Healthcare Systems & Services, Public Sector, and Social Sector Practices

Not the last pandemic: Investing now to reimagine public-health systems

The COVID-19 crisis reminds us how underprepared the world is to detect and respond to emerging infectious diseases. We must make smart investments now to simultaneously navigate COVID-19 and prepare for future pandemics.

by Matt Craven, Adam Sabow, Lieven Van der Veken, and Matt Wilson

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The COVID-19 pandemic has exposed overlooked weaknesses in the world's infectious-disease-surveillance and -response capabilities—weaknesses that have persisted in spite of the obvious harm they caused during prior outbreaks. Many countries, including some thought to have strong response capabilities, failed to detect or respond decisively to the early signs of SARS-CoV-2 outbreaks. That meant they started to fight the virus's spread after transmission was well established. Once they did mobilize, some nations struggled to ramp up public communications, testing, contact tracing, critical-care capacity, and other systems for containing infectious diseases. Ill-defined or overlapping roles at various levels of government or between the public and private sectors resulted in further setbacks. Overall, delayed countermoves worsened the death toll and economic damage.

Correcting those weaknesses won't be easy. Government leaders remain focused on navigating the current crisis, but making smart investments now can both accelerate COVID-19 response and strengthen public-health systems to reduce the chance of future pandemics. Investments in public health and other public goods are sorely undervalued; investments in preventive measures, whose success is invisible, even more so. Many such investments would have to be made in countries that cannot afford them.

Nevertheless, now is the moment to act. The world has seen repeated instances of what former World Bank president Jim Kim has called a cycle of "panic, neglect, panic, neglect," whereby the terror created by a disease outbreak recedes, attention shifts, and we let our vital outbreak-fighting mechanisms atrophy.[1] And while some are calling the COVID-19 crisis a 100-year event, we might come to see the current pandemic as a test run for a pandemic that arrives soon, with even more serious consequences. Imagine a disease that transmits as readily as COVID-19 but kills 25 percent of those infected and disproportionately harms children.

The case for strengthening the world's pandemic-response capacity at the global, national, and local levels is compelling. The economic disruption caused by the COVID-19 pandemic could cost between $9 trillion and $33 trillion[2]—many times more than the projected cost of preventing future pandemics. We have estimated that spending $70 billion to $120 billion over the next two years and $20 billion to $40 billion annually after that could substantially reduce the likelihood of future pandemics (Exhibit 1). These are high-level estimates with wide error bars. They do not include all the costs of strengthening health systems around the world. A comprehensive program of health-system strengthening at all levels would cost substantially more and also contribute to effective outbreak management. Our preliminary findings call for further investigation, but we hope the overall message is clear: infectious diseases will continue to emerge, and a vigorous program of capacity building will prepare the world to respond better than we have so far to the COVID-19 pandemic.

In this article, we describe the five areas that such a program might cover: building "always on" response systems, strengthening mechanisms for detecting infectious diseases, integrating efforts to prevent outbreaks, developing healthcare systems that can handle surges while maintaining the provision of essential services, and accelerating R&D for diagnostics, therapeutics, and vaccines (Exhibit 2).

From 'break glass in case of emergency' response systems to always-on systems and partnerships that can scale rapidly during pandemics

