UNPRECEDENTED AND UNFINISHED:

COVID-19 and Implications for National and Global Policy

International Science Council
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Contributors to this report can be found in Appendix II

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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 Serbian military personal setting up beds inside a hall at the Belgrade Fair to accommodate people suffering from mild symptoms of the coronavirus disease (COVID-19) on March 24, 2020. Image credit: Vladimir Zivojinovic / AFP

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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 the pandemic is far from over. This report examines the wide-ranging consequences of the pandemic. It seeks to describe how various decisions in one area of policy impact other areas of public life and personal wellbeing, and what this means for longer-term outcomes as we progress through the pandemic then rebuild and recover. Crucially, we need to learn how to mitigate devastation arising from such crises in the future.

What is clear is that managing the pandemic continues to be about much more than managing vaccine distribution chains. COVID-19, like all health crises, is a broader socio-political challenge. 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 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 and similar emergencies. It presents tools to map policy domains and scenarios and to observe interactions over approximately a five-year timeline. The lessons outline actions to be taken around an emergency such as a pandemic, both before and after, as well as beyond the sectors of health. Pandemics play out the way they do because of the way our societies are organized and our governments govern.

Given the unprecedented nature of the impact of COVID-19, the community of scientists and science advisors behind this report call for an equally unprecedented ongoing and accelerated response from the global community, governments, and civil society.

Peter Gluckman
President
International Science Council

EXECUTIVE SUMMARY

A. Why is a COVID-19 future scenarios exercise important?

The object of this report is, firstly, to inform policy-makers and the public about the wide-ranging, long-term impacts on the entire global community from COVID-19, and to help elucidate the key decisions and actions that could shift the evolution of the pandemic towards more positive and equitable outcomes across societies. Secondly, it should inform planning and responses to other existential crises, whether pandemics, natural disasters, or the impacts of climate change.

Some two years after the World Health Organization (WHO) declared the SARS-CoV-2 outbreak a Public Health Emergency of International Concern, COVID-19 and the successive emergence of variants of concern continue to put the global community, and every nation, under significant stress.

While the rapid development of vaccines has been a huge scientific success, made possible through unprecedented collaboration between the public and private sectors, neither vaccine deployment nor the imminent application of antiviral therapies will be enough to address the multiple consequences of the pandemic. Furthermore, the far-reaching consequences across all domains are far from over, and some will unfold well into the future.

In many countries, health systems remain overburdened; in others, notably in Africa, there is little access to lifesaving vaccines and there are ongoing challenges relating to issues such as vaccine hesitancy.

Too many governments have reacted to the pandemic as if it is solely an acute public health crisis, and have continued to focus narrowly on health consequences in their country. 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.

This report therefore provides an entry point to addressing the wide-ranging impacts of COVID-19 in two parts.

Part 1 sets the scene by outlining three plausible scenarios over a five year time horizon that could conceivably emerge from the pandemic's cascading impacts, taking into account policy interactions and uncertainties that may affect outcomes. These scenarios are intended as simply as illustrations to help the global community plan for the future, by seeking to assess the broader impact of decisions taken today and the costs of inaction.

Part 2 then provides recommendations on how the global community can prepare for the future to mitigate the impacts of COVID-19 and address other existential crises that we will inevitably face. The hope is that this should improve outcomes and provide many lessons for other global emergencies.

B. What approach was used?

A systematic approach was used to develop plausible five-year scenarios. The International Science Council (ISC), with support from the United Nations Office for Disaster Risk Reduction (UNDRR) and the WHO as observers, appointed a high-level oversight panel of 2 observers and 18 geographically diverse experts in public health, virology, economics, behavioural science, ethics, sociology, and other areas (see Appendix II).

In Phase 1, from March to November 2021, the oversight group and its technical advisory and project management teams undertook an extensive number of consultations with the aim of outlining the drivers and possible outcomes of

the pandemic over a five-year horizon. This was accomplished by the following:

1. *Identifying the many factors* that would have an impact on the evolution of the pandemic and/or be influenced by the pandemic.

2. *Identifying key vectors of uncertainty.* These are critical events or policy issues that could significantly influence the long-term outcome of the pandemic.

3. *Developing a systems map* of the interactions between various dimensions of policy and how they affect the delivery of outcomes. This map is used as a conceptual device to guide policy-makers about the wider impacts of the decisions that they make within their specific policy domains.

4. *Describing some plausible global outcome scenarios* over five years.

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 integrating expert workshop to develop a set of recommendations that would have the most positive impact on ending this pandemic and increasing resilience to future crises.

This report summarizes the findings and the implications of these extensive consultations and analyses.

C. What are the drivers and how are we managing the impact?

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 are already prioritized by some governments, the private sector and certain 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 epidemic.

Overwhelmingly, however, our conclusion is that many of the factors that will have the most significant impact on societies over the long term (five years or beyond) are not being prioritized sufficiently by many governments or by the global community today. 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 misinformation – 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 UN Sustainable Development Goals.

D. What future COVID-19 scenarios should the global community prepare for?

Developing scenarios does not claim to predict the future. As this report points out, there are too many uncertainties to do that. But by considering a range of plausible futures as useful illustrations, this process allows policy-makers to identify actions that might narrow the landscape of possibilities to a more acceptable range.

The primary goal of the project was to explore outcomes beyond the direct impact of COVID-19 on health. As an illustration, three global COVID-19 futures are outlined for the year 2027. The project's expert consultation considered the first of these scenarios to be the most likely, the *Continuity* scenario; the second, plausible but more pessimistic, referred to as *Missed Recovery*; and the third, plausible but more optimistic, *Collaboration Plus*. These outcomes will be influenced by the evolution of the vectors of uncertainty that the project identified. More extreme and intermediate scenarios are, of course, also possible. Each scenario considers the interactions between the state of the COVID-19

pandemic, including ongoing evolution of the virus and vaccine development, global population health, the level of social wellbeing, societal stability, the state of the global economy, inequality levels, impact on the sustainability agenda, and the impact on future threats.

The **Continuity scenario** describes a near future where global and regional collaboration has led over the next five years to effective vaccines (continually updated in relation to the evolving nature of the virus). The unvaccinated population remains primarily in low-income countries, although vaccine-hesitant groups everywhere remain a stumbling block to achieving widespread immunity. Additional manufacturing capacity has allowed for the supply of updated vaccines and boosters in most countries. Some public health and social measures have been maintained or temporarily re-established in countries where there have been surges of COVID-19. Greater awareness of the importance of robust social and health systems has resulted in the implementation of some social recovery mechanisms and investment, but such actions are sporadic and uneven within countries and internationally. As a result, and because of its biology including presence in non-human hosts, COVID-19 has become an endemic disease across the world, with seasonal surges occurring, requiring updated vaccines and the use of antiviral pharmaceuticals. Progress toward the United Nations Sustainable Development Goals (UN SDGs) slowed during the first few years of the pandemic, but could then accelerate, in part because of lessons learned during the pandemic. However, trust between citizens and State has been adversely affected, in part by disinformation, with a rise in populism and loss of social cohesion, creating broader political implications at both national and global levels.

The **Missed Recovery scenario** depicts a world in five years' time with declining societal conditions and increasing inequalities, arising from growing geopolitical tensions as already illustrated by the Ukraine conflcit, protectionist policies and poor global and regional collaboration in response to the pandemic. The use of COVID-19 boosters – updated for new variants in some instances – has been authorized in most countries in response to waning immunity and poor immune response in vulnerable groups, in response to more pathogenic or transmissible variants and among those with high exposure. But some low-income countries still have limited access to initial vaccine doses and antiviral medicines. Less than 60% of the global population has been effectively fully vaccinated against COVID-19. Restrictive public health and social measures, such as work-from-home policies and regional lockdowns, are still required in some countries. In this scenario, COVID-19 recovery mechanisms and investment in social care and health systems have been limited. As a result, COVID-19 remains largely uncontrolled, with severe recurrences in parts of the world. The rise in populism has further compromised international cooperation and promoted a rise in authoritarian governance. The multilateral system, already weakened, is further compromised and progress towards the UN SDGs is severely set back.

The more optimistic **Collaboration Plus scenario** depicts a world over the next five years where COVID-19's importance has been reduced because of high levels of international collaboration. More than 70% of people have received an effective COVID-19 vaccine. Vaccine development and enhanced manufacturing and distribution capacity allows a high protection rate to be maintained globally. Effective antivirals are widely available at a cost that allows access for low-income countries. Public health and social measures to control the virus are much less restrictive. The shock of the pandemic has prompted high income countries to commit to substantial investments in green recovery from COVID-19 and to building up their social care and health systems. Health systems in low-income countries can still be overburdened when surges of COVID-19 do occur, but the disease has become more manageable. Governments and the multilateral system have taken lessons from the pandemic and strengthened disaster-preparedness and science-advisory mechanisms to enhance resilience against future crises. The weakening of the pandemic has allowed multilateral actors to reprioritize the UN SDGs.

In summary, the experts interviewed considered any of these three scenarios, or intermediate scenarios that draw on them, to be entirely possible. It is therefore crucial that the global community focuses on actions that can be taken to achieve the best possible outcome. To do this, they need to understand the drivers that shape these scenarios and how these might interact.

To support this interrogation of scenarios, various aspects of the COVID crisis are explored using the concept of policy dimensions, or 'clocks'. Seven clocks are used to represent the critical factors that will affect the mid- to long-term outcomes of the pandemic. These are health; social; national governance; economics; global governance; the environment; and science and technology. Clocks are used to represent these factors because they occur at varying speeds, and their impacts will be realized on different timescales. Countries and regions may also be at different phases of these clocks at any one time.

E. What are the key recommendations for how the global community prepares?

Mapping the clocks, the vectors of uncertainty and the resulting outcomes provides an overview of the complexity of the pandemic's impact and the multiple chain reactions that it has unleashed. Decisions and actions must be scrutinized in the context of cascading risks, complex feedback loops and multiple trade-offs.

Considering the multidimensional nature of the COVID-19 pandemic, Part 2 of the report outlines the most important lessons and policy implications that are widely applicable for either national or multilateral action. The aim is to suggest ways to shift the current trajectory towards a more optimistic outcome that is closer to the Collaboration Plus scenario.

Some of the key recommendations are shown in Table 1. These include the following:

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 indeed of the Ukraine crisis) call for reform in the way this operates to handle major crises. 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. In order 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 impacts, 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.

3. Governments must review and reframe the way they assess risk, integrating it more formally 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, considering interconnected risks and consequences.

4. Governments must prioritize building and maintaining trust, 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.

5. There is a need to address the challenges of disinformation, and to strengthen pluralistic science advice systems to increase trust in science, thereby protecting societies from risks.

6. Equally, there is a need invest in R&D for the public good. As part of this, the UN should develop a more integrated approach to science so that challenges can be overcome by working towards common goals.

7. Policy learning at the local, regional, national, and international level must be increased. This includes sourcing multiple kinds of data and knowledge to learn what precipitated events and what went wrong, in order to develop better mechanisms to address future risks.

F. 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 global and regional cooperation and solutions, in addition to well-thought-through national and local responses.

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.

This project provides a template for policy-makers and experts to consider 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 course of the pandemic, and its consequences that extend well beyond the health regime, will depend on policy decisions taken today. Such decisions will shorten or prolong the course of the pandemic and mitigate or aggravate its impacts.

Therefore, Part 2 of the report makes recommendations across several action areas to help mitigate future risks, with the goal of moving towards a Collaboration Plus scenario. 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 (see Table 1).

Table 1: Policy recommendations to mitigate the long-term impacts of COVID-19 and prepare for future crises

POLICY/ACTION AREA	MAIN RECOMMENDATION	ACTIONS
Global equity	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 3. Adapt the crisis management approach as the situation changes 4. 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 and resilience building	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 a UN Science Advisory Board

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 the 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 in events, focusing on developing understanding and 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

Part 1:

INTERACTIONS AND SCENARIOS

1 INTRODUCTION

1.1 The complexity of COVID-19

1. This report has the primary purpose of informing policy-makers and the public about the choices that can be made now to influence COVID-19's wide-ranging, long-term impacts on all communities from local to global. Its conception of COVID-19 goes well beyond an infectious disease pandemic that affects the health sector, to a much broader approach including a full range of societal measures, including the wellbeing of populations, the economy and levels of inequality.

2. The pandemic is transforming established institutions, societal relationships, and individual and collective attitudes, making COVID-19 a systemic event with complex outcomes rather than just an epidemiological or infectious disease problem.

3. Alongside growing inequality, countries all over the world have already suffered severe disruptions to their economies, and to their education, care, and health systems during the pandemic. People have lost jobs and income, children and students have missed classes, food supply chains have been impeded and wellbeing and mental health have been affected by social isolation. There have been geostrategic consequences.

4. COVID caused over 6 million deaths thus far (according to Our World in Data, May 2022) and some estimate the real number is as much as four times the official figure (*The Economist*, n.d.). In addition, 8.8% of working hours were lost during the same year, equivalent to 255 million full-time jobs (International Labour Organization (ILO), 2021b). Some 118 million more people faced hunger in 2020 than in 2019, with estimates ranging up to 161 million (FAO et al., 2021). Reflecting global inequalities, by 2020, over one in five people in Africa faced hunger, more than double the proportion in any other continent (World Vision, 2021).

5. Many of the impacts from COVID-19 will continue well into the future, especially in lower- and middle-income countries (LMICs) that have been unable to invest in adequate recovery policies. But governments have often not recognized the critical results that their short-term decisions can have on these long-term outcomes.

6. Given the complexity and wide-ranging nature of COVID's impact, with multiple diverse drivers, uncertainties and cascading effects, a perspective that encompasses all these potential consequences must be taken to begin to comprehend the future impact of the pandemic.

1.2 A framework for analysis

7. Considering the complexity of gauging all the long-term societal impacts of COVID, a conceptual framework was devised to help visualize the potential outcomes and aid policy-makers in plotting a path to recovery (see Figure 1).

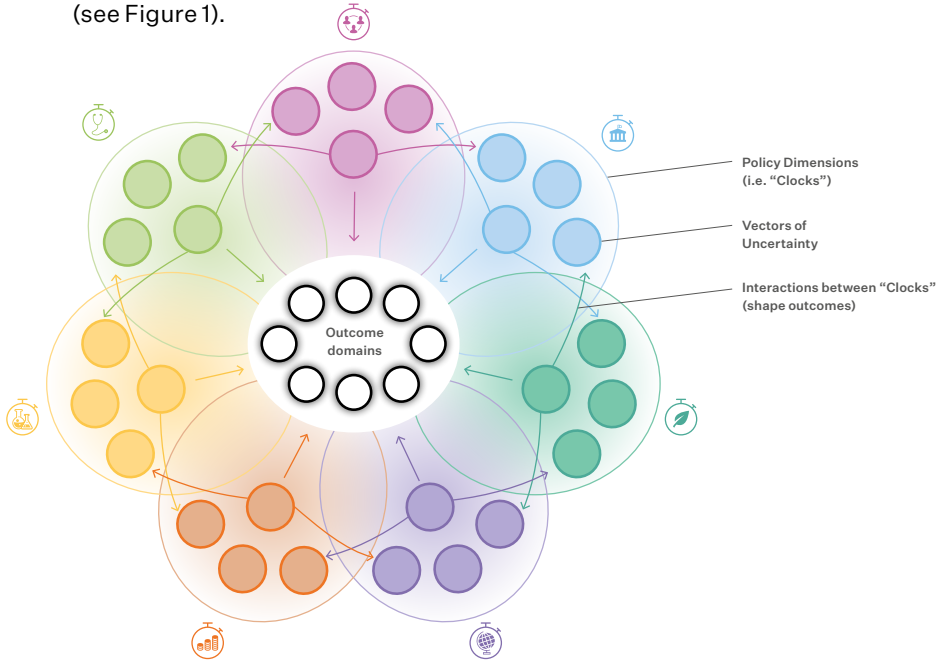


Figure 1 Framework for analysis

8. To form this framework, eight principal *outcome domains* were first identified. These *outcome domains* describe the broad range of impacts of the pandemic on society. The domains are the current state of COVID-19; wider health issues; impacts on social wellbeing; impacts on inequality; societal stability; the economy; sustainability; and future global threats (see Table 2).

Table 2 Principal outcome domains

PRINCIPAL OUTCOME DOMAIN	DEFINITION
State of COVID-19 health	This outcome explores the evolution of the virus, vaccines and therapies, the number of COVID-19 cases, the levels of hospitalization, morbidity rates (long COVID) and mortality rates because of COVID-19 across the world, including differences by income level or region.
State of population health (non-COVID)	Considers the pandemic's impact on other aspects of health, such as healthcare utilization, public health indicators, the mental health burden, immunization programmes, critical care capacity and life expectancy.
Level of social wellbeing	Looks at impacts on the standard of living across the globe in a cumulative reflection of subjective wellbeing. This includes levels of employment and poverty, disruption to education and educational attainment levels, and citizen safety (including violence and discrimination).
Levels of equality/ inequality	Considers the impact of the pandemic on in-country and global inequalities. This encompasses inequalities in health, gender, age, digital access, economic status, considering ethnicity and nationality, and areas of social services and care.
Institutions of governance and societal stability	Considers the impact on political stability across the world, levels of social resilience during and after the pandemic, social cohesion, the ability of citizens to participate in society, and the rise of disinformation and misinformation. This includes the rise of populism, authoritarian regimes and polarization of politics. The ability of the multilateral system, of governments and of society to respond to scientific advice is also considered as COVID-19 has put multilateral and government decisions under intense scrutiny and has changed the methods and speed with which data and information are shared.
The economy	Considers the state of the global economy and, in particular, inclusive economic growth at both the macro and micro level.
Sustainability agenda	Considers the progression of the United Nations Sustainable Development Goals during and after the pandemic.
Impact on future existential threats	Considers the state of the multilateral system and the global ability to deal with future threats as much of the world focuses on managing the pandemic or recovery mechanisms.

9. In turn, the direction and size of these outcomes is influenced by *dimensions of societal, national and global policies (abbreviated to 'policy dimensions').* Here, we use the term 'policy' to describe a collection of actions and values, as well as the framing of events and current societal circumstances.

10. Seven primary policy dimensions were thus identified through interviews with experts, including categories such as national and global governance, environment, economics, and science and technology. These dimensions interact to feed into the principal outcomes, as shown in the diagram of the general framework set out in Figure 2.

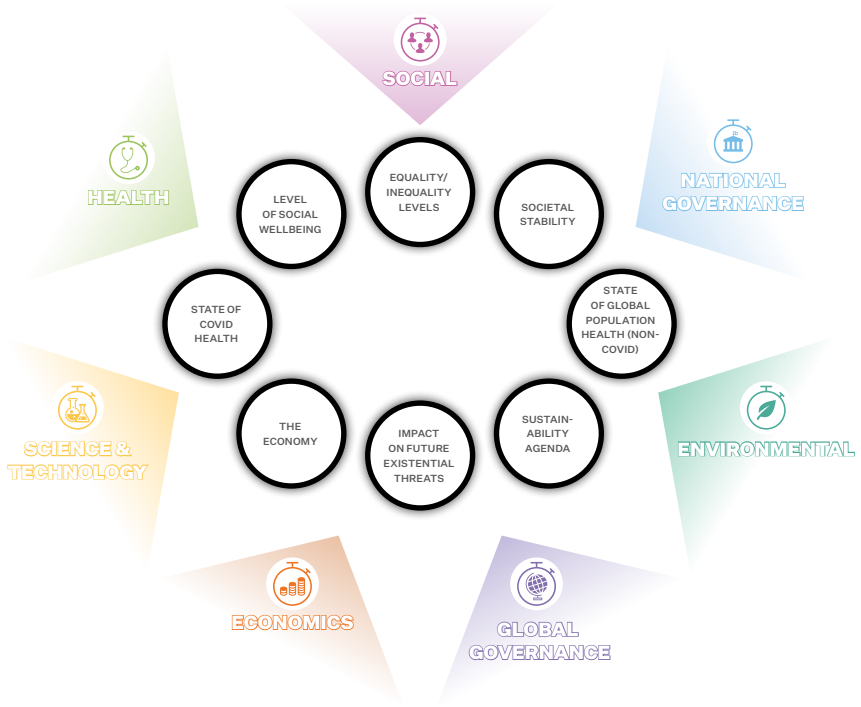


Figure 2 Policy dimensions and outcomes

11. Within each of these seven *policy dimensions* are a multitude of interacting drivers that influence outcomes. As these drivers result in unknown future outcomes, they are termed *vectors of uncertainty.* These are uncertain because of the way that they interact, the unknowability of external events, and variations in the development and implementation of policy.

