comparable spending in the event of a future pandemic.

Finally, private organizations—for-profit and nonprofit—employ most American workers. Inducing these organizations to take sensible steps to prepare for the next pandemic will require market signals about the different types of pandemic risk that different organizations face. Such signals do not currently exist, and EO 13987 does not address how to foster their development.

The remainder of this paper provides background information on pandemics, analyzes why the general awareness that a pandemic was likely in the near term did not lead to greater action before the Covid-19 outbreak, and makes recommendations for the assessment, prevention, and management of risks posed by pandemics. The federal government should take steps to promote periodic structured expert judgment studies of pandemic risks, and greatly increase surveillance and prevention activities conducted in a revised PREDICT program under the US AID. Crucially, it should examine and correct all regulatory and legal obstacles impeding the growth of robust prediction markets for pandemics and pandemic-related catastrophe bonds, including measures to allow such bonds to be traded on secondary markets.

Warnings Ignored

Years before Covid-19, there were many predictions that the U.S.—and the world—could expect a pandemic. Bill Gates, a major supporter of global public health initiatives through the Bill and Melinda Gates Foundation—and a widely respected voice—gave a 2015 TED Talk describing that the country was unready for an outbreak.[28] In 2017, the Department of Health and Human Services (HHS) issued a public report on the state of influenza pandemic preparedness.[29] A 2018 *Washington Post* story reported that Gates had urged President Trump to prepare for a pandemic that could kill tens of millions.[30] Later that year, Lisa Monaco and Vin Gupta published an essay in *Foreign Policy,* "The Next Pandemic Will Be Arriving Shortly."[31] Hollywood, for its part, pumped out a steady stream of movies like *Outbreak* (1995), *I Am Legend* (2007), and *Contagion* (2011) about apocalyptic pandemics. And in September 2019, Laurie Garrett, a former senior fellow for the Council on Foreign Relations, published "The World Knows an Apocalyptic Pandemic Is Coming: But Nobody Is Interested in Doing Anything About It."[32] Garrett's article now appears prescient.

To be sure, significant pandemic prevention efforts predate Covid-19. Since its creation in 2009, the U.S. Agency for International Development's (USAID) Emerging Pandemic Threats (EPT) program received about $200 million, until its funding was cut in late 2019.[33] EPT's three overarching purposes—the prevention of new zoonotic diseases (from bacteria, viruses, or other pathogens jumping from animals to humans), the early detection of new threats when they do emerge, and their timely and effective control—seem essential in light of the current pandemic. Since 2009, PREDICT, a project of the EPT program based at the University of California–Davis, had worked to strengthen global capacity for detection of viruses with pandemic potential that can move between animals and people.

Several international organizations have also sought to prepare for and respond to pandemics. WHO developed a framework to describe the progression of emerging pandemic diseases, beginning with the first known human infection and ending when the disease becomes seasonal, as with flu. In the first phase, a potential pandemic-causing pathogen may be identified circulating among animals, but it has yet to infect a human host. The second phase occurs

when there are known cases of human infection. The next stage may occur when small clusters of human cases are identified, possibly including human-to-human infection in rare cases. In these early stages, the risk of a pandemic is not known—and indeed, an outbreak can go completely unnoticed or unreported. Diseases can even persist in the first three stages for decades without subsequent emergence onto a regional or global level.[34] WHO's recommended actions in these stages largely focus on surveillance, communication, and health-system preparations.[35] A country that successfully implements these steps may be able to keep the disease from becoming more widespread.

When a community-level infection begins, with sustained outbreaks in one area, an emerging disease enters the fourth phase and may threaten to become a pandemic.[36] At this point, WHO recommends that containment measures be implemented and surveillance of affected areas ramped up. When a disease has spread to another country in the same WHO region (e.g., the Americas, eastern Mediterranean, etc.) and to another country in a *different* WHO region, it enters phases 5 and 6—a global pandemic—respectively. During these phases, WHO calls health systems at all levels to activate their pandemic contingency plans and to implement the now-familiar social distancing and other risk-mitigating measures.[37]

Agencies other than WHO also work to limit damages from pandemics. Following the 2014–16 Ebola outbreak in West Africa, the World Bank launched the Regional Disease Surveillance Systems Enhancement (REDISSE) program to help protect countries from epidemic threats due to Ebola and other pathogens, including the novel coronavirus.[38] The lion's share of current pandemic-related World Bank funding appears related to vaccines for Covid-19 and not to prepare for the next pandemic.[39] The OIE (formerly known as the Office International des Epizooties), created in 1924 to protect animal health, has long had a focus on emergency preparedness and response planning for outbreaks of contagious new animal diseases, including in areas that previously had no such disease.[40] Controlling outbreaks of novel varieties of bird flu and swine flu is thus its responsibility once they pose risks to domesticated animals.

Nevertheless, it has become clear that the prevention efforts of WHO, the World Bank, OIE, and USAID were insufficient in light of the current pandemic—at least they did little to offer actionable information before Covid was already spreading in multiple countries.

