How an outbreak became a pandemic

The defining moments of the COVID-19 pandemic

The Independent Panel FOR PANDEMIC PREPAREDNESS & RESPONSE

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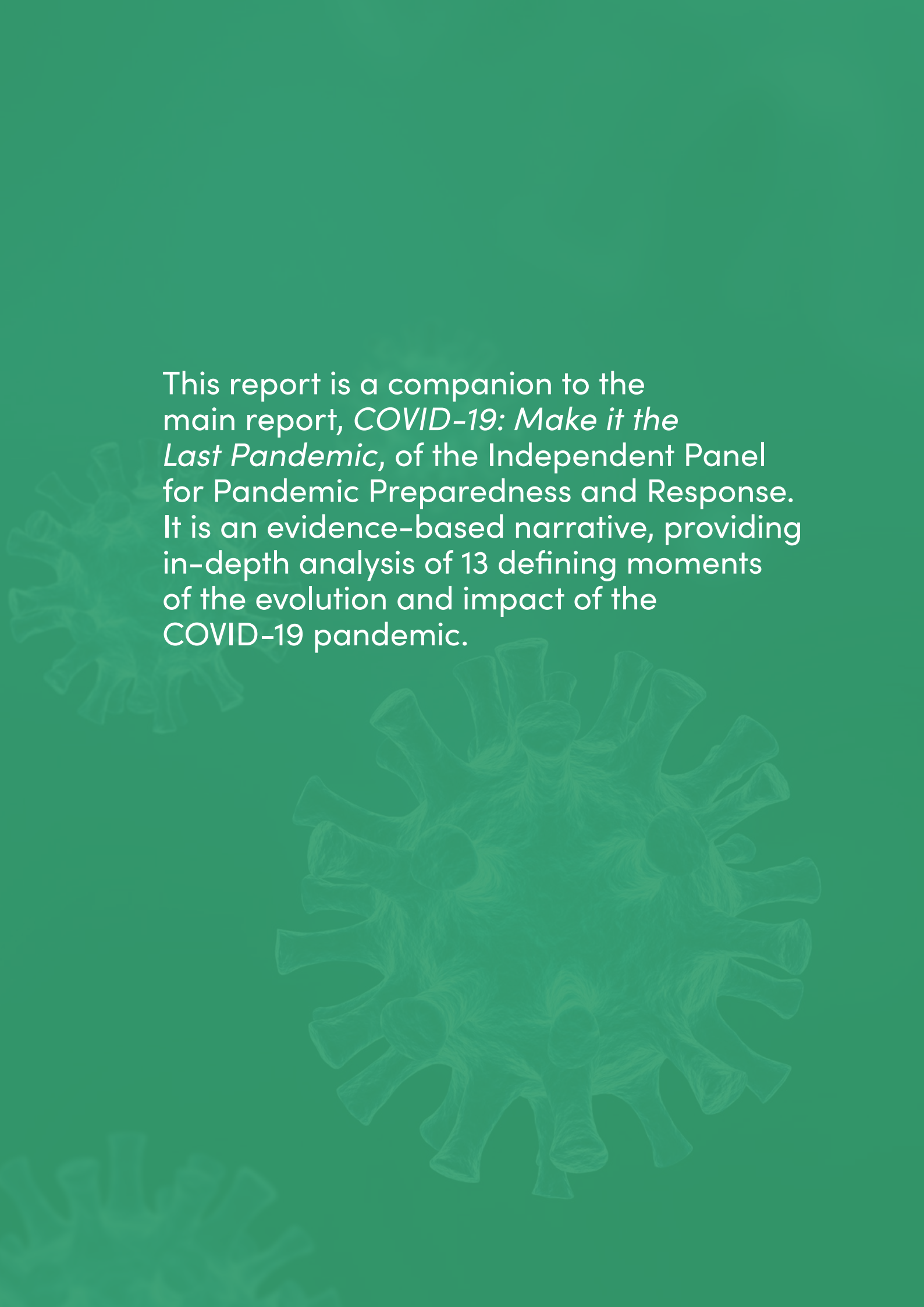
Abbreviations

ACT-A	Access to COVID-19 Tools Accelerator
Africa CDC	Africa Centres for Disease Control
CEPI	Coalition for Epidemic Preparedness Innovations
COVAX	COVID-19 Vaccines Global Access
COVID-19	coronavirus disease
C-TAP	COVID-19 Technology Access Pool
ECDC	European Centre for Disease Prevention and Control
EU	European Union
GDP	gross domestic product
ICU	intensive care unit
IHR (2005)	International Health Regulations (2005)
KEI	Knowledge Ecology International
MERS	Middle East respiratory syndrome
PCR	polymerase chain reaction
PHEIC	public health emergency of international concern
PPE	personal protective equipment
R&D	research and development
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
UK	United Kingdom of Great Britain and Northern Ireland
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
US	United States of America
US CDC	United States Centers for Disease Control and Prevention
US$	United States dollars
US FDA	United States Food and Drug Administration
WEF	World Economic Forum

This report is a companion to the main report, *COVID-19: Make it the Last Pandemic*, of the Independent Panel for Pandemic Preparedness and Response. It is an evidence-based narrative, providing in-depth analysis of 13 defining moments of the evolution and impact of the COVID-19 pandemic.



What happened, what choices were made, and what can we learn?

In physics, a "moment" is defined as the change in direction produced when a force acts to move a system around a pivot point. The moments we describe here are the critical junctures which changed the direction or nature of the force of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the pandemic it caused. Some are discrete moments in time; others are more extensive. Together, they account for where we are today, and why.

The Panel has ranged widely in its investigations, consulting experts within and beyond the health sector, hearing from those on the frontline, from midwives and nurses to city mayors, obtaining the perspectives of women and youth, the private sector and people living with chronic diseases. Its analysis synthesizes the evidence from hundreds of studies of responses to the pandemic and its impact. That volume of information is daunting but, as the Panel compiled it all, key themes emerged clearly and were held in common across the world, despite the very different lived realities of the COVID-19 pandemic in different countries.

The evidence the Panel gathered showed that decisions mattered and had consequences. It also showed that prior conditions mattered — there was much more freedom to act and more choices available in those places where a robust and resilient health system existed, where social and economic protections were solid, and where governments, scientists and citizens trusted one another to do their best.

It is a basic human trait to make sense of new information on the basis of past experience. We could not function any other way. But when we encounter something genuinely new, that trait can lead us astray. We alternate between the paralyzing anxiety of indecision, when faced with something truly unpredictable, and the temptation to impose our old models on the new events, whether they fit well or not. This pandemic has seen plenty of evidence of both reactions.

As the Panel submits its report, nearly one-and-a-half years into this pandemic, it is tempting to assert that it is "obvious" what should have been done at each stage in the past, based on the knowledge we have gained now. But that temptation fails to respect the difficulty of decision-making when a new disease is emerging and the radical uncertainty about how it will unfold.

Our account of 13 defining moments on which the response to this pandemic has turned is based on a meticulous examination of the evidence and the evolving knowledge. We look at the state of preparedness prior to this pandemic, the identification of the virus (SARS-CoV-2) and the disease it caused (COVID-19) and responses globally, regionally and nationally, particularly in the pandemic's early months, and the wide-ranging impact and social and economic crisis it has precipitated up to today.

The pandemic is not yet over. It is continuing to surprise us. The moments described below will therefore have a sequel. The "defining moment" of the end of the pandemic is the most important one of all, but that is yet to come. How we approach that moment will depend on how willing the world is to take stock honestly, but without blame or rancour, and determine what could have been done better, and how to ensure that is the path that is taken in the future.

Credit: Watsamon Tri-yasakda

1. Despite warnings, the world was not prepared

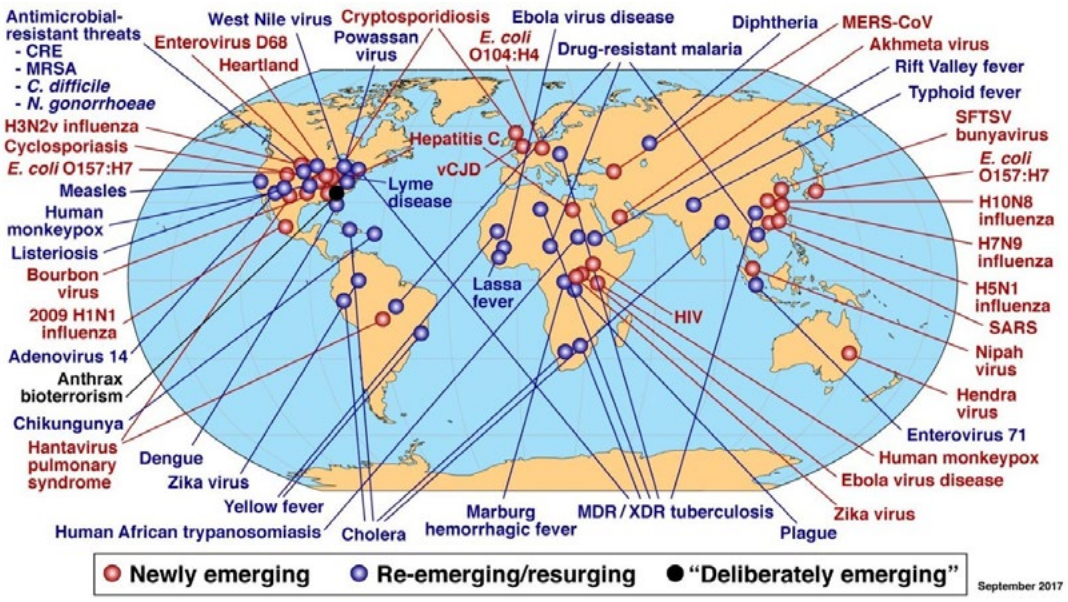
In under four months from the moment when SARS-CoV-2 was first identified as the cause of clusters of unusual pneumonia cases in Wuhan, China, COVID-19 became a global pandemic threatening every country in the world.[1] Although public health officials, infectious disease experts and previous international commissions had warned of potential pandemics and urged robust preparations since the first outbreak of severe acute respiratory syndrome (SARS), COVID-19 still took large parts of the world by surprise.

This should not have been the case. The number of infectious disease outbreaks has been accelerating. Major outbreaks this century in addition to SARS have included influenza, Ebola virus disease and Zika virus disease. At the end of the last century, the HIV pandemic took hold, and remains with us — there is still no HIV vaccine, millions rely on antiretroviral treatment to remain alive and new infections still occur at an unacceptable rate.

Population growth and accompanying environmental stresses are driving an increase in emerging novel pathogens. Air travel has increased fourfold since 1990, which means a virus can reach any place in the world in a matter of hours[2].

Figure 1: Global emergence of selected pathogens over the past 50 years (naturally emerge/re-emerge/deliberately released)

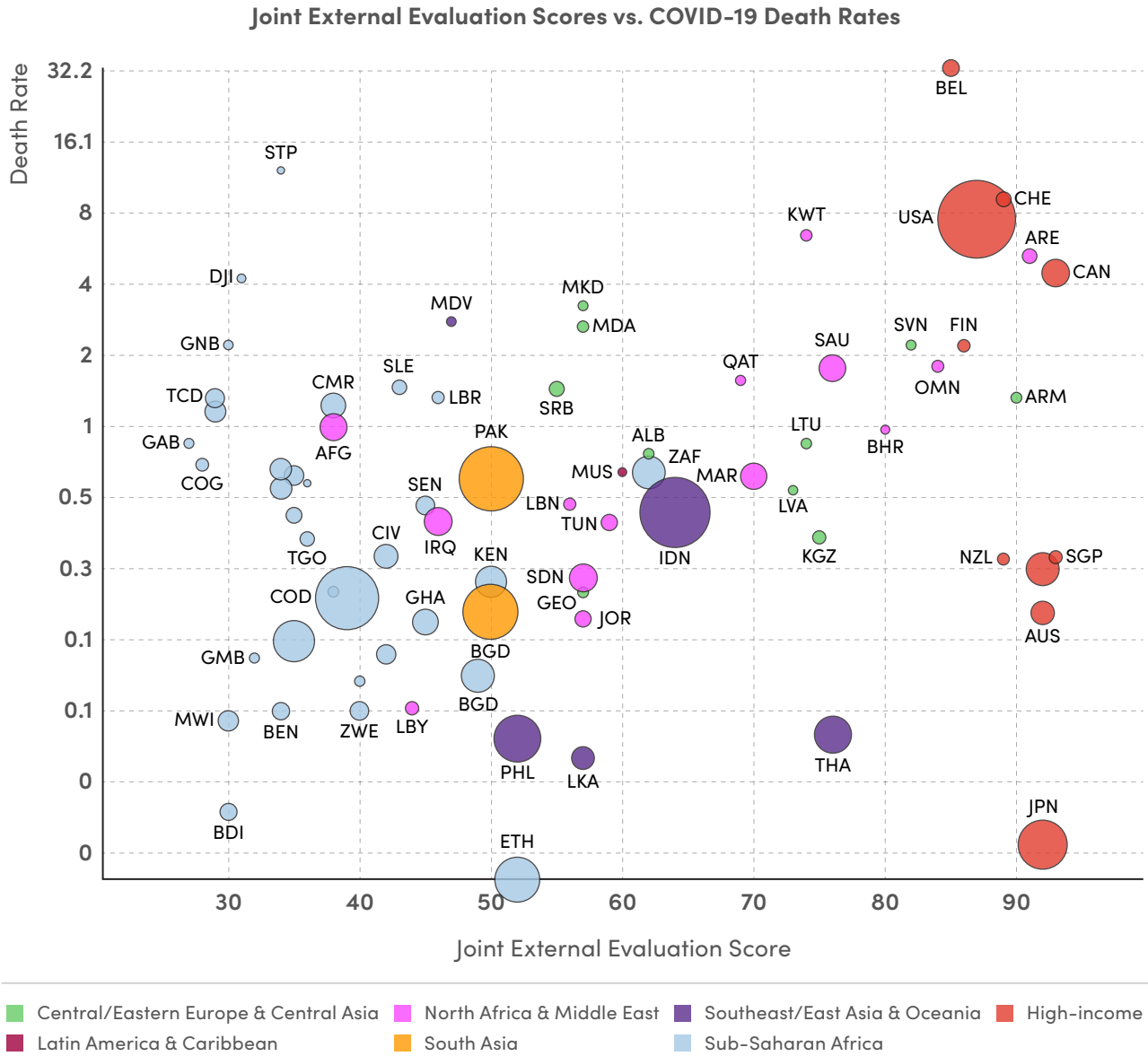
Source: United States National Institutes of Health, National Institute for Allergies and Infectious Diseases.



Concerted efforts have been made in recent years to boost pandemic preparedness, but too many national governments still lack solid preparedness plans and core public health capacities, as well as organized multisectoral coordination [3]. Country self-reported assessment of preparedness capacities, required by WHO under the International Health Regulations (IHR) (2005), gave a global average score of 64 out of 100 [4]. Only two thirds of countries reported having full enabling legislation and financing to support needed health emergency prevention, detection and response capabilities [5]. Country preparedness was also assessed under the voluntary joint external evaluation process, undertaken to date by 98 countries. An independent academic exercise, the Global Health Security Index, also sought to score country pandemic preparedness.

Figure 2: Death rates in this figure shows the cumulative, reported, age-standardized to COVID-19 deaths per hundred thousand people in the 50 days following the date of the first death in that country

Source and adapted from: Sawyer Crosby et al, IHME, Think Global Health



The thing that all these measures had in common was that their ranking of countries bore no relation to the countries' success in containing COVID-19 [6, 7, 8]. They missed the importance of political leadership, trust in government institutions and speed of response [9]. For example, while the US ranked highest in its aggregate score on the Global Health Security Index, it scored less well on universal health care access, and in relation to public confidence in government, and received a score of zero indicating a confidence level of less than 25%. [10]

The need to prepare for and prevent the growing risk of zoonotic outbreaks of new diseases with pandemic potential has been recognized. One Health approaches seek to better understand the interdependence between animals, humans, and the environment [11]. Predicting and controlling zoonotic outbreaks requires close coordination across a range of experts and disciplines. Under the tripartite collaboration between WHO, the Food and Agriculture Organization of the United Nations and the World Organisation for Animal Health, guidance was developed in 2019 on the prevention, preparedness, detection and response to zoonotic threats with examples of best practices [12].

"What all these assessment measures had in common was that their ranking of countries bore no relation to how well countries have contained COVID-19."

However, implementation has not taken place at the scale needed. The World Bank's COVID-19 response framework committed US$220 million for One Health activities in 13 countries in 2020, far short of their estimate of an annual US$3.4 billion needed to build and operate systems for effective zoonotic disease prevention and control in low- and middle-income countries through One Health systems [13].

It seems that preparedness systems need to be put to the test frequently if they are to remain supple. Many of the countries that have successfully contained COVID-19 drew on their experiences of both success and failure in their relatively recent responses to SARS, Middle East respiratory syndrome (MERS) and Ebola virus disease.

The 2003 SARS epidemic galvanized WHO Member States into rapidly concluding their decade-long comprehensive redraft of the International Health Regulations, which was agreed in 2005 and entered into force in 2007. The SARS epidemic also set in train a pattern of post-pandemic reviews, repeated after the pandemics of Ebola virus disease and H1N1 influenza of the past two decades.

Eleven high-level panels and commissions have laid out specific recommendations for global pandemic preparedness in 16 reports since 2011. Despite their consistent messages, few of these suggestions have been implemented.

In Summary

Zoonotic disease outbreaks are increasing and will continue to do so. The risk of a new respiratory pathogen is high.

Countries were not prepared and investment in disease outbreak preparedness systems and capacities has been insufficient; in too few cases were national response capacities subjected to rigorous stress tests.

Preparedness metrics failed to predict weaknesses — COVID-19 has laid bare the deficiencies.

In spite of the warnings of pandemic risk and clear recommendations on what needed to be improved, the world had not taken these issues seriously.

