2nd Edition

UNPRECEDENTED AND UNFINISHED:

Policy Lessons and Recommendations from COVID-19

International Science Council
The global voice for science

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About the International Science Council

The International Science Council (ISC) is a non-governmental organization that convenes the scientific expertise and resources needed to lead on catalyzing, incubating and coordinating impactful international action. It is the largest organization of its kind to bring together natural and social sciences for the global public good, bringing together over 200 international scientific unions and associations as well as national and regional scientific organizations including academies and research councils.

Cover Photograph: A general view shows beds inside a hall.
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CONTENTS

PREFACE

The COVID-19 pandemic brought unprecedented disruption to lives and businesses around the globe. As a health crisis, it has tragically cost millions of lives, but its impacts go way beyond health, and these are far from over. The wide-ranging consequences of the pandemic will echo across several years to come.

In May 2022, the International Science Council released a two-part report. The first part was the result of a year's extensive consultation and analysis of the impacts of different levels of vaccination on a broad range of outcomes, including on health, health services, mental health, education, social care, economy, government, geopolitics, and the science and innovation system. The second part flowed from the first and drew on further consultation, particularly with the policy community, on lessons to be learned for managing the ongoing evolution of the pandemic and the implications for dealing with future crises.

Clearly the pandemic has evolved considerably since the first edition of this report. The virus itself has continued to evolve. Countries have removed the restrictions put in place to manage the acute spread of the virus and have accepted that it has become endemic. Global travel is again largely unrestricted. Vaccination strategies have evolved, with monovalent vaccines gradually but not universally being replaced by bivalent vaccines to address the Omicron family of variants. The use of antiviral therapeutics is increasing, but their availability remains highly variable.

Over the last year the issues of climate change, biosecurity loss, stasis on the sustainability agenda, issues of food security, economic wellbeing and equity have grown, not diminished. The situation remains unstable, with ongoing conflicts, threats of a global recession, geopolitical uncertainties, energy, food, and humanitarian crises, with continuing civil discord in many societies intensifying problems that were in part fuelled by the original responses to the crisis.

Many countries face growing threats to their social cohesion, and trust in institutions continues to decline. In the context of a pandemic in which the risk of a new serious variant emerging persists, the ability of countries and the multilateral system to deal with other existential risks remains a matter of high concern.

The national and global policy communities will continue to have to be adaptive across the full range of domains affected directly or indirectly by the pandemic. Many longer-term effects on areas such as education, mental health, employment, economic development, work practices, rights and social care continue to challenge societies. Disinformation and threats to sustaining trust in science are challenging the potential for effective decision-making. The concept that countries can just move on and forget the pandemic is simply unrealistic. The weaknesses of the multilateral system have become more obvious over time, not less, as exemplified in the slow and problematic work on producing a better multilateral pandemic instrument.

In this second edition, we update our commentary and discuss the lessons and experiences to date which might provide further insights to nations, the multilateral system and civil society on other complex and cascading risks irrespective of scale. At the time of concluding this edition, China has opened travel and removed internal restrictions; the XBB.1.5 variant, which is highly transmissible, has emerged as the dominant strain in many countries.

COVID-19 has illustrated how decisions in one area of policy impact other areas of public life and personal and societal wellbeing, and what this means for longer-term outcomes as we progress through a complex and cascading crisis, then rebuild and recover. Crucially, we need to learn how to mitigate the devastation arising from such crises in the future. COVID-19, like all health crises, is a broader socio-political challenge that requires more than biomedical or health sciences to be overcome. Speaking at the 2021 Conference of the International Network for Government Science Advice, Chor Pharn Lee said, 'Science gives us vaccines, but pandemics are social'.[1]

This means we cannot afford to respond to pandemics as if they are only health issues, nor view the needed science solely through a life sciences lens. This report seeks to support the shift in thinking that is required to achieve a more comprehensive 'worldview' of pandemics, similar emergencies, and indeed existential threats such as climate change. In this, the complexity of interactions between science (which will inevitably be incomplete and uncertain in a crisis), diverse societal and individual values, and politics must be acknowledged. But as has been clearly demonstrated in the first three years of the pandemic, effective scientific input into both societal and policy decisions is essential to quality and inclusive decision-making.

Pandemics play out the way they do because of the way our societies are organized, how our governments govern, and the weak state of the multilateral system.

1 Allen, K., Simon-Kumar, N. and Mills, G. (Eds.) 2021. Building Back Wiser: Knowledge, Policy and Public in Dialogue. INGSA 2021. https://ingsa.org/ingsa2021/viewpoints (Accessed 28 December 2022).

Both this and the earlier edition represent the collective inputs and reflections of a large and pluralistic group of scientific and policy experts. It leads to recommendations that have application to this and future pandemics, but also much more broadly to crisis and disaster management. Given the unprecedented impact of COVID-19, the community of scientists, other experts and science advisors who contributed to this report call for an equally unprecedented ongoing and accelerated response to this and other existential threats from the global community, governments and civil society.

Sir Peter Gluckman
President
International Science Council

March 2023

EXECUTIVE SUMMARY

The objectives of this second edition are, firstly, to inform policy-makers and the public about the wide-ranging, long-term impacts of COVID-19 to help elucidate the key decisions and actions that could shift societies towards more positive and equitable outcomes. Secondly, it should inform planning and policy responses to other existential crises, whether they are pandemics, natural disasters, or the impacts of climate change.

It is now three years since the World Health Organization (WHO) declared the SARS-CoV-2 outbreak a Public Health Emergency of International Concern. Yet COVID-19 and the successive emergence of variants of concern and the associated waves of disease continue to put the global community, and the health, social and economic systems of every nation, under significant stress. The sequelae arising from the initial crisis responses continue to cause massive echoes for individuals, society and countries, and have disproportionately affected the already disadvantaged. The longer-term consequences intertwine with other crises and challenges, including geostrategic instability, conflict, energy and food security issues, and extreme weather events. Progress on the broader sustainability agenda, including addressing the existential challenges of climate change, has been inhibited. Disrupted education, increased loss of subjective wellbeing, issues of social care and employment loss are but some of the long-term impacts that governments and societies are yet to fully face. More broadly, some aspects of the way people work and interact, and the ways businesses operate have been forever changed.

While the rapid development of vaccines has been a huge scientific success, neither vaccine deployment nor application of antiviral therapies, while critically valuable, will be enough to address the multiple long-term consequences of the pandemic. The far-reaching consequences across all domains are far from over, and some will unfold well into the future.

Too many governments reacted to the pandemic as if it was solely an acute public health crisis, continuing to focus narrowly on health consequences in their countries, and have tried to put the pandemic behind them. The result has been an uneven response, with insufficient global solidarity, a tendency to short-term planning, and too little consideration of the broader impacts on societies.

We make recommendations across several action areas which if followed should help mitigate future risks. These areas cover global equity; understanding risks; trust and public mobilization; science diplomacy; capacity development for science advice and resilience building; multilateral system reform; and investment in policy learnings.

Key messages

The pandemic has affected every society and is truly a global crisis. Policy-makers have focused predominantly on national solutions. However, a global crisis requires both global and regional cooperation and solutions, in addition to well-thought-through national and local responses. Pre-existing inequalities shape and are magnified by every major crisis, as has been well demonstrated by who was most affected within and between countries during the pandemic. Policies and strategies adopted to respond to a crisis can exacerbate inequalities or potentially help mitigate them.

While the pandemic has evolved from an acute to an endemic phase, this does not mean that its direct risks are over. The potential for further acute phases arising from viral evolution remain. Furthermore, although the pandemic will continue to affect every aspect of social, political, economic and diplomatic life, many decision-makers continue to take a short-term perspective, neglecting the potential impact of their decisions on non-health-related policy domains far

into the future. Indeed, the impact of the acute phase of the pandemic will be felt across a lifetime for some communities and many individuals.

This report provides a template for policy-makers and experts to consider their local decisions in a wider context. It highlights the types of decisions that might lead to better and more equitable outcomes and illustrates the complex interactions between these decisions.

The future of the pandemic and its consequences will depend on policy and societal decisions taken today that will influence the course of the pandemic and mitigate or aggravate its impacts.

Recommendations

1. Global and regional cooperation are essential as a core component of seeking remedies and ongoing protection. Current shortcomings in the multilateral system, highlighted by the handling of the pandemic and in the sharing of virus-related data, bring to the fore the need for reform in the way major crises are handled. This is especially the case given the need to navigate through COVID-19 while facing multiple risks related to climate change, geopolitical tensions, food security and other areas.

2. While international cooperation is essential, pandemic responses must respect national sovereignty and be effectively organized within each country. Accordingly, governments must look to strengthen their domestic crisis management and public health systems. Donor countries must be prepared to assist.

3. Divergent levels of development have a major impact on how countries are affected and can respond. Inequalities within a society determine which communities and individuals are most affected in a crisis such as the pandemic. In turn, the crisis will magnify such inequalities. These differences must be considered in crisis management and planning the recovery.

4. To address the widening inequalities that have resulted from the pandemic, governments need to focus on ensuring that the benefits of any future economic recovery are widely shared. This means investing in several areas of overlapping impact, including inclusive governance; the acceleration of international mechanisms to ensure high-quality therapeutics for low-income countries; elimination of the digital divide in education; and mitigation of social isolation arising from the pandemic through mechanisms for engagement across society.

5. Governments must review and reframe the way they assess risk, integrating it more formally and transparently into policy development. Transdisciplinary thinking and a focus on resilience are required both before and during a crisis to increase preparedness for and resilience to a wide range of disasters, taking into account interconnected risks and cascading consequences.

6. Governments must prioritize building and maintaining trust, seek to reduce affective polarization, help strengthen societal cohesion, and foster cooperation and resilience. Community engagement should be a central activity in preparedness plans for pandemics and other crises, with a diversity of views heard.

7. There is a need to address the challenges of disinformation broadly, and to strengthen pluralistic science advice systems, thereby enhancing the ability to protect societies from risks. This means promoting trust in science and contesting the political weaponization of distrust in science by both state and non-state actors – for example in promoting vaccine hesitancy.

8. Many countermeasures to a crisis such as a pandemic are likely to engender controversy and resistance in some quarters. Inequalities make susceptibility to disinformation and rumour more likely. Policy-makers need to consider the impacts (both positive and negative) on different groups within a society when they introduce any measure for mitigation or prevention as well as looking at the aggregate effects on their population. The increased divisions

in some societies based on identity and emotion (affective polarization) can lead to the misuse of science to support particular views, thus diminishing trust in science and limiting the response.