The origins of Covid-19 are unclear. A U.S. intelligence report presented to President Biden in August did not provide a definitive conclusion about the origins of Covid-19, according to a *Wall Street Journal* report.[41] The more common narrative is that the outbreak arose from mutations and reassortments of an earlier novel coronavirus harbored in bats, and perhaps later in pangolins, before transmission to humans through the sale of wild animals at a market in Wuhan. At this point, no reservoir of the novel coronavirus has been reported among wildlife in China or elsewhere. Yet the implications of this fact are unclear, since scientists have also been unable to identify reservoirs of other emerging infectious diseases. An alternative origin—an accidental release following an experiment at the Wuhan lab to modify wild viruses and examine how they perform—is also possible. Chinese virologists and one foreigner working at the lab have denied knowledge of any such accident,[42] but the *Wall Street Journal* has cited unnamed U.S. government officials as saying that three staff at the Wuhan lab were hospitalized in November 2019 for respiratory ailments consistent with both Covid-19 and common seasonal illness.[43] A team of scientific experts assembled by WHO recently reported that the window of opportunity for key scientific studies to the origin of Covid-19 is closing.[44] The merits of lab research on virus capabilities and limits on such research deserve much more serious consideration but are beyond the scope of this report. Importantly, a lab origin for the novel coronavirus does not mean that a natural origin for the next pandemic is less likely.

Pandemic Predictions: The Public Policy Paradox

In retrospect, there appear to be several reasons for Laurie Garrett's 2019 lament that an apocalyptic pandemic was surely on the way but nobody was interested in doing anything about it. First, consider the scarcity of information about the likelihood of a new pandemic. Before the recognition of the Covid-19 pandemic in 2020, there was no quantitative estimate of the risk that one might occur in a given year. I am unaware of a published model that projected, for example, the odds of a pandemic in 2020 killing at least 300,000 Americans,[45] or ruled out that such odds were, say, less than one in a thousand.

Public health experts agree that future pandemics are unpredictable. CDC states that "it is impossible to predict when the next pandemic will occur" in describing the analytic tools that it has developed.[46] These tools include a Pandemic Intervals Framework, describing the stages of development of a pandemic, the Influenza Risk Assessment Tool, and a Pandemic Severity Assessment Framework.[47]

"Biological threats are increasing," the administration's new report on pandemic preparedness states, "whether naturally occurring, accidental, or deliberate, and the likelihood of a catastrophic biological event is similarly increasing." The claim that the likelihood of a catastrophic event is increasing seems bold, since if it is not quantified or quantifiable, how does one know it is increasing? Indeed, before Covid-19—and with the exception of HIV/AIDS, which is now a serious disease with multiple safe and effective treatments—U.S. mortality from each new pandemic or emerging disease had been falling for more than a century, even while population was rising. As for Covid, much of the U.S. mortality was avoidable in principle—per capita Covid-19 mortality in Australia, according to the Worldometer, was 50 times less than in the U.S. This is not to say that risks are not rising, but rather that there is no agreement about how to quantify severity or likelihood of future pandemics.

Several factors underlie this unpredictability. Importantly, there is no agreement on a quantitative definition for a pandemic.[48] Many possible definitions—the numbers of people or percentage of the population who fall sick from a new disease in a given period—are hard to apply empirically. What, exactly, is meant by falling sick from a new disease? Under alternate definitions, an epidemiological model produces different estimates of the probability of a pandemic.[49]

Another problem: precise estimates of the current number of infected individuals—and consequently, the chance of a major outbreak in the future—cannot be inferred from data on symptomatic cases alone.[50] Instead, an accurate prediction of whether an epidemic will occur requires that records of symptomatic individuals be supplemented with data on the true infection status of apparently uninfected individuals. Timely acquisition of such data early in outbreaks of emerging disease is daunting, however, because reliable diagnostic tests are so scarce at that point.

Finally, the course of novel infectious diseases involves nonlinear dynamics, with positive feedback loops driven by the fact that the biggest risk factor for acquiring an infection is the presence of infected individuals.[51] Put differently, small uncertainties in initial conditions, such as the number of infected individuals, have large implications for the eventual size of the outbreak.

Emerging diseases and pandemics may also be unpredictable because of the intrinsic complexity of processes governing exposure to and movement of domestic and wild mammals and birds, as well as mutation and reassortment of viruses. A 2017 report for the World Bank noted that the introduction of a pathogen to humans—a spark—could come from domesticated animals or wildlife and be driven by the hunting and consumption of bushmeat, the use of animal-based traditional medicine, and the extraction of natural resources, e.g., logging and silviculture. The risk that a spark will spread depends on genetic adaptation, the mode of transmission, the ease and extent of human movement, and the speed and effectiveness of public health and surveillance measures.[52] The report concluded that both the spark risk and the spread risk are heavily influenced by these different human activities.