12. Crucially, each vector of uncertainty will have associated risks which shape it and in turn trigger other vectors. The policy challenge is to monitor and anticipate such risks.

13. It should be noted that not all vectors are equally uncertain. There are some that are more probable or known in isolation, but the way they interact with other vectors makes the resulting outcomes uncertain.

14. A full list of the vectors identified by the experts can be seen in Appendix I.

15. Within the *policy dimension* of 'Economics', for instance, there are vectors such as the extent of disruption to global trade, the level of inflation and the level of access of lower- and middle-income countries to global capital markets. In the 'Environmental' dimension there are cascading risks of disasters and environmental degradation.

16. The project is intended to provide a template for policy-makers and experts to consider local decisions in a more global context and beyond the health domain. It highlights the types of decisions that might lead to more equitable outcomes and greater socio-economic resilience, while revealing the complex interactions between these decisions.

1.3 The problem with current priorities

17. This type of framework, which takes a systems approach, can help to guide decisions relating to COVID-19 as it provides a clearer view of potential consequences over the long term (five years and beyond).

18. Policy-makers often have a very short-term perspective when responding to the immediate crisis and may be unaware of the impact of their decisions on other domains. They have also focused predominantly on national solutions, even though a global crisis requires global cooperation and solutions.

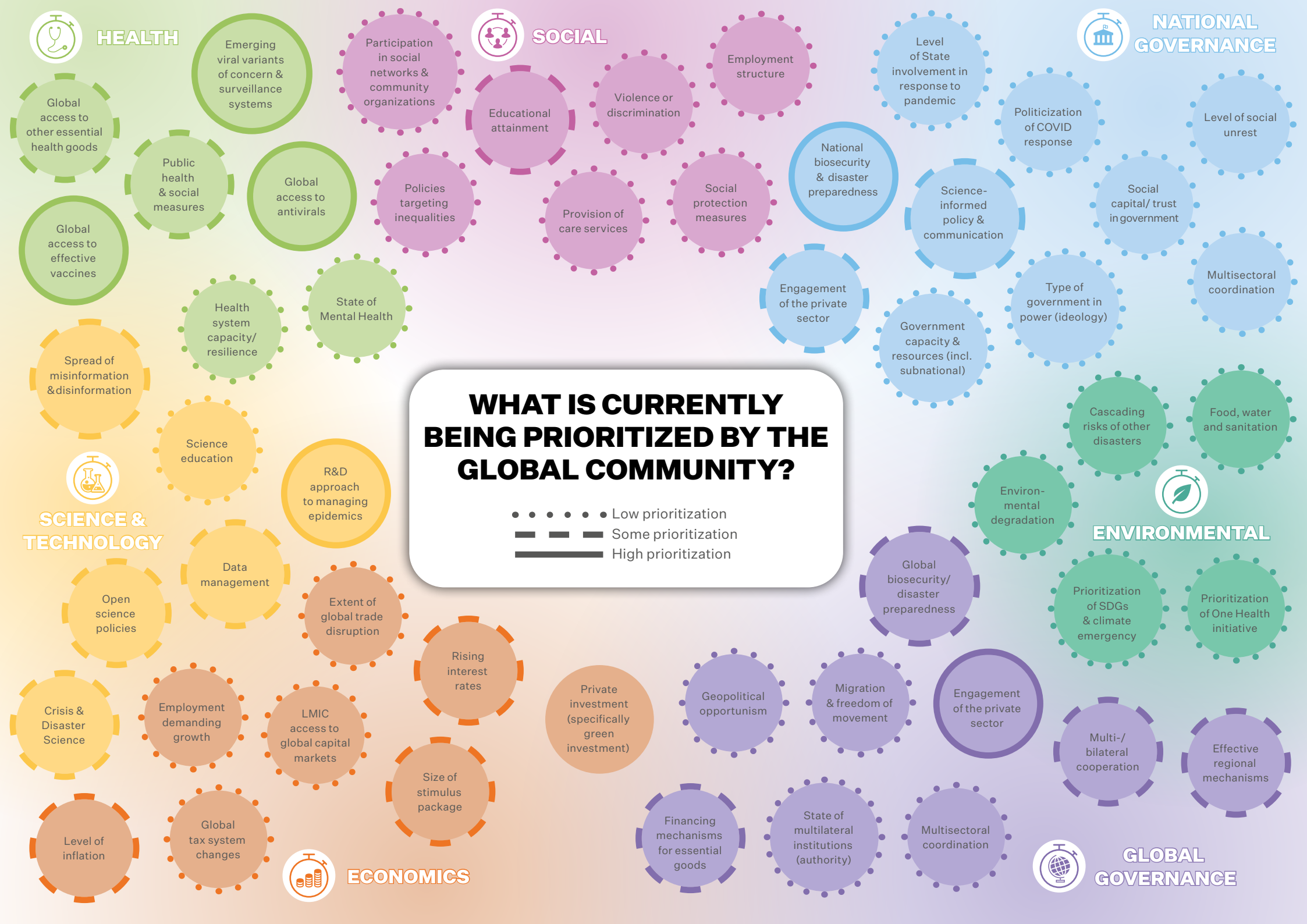
19. One key motivating factor for starting this project in March 2021 was the perception at that time that many policy-makers viewed the arrival of effective vaccines as signalling the end of the pandemic, with the possibility for the world to rapidly return to business-as-usual. This perspective has been shown to be incorrect as the Delta and then Omicron variants emerged. But even beyond the virus, vaccines and therapies, such belief in a quick return to a pre-COVID existence is misguided and will likely result in suboptimal policy approaches. A vision of the future that looks like that prior to the pandemic is liable to lead to decisions that overlook cascading and longer-term impacts on multiple policy domains and broad and long-lasting effects on society.

20. Our concern is therefore that many of the *vectors of uncertainty* that will have the greatest impact on societies and outcomes over time are not being prioritized sufficiently today either by governments or the global community.

21. Those that are being prioritized by governments, the private sector and multilateral actors include vaccine and antiviral supply and access, biosecurity preparedness and response planning, along with the surveillance of emerging viral variants of concern. These measures are essential but insufficient, and even these responses remain uneven across the world. Others, such as monetary stimulus packages to boost economic growth, policies to recover educational losses or to address long-term social or mental health consequences, are almost solely restricted, and then unevenly so, to advanced economies (see Figure 3). The multilateral system itself remains ill-equipped to deal with such crises.

22. Of particular concern is the limited focus on policies to improve fundamental government services such as health system capacity, the provision of care for vulnerable populations, the state of education systems and access to mental health services. Further critical factors include the spread of misinformation and its impact on societal decision-making, poor access to capital markets for low- and middle-income nations, and stalled progress on the UN Sustainable Development Goals.

Figure 3 Current priorities of the global community (see next page)


WHAT IS CURRENTLY BEING PRIORITIZED BY THE GLOBAL COMMUNITY?
Low prioritization
Some prioritization
High prioritization
HEALTH
Emerging viral variants of concern & surveillance systems
Global access to other essential health goods
Public health & social measures
Global access to antivirals
Global access to effective vaccines
Health system capacity/ resilience
State of Mental Health
SOCIAL
Participation in social networks & community organizations
Educational attainment
Violence or discrimination
Employment structure
Policies targeting inequalities
Provision of care services
Social protection measures
NATIONAL GOVERNANCE
Level of State involvement in response to pandemic
Politicization of COVID response
Level of social unrest
National biosecurity & disaster preparedness
Science-informed policy & communication
Social capital/ trust in government
Engagement of the private sector
Government capacity & resources (incl. subnational)
Type of government in power (ideology)
Multisectoral coordination
Spread of misinformation &disinformation
Science education
R&D approach to managing epidemics
SCIENCE & TECHNOLOGY
Open science policies
Data management
Extent of global trade disruption
Rising interest rates
Crisis & Disaster Science
Employment demanding growth
LMIC access to global capital markets
Size of stimulus package
Level of inflation
Global tax system changes
ECONOMICS
Private investment (specifically green investment)
Cascading risks of other disasters
Food, water and sanitation
Environ-mental degradation
ENVIRONMENTAL
Global biosecurity/ disaster preparedness
Prioritization of SDGs & climate emergency
Prioritization of One Health initiative
Geopolitical opportunism
Migration & freedom of movement
Engagement of the private sector
Multi-/ bilateral cooperation
Effective regional mechanisms
Financing mechanisms for essential goods
State of multilateral institutions (authority)
Multisectoral coordination
GLOBAL GOVERNANCE

23. The future course of the pandemic, and its consequences well beyond the immediate health regime, will depend on policy decisions taken today. It is crucial that we examine these decisions because they will shorten or prolong the course of the pandemic and mitigate or aggravate its negative impacts.

1.4 Science as a public good and COVID-19

24. This report is published by the International Science Council (ISC), the only international non-governmental organization bringing together the natural and social sciences, and the largest global science organization of its type.

25. Through its membership, the ISC unites more than 200 international scientific unions and associations, as well as national and regional scientific organizations such as academies and research councils.[2] It convenes the scientific expertise and resources required to lead on developing and coordinating impactful actions of major scientific and public importance.

26. With its wide reach, coverage, and vision of advancing science as a global public good, the ISC is in a unique position to represent science worldwide and bring these disciplines into play in assessing likely future scenarios and appropriate responses to the COVID-19 pandemic.

27. This study accordingly distils the wisdom of scientists and experts in a wide range of disciplines. It is primarily targeted at key decision-makers in the multilateral system and in national and subnational governments, civil society groups, the private sector and the global scientific community.

28. The ISC's interdisciplinary and global membership allows it to provide two critical perspectives on the COVID-19 pandemic: a) assessing the pandemic's impact from both a social science and a natural science perspective; and b) providing a global view on the pandemic that gives it insight into the interplay of contextual realities and the science of viral transmission.

29. These factors make the ISC well-placed to examine the potential long-term outcomes of the COVID-19 pandemic on a global scale. This report is particularly concerned with the broad and potentially long-term impacts that the pandemic has had and will continue to have on every aspect of social, political and economic life.

2 METHODOLOGY AND APPROACH

2.1 Methodological overview

30. In November 2020, the ISC established an advisory group of epidemiologists and infectious disease experts, along with members of the ISC Governing Board. The advisory group was brought together to consider what was missing from the global response to the COVID-19 pandemic, and how a global scientific organization like the ISC, in conjunction with key UN partners such as the United Nations Office for Disaster Risk Reduction (UNDRR) and the World Health Organization (WHO), might convene the international science community to aid policy-makers by addressing critical knowledge gaps.

31. As a result, with support from the UNDRR and the WHO as observers, in March 2021 the ISC appointed a high-level oversight panel of 20 geographically diverse experts in public health, virology, economics, behavioural science, ethics, sociology and other areas (see Appendix II). The work was undertaken by a project team supported by technical experts (see Appendix II).

32. The role of the oversight panel was to deliberate on progress reports and make recommendations throughout the project. The group considered the policy implications of this analysis. Crucially they also reflected on the wider expert elicitation to propose actions that would help realize a more optimistic set of outcomes over the five-year horizon.

33. The project began by outlining the drivers and possible outcomes of the pandemic over the next five years. To do this, the ISC first engaged with experts through structured interviews to identify the factors (vectors of uncertainty) that could influence and be influenced by the pandemic. The substance of the report reflects the synthesis of the experts' qualitative opinions and knowledge, rather than quantitative data on each of the variables mentioned or quantitative measurements of their interactions.

34. The team consulted 167 experts from more than 30 countries at different levels of economic development across a plurality of disciplines including public health, virology, immunology, finance and economics, and individuals working in government, the multilateral system and the private sector. The process was designed to have diverse inputs to ensure that different contexts and issues pertinent to all parts of the world were covered.

35. The interview data informed the iterative development of a multi-layered, qualitative systems map showing linkages between vectors of uncertainty, policy dimensions and long-term outcome domains from the pandemic.

36. In conjunction with a further set of 63 expert interviews, an online survey of 30 ISC members and 6 moderated regional workshops attended by 76 participants, the systems map was used to determine likely, more optimistic, and more pessimistic five-year scenarios.

37. For Part 2, a further 17 international policy experts participated in semi-structured interviews or responded to a questionnaire to identify key lessons and implications across each policy domain. This was followed by an integrating expert workshop to develop a set of recommendations that would have the most positive impact on ending this pandemic and increasing resilience to future crises.

2.2 Key assumptions

38. Two key assumptions were made in putting together the report and determining the long-term outcomes of the pandemic.

39. A first assumption was that COVID-19 will continue to evolve with new variants of concern, while vaccines and antiviral therapeutics are further developed. Over time COVID-19 would therefore shift to being an endemic disease – whether on the scale of seasonal surges that overwhelm health

systems in multiple countries, less severe seasonal spikes, or low and controlled transmission in most countries.

40. A second assumption was that the current different national approaches to the economy and governance will persist for the foreseeable future. This shapes the report's understanding of the intentions behind policy formulation and, particularly, economic choices that have been or will be made.

2.3 Systems approach

41. In carrying out the study, the team adopted a systems approach. This is an approach based on the idea that the constituents of a system are interrelated and interdependent. It acknowledges that the system is open and not bounded or closed. In the case of this study, there are interlinkages between the multiple different *vectors of uncertainty* and *policy dimensions*, ultimately resulting in the long-term pandemic outcomes. Further, there is always the possibility of external factors influencing the systems beyond those considered – for example a major natural disaster or major conflict, or the emergence of another pandemic agent.

42. This approach resulted in the creation of a multi-layered, qualitative systems map to display these complex interconnections and facilitate systemic thinking. Such a systems map shows the interlinkages between the different parts of the system such that decision-makers can see how decisions taken in one dimension will have impacts on other policy dimensions or outcomes.

43. The framework (and particularly the conceptualization of 'clocks') was developed using the *Ako Map* system developed by Cognitive Performance Labs.[3] The map can be adjusted to illustrate different factors and relationships in real time.

44. Essentially, the systems map displays the main links and interactions between the critical vectors in each of the dimensions of social policy, supporting decision-makers to assess how decisions taken in one area will have impacts on others and the various outcomes as the pandemic evolves.

3 SCENARIOS

3.1 Approach to scenario building

45. By mapping out and considering the interacting *vectors of uncertainty*, the *policy dimensions* they feed into and the resulting *outcome domains*, three global COVID-19 futures have been outlined for the year 2027.[4]

46. Each of these scenarios considers the impacts in the various outcome domains, specifically, the state of the COVID-19 pandemic, global population health, the level of social wellbeing, societal stability, the state of the global economy, inequality levels, impact on the sustainability agenda, and the impact on future existential threats.

47. These scenarios have been named: a) the *Continuity* scenario, referring to the five-year scenario that the research team considered arguably the most likely based on current trends; b) the *Missing Recovery* scenario, considered a plausible but more pessimistic scenario; and c) the *Collaboration Plus* scenario, considered a plausible but more optimistic scenario based on higher levels of global and regional collaboration (see Figure 4).

48. There is, of course, a vast array of future scenarios, but the report focuses on three of the most probable. Summarised in Table 3.

49. This approach is aimed at reducing the number of configurations that need to be considered and making the analysis as expedient as possible for policy-makers, helping them to identify key trade-offs and significant catalysing actions.

50. These scenarios can then be used to design tools and policy actions to better manage the long-term results of the pandemic.

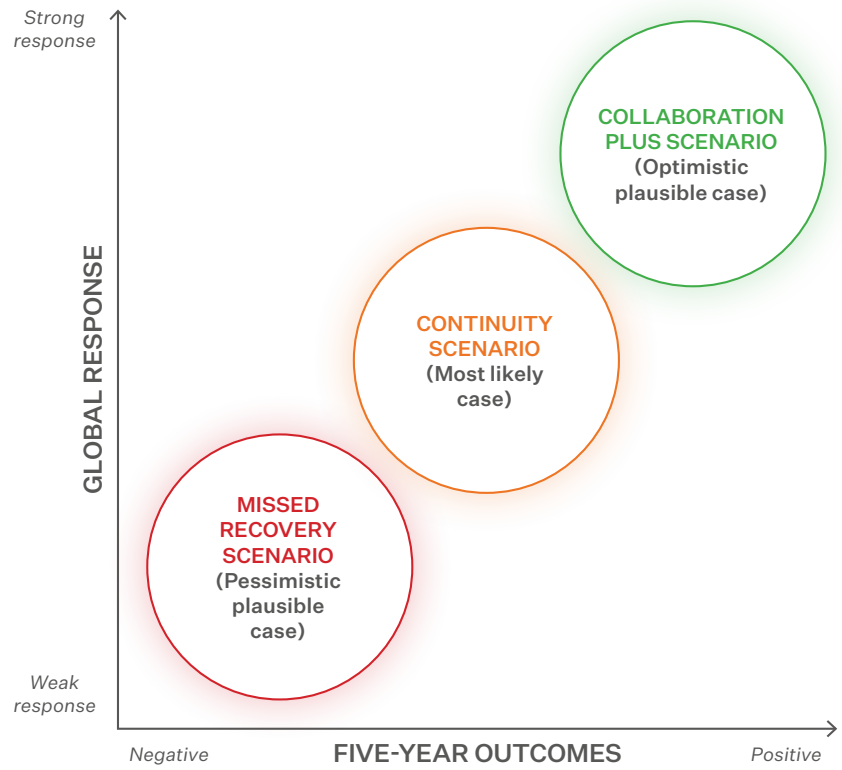


Figure 4 Plotting COVID-19 scenarios

3.1.1 Continuity scenario

51. *Continuity* refers to the most likely future scenario based on current trends.

52. It describes a world in which global and regional collaboration has led by 2027 to the supply of effective vaccines (against whatever variants are circulating at that time) to the majority of the world's population.

53. In this scenario, the unvaccinated population is primarily in LMICs, although vaccine-hesitant groups globally remain a significant factor in ongoing viral transmission.

54. The threat of new variants remains a key *vector of uncertainty* for future disease burden. Under this scenario, new variants are more transmissible, but may also cause less severe disease.

55. Additional manufacturing capacity enables the supply of effective vaccines and boosters and antiviral therapeutics in most countries, but access remains uneven.

56. Some public health and social measures have been maintained in countries that still see COVID-19 surges. As a result of greater awareness of the importance of robust social and health systems, some recovery mechanisms have been implemented and there is some investment, but these are sporadic and uneven within and between countries.

57. As a result, COVID-19 is an endemic disease across the world, with seasonal surges.

58. Health systems continue to be stretched and risk collapse in many low- and middle-income countries. High-income countries with high vaccine uptake levels and access to antiviral therapeutics do not experience further major waves of COVID-19.

59. In many countries, disruption to routine healthcare provision and immunization has continued to exacerbate the non-COVID-19 disease burden and the health system has insufficient capacity to cope with winter surges.

60. Short-term remediation mechanisms with limited effectiveness and inadequate investment have affected social wellbeing; the most prominent impacts are on social care and education. One estimate is that the educational impact will be felt until the end of the century, potentially resulting in as much as $17 trillion in reduced earnings over the lifetime of an entire generation of students (World Bank, 2021c).

61. The increasing mental health burden has been inadequately recognized as health systems are stretched and health investment remains focused on COVID-19. A recent study covering 204 countries estimated that the COVID-19 pandemic has resulted in an additional 53.2 million cases of major depressive disorder and an additional 76.2 million cases of anxiety disorder globally (Azevedo et al., 2020).

62. Furthermore, under this scenario, societal distrust and polarization have increased in some countries where there is uncontrolled COVID and disinformation is rife, weakening compliance with public health measures and disrupting relationships between governments and citizens. Trust in science is compromised in sectors of the population and there is an associated rise in populism and authoritarian political movements.

63. Yet in other countries, enhanced transparency, science-informed policy and communication has improved trust in government. Increased collaboration with scientists in certain countries has also enhanced public understanding and appreciation of science. The use of science advice in these countries is strengthened.

64. Global economic growth is significant, and primarily fuelled by the large monetary and fiscal packages of the industrialized countries such as the US and China and those in the European Union. These countries have good access to vaccines, and the pandemic accordingly causes them only limited economic disruption.

65. Conversely, growth is much more subdued in LMICs, though highly variable between countries. Many LMICs have yet to achieve pre-COVID income levels. Many countries were already performing poorly before the pandemic, when the pandemic caused severe loss of output and employment. As these countries have more limited access to effective vaccines, the pandemic continues to constrain economic growth.

66. The pandemic (and now the Ukraine crisis) has also caused disruption in the food supply chain, and the lack of resources in LMICs makes it difficult for them to limit the impact and the effects on food prices. Inequalities in economic and social wellbeing are not adequately rectified and continue to grow in many countries and regions.