Credit: Angela Ponce

2. The detection of a novel coronavirus: SARS-CoV-2

In late December 2019, several health facilities in China reported clusters of a pneumonia of unknown origin. As patients did not respond to typical pneumonia treatments, clinicians became concerned that the illness might be something new and sent samples to laboratories for evaluation. The pathogen turned out to be a new coronavirus.

The course of the COVID-19 pandemic was shaped by a series of insights, research findings, actions and reactions that took place amid great uncertainty. Many of the choices made and decisions taken were highly time-sensitive — conditions changed from day to day; in some cases, from hour to hour. While it may not be possible to dismiss completely the wisdom of hindsight, any account of events as they unfolded needs to recognize, in all humility, the radical uncertainty involved in responding to a novel disease event.

One of the urgent notices issued on 30 December 2019 by the Wuhan Municipal Health Commission.


武汉市卫生健康委员会

市卫生健康委关于报送不明原因肺炎救治情况的紧急通知

各有关医疗机构：

根据上级紧急通知，我市华南海鲜市场陆续出现不明原因肺炎病人。为做好应对工作，请各单位立即清查统计近一周接诊过的具有类似特点的不明原因肺炎病人，于今日下午4点前将统计表（盖章扫面件）报送至市卫健委医政医管处邮箱。

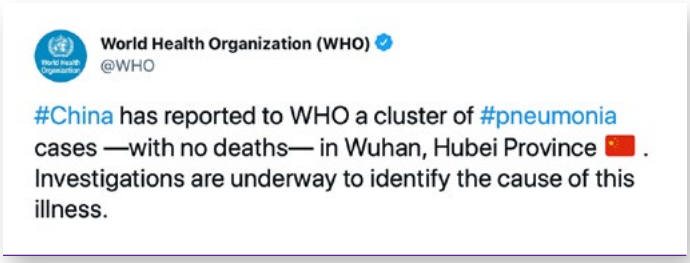
附件：相关信息上报表

武汉市卫生健康委员会医政医管处

On 30 December 2019, the Wuhan Municipal Health Commission issued two urgent notices to hospital networks in the city about cases of pneumonia of unknown origin. Discovering what was causing the cases and how it might be transmitted was an urgent concern. While a majority of the people with confirmed exposure had attended the Huanan Seafood Market, a substantial minority had not, raising the question of which common factor was causing their illness, including the possibility of human-to-human transmission.

While the market was the initial focus of investigation of spread, two later studies of the early laboratory-confirmed cases [14, 15] linked only 55% to 66% of cases to exposures there, suggesting the market may have been a site of amplification of the virus rather than its origin, and that human-to-human transmission in December 2019 was very likely. The SARS-CoV-2 virus has zoonotic origins, and current evidence suggests a species of bat is the most likely reservoir host; the intermediate host is still unknown, as is the exact transmission cycle. WHO has convened a technical mission to better understand the origins of the virus which reported on 30 March 2021. [16].

The WHO China office took note of the public bulletin issued by the Wuhan Municipal Health Commission on 31 December, and WHO headquarters was alerted via the news reports which had appeared on 31 December. The WHO Western Pacific regional office (WPRO) requested further information from China. Chinese officials initially met with WHO to



The World Health Organization's tweet on 4 January 2020.

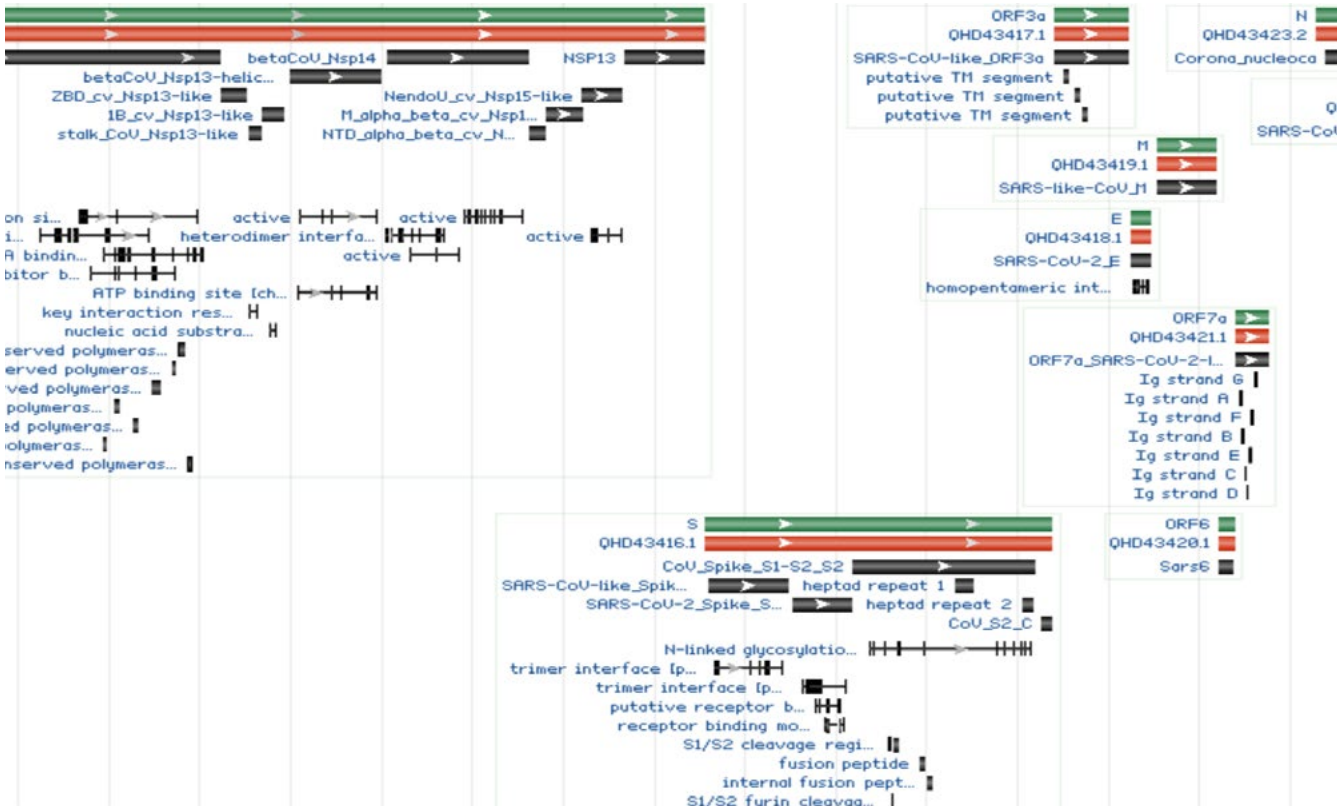
discuss the outbreak at a technical briefing on 3 January 2020. WHO subsequently published a Twitter message about the cases on 4 January, and on 5 January officially alerted all country governments through the IHR (2005) Event Information System, as well as issuing its first "Disease Outbreak News" notice. Meanwhile, by 1 January, both Taiwan, China and the Hong Kong Special Administrative Region had announced their intention to screen incoming travellers. Others soon followed their lead.

The Wuhan Institute of Virology had sequenced almost the entire genome of the virus on 2 January. The Chinese Center for Disease Control and Prevention developed a diagnostic test that was distributed to facilities in Wuhan on 11 January, and a draft digitized sequence of the SARS-CoV-2 genome was published, making it available to researchers worldwide. WHO published the first protocol for a polymerase chain reaction assay for detection of the novel coronavirus, developed in collaboration with partner laboratories, on 13 January.

WHO began developing guidance for countries on how to respond to the new disease, including advice for international travel and trade, although it did not recommend travel restrictions. Meanwhile, the first

Figure 3: Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, a close-up of part of the genome sequence

Source: GenBank: MN908947.3



case outside China was confirmed on 13 January; a woman who had travelled to Thailand from Wuhan on 8 January. Japan reported an infected person on 15 January. More countries began screening passengers from Wuhan, looking for fever or other symptoms of respiratory disease. On 23 January, following investigation by Chinese officials and a few days after human-to-human transmission was publicly confirmed, Wuhan instituted a drastic population lockdown to try to contain the virus as 581 cases and 17 deaths were reported [17]. According to the report of the second WHO-China joint mission, which took place from 16 to 24 February 2020, the lockdown and public health measures taken in China were considered successful in rapidly reducing transmission [18].

At the 22–23 January meeting of the WHO IHR Emergency Committee to discuss the outbreak, the Committee was divided about whether it should recommend that the outbreak be declared a public health emergency of international concern (PHEIC). The IHR Emergency Committee met again one week later, and the Director-General of WHO declared that the outbreak constituted a PHEIC on 30 January. At that time, there were 98 cases in 18 countries outside China [19]. Stating that it was alarmed by the extent of both spread and inaction, WHO went on to characterize COVID-19 as a global pandemic on 11 March 2020, when there were a reported 118 000 cases in 114 countries [20].

The ability of SARS-CoV-2 to transmit from person to person before people show symptoms, or from people who may never show symptoms, complicates its detection. Estimates of the rate of asymptomatic infection (i.e. infection where the person never develops signs of illness) from meta-reviews put the average rate between 17% and 20% [21]. Because of widespread travel, the virus moved quickly and stealthily to localities throughout China and the world. Cases were identified in many places throughout February and March as new epicentres emerged, including the region of Lombardy in Italy and New York City in the United States. By the end of March 2020, the virus had been confirmed in nearly every country in the world [22].

A meticulous and verified chronology of the events as they unfolded shows the evolution of the science, the spread of the outbreak, the guidance issued and the decisions that were made [a]. Clinicians and laboratory staff in Wuhan were quick to investigate suspicious clusters and collect and analyse samples. Once WHO was alerted to the outbreak, the Organization took immediate steps to activate a response and request more information. Although the public health measures introduced in Wuhan caused severe hardship for many, they helped to contain transmission substantially. Researchers sequenced the genome of the novel virus rapidly, and a reliable test became available.

However, the evidence collected by the Panel suggests that action should be taken to ensure an even more rapid and efficient early response in the future. Viruses move in the space of hours, and every moment gained is an

a See the Independent Panel's Authoritative Chronology

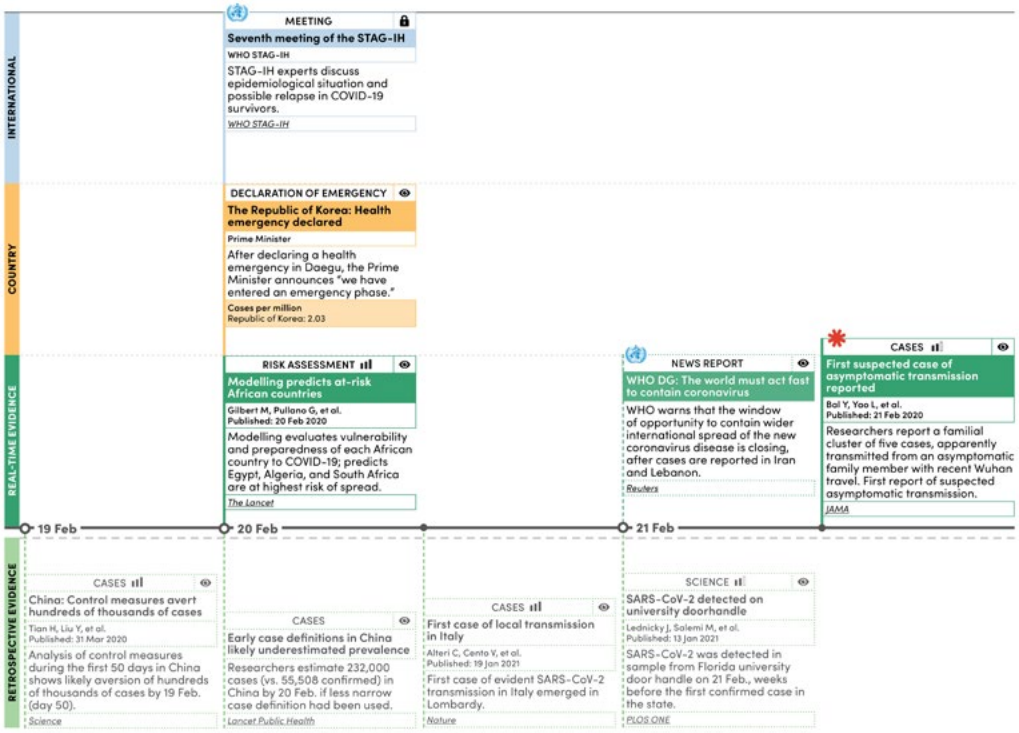
opportunity to curb further outbreaks. Information about cases and their characteristics was not available quickly enough. The different IHR articles require information to be shared, but some of the requirements are too vague. There were few restrictions on the movement of people in Wuhan before 23 January, and people were travelling extensively within China and abroad.

While continuing to warn of the possibility of human-to-human transmission, WHO communication continued to report a lack of definitive evidence of that, until the WHO Regional Office for the Western Pacific (WPRO) tweeted on 19 January that there was evidence of limited human-to-human transmission. Following a Chinese national mission to Wuhan it was confirmed on national television on 20 January that there were cases involving human-to-human transmission.

Several countries did begin to monitor incoming travellers and initiate emergency processes, but even when the PHEIC was declared on 30 January, most countries still did not respond adequately. The chronology suggests that formal identification, verification, notification, and response systems need to be more rapid and seamless if local outbreaks are to be contained before they can spread out of control.

Retrospective analysis shows there was a significantly greater number of cases and a greater extent of spread than was recorded at the time, both within and outside China. Estimates of the true extent of infection required diagnostic tests and estimates of case fatality rates, but even after tests were developed, early screening criteria focused on travel histories and so

Figure 4: A short segment of the Independent Panel's authoritative COVID-19 chronology
Source: The Independent Panel for Pandemic Preparedness and Response



failed to pick up the extent of virus circulation in the community. Symptom-based screening missed the true extent of asymptomatic infection.

The International Health Regulations, which are a legally binding instrument agreed by all WHO Member States, are designed to facilitate rapid information sharing to enable effective global action in the face of a widespread health emergency. A fundamental question is how fit for this purpose the IHR are, and how to guarantee the seamless information exchange and collective action required for the world to get ahead of a fast-moving virus.

In Summary

The conclusion is that the alert system does not operate with sufficient speed when faced with a fast-moving respiratory pathogen, that the legally binding IHR (2005) are a conservative instrument as currently constructed and serve to constrain rather than facilitate rapid action and that the precautionary principle was not applied to the early alert evidence when it could have been.

The earliest possible recognition of a novel pathogen and open and rapid sharing of emerging information and science regarding its modes of transmission are critical for alerting governments to a potential health emergency and for containment measures.

The speed and the pace of the formal procedures that WHO is required to follow, as prescribed in the IHR (2005), do not reflect the rapid availability of data and information today through digital tools and social media.

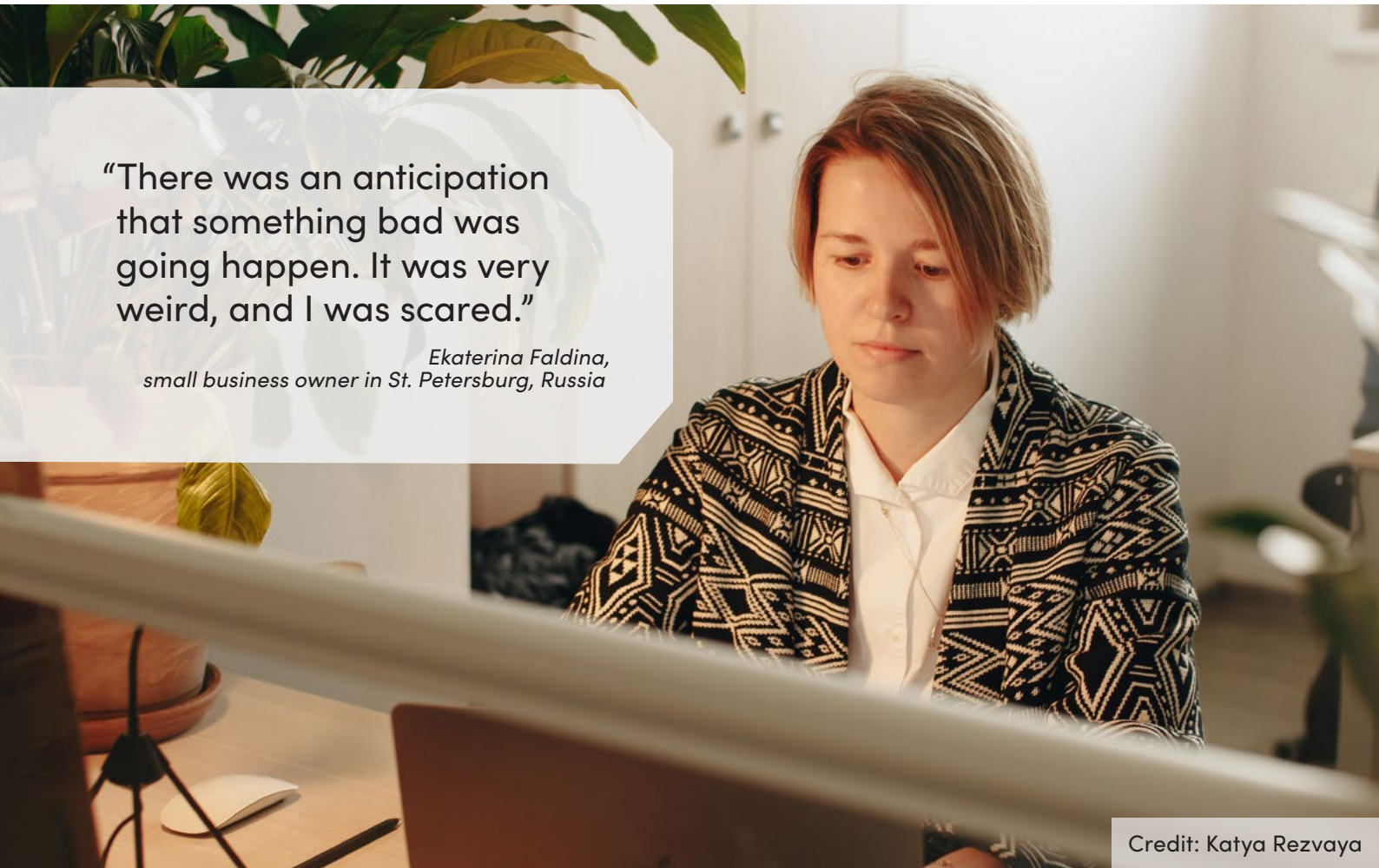
For the future, a precautionary approach should be used from the outset, acknowledging that a respiratory disease may spread from person to person unless and until established otherwise.