9. As in any compounding and complex crisis, the impacts and actions needed are not restricted to one domain of public policy such as health. Balancing the complex interactions between health, economic and other dimensions requires pluralistic inputs into decision-making and clear communication to the public of the rationale for decisions made. As the response to crises such as a pandemic evolves, the inputs needed for decision-making in each phase change. As much attention must be given to planning for the change in prevention regimes (e.g. removal of travel social restrictions) as to their imposition.

10. There is a need to continue to invest in research and development (R&D) for the public good.

11. The United Nations (UN) system, both centrally and through its specialist agencies, should develop a more integrated approach to science and the science–policy nexus so that challenges can be overcome by working towards common goals.

12. Policy learnings at the local, regional, national and international level must be increased through systematic and honest evaluation of what went well and what went badly before, during and after the acute phase. This will aid in developing better mechanisms to address future risks.


SA 13

1. In 2020, the International Science Council (ISC) initiated a study that led to the first edition of this report, which was published in May 2022.[1] That report had two parts. Part 1 set the scene by outlining three plausible scenarios over a five-year time horizon that could conceivably emerge from the pandemic's cascading impacts, considering the degrees of effective vaccination, viral evolution, and policy interactions and uncertainties that may affect outcomes. Part 2 provided recommendations on how the global community can prepare for the future by mitigating the impacts of COVID-19 and addressing other existential crises that we will inevitably face.

2. The report development was overseen by an ISC-appointed panel of 18 geographically diverse experts in public health, virology, economics, behavioural science, ethics, sociology and other areas, supported by high-level observers from the United Nations Office for Disaster Risk Reduction (UNDRR) and the World Health Organization (WHO) (see Appendix III).

3. In Phase 1, from March to November 2021, the Oversight Panel and its technical advisory and project management teams undertook over 150 consultations with a diverse range of experts in a variety of geographical contexts with the aim of outlining the drivers and possible outcomes of the pandemic over a five-year horizon.

4. In Phase 2, from January to April 2022, a further 17 international policy experts participated in interviews or responded to a questionnaire in order to identify key lessons and implications across each policy domain. This was followed by an expert workshop to integrate the diverse perspectives and develop recommendations that would have the most positive impact on ending the pandemic and increasing resilience to future crises.

5. The global experts engaged in Phase 1 of this project identified 53 critical factors that could most significantly impact the long-term outcomes of the pandemic. Some were already prioritized by certain governments, the private sector and multilateral actors. These include vaccine and antiviral supply and access, biosecurity preparedness and response planning, and the surveillance of emerging viral variants of concern, along with other public health and social measures to control the pandemic.

6. Overwhelmingly, however, the conclusion was (and remains) that many of the factors that will have the most significant impact on societies over the long term (five years or beyond) continue to be relatively overlooked or not prioritized sufficiently by many governments or by the global community. These include policies to improve fundamental government services such as public health system capacity, the provision of care for vulnerable populations, the state of education systems, and access to mental health services. Other critical factors include the spread of mis- and disinformation – particularly on social media – geopolitical opportunism, poor access to capital markets for low- and middle-income nations, the weakening of the multilateral system, and loss of progress on the Sustainable Development Goals (SDGs).

7. This second edition focuses on the lessons from the pandemic for the policy community at every level, from local to global, and thus is restricted to a revised Part 2 under oversight of the same expert committee. The hope is that this report will assist in improving outcomes and provide lessons for other global emergencies.

8. Through the third year of the pandemic, the SARS-CoV-2 virus, as well as the societal response to it, have continued to evolve. All countries have now accepted the inevitability of it becoming an endemic viral infection. Yet it remains rather new to the human host, and it cannot be assumed that its future evolution will be in a more benign direction. Certainly, since the Omicron variant and its many subvariants have emerged, the general nature of the infection has changed, due partially to the virus itself, but also to public health vaccination strategies, therapeutic development, and the nature of policy responses in different countries.

9. At the time of writing (March 2023), the acute pandemic emergency is generally receding, as widespread immunity (both natural and vaccine-induced) reduces severe disease to levels which are more manageable, at least where there are functioning health systems. COVID-19 is spreading less often in waves, primarily because there has not been a new variant of concern in 2022 – just variations of Omicron. China is the exception, due to social restraints having been recently withdrawn in the absence of a broadly based vaccination programme.

10. The mutations present in the Omicron variant and its sub-lineages including the current XBB variant have greater capacity to escape the immune response induced by the first-generation vaccines, thereby reducing their effectiveness. In addition, the protection conferred by monoclonal therapies is no longer effective, increasing the need for antiviral treatments such as Paxlovid.

11. This has major implications. Simple and effective preventative regimes will be needed, for example a single annual vaccine. Until a universal vaccine is available, updated vaccines will be required to be developed for the prevailing strains, as is the case for influenza vaccines. Secondly, older people and others at high risk who become infected must have access to antiviral therapies where they have been shown to be effective at an early stage in their illness to reduce the likelihood of requiring hospitalization or intensive treatment. The global community must work to ensure equitable access to effective antiviral therapeutics and vaccinations as they evolve.

12. 'Long Covid' remains poorly understood and its management uncertain. But the evidence suggests that it will be a significant long-term burden on some individuals and society. Clinical research focused on its definition, but diagnosis and management must be a priority.

3 GENERAL OBSERVATIONS

13. This section summarizes some of the major policy implications of the pandemic. A central lesson is that there is an elevated risk of significant policy failure when major crises and emergencies are addressed through a rather narrow lens.

14. The first edition of this report illustrated the systemic nature of the COVID-19 pandemic, and how action or inaction in one policy domain has consequences that ripple across many others. Its long-term and multidimensional consequences illustrate how complex crises have implications for virtually every domain of domestic and international policy-making.

15. Such an analysis suggests the actions that are needed at both national and international levels to achieve the best possible long-term outcomes from this pandemic, to ensure a better preparation and response to the next pandemic, and the implications for other global crises. In this second edition we summarize the key lessons and implications. We highlight considerations that governments, international agencies, non-governmental organizations (NGOs) and civil society must consider as the pandemic evolves, and in preparing for subsequent crises. The scientific and diplomatic communities will continue to have significant roles, along with others whose cooperation will be necessary for achieving better outcomes over the long tail of this pandemic, and in preparing for other crises the world will inevitably face.

16. By exposing vulnerabilities and blind spots, crises uncover the potential for change and for reorganizing priorities. Such situations paralyse some actors while empowering others: they can simultaneously reveal large gaps in competence and mobilize previously untapped capabilities. The pandemic crisis could therefore be taken in either direction – as an inflection point to implement better policies, make better decisions and inspire genuine cooperation, or to further divide communities and nations – with ripple effects on other issues of governance of the global commons. Unfortunately, this situation has been further confounded by the war in Ukraine and a more complex and unstable geostrategic and economic milieu, which further compromises global cooperation.

3.1 Lessons for global equity

17. Global inequity continues to have a central and cascading impact on implications of the pandemic, as well as being exacerbated by it, and on the effectiveness of efforts to contain or recover from COVID-19.

18. Agenda 2030, as encapsulated in the SDGs, was subscribed to by every member of the United Nations (UN).[2] It aimed to advance not only environmental sustainability, but also human, social, cultural and economic development, peace and justice. Although much progress was made in eradicating the most extreme poverty over the 10 years prior to the pandemic, great inequality remains and is again growing as the multilateral space becomes more fragmented. Both the pandemic and the war in Ukraine have compromised food security worldwide, hitting those countries with high reliance on staple food imports particularly hard.[3–7]

19. This inequality was clearly demonstrated during the pandemic, both between and within nations. Low-income countries were generally far more negatively impacted by the pandemic than were the high-income countries.[8,9] Although health systems were overburdened around the world, including in middle- and some high-income countries, the limited progress in improving public health in low-income countries meant that their health systems became even more rapidly overwhelmed, prolonging the health crisis and all its cascading impacts.[10,11]

20. Further, even in high-income countries, the impacts on individuals were unevenly distributed, with minorities and socio-economically disadvantaged people, as well as women (who do most of the care work), at greater risk.[12–15] This has exacerbated inequalities within societies, with political and social consequences.

21. While high-income countries have greater capacity to return to pre-pandemic levels of economic activity than low-income countries, all are compromised by continuing macroeconomic drivers of inflation and recession. Low-income countries are at a further disadvantage because of their lack of fiscal flexibility and capacity to implement stimulus and social support packages. The net result is a widening of inter-country global inequality.

22. More rapid rates of recovery and of economic growth for low-income countries will depend, in large part, on their governments being able to expand expenditures. These countries, therefore, need enhanced access to global credit markets.

23. The commitment and capacity of the multilateral system to respond to or prevent this worsening inequality has been suboptimal. Geopolitical issues complicated the response at some levels, and almost three years since the pandemic emerged there remain ongoing debates about technology and therapeutics transfer from the Global North to South, and a failure to rapidly progress towards a pandemic treaty or review of the International Health Regulations (IHR). Little real progress has been made on addressing the deficits that were clear in the IHR, and in the COVID-19 Vaccines Global Access (COVAX) and the Access to COVID-19 Tools Accelerator (ACT-A) mechanisms. These remain less than fully effective as ways of managing a global response.

24. As the pandemic continues to evolve, new vaccines and new therapeutics will be needed, and vaccine coverage will remain central to reducing the longer-term impact of the pandemic. While some progress has been made in developing vaccine production capacities in the Global South, intellectual property regimes and related issues will limit progress. Nonetheless, access to high-quality and effective vaccines is likely to remain highly uneven.

25. The issues of access to effective antiviral therapies and their appropriate use (which generally requires use early in the infection) are yet to be well resolved not only in low-income countries but in many high- and middle-income countries.

26. While inequalities of access to science and technologies persist, responses to the pandemic and future crises will also be uneven. In an interconnected world this hinders recovery for all. Unfortunately, the war in Ukraine and conflicts elsewhere have added additional burdens of acute refugee crises. Political barriers, rising geopolitical tensions, conflict and policy diversion can only compound and complicate recovery, and the lowest-income countries will indirectly be those most affected outside the conflict zone.[16] At the same time, instability and conflict in other areas remain a threat to equitable pandemic recovery.

27. Low-income countries not only have limited health system facilities, health workforce and public health capacities, but their situation is exacerbated by relatively weak policy responsiveness and governance capacity. Indeed, effective within-country distribution and administration of vaccines is now at least as big a problem as obtaining the vaccines and is more difficult to solve. Efficient within-country administration capacity building is urgent, and international agencies such as the World Bank, United Nations Development Programme (UNDP) and other financial and development agencies must take an active partner role in this. The risk of neglecting this need is a deepening of already existing disparities in health, economic and social development.

28. Balancing the cost of prevention and mitigation measures against other healthcare and social priorities is a challenge for every country, and is acute for those with the least resources. Not all countries were affected equally by the pandemic and many low-income countries faced other major health challenges (e.g. malaria). Policy-makers have responsibility to determine priorities for their own populations, and as they do so should be informed by the evidence and cognizant of their obligations to engage with the multilateral system in the case of infectious outbreaks.