Second, consider the paradox created by modern performance-based management practices. For decades, federal agencies seeking congressional appropriations have been asked to justify their requests for funding with performance commitments—that is, quantifiable improvements in outcomes that matter to voters and taxpayers. For the Food and Drug Administration (FDA), such performance commitments include reductions in cases of food-borne illness related to foods that the agency regulates.[53] For the Environmental Protection Agency, performance may be measured by enforcement actions against polluters that cause air pollution to exceed safe levels.[54]

The responsibility for pandemic preparedness in the U.S. lies with the federal Department of Health and Human Services (HHS), which oversees CDC and FDA, and, in particular, the Office of the Assistant Secretary for Preparedness and Response (ASPR). ASPR seeks to save lives and protect Americans from 21st-century health-security threats by leading the nation's medical and public health preparedness for, response to, and recovery from disasters and public health emergencies.

In 2017, HHS claimed that it had "made substantial progress in pandemic influenza preparedness since the 2005 Plan was released." It spoke of "the successes and remaining gaps in our preparedness and response activities for pandemic influenza. Most significantly, HHS efforts in pandemic influenza preparedness now are closely aligned with seasonal influenza activities, harnessing expanded surveillance, laboratory, vaccine, and antiviral drug resistance monitoring capacity."[55] Curiously, the report focuses exclusively on pandemic influenza preparedness without mentioning the possibility of non-influenza pandemics, even though two different coronaviruses had recently caused international outbreaks of two new deadly infectious diseases, SARS and MERS.

The tone—substantial progress, successes, and remaining gaps—is professional, avoiding alarm, although alarm was fully merited. Here, it is important to see that, *in the absence of information about the likelihood of an emerging disease of a given infectiousness or lethality*, there was little basis for Congress to appropriate the increases in funding necessary to avoid the most devastating effects of the Covid-19 pandemic. Moreover—and perhaps as important—without any recent experience with a serious new infectious disease, members of Congress and many in the business community did not seem to understand the peril from a pandemic and thought it remote.

To see the difficulty, consider instead a sundry environmental health risk—such as illness from eating contaminated leafy greens or drinking improperly treated tap water. In that instance, Congress, members of the public, and journalists would know to ask about increases in the incidence of illness from E. coli or cryptosporidium. With pandemics, however, available data systems and lack of familiarity left many decision-makers in the dark while a pandemic was forecast.

A third major explanation for Garrett's lament is the lack of private-sector financial instruments *to signal changes in risk* or to protect households and businesses. No bonds or other insurance-linked securities are known to exist for outbreaks of a new infectious disease or pandemic. Without financial instruments to provide information to policymakers or business leaders about how markets viewed relevant risks, conventional business planning decisions—whether to develop or expand contingency plans for telework, for example, or to stockpile personal protective equipment—were handicapped by the lack of market benchmarks. In addition, the lack of such instruments makes it more difficult to make money by developing better means of predicting pandemics—limiting such efforts to those funded by government agencies and philanthropists.

Recommendations

The greater involvement of the private sector in pandemic preparedness will require taking additional steps toward predicting their occurrence, as well as reducing and sharing the risks to the economy and society.

First, there needs to be a reasonably credible estimate of the probability that a pandemic of a given severity will occur by a given date. If a quantitative risk assessment is developed and published periodically, upward trends could be noted at an early stage. Such estimates could help provide an empirical basis for deliberations over congressional funding for federal pandemic preparedness.

Information about the probability of a pandemic occurring could also be useful to businesses and households for long-term financial planning. For example, a small retail business might think about the need for high cash reserves differently if the probability of a moderately severe pandemic in three years is 3% as opposed to 1%. Similarly, a firm making residential window fans or outdoor home furniture may consider differently a potential investment in additional production capacity if the probability of a moderately severe pandemic in three years is 3% instead of 1%. A family seeking additional care for an older grandparent might think twice about a move to assisted living if told the moderately severe pandemic might occur with a probability of 3% instead of 1% over the next five years. Today, as in 2019, no such pandemic forecast is available to policymakers, let alone heads of businesses large or small.

Second, there need to be financial instruments to allow firms and households to protect against the financial risks of pandemics. Service industries—including airlines (and aircraft manufacturers), hotels, restaurant chains, cruise lines, and the travel industry generally—were very hard hit by the pandemic. So, too, were manufacturers and distributors of business apparel for men and women. At the same time, the pandemic made winners of private enterprises making goods or services that could aid people and businesses. Apart from vaccine developers and makers of personal protective equipment, such winners included the tech giants offering telecommunications hardware and software including Apple, Google, and Microsoft. Other winners included makers of UV lighting systems capable of zapping coronaviruses, medical-grade indoor air-filtration systems, and lumber mills trying to meet unanticipated growth in demand for residential construction. The disparate effects of the Covid pandemic across different industries, coupled with the adverse effects of the legislative response on federal indebtedness, suggest that private-sector risk-sharing mechanisms deserve another look.