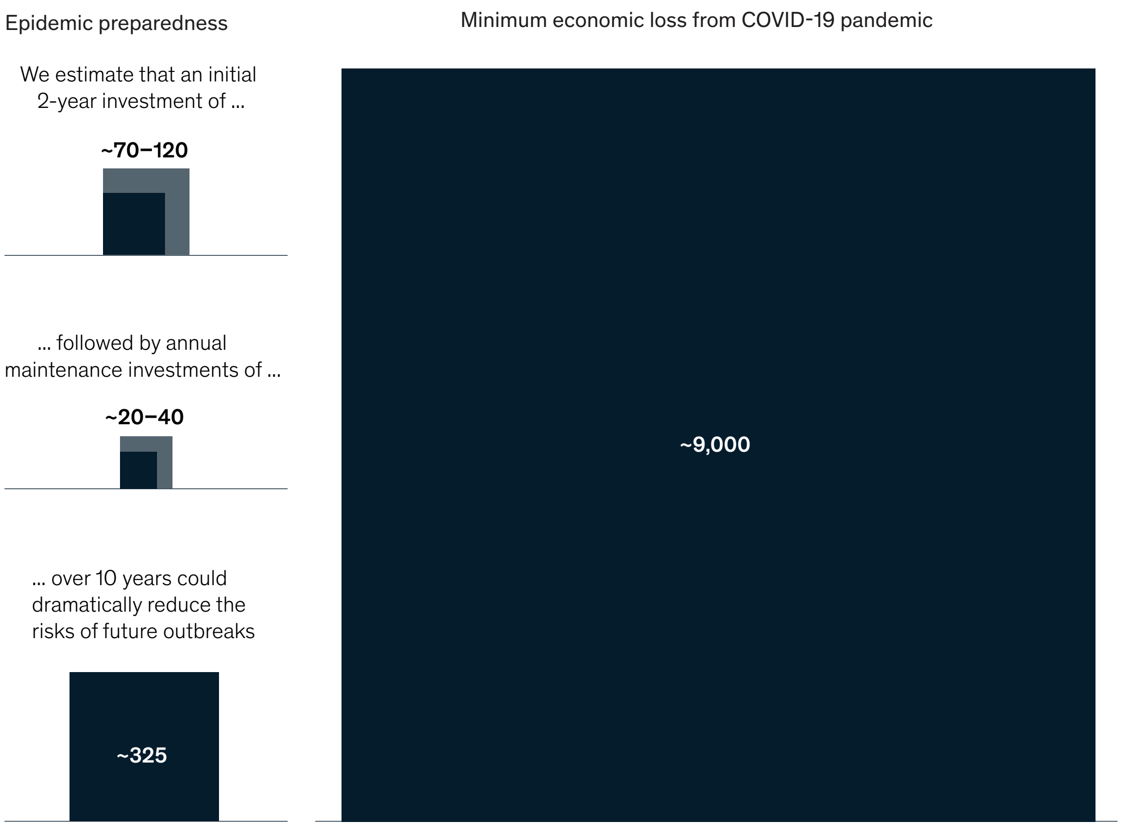
Responding to outbreaks of infectious diseases involves different norms, processes, and structures from those used when delivering regular healthcare services. Decision making needs to be streamlined; leaders must make no-regrets decisions in the face of uncertainty. But much of our present epidemic-management system goes unused until outbreaks happen, in a "break glass in case of emergency" model. It is difficult to switch on those latent

[1] Sophie Edwards, "Pandemic response a cycle of 'panic and neglect,' says World Bank president," Devex, April 5, 2017, devex.com.
[2] "Crushing coronavirus uncertainty: The big 'unlock' for our economies," May 2020, McKinsey.com.

Exhibit 1

Assuming a COVID-19-scale epidemic is a 50-year event, the return on preparedness investment is clear, even if it only partly mitigates the damage.

Estimated costs, $ billion



response capabilities suddenly and unrealistic to expect them to work right away.

A better system might be founded on a principle of active preparedness and constructed out of mechanisms that can be consistently used and fine-tuned so they are ready to go when outbreaks start (Exhibit 3). We see several means of instituting such an always-on system. One is to use the same mechanisms that we need for fast-moving outbreaks (such as COVID-19) to address slow-moving outbreaks (such as HIV and tuberculosis) and antimicrobial-resistant pathogens. Case investigation and contact tracing are skills familiar to specialists who manage HIV and tuberculosis. But few areas have deployed their experts effectively in responding to the COVID-19 pandemic.

Another way to build active preparedness is to form cross-sector partnerships—something that becomes much more challenging during a crisis. The private sector has generally been willing to help during the COVID-19 crisis, but many companies have had trouble finding effective channels. The Coalition for Epidemic Preparedness Innovation (CEPI) represents a model for always-on partnerships across sectors. It was founded in 2017 as a not-for-profit platform to accelerate the development of vaccines against emerging infectious diseases. When the COVID-19 outbreak began, the organization pivoted from

Exhibit 2

Five shifts in healthcare systems can help reduce the chance of future pandemics.