67. The multilateral system remains slow in addressing the defects illustrated and highlighted by the pandemic and its consequences. Only minor changes are made to the WHO's structure and to the International Health Regulations (IHR).

68. The international community is poorly focused on other issues including addressing the sustainability agenda and effectively confronting geostrategic challenges.

3.1.2 Missed Recovery scenario

69. The *Missed Recovery* refers to a future scenario up to 2027 that is plausible but more pessimistic.

70. It depicts a world with declining societal conditions and increasing inequalities, arising from profoundly escalating geopolitical tensions, protectionist policies, and poor global and regional collaboration in response to the pandemic.

71. In this scenario, less than 70% of the global population has been effectively vaccinated against COVID-19. Access to and uptake of even initial vaccine doses remains problematic in some LMICs.

72. The use of effective COVID-19 boosters and antiviral agents has been authorized in most countries in response to waning immunity and poor immune response in vulnerable groups, and among those with high exposure to new variants of the virus.

73. Restrictive public health and social measures such as work-from-home policies and regional lockdowns are still required in some countries or have needed to be reintroduced.

74. Most LMICs have poor access to vaccines and antiviral therapeutics due to shortfalls in supply, a lack of manufacturing capacity and an insufficient effort to strengthen the COVAX initiative aimed at equitable distribution of COVID-19 vaccines.

75. Science denialism and mistrust in science are badly hindering the capacity of governments to implement vaccination.

76. COVID-19 recovery mechanisms and investment in social care and health systems have also been limited. Poorly resourced health systems are financially unable to prepare for future surges and emergencies, and continue to depend on external funding for basic care. However, international aid has been cut by donor countries as they invest in their own recovery.

77. High levels of harm to social wellbeing have been caused by repeated use of stringent public health and social measures, inadequate prioritization of remediation mechanisms to address care, health and education deficits resulting from the pandemic, unemployment and social unrest. In some countries populist and authoritarian governments have further restricted social liberties and welfare.

78. The will or capacity to raise levels of education, care and mental health to pre-COVID-19 levels has been lacking, with countries still working to mitigate the negative social and economic effects of the crisis.

79. A strict and narrow focus on economic recovery to alleviate the public debt caused by COVID-19 has undermined the investment needed to recover care and education. This has been even more the case for countries with restricted fiscal space that have also received little or no international aid or development assistance.

80. Multilateralism is increasingly replaced by nationalism, with trade wars and technology wars becoming more intense. Disruptions to global trade and investment flows further depress global growth.

81. There has been no reform of the WHO and defects in the IHR have not been addressed.

82. A lack of resources leaves governments financially incapable of preparing for future pandemics or other crises.

83. Humanity is not on track to achieve net zero emissions by 2050 and has not transitioned to more sustainable agricultural practices. In LMICs, food insecurity is increased by a series of negative factors that affect food systems. In parts of Africa, for example, unemployment or increasing terrorism lead to border closures, further disrupting food systems.

84. Combinations of negative impacts (climate change, education loss, unemployment, terrorism, political instability, loss of social cohesion) lead to famine and conflict in some parts of the world.

3.1.3 Collaboration Plus scenario

85. The *Collaboration Plus* refers to a future scenario that is plausible but more optimistic.

86. It depicts a world in which, by 2027, COVID-19 has become a more manageable disease and is no longer such an acute priority, due to high levels of global and regional collaboration.

87. In this scenario, the COVID-19 crisis has been seized as an opportunity to start bringing in long-term system changes at subnational, national and multinational levels that increase the level of wellbeing and resilience of societies.

88. The pandemic has highlighted the importance of collectively addressing the interconnected issues of hunger, malnutrition, climate change and environmental degradation.

89. An overwhelming majority of the world's population have received effective COVID-19 vaccine courses, and vaccines are updated as necessary to respond to new variants. Boosters are readily available due to improved manufacturing and distribution capacity. Equitable distribution of vaccines and antiviral agents reduces global inequality.

90. The ACT-A programme, an vaccine accelerator initiative of the Global Fund, and the COVAX mechanism have brought together governments and key international philanthropic organizations, as well as the private sector, to supply effective and updated COVID-19 vaccines.

91. The WHO and other components of the multilateral system have been reformed and the IHR significantly updated.

92. The COVID-related disease experiences of high-income countries (HICs) and LMICs become more similar, narrowing global inequality. In many countries, the disease does not become endemic, or is endemic only at low levels, with much-reduced morbidity.

93. Where variants of concern do emerge, they do not spread widely due to increased genomic surveillance, vaccine updates and public health responses. Life expectancy and fertility rebound quickly, and health systems are not at risk of collapse.

94. Public health and social measures to control the virus are no longer restrictive.

95. Routine healthcare exceeds pre-pandemic performance, global declines in health-related progress are reversed and improvements are observed. Health systems receive sufficient investment and action to achieve global health security.

96. In most countries, schools have not been subject to further disruption and have reopened safely, for example with appropriate ventilation systems. Alternative schooling systems such as decentralized tutoring have been deployed in settings with a high risk of COVID-19 infection.

97. While attempts to obtain patent waivers for COVID-19 products have not been a success, all major pharmaceutical companies have agreed not to contest intellectual property infringements for COVID-19 products and to support technological capacities. Laws and licensing concerning vaccine production are regularly reframed to facilitate production and distribution.

98. Countries with greater state capacity and control over economic policies, such as China, other countries in East Asia and some in Latin America, have learned the lessons of the COVID-19 pandemic. They have started reforming care systems, strengthening social protection measures and welfare systems, and making sure that those most affected by the crisis are included.

99. More equal access to housing, education, social assistance and mental health services has improved social wellbeing across the world. Measures have been introduced to support families whose livelihoods, safety and health have been disrupted during the pandemic and this is buttressed by specific policies to redress gender inequalities in all areas of social life.

100. Economic growth, along with redistribution and inequality-reducing policies and new labour standards have started to significantly reduce poverty.

101. Governments' efforts to address the inequities exacerbated by the pandemic have started to show signs of improved social cohesion, although differences remain across countries around the world. This change will increase their preparedness to face future environmental, social and political threats.

102. Better protection of vulnerable communities and improved social protection and care have resulted in a reduced risk of uncontrollable COVID-19 spread.

103. Following the shock of COVID-19, substantial investments have been made in green recovery and building up social care and health systems.

104. Health systems in many LMICs are still overburdened when surges of COVID-19 do occur, especially when they coincide with other crises such as weather disruptions or outbreaks of another infectious disease. However, risk-prediction algorithms are being developed to model health outcomes for populations, allowing for more tailored public health interventions and to improve the efficiency of deployment for essential health resources.

105. Science advisory mechanisms have been reviewed and enhanced in many countries and within the multilateral system. The weakening of the pandemic has allowed multilateral actors to reprioritize the UN SDGs. Increased investment has accelerated economic and social progress.

106. Collaborations between national and local governments, together with civil society including community organizations, NGOs (non-governmental organizations), business networks, philanthropists and other networks, enhance societal trust and cohesion.

107. The multilateral system is taking lessons from the pandemic. A new pandemic alerting, reporting and management system has been agreed. There is increased confidence in global cooperation against biological risks arising either from nature or through anthropogenic origin. Science advisory mechanisms for the UN central agencies have been strengthened.

Table 3 Scenarios and their outcome domains

PRINCIPAL OUTCOME DOMAIN	***CONTINUITY* SCENARIO**	***MISSING RECOVERY* SCENARIO**	***COLLABORATION PLUS* SCENARIO**
State of COVID-19 health	Disease is endemic with spikes in cases (seasonal).	High impact across the globe, with seasonal surges overwhelming health systems in multiple countries.	Low endemic transmission of virus. Prevalence is low and controlled in the majority of countries (LMICs and HICs).
	~ 70–80% adult global vaccine coverage in 5 years.	< 70% adult global vaccine coverage.	> 80% adult global vaccine coverage.
	Some vaccine escape occurs as variants emerge but is addressed through new vaccines and antiviral therapeutics.	Multiple variants have evaded natural and vaccine immunity.	Vaccines and antivirals control emergent variants. There is minimal population resistance to updated vaccinations
	Booster mandates in HICs and some middle-income countries are common and near universal for vulnerable populations and healthcare workers. Public health measures can be relaxed but at times need to be reimposed.	Booster mandates have limited success and adherence to public health and social measures has weakened.	. The mix of vaccines and therapeutics obviates fear and health system compromise.
	Multiple antiviral therapeutic options available, but cost is a deterrent to access in many LMICs. High impact remains in low-income countries because of poor access to effective vaccines and emergence of variants of concern.	Vaccine/booster supply in LMICs is limited because of vaccine capture by HICs. Regional manufacturing plants are still being developed.	Cost-effective vaccines and therapeutics are widely available through scientific advances and are supported by global financing mechanisms.
	Impacts fall disproportionately on vulnerable populations, essential and informal sector workers, and migrants.	Impacts fall disproportionately on vulnerable populations, essential and informal sector workers, and migrants.	Other innovative technologies such as universal coronavirus vaccines are launched, but access is still limited.

PRINCIPAL OUTCOME DOMAIN	*CONTINUITY* SCENARIO	*MISSING RECOVERY* SCENARIO	*COLLABORATION PLUS* SCENARIO
State of population health (non-COVID)	High levels of sustained harm as health and social care systems struggle to recover and investment is inadequate. There is a risk that critical care will be overwhelmed during surges in LMICs in particular.	High levels of sustained harm as health and social care systems fail to recover. Critical care is overwhelmed during surges in HICs and LMICs.	Low levels of non-COVID health harm in HICs due to targeted recovery policies that focus on boosting health systems and health worker recovery, and that take advantage of innovative tools that became widespread during the pandemic (digital health). In LMICs attention returns to non-COVID health needs. Mental health concerns remain.
Level of social well-being	Sustained levels of harm to social wellbeing due to ineffective and short-term remediation mechanisms and inadequate investment. Mental health and education harms are the most prominent. The elderly, women (exposure, burden of care and gender-based violence) and youth are the worst affected groups.	Very high levels of harm to social wellbeing due to repeated use of stringent public health and social measures, inadequate prioritization of remediation mechanisms, unemployment and social unrest. LMICs are most affected. Gender inequalities/violence increases. A lost generation who stopped attending school, with consequent impacts on social skills. Mental health concerns are largely ignored.	Improved remediation policies and targeted investment focus on vulnerable communities, the impact of which will be seen in the longer term. Care is central to social and population health strategies. Efforts to remediate educational losses are emphasized. Systemic approaches are taken to focus on population mental health and subjective wellbeing, but the burden remains high compared to pre-COVID levels.

PRINCIPAL OUTCOME DOMAIN	*CONTINUITY* SCENARIO	*MISSING RECOVERY* SCENARIO	*COLLABORATION PLUS* SCENARIO
Economy and economic growth	Growth is sustained in high-income markets and in China, for 3–5 years, fuelled by large monetary and fiscal packages. Longer-term growth is uncertain. Growth is varied but limited in LMICs.	HICs: Stimulus packages combined with pent-up consumer demand have fuelled inflation and rapid rises in interest rates. LMICs: Lower growth rates in the HICs have had knock-on effects in LMICs. Nationalism severely impedes trade.	Stimulus packages enhance productivity and growth in HICs and China. LMICs: Debt write-offs/restructuring allows access to global capital markets, spurring growth. Green growth results in more private investment.
Level of inequality	Major disparities within countries and across the globe. HICs and LMICs are both affected despite some global and national efforts to target vulnerable populations.	Disparities in countries and across the globe have worsened beyond 2021 levels due to repeated surges, worsened economic outlook and inadequate recovery policies and investment.	Some reduction in disparities in countries across the globe.
Societal stability and level of social cohesion	Polarization increased in countries with uncontrolled COVID and where mis/disinformation is rife, weakening compliance to public health measures. Asian and Nordic countries with higher social capital fare better. In many countries centralization of powers has weakened local/subnational governance, e.g. in public health. Levels of corruption have increased, and civil engagement and democratic governance is eroded in some countries, especially in unstable regions.	Same as Continuity scenario, except outcomes are worsened due to inability of government and health systems to cope with future surges. Trust in government is further undermined.	Local government and community leadership strengthened in many parts of the world.

PRINCIPAL OUTCOME DOMAIN	*CONTINUITY* SCENARIO	*MISSING RECOVERY* SCENARIO	*COLLABORATION PLUS* SCENARIO
Impact on sustainability agenda	SDGs are not reset. Progress set back by >10 years.	SDGs are largely not reset and remain set back by a decade .	SDGs are reset with new investment to recover progress lost during the pandemic. Although no outcomes are realized in five years, investment and policy commitments are made. Long-term benefits are likely.
Impact on future existential threats	Countries are aware and act to enhance their biosecurity preparedness (for at least ten years post pandemic), which means that most countries are better equipped to deal with new infectious disease outbreaks. Green recovery measures remain a fraction of COVID spending. Efforts to lessen impact on biodiversity and on water and sanitation are inadequate. Food security remains a major concern in many countries as supply chain disruptions continue and economies struggle in many LMICs.	Weakened health systems and stagnant growth in LMICs have undermined pandemic preparedness responses. Attempts to accelerate economic recovery during/after the pandemic result in some relaxation of environmental and green recovery regulations, impacting progress on SDGs. COVID coupled with other natural emergencies, social unrest and conflicts further impacts supply chains, reducing food security.	With leadership from strengthened multilateral organizations, pandemic preparedness in many countries is enhanced. Countries give greater priority to investment in universal health coverage. Significant funds are allocated to green recovery.

3.2 Managing the future

108. All three illustrative scenarios considered in this report lead to sober reflection. They highlight the need for policy-makers to take a more holistic view of how to manage the pandemic and abandon the idea that things will return to a pre-COVID state in the foreseeable future.

109. Policy interventions will be required over many years and need to be based more broadly than is currently the case in many jurisdictions. While the future interaction between the virus, vaccines and therapies will remain critical, policy choices and actions by individuals, NGOs and the private sector will increasingly influence the pandemic's longer-term impact.

110. It is obvious that nations are not equal in the face of the virus. Their capacity to respond depends on development levels, geography, cultural differences, and political and constitutional settings.

111. Access to vaccines and therapeutics, and the attitude of the population to public health measures, to experts and to the government affect societies' capacity to deal with this and other threats.

112. It goes beyond the purpose of this report to conjecture how the future as illustrated by the scenarios will play out in different contexts, and how the coexistence of very different outcomes in different countries will impact our global response.

113. Nonetheless, the three scenarios presented should, when considered alongside the systems map, allow decision-makers to put their own situation into context, and assist in identifying where key decisions made now will have long-term impacts. By examining how the dimensions of social policy interact, countries and multilateral mechanisms may have more agency in managing and planning for the future.

4 CLOCKS AND COVID-19 FUTURES

4.1 The concept of clocks

114. There are many uncertainties that will influence the longer-term outcomes of the pandemic. Exploring the range of possible futures in more detail beyond the simplistic scenarios illustrated above required consideration of known and probable factors, as well as an assessment of the more uncertain components.

115. It was also apparent that the interacting *vectors of uncertainty* within the different dimensions of social policy would each evolve on its own timescale and their impact would manifest at different speeds. This insight led to the decision to frame these *policy dimensions* and the vectors of uncertainty that influence them as interconnected 'clocks', emphasizing the further complexity that the element of time adds to the policy dimensions. And as with time zones, countries or regions might be in different phases of the 'clock' at the same time.

116. A clock therefore describes a *policy dimension* and, crucially, the timeframe at which the outcomes of interest manifest. The concept of a systems map based on interconnected clocks is a heuristic tool that can help policy-makers or other users assess how decisions made in any one area may affect other areas.

117. This report examines each of the clocks and the interactions between them that collectively make up the system, along with the various implications of the scenarios.

118. The seven clocks are presented in no particular order of importance, consequence or timescale.

4.2 The seven clocks

4.2.1 Health clock

119. The *health clock* considers policy decisions and actions (*policy dimensions*) that have a direct impact on the state of COVID-19 and health system capacity.

120. In a limited way, it also considers wider population health, such as surveillance of viral variants, clinical management and health services, and the use of public health and social measures.

121. These are typically factors considered in preparedness and response plans for international or national infectious disease outbreaks, such as the WHO's Pandemic Influenza Preparedness Framework (WHO, 2011) or the more recently updated Checklist for pandemic influenza risk and impact management (WHO, 2018).

122. A key *vector of uncertainty* in the *health clock* is global access to effective vaccines in the face of continuing viral evolution. Many factors will continue to influence this, including: a) the ability of governments and companies to manufacture and distribute vaccines to all regions of the world, including for remote and difficult-to-access populations; b) the affordability of vaccines and the ability to source them through global financing mechanisms; c) the efficacy of vaccines supplied, including those to tackle new SARS-CoV-2 variants; d) the administration of booster vaccine doses; and e) vaccine hesitancy levels and the role of disinformation.

123. Another key *vector of uncertainty* in this clock is the emergence of viral variants of concern – referring to variants with mutations that increase the transmissibility or virulence of SARS-CoV-2 or reduce vaccine effectiveness. In conjunction with this is the capacity of countries and the global community to monitor for these variants.

124. At the time of writing (April 2022), less than 60% of the world's population have been fully vaccinated against COVID-19; many countries have vaccination rates of less than 10%.[5] Most of the unvaccinated are in LMICs, primarily in the continent of Africa.[6]

125. As well as the inequitable supply of vaccines around the world, access to public goods such as personal protective equipment and basic medical supplies is even more important in LMICs, as they can typically be produced without delays resulting from intellectual property restrictions.

126. Progress has been reported on the development of effective antiviral therapeutics, but it remains to be seen how effective and safe they will be at scale. In turn, production capacity and cost may have enormous impacts on how the pandemic evolves.

127. The declining state of mental health is especially concerning because of the many cascading factors that influence it. The stress of lost work or insecure occupations, burnout experienced by healthcare workers, problems encountered by many parents when working from home while providing childcare and educational support, educational disruption especially for those without digital access, exam postponements in schools, and poor access to services for those with ongoing mental health conditions are just some of the issues leading to heightened feelings of anxiety and depression because of the pandemic.

128. Adding to this, the inadequate focus on mental health support in social welfare, labour and youth policies before the pandemic has resulted in overburdened and inadequate delivery throughout the pandemic.

Key interactions

129. As Figure 5 shows, all the critical *vectors of uncertainty* in the *health clock* are connected and will have an impact on multiple other clocks.

130. Some of the key linkages are with the *social clock*. For example, health system capacity and the use of some public health and social measures will affect the ability of citizens to access basic social services.

131. These *vectors of uncertainty* will also affect the ability of children to go to school or participate in society, thus having a detrimental impact on levels of educational attainment.

132. In addition, *vectors of uncertainty* in the *health clock* will affect participation in social networks and community organizations, as well as the employment structure and provision of care services.

133. This clock will also have an impact on levels of social unrest and social cohesion, and on national biosecurity and disaster preparedness in the *national governance clock*.

134. The state of mental health in a country will have an impact on employment in the *economics clock*.

135. On top of this, *vectors of uncertainty* in the *health clock* will interact with other vectors in the *economics*, *environmental* and *global governance* clocks (see Figure 5 for more connections).

Implications for scenarios

136. The most significant *vector of uncertainty* relating to the *health clock* is global access to essential public health goods including effective vaccines and therapeutics. These are vital public health tools that can be drawn upon to manage the spread of SARS-CoV-2.