There are several complementary approaches to implementing these recommendations. The approaches differ in terms of their cost and technical feasibility, as well as how much time they may take to implement. They focus on ways to develop estimates of the probabilities of new outbreaks of emerging diseases or pandemics and to motivate reduction or sharing of losses from such events. These approaches include:

- Periodic structured expert judgment

Many technical questions involving substantial uncertainty, including power plant safety and earthquakes,[56] have been addressed through the use of structured expert judgment studies.[57] Such studies involve asking recognized experts specific, carefully crafted questions that are of interest to decision-makers and very hard to answer using any other method. For example, experts might be asked to consider a hypothetical new respiratory disease with the same efficiency of human-to-human transmission and the same fatality risks as measles. They might be asked how many deaths would occur within 12 months among people who fall ill from the new disease, assuming that no preventive actions are taken until 100 or 1,000 people have contracted it.

One expert judgment study in 2006 addressed pandemic influenza risks from the specific bird flu H5N1.[58] It concluded that there was a 15% chance of efficient human-to-human transmission in the next three years. Such explicit and easy-to-interpret estimates are not found in reports on pandemic preparedness by federal or international public health agencies.

Expert judgment methods can incorporate uncertainty by presenting a probability distribution rather than a single point estimate.[59] In addition, some expert methods weigh the judgments of various experts by how well they answer questions with knowable answers that are closely related to the research question at hand. These methods reduce the sensitivity of results to the identities of participating experts.[60] Finally, the convenience and low cost of such methods may permit their repeated use at regular intervals to identify trends.

- Collecting, organizing, and synthesizing big data

A big data early warning system approach, as was sketched in the Sepetember 3 White House report, would build upon the USAID's now-defunct PREDICT program, including surveillance and testing of livestock, poultry, and wildlife of special concern for the presence of viruses either novel or of special interest. PREDICT sought to identify where pathogens are most likely to spill over to humans, where they will amplify, and who is at risk.[61] It also sought to provide information on which pathogens are most likely to become pandemic and which control strategies can be most effective.[62]

PREDICT would need a major modernization to go beyond updating the cataloging of first occurrences of emerging infectious disease outbreaks that EcoHealth Alliance conducts for its Emerging Infectious Disease Repository.[63] This would entail systematic surveillance and testing for the presence of disease, as well as the development and qualification of *semi-quantitative estimates of the risks of spillovers to humans*. A 2020 study suggested that such monitoring coupled with preventive measures, including changes in land use such as logging, would likely pass a benefit-cost test if it reduced modestly the risks of a Covid-scale pandemic.[64] Bioinformatics[65] could be used to develop indices of the likelihood of reassortment leading to new functionality that could promote infectivity in humans. This approach would likely be time-consuming; it would require a major investment and renewed international cooperation in the collection and analysis of specimens outside the United States. It would also require novel systems for data integration and synthesis.

The administration's new pandemic preparedness report mentions early warning goals: early warning systems that would consist of improved viral threat detection in clinical settings and through environmental monitoring of wastewater, aggregation of public health information, and the creation of early warning networks to better share data internationally. The proposed budget for these goals, or perhaps simply progress towards them, is $3.2 billion, over the 7–10-year planning horizon, a modest share of total budget of $65 billion. The report offers, however, no information about how much the different budget items would improve national preparedness. It lacks information on performance from the proposed investments, either in aggregate or by specific item. Regardless, early warning systems, if well managed, may be key to keeping small outbreaks of emerging disease to becoming uncontrollable infectious disease.

- Prediction markets

Prominent economists, including Nobel Prize winners Kenneth Arrow, Thomas Schelling, Robert Schiller, and Vernon Smith, argued for the creation of prediction markets (aka event markets) to aggregate information from large numbers of people about the likelihood that uncertain events will actually occur.[66] They recommended that the Commodity Futures Trading Commission (CFTC) establish safe-harbor rules for selected small-stakes markets and that Congress should support the commission's efforts.

A prediction market allows interested parties to make a bet—say, five cents—that a pandemic of a specific severity or worse will occur by a target date—say, December 31, 2024. Each such bet requires a willing party to take the opposite bet, 95 cents, that no such pandemic occurs by that date. The broker, who solicits and matches such bets, holds payments for both bets until the target date or the event, whichever is first, and pays the winner the sum of both payments—one dollar—once the outcome is clear. Such information is credible because it can elicit participation from large numbers of people with access to public and private information.

A 2016 study of prediction markets created in Taiwan for a period of 31 weeks considered five disease indicators (confirmed cases of dengue, severe and complicated influenza, the rate of influenza-like illnesses, confirmed cases of severe and complicated enterovirus infection, and the rate of enterovirus infections).[67] The markets predicted the trends of three out of five disease indicators more accurately than the preexisting system. Markets that allowed more participants and persisted for longer periods might lead to more precise estimates.

In this country, CFTC regulates prediction markets for such bets, called "event contracts." It prohibits event contracts that deal with or refer to "terrorism, assassination, war, gaming, or an activity that is unlawful under any State or Federal law."[68] Any entity desirous of running a prediction market must file with CFTC to become a Designated Contract Market (DCM), which will then operate much like a traditional futures exchange.[69]

KalshiEx LLC was granted DCM status in November 2020.[70] With a maximum allowed risk exposure inexplicably limited by CFTC to $25,000 per contract, it offers event contracts as a way to offer direct risk-hedging options.[71] Kalshi has announced a collection of markets in beta version and recently launched a market for whether the CDC will identify a coronavirus variant of high consequence.