Capacity for local and rapid access to next-generation genetic sequencing should be expanded as an invaluable tool to investigate suspected novel pathogens without delay.

3. The reality hits home

At the end of January 2020, news footage showed dozens of excavators furiously digging the foundation for a new 1000-bed hospital in Wuhan [23]. It was needed quickly to treat a growing influx of patients with the newly identified coronavirus disease. For most observers, the outbreak seemed a distant development. But some governments, mostly those which had experienced SARS and/or MERS, had noted the 31 December 2019 press reports of a new pneumonia identified in Wuhan and WHO's early January alert. Immediately understanding the threat, they began to activate response plans.

Thailand activated its Emergency Operations Centre by 4 January 2020, even before its first case was reported on 13 January [24]. In Viet Nam, on 16 January, the Deputy Prime Minister tasked the health ministry with urgently issuing an action plan. The Vietnamese response established a unified chain of command from national to village level, enabling rapid action [24, 25]. Singapore set up a multi-ministry task force to tackle the coronavirus on 22 January, the day before its first case was confirmed [26].



"There was an anticipation that something bad was going happen. It was very weird, and I was scared."

Ekaterina Faldina, small business owner in St. Petersburg, Russia

Credit: Katya Rezvaya

All of these early responders established multi-ministry committees at the highest level to coordinate a whole of government response. But early responders were a small minority. The highest level of global alert, a PHEIC, declared by the Director-General of WHO on 30 January, did not spur a worldwide response as it should have done.

On 4 February 2020, the Director-General briefed the Organization's Executive Board about the coronavirus outbreak, reporting that there had been 20 471 confirmed cases and 425 deaths in China and a total of 176 cases in 24 other countries [27]. The number of countries with confirmed cases reached 53 by the end of February and 93 by the following week [28, 29]. Amid a clamour of calls for urgency, the Director-General, alarmed by both the spread of the disease and the lack of action, said on 11 March that "COVID-19 can be characterized as a pandemic" [19].

For many countries, it was not until they had already seen widespread local transmission and their hospitals were starting to fill with desperately ill patients that they finally took action.

Hospital admissions were a lagging indicator of spread. Looking back, it is very clear that the extent of local transmission had been vastly underestimated well before any response was instituted.

The first case in the United States of America was in a person who arrived on 15 January 2020 and tested positive six days later. By the first week of March, the epidemic in the country was doubling in size every 2.68 days, suggesting rapid uncontrolled spread [30]. On 13 March, the Government declared the pandemic a national emergency.

The first confirmed case in Africa was in Egypt on 14 February. On 22 February, a meeting of African Union health ministers with the Africa Centres for Disease Control (Africa CDC) and WHO established a task force and containment strategy for the continent.

Italy reported its first cases on 31 January 2020 and quickly became an epicentre for infections, although substantial undetected local transmission was almost certainly happening much earlier [31]. On 10 March, Italy became the first European country to enact strict public health measures, followed shortly by Spain and France.

For many countries, it was not until they had already seen widespread local transmission and their hospitals were starting to fill with desperately ill patients that they finally took action.

New Zealand reported its first case on 28 February and acted to isolate new cases rapidly. However, during the first three weeks of March, the virus spread rapidly, mainly via superspreading social gatherings. At 23:59 on 25 March 2020, the country was placed in a strict national lockdown which lasted seven weeks [32].

The first confirmed case in Latin America was in Sao Paulo, Brazil on 26 February. It prompted closures of schools and businesses, and restrictions on international flights beginning around 12 March. Countries around Latin America instituted stringent control measures relatively early. Even so, many countries in the region were unable or unwilling to sustain them and, as a result, cases began to rise relentlessly.

Globally, 750 890 confirmed cases of COVID-19 were reported as of 31 March 2020 — a substantial underestimate of the actual number.

The Panel's review of country responses [b] emphasizes that countries that recognized the threat of SARS-CoV-2 early and reacted comprehensively fared much better than those adopting a "wait and see" approach and whose responses were more fragmented.

Countries with more successful outcomes, measured by deaths per capita, introduced precautionary action earlier to prevent community transmission, buying time to collect more information and develop and operationalize a cohesive approach. Response models developed in relation to earlier outbreaks were rapidly adapted to the novel virus and its pathways of transmission. Timely triage and referral of suspected cases to ensure swift case identification and contact-tracing were key elements, as was providing designated isolation facilities. Social and economic support was instituted to promote widespread uptake of public health measures.

Resilient and successful country responses heeded the evolving science; they quickly mobilized, trained and reallocated their health workforce. System capacity increased in some cases with the rapid construction of makeshift hospitals, but also by extending telemedicine services, postponing elective procedures and supporting primary care. Local research and development in many countries were used to bolster supplies and begin the development of response tools, ranging from personal protective equipment (PPE) to test kits and vaccines. National efforts were both catalysed and amplified by good regional responses, where these existed. For example, the Africa Centres for Disease Control and Prevention were able to coordinate a continent-wide approach by virtue of their location within the African Union, for instance through the Africa Medical Supplies Platform. [33]

Countries with less successful outcomes to date had adopted uncoordinated approaches that devalued science, denied the potential impact of the pandemic, delayed comprehensive action and allowed

b The Panel has conducted a review of policy responses in 28 countries selected to represent different regions and the best, worst and median outcomes measured by deaths per 100 000 population.

Credit: Tuane Fernandes Silva

"As soon as the World Health Organization declared a pandemic, we understood what it was and that it would arrive here, and it would arrive with power."

Father Julio Lancellotti, a priest in Sao Paolo, Brazil, cares for people in his community, including by delivering breakfast every morning to people who need a meal.

Credit: Angela Ponce

distrust to undermine efforts. Many had health systems beset by long-standing fragmentation, undervaluing of health workers and underfunding. They lacked capacity to mobilize quickly and coordinate between national and subnational responses. Many poorly performing countries prioritized just one public health intervention at the population level, such as mandatory face masks or school and business closures, rather than a comprehensive approach alongside public outreach and social and economic support.

Evidence and guidance were important in shaping country action. The first package of guidance documents for countries was issued by WHO in the second week of January 2020, and a strategic preparedness and response plan was first issued on 4 February, being subsequently updated in April and June. Between January and November 2020, WHO issued over 250 guidelines and policy and scientific briefs on clinical and public health management of COVID-19. Comprehensive guidelines published on 27 May 2020 were downloaded an average of 34,000 times per month from June until November.

As the pandemic developed, countries sought advice more tailored to their specific context, relying both on documents developed by the WHO

Mobilization of community health workers was one success factor for countries.

Credit: Miriam Watsemba

regional offices and evidence generated by their own expert scientific groups. Countries did not always follow WHO guidance when they found it lacking or disagreed with it, notably in the case of mask-wearing and aerosol transmission of SARS-CoV-2.

In Summary

The declaration of a PHEIC, the highest level of global concern specified in the international legally binding health regulations, did not lead to an urgent, coordinated, worldwide response.

It was not until the number of COVID-19 cases increased dramatically at home that governments took serious action to prevent transmission.

February was a lost month of opportunity to contain the outbreak, even as the evidence of infections spreading globally was apparent.

Timing mattered — early recognition of the COVID-19 threat and quick responses kept the epidemic small. But even countries that acted later have been able to maintain success with adaptable responses that are coordinated, multisectoral and science-based.

Countries that devalued science, failed to build trust in their response and pursued inconsistent strategies found themselves continually lagging behind the epidemic and have seen the consequences in high rates of infection and death.

4. The frontline under stress and requiring protection

As the COVID-19 pandemic progressed, graphic news footage was broadcast of thousands of distressed patients overwhelming health facilities across the world, many of which were woefully unprepared for the surge. Ambulances waited in line, emergency rooms overflowed, and hospital beds were dangerously oversubscribed. In Spain, to give just one example, many intensive care units (ICUs) operated at 200% to 300% of capacity, and other countries were under similar strain [34].

Holding it all together were health professionals and other essential workers on the frontline — medical technicians, doctors and nurses, border and quarantine staff, midwives and community workers, food suppliers and cleaners — working hour after hour, often lacking adequate PPE and patient supplies, watching helplessly while patients died without loved ones by their side, and worrying about their own health and their families. Response measures added to their stresses — as schools and day-care centres closed down, parents who were essential workers found themselves having to juggle impossible demands on their time.

"In the beginning of the pandemic, there was a lot of confusion. It was total chaos. Nobody knew. There were no guidelines. There was nothing."

Health worker participating in an Independent Panel focus group

The COVID-19 pandemic has taken an enormous physical and emotional toll on the world's health workers. While there is a lack of globally representative data, Amnesty International, Public Services International and UNI Global Union drew on a wide range of sources recently to estimate that at least 17 000 health workers died from COVID-19 in the first year of the pandemic' [35]. In addition to the unacceptable death toll, health workers have suffered extreme and sometimes debilitating stress. A recent analysis of 65 studies enrolling nearly 100 000 health workers in 21 countries found a high prevalence of moderate depression, anxiety and post-traumatic stress disorder [36]. Research shows increases in substance abuse and even suicides [37, 38]. Experts predict the strain on caregivers during COVID-19 could result in high levels of burnout and exacerbate human resource shortages.

Preparing for the worst

Dr Alia Dharamsi remembers the exact moment she heard a person had been admitted with the novel coronavirus in a Toronto hospital. “I texted my friend and said ‘I don’t want to die from this’.” Alia, six months out of residency and one of the youngest doctors on her team, made a decision to learn all she could. She set up in-situ simulation exercises with her colleagues, which partly involved a medical mannequin to “cough” out phosphorescent dust. Using a glow light, the team could then see where the dust was landing including “on our necks, on the walls and in the ventilator ducts”. Through these exercises, she and her colleagues determined how to organize resuscitation teams, what safety/PPE precautions were needed, and how to prepare. “We built protocols from the ground up”, she says. She shared everything the team learned on an open blog site that encourages peer-reviewed cases, and the case has been viewed thousands of times by doctors from around the world. “This was very purposeful. It was a way for all of us to prepare, at a time we weren’t sure if we would even need to use the skills.” By mid-March, with cases spreading around the world, Alia knew the simulations had been essential. “We walked into a fire everyone was trying to escape from. We walked towards our patients, as prepared as we could be.”

Credit: Christine McNab

Countries adopted a range of measures to provide health worker surge capacity. In Europe, 75% of countries allowed early recruitment of health professionals who were finishing their formal training, 71% asked professionals to work additional hours, and nearly half have allowed retired personnel to re-enter the workforce. Community health workers were engaged in some countries to help with prevention and ensure continuity of services other than COVID-19 care.

"Nurses do so much of the work in patient care, yet we are undervalued and not heard. My submission is to encourage those of us in areas of evidence-based research to influence the policies and change the old narrative."

Comment from Uzoma, a nurse in Nigeria, during an Independent Panel exchange with nurses

Countries adopted a variety of strategies in an effort to reduce the extent to which COVID-19 disrupted services. In Kenya, for example, highly targeted COVID-19 restrictions were coupled with efforts to mitigate negative impacts on the health system, including home-based malaria visits with community health workers, vaccine catch-up campaigns, and the use of telemedicine and phone-based consultations [39]. Redesign of delivery can reduce the strain, for example introducing triage systems in primary health care that can direct patients either to routine services or to dedicated pandemic management facilities [40].

Telemedicine, multi-month medicine dispensing and expanded home visits can reduce pandemic impacts on essential health services. In a sample of 46 countries, UNAIDS found that accelerated use of multi-month dispensing of antiretroviral medicines for people with well managed HIV had reduced clinic visits by half by mid-2020 [41]. In addition to health system reconfigurations, essential service disruptions can be minimised by targeting lockdown policies in a way that ensures access to needed care.

In addition to health workers, the pandemic has also affected other essential workers, including those working in food shops or delivery and transportation, cleaning staff and others. Those involved in meat processing were at particular risk of infection. Meat-packing plants provide favourable conditions for viral transmission, given their low temperature, metallic surfaces, dense production of aerosols, noise levels requiring workers to shout, crowded working conditions and, often, limited access by employees to sick leave.

The nature of the frontline and the degree of risk to workers reflects an income gradient, both between and within countries. While those who could (and could afford to) worked from home during the crisis, others kept food supplies, transportation and deliveries functioning. These largely lower-income workers themselves were at risk of infection.

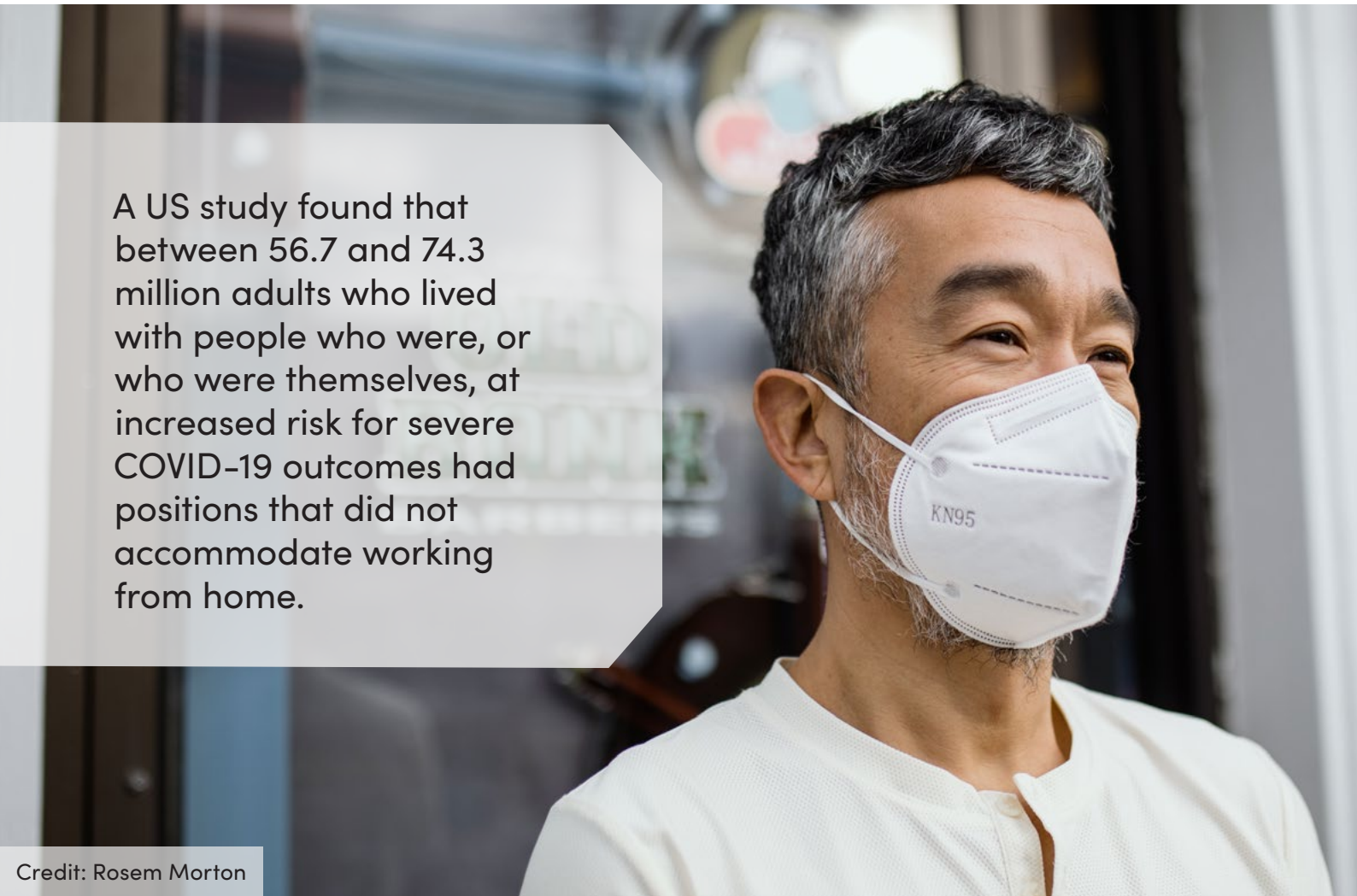
A United States study found that between 56.7 and 74.3 million adults who lived with people who were, or who were themselves, at increased risk for severe COVID-19 outcomes had positions that did not accommodate working from home[42].

Early in the pandemic in New York City, 120 employees of the Metropolitan Transportation Authority died from COVID-19, and nearly 4000 tested positive. In London, 28 bus drivers died[43]. Especially early on, those forced to go to work and associate with possibly infected co-workers and members of the public lacked proper protective equipment and government guidance. Those who quit to protect themselves and their families faced long-term unemployment in depressed economies.

In Summary

Health systems were not prepared, and health workers have not only been put under enormous stress, but also at personal risk.

Health systems will be prepared to meet the needs of a crisis only if they have preplanned across multiple dimensions, including for supply and use of proper protective equipment, adequate staffing, childcare support, mental health support, and income support for those for whom continuing to work is too risky. Those capacities need to be in place well in advance of the point when a crisis hits.



A US study found that between 56.7 and 74.3 million adults who lived with people who were, or who were themselves, at increased risk for severe COVID-19 outcomes had positions that did not accommodate working from home.