137. Of these, global access to effective COVID-19 vaccines is considered the most urgent to defeat the pandemic.

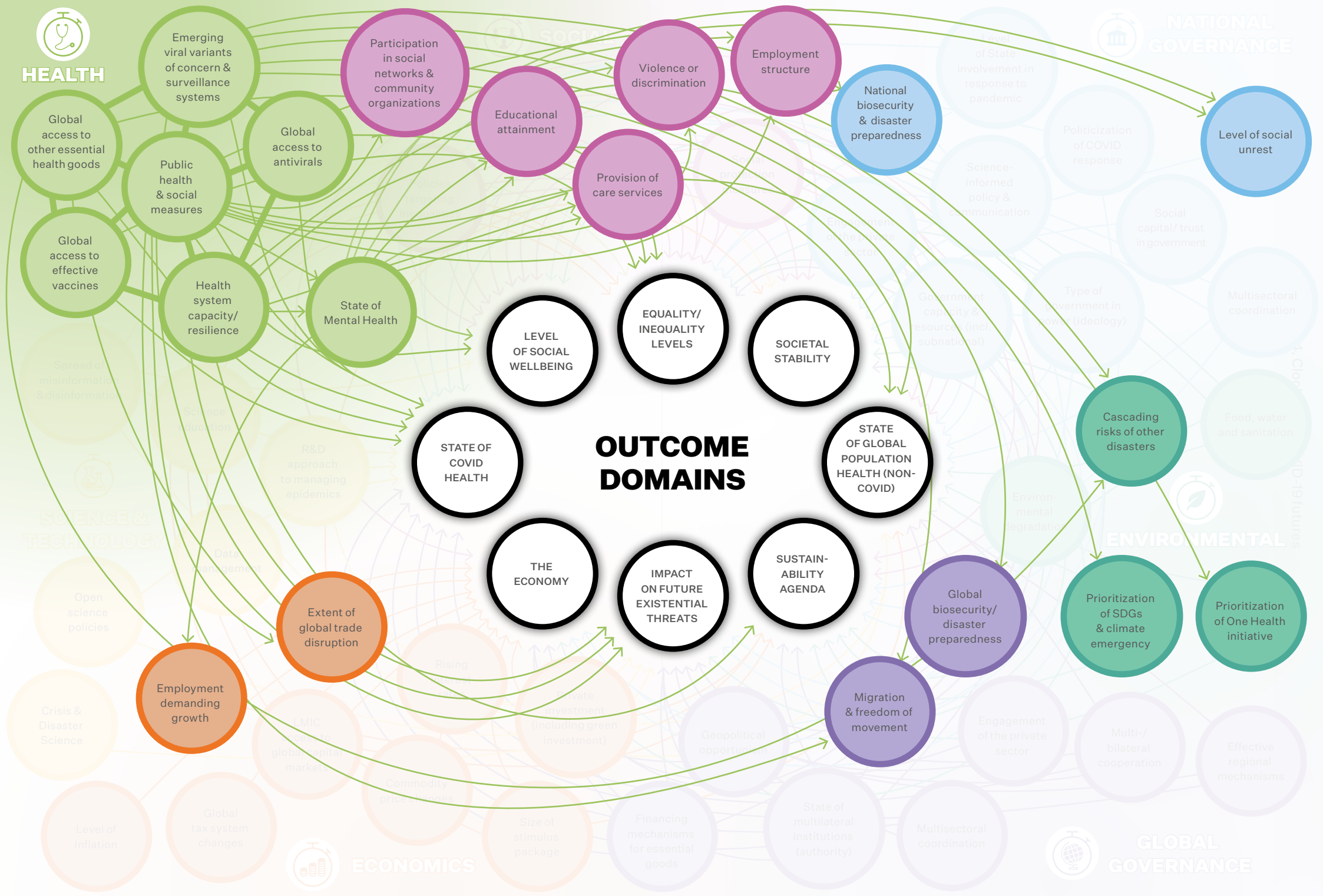


FIGURE 5: THE HEALTH CLOCK: AN OVERVIEW OF THE MOST CRITICAL GLOBAL HEALTH-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

138. The future evolution of the pandemic and which scenario unfolds therefore depend critically upon the ability of countries to achieve high vaccination coverage.

139. The more optimistic *Collaboration Plus* scenario can be aided by strengthening the international COVAX programme aimed at equitable distribution of COVID vaccines, alongside better international cooperation and leadership, as well as coordination between the public and private sectors. Other strategies include the removal of patent protection and faster regulatory approval for updated mRNA vaccines.

140. Making new medicines that can reduce hospitalization and mortality rates more widely available and affordable would lower the burden on health systems.

141. Ongoing genomic surveillance is critical, and LMICs must be assisted to ensure that they have the capacity to perform this. Countries must be encouraged to be fully transparent in sharing such data as soon as it is available.

142. Where new variants are detected, the responses must be proportionate to the risk identified.

143. More inclusive measures will lead to the disease experiences of HICs and LMICs becoming more similar, narrowing global inequality.

144. Most instrumental are targeted recovery policies that focus on boosting health systems and health worker recovery, as well as taking advantage of innovative digital and diagnostic health tools that have seen increased uptake during the pandemic.

145. Global access to personal protective equipment and to diagnostic COVID-19 testing kits and emerging antiviral treatments, which reduce hospitalization and mortality rates, will be critical for better outcomes.

146. A pessimistic scenario will result if countries prematurely declare the end of the pandemic, abandoning many public health and social measures, and reopening society. In this scenario, immune protection would likely wane, allowing reinfection to occur, while therapeutics would have only a limited impact.

147. Largely unvaccinated communities would naturally be most severely affected, with political willingness to reimpose mandates low and taking effect too late, and health systems becoming overwhelmed.

148. Preventing the most vulnerable people from becoming mentally unwell requires aid to regions lacking basic social protections including food security, shelter and basic safety. Otherwise there can be little hope for sustaining good mental health during or after this crisis.

149. The possibility of a pessimistic *Missed Recovery* scenario is increased by the absence of a global movement to support vaccine access, and by rich nations stockpiling raw materials and vaccines while buying more doses to administer as updated boosters.

150. While pharmaceutical manufacturers have suggested that vaccine supply will outstrip demand by mid-2022 (IFPMA, 2021), global vaccine production, distribution and administration rates are severely lagging.

4.2.2 Social clock

151. The *social clock* captures how shifts in sociocultural *vectors of uncertainty* throughout the pandemic will affect general wellbeing, poverty levels and global inequalities in the long term.

152. It primarily looks at population access to goods, services and networks that impact mental and social wellbeing.

153. The extraordinary circumstances during the pandemic have changed many aspects of society as we know it. The decline in social interaction, the increased burden of caregiving and increases in certain types of violence and discrimination, particularly gender-based violence, have taken a toll on mental wellbeing.

154. Around the world, many sociocultural shifts have occurred and may continue due to the implementation of restrictive public health and social measures needed to manage the uncontrolled spread of COVID-19. These include stay-at-home policies and a reduction or pause in key public services, such as the provision of education, mental health services, sexual and reproductive health services, employment and effective social protection measures.

155. Global and national policies targeting reduction of inequalities are considered the most critical *vector of uncertainty* in the *social clock,* because all the vectors in this clock will typically affect vulnerable populations most severely. These inequalities have been exacerbated by pandemic responses and pre-existing conditions.

156. The decline in progress towards gender equality and the empowerment of women and girls (UN SDG 5) is particularly worrying because of the considerable and additive effects that COVID-19 has had on women.

157. These effects include: a) an increased exposure to the virus due to the predominance of women as healthcare workers globally; b) an increased burden of caregiving for family and community members; c) a rise in gender-based violence as a result of some stay-at-home policies; d) worsened maternal mortality outcomes as sexual health and reproductive health services are closed or overburdened; and e) an upsurge in girls entering into child marriages as schools are closed (Azcona, Ginette et al, 2021, p.3).

158. Many other vulnerable groups are also at risk of worsened health and wellbeing outcomes, including children and young adults, ethnic minorities, undocumented migrants, indigenous populations, the elderly and families of lower socio-economic status.

Key interactions

159. The *social clock* intersects closely with the *health clock*. For example, policies targeting inequalities will have an impact on health system capacity and resilience, while the various *vectors of uncertainty* in the *social clock* will have an effect on public health and social measures.

160. Vectors including mental wellbeing, violence and discrimination, the employment structure and social protection measures will affect the level of social unrest in the *national governance clock*.

161. Furthermore, vectors in the *social clock* will have an impact on food, water and sanitation, the prioritization of SDGs and the climate emergency, and prioritization of the One Health initiative in the *environmental clock*.

162. On top of all this, vectors such as policies targeting inequalities will have an impact on migration and freedom of movement in the *global governance clock*.

163. Figure 6 shows how the *vectors of uncertainty* in the *social clock* are connected to those in multiple other clocks.

Implications for scenarios

164. Working towards a more optimistic *Collaboration Plus* scenario will require a balanced approach to economic security and the prioritization of key far-reaching social issues by governments and policy-makers.

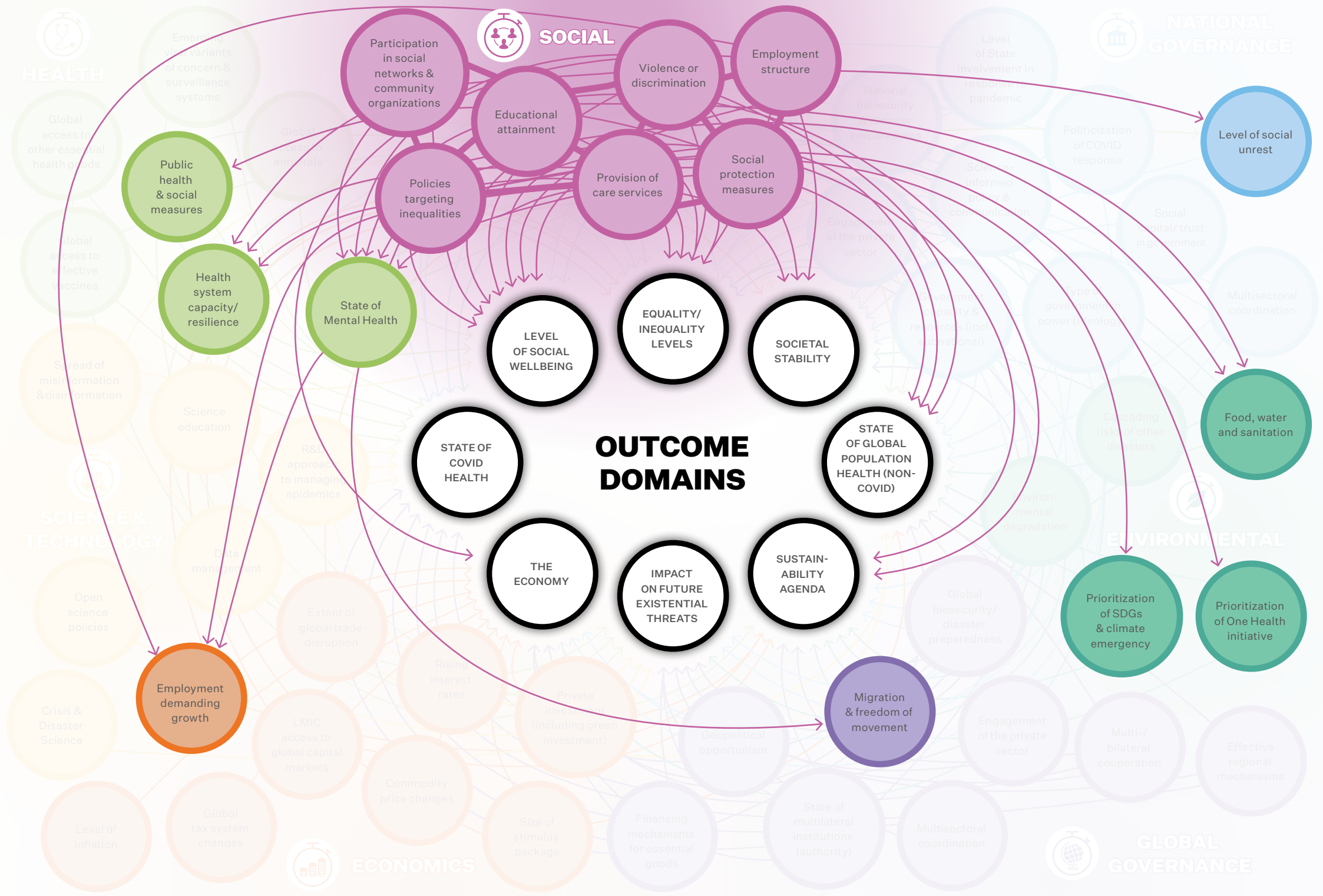


FIGURE 6: THE SOCIAL CLOCK: AN OVERVIEW OF THE MOST CRITICAL GLOBAL SOCIAL-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

165. Alternative schooling systems such as decentralized tutoring have been deployed in settings with a high risk of COVID-19 infection, especially if digital access is available.

166. Governments can implement new policies to better protect and value essential workers such as healthcare workers and teachers, and invest in retention, training, new resources and technology.

167. Global stakeholders can address inequities exacerbated by the digital divide, enhancing social protection mechanisms through methods such as providing free internet access and delivering digital devices to underserved children.

168. They should seize the COVID-19 crisis as an opportunity to start long-term system changes that increase the level of wellbeing and resilience of societies.

169. Digital innovation can be used in schools to foster active participation and engagement among students. This would be likely to have positive effects on citizens' participation in societies and on the advancement of the SDG agenda.

170. One contributory factor leading to a more pessimistic *Missed Recovery* scenario would be a strict and austere focus on economic recovery to alleviate the public debt caused by COVID-19, undermining the investment needed to recover care and education.

171. This may be particularly relevant for countries with restricted fiscal space that have received little or no international aid and development assistance.

172. Experts predict that there may be decades-long echoes from the pandemic on social wellbeing.

4.2.3 Economics clock

173. The *economics clock* (see Figure 7) considers the impact of *vectors of uncertainty* arising from the pandemic on global economic conditions.

174. This clock involves vectors that influence economic growth, income equality, the evolution of the pandemic, longer-term health outcomes, and the sustainability agenda. This includes access to markets and to market opportunities now and in the future.

175. Of course, measures designed to limit the spread of COVID-19 will have an impact on the state of the global economy – most notably border restrictions, national lockdowns, stay-at-home policies, closure of service industries and border closures – leading particularly to failure of small businesses and those in specific sectors such as tourism.

176. The pandemic has accentuated inter-country and intra-country inequalities in wealth and income.

177. The relatively rapid economic recovery of HICs and China, compared to most LMICs, will likely exacerbate inter-country economic inequality, deepening the development divide.

178. In both HICs and LMICs, inequalities that existed at every level prior to the pandemic are likely to increase. In HICs, wealth inequality is likely to continue to increase, due to rising share prices and property prices resulting from stimulus packages.

179. Government policies will have a critical impact on inequality, and targeted policies will be required to address this.

Key interactions

180. The *vectors of uncertainty* in the *economics clock* clearly interact with a variety of other clocks, given their key role in influencing available

resources for stimulus packages, health systems and general funding initiatives. Rising interest rates and levels of inflation also have key knock-on impacts around the globe.

181. The *economics clock* has a significant impact on the *health clock*, for example, in terms of affecting health system capacity and resilience, and levels of global access to other essential health goods, effective vaccines and antivirals.

182. The *economics clock* interacts strongly with the *social clock* too, affecting policies targeting inequality, levels of educational attainment, provision of care services, social protection measures, employment structures and indicators of general wellbeing.

183. The *economics clock* interacts with both the *national* and *global governance* clocks, affecting government capacity and resources, national biosecurity and disaster preparedness, as well as engagement of the private sector and the delivery of public goods.

184. The way in which governments use stimulus packages may affect social cohesion. If used to advance narrow government agendas, they could further undermine trust in governments and reinforce autocracy, cronyism and corruption.

Implications for scenarios

185. According to economists engaged in this exercise, a variety of *vectors of uncertainty* will affect the long-term direction of the *economics clock* – whether towards a *Continuity*, a pessimistic *Missed Recovery* or an optimistic *Collaboration Plus* scenario.

186. These include the use of stimulus packages to support economic recovery, changes in the levels of inflation and interest rates, LMIC access to global capital markets, the extent of global trade disruptions and the levels of private investment.

187. The types of expenditures undertaken via the stimulus packages will have an impact on: a) future economic growth; b) the extent to which social disruptions caused by the pandemic are mitigated; c) inequality, depending on the extent to which expenditure is targeted at addressing the needs of the poor and marginalized; and d) trust in government or increased risks of corruption and cronyism.

188. A more optimistic *Collaboration Plus* scenario can be approached through appropriate use of stimulus packages to help rapidly improve physical and soft infrastructure and enhance productivity and growth in HICs and China.

189. To move towards this scenario, enhanced commitment to multilateralism on the part of the HICs and China – in trade, technology and addressing the climate crisis – would significantly lift growth rates. Higher global growth rates would, in turn, result in higher commodity prices, with a direct benefit to commodity-exporting LMICs.

190. Conversely, increased nationalism and the associated trade wars and military and authoritarian aggression would undermine recovery.

191. Debt write-offs or debt restructuring for LMICs would allow greater access to global capital markets and spur growth. Higher growth would also spur investors' confidence in LMIC currencies and so encourage private capital flows into these countries.

192. However, the economic constraints of high debt, and hence an inability to borrow, will deter LMICs from undertaking the necessary expenditures to meet local requirements arising from the pandemic and to enhance growth. The size of stimulus packages will have an impact on inflation, interest rates and economic growth.

193. Banks will raise interest rates principally in response to inflationary pressures. In many LMICs, interest rates are also sensitive to interest rates in the HICs. Interest rates are, therefore, a key determinant of the sustainability of LMIC debt. Low interest rates for LMICs and support from

FIGURE 7: THE ECONOMICS CLOCK: AN OVERVIEW OF THE MOST CRITICAL ECONOMICS-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

the international financial market would pave the way for cheap capital financing and debt alleviation.

194. High interest rates will result in higher debt repayments and lower government expenditure on other services.

195. Increasing access to capital markets will depend on debt alleviation, which will in turn depend on political processes, global cooperation and agreement from creditors. Global agreements on debt alleviation appear to have become more difficult to organize with the entry of China as a major creditor.

196. Further, increased support from the International Monetary Fund and other global institutions would allow LMICs some leeway to invest more in overcoming the social and economic consequences of the pandemic, and assist them in developing infrastructure to promote future growth.

197. Key to achieving longer-term sustainable economic growth are the nature of government spending and the degree to which countries and global institutions can 'crowd in' private investment for sustainable projects.

198. Economic growth and income equality will depend critically on the character of government spending and the number of jobs created.

199. The economic response will also be greatly affected by how technology is adopted and used.

4.2.4 Environmental clock

200. The *environmental clock* explores the impact that the pandemic will continue to have on the environmental sustainability agenda, and progress on food and water security and sanitation.

201. This clock considers the impact of environmental degradation, prioritization of a One Health approach or the occurrence of other disasters on COVID-19 outcomes in the mid- to long term.

Key interactions

202. This clock will have an impact on all the outcome domains considered in this exercise. It is connected to key *vectors of uncertainty* in the *health*, *social*, *economics*, and *science and technology* clocks and will be impacted by actions in the *global governance* and *national governance* clocks. (See Figure 8)

203. For instance, in the *environmental clock*, the level of prioritization of the SDGs and the climate emergency will affect health system capacity and resilience in the *health clock*. And measures on food, water and sanitation will have an impact on public health and social measures.

204. The *environmental clock* will also have a variety of interactions with the *social clock*, in areas such as employment, educational attainment and policies targeting inequalities.

205. The approach to the constituent parts of this clock can provide lessons to the global community about managing other emergencies, and existential risks such as climate change, in the mid- to long term.

Implications for scenarios

206. A likely picture in the *Continuity* scenario involves insufficient attention to climate action over the next five years, leading to 'cascading risks' whereby societies face multiple hazards simultaneously. This may be resolved in the longer term, however, by countries recognizing the importance of the climate emergency and investing in greener forms of growth. The more optimistic *Collaboration Plus* scenario anticipates that such action on climate is taken more promptly, inspired by the collective sense of vulnerability induced by COVID-19.