From	To	Rationale
"Break glass in case of emergency" response systems	"Always on" systems and partnerships that can scale rapidly during epidemics	Outbreak response is most effective when it uses mechanisms that we apply regularly
Uneven disease surveillance	Strengthened global, national, and local mechanisms to detect infectious diseases	Effective detection capacity is needed at all levels
Waiting for outbreaks	An integrated epidemic-prevention agenda	Targeted interventions can reduce pandemic risk
A scramble for healthcare capacity	Systems ready to surge while maintaining essential services	Epidemics require the ability to divert healthcare capacity quickly, without lessening core services
Underinvestment in R&D for emerging infectious diseases	A renaissance in infectious disease R&D	COVID-19 has shown how fast we can move against infectious diseases when we are motivated

studying a wide set of diseases with epidemic potential to focus much of its attention on the new threat. Along with the Gavi alliance and others, CEPI has been an important vehicle for ensuring that vaccine-development efforts for COVID-19 hit the ground running.

Governments can also maintain their information-sharing practices between major outbreaks and then ramp them up when outbreaks start. South Korea, for example, built an always-on disaster- and safety-information system to capture risk information in real time following its experience in responding to MERS. The system brings together data, including localized geospatial information, from 11 existing disaster-management systems and 16 government ministries. It includes a rapid emergency-approval system for diagnostic-testing kits. As COVID-19 spread, South Korea activated that approval system to scale up testing quickly.

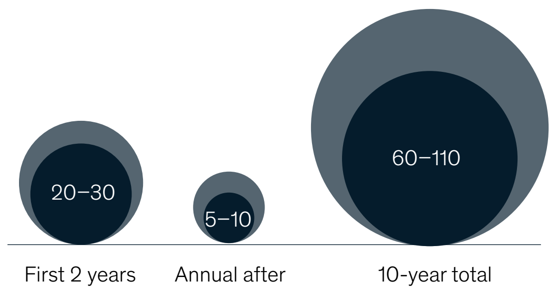
The principle of active preparedness might also lead governments to strengthen other aspects of pandemic response, such as the development of diagnostics and therapeutics for emerging infectious diseases (which might focus on known gaps between epidemics), the manufacturing of personal protective and medical equipment, and the sharing of information. Predefining response roles for different stakeholders at the global, national, and local levels is also an important part of active preparedness, since well-defined roles prevent delays and confusion when an outbreak occurs.

Last, governments can keep outbreak preparedness on the public agenda. Iceland offers an example of how to do that effectively. Since 2004, the country has been testing and revising its plans for responding to global pandemics. Authorities there also encourage the public to take part in preparing for natural disasters. The government's efforts to

Exhibit 3

Building 'always on' epidemic-management systems means they are ready as soon as outbreaks start.

Summary of estimated epidemic-preparedness initiatives and investments, $ billion



- Build and maintain high-quality outbreak-investigation capacity
- Support epidemiological-response capacity
- Maintain robust medical-supply stockpiles and emergency supply-chain mechanisms
- Conduct regular outbreak simulations and cross-sector preparedness activities

Source: Gavi, the Vaccine Alliance; Georgetown University; Global Virome Project; National Academy of Medicine; *Nature*; *The Lancet*; US Centers for Disease Control and Prevention; World Bank; World Health Organization; World Organisation for Animal Health

heighten public awareness of the threat posed by infectious diseases and to engage the public in the necessary response measures aided the country's successful response to the COVID-19 pandemic.

To build always-on systems around the world, an up-front two-year investment of $20 billion to $30 billion and ensuing annual investments of $5 billion to $10 billion (for a ten-year total of $60 billion to $110 billion) would go into the following areas:

— building and maintaining high-quality, flexible outbreak-investigation capacity in all geographies: most countries have a field-epidemiology-training program of some kind, but many of them are underfunded and place their graduates onto uncertain career pathways; strengthening such programs is likely to be one of the most effective investments that a country can make in developing its outbreak-investigation capacity

— supporting epidemiological-response capacity with emergency operations centers (EOCs) that function during all types of major crises

— maintaining robust stockpiles of medical supplies and emergency supply-chain mechanisms at the subnational, national, or regional levels (depending on the setting)

— conducting regular outbreak simulations and other cross-sectoral preparedness activities