Prediction markets offer information to nonparticipants about the odds of future events and a simple way to protect against certain risks. For example, the owner of a brick and mortar retail business facing the (nearly) complete loss of revenue from a pandemic might find it useful to place 100,000 bets of a pandemic occurring in the next three years. Such a bet might cost $5,000 but pay out $100,000 in the event that the pandemic occurs. Similarly, producers of UV lighting systems that kill viruses, or improved ventilation systems, might be willing to pay $95,000 in the form of 100,000 bets of $0.95. These bets would return $1.00 in the common

scenario where no pandemic occurs, offering a modest return well above current real interest rates, in exchange for a loss of $0.95 in the event of a pandemic. These firms could find such losses acceptable during a pandemic because it would coincide with large spikes in demand for the products that they sell.

A technical challenge with prediction markets for pandemics is ambiguity about what exactly is a pandemic. Definitions based on public reports of the number of confirmed cases of a new infectious disease may be impractical because of inconsistent definitions of a confirmed case, a shortage of diagnostic tests, and incomplete reporting by relevant government authorities. To illustrate, on January 5, 2020, WHO reported that there had been 44 cases of pneumonia in Hubei Province, China, from an unknown cause.[72] Two weeks later, there were only about 200 confirmed cases of SARS-CoV-2—Covid-19—and three known deaths.[73] Seventeen months later, researchers with the National Institutes of Health reported evidence that the coronavirus had traveled to America as early as December 2019—well before identification of the pathogen, and nearly a month in advance of the first confirmed American case.[74] Thus, counts of confirmed cases remain uncertain and subject to lengthy debate by analysts. Other potential definitions, such as the determination of a public health emergency for Covid on January 31, 2020, by Secretary of Health and Human Services Alex Azar, are not clearly linked to objective criteria, and applied to challenges quite different from Covid-19, including the opioid crisis, the outbreak of Zika virus, the 2009 presidential inauguration, and the H1N1 flu outbreak.

- Insuring Pandemic-Related Business Interruption Risks.

Regardless of how pandemics are defined, the lost revenues and profits from pandemic-related interruptions of business activities are widely seen as very hard to insure, and extant business interruption insurance policies generally exclude disease outbreaks from coverage.[75] Losses can hit (nearly) all insured parties concurrently, or at least in the same one- or two-year period. Losses, which are difficult to measure, are not determined entirely externally but result partly from management decisions to close and largely from government shutdown and lockdown orders. Losses from moderately severe pandemics may be so large as to threaten the solvency of many insurers. In addition, estimating the probability of pandemics (or outbreaks of emerging infectious disease) of a given level of severity is currently beyond the capabilities of published models. Thus, premiums in this environment may be unaffordable.[76] Unsurprisingly, witnesses at a recent House subcommittee hearing, including an economic expert[77] and a representative of Chubb (the largest U.S. commercial insurer),[78] agreed that pandemics are uninsurable.

A 2020 white paper by Lloyd's of London, however, outlined a set of insurance innovations that might improve risk-sharing for events like the Covid-19 pandemic.[79] A common thread of the innovations is dependence on "partnerships" between the insurance industry and sovereign governments, which would subsidize the payment of premiums, or backstop the payouts when qualifying events are triggered and payouts exceed the capacity of the insurers. In the Lloyd's paper, future pandemics are placed with systemic catastrophic "black swan" events, notwithstanding their recurring nature. That's because, according to Lloyd's, they are similar to events such as widespread telecommunications or utility failures, either from space weather phenomena (such as the Carrington Event, a massive solar storm in 1859 that caused widespread damage to telegraph systems) or regional cyberattacks.[80]

Another approach to insuring business interruption risks, which might be feasible with minimal government support, is catastrophe bonds (cat bonds), a type of insurance-linked security. Cat bondholders bear the risk of catastrophes—they would lose some interest payments and/or principal—in exchange for coupon (interest) payments higher than would be the case without that risk. A cat bond requires a "trigger," i.e., an uncertain future event, that is promptly

and objectively verifiable and that—if it occurs—would initiate a particular contractual provision. Triggers can be based on either a loss of a prespecified amount, or an objective and easily verifiable event.

According to the Lloyd's report, the global *reinsurance* industry has an opportunity to work with the capital markets to provide parametric protection for pandemics and non-damage business interruption through devices such as catastrophe bonds. Cat bonds may be attractive because the value of capital markets is estimated to be $180 trillion, while the global commercial (re) insurance industry's total capital base is around $2 trillion.[81] Currently, only a relatively small proportion of the former amount is used to take on insurance risk to diversify against market risk. Yet such diversification may offer value because pandemic risks and market risks are not perfectly correlated: recessions, which occur regularly, do not lead to pandemics.