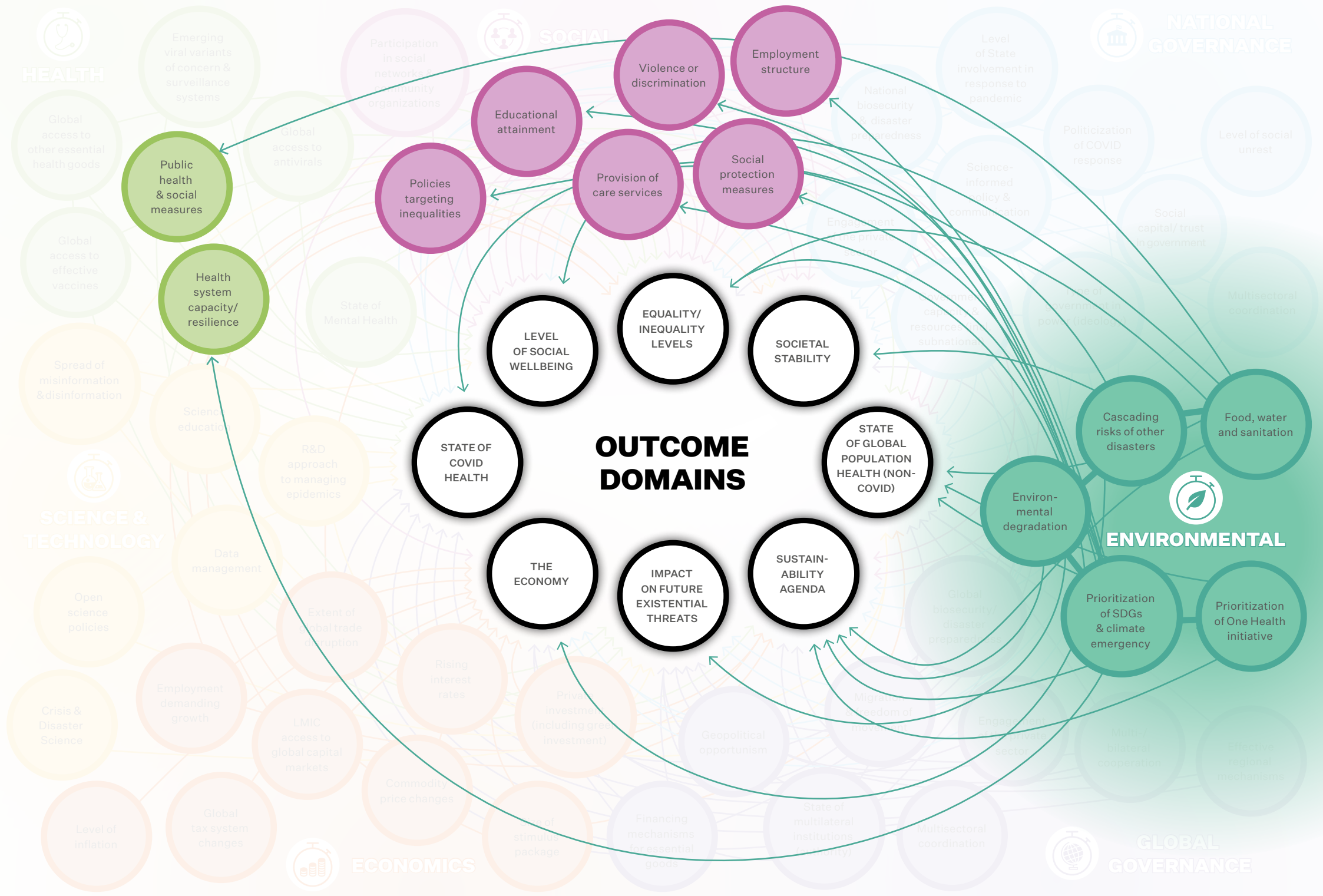


FIGURE 8: THE ENVIRONMENTAL CLOCK: AN OVERVIEW OF THE MOST CRITICAL ENVIRONMENTAL-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

207. Far greater international cooperation is required to share knowledge and experience, fighting the pandemic, addressing climate change and sustainable development and in making the required global public investments to achieve these goals.

208. Achievement of the more optimistic *Collaboration Plus* scenario also involves worldwide actions to build resilient local and regional supply chains based on diverse local food systems and sustainable management of natural resources.

209. Policy-makers can build resilience into food systems by actively listening to the recommendations of climate and environmental scientists to enable them to make evidence-based decisions. Resilience of food systems can then be improved globally through regional cooperation, particularly in LMICs, to build up preparedness for future challenges and deal with cross-border issues such as water supply.

210. Adoption of the One Health approach in countries around the world could help prioritize examination of the inseparable interconnection between animals, humans and the environment.

211. Improvements in biosecurity for livestock and farmed wild animals, and an intergovernmental partnership to address spillover risks of zoonotic transmissions may also help prevent future epidemics and pandemics.

212. Countries can also enable coordinated research on establishing which interventions are most effective at preventing animal-to-human spillovers, assessing pandemic drivers and continuing viral discovery in wildlife to assess the threat of future pathogens.

213. To be better prepared for the emergence of potential pandemic pathogens, COVAX or a COVAX-type institution can be strengthened, with all the world's big players participating to deal collectively with viruses and make sure no country is left behind. A new international instrument is likely needed to give confidence to all countries that an effective warning system exists, that expertise is rapidly available and that national interests do not override the need for an all-country approach.

214. Other approaches that would contribute to a *Collaboration Plus* scenario are measures to protect unexploited forests, ban wild animal markets and preserve natural habitat and biodiversity.

215. Conversely, the more pessimistic *Missed Recovery* scenario will result if inaction on climate change mitigation leads to environmental degradation, increasing the risk of spillovers of emerging pathogens. Causes of this may include livestock farming, wildlife hunting and trade, the destruction and exploitation of tropical forests, the expansion of agricultural land and rapid, unplanned urbanization.

216. Attempts to accelerate economic recovery by relaxing environmental and climate change regulations would worsen biodiversity loss and climate change, making climate change scenarios increasingly negative.

217. In the recovery from COVID-19 there would be an increased risk if old models of development are followed rather than investment in resilient, risk-informed, green and more equitable societies.

218. Countries would also face combinations of escalating risks, challenging their ability to finance public health and respond to pandemics or other disasters.

4.2.5 Science and technology clock

219. The *science and technology clock* has several dimensions. It considers the long-term outcomes of the innovation spurred by the pandemic – for example, accelerating the digital transition in areas such as education.

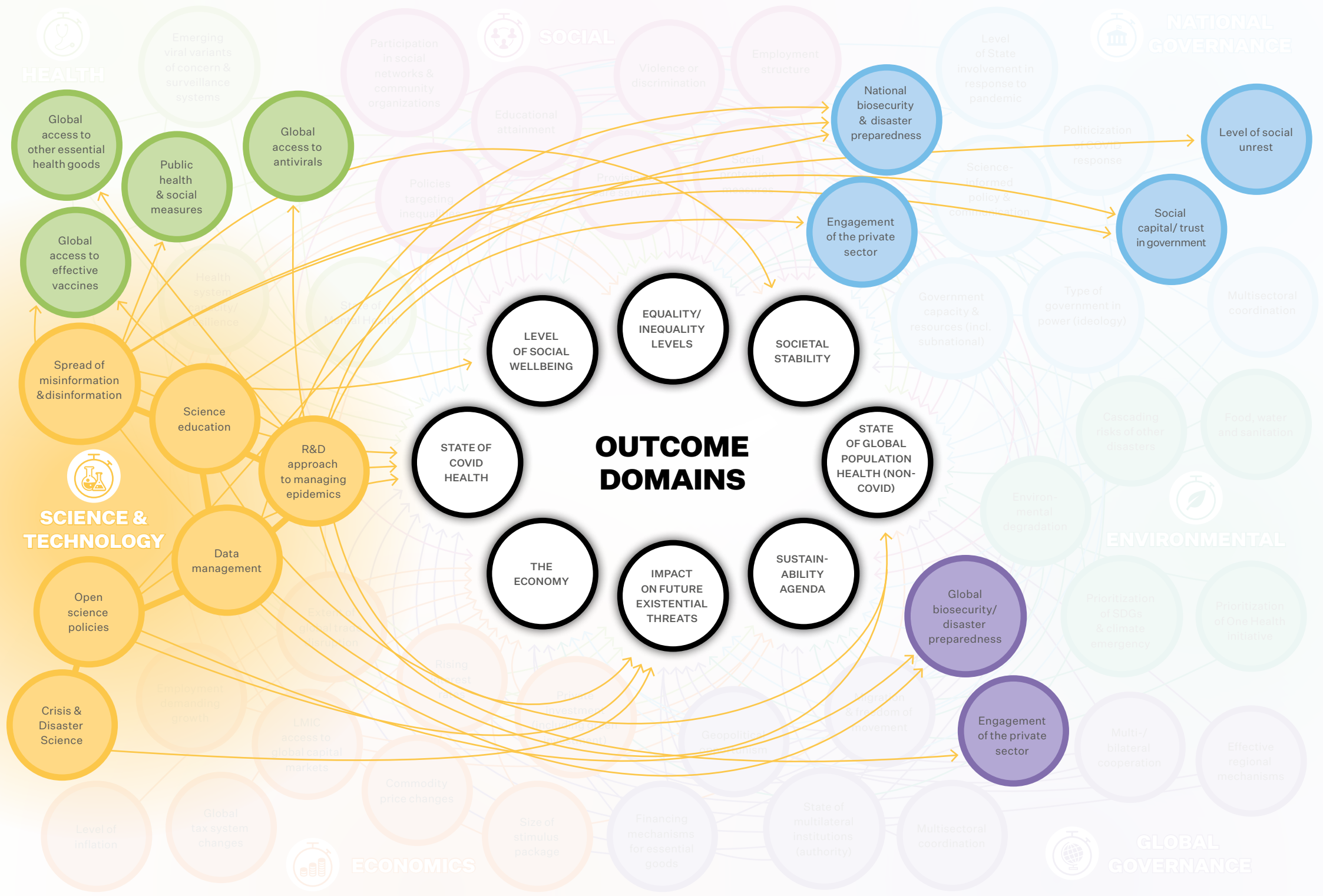


FIGURE 9: THE SCIENCE & TECHNOLOGY CLOCK: AN OVERVIEW OF THE MOST CRITICAL SCIENCE & TECHNOLOGY-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

220. Science, too, has been changed by the pandemic. The pandemic has accelerated the move to open science, because of the use of preprint mechanisms for science publication and for use by media and for policy. The pandemic has also highlighted the importance of an interdisciplinary approach to scientific research, in which natural and social sciences combine efforts to understand the pathways for change.

221. Attitudes to science have also been increasingly used as political labels. Misinformation and disinformation have devalued science repeatedly throughout the pandemic. The long-term impacts could undermine trust in science more broadly.

222. However, as was seen during and after World War II, the pandemic could be harnessed to provide fresh impetus for significant developments in science and technology.

223. COVID-19 highlighted the importance of open-access publishing and rapid dissemination of findings. Journals could help by committing to broadening open access beyond the period of the pandemic.

Key interactions

224. The *science and technology clock* has key interactions with several clocks, including the *health*, *national governance* and *global governance* clocks. (See Figure 9)

225. The spread of misinformation and disinformation will, for example, affect global access to effective vaccines, as well as public health and social measures, in the *health clock*. It will also affect the level of social unrest and trust in governments in the *national governance clock*.

226. In addition, policy on science and technology will have a major impact on global governance in the future, including on global biosecurity and disaster preparedness.

Implications for scenarios

227. COVID has spurred the use of 'live reviews' of ongoing studies, further enhanced by the 2021 UNESCO Recommendation on Open Science. This accelerates true partnerships between Global North and South scientists on many other issues within the sustainability agenda.

228. Increased partnerships between academic institutions and news media outlets will help build trust in science and inform the public, through boosting their complementary strengths and mitigating their respective weaknesses.

229. Innovation through new digital data techniques and acceleration of their roll-out can also help to achieve an optimistic *Collaboration Plus* scenario. If data-driven digital health technologies can be sustainably delivered at scale to everyone, everywhere, many could have equitable access to expert care, narrowing gaps in health and wellbeing. This might include the development of risk-prediction algorithms to model health outcomes for populations, allowing for tailored public health interventions.

230. Enhanced harmonization of data across regions is essential to ensure appropriate public health policies are devised that reflect the true burden of disease or infection in communities. This may help to identify the most vulnerable communities and permit monitoring of societal inequalities and progress towards their reduction.

231. Collaboration between governments in LMICs via regional alliances can pool procurement and laboratory networks, and intensify data sharing, helping forecast and respond to future crises.

232. Conversely, a more pessimistic *Missed Recovery* scenario may result if governments around the world implement strict austerity measures, constraining resources for the education and science sectors. Inequalities in education may widen, with the digital gap exacerbated and vulnerable populations left behind.

233. A *Missed Recovery* scenario may also be exacerbated if governments not only fail to resist fake news, but even spread it themselves.

234. If fake news proliferates, if social media platforms remain unregulated or ineffective at reducing its spread, and if people are unable to distinguish reliable sources among the mass of information, future pandemic responses and measures to control other global and local threats will be jeopardized.

235. As well as consequences for the economy, distrust can have significant implications for societal stability, as weaponized information undermines the democratic process, and general distrust in society affects social cohesion and citizen participation.

4.2.6 National governance clock

236. The *national governance clock* (see Figure 10) considers the ability of central and local governments to effectively provide a range of public goods such as strong public health outcomes and educational attainment as well as social and environmental protections.

237. This clock reflects on the capacity of governments to prepare, coordinate and deliver key resources and services related to pandemic management and its legitimacy in the eyes of citizens.

238. Critically, it also reflects the type of government in power and its political ideology. These factors determine the types of policy responses implemented nationally, the politicization of COVID-19, the level of multilateral cooperation, regional and global geopolitics, and the level of national biosecurity and disaster preparedness, among other *vectors of uncertainty*.

239. In this clock, governance is not limited to the institutions of government, but includes the role of community leaders, philanthropic organizations and the private sector in managing the impacts of the pandemic within countries.

240. The *national governance clock* has a significant influence on all the long-term outcomes of the pandemic, making it the clock with the highest number of connections to *vectors of uncertainty* in other dimensions of social policy.

241. Across the world, the acute responses to the pandemic affected the relationships between citizens and governments. The responses, and at times science itself, became highly politicized. The long-term consequences will depend on how leaders respond – in some cases autocracy, cronyism and corruption appear to have increased. This cannot be healthy in any society, and the longer-term consequences will depend on factors beyond the scope of this project.

Key interactions

242. The *national governance clock* will have a whole range of interactions with other clocks across the board, pertaining as it does to *vectors of uncertainty* including key government decisions, the type of government in power, the level of involvement in response to the pandemic, government capacity and resources, and multisectoral coordination.

243. Clearly, national governance will have an impact on the *vectors of uncertainty* in all of the *health*, *social*, *economics*, *science and technology*, *environmental* and *global governance* clocks, giving these vectors extremely wide-reaching effects.

244. The capacity and types of government determine their level of national biosecurity and disaster preparedness, and the level of state involvement in the pandemic response. This could be both positive in terms of the

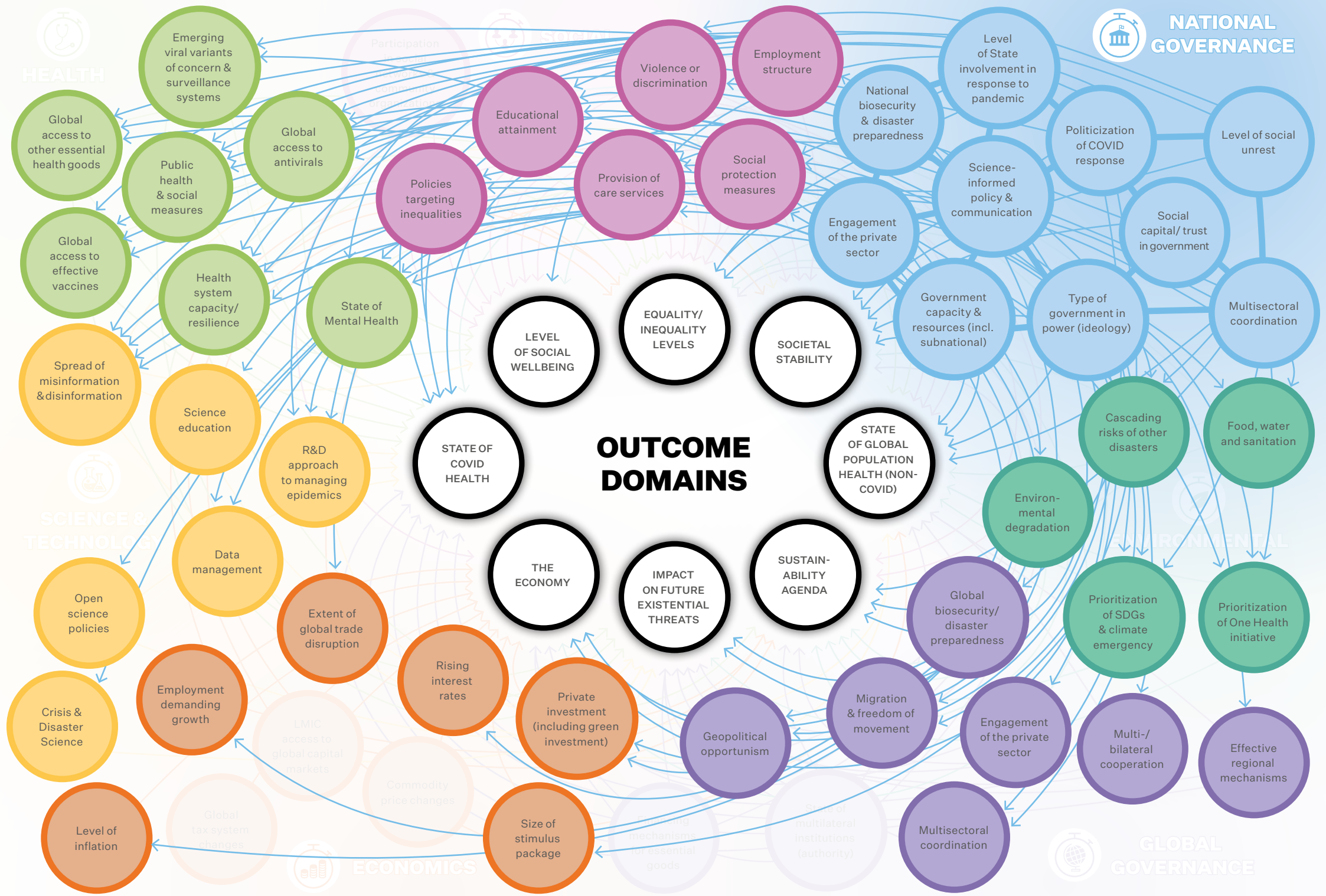


FIGURE 10: THE NATIONAL GOVERNANCE CLOCK: AN OVERVIEW OF THE MOST CRITICAL NATIONAL GOVERNANCE-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

reinsertion of the state and state regulation in highly individualistic and neoliberal countries, or negative in cases where creeping autocratic-type leadership infringes on citizen freedoms and human rights.

245. In addition, the type and capacity of government affect the delivery of science-informed policy and communication, engagement of the private sector and the level of multisectoral coordination.

246. The latter is particularly important because of the wide-ranging and long-term impacts that the pandemic will have on society, and because an effective multisectoral response that brings together governments, different academic disciplines, the private sector and civil society has been absent in many countries throughout the pandemic.

247. Additionally, government success in handling the pandemic is strongly dependent on the level of trust in government and the social capital that it has among its citizens. This affects the willingness of citizens to adhere to public health and social measures, especially with the onset of pandemic fatigue, and will have an impact on the level of ongoing or emerging social unrest.

248. Figure 10 shows how the *vectors of uncertainty* in the *national governance clock* are connected to those in multiple other clocks.

Implications for scenarios

249. An optimistic *Collaboration Plus* scenario in the *national governance clock* will depend on governments' willingness to renew their social contract to 'build back better', putting a primacy on investing in the common good, and in the health and social sector.

250. Stronger alliances between the private and public sector can increase growth and tackle inequalities, climate change and weakened health structures.

251. Furthermore, collaboration between governments via regional alliances can pool procurement and laboratory networks, and intensify data sharing, helping forecast and respond to future crises.

252. A rising demand for better social protection systems and stronger public institutions could contribute to stronger health systems and institutions. However, some of those changes may take longer than five years.

253. Prioritization of values by governments could lead to stricter conditions for public-sector investment, potentially having societal benefits. One example is to base recovery funds for businesses on requirements to lower carbon emissions (green recovery).

254. Furthermore, government efforts to redefine and strengthen social protection mechanisms with an emphasis on care would reduce gender and ethnic-based inequalities and deliver a more resilient, cohesive society.

255. Government investments in digital infrastructure would help create jobs and allow new models of work and learning styles, further spurring environments for remote working or online learning. This could help reduce inequalities and remove access barriers.

256. Conversely, there may be the risk of a more pessimistic *Missed Recovery* scenario if austerity measures result in inadequate investment in public health services and health system resilience, leaving society vulnerable to future pandemics or other crises.

257. Growing health and economic inequality may affect the level of social cohesion in many countries and further reduce trust in governments.

4.2.7 Global governance clock

258. The *global governance clock* examines the ability and willingness of states, regional and global institutions, and private actors to work together to address the pandemic.

259. It also looks at the authority and capacity of multilateral institutions, and their influence on the management and outcome of the pandemic.

260. Rising nationalism and the obvious weakening of the multilateral system are causes for concern. The multilateral system did not respond well or with sufficient rapidity to the pandemic, while perceived national interests have been a substantial impediment to permitting a coordinated global response to this (and future) global crises.

261. A particular focus of concern is the shifting of global power dynamics and their impact on the outcome of the pandemic, and in turn how the consequences of the pandemic will impact the geostrategic landscape.

262. This clock also encompasses issues and policies around migration and forced displacement of populations, which have been exacerbated by the Ukraine conflict and other geopolitical tensions and will continue to worsen as the impacts of climate change force communities to abandon certain areas.