Credit: Rosem Morton

5. The scramble for supplies

Within days of COVID-19 being declared a PHEIC, it became clear that getting basic PPE and medical supplies into the hands of affected people, health professionals and other frontline workers would be a massive and persistent problem.

In February 2020, the Director-General of WHO warned that severe global shortages of face masks and protective suits could delay supplies by four to six months [19]. As the pandemic spread in March 2020, WHO estimated that 89 million masks, 76 million gloves and 1.6 million pairs of goggles would be needed every month, 40% more than manufacturers could produce.

Mechanisms intended to route supplies to where they were most needed broke down.

The demand for essential protective and medical supplies extended to PPE, respirators, gloves, gowns, oxygen bottles, sanitizing products and intensive-care beds. Many factors were at the root of the shortages: poor stockpiling, hoarding, panic-buying, protectionism, cargo restrictions, trade barriers, overdependence on a few supplier countries and the lack of immediate procurement funding, especially for low- and middle-income countries.

Stockpiles created in the wake of the 2009 H1N1 influenza outbreak had been depleted — in France and the United States, for instance, they were in a parlous state by around 2013 [44, 45]. Hoarding and fraud occurred in many countries — the European Anti-Fraud Office identified over 340 companies brokering or trading counterfeit or substandard face masks, medical devices, disinfectants, sanitizers and test kits [46].

The smooth flow of goods was impeded by trade and border restrictions. Beginning with China, lockdowns and port-of-entry restrictions, designed to curb the spread of the virus quickly, proliferated around the world. Border restrictions also affected trade and the movement of goods, whether by land, sea or air.

Movement restrictions within countries compounded the problem. Mechanisms intended to route supplies to where they were most needed broke down. As well as the logistical challenges, by April 2020, 75 countries had enacted controls on exports of medical supplies and medicines [47]. However, on the other side of the ledger, a number of countries removed import taxes on medical supplies to facilitate access and reduce costs.


Credit: Christine McNab

As Italy became the first European epicentre of the pandemic, it sought supplies of face masks through the European Union civil protection mechanism. A week after its request of 28 February, it had still received no response. Meanwhile France and Germany imposed export limits on protective medical equipment. It was only on 18 March that Germany cleared export licences for protective equipment, opening the way for 400 000 protective masks to be sent to Italy, along with 300 ventilators, and it was not until the end of April that the European Union civil protection mechanism bore fruit, enabling the supply of some 3360 litres of hand disinfection liquid from neighbouring Austria[48].

Oxygen supplies are critical in many health contexts, and especially during a respiratory pandemic, but there is no clear leading agency devoted to the delivery of oxygen. This is not a new problem. One quarter of hospitals surveyed in resource-limited countries lack sufficient oxygen supply[49] and another survey of Ethiopia, Kenya, India, Nigeria and Uganda found that fewer than half of health facilities had reliable oxygen supplies[50].

A global pandemic demonstrates the fragility of global supply chains tied to a few manufacturers or concentrated in a few supplier countries. With China the major global producer of PPE and also the first country to be hit by the coronavirus, there were spillover impacts in many countries[51]. Similarly, nitrile glove manufacturing was largely concentrated in Malaysia; when Malaysia locked down, global supplies were affected.

"The first few months were terrifying. Presidents were calling me asking for diagnostics. We were waiting for the task force in Geneva. It took forever."

Leader in the response, Africa

Prices shot up: by early March 2020, surgical masks were six times more expensive than before the pandemic, prices of N95 respirators tripled, and surgical gown prices doubled. Procurement came with higher financial risk, with 50% upfront payments, excessive mark-ups and limited access to known, quality-assured suppliers. Low- and middle-income countries were excluded from this market for essentials, with dire consequences — for example, in March 2020, some countries reported health workers reusing masks for multiple days to conserve stocks. Globally, one estimate suggested that less than 20% of global demand for protective equipment and test kits had been fulfilled by June 2020. Delivery delays permeated the system.

...in March 2020 some countries reported health workers reusing masks for multiple days to conserve stocks.

Credit: Angela Ponce

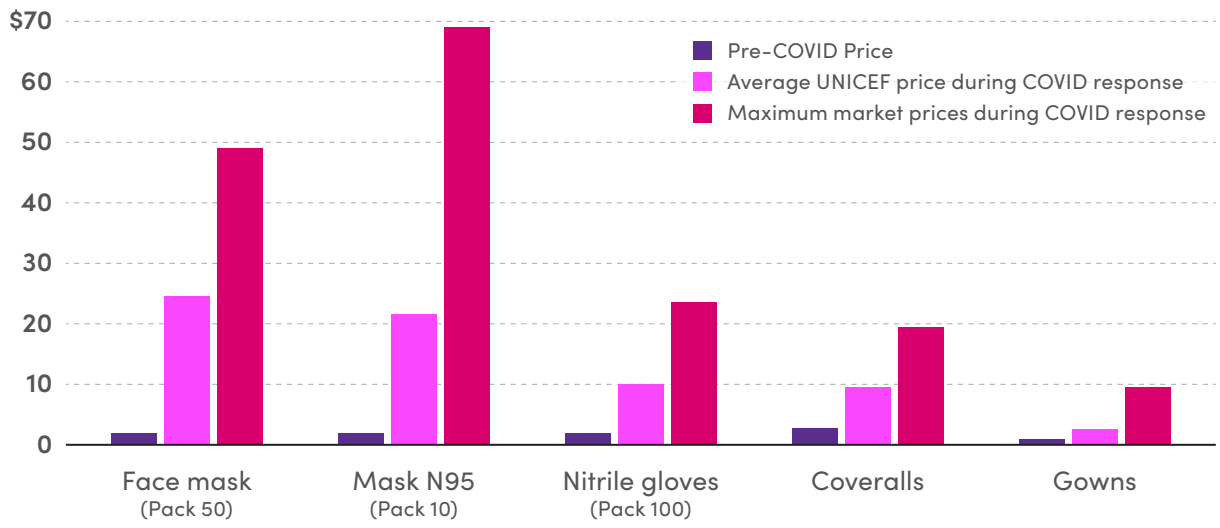
National and international efforts sought to increase the flow of essential supplies. Countries which were able to establish purchasing partnerships nationally and with neighbours fared best. At international level, the United Nations and WHO launched the United Nations COVID-19 Supply Chain System — a procurement consortium. It eventually provided half of the essential supplies reaching lower- and middle-income countries, but the results were mixed: the new system created confusion among international actors, and big gaps remained, some of which persist to this day. Surge manufacturing capacities were rapidly developed in some countries — India established 100 PPE manufacturers from zero in a few months. A new pan-African online market set up direct procurement channels with China, creating an alternative regional channel to get around the delivery delays that beset international platforms.

In the pandemic context, sluggish capital flow and financing gaps quickly restrict efforts to obtain supplies, especially for middle- and low-income countries in competition with high-income countries. Opaque market data make it even more difficult. Financial and data networks are needed to ease supply bottlenecks, especially fast-moving risk capital that is not tied to specific products or channels. Information on what will arrive, when, and from whom is essential for the coordination of operational support.

Pre-procurement quality assurance will be useful for vetting the small, new or "grey" manufacturers of medical supplies that are repurposing production lines or entering the market during times of stress. These sources can help fill gaps, but procurement also needs to screen out potential bad actors. Market-making is needed for all essential supplies, but particularly oxygen, diagnostic tests and PPE.

Figure 5: Personal Protective Equipment Prices (as of 15 July 2020)

Source: UNICEF Global COVID-19 Special Interim Report, August 2020.

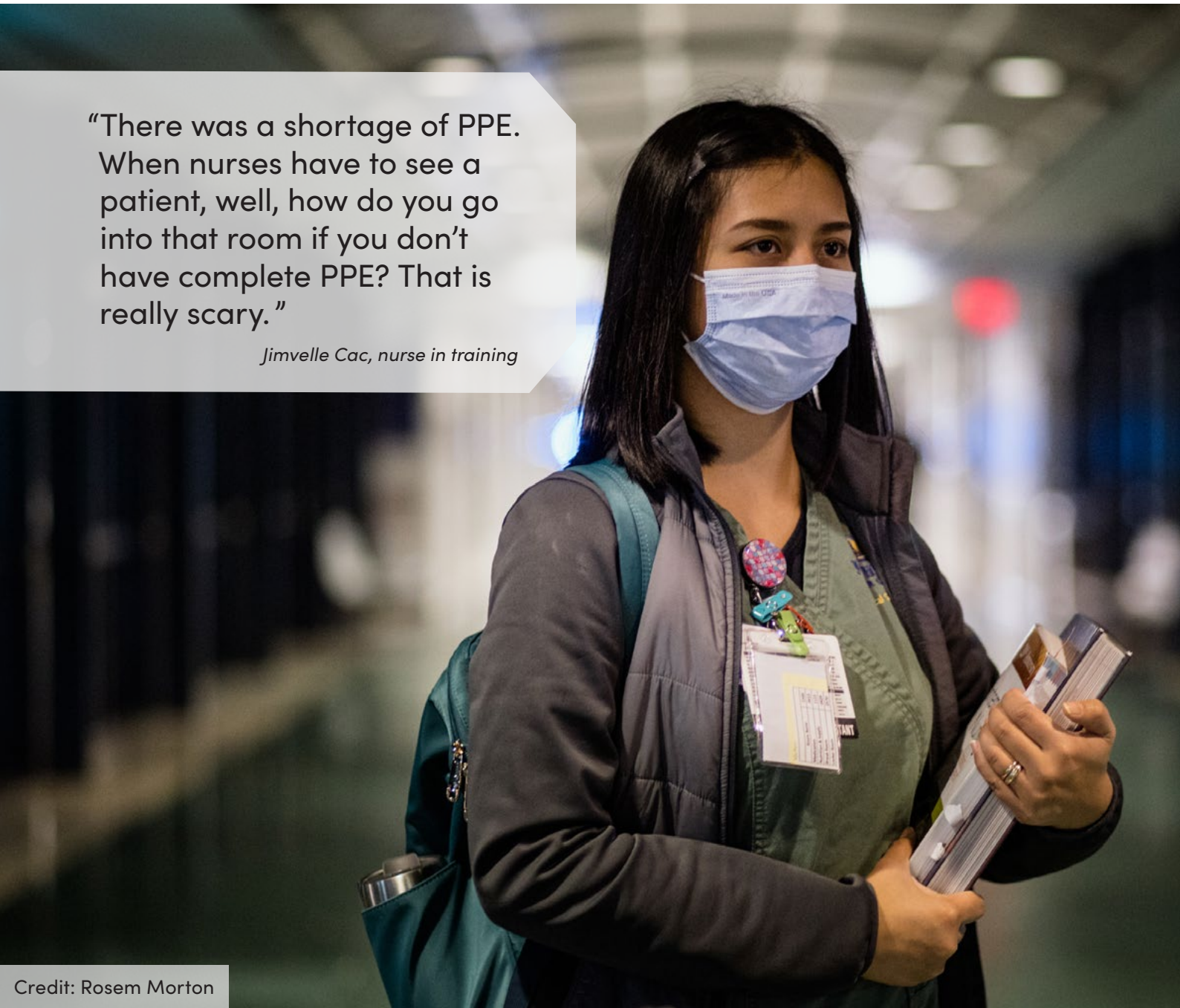


In Summary

The world faced major shortcomings in terms of obtaining basic protection and medical supplies. Neither national nor international systems managed to meet the initial and urgent demands.

There was a lack of rapid and dedicated financing at the right scale and decentralized manufacturing and procurement capacities.

The international system fell short in terms of agreed playbooks, clear leadership and defined roles for multilateral organizations in support of procurement of basic supplies.



"There was a shortage of PPE. When nurses have to see a patient, well, how do you go into that room if you don't have complete PPE? That is really scary."

Jimvelle Cac, nurse in training

Credit: Rosem Morton

"One important lesson is that we needed more information and knowledge. Dealing with the market on specific products is a highly specialized area. I did not have someone who could help me to assess products and negotiate price. I wish we had a specialized agency in the region to support us."

ex-Health Minister, Latin America

Credit: Angela Ponce

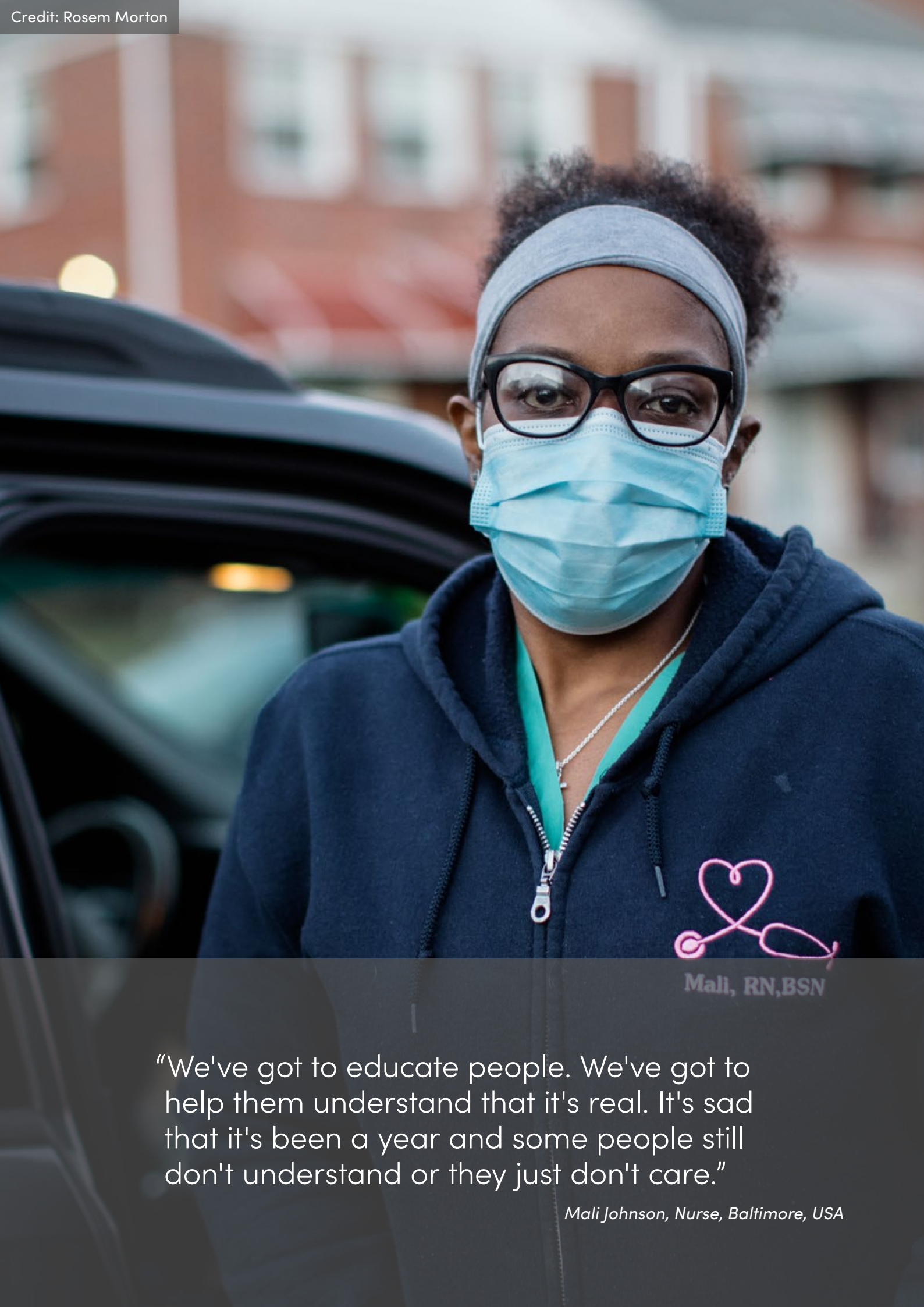
6. Navigating the digital environment and the trust deficit

The communication landscape in which the COVID-19 pandemic unfolded is marked by vast social networks, a relentless appetite for instant information, a digital divide and, in many places, a deep distrust of government and institutions. Breaking news of the coronavirus itself emerged through social media channels, from within Chinese networks where people were alarmed by rumours of a possible SARS outbreak, and then through WHO's first "official" information about the new pathogen via Twitter.

In a fast-moving crisis with many unknowns, the stakes are high: clear technical guidance and effective risk communication from a high-level information source like WHO can make the difference between virus containment and rampant spread, illness and death. Even when filtered through people with good intentions — national and local governments, academics and influencers, health practitioners, translators and local leaders — accurate information can arrive fragmented. When disruptors — wilful political manipulators, armchair experts, denialists, profiteers and bots — meddle with information, the results are even worse. In this environment, a global "infodemic" of information, misinformation and disinformation spread almost as fast as the virus [52].

Public distrust goes hand in hand with social division and inequality. According to the annual survey across 28 countries by a global communications firm, trust in government briefly rose in May 2020 as people looked to governments to lead the fight against COVID-19 and restore economic health but, by the beginning of 2021, they had squandered that trust bubble. Their assessment of people's trust in government, business, nongovernmental institutions and the media declares "information bankruptcy" for all realms [53, 54]. They also find the divide between the highly informed and the mass of the population at an all-time high.

Advice emerging from the evolving science around COVID-19 has to contend with this complex and divided information environment. To take one example: cultural norms in many Asian countries are to wear masks when sick and the reflex action in many communities was to adopt mask-wearing at the earliest sign of the outbreak. The European Centre for Disease Prevention and Control and the United States Centers for Disease



"We've got to educate people. We've got to help them understand that it's real. It's sad that it's been a year and some people still don't understand or they just don't care."

Mali Johnson, Nurse, Baltimore, USA

"We're trying to make sure that timely, accurate, and authentic information is communicated clearly and simply to our people."