29. Nevertheless, changing the trajectory of this pandemic and future ones requires continuing and accelerating efforts to ensure high-quality vaccine and antiviral therapeutics access to low-income countries. Manufacturing capacity is gradually being established in low income countries but major intellectual property and trade barriers have been inhibitory. For example, non-proprietary access to mRNA vaccine technologies has been limited and slow. Only very recently has the global mRNA technology transfer hub initiative,[17] in partnership with WHO, the Medicines Patent Pool, ACT-A/COVAX, the African Union, and the Africa Centres for Disease Control and Prevention, granted six African countries (South Africa, Egypt, Senegal, Kenya, Tunisia and Nigeria) access to the technology to establish mRNA vaccine production capability. Such solutions should ensure that this global public good is supported, while allowing the private sector to have a fair but not excessive return on their investment.

30. Even if the lingering health crisis can be brought under control, under-resourced, low-income countries will be compromised in terms of broader aspects of their health system, and in economic recovery, with less ability to afford the income support schemes that have allowed high-income countries to jump-start their economies. The challenge will be to use the pandemic 'reset' to focus on equitable distribution of the benefits of economic recovery, rather than allowing the gap to widen.

31. Heads of government must commit to and invest in several critical areas of overlapping impacts. This includes recognizing the importance of better and inclusive governance, addressing corruption, embracing trusted relationships with civil society, and progressing aspects of Agenda 2030 that have been stalled by the pandemic, and which are discussed in Part 1 of the first edition of the report.

4 NATIONAL AND SECTORIAL LESSONS

32. While a multilateral response is essential in a pandemic, so too is national sovereignty, which must be respected. The capacity for evidence-informed decision-making at the national level must be enhanced in all countries irrespective of their state of development.

33. Mitigation and prevention decisions are primarily made at the national level and inevitably require trade-offs. Many countermeasures to a pandemic are likely to engender controversy and anger or frustration within some element of a society. Objections are in part rooted in interests, but also in inequalities as well as political polarization. The challenge for the policy-maker is how to evaluate the likely impact of different measures on different stakeholders or sectors of the community and consider these as well as the aggregate effects on the whole population.

4.1 Lessons for public health systems

34. Countries must prioritize and dedicate domestic resources and recurrent spending to improve the capacity and preparedness of their public health and health systems in general. In every country, the capacity of the health service was often the most important determinant of governmental responses to the pandemic, for example in determining when to implement lockdowns or other restrictive measures. Everywhere, even in countries with advanced public health systems, the health sector came under considerable strain (and in some cases are still under extreme pressure). Depending on how the pandemic evolves in the future, and if again it overwhelms health systems, governments may need to resort to harsh and economically and socially damaging measures.

35. In the short term, the reserve capacity within hospitals and clinics has, and will need to continue, to scale up to cope with the demands of parallel surges of infectious admissions every winter, from seasonal SARS-CoV-2, influenza and respiratory syncytial virus (RSV). Public health services should be prepared to deal with the potential of needing to administer repeat vaccinations as new strains emerge.

36. In the longer term, to be better prepared for major health crises, investment in surveillance systems and laboratory infrastructure is critical, as is having emergency funds that are kept aside or made available, in every country, for responding to future pandemics (including funds for surveillance and research).[18]

37. The pandemic clearly exposed the need to continue to promote investment in basic healthcare infrastructure. It demonstrated how important vaccination can be in the management of an emergent infectious outbreak, and that it is not only the access to the vaccine that is critical, but also the capacity to distribute the vaccine safely and have sufficient pre-trained vaccinators. Cold chain distribution creates additional challenges.

38. In public health emergencies as in other crises, trusted and transparent communication is essential. The challenges of confused and manipulated information or dealing with rapidly spreading conspiracy memes are a reality of the modern world. Public health authorities, governments and academia need to be prepared to confront these issues from the outset.

39. Countries and communities that were already vulnerable prior to the pandemic were least able to cope with the impacts of a novel and rapidly spreading infectious disease. At the same time, the pandemic also exacerbated inequalities in other areas of health, both within and between countries.

40. The diversion of resources to control viral outbreaks disproportionately affected populations that were already at higher risk of chronic disease and ill health due to poor access to healthcare.

41. Mental health issues have increased in every sector of the population, but again, disproportionately so for young people in education, and those facing disadvantages from poor housing and overcrowding, disrupted food security, precarious employment, and other factors.[19–23] Lockdowns disrupted normal social support systems and exposed women to greater risks of domestic violence.[13,14] The residual impacts on mental health will be particularly severe for those who have the least access to support through counselling and other services. This will be even more so for those whose food and income security are even more precarious as a result of the pandemic.

42. Mental health has long been the poor cousin of other health challenges. Investment in all dimensions of mental health support, particularly at the community level, is key. This requires an integrated approach between health and other social care authorities and inclusion of community groups and NGOs in identifying locally effective strategies.

4.2 Lessons for the education sector

43. Most countries experienced severe disruptions to their educational systems. The digital divide was manifest in every country including high-income countries, conferring a further disadvantage on children and adolescents who did not have adequate digital access. Moreover, digital pedagogy remains poorly developed in many areas, even in the third year of the pandemic.

44. Mental health problems were already rapidly escalating for adolescents prior to the pandemic for a variety of reasons. The impact of the pandemic has compounded the situation.[21,22]

45. Students in the later years of schooling and entering tertiary education have been particularly badly affected. Many young people abandoned their education, and even now levels of truancy and education abandonment remain much higher than prior to the pandemic emerging in 2020.[24–27]

46. Many students in low-income situations had to choose between education and supporting their families in whatever way they could. Given this level of disruption, there is a need for educational policy to address the disadvantage that could accompany this cohort for many years as they try to enter the workforce.

4.3 Lessons for the care economy

47. Countries with well-developed social care systems, mainly advanced economies, found that they had to respond rapidly during the acute stages of the pandemic, though even those systems often fell short, placing an increased burden particularly on women in households.[28] More flexibility will likely be needed in future as the sequelae of the pandemic play out, with unequal recovery, ongoing mental health concerns and related issues in vulnerable groups.

48. Where social care systems are underdeveloped, lessons learned from the pandemic merit reflection. The pandemic fractured social relations in all categories of the population. Women were particularly adversely affected by the additional burdens placed on them. Lockdowns also exposed them to a greater risk of domestic violence.[13,14] In addition, the consequences for the young were particularly dire as they had much reduced social contact at the time of their lives when such contact is so essential to their development, both social and economic.

49. Other informal sector workers were also severely impacted, and countries where the informal economy provides livelihoods, particularly for women, were particularly set back.

50. The lack of family and community contact and fracturing of social networks has many adverse social and economic consequences. Governments and NGOs need to develop new policies and provide resources to mitigate the social isolation and alienation arising from the pandemic to facilitate the rebuilding of social networks. To develop effective policies, governments and NGOs should set up institutional mechanisms for engagement and dialogue with society, including the young, to ascertain their social needs and what can be done to meet those needs.

5 — LESSONS FOR RISK ASSESSMENT & POLICY RESPONSES

5.1 Understanding risks

51. A particularly important lesson arising from this pandemic is that its causes and consequences are globally systemic, and all policy spheres, especially at the national and subnational levels, are impacted by nearly every decision made in the effort to contain or mitigate the damage. The goals of any intervention should be clear, as well as the foreseeable spillover effects. This requires pluralistic perspectives from the outset to avoid decisions being inappropriately focused on one domain (e.g. health) without fully comprehending the broader implications. A clear and transparent whole-of-government response is needed, which in turn requires a multiplicity of expert inputs into decision-making.

52. Addressing the systemic nature of risk requires transdisciplinary thinking and systems thinking both before and during a crisis, in both risk assessment and communication. For pandemics, this means thinking about interconnected risks and consequences far beyond impacts on health.

53. To make the best possible decisions to mitigate risks, policy-makers need to understand the broad risk landscape. Scientists and experts likewise need to understand how policy-makers hear and respond to risk information. The challenge is how to ensure that risk advice, with all its uncertainties, is not ignored or underplayed. This is an issue of direct relevance to other existential risks such as climate change.[29]

54. Indeed it is clear that even in those countries with apparently good risk analysis capacities, the full range of risks associated with a viral pandemic had not been adequately appreciated. There was a policy or political overconfidence in the ability to respond, indicating a gap between risk assessment processes and their integration into decision-making. The gap likely reflects a range of cognitive and political biases that are equally obvious in areas such as climate change. This highlights an area requiring attention to improve how risk analyses can be incorporated into policy processes.[30]

55. In many cases, identifying very specific risk scenarios might be counterproductive, because events never unfold precisely as imagined. This has implications for how national risk registers are developed and used in national security systems, and how the risks they outline are understood by the public.

56. The risk of a pandemic arising from a novel zoonotic pathogen was well recognized before COVID-19 emerged, but very few countries, aside from those that had been exposed to severe acute respiratory syndrome (SARS), had a broad enough understanding of the responses that might be necessary. Many framed their initial responses around presumptions based on previous influenza episodes and, as we have all now learned, a novel zoonotic virus entering the human host does not respond in the same way as a virus that is well adapted to our species.

57. The pandemic has made evident the critical importance of global early warning systems for biological events that spread beyond national borders. A 'One Health' approach should be adopted.[31] Some aspects of such a system would be generic, and able to pivot to differing circumstances, such as the emergence of novel pathogens like SARS-CoV-2. For this and other viruses, investment in global genetic surveillance for new and emerging variants is critical, with data to be made publicly available, and rapid detection supported by access to laboratories. Critically, countries in the Global South need to have the resources that they require for surveillance.

5.2 Focus on consequences, not just specific risks

58. It is not possible to identify all possible risk scenarios; as a result, a resilience-focused strategy favours generalizing consequences and preparing for them without a narrow focus on the specific cause.[32] This fosters the development of response capabilities that are agile and mindful of previous blind spots. Numerous disparate events can result in a similar array of social, economic and public safety concerns and, indeed,

preparing for various forms of disruption rather than focusing on specific causes can help to bolster societal resilience to the many challenges we are likely to face in the future, including other pandemics.

59. This does not dismiss the importance of pandemic preparedness as a critical exercise. However, the preparation needs to consider how to be agile in the face of different types of pathogens (e.g. viral, bacterial, fungal, biowarfare), including completely novel ones with the capacity to evolve rapidly, as SARS-CoV-2 has demonstrated. Preparing only for an influenza pandemic left many countries at a loss when confronted with a novel coronavirus that behaved quite differently from influenza viruses. Many countries and indeed the global system were not prepared for such a rapidly evolving pandemic, despite many expert warnings. The IHR and associated advice were found wanting and not appropriate for the context of a highly globalized and interconnected world.