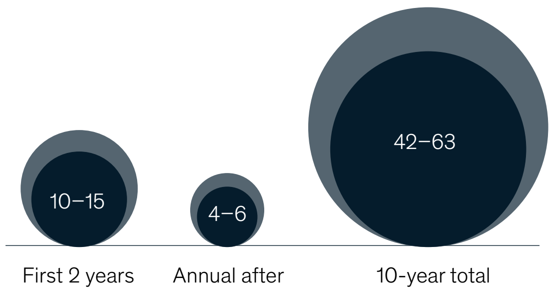
From uneven disease surveillance to strengthened global, national, and local mechanisms to detect infectious diseases

Retrospective analysis of tissue samples shows that SARS-CoV-2 was circulating in a number of countries well before it was first recognized. Failures to detect the disease meant that chains of transmission had been firmly established before countries began to respond. Such problems occur because disease surveillance is often based on old-fashioned practices: frontline health workers noticing unusual patterns of symptoms and reporting them through analog channels. Most countries are far from realizing the potential of advanced analytics to supplement traditional event-based surveillance in identifying infectious disease risks so that authorities can initiate efforts to stop individual chains of transmission. We have begun to see wider use of nontraditional data during the response to the COVID-19 pandemic—for example, the use of mobility and credit-card-transaction data to monitor compliance with public-health measures—but there is potential to do much more (Exhibit 4).

Exhibit 4

Strong disease surveillance mechanisms help stop chains of transmission sooner.

Summary of estimated epidemic-preparedness initiatives and investments, $ billion



- Strengthen disease-surveillance systems in low- and middle-income countries to improve compliance with international health regulations
- Address surveillance gaps in high-income countries
- Improve regional surveillance in hot spots
- Support development and use of innovative technologies for disease surveillance

Source: Gavi, the Vaccine Alliance; Georgetown University; Global Virome Project; National Academy of Medicine; *Nature*; *The Lancet*; US Centers for Disease Control and Prevention; World Bank; World Health Organization; World Organisation for Animal Health

Stopping individual chains of transmission requires strong detection and response capabilities at the national and local levels. Those capabilities are important to have in place across the globe, especially in parts of the world where frequent human–wildlife interactions make zoonotic events (transmission of pathogens from animals to people) more likely. Many developing countries will need external funding and support to build up their disease-surveillance systems. Donor countries might think of their investments in those systems as investments in their own safety.

Recognizing that one country's infectious-disease threat is a threat to all nations—a lesson reinforced by outbreaks of SARS in Toronto, cholera in Haiti, MERS in South Korea, and Zika across the Americas—previous generations created the International Health Regulations (IHR) to promote cooperation and coordination on outbreak response. However, compliance with the IHR has been imperfect because countries may be reluctant to suffer the economic consequences of admitting to a major outbreak. Weak cooperation efforts were identified as a factor in the slow initial response to the West Africa Ebola outbreak. As the COVID-19 crisis continues, leaders might find reason to renew their commitment to global and regional mechanisms for coordinating outbreak responses.

Such an agenda might include deepening understanding of viral threats around the world, renewing and strengthening commitments to sharing data on infectious diseases, taking steps to limit the trade in wildlife, cooperating more extensively on R&D, and ensuring that access to information is widely available. An investment program of $10 billion to $15 billion for the first two years and $4 billion to $6 billion per year thereafter (for a ten-year total of $42 billion to $63 billion) would pay for the following:

- significantly strengthening disease-surveillance systems (including for animal health) in low- and middle-income countries and promoting their interoperability to improve compliance with IHR; investments at the local and national levels would help pay for the technology systems and human capacity needed to detect pandemic-prone pathogens

- addressing surveillance gaps in high-income economies through investment at the national and local levels

- developing stronger regional surveillance networks in Africa, Asia, and South America

- supporting the development and global rollout of advanced technologies for disease surveillance

From waiting for outbreaks to an integrated epidemic-prevention agenda

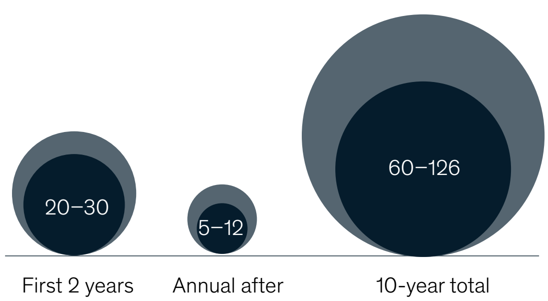
While we cannot prevent all epidemics, we can use all the tools in our arsenal to prevent those we can. Three approaches to doing so stand out: reducing the risk of zoonotic events, limiting antimicrobial resistance (AMR), and administering vaccines more widely (Exhibit 5).