Alvin Tan, a Minister of State in Singapore

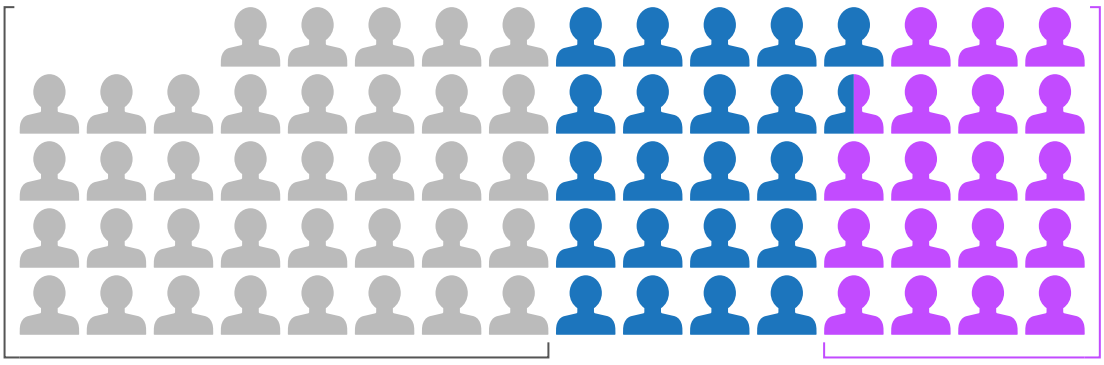
Control and Prevention recommended more widespread use of masks in April 2020, while WHO updated its community masking guidance on 5 June. In some places, mask-wearing became a divisive issue, pitting social responsibility against individual liberty.

The unprecedentedly fast pace of vaccine development caused both elation and suspicion, and the internet was a prime space for the spread of vaccine rumours. As concerns grew that vaccination strategies were under threat, major social media companies cracked down more firmly on vaccine misinformation in early 2021.

The digital divide shaped strategies — where access is good, "myth-busting" has extended to ever-growing social media channels [55], but where access is limited countries had to invest in reaching out to communities directly in local languages and in accordance with local norms. [56] Messaging services were also a challenge, with misinformation spread widely through friends and family but with no source to fact-check. Fact-checking itself in the contemporary information environment can confuse as much as clarify when done with a point of view, or as a vehicle for partisan content [57]. As the pandemic has demonstrated, social media channels are a double-edged sword — they are an effective and vital way to convey evidence-based information quickly, but are also a space where rumours, anxieties and fears can be amplified instantly.

Figure 6: A digital divide, and a gender gap

Source: The Mobile Gender Gap Report, GSMA, 2020.



3.7 billion people are not online.

300 million fewer women than men in low- and middle-income countries access the internet on a mobile.

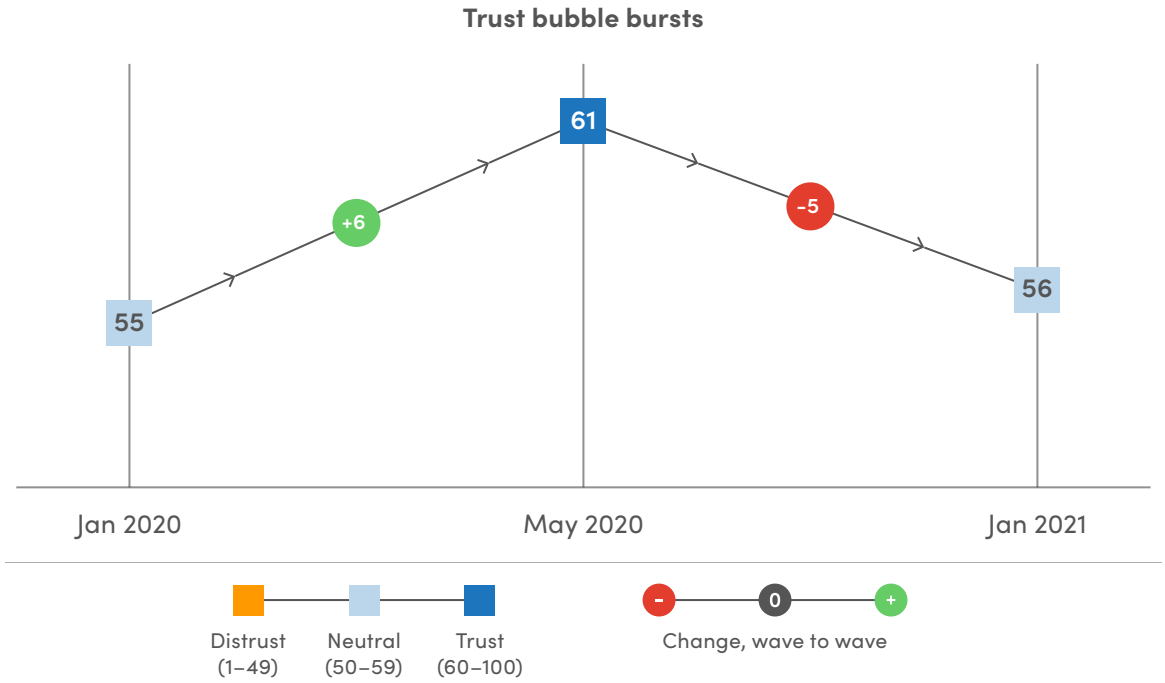
While millions of people follow WHO as well as their own government public health messaging on social media, most do not[c]. Central to risk communication is listening to and working with communities — with the knowledge that people trust their neighbours more than they trust faraway officials[58]. Among the many examples across the world, Thailand, before the pandemic, had in place a dedicated budget for national and provincial coordinated all-hazards risk communication. It made use of an extensive network of health volunteers in dialogue with village communities when the pandemic came. Another example of extending the reach of messaging is India's use of public service announcements on its mobile phone services in regional languages[d].

Digital tools are now core elements of disease surveillance and alerts, sifting through vast quantities of instantly available information — countries and news media picked up digital postings from Wuhan about a new disease moments after they were published. Surveillance, contact-tracing, data-sharing and early warning systems have digital management technologies at their core. But these tools can also be accompanied by overhyped promises about what can be done with big data and artificial intelligence, and not enough thought about how algorithms may work in practice, including the risk they will amplify social biases[59].

Data collection needs to be accompanied by privacy and other protections[60]. Under pressure to track the status of the pandemic, there was a push to create digital tools and national up-to-the-minute

Figure 7: Change in public trust in government during the first year of the pandemic

Source and adapted from: Edelman Trust Barometer, 2021.



c WHO's Twitter following, for example, has grown from just over five million followers in early January 2020 to more than nine million as of 30 March 2021.

d The Independent Panel National Responses paper

dashboards. But fancy portals could mask inconsistent data fed from local health units. Experts warn against an instinct to add more digital solutions without taking stock of what is already there, and also ensuring high-quality field data collection. At the other end of the information cycle, digital solutions must not forget the people they are addressing: a prompt to self-isolate will not work if a person has no home in which to isolate, or no food in the fridge[61].

In Summary

Digital tools and solutions provide major opportunities for information-sharing, data analysis and improved management and international cooperation.

The present digital and social media environment has also proven perilous, with disinformation, misinformation and inconsistency — of words and actions — eroding trust in institutions and governments.

Rapid and clear communication has been a matter of life and death during this pandemic and will continue to be with the intensification of vaccination and public health control measures. The fast-evolving science of SARS-CoV2 and COVID-19 disease makes risk communication even more important, despite the challenges.

Digital communication does not reach everyone. The billions of people and their communities who are offline must not be forgotten in communication outreach — and the needs involved in responding to the pandemic can also provide the opportunity to help bridge the digital divide.

Digital communication does not reach everyone. The billions of people who are offline must not be forgotten.

Students in this region trek up the mountain to sit by a transmission tower so they can complete their assignments.

Credit: Saiyna Bashir

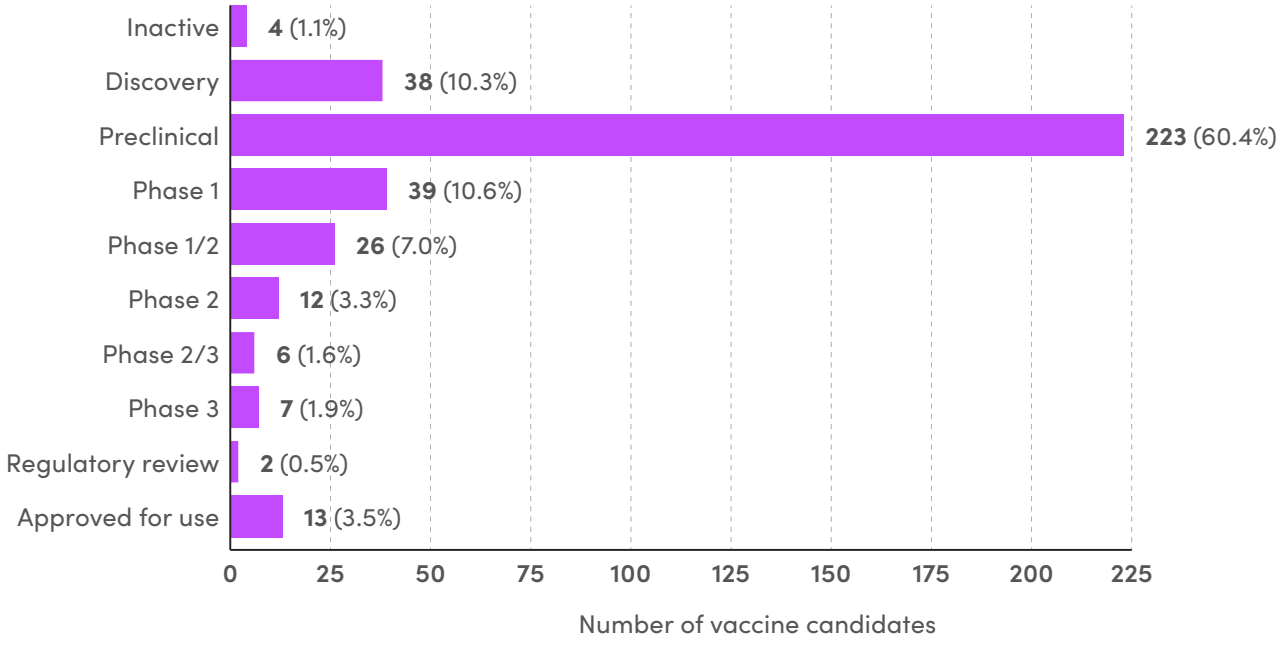
7. The unprecedented pace of R&D acceleration

The emergence of SARS-CoV-2 was met by the largest and fastest accumulation of scientific research in human history, much of it coming through more open channels than ever before. Scientific journals opened to greater sharing, preprint servers distributed findings quickly, databases such as the European Bioinformatics Institute collated information. Researchers have been able to make broad use of tools such as SAGE, a technological infrastructure that makes sharing relevant data such as genome sequencing easier.[62] There are now approximately 650,000 genome sequences available, although half are from just five countries, with the most coming from the UK, and there are major gaps from the African and Middle East regions.

Laboratory researchers and large public health institutions immediately began working on vaccines, therapeutics, and test assays from the day the novel virus was sequenced—it was made publicly accessible on GenBank on 11 January 2020. As of April 2021, 23 vaccine candidates were in Phase III or IV clinical trials and 13 vaccines are in use—a feat accomplished within 12 months, versus a conventional vaccine development timeline of 8–10 years.

Figure 8: Number of COVID-19 vaccine candidates by development stage

Source: UNICEF COVID-19 Vaccine Market Dashboard. Data as of 21 April 2021.



The unprecedented pace of research and development was backed by a massive infusion of public funds. Expertise and technology from decades of work — especially on HIV, Ebola, cancer vaccine research, and immunology — was available and ready to apply toward the new virus. Regulators also raced to find ways to speed clinical testing while doing the utmost to maintain safety. Several regulatory agencies, including in Europe, India, the US Food and Drug Administration, and Health Canada approved emergency procedures to expedite clinical testing and approval.[e]

"When we started, we did not have at-risk ignition funding for R&D. So, we borrowed $100 million in our bank account to pay manufacturing lot for a phase 1 clinical trial to get things started. Also, CEPI does not normally pay for manufacturing. However, there was no financing for that. So, we stepped up and put in US$600-$700 million. We had to borrow from our core funding to fill this critical gap."

CEPI leadership

COVID-19 reaped the reward of years of effort to expand capacities for R&D to address potential pandemics. The WHO's R&D Blueprint was launched in 2015 and the following year in the throes of the West Africa Ebola outbreak it was used to create a new model for R&D response to emerging pathogens.[63] It identified bottlenecks in international collaboration, encouraged agreement on basic data-sharing, and sought more efficient ways to conduct clinical trials in times of distress.[64] The Coalition for Epidemic Preparedness Innovations (CEPI) was launched in 2017 as a non-profit organization funding basic research and early clinical trials against a list of epidemic-prone infectious diseases.

This infrastructure deployed almost as soon as the COVID-19 alert was sounded. CEPI sought out and sponsored some of the first vaccine candidates (Moderna and Oxford University) when there were fewer than 600 cases around the world. The R&D Blueprint encouraged adaptive clinical trials and launched the Solidarity trial in mid-April 2020, which exemplified an efficient and robust way to generate randomised evidence using simple large trials. Alongside the global efforts were national measures to support COVID-19 R&D, the largest of which was the US federal Biomedical Advanced Research and Development Authority whose cumulative investment was US$14 billion by November 2020.[65]

However, the existing R&D infrastructure was not adequate to the scale of the emerging pandemic. In April 2020, WHO and partners established ACT-A, the Access to COVID-19 Tools Accelerator, to push ahead the development, procurement, and allocation of vaccines, tests, and treatments.[66] ACT-A brought together partners to define and accelerate vaccine development from the basic science to clinical trial stage, although the constraints of finances and dose availability limited its power to resolve access and equity matters. Major vaccines currently produced in the world are not necessarily fit for global access. They have not fully followed Target Product Profiles established under the WHO R&D Blueprint for COVID vaccines since they require, for example, ultra-cold-chain and specific technical know-how for various platform technologies.

e The Panel has conducted a review on efforts to develop and delivery COVID-19 vaccines, diagnostics, and therapeutics.

"I'm not so sure if we will ever even get the vaccine. And those who will get it I think are the ones who will have the money."

Mildred Nakahima, a small café owner owner in Kampala, Uganda

Credit: Esther Ruth Mbabazi

The collaboration among key institutions under ACT-A is unprecedented. It is, nevertheless, seen by some countries and civil society interest groups as supply-driven, exclusive, and biased toward western interests. The involvement of Russia, China, and India in ACT-A was weak especially at the outset, although these three countries are key vaccine producers and now supplying vaccines to many countries around the world. The delayed participation of the US government also limited the scope of ACT-A as a global mechanism. 'Operation Warp Speed,' the US public sector effort to accelerate vaccine development, had its own notable success; so did purely private sector efforts such as that of Pfizer/BioNTec.

ACT-A also supported diagnostics development with a degree of success, and to a lesser extent therapeutics, although not many effective therapies have been found. From 2020 to early 2021 more than 600 potential therapies for COVID-19 were brought to preclinical or clinical development.[67] Efforts to develop therapeutics cover several categories, including immunomodulators, neutralizing antibody therapies, cell therapies, and gene therapies.

While the virologic and immunological complexities of SARS-CoV-2 made the development of therapeutics a challenge, it has also been hampered by a lack of funding, a fragmented research landscape, and the absence of a strong aggregator to help drive efforts forward. Trial coordination needs an over-arching framework, fed by head-to-head comparison studies of products within each product/tool category. Many therapeutic trials were poorly designed for decision making, and trialling in low- and middle-income countries and in diverse populations is crucial.

Credit: Katya Rezvaya

In some countries diagnostic development and rollout was a challenge due to slow bureaucracies, cautious rollout, and a spike of unfamiliar entrants into the test manufacturing market. But there have also been rapid and effective diagnostics programmes such as that from the Korea Centers for Disease Control and Prevention. By early March 2020 tests had been ramped up to 20,000 a day with five local manufacturers producing kits for domestic use and export.[68]

Globally, there is a mismatch between commercial developments and international approval. As of March 2021, only 26 out of hundreds of commercialized tests and diagnostic kits had gained the WHO emergency use listing required for global distribution through ACT-A.

Modelling efforts were part of the COVID-19 response from the beginning.[69] These had immediate effects in official efforts to modulate public behaviour and enforce distancing, quarantine, trade, travel, border, and social restrictions. The role of nonpharmaceutical interventions were part of the research agenda for COVID-19 under the R&D Blueprint.[70] While the success of nonpharmaceutical interventions in COVID-19 containment has been manifest, there is less clarity about which levers produce best results, partly as they are highly context-dependent, and also because of their inherent complexities.[71, 72, 73]

Increasingly, the paradigm of knowledge to be shared will be digital. The Nagoya Protocol provides the legal basis for the fair sharing of genetic resources, and voluntary science networks such as GISAID, which made widely available the first whole genome sequence of SARS-CoV-2, shows the critical role of open science and data platforms to pandemic response.

While there are hundreds of trials for possible COVID-19 drugs taking place globally, there are very few in Africa. One of the few good examples is the ANTICOV Trial, a collaborative effort launched by an international network of research institutions and 13 African countries, that aims to find cheap, readily available drugs that can keep those suffering from COVID-19 out of hospital, so that already-weak health systems are not overwhelmed. More specifically, the trial seeks to find a drug that reduces by half the likelihood that mild COVID-19 cases progress to severe illness. ANTICOV leveraged the African Vaccine Regulatory Forum, a platform established by WHO that brings together National Regulatory Authorities and national Ethics Committees on the African continent with the objective of strengthening clinical trial regulation in Africa. More strategic and coordinated investment in clinical trial capacities across the world will be a critical part of preparedness for the future pandemics.