60. Attentiveness to the likely cascading consequences of any specific risk (e.g. to the environment, food systems, supply lines and trade) is critical, not only so that the correct breadth of expertise is brought in, but also so that the potential mitigations and responses can be prepared. Hidden impacts need to be explored with an extended peer community, including citizens. Such awareness in the public sphere also helps to bolster resilience in the face of future uncertainty. It should be emphasized that all parts of society, including the policy community, the private sector, the science community, academia, NGOs and the media, have a vital role to play.[33]

61. Crises evolve over time and the inputs into decision-making must change as the event unfolds. This may be quite significant at the time of critical phase changes in regulations (e.g. travel restrictions), public health recommendations (e.g. school closures) and clinical practice (e.g. use of antivirals). For example, transitions in prevention regimes from high levels of social restriction to openness is itself a process that policy-makers need to understand, plan and manage to avoid unintended consequences (e.g. super-spreader events).

62. A wide range of disruptions, from pandemics to natural hazards to wars and terrorist activity, have critical consequences. Risk assessments and crisis management advice should consider how a range of cascading impacts can be handled. This needs to occur before an event transpires, and such questions need to be continually revisited as the crisis evolves, to help ensure that hidden impacts are not left to amplify.

63. Preparing for a broad range of risks must involve the whole of government in exercises and simulations to increase preparedness for all kinds of disasters. Doing so not only addresses the need for action and improvements to tackle potential problems, but importantly, provides an incentive to politicians to act outside times of crisis. Such explorations should also involve the private sector and civil society, for they too must be prepared. For this reason, risk assessments should be made public.

64. Involving the public in thinking about risks also provides an opportunity for people to articulate what they care about most and wish to safeguard. The goal is to nurture a rational, science-based sense of risk that will also create an understanding of public expenditures and policies, and not to generate fear. Deliberative processes allow the public to interact with experts and build consensus for collective decisions in risk preparedness and mitigation investment. This can be supported by science advice mechanisms established at city levels that can help the public to contextualize broader risks to local circumstances.[34]

65. The boxes below illustrate the type of questions that might frame a pre-emptive risk analysis, the responses to a variety of risks and how we frame such responses at national and global levels.

AT THE NATIONAL LEVEL **BOX 1**

In preparing the response system:

- What expertise needs to be accessible?
  1. Ensure a plurality of expert inputs.
  2. What data and information are needed?

- What precautions need to be in place: training, regulatory, resources, infrastructure, etc.?

- Is there a clear understanding of how decisions will be informed and made?

- Are there appropriate links in place to regional and global authorities, agencies, and scientific and other expertise that can assist in the event of a crisis?

In considering the full range of possible impacts:

- Public health: Can essential health services be maintained in the face of a range of different events? How can impacts on mental health and wellbeing be minimized and managed, considering the varying needs of different sectors of the population? How can continuity of care services be maintained?

- Food insecurity: What is needed to secure food supply chains from a range of disruptions, and how will vulnerable communities be reached?

- Supply chain vulnerabilities and disruption in trade: Can access to essential goods and services be assured?

- Economic disruption: What business sectors are most vulnerable to disruption, and how can business continuity be supported or enhanced? How can the informal economy be made more resilient and those engaged in it supported?

- Socio-economic precarity of individuals and communities: How will the vulnerable be reached? Is the social safety net sufficiently robust?

- Educational disruption: How can the impacts of likely educational disruption be minimized?

- Infrastructure failure: What are the plans in the event of failure of one or more elements of critical infrastructure?

- Environmental risks: What potential environmental impacts can be foreseen from a range of infrastructure failures, industrial accidents or other incidents, including those that are secondary to other types of events (e.g. natural hazards, terrorist attacks, armed conflict or negligence)? How might these be mitigated?

Interactions beyond the role of the state:

- What is the role of the private sector, and other components of civil society?

- How can the public best be kept informed about the basis of decisions that affect them? How can citizens be better engaged in co-creating solutions?

- How can the institutions of state avoid compromising trust between citizens and governing bodies? How can trust be sustained? How can disruption to social cohesion be minimized?

AT THE REGIONAL AND GLOBAL LEVEL **BOX 2**

Pandemics and other global crises require pre-emptive recognition of the need for global cooperation in sharing data, information and technology. The instruments for sharing should meet several criteria, including:

- Ensuring that the operating mechanisms of multinational agencies and relevant international agreements allow them to meet their obligations and expectations with minimal political input that may override public need and technical advice.
- Ensuring that multilateral agencies are well connected and have access to appropriate expert input.
- Ensuring that national interests do not undermine the need for a coordinated global response.
- Recognizing that all countries can have a voice and that mitigation and recovery require an effective multilateral system.
- Ensuring that multilateral arrangements and policy and advice frameworks are fit for purpose and enable a rapid response.
- Consideration of other factors such as geopolitical tension that might amplify the threat of conflict during a crisis.
- Ensuring equitable global reach for vaccine and therapeutic access and avoiding or counteracting geopolitical gaming.

5.3 Reframe long-term risks around actionable measures to address acute needs

66. Humans are much better at responding to an acute crisis than to one that develops slowly. Things that have not yet happened or slowly evolve over a long period of time tend to lose their urgency. This has been particularly true for climate change and has been demonstrated in the long-ignored risks of a novel zoonotic pandemic. Government spending prioritizes short-term problems that fall within an electoral cycle, or in more autocratic countries, the interests of those in power. Though the longer-term risks may be appreciated, they are not generally prioritized.

67. Further, there is generally little political reward when investment in prevention is successful because the counterfactual of crisis avoidance is not usually appreciated by the public.[30] It may be possible, however, to reframe some of these longer-term chronic challenges into more acute challenges that are more readily actionable. For example, investment in an integrated health data management system which could be used for both managing health system resources and real-time disease surveillance, with a focus on infectious disease management in the event of an epidemic or pandemic.

68. Going forward, governments should transparently review and reframe the way they assess risk and integrate it more formally into policy development.

5.4 Remain vigilant to other existential risks and prioritize sustainability

69. In the face of a catastrophic crisis such as a pandemic, it is easy to ignore many issues that cannot compete with the immediate crisis in people's minds. However, governments cannot lose sight of the need for continued surveillance against future threats. There is no reason to believe that other crises cannot emerge simultaneously.

70. Climate change continues to progress without regard for the COVID-19 pandemic. The pandemic, along with ongoing geostrategic conflicts and their economic and other impacts, have in general diverted the international community's focus from, and progress towards, sustainability. The latter cannot wait, despite difficulties in coordinating international efforts and domestic political barriers. There have been many calls to incorporate the sustainability agenda into any 'reset' of social and industrial policies in the wake of COVID-19.

71. The war in Ukraine and the accompanying overt failure of the multilateral system to maintain a rules-based approach to international relationships is a stark reminder that world leaders and international organizations cannot afford to lose focus on conflict resolution and international cooperation.

6 — SOCIAL TRUST, COMMUNICATION & DECISION-MAKING

6.1 Trust and public mobilization

72. Governments must prioritize trustworthy decision-making and access to reliable information, particularly when asking the public to undertake difficult measures in a crisis.[35–39] Irrespective of the form of government and the state of economic development, a nation cannot thrive without a cohesive approach to managing a crisis, which necessarily involves actions by citizens.

73. Social trust and social capital – that is, the ability of people to work together for common purposes – are critical in pandemic situations and other emergencies that require difficult or uncomfortable actions by citizens. States need to build a stock of social capital in peacetime, so that this can be drawn upon in times of crisis. Social capital is based on trust and trustworthiness, transparency and lack of corruption, inclusiveness, and the provision of social infrastructure and support. High social trust strengthens societal cohesion and fosters cooperation and resilience.[40,41]

74. Those countries with higher perceived levels of social cohesion before the pandemic were able to convey messages of solidarity in the face of hardship and had more success at keeping casualties low. Yet in many cases, colonial histories and discriminatory practices towards migrants, ethnic minorities and the like meant that social trust did not embrace the whole of the population.[42]

75. Trust is a two-way street: governments and public health officials also need to trust the public, and not implement overly restrictive rules that can convey a disdain for the ability of citizens to think for themselves and take sensible actions for their own safety and that of others. Overly paternalistic rules do not engender citizens' faith in leaders, and can backfire, degrading social cohesion.

76. Indeed, in some cases a lack of understanding or appreciation of the damaging effects of social isolation and other measures created dissonance between government directives and local community perspectives about how to protect themselves from harm. Such a disconnect leads to loss of trust, creating a feedback loop that reduces compliance with actions that are aimed to benefit society as a whole.

77. The politicization of science and expert inputs is harmful to institutional trust, and therefore hinders cooperation and collective action. Both politicians and scientific experts must take responsibility for how expertise is used and conveyed to support public trust in decision-making.

6.2 The importance of transparent decision-making and information flows

78. As with most crises, at the start of the pandemic important and urgent decisions had to be made based on very limited information and data, and in the face of much uncertainty. With only very crude models and incomplete knowledge, decision-makers claimed to be 'following the science', but this phrase was frequently misused. Both they and the science community needed to be clear about what was known and not known, the uncertainties that existed and that the initial strategies were provisional, and that responses would need to evolve as knowledge improved.

79. Although some strategies changed based on evolving knowledge of SARS-CoV-2 biology, transmission and disease characteristics, in many cases decision-making seemed to be based less on science than on ideology, public pressure or vested economic interests. Thus, some political leaders failed to take unpopular measures to control the spread of the virus within their borders, discounting science in favour of intuition, and in doing so exacerbated risks for both their own countries and others.

80. At other times, a dominant focus on the public health perspective created conflicts with the social and economic domains. Governments were not always well prepared to explain the trade-offs needed and to explore and communicate the justification for their decisions. The result was growing tensions between policy-makers, experts and sections of society, which in turn affected the quality of decision-making. A focus on those elements that sustain institutional trust (i.e. trust in government) and trust in science is key to reducing such conflict and allowing for better decision-making as a crisis evolves.

81. Inconsistencies and changes in strategies are almost inevitable in trying to manage a complex crisis that continues to evolve. But equally, decision-makers need to be clear about the basis on which their decisions are being made – either to hold fast to a particular strategy or to shift its direction – and to assure the public that a broad range of factors and expert inputs have been considered. Incorporating expert knowledge from a wide range of disciplines into policies and decisions from the start, including sociological, anthropological and ethnographic expertise, is key to understanding the social context and possible responses.