263. The demonstrated lack of global solidarity in addressing the pandemic, the increasing use of protectionist policies by HICs and growing geopolitical tension are likely to increase international instability over the next few years. While beyond the scope of this report, this points to a rising risk of conflict and a loss of focus on equitable progress on the sustainability agenda.

Key interactions

264. The *global governance clock* will again have a wide range of interactions with other clocks.

265. It will have important effects on the *health clock*, on vectors including health system capacity and resilience, and global access to effective vaccines and essential health goods.

266. In addition, the *global governance clock* will have a variety of interactions with the *science and technology clock*, affecting the spread of misinformation and disinformation, policies on open science, and data management, among others.

267. Another key area of impact is the *environmental clock*, with global governance affecting *vectors of uncertainty* such as the prioritization of the SDGs and climate emergency, and food, water and sanitation, while it will also affect government capacity and resources in the *national governance clock*.

268. Finally, vectors in the *global governance clock* will be key for LMICs, with impacts on their ability to gain access to capital markets, while private investment will also be affected in the *economics clock*.

269. Figure 11 illustrates how the *vectors of uncertainty* in the *global governance clock* are connected to those in multiple other clocks.

Implications for scenarios

270. An optimistic *Collaboration Plus* scenario can be aided by the renewal of international cooperation and global solidarity, prompted by actors taking heed of weaknesses in the current multilateral system and its ability to govern global crises fairly or independently, as highlighted by the pandemic. This would require the multilateral system to undertake genuine reform.

271. The pandemic has also highlighted the lack of a coherent input of science into the multilateral system, particularly its most central components. This should be prioritized in the reform of the multilateral system.

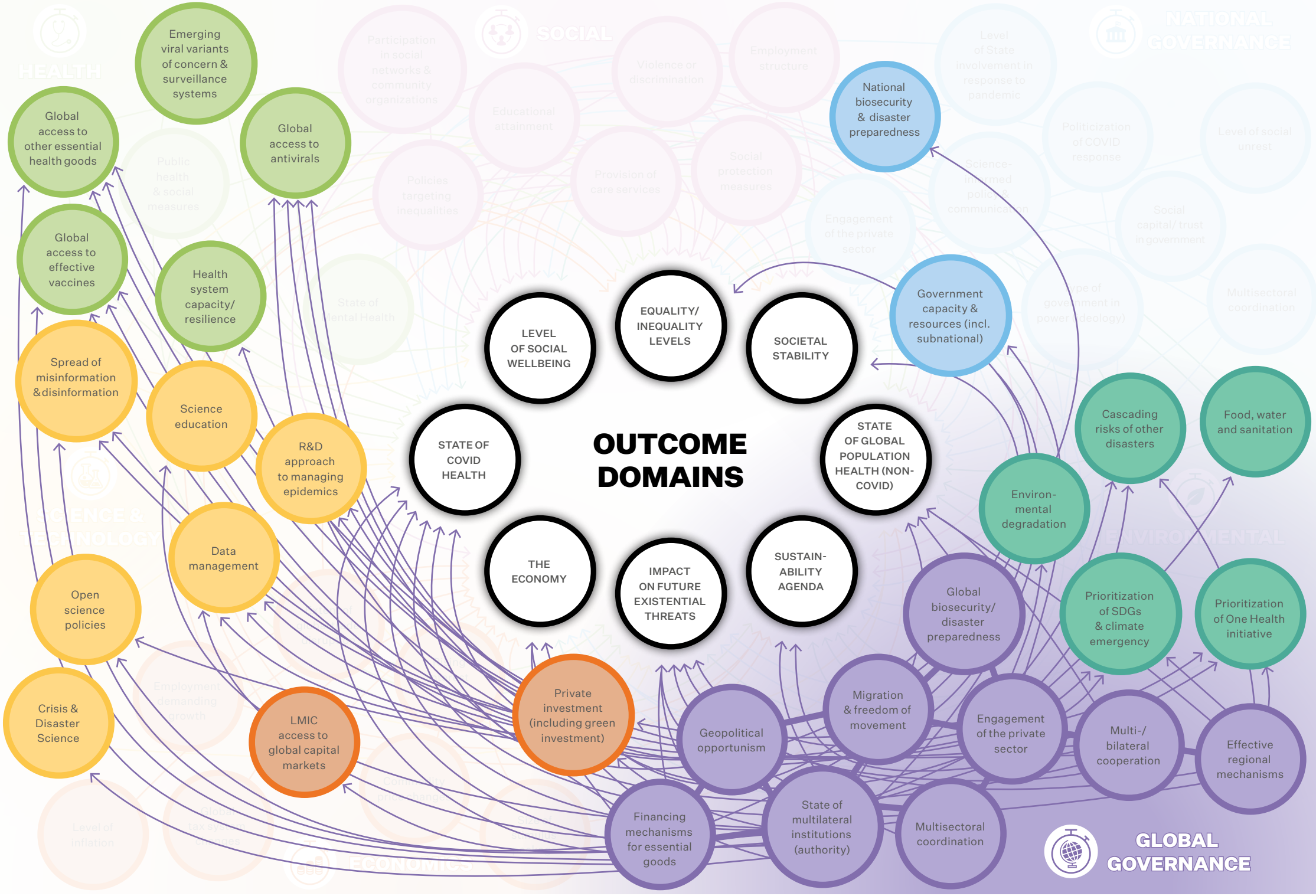


FIGURE 11: THE GLOBAL GOVERNANCE CLOCK: AN OVERVIEW OF THE MOST CRITICAL GLOBAL GOVERNANCE-RELATED VECTORS THAT WILL IMPACT OUTCOME DOMAINS

The graphic also shows how the health clock influences vectors in other clocks. *Only the most crucial connections are portrayed.*

272. Renewal of multilateral cooperation mechanisms could also prompt new sources of sustained financing, increased commitment to tackle the UN SDGs, and legislation that gives organizations such as the WHO more authority to act with independence when a new crisis emerges. In this regard it may be important to separate more clearly technical responses from political ones.

273. Expanding on the foundations of initiatives such as the ACT-A and COVAX programmes can help foster further collaboration for supply of COVID-19 vaccines and other health initiatives, aiding movement towards a *Collaboration Plus* scenario.

274. An extension of this idea is the establishment of regional hubs dedicated to innovative vaccine manufacture across multiple regions, including Africa, Asia and Latin America.

275. Further action towards an optimistic scenario would be a sustained effort to mobilize citizens and community leaders to address global issues such as environmental degradation, and the prioritization of biosecurity and disaster preparedness.

276. Conversely, growing nationalism, increased national political tension and less global collaboration in the wake of the pandemic would make the world even less well-prepared for the next global crisis, moving it toward a more pessimistic *Missed Recovery* scenario.

277. This would also take its toll on COVID response, worsening indirect health and social outcomes.

278. If the supply of effective vaccine and antiviral agents in HICs continues to take precedence over the needs of LMICs, primarily in Africa, the more likely outcome would be a pessimistic scenario.

279. The stockpiling of materials, export bans, limited local manufacturing capacity and continuing global supply chain disruptions could limit access to other essential public goods in many regions.

280. In the more pessimistic scenario, geopolitical tensions may also take a more drastic turn, with governments adopting even more nationalistic policies.

281. These events may lead to strained relations between major powers, weakening multilateral structures and global and regional trade relations, as well as creating geopolitical divisions.

Part 2:

LESSONS AND RECOMMENDATIONS

5. THE SUM OF INTERACTIONS

282. Mapping the clocks, the *vectors of uncertainty* and their interactions with the outcome domains provides an overview of the complexity of the pandemic's current and longer-term impacts and the multiple chain reactions that it has unleashed (see Figure 12).

283. Part 1 of this report illustrates the systemic nature of the COVID-19 pandemic, and how action or inaction in one policy domain has consequences that ripple across many others. It also highlights the long-term and multidimensional nature of the pandemic, which has implications for virtually every domain of domestic and international policy-making. There is a risk of significant policy failure when major crises and emergencies are addressed through too narrow a lens. This is a central lesson of the pandemic.

284. Many lessons emerge from the analysis described in Part 1. It suggests what should be done at both national and international levels to achieve the best possible long-term outcomes from this pandemic, to ensure better preparation and response to the next, and the implications for other global crises. This part of the report summarizes the key lessons and implications that the study has identified. It highlights considerations that governments, international agencies, NGOs and civil society must take into account over the next phases of the pandemic and in preparing for subsequent crises. It discusses the essential roles for the science and diplomatic communities, and 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.

285. By exposing vulnerabilities and blind spots, crises uncover the potential for change, and for reorganizing priorities. Such situations paralyse some actors while empowering others and 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, take better decisions and inspire genuine cooperation, or to further divide communities and nations – with rippling effects on other issues of governance of the global commons. Sadly, this situation is further confounded by the conflict in Ukraine, which is also compromising global cooperation at one level, although potentially enhancing alignment of values within democratic societies.

286. The analyses demonstrate that without more committed global cooperation and broader domestic actions over several years, societies will be severely compromised, and individuals and communities will face ongoing preventable trauma.

287. Here we summarize some of the most critical lessons that go beyond the immediate control of a public health emergency, to offer insights into how we might better manage a range of future crises, and to help ensure a more positive trajectory out of the current one.

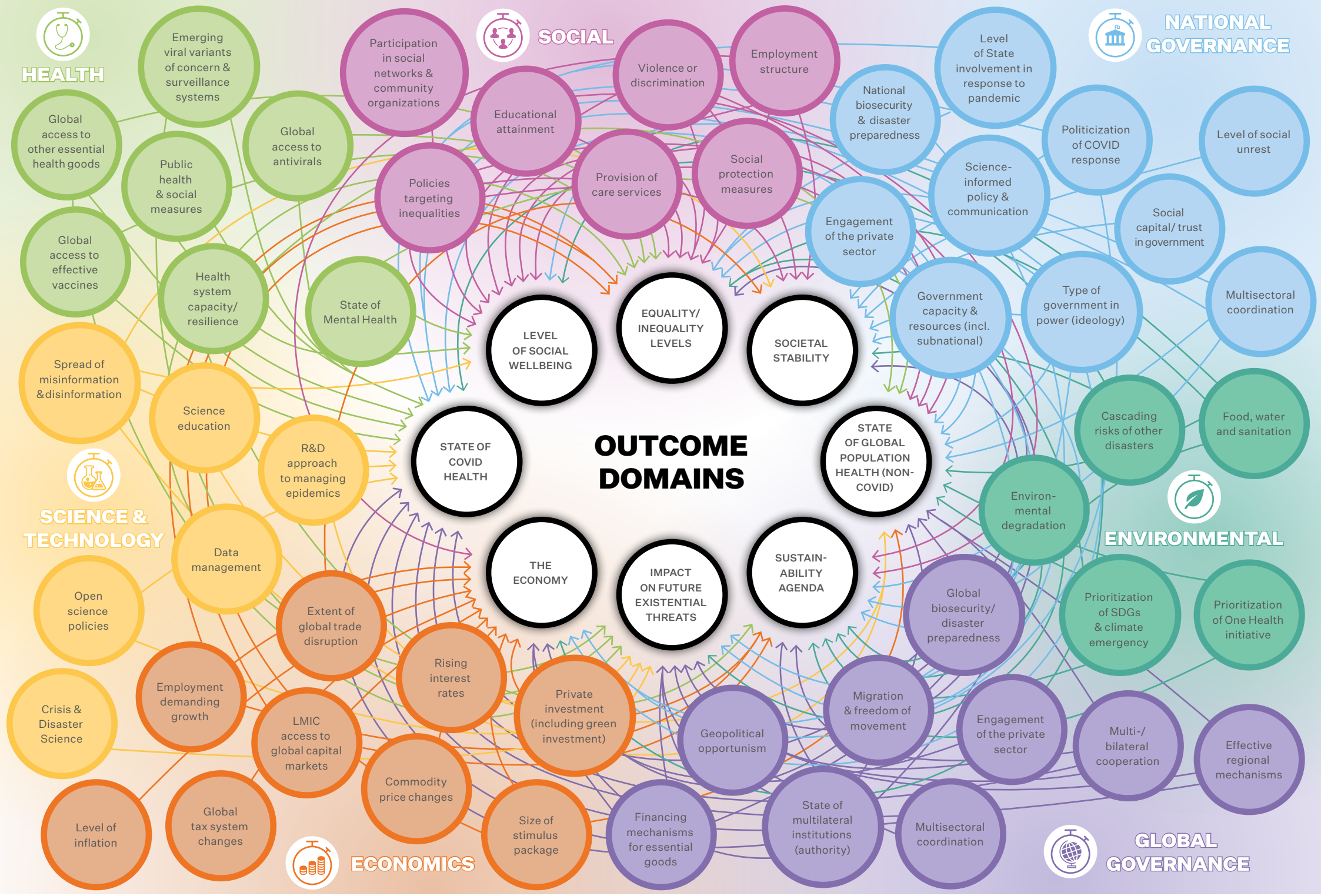


FIGURE 12: A SYSTEMS MAP OF GLOBAL CRITICAL VECTORS (EVENTS OR POLICY DECISIONS) AND THE MAIN OUTCOMES THAT THEY INFLUENCE

Many vectors act through others to influence outcomes either positively or negatively. For clarity, not all connections between vectors or to outcome domains are shown.

6 LESSONS FOR GLOBAL EQUITY

288. Agenda 2030, as encapsulated in the Sustainable Development Goals (SDGs), was subscribed to by every member of the United Nations. Both it and the accompanying United Nations Development Programme (UNDP) aimed to progress not only environmental sustainability, but also human, social, cultural and economic development, and, sadly (in the context of Ukraine and other ongoing conflicts), peace and justice. Although much progress was made in eradicating the most extreme poverty over the ten years prior to the pandemic, great inequality remains, and is again growing. Food security has been compromised worldwide, hitting those countries with high reliance on staple food imports particularly hard.

289. This inequality was clearly demonstrated in the pandemic, both between and within nations. Low income countries were generally far more negatively impacted by the pandemic than were the HICs and China. Although health systems were overburdened around the world, including in middle- and high-income countries, the limited progress on 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.

290. Further, even in HICs, the impacts on individuals were unevenly distributed, with minorities and socio-economically disadvantaged people, as well as women (doing most of the care work), at greater risk.

291. High-income countries and China are able to get back towards pre-pandemic levels of economic activity far more rapidly than low-income countries. The latter are at a 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. 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.

292. The commitment and capacity of the multilateral system to respond to or prevent this worsening inequality was suboptimal. Geopolitical issues confounded the response at some levels, and two years after the pandemic emerged there remain ongoing debates about technology and therapeutics transfer from the Global North to South. No real progress has been made on addressing the deficits that were clear in the IHR. COVAX and ACTA-A remain less than fully effective as ways of managing a global response.

293. The access to high-quality and effective vaccines is still very uneven, and vaccine coverage remains central to reducing the impact of the pandemic and allowing a more rapid recovery. While vaccine access has improved, in many societies much of the population remains exposed to the virus without any immune protection.

294. While such inequalities persist, responses to the pandemic and future crises will remain uneven. In an interconnected world this inhibits recovery for all. Sadly, the conflicts in Ukraine and elsewhere have added additional burdens of acute refugee crises. Political barriers, rising geopolitical tensions, conflict, and policy diversion can only further compound and complicate recovery, and the lowest income countries will indirectly be the ones most affected outside the conflict zone. At the same time, instability and conflict in other areas remains a threat to equitable pandemic recovery.

295. Low-income countries not only have limited vaccine access, health system facilities, health workforce and public health capacities, but their situation is compounded 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, UNDP and other financial and development agencies have to take an active partner role in this. The risk is a deepening of already existing disparities in health, economic and social development.

296. However, changing the trajectory of the pandemic first requires continuing and accelerating efforts to ensure high-quality vaccine and therapeutics access to low-income countries. Manufacturing capacity is gradually being established in the developing world, 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 (African Development Bank Group, 2022), in partnership with the WHO, the Medicines Patent Pool, the Act-Accelerator/COVAX, the African Union, and the African Centers 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 will ensure that this global public good is supported, while allowing the private sector to have fair but not excessive return on their investment.

297. Even if the health crisis can be brought under control, under-resourced, low-income countries will be compromised in terms of economic recovery, with less ability to afford income support schemes that have allowed HICs 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.

298. 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 exacerbated by the pandemic, and which are discussed in Part 1 of this report.

299. As Part 1 illustrated, there are certain issues that disproportionately affect those who are disadvantaged in every country, irrespective of its state of development. These merit particular attention.

6.1 Health system access, capacity and adaptiveness

300. Countries must prioritize and dedicate domestic resources and recurrent spending to improve the capacity and preparedness of their public health and health systems. 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. Everywhere, even in countries with advanced public health systems, the health sector came under considerable strain and in some cases remains so, often requiring governments to resort to harsh and economically and socially damaging measures such as lockdowns. In the short term, reserve capacity in hospitals and clinics will need to scale-up to cope with the demands of a potential double surge every winter, from seasonal COVID-19 and influenza. In the longer term, to be better prepared for future major health crises, investment in surveillance systems and laboratory infrastructure is critical, as is having emergency funds kept aside or made available, in every country, for responding to future pandemics (including funds for surveillance and research).

301. 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. The diversion of resources to control viral outbreaks disproportionately affected populations who were already at higher risk of chronic disease and ill health due to poor access to healthcare. Mental health issues have increased in every sector of the population, but again disproportionately so for those facing disadvantages from poor housing and overcrowding, disrupted food security, precarious employment and other factors. The residual impacts on mental health will be particularly severe for those who have the least chance of support through counselling and other services. This will be even more so for those whose food and income security is even more precarious as a result of the pandemic.

6.2 Recovery of education

302. Most countries experienced severe disruptions to their educational systems. The digital divide was manifest in every country, conferring further disadvantage to children and adolescents who did not have adequate digital access. On top of that, digital-based pedagogy remains poorly developed in many areas, even in the third year of the pandemic. Many students in low-income situations had to choose between education and supporting their families in whatever way they could. Students in the later years of schooling and entering tertiary education have been particularly badly affected. Given this level of disruption, there is a need for educational policy to address the disadvantage which could accompany this cohort for many years as they try to enter the workforce.

6.3 Supporting the care economy

303. Countries that had well-developed social care systems, themselves mainly advanced economies, found that they had to be rapidly responsive during the acute stages of the pandemic, though even those systems often fell short, placing an increased burden on women in households. 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.

304. 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 with additional burdens placed on them. Lockdowns also exposed them to a greater risk of domestic violence. 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.

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

306. The lack of 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.

6.4 Looking ahead

307. Inequality remains a pervasive disease, one that has grown in recent years in all societies, and has worsened in the pandemic, with minorities, 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.

7 UNDERSTANDING RISKS

→ **308. Governments must review and reframe the way they assess risk and integrate it more formally into policy development.**

309. 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. 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.

310. 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.

311. 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 framed and used in national security systems, and how the risks they outline are understood by the public.

312. 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 on presumptions taken from 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.

313. The pandemic has made evident the critical importance of global early warning systems for biological events that spread beyond national borders. A 'One Health'[7] approach should be adopted. Some aspects of such a system would be generic, 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.

7.1 Focus on consequences, not just specific risks

314. 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. 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.

315. 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 (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 International Health Regulations and the associated advice were found wanting and not appropriate for the context of a highly globalized and interconnected world.

316. Attentiveness to the likely cascading consequences of any specific risk (for example, 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, private sector, academia, NGOs and the media, have a vital role to play.

317. 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.

318. 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 take action outside crisis times. Such explorations should also involve the private sector and civil society for they too must be prepared.

319. Involving the public in thinking about risks also provides an opportunity for them to express what they care about most and wish to protect. The goal is to nurture a rational, science-based sense of risk which will also create understanding of public expenditures and policies, 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.

320. Box 1 illustrates the types of question that might frame a pre-emptive risk response to a variety of risks.

Box 1 Framing risk responses (national and global levels)

AT THE NATIONAL LEVEL

In preparing the response system:

- What expertise needs to be accessible? 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 and agencies 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 its inevitable impacts 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 (such as natural hazards, terrorist attacks, armed conflict or neglect)? 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 publics be better engaged in co-creating solutions?

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

AT THE REGIONAL AND GLOBAL LEVEL

Pandemics and other global crises require early recognition of the need for global cooperation in sharing data, information and technology. The instruments for sharing should meet several principles, 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 the multilateral agencies are well connected and have access to appropriate expert input

- Ensuring 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 are rapidly responsive.

- Considering geopolitical tension: What circumstances might amplify the threat of conflict in the midst of another crisis?