Credit: Xavier Vahed-DNDi

Knowledge generation and technology transfer is far from even in the world. The pandemic exposes the cost of not investing in these capacities in low- and middle-income countries. That many of the most effective health responses to COVID-19 have come from these countries should be a signal to redress the balance in the way knowledge is generated and valued — to the benefit of the world as a whole.

In Summary

The speed of the scientific and R&D response to COVID-19, especially with vaccines, is unprecedented. The pace of has shown the value of pre-existing platforms, secured funding to reduce investor risk, and agile stakeholders prepared to cooperate.

R&D needs to be guided by explicit strategies to deliver widely accessible tools that can be used fairly, and participation from low- and middle-income countries needs to be built in from the outset.

Technical leadership works best with distinct research, development, and manufacturing streams, but with a common strategic focus and end-to-end coordination to reduce the time from pathogen characterization to emergency use authorization.

Upfront public sector funding is necessary for research acceleration but needs to be matched with equitable access. Critical areas of market failure need to be addressed — such as underinvestment in diagnostics, especially given the vital role of testing.

8. Geopolitical tensions challenging multilateralism

The line between geopolitical conflict and health protection has always been a fine one. Florence Nightingale invented modern health informatics with her polar charts produced in the Crimean war demonstrating that sanitary conditions were causing more deaths than war wounds. Even as the League of Nations was failing to prevent the outbreak of the Second World War, combating countries continued to contribute information to its Health Organization's technical epidemiology bulletins until 1941.

Competition between the world's two largest economies has shaped the global landscape of response to COVID-19. Former United States President Donald Trump announced a withdrawal from WHO because he felt it lacked impartiality and was biased towards China. This challenge, however, appeared to result in rallying support for the organization. Six Heads of State or Government spoke at the May 2020 opening of the World Health Assembly — from Barbados, China, France, Germany, the Republic of Korea, and South Africa. This was a larger number of national heads than has ever before been present at a World Health Assembly.

The General Assembly held a Special Session in Response to the COVID-19 Pandemic in December 2020.

Credit: Eskinder Debebe / United Nations Photo

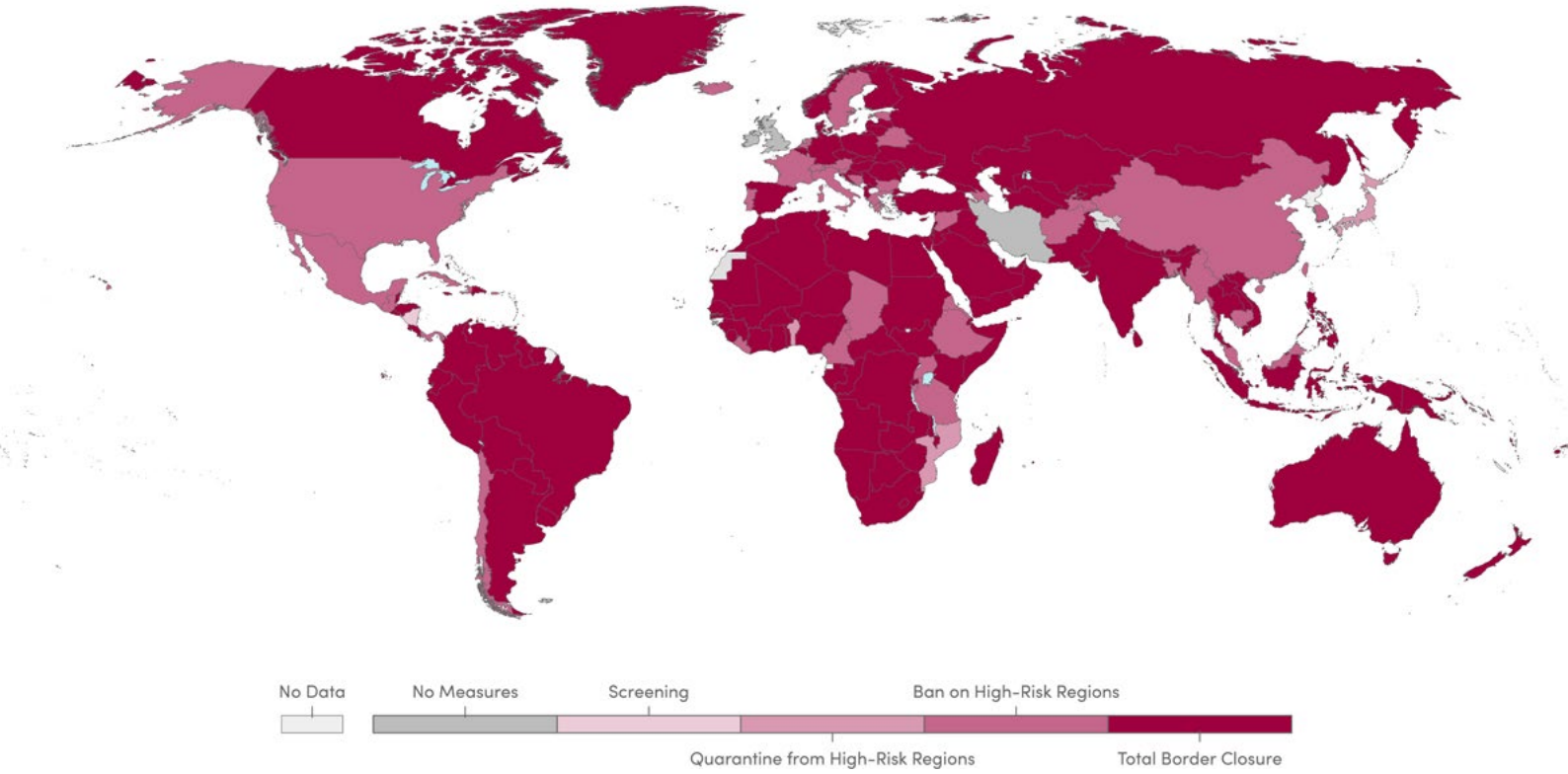
Tortuous negotiations behind a UN Security Council resolution on the pandemic are a case in point. Estonia first proposed that the Security Council issue a statement on the growing pandemic on 18 March 2020. Discussions among the five Permanent Members of the Security Council on a resolution began around the same time, but soon stalled. Attempts by the elected members of the Council to break the deadlock also foundered. It was not until 1 July that a resolution was passed expressing "grave concern about the devastating impact of the COVID-19 pandemic across the world, especially in countries ravaged by armed conflicts, or in post-conflict situations, or affected by humanitarian crises." It lacked concrete proposals, however, and made no reference to WHO.[74]

While the tension between US and China over COVID-19 made the headlines in international news, the tendency for nationalism and protectionism rather than cooperation and multilateralism has been much wider. In many countries, domestic priorities drove the closure of borders, sometimes on a selective basis more reflective of alliances than driven by public health evidence. The major non-compliance with the IHR in the COVID-19 pandemic has been in the selective imposition of travel and trade restrictions.[75] In our highly interconnected age the science around travel restrictions need to be updated urgently to inform the application of the IHR in respect to travel and the containment of pandemics.

In the contest between national needs and global solidarity, nationalism has often won out with the imposition of bans on the export of essential

Figure 9: International travel controls during the COVID-19 pandemic as of 31 March 2020

Source: Hale, Angrist, Goldszmidt, Kira, Petherick, Phillips, Webster, Cameron-Blake, Hallas, Majumdar, and Tatlow (2021)."A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)." Nature Human Behaviour. — Last updated 20 April, 16:00 (London time) OurWorldInData.org/coronavirus



products, including in a range of measures designed to erect protective barriers around supplies of COVID vaccines. The rhetoric of global solidarity vanished into hot air when governments were faced with domestic political pressures.

This pandemic might suggest dismal prospects for multilateralism as a tool for progress, but a look over history suggests that while the road to securing agreement is never smooth, lasting resolve with real impact is possible.

The global response to HIV beginning in the 1980s failed to keep up with the scale of that pandemic and was unable to draw on the strengths not only of all the United Nations system organizations, but also of a global movement of activism and science. UNAIDS was created in 1996 as a new type of coalition, more able to bring UN organizations together in common purpose and including a formal place for civil society in its governing body. When effective antiretroviral therapy was developed in the mid-1990s, the lack of access in the most affected countries was cast as an intolerable global moral failing. From the turn of the century, access began to be ramped up for all in need in one of the largest-scale extensions of medicines access the world has ever seen.

Similarly, the Paris Climate Agreement and the 2030 Agenda for Sustainable Development suggest that multilateral corporation can deliver agreed targets despite differences between countries both on the nature of the problem and what solutions will work best.

In Summary

The multilateral system as whole failed to take collective responsibility.

There is no alternative to multilateral cooperation. No nation acting alone can bend the negative climate curve, nor stop the spread of a deadly virus which does not respect national borders.

A crisis of the scale of COVID-19 demonstrates the indispensability of governments acting together in their mutual self-interest. But it has also made graphic the frustrations attendant on a multilateral system held hostage to international rivalries and bogged down in endless negotiation on minor matters.

This mega-crisis makes a compelling case for strengthening a true and effective multilateral system which ensures that disease outbreaks do not become pandemics and pandemics are not allowed to escalate into world-wide social, economic, and health crises. This opportunity must be seized.

Understanding the political economy of incentives and barriers to international agreement is a vital task that needs to draw on research disciplines much wider than done today.

9. Economies take major hits

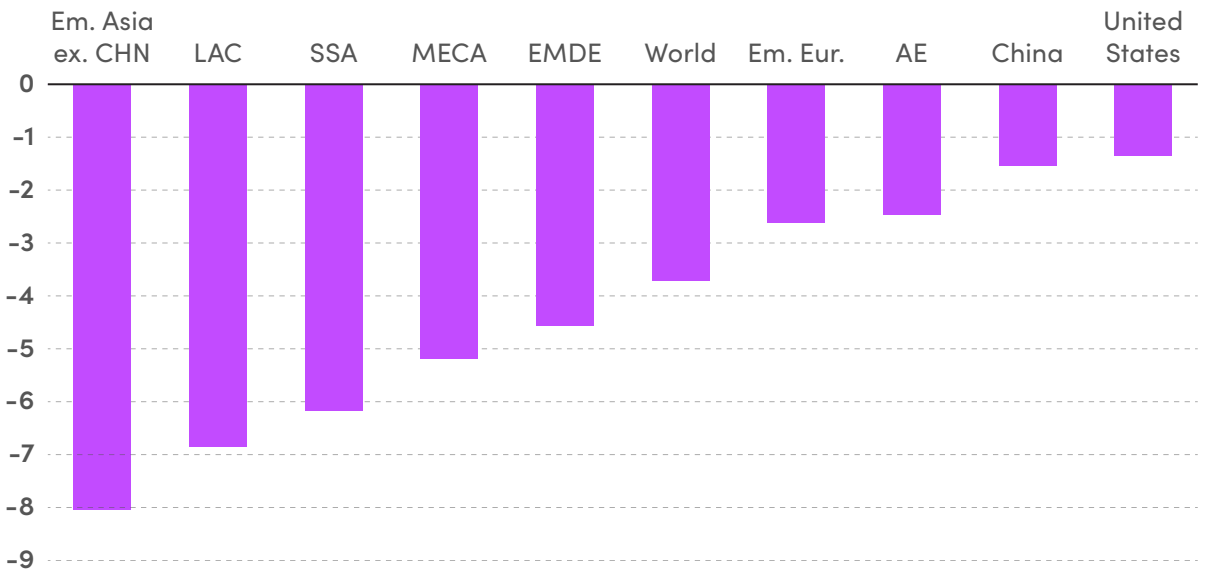
The economic toll of the COVID-19 pandemic will take years to emerge, but already the impact is stark. The global economy shrank by 3.5% in 2020, and US$10 trillion of output is expected to be lost by the end of 2021, growing to about US$22 trillion in the period 2020-2025. For the first time in decades, global poverty is likely to significantly increase.[76, 77, 78] COVID-19 has pushed some 115-125 million people into extreme poverty.

These costs are spread around the world, albeit not equally: East Asia and the Pacific are projected to grow a very weak 0.5%, South Asia to contract by 2.7%, sub-Saharan Africa by 2.8%, the Middle East and North Africa by 4.2%, Europe and Central Asia by 4.7%, and Latin America by 7.2%.[79] More than nine out of ten national economies experienced contraction in per-capita gross domestic product, which is the highest share of countries simultaneously contracting since the Great Depression of 1930-32.[80] The world has seen in its worst period of economic contraction since the Second World War.

The economic impact of COVID-19 has depended on the interplay of pre-existing structural conditions in economies, the amount of fiscal and governance space made available for mitigation, and the nature and timing of decisions made in response to the pandemic.

Figure 10: Forecast global GDP growth in mid-2020

Source: Extrapolated from World Bank Data.[f]



f The World Bank: The Global Economic Outlook During the COVID-19 Pandemic: A Changed World, June 8 2020.

The economic impact of COVID-19 on the workforce is massive but distributed unevenly—a banker, lawyer, or software engineer may be able to carry on with work remotely using information and communications technologies, while a restaurant employee, hotel clerk, or market stall operator could not. Around the world some 600 million people work in hard-hit sectors like hospitality or retail.[81] The decline in travel and tourism in 2020 is expected to result in global losses of around US$2.1 trillion for that sector alone.[82] Shifts in workforce patterns may be long-lasting. For example, commerce in goods began to rebound after the initial pandemic shock, but services, such as transportation and contact-heavy activities, continued to decline.

Those able to lean on technology in order to support their jobs found it easier to do in some parts of the world than others. Between 25 and 50% of the population in Latin America has no internet access at home; that figure is more than 75% in much of sub-Saharan Africa and India. Informal workers, of which there are 1.6 billion in the world, did not have the option of working remotely. Either the work disappeared, or it was done at risk of exposure.[83, 84]

"We wouldn't have survived another two months of the lockdown. The whole business would have fallen apart. At the time, it was a nightmare."

Alex Vardanyan is a café-bar owner in St. Petersburg, Russia

Credit: Katya Rezvaya

The extent of the economic impact of the pandemic on individuals is directly related to the extent of social protection. If economic downturns result in job losses and if health insurance is tied to employment, then the results can be catastrophic. If precarious employment conditions leave workers without access to sick leave, then transmission will increase. The risk is the creation of a feedback loop.[85]

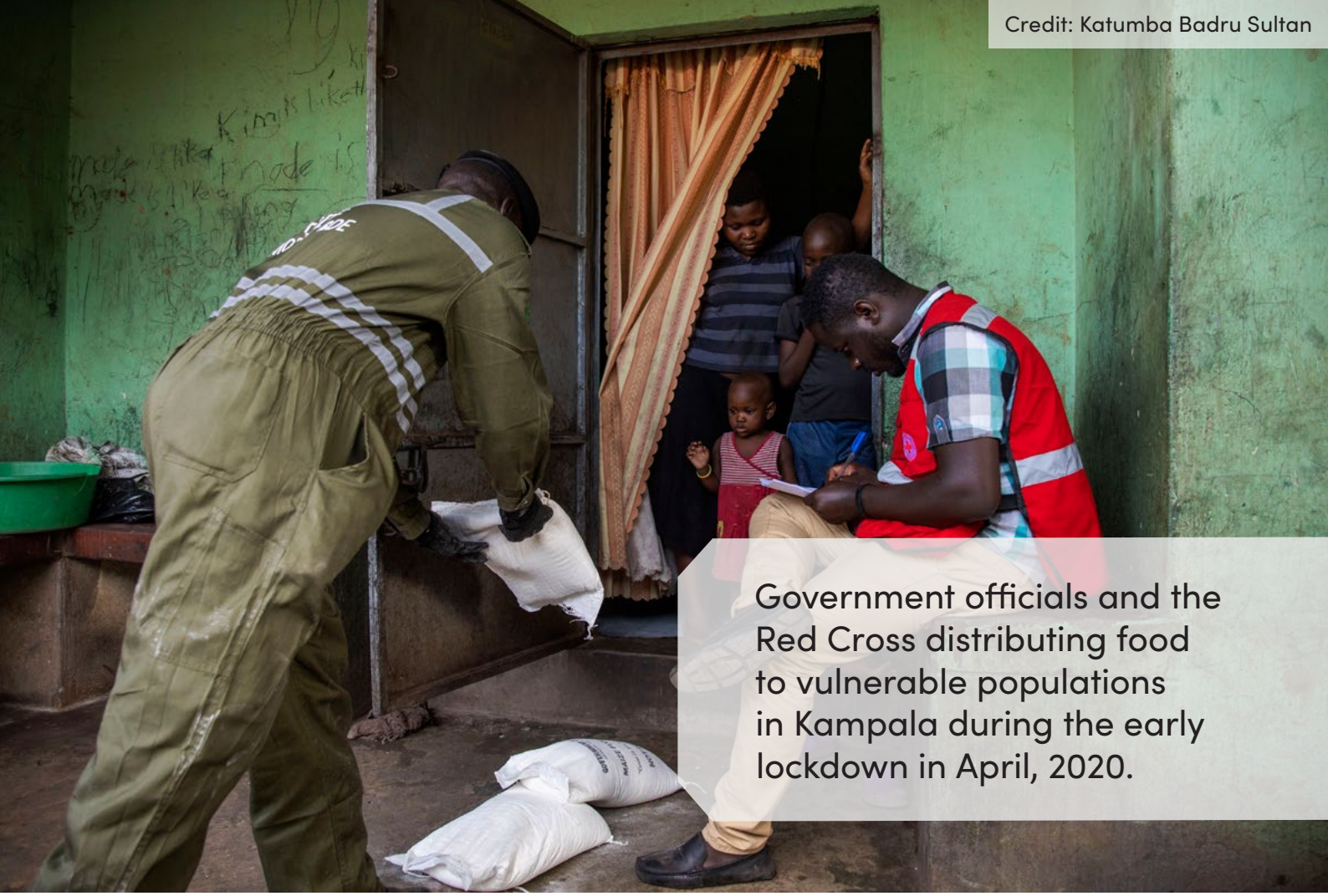
Where there were high levels of informal employment, mobility, restrictions did not reduce the number of cases, according an analysis of more than 80 countries. Stay-at-home orders can only be successful when households can make ends meet through the lockdown period, when workers are able to work remotely, and when there is a level of trust in government sufficient for orders to be complied with.[86]

Responses to COVID-19 have often been framed as a 'trade-off' between economic costs and public health costs, or between saving lives and saving livelihoods. However, health and economics are inseparably intertwined.