Zoonotic events, in which infectious diseases make the jump from an animal to a human, touched off some of the most dangerous recent epidemics, including of COVID-19, Ebola, MERS, and SARS. Zoonosis can't be eliminated, but its occurrence can be reduced. Areas with high biodiversity and places where humans frequently encounter wildlife present the greatest risk of zoonotic events and therefore require special attention. Another root cause is ecosystem degradation, which makes zoonotic events more likely by increasing interactions between humans and wildlife. Scientists have estimated that a large portion of zoonotic-disease outbreaks can be linked to changes in agriculture, land use, and wildlife hunting over the past 80 years. Economic incentives, legal changes, and public education can lessen contact between humans and wildlife and help protect forests and wilderness areas, thereby decreasing the likelihood of zoonosis. There is also much more to learn about the threats we face through wider mapping of the viruses that exist in animal populations.

Exhibit 5

Outbreak prevention calls for new approaches to zoonosis, antimicrobial resistance, and immunization.

Summary of estimated epidemic-preparedness initiatives and investments, $ billion



- Reduce human–wildlife interactions
- Discover unknown zoonotic viral threats, including mapping global virome
- Limit antimicrobial resistance
- Close the global immunization gap

Source: Gavi, the Vaccine Alliance; Georgetown University; Global Virome Project; National Academy of Medicine; *Nature*; *The Lancet*; US Centers for Disease Control and Prevention; World Bank; World Health Organization; World Organisation for Animal Health

Limiting AMR—the evolution of pathogens to be less susceptible to antimicrobial agents—is another important way to prevent epidemics. AMR is a public-health crisis to be managed in its own right. It is also a potential accelerant of future outbreaks: as pathogens become resistant, diseases that are currently controllable can spread more widely. Conveniently, managing AMR requires many of the same tools and techniques that support responses to acute outbreaks, including surveillance, case investigation, information sharing, and special protocols for healthcare settings. Efforts to improve AMR management, therefore, not only strengthen outbreak-response capabilities but also help prevent outbreaks in the first place.

Finally, the unprecedented R&D effort that has been launched to develop a vaccine against COVID-19 serves as a reminder that we are not realizing the full benefit of existing vaccines. Recent outbreaks of measles, for example, show that places with lower vaccination rates are more susceptible to diseases that vaccines can prevent. Achieving full global coverage of all of the vaccines in our arsenal would save millions of lives over the coming decades. It will be especially important to jump-start immunization efforts after the current pandemic with catch-up campaigns for children who have missed scheduled vaccines.

The approaches we have described represent important steps toward preventing outbreaks. We estimate that it would cost approximately $20 billion to $30 billion for two years and then $5 billion to $12 billion per year thereafter (for a ten-year total of $60 billion to $126 billion) to limit human exposure to wild animals, map more of the global virome, slow the spread of AMR, and close the global immunization gap.

From a scramble for healthcare capacity to systems ready to surge while maintaining essential services

Exponential case growth during the early phases of the COVID-19 pandemic compelled officials in some countries to rapidly redirect much of their healthcare capacity to treating patients with COVID-19. Most health systems have met this challenge, but future waves of COVID-19 or other epidemics may provide sterner tests (Exhibit 6). To prepare, health systems can establish plans detailing how capacity can be diverted to pandemic management and how additional capacity can be added quickly (for example, by converting nonmedical facilities to temporary healthcare facilities and by establishing field hospitals). Some places used existing plans of that type to respond to the COVID-19 pandemic; others created emergency plans during the outbreak. More can be done to codify and improve such plans. Not all health-system gaps around the world can be addressed in the short term, but tools such as the Service Availability and Readiness Assessment (SARA) and joint external evaluations (JEEs) can help in assessing overall system readiness and identifying the highest-priority needs.