Unfortunately, most cat bond activity appears to occur in Europe, not the United States. In addition, while such bonds have existed for several years, there is no indication that the number or value of cat bonds intended to share pandemic-related risks has grown since early 2020. Indeed, the total global capital for cat bonds was about $46 billion in 2020—less than one-tenth of what was available in the reinsurance market.[82] Finally, there is little evidence that small investors participate in cat bond markets.

The federal government should examine what regulatory or legal impediments may exist for the greater use of cat bonds in the U.S. for private parties to share risks of pandemics (or other natural catastrophes).

Conclusion

The pre-Covid awareness of a pending pandemic that happened without adequate preparations has led the Biden administration to an assessment of how to ensure that preparations are more thorough before the next such disaster. This paper urges that the government take additional steps with an eye toward increasing private-sector involvement in assessing, mitigating, and sharing such risks. This means promoting periodic structured expert judgments of pandemic risks, greatly increasing the surveillance and prevention activities conducted by a revived PREDICT program under the auspices of USAID. And crucially, it should examine and correct all regulatory and legal obstacles impeding the growth of robust prediction markets for pandemics and pandemic-related catastrophe bonds, including measures to allow these bonds to be traded on secondary markets.

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Endnotes

1 Amy Maxmen, "Has Covid Taught Us Anything About Pandemic Preparedness?" *Nature* 596 (Aug. 19, 2021): 332–35.

2 World Health Organization (WHO), "WHO Coronavirus (COVID-19) Dashboard."

3 Centers for Disease Control & Prevention (CDC), "COVID Data Tracker."

4 CDC, "Cases, Data, and Surveillance," May 19, 2021.

5 David M. Cutler and Lawrence H. Summers, "The COVID-19 Pandemic and the $16 Trillion Virus," *JAMA* 324, no. 15 (Oct. 20, 2020): 1495–96.

6 M. Szmigiera, "COVID-19: Forecasted Global Real GDP Growth 2022," Statista, June 4, 2021.

7 Relief measures enacted in FY2020 are projected to raise deficits over the following 10 years by $2.6 trillion. President Trump signed into law additional Covid-related relief and stimulus of $868 billion in the Consolidated Appropriations Act, 2021 (P.L. 116-260). Finally, the American Rescue Plan Act of 2021 will increase deficits by more than $1.8 trillion over the next 10 years. See Linda R Weinstock, "Federal Deficits, Growing Debt, and the Economy in the Wake of COVID-19," Congressional Research Service (CRS), Mar. 23, 2021.

8 Fitch Ratings, "US Stimulus Will Boost Growth at a Cost of Higher Deficits, Debt," Mar. 9, 2021.

9 Victoria Y. Fan, Dean T. Jamison, and Lawrence H. Summers, "Pandemic Risk: How Large Are the Expected Losses?" *Bulletin of the World Health Organization* 96, no. 2 (Feb. 1, 2018): 129–34.

10 Mark Woolhouse et al., "Human Viruses: Discovery and Emergence," *Philosophical Transactions of the Royal Society B: Biological Sciences* 367, no. 1604 (Oct. 19, 2012): 2864–71.

11 Michael Letko et al., "Bat-Borne Virus Diversity, Spillover and Emergence," *Nature Reviews Microbiology* 18, no. 8 (August 2020): 461–71.

12 Ibid.

13 WHO, "Cumulative Number of Confirmed Human Cases for Avian Influenza A (H5N1) Reported to WHO, 2003–2012," Aug. 10, 2012.

14 Declan Butler, "H7N9 Bird Flu Poised to Spread," *Nature News,* Apr. 15, 2013.

15 Joel L. Greene, "Update on the Highly-Pathogenic Avian Influenza Outbreak of 2014–2015," CRS, July 20, 2015.

16 CDC, "2009 H1N1 Pandemic."

17 Ignacio Mena et al., "Origins of the 2009 H1N1 Influenza Pandemic in Swine in Mexico," ed. Richard A. Neher, *ELife* 5 (June 28, 2016): e16777.

18 "American Pandemic Preparedness: Transforming Our Capabilities," whitehouse.gov, September 2021. Executive Order 13987, "Organizing and Mobilizing the United States Government to Provide a Unified and Effective Response to Combat COVID-19 and to Provide United States Leadership on Global Health and Security," *Federal Register* 86, no. 14 (Jan. 25, 2021).

19 Brian Kuhlmann, testimony, "Insuring Against a Pandemic: Challenges and Solutions for Policyholders and Insurers," Committee on Financial Services, Subcommittee on Housing, Community Development, and Insurance, U.S. House of Representatives, Nov. 19, 2020.

20 U.S. Dept. of Health and Human Services, "Strategic National Stockpile."

21 Jennifer B. Nuzzo, Jessica A. Bell, and Elizabeth E. Cameron, "Suboptimal US Response to Covid-19 Despite Robust Capabilities and Resources," *JAMA* 324, no. 14 (Oct. 13, 2020): 1391–92.