The timing of public health and social measures and when to relax them has been critical. Countries that have been unable or unwilling to sustain measures even when the epidemic is trending upwards have often found themselves experiencing both the economic pain of lockdown and the health consequences of rampant spread. Short and sharp measures are less problematic than lengthy restrictive orders that fail to take account of structural vulnerability. For example, stringent lockdowns in India disproportionately impacted internal migrants employed in the informal sector. The lengthy stay-at-home orders in Argentina saw its economy contract by 26.4% in April 2020 alone.

There are countries that have managed to reap the benefits of swift containment in terms of economic growth — or at any rate less contraction than might have been expected. Viet Nam emphasized transparency and real-time information sharing and was one of the few nations to record positive economic growth in 2020.[87] The 2015 MERS outbreak cost the Republic of Korea US$2.6 billion in lost tourism revenue and US$1 billion in response. Not wanting to repeat that experience, its swift response to COVID-19 was grounded in testing, tracing, isolation, and treatment rather than closing businesses and issuing stay-at-home orders. For many leaders it was important to argue explicitly that there was not a trade-off between the economy and health.

Recovery from COVID-19 will be protracted. Even optimistic forecasts suggest major advanced economies will have depressed output levels until at least 2024.[88] Emerging and low-income economies may find recovery takes even longer.



Credit: Katumba Badru Sultan

Government officials and the Red Cross distributing food to vulnerable populations in Kampala during the early lockdown in April, 2020.

As the ripple effects of income and job losses persist, the consequences emerge of putting off health care and of mental health stresses. Development of human capital is set back. Stabilization of national economies in the face of the COVID-19 shock is just the first task—a concerted focus is needed on long term protection, stability, and resilience.

WHO estimates that additional spending of US$72 billion is needed on pandemic preparedness annually (US$19.1 billion for low- and middle-income countries and US$47.5 billion for high income countries). [89]

This pandemic has shown that the returns on investment in pandemic preparedness will be vast and will flow to all. Pandemic preparedness is a paradigmatic global public good. It has to overcome both the free-rider problem, where beneficiaries do not feel they have to shoulder the costs, and the weakest link problem, where a single act of non-compliance can jeopardize the benefits. [90] The sheer scale of this pandemic shows the need to overcome these problems and secure the necessary investment.

In Summary

The US$22 trillion impact of the COVID-19 pandemic is the biggest shock to the world's economy in three-quarters of a century.

The return on investment in pandemic preparedness is vast. The US$72 billion estimated cost for preparedness corresponds to less than 1% of the total cost as we know it right now.

The capacity of countries to respond has been shaped by the policy choices but also by pre-existing structural conditions and the availability of fiscal space.

Responses were less effective when social measures were not applied, or as structural weaknesses and lack of social protections in economies prevented them from working.

Credit: Tuane Fernandes Silva

10. The pandemic affects everyone, but not everyone is affected equally

The impact of COVID-19 has landed unevenly. It has deepened the entrenched structural inequalities of income, health, and education. The best line of defence to prevent the epidemic from becoming a pandemic would have been to recognize that the virus would exploit these fault lines and accelerate measures to overcome them. Instead, heedless 'beggar thy neighbour' responses and the inconsistency of one rule for the rich and another for the poor accelerated the pandemic and made inequity worse.

11 million of the poorest girls in the world may never go back to the classroom.

Credit: Katumba Badru Sultan

Disparities in digital access and entrenched education inequalities means that the 90% of students whose education was disrupted by the pandemic will not all return at the same rate or be able to make up lost ground.[91] Children with disabilities, ethnic minorities, refugees, and displaced populations are less likely to both be able to access remote learning materials and to return to school post-crisis. The impact on girls is acute—perhaps 11 million of the poorest girls in the world may never go back to the classroom, and an additional 10 million girls are at risk of early marriage.[92, 93]

At one point in 2020, about 90% of schoolchildren around the world were unable to go to the classroom.[94, 95] By the end of 2020, 320 million of the world's 1.6 billion student population were still locked out of schools. Seventy-two million primary school-aged children risk being unable to read or understand a simple text by age 10.[77, 96] The impact of gaps in education may be felt long term, with the World Bank estimating up to US$10 trillion in lifetime earnings lost. Early reports suggest that pupils from lower income households are taking longer to catch up due to lost schooling. Schools also provide social support and, in many places, a hot meal every day. One estimate counts 39 billion lost school meals since shutdowns began.[97]

The pandemic is driving a shortfall in human capital—the knowledge, skills, and health that people accumulate over their lives. The World Bank's Human Capital Index is designed to capture the human capital a child born today can expect to attain by age 18 as a marker of future well-being. COVID-19's economic impacts threaten all inputs, with drops projected in all country income bands, but they will be worse for low- and lower-middle-income countries.[98] COVID-19 kept children at home, and survey data from the UK and Italy has shown increases in anxiety levels, depression, and adjustment problems among children, parents, and caregivers.[99, 100]

Mayor Yvonne Aki-Sawyerr of Freetown, Sierra Leone helped the Panel to invite mayors together to share their pandemic experiences.

Mayors on the frontline

The pandemic has also highlighted struggles for cities trying to provide for marginalized people including those without documentation. From Accra to Geneva, lack of an identification card or proof of residency translated to lack of access to government social protection. Mayors from several cities told the Panel they were shocked by the hardships revealed during the pandemic, as they tried to meet the needs of people who were not officially resident in their cities but without a place to live, suddenly exposed during lockdowns. Mayors stressed that the pandemic underscored why they need a bigger role to inform decisions and policy in pandemic preparedness and response, as national responses can fail to address the realities of everyday life. As Mayor Yvonne Aki-Sawyerr of Freetown explained: "You are first in the response, but often last in the queue for policy formation."

The pandemic is causing a sharp rise in the newly poor, many from middle-income countries. The International Labour Organization projects that the proportion of the newly poor who are paid employees will rise sharply, which is a measure of thinning resources—wages will be reduced or will simply not be high enough to keep pace with expenses. Large numbers of poorer families in developing countries rely on remittances, which are estimated to decline globally by 14 percent in 2021.[101] Meanwhile, migrant workers are often shut out of health care and vaccination programmes, either by eligibility rules or because of fears of reporting or deportation due to migration status. For that reason, multilateral organizations have issued clear guidance not only that vaccination is a right for migrants, but also that firewalls should be established between immigration enforcement and COVID-19 vaccination access.[102]

"If COVID doesn't kill me, hunger will kill me."

Olinda Silvano Inuma is a leader of the Shipibo-Konibo Amazonian migrant community in Lima, Peru.

Credit: Angela Ponce

The pandemic has increased inequality within countries. In a survey of developed countries reporting overall unemployment increases in 2020, women were the most affected.[103] Economic and race-based disparities have been observed from the wealthiest to the most resource-constrained settings. Los Angeles is reckoned to be the third-wealthiest city in the world. Despite its periodic lockdowns, it became an epicentre of COVID-19's spread in October and November 2020, with caseloads falling disproportionately among poorer populations and ethnic minorities. Patterns of inequality are not restricted to high-income countries — in Nigeria, also, incidences of COVID-19 seem to be higher among particular ethnic groups.[104, 105]

In low-and low-middle income countries, the largest part of the labour force is in informal work, and the majority of these informal workers are women. Most have limited earnings, few labour law protections, limited

"Inequality makes you fundamentally ill-unprepared for a pandemic."

Community NGO lead, Cape Town

social benefits coverage such as pension, health insurance, or paid sick leave, and little savings. Informal labour is often undertaken in unsafe conditions. Caregiving for children, parents, or relatives, which is time-consuming and often unpaid, has markedly increased with the pandemic, and also needs to be seen through a gender lens — the largest share of this burden falls on women. [106, 107]

The social impact of the pandemic has included untreated mental health, including depression and social anxieties. The pandemic has also contributed to the rise of gender-based violence. This is not surprising, given that home is the primary location where gender-based violence occurs and exposure to abusers has increased with measures requiring people to stay at home. UN Women has documented the increasing incidence of gender-based violence in many countries. [108] To take just one example: in France, reports of domestic violence increased by 30% in the 10 days following the announcement of the lockdown.

According to a McKinsey survey, women make up 39% of global employment, but account for 54% of overall job losses — jobs in sectors where women are more prevalent are more at risk. [109] Current global statistics show more men than women are dying of COVID-19; whereas women may suffer more than men from the health, social, and economic consequences in the long term. [110] Increased gender inequality is a major impact of COVID-19.

Previous pandemics suggest COVID-19's impact will linger as equity gaps increase. A study of five pandemics between 2003 and 2016 found that income inequality increased in affected countries over the five years following each event, and this pandemic is on a larger scale. [111] But well-functioning safety nets mitigate impact. Among the innovations that have paid off in this pandemic are unique-code-based payments to ensure cash transfers and social insurance reach vulnerable populations in Guatemala and Peru or the use of financial inclusion agents in India. These are measures that can have lasting benefit beyond the pandemic.

In Summary

Inequality has been the determining factor explaining why the COVID-19 pandemic has had such differential impacts on peoples' lives and livelihoods.

If national governments had better social protection systems already in place, they would have been more resilient, and people would have suffered less, and if there were fewer people in precarious or informal employment, there would have been fewer people exposed to risk.

Preparedness and response systems need to be gender responsive from design through to implementation.

Credit: Christine McNab

11. Vaccine nationalism

Vaccine access and distribution takes place now in a highly charged and political environment. Governments are struggling to meet demands to take care of their own people, even as they address the greater good. In this sense vaccine nationalism is not just a selfishness to be condemned, but a force to be feared and a problem to be reckoned with.

As of now, high-income countries such as Canada, the UK, Australia, New Zealand, and the United States and across the EU have been able to secure vaccine doses that would be enough to cover 200% and more of their populations. [112]

It took a powerful effort to get to the point of making a COVID-19 vaccine. Back in April 2020, public health experts said the optimistic expectation was that a vaccine was at least 12-18 months away. [113]

A core mechanism to address global vaccine availability is COVAX, launched by WHO and partners in April 2020 as the vaccines pillar of its Access to COVID-19 Tools Accelerator (ACT-A). Its initial aim expressed in September 2020 was to purchase two billion COVID-19 vaccine doses by the end of 2021 and deliver them to people in 190 countries. By mid-March 2021, COVAX had shipped 30 million doses to at least 54 countries, a number that was rapidly increasing. [114, 115] At that time, COVAX expected approximately 1.8 billion doses to be available to 92 low- and middle-income countries before the end of 2021, covering 27 per cent of their populations.

But these expectations must contend with uncertainties of manufacturing capacity, regulation, funding availability, final contract terms, and the readiness of countries to begin their national COVID-19 vaccination programmes. The lack of enough early and readily available funding for COVAX contributed to the failure to secure enough immediate supply to meet its aims. [116] Further, twenty-seven per cent is well short of the coverage required for herd immunity and many people beyond this coverage level may have to wait until 2023 or 2024 for vaccination. [113]

However, the main immediate issue is how to reach a political agreement for sharing and redistributing available doses of vaccine and committed doses based on what is best from a global public health perspective with equity at the centre. There is an agreement that covering only your own population will not end the pandemic but moving from that rhetoric to an actual effective flow and allocation of vaccine doses as they become available is critical to the fight against COVID-19.

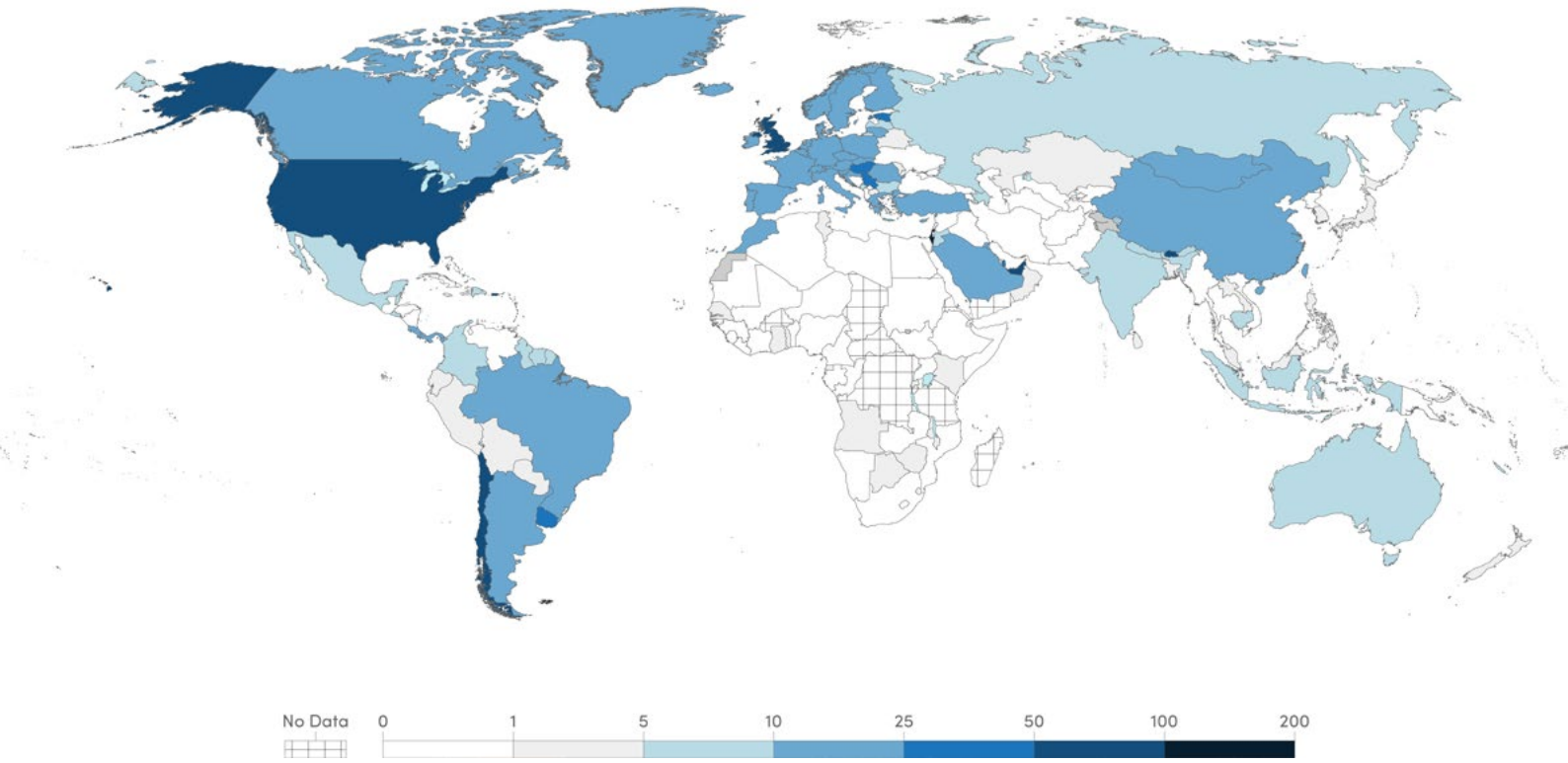


Figure 11: Total COVID-19 vaccine doses per 100 people as of 21 April 2021

Source: World Health Organization Coronavirus (COVID-19) Dashboard. Data as of 21 April 2021.

Never has there been a nearly overnight need for so many doses against a novel virus.[117] UNICEF calculates 5.3 billion doses by the end of 2021 would be needed to take care only of all of the world's essential workers, people over 65, and people with comorbidities.

There is no definitive information source on the state of facilities world-wide now ready and able to produce COVID-19 vaccine and in what quantities, nor of the raw materials required. Some vaccine manufacturers are producing a finished product in-house; others have manufacturing partners and a distributing supply chain. Knowledge Ecology International (KEI) shows about 115 current COVID-19-related vaccine manufacturing facilities in 38 countries with dozens more that could be turned over toward COVID-19-related tasks.[118]

But a raw count of facilities does not show where there may be bottlenecks in highly specialized equipment. Limits in manufacturing capacity contribute to inequity and threaten the effectiveness of

As COVID-19 trends towards endemicity, the world's population may need multiple vaccinations. The current manufacturing capacity is well short of the potential demand.

vaccination efforts. Current vaccine production capacity for 2021 across all vaccine technology platforms sits at an estimated 14 billion doses, [119] assuming that all vaccine candidates will be successful. As COVID-19 trends toward endemicity, the world's population may need multiple vaccinations. The current manufacturing capacity is well short of the potential demand. Insufficient doses and untimely administration of vaccines creates more opportunity for viral mutations. Moreover, it focuses in a few regions: Europe, the US, China, the Russian Federation, and India, with very limited capacity in Africa and Latin America. [120, 120] This makes it difficult for these regions to access new vaccines. This is even more serious in the case of producing mRNA vaccines, the platform critical for adapting to and controlling variants.

"...adding output capacity can take months or years..."

CEPI board member Rajeev Venkayya

Manufacturers in 2020 were having difficulty even predicting how much vaccine they could make for clinical trials, much less in bulk by the billions of doses. Raw materials in thin supply include syringes and glass vials. [121]

Sharing of capacity has been one strategy to increase total availability. Merck and Johnson & Johnson made a deal to share manufacturing; this could be one kind of positive step. Other partnerships include between Sanofi and BioNTech, IDT Biologika and AstraZeneca (five new bioreactors, operational by end 2022), and Novartis and BioNTech. These agreements are however limited in scope — the intellectual property licensing and technology transfer is exclusively to the agreed manufacturer and under the control of the original manufacturer.