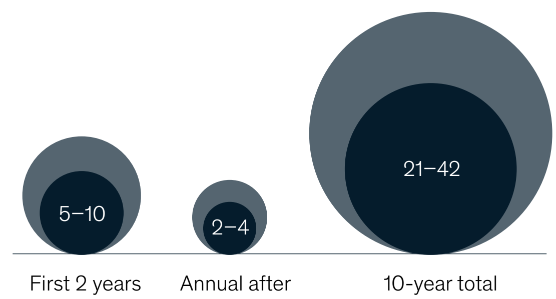
Surge-capacity plans for pandemics should account for the need to maintain essential healthcare services (Exhibit 6). It does little good to prevent 1,000 epidemic deaths if 1,000 other people die because they couldn't obtain healthcare. In addition to the deaths attributed to COVID-19, the pandemic has resulted in excess short-term mortality for reasons such as delays in urgent care for acute conditions. The US Centers for Disease Control and Prevention, for example, has estimated that approximately 5 to 10 percent more deaths than normal have occurred during the COVID-19 outbreak, excluding those that are fully attributable to the disease itself.[3]

In the long term, epidemics also tend to increase mortality because people defer preventive measures (such as routine immunization) and care (such as diabetes management). Similar challenges arose during prior outbreaks. Amid the 2014–16 Ebola outbreak in West Africa, decreases in healthcare delivery led to setbacks in non-Ebola care, with more than 1,000 measles cases resulting

Exhibit 6

Local healthcare systems can be made ready to handle surges in demand while still delivering essential services.

Summary of estimated epidemic-preparedness initiatives and investments, $ billion



- Conduct assessments to highlight gaps in healthcare systems
- Target strengthening of health systems to address largest gaps
- Plan for secondary health impacts
- Improve use of real-time data for early warning of secondary health effects
- Employ alternate care-delivery models

Source: Gavi, the Vaccine Alliance; Georgetown University; Global Virome Project; National Academy of Medicine; *Nature*; *The Lancet*; US Centers for Disease Control and Prevention; World Bank; World Health Organization; World Organisation for Animal Health

[3] "Excess deaths associated with COVID-19," US Centers for Disease Control and Prevention, July 1, 2020, cdc.gov.

from reduced vaccination coverage. Similarly, the 2010 earthquake and ensuing cholera epidemic in Haiti stalled improvements in the mortality rates for children younger than age five to a greater extent than could be directly attributed to those events (Exhibit 7). Last, the response to the COVID-19 pandemic has increased the burden of mental illness and caused an economic downturn that could worsen the health of many people.

Certain investments can help prepare healthcare systems to handle surges while delivering essential and routine services. An initial two-year outlay of $5 billion to $10 billion and yearly spending of $2 billion to $4 billion thereafter (for a ten-year total of $21 billion to $42 billion) would pay for the following actions:

— conducting relevant assessments (such as SARA and JEEs) to highlight gaps and address the challenges identified in scaling health-care capacity

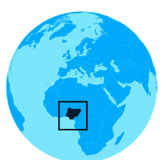
— strengthening health systems in targeted ways: while building resilient health systems around the world is a multidecade agenda, closing the largest gaps in care capacity offers disproportionate benefit (the total cost of building high-quality, resilient health systems will be far higher than the cost of closing capacity gaps and goes beyond the scope of the analysis presented in this article)

— planning explicitly to manage secondary health impacts and maintain continuity, including task shifting and expanded use of telehealth

Exhibit 7

To mitigate the secondary health effects of public-health crises, health systems need to plan for surges and continuation of essential services.

Example secondary health effects



Under-5 mortality progress **stalled** during Nigeria's economic crisis in the 1980s and 1990s

The under-5 mortality rate had been dropping steadily prior to the crisis in the 1980s and 1990s, then stalled for 15 years before resuming a downward trajectory after the crisis

Immunization rates dropped after the 2010 earthquake in Haiti and subsequent cholera outbreaks

Low baseline coverage and temporary suspension of campaigns resulted in lowered DTP3 immunization coverage and a concurrent diphtheria outbreak

Maternal mortality increased across 3 West African countries during the 2014–16 Ebola crisis

Maternal mortality in Guinea, Liberia, and Sierra Leone was correlated with a decrease in skilled birth attendance and prenatal care, with additional disruptions in family planning

Deaths occurred **in excess of expected rates** across a number of states in the US during COVID-19 crisis