82. There is a general lesson here: all crises are complex and multidimensional. The pandemic showed the challenge of balancing among healthcare, social care, economic costs and individual rights. It is important to recognize that the point of equilibrium between these potentially conflicting needs will change as the crisis evolves. Economic costs that are acceptable at one stage in the pandemic may not be acceptable at another stage. While it may be difficult, it is essential that governments enhance their ability to communicate honestly about the complex trade-offs they face in balancing competing values and interests when making decisions during a crisis. Only through such transparency can trust between citizens and government be sustained. This is true irrespective of the nature of government and the level of economic development of the country.[36]

83. Moving forward, it will be important to ensure that transparent community engagement is anchored as a central activity in preparedness plans for pandemics and other major risks. The public should be engaged as a central part of all control efforts and not only as passive receivers of messages. Societies cannot be treated as homogeneous, and the diversity of their views needs to be heard if there is to be an effective and cohesive societal response to crises.

6.3 Mitigate misinformation and disinformation with planning, policies, regulation and trust

84. The capacity and willingness of citizens to take a critical and rational approach to the information that they receive has been the key determinant of the effectiveness of their response to the pandemic, be it in complying with social measures or in accepting vaccination.[42] But what is considered valid information, and by whom, is not straightforward. There are always unknowns and uncertainties, particularly at the onset of a crisis.[35,36]

85. Trust in science and evidence-based decision-making has often been compromised by the prior history of relationships between groups and individuals and the conflation of expert input with political agendas. The resulting lack of trust impairs the response to a crisis, facilitating responses and actions that may not be in the collective interest but serve to strategically protect various groups or to advance the interests of particular parties. It is in these circumstances that the politicization of science grows, and evidence-based decision-making is impaired.

86. People are much more vulnerable to misinformation, disinformation (intentional misinformation), conspiracy theories and rumour when they are fearful, as many have been throughout the pandemic. It is one of the major challenges of current times to find a way to address the spread of disinformation, particularly as new modes of digital communication such

as 'deepfakes' (manipulated videos) emerge.[43] The evidence is very clear that eradicating disinformation is much harder than promoting accurate information.

87. Disinformation and partisan and vested-interest politicization have compromised trust in science, undermining the ability to manage any such complex crisis (as noted in Section 6.1). Trust in science is not achieved by scientists exhibiting self-interest or hubris, but rather requires scientists to be aware of their own limitations and conduct, and it requires trustworthy science brokers and communicators and quality science journalism.

88. The way information spread during the pandemic underlined the critical importance of internet companies and social media. The business models of many online platforms rely on the attention economy, which seeks to massively amplify the reach and the frequency of messages and match audiences to preferences, thereby fuelling disinformation and increasing political polarization. Although some countries and companies have made attempts to redress this, these efforts have largely failed to stem the tide. Given the cascading impacts, a more comprehensive and sustained approach will be needed as decentralized platforms producing news, commentary and opinion proliferate.

89. Governments and the information technology sector will need to collaborate to find new ways to monitor and mitigate disinformation flows, while also involving citizens so that various publics and policy spheres learn to recognize cues and think critically about information sources.[44] Importantly, this is not a problem solely for high-income countries – it affects every society.

90. The challenge of increasingly distinctive approaches to the digital world and access to information between the major power blocks and across countries creates additional problems, particularly when a crisis has multilateral dimensions. This challenge of decentralized information production and its distribution via social media and the internet has consequential implications for public health and wellbeing globally. It would be highly desirable, albeit politically difficult, to find an innovative and collective approach to information flow that may be required to deal with collective or common threats.[45] The subcultures intentionally manipulating information for disruptive purposes are as dynamic as the technology itself. This is likely one of the key challenges for society in the 21st century.

91. In the interim, it is important that governments have clear communication strategies in place before a crisis emerges. These must focus on reliable and trustworthy communication, with transparency around what is known and not known, and how decisions are reached under evolving and uncertain circumstances. It is critical to explain the provisional nature of knowledge: that science will always be operating on the edge of uncertainty, but that it allows for corrections as new and better information comes to light.[36]

92. Deciding whether the communicator should be a politician, a community leader, or a health or science expert is context specific, but trust is central to whether the messaging will be effective. While acknowledging that every decision has a political dimension, overtly political messaging is far less likely to be trusted. It is therefore important where possible to decide on lines of communication and crisis protocols in advance. Because information now travels faster, with greater intensity and from a broader range of sources to the public, far greater attention needs to be paid to this side of crisis management.

93. It is also important for the science community to practise more progressive ways of engaging communities with a view to enhancing trust in science. Among other things, this means moving away from the notion that science communication is principally about converting perceptions and behaviours in an audience to an approach that is more about recognizing opportunities to support mutual learning across communities.


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7.1 Adapt crisis management approach as the situation changes

94. Crisis management strategies must evolve with the situation. While the system must involve the whole of government from the start, responsibilities will likely change throughout the crisis, as will the nature of expertise that will be required. Leaders need to be open to new ideas, new strategies and new expert inputs throughout the duration of any crisis event.

95. In general, leadership needs to be more agile in its ability to pivot in response to changing knowledge and circumstances, while being as fully transparent as it can about the scientific and social basis on which decisions are being made.

96. Communication approaches must adapt at different stages of a pandemic. For instance, at the very beginning it is often important to communicate urgently and in a way that is directive. This is not sustainable, however, as any adaptation in behaviour will need dialogue and negotiation with communities, which in turn suggests audience disaggregation and different communication models.

97. Effective communication in a crisis relies on a clear route to accessing the range of scientific and other necessary expertise. Policy-makers cannot be expected to be scientific referees. Therefore, structures that support unbiased and robust evidence synthesis across the range of relevant (broadly defined) disciplines must inform a brokerage mechanism that ensures that scientific understanding, with all its caveats, is continuously available to the policy and political community, and to society.[46] Similarly, the brokerage mechanism must ensure that the appropriate inputs are being gathered, and the need will evolve as the crisis evolves. These should be regarded as important features of adaptive crisis communication.

98. The types of inputs needed will evolve over time, as has been clear over the evolution of the pandemic. Some countries managed to put together structures that were effective very quickly; in some cases existing mechanisms were effective; while in others those structures did not work for a variety of reasons.[47,48] The ability to be agile and pivot rapidly out of existing structures is critical if new and different types of input are needed. Because the circumstances of any emergency are unique, the concept of constructively challenging decisions through 'red teaming' advice by fully informed experts who are not directly managing the crisis has much merit.

7.2 Changing definitions of success: beware the rhetorical power of numbers

99. Political leaders have been challenged to convey acceptable measures of 'success', which for a long time were largely focused on cases and deaths. Few countries have articulated what success means over the longer term, other than claiming a return to business as usual (which in the context of conflict, climate change and economic complexity seems implausible), let alone decided on a strategy to achieve it.

100. Epidemiological models have been useful in thinking about the possible trajectories of the pandemic, but in general they cannot consider complex consequences. Over-reliance on such models as the principal evidence for decision-making can be counterproductive, and even dangerous in some circumstances. It is critical to consider how decision-makers and the public respond to numbers derived from models, which tend to stick in the mind as 'truth', when often they are only very rough estimates based on uncertain and often uncommunicated assumptions and limited types of inputs.[38] Whenever models are used, they must be adequately explained, and not allowed to be politicized or misconstrued by politicians or media seeking to tell a particular story of success or failure. Nor should they be

used to generate fear and thus wield power over a nervous population. Given their overall importance and their use in near real-time conditions, they should be subject at a minimum to informal but independent expert peer review.

101. Uncertainty is inherent in all models including those derived during a crisis, and their inherent imprecision needs to be clearly articulated so that the data are not misused.

102. Too many countries apparently took comfort in measuring preparedness using composite indices such as the Global Health Security Index (GHSI).[49] This index turned out to be highly misleading. In late 2019, the GHSI ranked individual country preparedness for a pandemic, but did not consider the system as a whole, except to point out that countries that have weak systems to prevent, detect or respond to outbreaks thereby increase the risk of spread across national borders. Yet the GHSI did not accurately predict how nations would cope with a pandemic, and in fact was wildly inaccurate, possibly leading to some pre-event complacency on the part of those nations that ranked highly.

103. As the pandemic progressed and its broader complexity became increasingly evident, the multiple impacts on societies needed to be considered, from the capacity of the health system to cope, to education deficits, human rights and social protection, inequalities and impacts on vulnerable populations (e.g. the aged, youth, women), and economic wellbeing, as well as the wider range of inter-country and regional, gender, age and national/ethnic inequalities that have deepened. Merely citing case numbers and deaths as a measure of long-term success will not convey the range of impacts that will really matter to citizens as they struggle to rebuild and move forward.

7.3 Plan for science communication, science literacy and 'risk listening'

104. For both decision-makers and the public, a level of science literacy (understanding probability, risks and cost–benefit concepts) is necessary to understand COVID-19 data and the rationale behind public health and other measures. Risk assessments can be difficult to understand and thus easily rejected or misunderstood. Risk advice, like other forms of advice, is not for the purpose of advancing the interests of the communicator, but to assist the listener (the public or the policy-maker) in making choices. Often these choices involve trade-offs and investments the policy-maker would prefer not to make, and which may be politically difficult. The scientific and expert community needs to reflect on how to improve risk communication, so it is better 'heard' in this context.[36]

105. Advisors and scientists need to consider how to express uncertainty and how the policy audience is likely to respond, given the need to balance scientific rigour with urgency during a crisis, and the fact that the science is likely to be uncertain and evolving. This is also true of communicating technical information and risk assessments to the public. A coherent and transparent link between the evidence, the advice, the range of considerations and the voice of a trusted communicator is critical.

106. Underpinning this is improved science literacy, which when adequately supported provides the public with a better understanding of the nature of science, including how inferences from what is known will evolve and change with new evidence, and are always subject to uncertainties and caveats.[36,37] Such literacy not only enhances trust in the use of science and evidence, but is also an important defence against disinformation.

107. Importantly, there is a need to understand the interplay between the communication of the relevant data and science on the one hand, and the communication of societal and governmental responses to the science on the other. They are distinct matters given that all policy decisions extend beyond purely evidence-based considerations. It is insufficient for a politician to state ‘we are just following the science’ when in most cases other considerations are clearly in play. These other considerations should be communicated so that the public understands the basis of decisions made. Otherwise, there is a risk that the science will be politicized and distrusted. This has important ramifications for how future risks can be communicated and managed.[50]

8.1 Science collaboration

108. Science collaboration and science diplomacy need to be prioritized in times of peace, so that research and knowledge can be promptly and equitably mobilized in a crisis.

109. Arguably, science has never been more on display than in the response to COVID-19. Indeed, international science collaborations involving both the public and private sectors brought about truly remarkable progress in vaccine development, which enabled some effective control over viral spread and reduced morbidity and mortality. It is clear this effort must continue and expand beyond vaccines into therapeutics, surveillance and diagnostics.