22 Stefan Thomke, "Why Is the U.S. Behind on Coronavirus Testing?" *Harvard Business Review*, Mar. 30, 2020.

23 Derek Thompson, "The Pandemic Mistake America Can't Repeat," *Atlantic*, Mar. 17, 2021.

24 Janice Hopkins Tanne, "COVID-19: CDC Publishes, Then Withdraws Information on Aerosol Transmission," *BMJ*, Sept. 24, 2020; Caroline Chen et al., "Key Missteps at the CDC Have Set Back Its Ability to Detect the Potential Spread of Coronavirus," *ProPublica,* Feb. 28, 2020.

25 Congressional Budget Office, "The 2021 Long-Term Budget Outlook," March 2021.

26 CRS, "Federal Deficits, Growing Debt, and the Economy in the Wake of COVID-19," Mar. 23, 2021.

27 Wendy Edelberg and Louise Sheiner, "The Macroeconomic Implications of Biden's $1.9 Trillion Fiscal Package," *Brookings Up Front* (blog), Jan. 28, 2021; Lawrence H. Summers, "The Biden Stimulus Is Admirably Ambitious. But It Brings Some Big Risks, Too," *Washington Post*, Feb. 4, 2021; Brian Riedl, "$1.9 Trillion Is Too Much and Biden and the Democrats Know It," Daily Beast, Mar. 4, 2021.

28 Bill Gates, "The Next Outbreak? We're Not Ready," TED Talk, March 2015.

29 U.S. Dept. of Health and Human Services (HHS), "Pandemic Influenza Plan: 2017 Update," 2017.

30 Lena H. Sun, "Bill Gates Calls on U.S. to Lead Fight Against a Pandemic That Could Kill 33 Million." *Washington Post*, Apr. 27, 2018.

31 Lisa Monaco and Vin Gupta, "The Next Pandemic Will Be Arriving Shortly," *Foreign Policy*, Sept. 28, 2018.

32 Laurie Garrett, "The World Knows an Apocalyptic Pandemic Is Coming," *Foreign Policy*, Sept. 20, 2019.

33 USAID, "Emerging Pandemic Threats Program (EPT-2)," July 12, 2021; CRS, "The Global Health Security Agenda (GHSA): 2020–2024," Mar. 16, 2020; Zachary Cohen, "Trump Administration Shuttered Pandemic Monitoring Program, Then Scrambled to Extend It," CNN, Apr. 10, 2020.

34 WHO, "Pandemic Influenza Preparedness and Response: A WHO Guidance Document," §4: The WHO Pandemic Phases, 2009.

35 WHO, "Pandemic Phase Descriptions and Main Actions by Phase."

36 WHO, "Pandemic Influenza Preparedness and Response," §4: The WHO Pandemic Phases.

37 WHO, "Pandemic Phase Descriptions and Main Actions by Phase."

38 World Bank, "Epidemic Preparedness and Response," Oct. 12, 2020.

39 World Bank, "World Bank Approves $12 Billion for COVID-19 Vaccines," Oct. 13, 2020.

40 World Organisation for Animal Health, "Emergency Preparedness and Response Planning," 2018.

41 Michael R. Gordon and Warren P. Strobel, "New U.S. Intelligence Report Doesn't Provide Definitive Conclusion on Covid-19 Origins," *Wall Street Journal*, Aug. 24, 2021.

42 Michelle Fay Cortez, "The Last—and Only—Foreign Scientist in the Wuhan Lab Speaks Out," Bloomberg.com, June 27, 2021.

43 Michael R. Gordon, Warren P. Strobel, and Drew Hinshaw, "Intelligence on Sick Staff at Wuhan Lab Fuels Debate on Covid-19 Origin," *Wall Street Journal*, May 23, 2021.

44 Marion Koopmans et al., "Origins of SARS-CoV-2: Window Is Closing for Key Scientific Studies," *Nature*, Aug. 25, 2021.

45 Farida B. Ahmad et al., "Provisional Mortality Data—United States, 2020," MMWR (Morbidity and Mortality Weekly Report), CDC, Apr. 9, 2021.

46 CDC, "National Pandemic Strategy."

47 See CDC, "Pandemic Intervals Framework (PIF)"; "Influenza Risk Assessment Tool (IRAT); "Pandemic Severity Assessment Framework (PSAF)."

48 Benjamin J. Singer, Robin N. Thompson, and Michael B. Bonsall, "The Effect of the Definition of 'Pandemic' on Quantitative Assessments of Infectious Disease Outbreak Risk," *Scientific Reports* 11, article 2547, Jan. 28, 2021.

49 Ibid.

50 Robin N. Thompson, Christopher A. Gilligan, and Nik J. Cunniffe, "Detecting Presymptomatic Infection Is Necessary to Forecast Major Epidemics in the Earliest Stages of Infectious Disease Outbreaks," *PLoS Computational Biology* 12, no. 4 (Apr. 5, 2016): e1004836.