US Centers for Disease Control and Prevention estimated 5–10% excess deaths above expected baseline, excluding COVID-19-related deaths that were not fully attributable to the disease itself, with > 5,000 deaths in New York City alone at peak crisis

Source: Academic articles; expert/field interviews; ministries of health; news reports; US Centers for Disease Control and Prevention; World Bank data sets; World Health Organization

— improving the use of real-time data to provide early warnings of secondary health consequences (for example, mortality in excess of historical baselines, home-birth rates, and short-term immunization rates) and to share information across entire healthcare systems

— employing alternate care-delivery models, such as campaigns about immunization and family planning

From underinvestment in R&D for emerging infectious diseases to a renaissance

Humans have done more to overcome the threat posed by infectious diseases in the past 100 years than during the previous 10,000. The widespread availability of antibiotics allows us to manage most bacterial infections. HIV remains a serious condition, but it isn't usually an immediately life-threatening one for people with access to antiretroviral therapy, thanks to the innovations of the past 35 years. And the past decade has seen remarkable progress in our ability to cure hepatitis C.

However, important gaps remain. Public-health leaders have frequently called attention to the threat posed by emerging infectious diseases. Even before the COVID-19 outbreak, the pandemic threat posed by known pathogens such as influenza and by an unknown "pathogen X" was well understood.[4] The pace of innovation in antibiotics is not keeping pace with the increases in antimicrobial resistance. Current regulatory and incentive structures fail to reward innovations that can help counteract emerging infectious diseases or resistant bacteria. It is difficult for companies to project the financial returns from interventions for diseases that emerge sporadically and may be controlled before clinical trials are complete (as happened during the West Africa Ebola outbreak). That is especially true of interventions for diseases that mainly affect people in low-income countries.

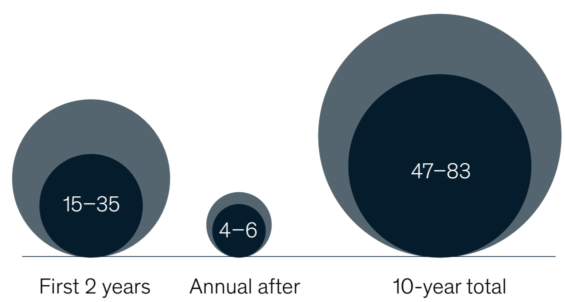
R&D efforts in response to the COVID-19 pandemic have been unprecedented: hundreds of vaccine and therapeutic candidates are being evaluated. While these efforts have been extremely exciting, many eyes will also be focused on whether the market dynamics (such as economics, competitive dynamics, and demand) in the coming months demonstrate that healthy markets are possible for pandemic-response products and how these dynamics will affect incentives for future development.

Building on the momentum created by COVID-19-related R&D, there is potential to spark a renaissance in infectious-disease R&D (Exhibit 8). The renaissance might focus on several necessities that the response to the COVID-19 pandemic has highlighted. One necessity is a portfolio of options. We can be cautiously optimistic about the potential of an effective COVID-19 vaccine being available during 2021—but only because so many candidates are in the works. Another necessity is flexible manufacturing capacity that can be

Exhibit 8

The efforts behind the COVID-19 response may start a renaissance in infectious-disease R&D.

Summary of estimated epidemic-preparedness initiatives and investments, $ billion



- Accelerate development of diagnostics, therapeutics, and vaccines against known threats
- Accelerate development of next-generation antibiotics
- Establish and fund platforms for R&D focused on emerging infectious diseases
- Maintain capacity for manufacturing vaccines and therapeutics in large quantities

Source: Gavi, the Vaccine Alliance; Georgetown University; Global Virome Project; National Academy of Medicine; *Nature*; *The Lancet*; US Centers for Disease Control and Prevention; World Bank; World Health Organization; World Organisation for Animal Health

[4] "Prioritizing diseases for research and development in emergency contexts," WHO, who.int.

deployed rapidly to make massive quantities of the most effective vaccines and therapeutics. A third necessity is intervention across a range of potential outbreak pathogens, requiring active programs for more than ten diseases.