110. The central role of science, technology and innovation in responding to this and other global challenges is generally not in dispute. But there are lessons to learn from this pandemic on how scientific collaborations can be most effectively rallied to support crisis management of different kinds.

111. It will be essential to address the imbalance in global spending on research and development (R&D) and innovation, which is occurring overwhelmingly in high- and upper-middle-income countries. Even where research is conducted in low- and middle-income countries (LMICs), too much of it is led by funders from the Global North, who set the research agenda. Given that local knowledge and context is indispensable for knowledge to be applied in crisis situations, the LMIC community needs to be adequately engaged in the global scientific endeavour, not only in relation to information exchange and access to technology, but also decision-making and prioritization. Unequal access to vaccines and therapeutics disadvantaged many countries, despite critical efforts by scientists in those countries to provide information (e.g. South Africa's rapid identification of the Omicron variant) and be part of the global effort.

8.2 R&D for public good and benefit-sharing

112. New and effective tools for global governance are required to support R&D in areas that generate global public goods such as medicines and vaccines. These have long been sought but have not been effectively implemented on a global scale. For such a system to be politically and financially sustainable, it will require both fair contributions from all and fair benefit-sharing for all.[51]

113. While there is an obvious need for a fair return on investment for those private sector companies supporting R&D, this should not foster monopolistic control. There is a need to consider that their progress is always partially supported by public good science; rapid vaccine development, and in particular mRNA vaccines, would not have been possible without the immense public sector investment in biomedical research over several decades. Yet the economic benefits of these developments have remained in the hands of private sector companies.

114. It is critical to find a way to get beyond the inevitability that high-income countries, where the most advanced R&D occurs, will always have far greater access to needed therapeutics and diagnostics, even though many zoonoses first arise in low-income environments. Better global instruments to support vaccine and therapeutic development and scalable manufacturing capacities, as well as cheap and rapid testing technologies and diagnostic infrastructure in LMICs, are clearly needed.

115. It will be important to examine how the science capacities located in the private sector can best be mobilized in the event of a crisis. The private sector has expertise in management and logistics, which is an important resource for societies in crises, and governments need to consider how best to ensure that constructive partnerships can be rapidly developed in such situations.

116. Governments and the private sector should develop a framework agreement whereby R&D resources located in the private sector can be supported and mobilized to address future crises. This should ensure that government-provided financial support results in reasonable financial returns for public investors and/or is reflected in pricing to consumers.

8.3 Recognizing the work of scientists in LMICs

117. Scientists around the world worked at pace to identify pathogen strains, including in low-income countries where new pathogens often emerge. Yet little attention has been paid to where and by whom pathogen and pandemic-related research, data and knowledge are produced. Not only do scientists in LMICs too often fail to receive credit for their work, but their countries also often draw the short straw when it comes to benefiting from the outcomes of research, and in fact may suffer restrictions and ostracization from being seen as the source of a pandemic pathogen. This clearly needs to change. There is too much hubris exhibited by the scientific community, including funders and publishers in the Global North, regarding science in the Global South. The need for new arrangements to better support South–South and South–North partnerships in all aspects of science is critical.

8.4 Supporting further developments in open science

118. The principles that define science demand that the data, observations and conclusions be subject to challenge by knowledgeable peers. This centres the scientific publication as a core element of the system of science. Yet it is a system under pressure, with many incentives in both science and the science publishing sector creating concerns. The many stakeholders involved, from scientists themselves to their employers and publishers, are not well aligned on many aspects of this central issue of scientific publishing. The pandemic has further exposed the need for system changes in this crucial element of the scientific endeavour.[52–54]

119. The pandemic highlighted the importance of information sharing and the aims of the open science movement to make the scientific process more transparent, inclusive and democratic. Indeed, most major journals removed their paywalls to assist international scientific collaboration. But open publication measures do not necessarily mean open science unless the underlying data is also accessible. Open science has a cost that must be met, and further progress on the ongoing evolution of scientific publishing to support open access is needed.[54,55] There is growing concern, for instance, that low-income countries, less wealthy universities and young scientists, or those from minoritized communities, are discriminated against in the current approach to open science.

120. Global principles need to be developed to allow open science to flourish while ensuring quality control through peer review, ethical confidentiality and appropriate intellectual property development. Such work requires collective action by the science policy community, funders, agencies such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the international science community through the International Science Council (ISC) and partner bodies, and in partnership with the World Intellectual Property Organization (WIPO) and other bodies to review how open science and intellectual property protection can coevolve.

121. The explosion of preprints as a mode of scientific communication is welcomed, but also creates challenges. Many preprints were neither peer reviewed nor have subsequently appeared in the formal literature. Indeed, peer review was challenged even in traditional journals, with the flood of submissions highlighting some substantive underlying issues in quality control within the scientific publication endeavour.[56,57]

122. At the same time, much must be done to ensure more effective data linkages, data curation and data sharing, and that too has a cost that is inadequately met through current science funding systems.

123. There is a critical need for all countries to ensure broad, trustworthy and effective capacities in science advice, evidence synthesis and brokerage. Many of the problems that the public and decision-makers encountered in trying to manage the pandemic were related to how, and from whom, they sought and interpreted expert advice. In the process, in some societies, science was politicized and used as a shield (see Section 6.3) or dismissed as irrelevant or elitist. How well politicians did in accepting uncomfortable science advice and acting on it depended to some extent on the timing of the political cycle and how close they were to an election.[50,58,59]

124. While it is not possible to divorce science advice completely from political processes, it is more likely to be trusted and accepted by the public when it is and when it is perceived to be as independent from partisan politics as possible.

125. The complexity of possible pandemic responses has revealed the shortcomings of giving primacy to medical and epidemiological knowledge without considering, in parallel, the broader social and cultural dimensions. There is a need for transparent pluralistic and interdisciplinary inputs from the outset and throughout decision-making processes. Yet in many cases, the focus on information relating to public health and epidemiology was at the expense of other inputs. This meant both a narrow approach and poor implementation.

126. Although the role of science advice in emergencies is well recognized, the best means to obtain and implement such advice are not always well understood. In many countries, a lack of formal government science advice processes can hinder their capacity to recruit experts rapidly, and thus to address crises that have large and evolving scientific components, such as pandemics. While there are very many ways in which science advice may operate, depending on different cultural, constitutional and historical contexts, it is important that processes exist in all jurisdictions to evaluate and synthesize complex scientific information, and to communicate that information to policy-makers in an unbiased manner – a process known as brokerage.[46]

127. While specific ad hoc advisory mechanisms were developed in many countries during the pandemic, pre-existing pluralistic mechanisms had considerable value, not just for emergency management but also for assisting in broader aspects of policy development. Yet in some countries, public health alone appeared to dominate in advisory processes.

128. There is scarcely a sector of policy-making in which robust evidence synthesis and brokerage could not assist. This applies at both national and international levels.

9.1 Enhancing evidence synthesis and brokerage capabilities

129. Ensuring an effective bidirectional bridge between evidence and decision-making requires investment in the processes and appropriate institutions of skilled knowledge synthesis as well as those of knowledge production. This would ensure advice is available via knowledge brokers to decision-makers in a timely fashion and can also be understood by all stakeholders, including the public.[46] This can help ensure that the trade-offs and risks associated with difficult policy decisions are explained to citizens in a transparent manner.

130. It is important that a system exists pre-emptively in order to accumulate and synthesize evidence. Because of the complexity of the pandemic and its reach into every aspect of policy-making, it is important that no single discipline claims ownership of the advice proffered. Often a national or regional academy can play a central role in quality evidence synthesis. Unfortunately, however, many low-income countries have not established national academies or equivalent bodies.

131. 131. Modelling in isolation cannot and should not replace a more complete and nuanced assessment. It can be a valuable tool to explore and illustrate some variables and possibilities, but this depends on how the model is constructed, how its assumptions and uncertainties are laid out and what is included and excluded from the model and, in turn, how these limitations are communicated.[60]

132. A well-performing science advisory ecosystem should ensure multiple disciplinary inputs into evidence synthesis, even in an emergency. Decisions based on limited types of evidence, characterized for example by an over-reliance on numbers and models, should be avoided where possible. The range of potential spillover costs and benefits must be available to the decision-maker. Social and behavioural science can contribute explicit caveats about the flow-on effects of the behaviours that could influence the veracity of the models, and thus the impacts of decisions based on them.

133. The role of science advice is to provide a summary of what is known and not known, including the associated uncertainties, to policy-makers and to society at large. Such advice should also identify the key implications of any decision made, but ultimately all decisions must include value judgements that must properly lie with the policy and political community.

134. Effective brokerage that ensures good understanding by decision-makers in real-time emergencies is likely to be somewhat informal, rather than come about through formal reporting mechanisms. However, to the extent possible, the basis of advice should also be available in the public domain. Not every scientist can be part of a formal science advisory mechanism, and that can create problems if policy-makers are expected to referee contested advice. A well-developed science advisory system can address how any plurality of views is transmitted.

135. No science advisory mechanism can possibly cover every potential emergency pre-emptively, but it must be able to reach out to the appropriate components of the science system, either domestically or internationally, at very short notice. One of the advantages of a pre-existing science advisory ecosystem is that informal linkages can be virtually instantaneous. Such relationships proved to be very useful in the early stages of the pandemic.

9.2 Capacity building and advice sharing with low-income countries

136. Effective science advice and its uptake hinges on its relevance to the context. This requires locally developed science advice ecosystems, the heart of which is a community of experts, generally found in either universities or government laboratories. Those communities may be very small in the lowest-income countries and in the Small Island Developing States (SIDS), obliging them to rely heavily on international information and contacts or on pre-formed alliances. Open science systems help, but direct person-to-person or institution-to-institution advice is more responsive. This suggests a role for a science advisor (or equivalent) who is linked to the global science advice community and national academies in every country, irrespective of size or state of development.

137. Commentary and our analysis suggest that WHO was less than optimally responsive in the early stages of the pandemic,[61–63] partially due to the conflation of political and technical governance, among other factors. As is discussed below, a strengthened support system is needed within the multilateral community to assist countries seeking expert input under both emergency and non-emergency situations. Agencies such as UNDP, the World Bank and development banks need to prioritize the development of science advisory processes, as they will have broad impacts for national development.


2
Fresh meat
Fresh fish
Bacon & sausages

10.1 Multilateral system reform

138. COVID-19, climate change and current conflicts all reveal the fundamental weaknesses of the current multilateral system in dealing with common challenges. While we acknowledge the difficulties in the current geopolitical environment, there is a critical need to reform the multilateral system to enhance international cooperation and regional responsiveness before and during crises, and to address other issues related to the global commons.