- Ensuring equitable global reach for vaccine and therapeutic access; avoiding or counteracting geopolitical gaming.

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

321. 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 in the long-ignored risks of a novel zoonotic pandemic. The prioritization of government spending is primarily to take care of short-term problems that are within an electoral cycle, or the interests of those in power in more autocratic countries. Though the longer-term risks may be appreciated, they are not prioritized.

322. 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. 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 could both be used for managing health system resources and real-time disease surveillance and be turned to infectious disease management in the event of an epidemic or pandemic.

7.3 Remain vigilant to other existential risks, and prioritize sustainability

323. In the face of a catastrophic crisis such as a pandemic, it is easy to ignore 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.

324. Climate change continues to progress without regard for the COVID-19 pandemic. The pandemic has diverted the international community's focus from, and progress towards sustainability. This 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. Additionally, the Russia–Ukraine conflict is a stark reminder that world leaders and international organizations cannot afford to lose focus on conflict resolution and international cooperation.

8 TRUST AND PUBLIC MOBILIZATION

→ **325. Governments must give priority to trustworthy decision-making and access to reliable information, particularly when asking the public to undertake difficult measures in a crisis.**

326. 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.

327. Social trust and social capital – 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.

328. Those countries with high 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.

329. 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.

330. Indeed, a lack of understanding or appreciation of the damaging effects of social isolation and other measures in some cases 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 overall.

8.1 Ensure trust through transparent decision-making and information flows

331. 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, leaders 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, that initial strategies were provisional, and that responses would need to evolve as knowledge improved.

332. Although some strategies changed based on evolving knowledge of SARS-CoV-2 biology, transmission, and disease characteristics, in many cases decision-making seemed less based on science than on ideology or on public pressure or on 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 exacerbating risks in some cases both for their own countries and others.

333. Inconsistencies and changes in strategies are almost inevitable in trying to manage a complex crisis. But equally, leaders need to be clear on what basis 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 inputs have been considered. Incorporating expert knowledge from a wide range of disciplines into policies and decisions from the start, including anthropological and ethnographic expertise, is key to understanding the social context and possible responses.

334. There is a general lesson here. All crises are complex and multidimensional. 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 in crisis. Only by 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.

335. Moving forward, it will be important to ensure that 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 their diversity of views need to be heard if there is to be an effective and cohesive societal response to crises.

8.2 Mitigate misinformation and disinformation with planning, regulation and trust

336. The capacity and willingness of citizens to take an 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. But what is considered valid information, and by whom, is not straightforward. There are always unknowns and uncertainties, particularly at the onset of the crisis.

337. Trust in science and evidence-informed decision-making has often been compromised by the history of relationships between groups and individuals. This lack of trust impairs the response to the pandemic, facilitating responses and actions which 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.

338. People are much more vulnerable to misinformation 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 'deep fakes' (manipulated videos) emerge.[8] The evidence is sadly very clear that eradicating disinformation is much harder than promoting accurate information.

339. The way information spread during the pandemic underlined the critical importance of internet companies and social media. The business models of many online platforms massively amplify the reach and the frequency of messages, matching audiences to preferences, thereby fuelling disinformation and increasing political polarization. Although some countries and some companies have made attempts to redress this, these efforts have largely failed to stem the tide. Given the cascading impacts of this, a more comprehensive and sustained campaign of regulation is desirable as decentralized platforms for the production of news, commentary and opinion will grow.

340. Governments and the information technology sector will need to collaborate to find new ways to monitor and mitigate disinformation flows, while also involving citizens in learning to recognize cues and think critically about information sources. Importantly this is not a problem solely for HICs – it affects every society. This challenge of decentralised information production and its consequent implications for jurisdictional authority is one reason an innovative and collective approach to regulation is required. Another reason is that the sub-cultures imbibing this content are as emergent and dynamic as the technology itself. This may be one of the key challenges for society in the 21st century.

341. In the interim, it is important that governments have clear communication strategies in place before a crisis emerges. These must focus on reliable and trusted 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 and 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.

342. Deciding whether the communicator is a politician or 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 lines of communication and crisis protocols in advance. Because information now travels faster, with greater intensity, and from wider sources to the public, far greater attention is needed to this side of crisis management.

343. 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 recognising opportunities to demonstrate intention or to support mutual learning across communities.

8.3 Adapt crisis management approach as the situation changes

344. Crisis management strategies must evolve as the situation does. 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 and new strategies throughout the duration of any crisis event.

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

346. This includes the way that communication approaches must adapt at different stages of the 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.

347. This 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 disciplines must inform a brokerage mechanism that ensures that the scientific understanding, with all its caveats, is continuously available to the policy and political community, and to society. Similarly, the brokerage mechanism must ensure the appropriate inputs are being gathered. 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 didn't work for a variety of reasons. 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 manging the crisis has much merit.

8.4 Change definitions of success: beware the rhetorical power of numbers

348. Political leaders have been challenged to convey acceptable measures of 'success', which are still largely focused on cases and deaths. Few have articulated what success means over the longer term, across other domains, let alone decided on a strategy to achieve it.

349. Epidemiological models have been useful to think about the possible trajectories of the pandemic, but they generally 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 assumptions and limited types of inputs. 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 least to informal but independent peer review.

350. Similarly, too many countries apparently took comfort in measuring preparedness using composite indices such as the Global Health Security Index (GHSI).[9] Such indices can 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 by those nations who ranked highly.

351. As the pandemic unfolds and the many long-term echoes detailed in Part 1 become evident, new measures of success will be needed, beyond conventional measures of morbidity and mortality. The multiple impacts on societies need 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 (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.

9 THE ROLE OF SCIENCE DIPLOMACY

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

353. It has been said that science has never been more on display than in response to COVID-19. Indeed, international science collaborations involving both the public and private sectors have brought about truly remarkable progress in vaccine development, which has enabled some control over viral spread. It is clear this effort must continue and expand beyond vaccines.

354. 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 rallied to support crisis management of different kinds.

355. It will be essential to address the imbalance in global spending on R&D and innovation, which is occurring overwhelmingly in high- and upper-middle-income countries. Even where research is conducted in LMICs, too much of it is not led from that country but from a Northern funder that sets 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 about information exchange and access to technology, but also decision-making and prioritization. The unequal access to vaccines and therapeutics has 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.

9.1 Invest in R&D for public good and benefit sharing

356. 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.

357. While there is an obvious need for a fair return on investment for those private sector companies supporting the 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 would not have been possible without the immense public-sector investment in biomedical research over recent decades. Yet the economic benefits of these developments have remained in the hands of the private sector companies.

358. It is critical to find a way to get beyond the inevitability that HICs, where 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 development and scalable manufacturing capacities, as well as cheap and rapid testing technologies and diagnostic infrastructure in LMICs are clearly needed.

359. 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.

360. Governments and the private sector should develop a framework agreement whereby research and development 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.

361. The private sector has expertise in management and logistics that is an important resource to help societies in crises, and governments need to consider how best to ensure constructive partnerships can be rapidly developed in such situations.

9.2 Ensure the recognition of the work of scientists in LMICs

362. Scientists around the world have 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 or knowledge is 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 outcome of the 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 science community including funders and publishers of 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.

9.3 Support further developments in open science

363. 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 science has a cost that must be met, and further progress on the ongoing evolution of science publishing to support open access is needed (International Science Council, 2021). 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.

364. Global principles need to be developed to allow open science to flourish while ensuring that quality control through peer review, ethical confidentiality and appropriate intellectual property development can be assured. 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 ISC and similar bodies, and partnership with the World Intellectual Property Organization and other bodies to review how open science and intellectual property protection can coevolve.

365. 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.

10 SCIENCE ADVICE AND RESILIENCE BUILDING

366. Ensure broad capacities in science advice, evidence synthesis and brokerage.

367. Many of the problems that the public, political leaders and decision-makers encountered in trying to manage the pandemic were related to how they sought and interpreted expert advice. In the process, in some societies, science has been politicized and alternatively used as a shield ("we are following the science" when the decisions were overtly political) or dismissed as irrelevant or elitist. How well countries did in accepting uncomfortable science advice and acting upon it depended to some extent on the timing of their political cycle and how near or far they were from an election.

368. Regardless of this, we need to recognize that science advice is never free of values, and politics inevitably infuses nearly every decision a government makes. While it is not possible to divorce science advice completely from the political process, where it is as independent as possible, it is more likely to be trusted and accepted by the public. The complexity of possible pandemic responses has shown the shortcomings of giving primacy to medical and epidemiological knowledge without considering 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, producing both a narrow approach and poor implementation.

369. Although the role of science advice in emergencies is well recognized, the best means to obtain it are not always well understood. In many countries, a lack of formal government science advice processes hinders their capacity to rapidly address crises that have large and evolving scientific components, such as pandemics. While there are very many ways in which science advice may operate, which will be designed differently in 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 to the policy-maker in an unbiased manner – a process known as brokerage.

370. While ad hoc advisory mechanisms were developed in many countries during the pandemic, having pre-existing mechanisms in place has considerable value, not just for emergency management but also for assisting on broader aspects of policy development. There is scarcely a sector of policy-making in which robust evidence synthesis and brokerage could not assist. This applies at both the national and international levels.

10.1 Invest in an effective array of evidence synthesis and brokerage capabilities

371. Ensuring a strong bridge between evidence and decision-making requires investment in skilled knowledge synthesis in addition to knowledge production, such that accessible advice is available to decision-makers in a timely fashion and can also be understood by the public. This can help ensure that the trade-offs and risks associated with their decisions are explained to citizens in a transparent manner.

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

373. Modelling in isolation cannot and should not replace a more complete assessment. A well-performing science advisory ecosystem would ensure multiple disciplinary inputs into evidence synthesis, even in an emergency. Decisions based on limited types of evidence, such as over-reliance on numbers and models, should be avoided where possible. 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.

374. 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 properly lie with the policy and political community.

375. Effective brokerage that ensures good understanding by decision-makers in real time is likely to be informal, rather than 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 a plurality of views is transmitted.

376. No science advisory mechanism can possibly cover every potential emergency pre-emptively, but they 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.

10.2 Build capacity and support advice sharing with low-income countries

377. Core to effective science advice and its uptake is that the advice is given in context. This requires locally developed science advice ecosystems, the heart of which is a community of experts, generally found either in universities or government laboratories. Those communities may be very small in the lowest-income countries, obliging them to rely heavily on international information and contacts. Open science systems help, but direct person-to-person or institution-to-institution advice is more responsive. This suggests a role of a science advisor who is linked to the global science advice community and of national academies.

378. Surveys suggest that the WHO was less than optimally responsive in the early stages of the pandemic and, 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 the 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.

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

379. 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 easily denied 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.

380. 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.

381. Underpinning this is support for improved science literacy prior to crises, providing the public with a better understanding of the nature of science and how conclusions reached can evolve and change, and that there will always be uncertainties and caveats.

382. 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 the societal and governmental responses to the science on the other. They are distinctive 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 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 becomes politicized and distrusted. This has important ramifications for how future risks can be communicated and managed.

10.4 Establish a UN Science Advisory Board

383. As is discussed below, there is a large role for multilateral cooperation in any emergency, including the ongoing crisis 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. Some agencies such as the United Nations Environment Programme and the WHO have well-established expert input mechanisms, but these are separate and siloed from each other, have no effective way of being integrated and do not feed into the UN system as a whole. Further, very few emergencies stay solely linked to a single UN agency. While each may pick up and focus on elements that fall within its domain, integrating science to ensure a comprehensive and well-understood response is currently not possible.

384. Additionally, the UN needs a structured way of reaching out to the global science and engineering community beyond individual member state inputs. In this regard, the recommendation of the UN Secretary-General's 2021 report, *Our Common Agenda* (United Nations, 2021b), for a new UN Science Advisory Board is welcomed. However, this must not simply be a replication of the past transient experiment which operated through UNESCO, which was not resourced and did not have a clear mandate. Rather, it must link directly between the UN system as a whole and the science community. Such a committee could also assist in integrating individual UN agency expert inputs.

385. 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.

11 MULTILATERAL SYSTEM REFORM

386. Reform the multilateral system to enhance international cooperation and regional responsiveness before and during crises.

387. Given the widespread impact of COVID-19, the world will struggle to cope with another catastrophe, and yet one is already unfolding in Eastern Europe. The pandemic continues to ravage economies around the world, and in the case of Russia and Ukraine, tensions between governments have moved beyond rhetorical battles to actual combat. More than ever, we need robust intergovernmental institutions, just when they are in a state of decline, and when nationalism has dominated over global cooperation.

388. There is now a risk that as nations seek to address their domestic failings in this pandemic, such as prior underinvestment in health systems, the global response and preparedness for future pandemics and other risks could be undermined. Governments in HICs could turn their attention inward – thereby ignoring the economic and other interdependencies with low-income countries (and other HICs). The need for nations to consider their own citizens is lowering the level of priority given to achieving Agenda 2030, including addressing climate change, and other risks to the global commons.

389. Yet at the same time, the scientific communities have come together to produce remarkable results in terms of vaccine and therapeutic development. Never has the success of this 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. The same must extend to the broader agenda.

390. Concerningly, 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 for cooperation.

391. Building support for multilateralism will therefore require a careful balance between commitment to global mechanisms and responsibility to citizens. Support will be based on results rather than seeing multilateralism as a global good, despite the pandemic having amply demonstrated how the failure of states to work together has had serious impacts on ordinary citizens.

11.1 Address structural weaknesses in the WHO and other multilateral stakeholders

392. Even at the most obvious 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. The COVAX and ACTA-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.

393. The review by the Independent Panel for Pandemic Preparedness and Response[10] drew attention to many issues relating to the ability of the WHO to respond effectively, and a year after its report was released, little progress has been made. Problems with early notification of pandemic risk, data sharing, expertise sharing, and inspection and adequacy of facilities to support a global response were all highlighted. The fundamental weakness of the WHO – 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.

394. Crucially there remains a structural inability to reconcile competing and mutually exclusive positions of the WHO member states: this is as debilitating as the current funding challenges.

395. Of all the conventions related to conflict, the Biological Weapons Convention 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.

11.2 Establish multiple coordinated processes

396. Processes need to be established to mobilize the wider national, regional and international community at earlier stages of a crisis.

397. With respect to pandemics the WHO remains the core global agency. But its structure and functions are now more than 70 years old and designed for a very different world. Even at the outset its structure was somewhat predetermined by the prior existence of two regional bodies. The WHO is largely a technical agency, but its governance is heavily determined in 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. 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-central.

398. Despite the identified weaknesses within the current arrangements, reform appears remote, and discussion has been dominated by political rather than technical considerations. Nonetheless, the logic for more rapid reform is compelling.

399. A major focus needs to be on building and maintaining supply security for vaccines in critically underserved regions. 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. Critically, 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.

11.3 Support the role of civil society and the private sector in reducing social deficits

400. 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. GAVI provided much of the impetus and support for the development of COVAX, which has made critical contributions, 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, which have been core 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 is to be applauded, but this 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 change the trajectory towards a positive long-term scenario.

11.4 Improve international agreements in view of COVID-19 responses

401. The formal international mechanisms for addressing infectious disease have a long history based on the International Health Regulations (IHR) first developed in the 19th century in a very different world to deal with quarantine from ships carrying passengers with a specified set of diseases. Their prime purpose beyond public health was to ensure that trade was

not inappropriately disrupted. They were last revised in 2005 prior to experiences of Ebola, and certainly prior to the extraordinary progress in molecular science that enabled the world to address COVID-19.

402. Worryingly, the current version of the IHRs 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 wasn't as instantly globalized as it is now, and this needs to be reviewed. Another example is travel bans, which are specifically discouraged in the IHRs, but proved to be critical in early management of COVID-19 in many countries. 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 alerting public health crises could allow for a more pragmatic and flexible response to evolving emergencies.

403. Whether amendment of the IHRs alone is sufficient is a matter for diplomats, given the difficulties of achieving a new international instrument in the current context. However after the Chernobyl nuclear incident of 1986, new international agreements and surveillance, inspection and assistance mechanisms were reached very quickly including establishment of a new agency, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization in Vienna. However, the IHRs do have the standing equivalent to any other instrument in international law.

404. Perhaps it is possible to get beyond the IHRs to develop an international instrument (e.g. a treaty or convention) that addresses broader issues of pandemic responses. Critically, this must include financial commitments to support research, surveillance, expert advice, mutual assistance, 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 take investment in pandemic protection and in creating a more effective WHO as a priority.

405. 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. 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 largely moot given progress in molecular biology and its broad accessibility, which was not the case when the Convention was first drafted.

406. But 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 need reference to the Nagoya Protocol on Access and Benefit Sharing (Secretariat of the Convention on Biological Diversity, 2011).

12 INVEST IN LEARNING

407. Increase the capacity for policy learning at local, regional, national and international levels.

408. 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. The greater population density bringing wildlife and humans into closer contact, the 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 this and prior zoonotic outbreaks.

409. For policy-makers, politicians, diplomats, science advisors and researchers, learning what precipitated the event and what went wrong in response is more meaningful than knowing what was done right. Inquiries 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.

410. 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 to learn the right lessons. 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.

411. For this pandemic, and to respond to future ones, studies of 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.

412. There is a need to take human behaviour more into consideration in crises when 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 a 'normal' case. Much is known from the fields of sociology and anthropology of disasters, but was not generally taken into consideration as 'science' during the pandemic.

413. From an international perspective, inquiries such as that conducted by the Independent Panel for Pandemic Preparedness and Response[11] have already highlighted critical areas where reform is needed.

13. CONCLUSION

414. The pandemic is not yet over. Beyond the acute phase, which the world has experienced over the past two years, we continue to face ongoing infections, morbidity and mortality around the world. SARS-CoV-2 has only recently been transmitted to the human species, and we can assume the virus will continue to evolve. It is circulating in wild and domestic animals, and there is evidence that human-to-animal and animal-to-human transfer is associated with a greater risk of mutation. Further, the large population of immunocompromised and unvaccinated people adds to the opportunities for ongoing mutations. In this context we can assume the virus will become endemic, with the potential for episodic mutations to more virulent forms, and there will be an ongoing need for updated vaccines until vaccinology develops more universal protection.

415. The scenarios described illustrate how different decisions by national and international actors will affect long-term outcomes. Several actions and recommendations discussed would shift the current trajectory towards a more optimistic scenario, and away from the possibility of worsening consequences and greater division, inequality and suffering.

416. Clearly the COVID-19 pandemic is not just a public health disaster. It affects 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.

417. While the pandemic has highlighted the value of global scientific cooperation across the public and private sectors, it has also revealed the weaknesses in governance and cooperation with the multilateral system, both within 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 performed over the past two years.

418. 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 removed in many countries. Even if new variants of concern do not emerge, there are many ongoing consequences that will require active governmental intervention for years.

419. This report is the result of cooperation by the international science, policy and diplomatic communities in gathering and sharing ideas and knowledge across a broad range of domains.

420. In Part 1 we detailed and illustrated how the pandemic has influenced every aspect of domestic and global policy-making, and that it has an impact on every domain of the human endeavour. It shows the intertwined connectedness 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.

421. In Part 2 we have pulled out and highlighted 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. The tools illustrated in Part 1 give policy-makers a framework to do so for themselves.

422. The key lessons are, nonetheless, very clear. Even if the acute phase of the pandemic is winding towards an end in those countries with high vaccination rates, the risks will remain high while many in the world do not have access to an effective vaccine. New variants may yet emerge, and vigilance and ongoing vaccine and therapeutic development remain essential.

423. 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.

424. 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.

425. Finding ways to address the politicization of science and the impacts of disinformation 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.

426. Changing the trajectory of this pandemic towards better longer-term outcomes requires us to recognize what has been achieved and to build from that, while acknowledging that much more can be done across broad dimensions, both nationally and globally, to achieve better outcomes for all. We must learn from the lessons of this crisis to prepare better for the inevitable next crisis.

14. GLOSSARY

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

HICs ..... High-income countries

IHR ..... International Health Regulations

ISC ..... International Science Council

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

NGO ..... Non-governmental organization

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

UN ..... United Nations

UN SDGs..... United Nations Sustainable Development Goals

UNDP..... United Nations Development Programme

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

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

WHO .....World Health Organization

Definition of key terms

'Clocks'

Clocks describe a policy dimension and the timeframe at which the outcomes of interest manifest. This conveys the realization that different parts of the global system change and evolve at different speeds and across different timeframes, all while interacting with each other. This report examines seven clocks (health, social, national governance, economics, global governance, environment, and science and technology).