Aligning technology transfer, intellectual property, and manufacturing capacity could boost efforts to speed up vaccine rollout. Manufacturing capacity, an effective regulatory environment, and equitable distribution are interdependent problems, all of which can be solved. The approach needs to be more global: institutions like India's Serum Institute, Sinopharm in China, and Gamaleya Research in Russia may be key in growing the number of vaccine-making facilities in the world.

Progress in sharing know-how, licensing, and intellectual property has been slow. In May 2020, WHO set up the COVID-19 Technology Access Pool (C-TAP) as a place to pool knowledge, intellectual property and data. [122] Supported in principle by 41 high-, middle- and low-income countries, it has received no contributions so far. A recent push by South Africa and India at the World Trade Organization to waive intellectual property rules and allow generic manufacturers to make COVID-19 vaccines continues to run into opposition. India—potentially among the world's largest vaccine-makers — is itself lagging in vaccine production and delivery, and surges in cases there have constrained its vaccine exports. [123, 124]

In Summary

Despite a year of efforts to resolve fundamental issues, effective vaccine allocation and distribution based on public health needs has failed.

Given the emergence of new strands of SARS-CoV-2, slow and uneven distribution of the currently approved vaccines against the virus is a urgent global problem.

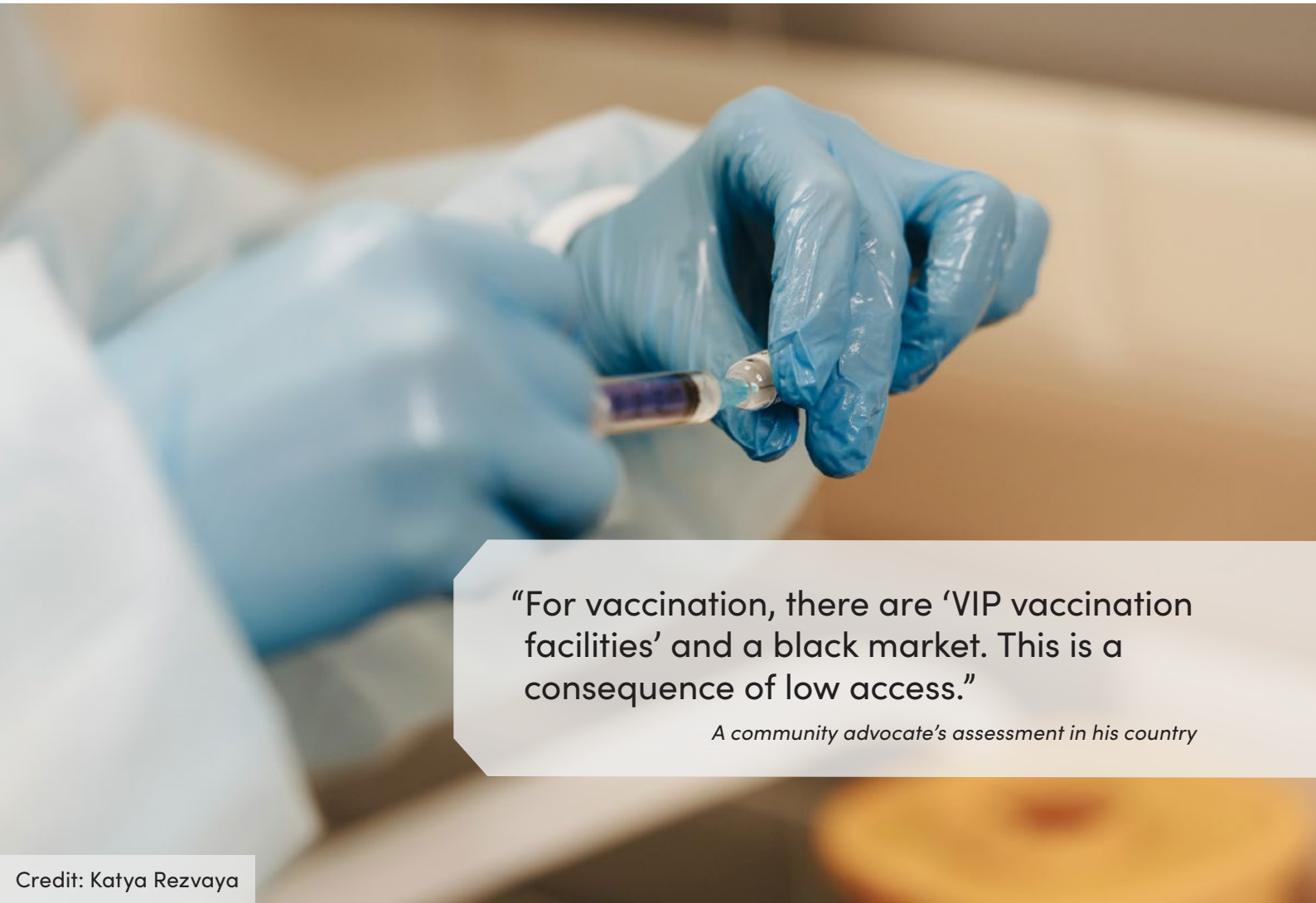
There is an immediate need for political agreement for redistribution of available and soon-to-come vaccine doses.

Free trade and flow of ingredients and material to produce vaccines must be established.

Medium term, but starting now, investments in additional manufacturing capacity and technology transfer is needed.

Endemic COVID-19 will potentially demand 5 billion booster vaccinations be globally accessible every year for the foreseeable future.

In addition to vaccines there are urgent needs to improve the access to diagnostics and therapeutics.



"For vaccination, there are 'VIP vaccination facilities' and a black market. This is a consequence of low access."

A community advocate's assessment in his country

Credit: Katya Rezvaya

12. Building forward better — realizing the sustainability vision

The COVID-19 pandemic has shaken confidence in the global agenda for sustainable development and its ability to cope with the stress of a major global crisis. But the crisis also presents windows of opportunity to see the challenges clearly and marshal the political will for change. As governments and societies contemplate the end of the initial crisis phase of the pandemic, the political conditions to secure a sustainable recovery need to be nurtured. Stimulus packages and public investment allow governments to set a new agenda. Co-benefits of health strengthening and action on climate change can be leveraged to create resilient societies.

The pandemic has thrust health to the centre of global attention, generating demand for bold action that recognizes the interdependence of global health security and systems for health which are accessible, affordable, and resilient, to provide the bedrock for healthier, greener societies.

A safe, healthy and green recovery will place people and communities at the centre. Emergency responses can no longer be gender neutral and inequity blind.

Credit: Mindy Tan

The crisis has also refocused our attention on creating equitable societies, shown that change is possible, and shown that science is an indispensable guide to progress. Nationalism and autocracy have proved poor weapons to counter this crisis; on the contrary, countries that have found success have seen soaring trust in public institutions and an endorsement of the need for global solidarity.

A safe, healthy, and green recovery will place people and communities at the centre. Emergency responses can no longer be gender neutral and inequity blind. The serious shift in mindsets required must be accomplished through a re-politicisation that explicitly commits to human rights and equality in policy design and implementation, acknowledging the intersectional nature of health and well-being. A green and healthy recovery from this pandemic would be built on three interlocking aims: a stronger system to prevent, detect, and respond to future outbreaks; resilient health systems that provide safe and affordable care to all when needed; and healthy, green societies promoting health and well-being for people and planet.

Figure 12: Building blocks for a green and healthy recovery

A future-proof, safe global health system should be equipped to address both the direct and indirect effects of pandemics, thinking beyond only surveillance and containing the virus to a long-term focus on resilient national systems that secure health for all. The challenges of inaccessibility, for example in health systems with high out-of-pocket costs, or of poor quality of care, undermine trust in the system. The impact of co-morbidities on COVID-19 death rates is a reminder that maximizing the health baseline is a key element of preparedness to pandemics. The right to health demands safe, affordable, quality health care — resilient health systems, able to step up in times of need, while maintaining routine health services.

But on the positive side of the ledger, people worldwide have seen proof that action across society is possible when the objective is to save lives. This momentum must be maintained to enable people not merely to survive, but also to make healthy choices and lead healthy lives beyond the pandemic. While there has been appropriate attention given to

Credit: Christine McNab

the negative impacts of lockdowns on social life and mental health, there have also been positive side-effects, as air pollution decreased, families were able to spend more time together, and values of solidarity were rediscovered.

COVID-19 made some health adaptations urgent, but many are of lasting value — telemedicine for example. The pandemic may also have achieved what years of education and policy change have failed to do in reducing inappropriate antimicrobial use. In Australia, that use decreased by 36% from April 2020 onwards, and similar data from the US has shown sustained falls in use of antibiotics commonly prescribed for upper respiratory tract infections.[125, 126]

The pandemic has shown the need for long-term investment in Universal Health Coverage, encompassing both service coverage and financial risk protection. Fundamentally, achieving resilient health systems pays off in terms of lives, the economy and public trust. The inequities made starker by the pandemic are neither inevitable nor insuperable, and there is a groundswell of determination to address them. A global recession should not provide the excuse to put off this momentum for change; it only makes it all the more urgent.

The COVID-19 pandemic has also made it clear that we can no longer separate human health from ecosystems and animal health.

Seizing the opportunity to address previously intractable problems and accelerate positive transitions is occurring across many fields — energy and food provide just two examples. The World Energy Council has been tracking the world energy transition with the impact of the pandemic. Analysing more than 3000 signals of change in the second half of 2020 from 85 countries, nearly two-thirds indicate that countries are taking this time of crisis as an opportunity to build forward better.[127] In food security, the COVID-19 shock not only forced policy makers to make urgent decisions to secure supply chains, it also focused attention on long term measures to address the "triple challenge" of food security and nutrition for a growing global population, protecting the livelihoods of millions of people working along the food chain from farm to fork, and the environmental sustainability of the sector.[128]

The COVID-19 pandemic has also made it clear that we can no longer separate human health from ecosystems and animal health. Climate change and the many consequences that follow create the conditions for future infectious diseases to emerge and thrive. The stresses resulting from climate change exacerbate the same inequities that have shaped the impact of the COVID-19 pandemic. A green recovery from COVID-19 will thus create co-benefits that address both the pandemic and climate change.

In Summary

The present global socioeconomic crisis has its root causes in the failure to pursue sustainability and resilience as our main objectives.

The pandemic has put health at the forefront of attention for all humanity and proven that decisive action to shape a better future is not only needed but possible. It has created both the opportunity and the obligation to act now.

A green and healthy recovery can help generate societies where both the likelihood of future health threats is reduced, and healthier populations are better prepared to overcome them. It will require investment but also political will and public engagement.

Prioritizing the health of people and planet is and must be a broad agenda — it includes investing in sustainable and safe food systems and clean energy.

Many of the practical solutions and action will come from subnational level — for example cities across the world are already invested in practical change to enable cleaner, safer, and more supportive societies.

This is the moment for transformative change. A healthier tomorrow is possible.

13. A future with mutant SARS-CoV-2?

SARS-CoV-2 variants continue to emerge, with their immunology and impact on vaccine effectiveness an urgent issue. As of April 2021, there were at least three significant COVID-19 variants in circulation: SARS-CoV-2 VOC 2020 12/01 (also known as B.1.1.7), 501Y.V2 (also known as B.1.351), and P.1 (also known as 20J/501Y.V3). All were detected through routine sampling, genomic testing, and surveillance.[129]

While these variants are still being evaluated, modelling and clinical findings suggest increased transmissibility.[130] These variants are now seen in several countries and regions, including through the European Union, United States, Asia, and Australia.

All viruses mutate. The question is what impact variants will have on the path of COVID-19, and whether it will become endemic.[131] Already, increased transmissibility has led to renewed border closings, restricting travel and extending lockdowns, and keeping schools closed. The start-stop and variable guidance both on containment and on vaccine rollout has hampered communication and epidemic control progress in different countries. Decision makers need to operate on the assumption that COVID-19 is here to stay and that it may continue to circulate in populations for the foreseeable future as an illness that flares up in waves at intervals from a baseline level of infections.

Vital information is needed on the kinds of immunity conferred by vaccines and viral infection and how severe reinfections may turn out to be. A lot of data is coming in from global surveillance and genetic testing about SARS-CoV-2 mutations; there are some suggestions about what the variants mean for vaccines, but it is far from clear what they will mean for vaccine strategies and for the pandemic itself.

Without doubt, the world is feeling, as one OECD report put it, "the need for speed" in vaccine rollout: every vaccinated person is a brake on the virus, and the fewer bodies the virus travels through, the fewer chances it has to mutate.[89] For vaccination to be a strategy to contribute to exiting the pandemic, clear estimates are needed of the rate-limiting factors at

...every vaccinated person is a brake on the virus, and the fewer bodies the virus travels through, the fewer chances it has to mutate.

each stage of rollout. Different bottlenecks require distinct solutions — resources, financial or technical, logistics at scale, readiness of facilities, workforce training, and public awareness and engagement.

Contemplating coexistence with COVID-19 is complicated. Will it be feasible to pursue zero-COVID-19, vaccine-aided virus elimination strategies: severe lockdowns or restrictive measures with the aim of ceasing transmission, keeping a population as airtight as possible against reintroduction of the virus? Or will the aim be mitigation and suppression, managing COVID-19 as best as possible while vaccines slowly subdue the pandemic? Will strategies be pursued on a global basis, or will there be differing national aims, with resulting needs to maintain border controls in perpetuity? How can nonpharmaceutical interventions be maintained?

Much will hinge on whether vaccines produce functional immunity, how long that immunity lasts, how effective the virus is at escape, how severe reinfection will be in humans, and the extent to which SARS-CoV-2 is established within animal reservoirs. One reason controllable diseases persist is because pathogens in animal reservoirs, such as insects or mammals, come back into contact with humans. This is what happens with Ebola virus disease, yellow fever, chikungunya, and rabies.[132]

Smallpox remains the only pandemic ever to have been really vanquished; polio nearly so. The campaign to eradicate smallpox, a disease old as can be, took 20 years. The Salk vaccine for polio was introduced in the United States in 1955; the disease was eliminated there in 1979. Global eradication of polio became a goal in 1988, coming tantalizingly close to achievement in the past 5 years. Pandemics and epidemics through history produce profound changes in social, urban, everyday life — in sanitation, in hygiene, in handling water, in the ways people relate to one another.

And if SARS-CoV-2 becomes endemic, it will be an open question how large-scale vaccine strategies, at whatever periodic scale required, will manage to cope, keeping in mind that the urgency of purpose will inevitably fade along with memory of the pandemic. Researchers are already investigating avenues to develop a "universal" vaccine, effective against all strains of SARS-CoV-2 — those extant now and in future. Will a new paradigm of universal, periodic, adult vaccination emerge and be pursued with the same unity of purpose that is applied to childhood vaccination?

Further tricky questions of both science and policy will continue to arise. Already, experiments are under way with vaccine passports, travel permissions, or other documentation to allow for movement and social participation. If SARS-CoV-2 immunity is waning, what will it mean for these documents? Countries which have brought the level of new cases to very low levels have put in place policies for snap lockdowns in the case of even very small outbreaks. Is this the possible future much more broadly, even in locations that look very different? How will that play out on a political and social level?

In Summary

Moving from the mindset of fighting to stop a pandemic to acknowledging it will be with us for the future is going to be difficult.

It requires judgements as to what level of ongoing COVID-19 spread and disease impact would be acceptable, and whether to tolerate different degrees of impact in different communities and countries. Countries which have adopted elimination strategies are unlikely to want to abandon them.

A world living with endemic, seasonal SARS-CoV-2 infection will require continuous, vigorous, and effective surveillance and public health measures. There will be challenges of both logistics and equity — viral variation will in all probability produce the need for repeated vaccinations. Leaving out countries will not only be inequitable, but a danger to public health.

Credit: Tuane Fernandes Silva

About the Panel

The Independent Panel for Pandemic Preparedness and Response has worked steadily to fulfil its vision to be trusted as an independent, evidence-based, impartial, respectful and diverse body the world can rely on to make bold recommendations which help safeguard every person's health, economic and social well-being.

The mission of the Panel has been to provide an evidence-based path for the future, grounded in lessons of the present and the past to ensure that countries and global institutions, including WHO, can prevent an outbreak from becoming a pandemic; and if a pandemic occurs, to prevent that from becoming a global health and socioeconomic crisis.

The Panel was initiated by the Director-General of WHO in response to World Health Assembly resolution WHA73.1.

The Panel's Co-Chairs, Her Excellency Ellen Johnson Sirleaf, former President of Liberia and Nobel Laureate, and the Right Honourable Helen Clark, former Prime Minister of New Zealand, were appointed by the Director-General. The Co-Chairs were then mandated to select panellists, establish their terms of reference and recruit an independent Secretariat. The Co-Chairs announced the full membership of the Panel on 3 September 2020.

The Panel comprises people with the experiences and expertise to focus on pandemics, health and the broader impacts of COVID-19. Their mix of skills and expertise covers a wide range of areas including infectious disease, global and national health policy and financing, public administration, outbreaks and emergencies, economics, youth advocacy and the well-being of women and girls. Panellists also share knowledge of the international system, including WHO, and other relevant international processes.

The Panel was charged with reviewing the spread, actions and responses to the COVID-19 pandemic, compile facts, distil lessons and make evidence-based recommendations to ensure countries and global institutions, including WHO, can more effectively address health threats.

In May 2021, the Panel delivered its main report to the 74th World Health Assembly, accompanied by this evidence-based narrative report, and a series of background papers including an authoritative chronology of events of the early alert and response to the pandemic.

The members of the Independent Panel are: Co-Chair HE Ellen Johnson Sirleaf, Co-Chair the Rt Hon. Helen Clark, Mauricio Cárdenas, Aya Chebbi, Mark Dybul, Michel Kazatchkine, Joanne Liu, Precious Matsoso, David Miliband, Thoraya Obaid, Preeti Sudan, Zhong Nanshan and Ernesto Zedillo.

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