139. Given the widespread impact of COVID-19, it was predictable that the world would inevitably struggle to cope with another parallel catastrophe. One has unfolded in Eastern Europe with global and regional consequences extending to energy and food insecurity being used as geostrategic tools. The worsening economic challenges and inflation that have ensued add to the other factors that greatly exacerbate global harm.

140. The pandemic continues to ravage economies around the world. In parallel, other humanitarian crises and geostrategic tension affect wellbeing and progress on Agenda 2030. In the case of Russia and Ukraine, tensions between governments have moved beyond rhetorical battles to actual combat. More than ever, we need robust and effective intergovernmental institutions, but these are increasingly ineffective as nationalism more and more displaces global cooperation.

141. There is now a risk that as nations seek to address domestic failings which were exposed in this pandemic, such as prior underinvestment in health systems, the global response and preparedness for future pandemics and other crises could be undermined. Governments in high-income countries could turn their attention inwards, thereby ignoring the economic and other interdependencies with low-income countries (and other high-income countries). The need for nations to consider their own citizens appears to have lowered the level of priority given to achieving Agenda 2030, including addressing climate change (as evidenced by the lack of compelling progress through the IPCC COP processes) and other risks to the global commons.

142. Yet at the same time, the scientific communities have come together to produce remarkable results in terms of vaccine and therapeutic development. Never before has the success of cooperation involving both the public and private sector been so critical. COVID-19 has clearly shown that preventing the emergence and spread of infectious disease should be considered a global public good.

143. The lessons extend well beyond the scientific community to national and global leaders, who need to recognize a broad range of global commons issues that must take priority over narrow interests.

144. Worryingly, the prevailing nationalist and populist framing argues that international cooperation represents a sacrifice of national interests. Protectionist policies for rebuilding economies are unlikely to prioritize global health, and cooperative climate action is also likely to suffer, if divergent trajectories create further barriers to cooperation.

10.2 Addressing structural weaknesses in WHO and other multilateral stakeholders

145. Even at the most basic level, the multilateral system was found wanting. Neither the Security Council nor the General Assembly gave sufficient urgency to the pandemic. Geopolitical interests clearly delayed part of the early WHO response, and there remain concerns over the adequacy of data sharing by some countries. The COVAX and ACT-A mechanisms were slow to ramp up and under-delivered on many promises. This suggests that profound and widespread reforms are required, ranging from matters of governance and authority to those of financing.

146. The review by the Independent Panel for Pandemic Preparedness and Response[63] drew attention to many issues relating to the ability of WHO to respond effectively, but more than two years since this report was released, little progress has been made. Progress on a global pandemic instrument has been slow and compromised by nationalistic issues and domestic politics.

147. Problems with early notification of pandemic risk, data sharing, expertise sharing, and inspection and adequacy of facilities to support a global response have all been highlighted. The fundamental weakness of WHO – with an over-reliance on voluntary contributions and donations, which influence its agenda – has been well identified, but there appears to be little enthusiasm for substantive reform. These are lessons that must be responded to with urgency by the global community and extrapolated to other contexts and risks.

148. There remains a structural inability to reconcile the competing and mutually exclusive positions of WHO member states. This is as debilitating as the current funding challenges.

149. Of all the conventions related to conflict, the Biological Weapons Convention[64] remains the only one without any scientific or inspection regime to support it. Despite previous leakages of biological material from research laboratories, there remains no international consensus on regulation and registration of biosecurity facilities.

150. Processes need to be established to mobilize the wider national, regional and international community at the earlier stages of a crisis. With respect to pandemics, WHO remains the core global agency. But the structure and functions of WHO are now more than 70 years old and were designed for a very different world. Even at the outset, its structure was somewhat predetermined by the prior existence of two regional bodies. WHO is largely a technical agency, but its governance is heavily determined by the political sphere. This limits its responsiveness. Its mandate is broad, perhaps too broad, as evidenced by the emergence of a distinct UN agency to deal with HIV/AIDS.[65] Because of its structure and its reliance on voluntary subscriptions and donations, its agenda is not well balanced. The East African Ebola crisis of 2015 highlighted the risks of disconnect between regional offices and WHO headquarters.

151. Despite these identified weaknesses, meaningful reform is difficult to achieve, and discussion has been dominated by political rather than technical considerations. Nonetheless, the logic for more rapid reform is compelling.

152. A major focus needs to be on building and maintaining supply security for vaccines in critically underserved regions. The failures of COVAX need to be addressed, but beyond that, a coordinated process is needed to promote vaccine and therapeutic innovation for the longer term, encompassing technical, production and quality-control capacities in low-income countries, and regulation that considers global equity in distribution during crises. Early developments in mRNA manufacturing facilities in some LMICs are promising but there remain significant issues of intellectual property that restrict opportunities. Crucially, attention must also be paid to ensuring capacity and logistics to distribute and administer vaccines within these countries, and minimize corruption, so that vaccines are used effectively and not wasted.[51]

10.3 Establishing effective UN science advisory mechanisms

153. There is a large role for multilateral cooperation in any major emergency, including the ongoing crises of climate change and global sustainability. But currently the global policy community does not have a coherent means to gather input from the science community. Agencies such as the United Nations Environment Programme (UNEP) and WHO have well-established expert input mechanisms, but these are, surprisingly, separate and largely

siloed from each other. There is no effective way of integrating them and they do not feed effectively into the UN system as a whole. Further, very few emergencies remain linked to a single UN agency. While each may pick up and focus on elements that fall within its domain, integrating knowledge to ensure a comprehensive and well-understood response is currently not possible.

154. Additionally, the UN needs a structured way of reaching out to the global science and engineering community beyond individual member state determined inputs. In this regard, the recommendation of the UN Secretary-General's 2021 report, *Our Common Agenda*,[45] for a new UN science advisory mechanism is welcomed. However, this must not simply be a replication of the transient and relatively tokenistic experiment that operated through UNESCO in the past. This was not resourced and did not have a clear mandate. Rather, it must be a mechanism that truly links the UN system, including its components, with the broader science community. Such a process might also assist in integrating individual UN agency expert inputs.

155. The ISC and partners have made submissions to the Office of the Secretary-General to point out the need to develop a system that indeed acts as a brokerage mechanism between the broad scientific community and its diverse expertise and the policy community, rather than simply a tokenistic board.

156. Importantly, decisions in the multilateral system are largely made by diplomats representing member states' interests. It is therefore important that domestic science advisory systems develop strong relationships with their ministries of foreign affairs.

10.4 The role of civil society and the private sector

157. The Bill & Melinda Gates Foundation played a critical role in the development of Gavi, the Vaccine Alliance, some 20 years ago – an initiative that is now supported by many governments and by the private sector.[66] Gavi provided much of the impetus and support for the development of COVAX, which has made vital contributions to pandemic control, although not at the scale and speed needed. The collaboration between academia and the private sector, often with government support, led to the unprecedented development of vaccines within 12 months. These have been crucial to controlling the acute phase of the pandemic. Many NGOs operating at local and regional levels have supported actions in social and other domains where deficits appeared in distribution and access. This level of cooperation and initiative is to be applauded, but should not absolve the international community, especially the policy and diplomatic community, from looking to address the deficits that have become obvious. Much more is still needed to shift the trajectory towards a positive long-term scenario.

10.5 Improving international agreements

158. The formal international mechanisms for addressing infectious disease have a long history, culminating in the IHR.[67] These formal mechanisms were first developed in the 19th century, in a very different world, to deal with the quarantine of passengers on ships with a specified set of diseases. Their prime purpose beyond public health was to ensure that trade was not inappropriately disrupted. The IHR were last revised in 2005 after the SARS outbreak but prior to the experiences of the Ebola crisis, and certainly prior to the extraordinary progress in molecular science that enabled the world to address COVID-19. While WHO has begun discussions on the further evolution of the IHR, it is disappointing that three years since the pandemic emerged, progress has been slow, with limited inputs.

159. Worryingly, the current version of the IHR contains a process that makes rapid revision impossible. The regulations are clearly outdated and were found to be inadequate in multiple ways in the early stages of the COVID-19 outbreak. The issues that emerged include the need for a better surveillance system, more rapid reporting of a suspected new zoonosis, immediate sharing of biological material and genetic sequence data, the availability of expert assistance, inspection capacities, and clinical, epidemiological and biological data sharing. The processes of global alerting were based on a world that was not as instantly globalized as it is now, and this needs to be reviewed. Another example is travel bans, which are specifically discouraged in the IHR, but proved to be valuable in the early management of COVID-19 in many countries.

160. Consideration should be given to a 'One Health' approach that does not distinguish between the source or target of the pathogen – be it plant, animal or human. Similarly, a Richter-scale approach to public health crisis alerts could allow for a more pragmatic and flexible response to evolving emergencies.

161. Whether amendment of the IHR alone is sufficient is a matter for diplomats, given the difficulties of achieving a new international instrument agreed to by all nations in the current context. However, following the Chernobyl nuclear incident of 1986, new international agreements and surveillance, inspection and assistance mechanisms were agreed on very quickly, including the establishment of a new agency, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization in Vienna.[68] It is worth noting, however, the IHR are as legally binding as any other instrument in international law.

162. Perhaps it is possible to get beyond the IHR to develop an international instrument (e.g. a protocol or convention) that addresses the broader issues of pandemic responses. Critically, this must include financial commitments to support research, surveillance, expert advice, mutual assistance, and medical and public health supply-line security and technology access (including vaccines and therapeutics) for all countries. Funding remains problematic, and the global costs of the pandemic should highlight why the global community must prioritize investment in pandemic protection along with the creation of a more effective WHO.

163. These are not easy matters. While the logic is compelling, geopolitical realities, including the challenges of passing agreements in polarized domestic political systems, limit many solutions.

164. The failure to have a scientific regime that includes consideration of anthropogenic biological risk, in the form of research laboratories or biological warfare developments, is another consideration. The Biological Weapons Convention does not have a robust scientific support and inspection regime, despite many years of discussion confounded by issues such as those of technology transfer and access. These matters are now moot, given the progress in molecular biology and its broad accessibility, which was not the case when the Convention was first drafted.

165. Beyond politics and funding, there are several technical issues that need to be addressed. For example, even dealing with the issue of sharing biological material for a putative new pathogen will require reference to the Nagoya Protocol on Access and Benefit-Sharing.[69]

166. Pandemics, like other disasters such as wars, are ultimately exacerbated and perpetuated by humans, even if they have a natural or biological origin. They happen randomly, but we need to understand the role people play, and how our decisions and actions can serve to either mitigate or exacerbate their effects. For example, greater population density that brings wildlife and humans into closer contact, growth in animal husbandry, the continued access to bush meat, the use of wet markets and greater mobility of humans are all factors that have played a role in zoonotic outbreaks. The capacity for learning such lessons at local, regional, national and international policy levels must be increased.