51 Mark Woolhouse, "How to Make Predictions About Future Infectious Disease Risks," *Philosophical Transactions of the Royal Society B: Biological Sciences* 366, no. 1573 (July 12, 2011): 2045–54.

[52] Nita Madhav et al., "Pandemics: Risks, Impacts, and Mitigation," in *Disease Control Priorities: Improving Health and Reducing Poverty*, ed. Dean T. Jamison et al., 3rd ed. (Washington, DC: International Bank for Reconstruction and Development / World Bank, 2017), pp. 315–45.

[53] Food and Drug Administration (FDA), "2019 FDA Justification of Estimates for Appropriations Committees," Sept. 20, 2019.

[54] Environmental Protection Agency, "Fiscal Year 2019: Justification of Appropriation Estimates for the Committee on Appropriations," February 2018.

[55] HHS, "Pandemic Influenza Plan: 2017 Update," 2017, p. 5.

[56] K. S. Jaiswal et al., "Use of Expert Judgment Elicitation to Estimate Seismic Vulnerability of Selected Building Types," 15th World Conference on Earthquake Engineering, Lisbon, 2012.

[57] See Simon French et al., "Introduction and Overview of Structured Expert Judgement," in *Expert Judgement in Risk and Decision Analysis*, ed. Anca M. Hanea et al. (Cham: Springer International, 2021), pp. 1–16; Roger Cooke, "The Science of Forecasting: The Special Sauce," Resources for the Future, July 27, 2020.

[58] W. Bruine De Bruin et al., "Expert Judgments of Pandemic Influenza Risks," *Global Public Health* 1, no. 2 (2006): 179–94.

[59] Cooke, "The Science of Forecasting."

[60] Ibid.

[61] USAID, "PREDICT: Reducing Pandemic Risk, Promoting Global Health."

[62] Ibid.

[63] EcoHealth Alliance, "Emerging Infectious Disease Repository."

[64] Andrew P. Dobson et al., "Ecology and Economics for Pandemic Prevention," *Science* 369, no. 6502 (July 24, 2020): 379–81.

[65] According to the National Human Genome Research Institute, "Bioinformatics is a field of computational science that has to do with the analysis of sequences of biological molecules. [It] usually refers to genes, DNA, RNA, or protein, and is particularly useful in comparing genes and other sequences in proteins and other sequences within an organism or between organisms, looking at evolutionary relationships between organisms, and using the patterns that exist across DNA and protein sequences to figure out what their function is."

[66] Kenneth J. Arrow et al., "The Promise of Prediction Markets," *Science* 320, no. 5878 (May 16, 2008): 877–78.

[67] Eldon Y. Li, Chen-Yuan Tung, and Shu-Hsun Chang, "The Wisdom of Crowds in Action: Forecasting Epidemic Diseases with a Web-Based Prediction Market System," *International Journal of Medical Informatics* 92 (August 2016): 35–43.

[68] Commodity Futures Trading Commission (CFTC), "Provisions Common to Registered Entities," Final Rule, *Federal Register* 76, no. 144 (July 27, 2011): 44776.

69 CFTC, "Designated Contract Markets (DCMs)," n.d.

70 KalshiEx, LLC, "Kalshi Wins CFTC Approval for Exchange to Trade Event Contracts," Nov. 4, 2020.

71 KalshiEx, LLC, "Rulebook v 1.8.40," Aug. 6, 2021.

72 WHO, "Pneumonia of Unknown Cause–China," Jan. 5, 2020.

73 Peng Zhou et al., "A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin," *Nature* 579 (Feb. 23, 2020): 270–73.

74 "NIH Study Offers New Evidence of Early SARS-CoV-2 Infections in U.S.," National Institutes of Health (NIH), June 15, 2021.

75 Robert W. Klein and Harold Weston, "Government Insurance for Business Interruption Losses from Pandemics: An Evaluation of Its Feasibility and Possible Frameworks," *Risk Management and Insurance Review* 23, no. 4 (2020): 401–40.

76 Kuhlmann, "Insuring Against a Pandemic."

77 R. J. Lehmann, testimony, "Insuring Against a Pandemic: Challenges and Solutions for Policyholders and Insurers," Committee on Financial Services, Subcommittee on Housing, Community Development, and Insurance, U.S. House of Representatives, Nov. 19, 2020.

78 Michelle McLaughlin, testimony, "Insuring Against a Pandemic: Challenges and Solutions for Policyholders and Insurers," Committee on Financial Services Subcommittee on Housing, Community Development, and Insurance, U.S. House of Representatives, Nov. 19, 2020.

79 Lloyd's, "Supporting Global Recovery and Resilience for Customers and Economies: The Insurance Industry Response to COVID-19," 2020.

80 CDC, "1957–1958 Pandemic (H2N2 virus)."

81 Lloyd's, "Supporting Global Recovery."

82 Tobias Götze and Marc Gürtler, "Risk Transfer Beyond Reinsurance: The Added Value of CAT Bonds," *Geneva Papers on Risk and Insurance—Issues and Practice*, May 31, 2021.