Delivering such necessities will require building on the early success of initiatives such as CEPI to reimagine product-development pathways, from funding models and collaboration platforms to regulatory review and access agreements. Spending $15 billion to $35 billion in the first two years and $4 billion to $6 billion per year thereafter (for a ten-year total of $47 billion to $83 billion) would fund these activities:

— accelerating the development of diagnostics, therapeutics, and vaccines against known threats—including influenza, for which effective R&D might yield significant advances

— accelerating the development of next-generation antibiotics to counter the threat of AMR

— establishing and funding platforms for the development of diagnostics, therapeutics, and vaccines against emerging infectious diseases

— maintaining the capacity to manufacture five billion doses of vaccine and large quantities of therapeutics

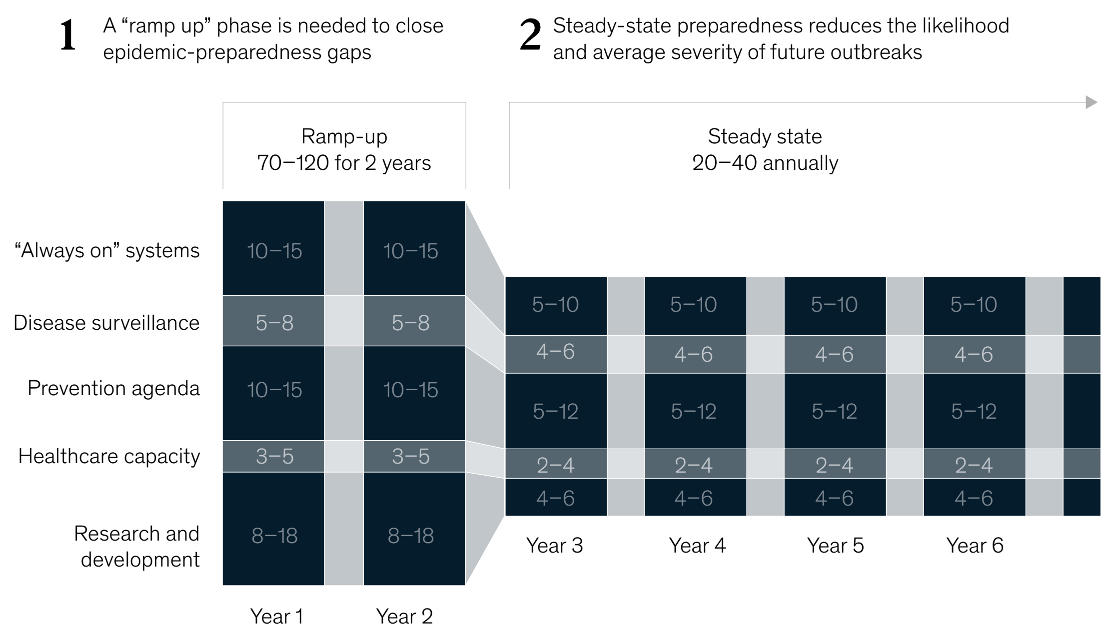
Bringing it all together

As we continue to respond to the COVID-19 pandemic, countries should make deliberate investments to reduce the chance of such a crisis happening again. We estimate that an initial global investment of $70 billion to $120 billion over the

Exhibit 9

Funding for epidemic preparedness requires an up-front investment to close current gaps.

Illustrative funding needed to invest in epidemic preparedness, $ billion



We have spent too much time behaving as though another deadly pathogen won't emerge.

next two years ($35 billion to $60 billion per year), followed by an investment of $20 billion to $40 billion per year to maintain always-on systems, would significantly reduce the chance of a future pandemic. Those figures, totaling $230 billion to $425 billion over the next decade, include spending at the global, country, and subnational levels (Exhibit 9).

The playwright Edward Albee once said, "I find most people spend too much time living as if they're never going to die."[5] So it is with the global response to infectious diseases: we have spent too much time behaving as though another deadly pathogen won't emerge. Outbreaks of SARS, MERS, Ebola, and Zika led to some investments in pandemic preparedness over the past 20 years, but few of them are the lasting, systemic changes needed to detect, prevent, and treat emerging infectious diseases. And now, even with all of humanity's knowledge and resources, hundreds of thousands of people have been killed by a disease that was only identified six months ago. The COVID-19 pandemic won't be the last epidemic to threaten the world. By taking action and funding changes now, we can better withstand the next one.

[5] David Richards, "Edward Albee and the road not taken," *New York Times*, June 16, 1991, nytimes.com.

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