167. For policy-makers, politicians, diplomats, science advisors and researchers, learning what precipitated the event and what went wrong in the response is more meaningful than knowing what was done right. Inquiries into national responses are inevitable and important, but they should not be focused on blame; rather, they must be focused on developing understanding and mechanisms to address future risks. To benefit from such inquiries, we need to ask the right questions, exclude political commentary as much as possible, and seek out multiple kinds of data and knowledge to help the relevant systems learn the right lessons.

168. The global community, as much as individual countries, needs to take stock. There are lessons for a broad range of possible crises, including another pandemic, climate change or major natural disaster, that must be learned.

169. For this pandemic, and to respond to future ones, research studies into what determined individual and collective behaviour and compliance, impacts on mental health, the use and usefulness of modelling and different modes of science advice, as well as assessments of policy effectiveness and impacts should help inform preparedness planning for the future.

170. There is a need to take human behaviour more into consideration in crises where broad societal cooperation is needed. This involves understanding those factors that lead people to ignore evidence of risk, to lack of cooperation and to distrust, and recognizing that non-perfect compliance is ‘normal’. Much is known about the sociology and anthropology of disasters but was not generally taken into consideration as ‘science’ during the pandemic.

171. From an international perspective, inquiries such as those conducted by the Independent Panel for Pandemic Preparedness and Response have already highlighted critical areas where reform is needed.[63]

12. CONCLUSION

172. The pandemic is not yet over. The acute phase has played out over much of the last three years, and yet we continue to face ongoing infections, morbidity and mortality globally. SARS-CoV-2 has now reached the stage of being endemic in all societies, and our responses will have to evolve as the virus and our knowledge and capacity to deal with it evolves.

173. SARS-CoV-2 has only recently been transmitted to the human species, and we can assume the virus will continue to evolve, although the impacts cannot be predicted. It is circulating in wild and domestic animals, and human-to-animal and animal-to-human transfer may be associated with a greater risk of mutation. Further, the large population of immunocompromised and unvaccinated people adds to the probability of ongoing mutations. In this context, we can assume the endemic virus will have the potential for episodic more virulent variants, and there will be an ongoing need for updated vaccines until vaccinology develops more universal protection.

174. As of March 2023, several features of the pandemic evolution are notable:

    I. The acute emergency is receding as widespread immunity reduces severe disease to more manageable levels.

    II. COVID-19 is spreading less often in waves, primarily because no new variants of concern emerged in 2022 – just new variations of Omicron with no obvious difference in infectivity or virulence. The new XBB.1.5 variant appears to be more transmissible but does not cause more severe disease. However, the potential remains for new variants of greater concern to emerge.

    III. Omicron and its sub-lineages have substantial immune escape, making current monoclonal antibody therapies less effective. Similarly, the effectiveness of first-generation vaccines has reduced.

    IV. The development of multivalent vaccines would thus be a critical advance. Additionally, greater and more equitable access to effective antiviral therapies, both pharmacological and immunological, is needed.

175. Clearly, the COVID-19 pandemic is not just a public health disaster. It has affected all parts of society, with consequences for people's physical, emotional and economic wellbeing, and their sense of autonomy and security. For example, youth around the world have been profoundly affected by disruptions to their education, with flow-on effects on their social and emotional growth, and even their sense of purpose. Nationally and internationally, the impacts on economic activity, trade and geopolitics, and trust in governance within and between nation-states, are severe and wide-ranging.

176. Inequality remains a pervasive disease, one that has grown in recent years in all societies and has worsened during the pandemic, with minoritized communities, women and youth bearing a disproportionate burden within countries. Greater societal resilience will require long-term microeconomic, macroeconomic and social policy responses along with real commitment to Agenda 2030.

177. While the pandemic has highlighted the value of global scientific cooperation across the public and private sectors, it has also revealed weaknesses in governance and cooperation within the multilateral policy system, both in the domain of pandemic and crisis management, and in ensuring equitable global access to effective protections and interventions. If we are to deal with the emergence of a more virulent variant or another pandemic, or indeed to address the challenges of climate change and other existential threats, we must reflect on how the multilateral system can reform to operate more effectively for the global good. There is little to take comfort from in how the multilateral system has performed over the past three years.

178. The way COVID-19 has been managed around the world, with varying levels (and sometimes differing definitions) of success and failure, has provided some important lessons for the ongoing management of the pandemic, as well as future pandemics and other crises. It has shown how essential it is to ensure pluralistic inputs into both crisis and post-crisis management, and to be open to different types of inputs as the pandemic evolves. Decisions and actions – both taken and planned – must be scrutinized in the contexts of cascading risks, complex feedback loops and multiple trade-offs. It is unwise to assume that the pandemic itself is winding down simply because public health restrictions are being lifted in many countries. Even if new variants of concern do not emerge, there are many ongoing consequences that will require active governmental intervention for many years.

179. In the first edition of this report, we illustrated how the pandemic had influenced every aspect of domestic and global policy-making, and how it has an impact on every domain of human endeavour. The report highlighted the interconnectedness of decisions in one policy domain to outcomes across many others, and how wrong decisions or lack of action may lead to very different long-term scenarios.

180. In this second edition, we highlight the most important generalizable lessons and policy implications for either national or multilateral action. It is neither possible nor appropriate to contextualize and comment on every aspect of the consequences of the pandemic for an individual country or community.

181. The key lessons are very clear. Even if the acute phase of the pandemic may be winding down in those countries with high vaccination rates, the risks will remain high. New variants will emerge, and vigilance and ongoing vaccine and therapeutic development remain essential.

182. There is no policy domain that remains unaffected, and governments must recognize that the pandemic's myriad impacts will not be resolved quickly. They must not pretend that the crisis is over just because mortality is reduced. For many citizens, there will be many years of difficulties and challenges ahead.

183. Global cooperation has proved critical, as demonstrated by the science community, but the multilateral system is not fit for purpose to handle major crises. Given the many foreseeable risks related to climate change, sea level rise and food security, among others, this is the time for the multilateral system to look to reform itself and ensure adequate expert input.

184. Finding ways to address the politicization of science, and the impact of disinformation on trust in science, is critical. All countries need to develop or strengthen their science advice ecosystems, and the UN must develop a more integrated and effective approach to enable science in all its forms and domains to contribute to protecting societies from major risks. As science has shown, when we cooperate for a common goal, challenges can be overcome.

185. We must learn from the lessons of this crisis to prepare better for the inevitable next crisis.

13. APPENDICES

I. Summary of actions

This table from the first edition report summarizes policy recommendations to mitigate the long-term impacts of COVID-19 and prepare for future crises.

POLICY/ACTION AREA	MAIN RECOMMENDATION	ACTIONS
Sectoral lessons	Focus on reducing growing inequalities affecting societies' capacity to cope with COVID-19	1. Improve health system access, capacity and adaptability 2. Support the recovery of education 3. Support the care economy
Understanding risks	Review and reframe the way risk is assessed and integrate it more formally into policy development	1. Focus on consequences, not just specific risks 2. Reframe long-term risks around actionable measures to address acute needs 3. Remain vigilant to other existential risks 4. Don't deprioritize sustainability
Trust and public mobilization	Build trust through coherent decision-making and reliable information	1. Ensure trust through transparent decision-making and information flows 2. Mitigate misinformation and disinformation with planning and trust
Crisis Management	Apply adaptive management to strategies for crises	1. Adapt the crisis management approach as the situation changes 2. Change definitions of success rather than focusing just on case numbers and deaths
Science and science diplomacy	Prioritize science collaboration and diplomacy in times of peace, so that research can be promptly and equitably mobilized in a crisis	1. Invest in R&D and sharing of benefits for the public good 2. Ensure recognition of the work of scientists in lower- and middle-income countries 3. Support further developments in open science to ensure equitable access 4. Enhance science advisory mechanisms at both the national and multilateral level
Capacity development for science advice	Ensure broad capacities in science advice, evidence synthesis and brokerage	1. Invest in an effective array of evidence synthesis and brokerage capabilities 2. Build capacity and support advice sharing with low-income countries 3. Plan for science communication, science literacy and 'risk listening' 4. Establish effective UN science advisory mechanisms

POLICY/ACTION AREA	MAIN RECOMMENDATION	ACTIONS
Multilateral system reform	Reform the multilateral system to enhance international cooperation and regional responsiveness before and during crises	1. Address structural weaknesses in WHO and other multilateral stakeholders 2. Establish multiple coordinated processes to mobilize the wider national, regional and international community at earlier stages of a crisis 3. Support the role of civil society and the private sector in reducing social deficits 4. Improve international agreements in view of COVID-19 responses
Investing in learning	Increase capacity for policy learning at local, regional, national and international levels	1. Analyse the role of people and their mobility in zoonotic outbreaks to understand how human actions can exacerbate effects 2. Analyse what went wrong during such events, focusing on developing mechanisms to address future risks 3. Seek out multiple kinds of data and knowledge to learn the right lessons 4. Improve understanding internationally through cooperation in the multilateral system

II. Acronyms

ACT-A . . . . . Access to COVID-19 Tools Accelerator (Global Collaboration to Accelerate the Development, Production and Equitable Access to New COVID-19 diagnostics, therapeutics and vaccines)

COVAX . . . . . COVID-19 Vaccines Global Access

COVID-19 . . . . . Coronavirus disease first recognized in 2019. The disease caused by SARS-CoV-2.

GHSI . . . . . Global Health Security Index

IHR . . . . . International Health Regulations

ISC . . . . . International Science Council

LMICs . . . . . Low- and middle-income countries

NGO . . . . . Non-governmental organization

RND . . . . . Research and Development

SARS-CoV-2 . . . Severe acute respiratory syndrome coronavirus 2, the virus that causes COVID-19.

SDGs . . . . . Sustainable Development Goals

SIDs . . . . . Small Island Developing States

UN . . . . . United Nations

UNDP. . . . . United Nations Development Programme

UNEP . . . . . United Nations Environment Programme

UNDRR . . . . . United Nations Office for Disaster Risk Reduction

UNESCO . . . . . United Nations Educational, Scientific and Cultural Organization

WHO . . . . . World Health Organization

WIPO . . . . . World Intellectual Property Organization

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V. Further reading

Unprecedented and Unfinished: Policy Lessons and Recommendations from COVID-19 – 2nd Edition is an updated version of, and is thus largely based on, 'Part 2: Lessons and recommendations' of the International Science Council's report *Unprecedented and Unfinished: COVID-19 and Implications for National and Global Policy*, released in May 2022. For further reading, please consult the full bibliography of the May 2022 report: https://council.science/UnprecedentedAndUnfinished-Bibliography

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