Collaboration Plus scenario

Optimistic plausible case for the development of the pandemic over a 5-year window

Continuity scenario

Most likely case for the development of the pandemic over a 5-year window

Missed Recovery scenario

Pessimistic plausible case for the development of the pandemic over a 5-year window

Outcome domains

Outcome domains describe the broad range of impacts of the pandemic on society. These domains are the State of COVID-19 health, the State of population health (non-COVID), the level of social wellbeing, level of inequality, the economy, the sustainability agenda, and the impact on future existential threats.

Policy dimension

'Policy' describes a collection of actions and values, as well as the framing of events and current societal circumstances.

Vectors of uncertainty

Vectors of uncertainty are a multitude of interacting drivers that influence outcomes, typically identified within dimensions of policy. These are uncertain because of the way that they interact, the unknowability of external events, and variations in the development and implementation of policy.

15. APPENDICES

I. Vectors of uncertainty

CLOCK	VECTORS OF UNCERTAINTY
Health 	Emerging viral variants of concern and surveillance systems
	Global access to antivirals
	Global access to effective vaccines
	Global access to other essential health goods
	Health system capacity/resilience
	Public health and social measures
	State of mental health
Social 	Educational attainment
	Employment structure
	Participation in social networks and community organizations
	Policies targeting inequalities
	Provision of care services
	Social protection measures
	Violence or discrimination
Economics 	Commodity price changes
	Employment demanding growth
	Extent of global trade disruption
	Global tax system changes
	Level of inflation
	LMIC access to global capital markets
	Private investment (including green investment)
	Rising interest rates
	Size of stimulus packages
Environ-mental 	Cascading risks of other disasters
	Environmental degradation
	Food, water and sanitation
	Prioritization of One Health Initiative
	Prioritization of SDGs and climate emergency
Science and technology	Crisis and disaster science
	Data management
	Open science policies
	R&D approach to managing epidemics
	Science education
	Spread of misinformation and disinformation
National governance 	Engagement of the private sector
	Government capacity and resources (including subnational)
	Level of social unrest
	Level of State involvement in response to pandemic
	Multisectoral coordination
	National biosecurity and disaster preparedness
	Politicization of COVID response
	Science-informed policy and communication
	Social capital/trust in government
	Type of government in power (ideology)
Global governance 	Effective regional mechanisms
	Engagement of the private sector
	Financing mechanisms for essential goods
	Geopolitical opportunism
	Global biosecurity/disaster preparedness
	Migration and freedom of movement
	Multi-/bilateral cooperation
	Multisectoral coordination
	State of multilateral institutions (authority)

II. Contributors

The initial ISC Advisory Group that led to the project comprised:

- Sir David Skegg (New Zealand), Chair
- Prof Salim Abdool Karim (South Africa)
- Prof Peter Piot (Belgium)
- Prof Gabriel Leung (Hong Kong)
- Prof Rafi Rafael (Uruguay)
- Prof Teo Yik Ying (Singapore)
- Sir Peter Gluckman (ISC Governing Board)
- Prof Geoffrey Boulton (ISC Governing Board)

The Project Oversight Panel comprised:

- Sir Peter Gluckman (chair)
- Prof Salim Abdool Karim (South Africa)
- Prof Geoffrey Boulton (ISC Governing Board)
- Prof Craig Calhoun (US)
- Prof George Gao (China)
- Prof Eric Goosby (US)
- Prof Elizabeth Jelin (Argentina)
- Chor Pharn Lee (Singapore)
- Prof Peter Piot (Belgium)
- Prof Lucia Reisch (Denmark/UK)
- Prof Aminata Sall Diallo (Senegal)
- Dr Ismail Serageldin (Egypt)
- Prof Anjana Singh (Nepal)
- Sir David Skegg (New Zealand)
- Sir David Spiegelhalter (UK)
- Prof Claudio Struchiner (Brazil)
- Prof Christiane Woopen (Germany)
- Prof Ian Goldin (UK)

Observers:

- Mami Mizutori, Assistant Secretary-General and Special Representative of the Secretary-General for Disaster Risk Reduction (UNDRR)
- Dr Soumya Swaminathan, Chief Scientist, World Health Organization (WHO)

The ISC project team included:

- Dr Inès Hassan, Project Lead (Part 1)
- Dr Anne Bardsley, Project lead (Part 2)
- Dr Mathieu Denis
- Dr Heide Hackmann
- Prof David Kaplan
- Nick Ishmael-Perkins
- Raina Klüppelberg
- Sarah Talon Sampieri
- Alison Meston
- James Waddell

Writing and editorial team:

- Dr Anne Bardsley
- Nick Ishmael-Perkins
- Prof David Kaplan
- Sir Peter Gluckman

Editorial Assistance:

- Mattias Schwedin
- Jay Patel
- Reece Salter-Orme
- Gareth Willmer

The Technical Advisory Group:

- Chris Bradley (McKinsey & Co, Australia)
- Chor Pharn Lee (Singapore)

The systems map was developed with Rachel Meadows (Cognitive Performance Laboratories, New Zealand)

The report was designed by Clinton Stringer

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IV. Bibliography

acatech (ed.). 2020. *A Resilient and Sustainable Food Supply: The Coronavirus Crisis and Other Challenges*. Munich, acatech IMPULSE.

Addo, I.Y. 2020. Double pandemic: racial discrimination amid coronavirus disease 2019. *Social Sciences & Humanities Open* Vol. 2, Article 100074. https://doi.org/10.1016/j.ssaho.2020.100074

African Development Bank Group. 2022. *Six African countries to receive initial transfer of mRNA vaccine technology*. https://www.afdb.org/en/news-and-events/six-african-countries-receive-initial-transfer-mrna-vaccine-technology-49460 (Accessed 21 April 2022).

Agaton, C.B. and Cueto, L.J. 2021. Experiences, coping strategies, and lessons learned during double disaster in the Philippines: COVID-19 pandemic and typhoons (preprint). In review. https://doi.org/10.21203/rs.3.rs-322295/v1

Alejo, K. 2014. Long-term physical and mental health effects of domestic violence. *Themis* Vol. 2, Article 5. https://doi.org/10.31979/THEMIS.2014.0205

Amarachukwu Nkechi, Nwoye & David-Okoro, Ijeoma & Chioma Stephanie, Mbaegbu & Top Academic Journals In the Usa, Best American Journals. (2021). The Impact of Covid-19 Pandemic on Science Education in Anambra State of Nigeria. 9. https://www.researchgate.net/publication/352091983_The_Impact_of_Covid-19_Pandemic_on_Science_Education_in_Anambra_State_of_Nigeria

Arbogast, I., Reinbold, B., and Wen, Y. 2020. *Anecdotal Evidence Suggests State Capacity Unrelated to COVID-19 Spread*. Federal Reserve Bank of St. Louis.

Azevedo, J.P. 2020. *Learning Poverty in the Time of COVID-19: A Crisis Within a Crisis*. World Bank. https://openknowledge.worldbank.org/handle/10986/34850 (Accessed 22 April 2022).

Azcona, G., Bhatt, A., Encarnacion, J., Plazaola-Castaño, J., Seck, P., Staab, S., Turquet, L. From Insights to Action: Gender Equality in the Wake of COVID-19. Page 3. UN Women Headquarters. https://www.unwomen.org/en/digital-library/publications/2020/09/gender-equality-in-the-wake-of-covid-19

Azevedo, Joao Pedro; Hasan, Amer; Goldemberg, Diana; Iqbal, Syedah Aroob; Geven, Koen. 2020. Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes : A Set of Global Estimates. Policy Research Working Paper; No. 9284. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/33945 License: CC BY 3.0 IGO.

Badker, R., Miller, K., Pardee, C., Oppenheim, B., Stephenson, N., Ash, B., Philippsen, T., Ngoon, C., Savage, P., Lam, C., Madhav, N. 2021. Challenges in reported COVID-19 data: best practices and recommendations for future epidemics. *BMJ Global Health* Vol. 6, No. 5, Article e005542. doi:10.1136/bmjgh-2021-005542

Baird, S., Ferreira, F.H.G., Özler, B., and Woolcock, M. 2014. Conditional, unconditional and everything in between: a systematic review of the effects of cash transfer programmes on schooling outcomes. *Journal of Development Effectiveness* Vol. 6, pp. 1–43. https://doi.org/10.1080/19439342.2014.890362

Balsari, S., Buckee, C. and Khanna, T. 2020. Which Covid-19 data can you trust?, *Harvard Business Review*, 8 May. https://hbr.org/2020/05/which-covid-19-data-can-you-trust (Accessed 5 October 2021).

Barbour, V. and Borchert, M. 2020. Open science: after the COVID-19 pandemic there can be no return to closed working, 22 April. https://www.science.org.au/curious/policy-features/open-science-after-covid-19-pandemic-there-can-be-no-return-closed-working (Accessed 5 October 2021).

Bauer, A. and Evans-Lacko, S. 2021. Prioritising the life chances of young people living in poverty during the COVID-19 pandemic: A call for integrating youth mental health into cash transfer programmes. LSE Global Health. https://blogs.lse.ac.uk/globalhealth/2021/06/07/prioritising-the-life-chances-of-young-people-living-in-poverty-during-the-covid-19-pandemic-a-call-for-integrating-youth-mental-health-into-cash-transfer-programmes/ (Accessed 1 October 2021).

Bauer, A., Garman, E., McDaid, D., Avendano, M., Hessel, P., Díaz, Y., Araya, R., Lund, C., Malvasi, P., Matijasevich, A., Park, A.-L., Paula, C.S., Ziebold, C., Zimmerman, A., and Evans-Lacko, S. 2021. Integrating youth mental health into cash transfer programmes in response to the COVID-19 crisis in low-income and middle-income countries. *The Lancet Psychiatry* Vol. 8, pp. 340–346. https://doi.org/10.1016/S2215-0366(20)30382-5

Becker, M., Dulovic, A., Junker, D., Ruetalo, N., Kaiser, P.D., Pinilla, Y.T., Heinzel, C., Haering, J., Traenkle, B., Wagner, T.R., Layer, M., Mehrlaender, M., Mirakaj, V., Held, J., Planatscher, H., Schenke-Layland, K., Krause, G., Strengert, M., Bakchoul, T., Althaus, K., Fendel, R., Kreidenweiss, A., Koeppen, M., Rothbauer, U., Schindler, M., and Schneiderhan-Marra, N. 2021. Immune response to SARS-CoV-2 variants of concern in vaccinated individuals. *Nat Commun* Vol. 12, Article 3109. https://doi.org/10.1038/s41467-021-23473-6

Billings, J., Abou Seif, N., Hegarty, S., Ondruskova, T., Soulios, E., Bloomfield, M., and Greene, T. 2021. What support do frontline workers want? A qualitative study of health and social care workers' experiences and views of psychosocial support during the COVID-19 pandemic. *PLoS ONE* Vol. 16, Article e0256454. https://doi.org/10.1371/journal.pone.0256454

Bong, C.-L., Brasher, C., Chikumba, E., McDougall, R., Mellin-Olsen, J., and Enright, A. 2020. The COVID-19 pandemic: effects on low- and middle-income countries. *Anesthesia & Analgesia* Vol. 131, pp. 86–92. https://doi.org/10.1213/ANE.0000000000004846

Boniol M, McIsaac M, Xu L, Wuliji T, Diallo K, Campbell J. Gender equity in the health workforce: analysis of 104 countries. Working paper 1. Geneva: World Health Organization; 2019 (WHO/HIS/HWF/Gender/WP1/2019.1). Licence: CC BY-NC-SA 3.0 IGO.

Borgonovi, Francesca, and Artur Pokropek. "Can We Rely on Trust in Science to Beat the COVID-19 Pandemic?." PsyArXiv, 21 May 2020. https://doi.org/10.31234/osf.io/yq287

Boswinkel, L. and Gaub, F. 2020. Geopolitical implications of the COVID-19 pandemic 54. Study requested by the European Parliament's Committee on Foreign Affairs. European Parliament, Brussels. doi:10.2861/526114

Boulton, G. 2020. *Covid-19 and access to scientific knowledge*, ISC Blog, 6 May. https://council.science/current/blog/covid-19-and-access-to-scientific-knowledge/ (Accessed 5 October 2021).

Bracken, M. 2021. About a quarter of health care workers have considered leaving their job since the onset of the pandemic. Morning Consult. https://morningconsult.com/2021/01/25/about-a-quarter-of-health-care-workers-have-considered-leaving-their-job-since-the-onset-of-the-pandemic/ (Accessed 24 September 2021).

The British Academy. 2021. The COVID Decade: understanding the long-term societal impacts of COVID-19. The British Academy, London. https://www.thebritishacademy.ac.uk/documents/3238/COVID-decade-understanding-long-term-societal-impacts-COVID-19.pdf

Brown, C. and Fischer, S. 2020. The industries that won't recover without a vaccine. Axios. https://www.axios.com/industries-recovery-coronavirus-vaccine-78a193bc-db73-4650-9be8-e42c892a754f.html (Accessed 1 October 2021).

Brown, F.Z., Brechenmacher, S., and Carothers, T. 2020. *How Will the Coronavirus Reshape Democracy and Governance Globally?* Carnegie Endowment for International Peace, Washington D.C.

Caldwell, M., Alayza, N., and Larsen, G. 2021. How Domestic Budget Shortfalls Due to COVID-19 Impact Climate Action. World Resources Institute, Washington D.C. https://www.wri.org/insights/how-domestic-budget-shortfalls-due-covid-19-impact-climate-action

Callaway, E. 2020. Will the pandemic permanently alter scientific publishing?, *Nature*, Vol. 582, No. 7811, pp. 167–168. doi:10.1038/d41586-020-01520-4

Castrillon, C. 2021. *This is the future of remote work in 2021*. Forbes. https://www.forbes.com/sites/carolinecastrillon/2021/12/27/this-is-the-future-of-remote-work-in-2021/ (Accessed 1 October 2021).

Cauchemez, S. and Kiem, C.T. 2021. Managing COVID-19 importation risks in a heterogeneous world. *The Lancet Public Health*, Vol. 6, No. 9, pp. e626–e627. doi:10.1016/S2468-2667(21)00188-2

Causey, K., Fullman, N., Sorensen, R.J.D., Galles, N.C., Zheng, P., Aravkin, A., Danovaro-Holliday, M.C., Martinez-Piedra, R., Sodha, S.V., Velandia-González, M.P., Gacic-Dobo, M., Castro, E., He, J., Schipp, M., Deen, A., Hay, S.I., Lim, S.S., and Mosser, J.F. 2021. Estimating global and regional disruptions to routine childhood vaccine coverage during the COVID-19 pandemic in 2020: a modelling study. *The Lancet* Vol. 398, pp. 522–534. https://doi.org/10.1016/S0140-6736(21)01337-4

Chang, H.-Y., Chiou, C.-J., and Chen, N.-S. 2010. Impact of mental health and caregiver burden on family caregivers' physical health. *Archives of Gerontology and Geriatrics* Vol. 50, pp. 267–271. https://doi.org/10.1016/j.archger.2009.04.006

Charron, N., Lapuente, V., and Rodriguez-Pose, A. 2020. *Uncooperative Society, Uncooperative Politics or Both?* Working paper No. 2020:12. University of Gothenburg.

Cingano, F. 2014. *Trends in Income Inequality and its Impact on Economic Growth*. OECD Social, Employment and Migration Working Papers No. 163. https://doi.org/10.1787/5jxrjncwxv6j-en

Ciobanu, C. 2021. *Poland further restricts media freedom, angers US with controversial media law*. Balkan Insight. https://balkaninsight.com/2021/08/12/poland-further-restricts-media-freedom-angers-us-with-controversial-media-law/ (Accessed 29 September 2021).

cOAlition S. 'Plan S' and 'cOAlition S' – Accelerating the transition to full and immediate Open Access to scientific publications. https://www.coalition-s.org/ (Accessed 5 October 2021).

Cobey, S., Larremore, D.B., Grad, Y.H., and Lipsitch, M. 2021. Concerns about SARS-CoV-2 evolution should not hold back efforts to expand vaccination. *Nat Rev Immunol* Vol. 21, pp. 330–335. https://doi.org/10.1038/s41577-021-00544-9

Cohen, J. 2021. The dream vaccine. *Science* Vol. 372, pp. 227–231. https://doi.org/10.1126/science.372.6539.227

Columbo, E., and Harris, M. 2020. *Extremist groups stepping up operations during the Covid-19 outbreak in sub-Saharan Africa*. Center for Strategic and International Studies. https://www.csis.org/analysis/extremist-groups-stepping-operations-during-covid-19-outbreak-sub-saharan-africa (Accessed 28 September 2021).

Cook, T.M. and El-Boghdadly, K. 2020. COVID-19 risk tools should incorporate assessment of working environment risk and its mitigation. *EClinicalMedicine*, Vol. 28. doi:10.1016/j.eclinm.2020.100613

Crichton, F. 2020. *What are the roots of science denialism in the time of COVID-19, and how do we untangle them?* Public Interest Media, 16 December. https://www.thebigq.org/2020/12/16/what-are-the-roots-of-science-denialism-in-the-time-of-covid-19-and-how-do-we-untangle-them/ (Accessed 4 October 2021).

Crivello, G. 2020. *Coming of age in the time of coronavirus: young lives and families in low- and middle-income countries*. University of Oxford, Oxford News Blog. https://www.ox.ac.uk/news/science-blog/coming-age-time-coronavirus-young-lives-and-families-low-and-middle-income (Accessed 1 October 2021).

Croucher, G. and Locke, W. 2020 *A post-coronavirus pandemic world: some possible trends and their implications for Australian higher education*. The University of Melbourne. https://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0010/3371941/a-post-coronavirus-world-for-higher-education_final.pdf (Accessed 21 April 2022).

Crutchfield, R.D. and Wadsworth, T. 2003. Poverty and violence. W. Heitmeyer and J. Hagan (eds), *International Handbook of Violence Research*. Dordrecht, Springer Netherlands, pp. 67–82. https://doi.org/10.1007/978-0-306-48039-3_4

Cuberes, D. and Teignier, M. 2016. Aggregate effects of gender gaps in the labor market: a quantitative estimate. *Journal of Human Capital* Vol. 10, pp. 1–32. https://doi.org/10.1086/683847

De Henau, J. and Himmelweit, S. 2020. A Care-Led Recovery from Coronavirus. Women's Budget Group, London. https://wbg.org.uk/wp-content/uploads/2020/06/Care-led-recovery-final.pdf

Deloitte. 2020. *The world remade by COVID-19*. Deloitte. https://www2.deloitte.com/global/en/pages/about-deloitte/articles/covid-19/covid-19-scenarios-and-impacts-for-business-and-society-world-remade.html (Accessed 5 October 2021).

The DELVE Initiative. 2020. *Data readiness: lessons from an emergency*. The Royal Society. https://rs-delve.github.io/reports/2020/11/24/data-readiness-lessons-from-an-emergency.html (Accessed 5 October 2021).

Denham, E. 2021. *Data Protection law can help create public trust and confidence around COVID-status certification schemes*. ICO Blog, 26 March. https://ico.org.uk/about-the-ico/news-and-events/blog-data-protection-law-can-help-create-public-trust-and-confidence-around-covid-status-certification-schemes/ (Accessed 5 October 2021).

Desai, A., Nouvellet, P., Bhatia, S., Cori, A.n Lassmann, B. 2021. Data journalism and the COVID-19 pandemic: opportunities and challenges. *The Lancet Digital Health*, Vol. 3, No. 10, pp. e619–e621. doi:10.1016/S2589-7500(21)00178-3

Deutsche Welle. 2021. *Coronavirus: Berlin anti-lockdown protesters clash with police*. DW, 1 August 2021. https://www.dw.com/en/coronavirus-berlin-anti-lockdown-protesters-clash-with-police/a-58722453 (Accessed 29 September 2021).

Devakumar, D., Shannon, G., Bhopal, S.S., and Abubakar, I. 2020. Racism and discrimination in COVID-19 responses. *The Lancet* Vol. 395, p. 1194. https://doi.org/10.1016/S0140-6736(20)30792-3

Djoomart Otorbaev et al. 2020. *An open letter to UN, G20, and national governments on COVID-19 impact on food security*. CGTN. https://news.cgtn.com/news/2020-05-05/An-open-letter-to-UN-G20-and-national-governments-on-COVID-19-impact-QdE0h4nQNG/index.html (Accessed 4 October 2021).

Douek, E. 2020. *How can social media platforms better prevent fake news? 3 questions to Evelyn Douek*. https://www.sciencespo.fr/public/chaire-numerique/en/2020/07/09/social-media-platform-prevent-fake-news-evelyn-douek/ (Accessed 4 October 2021).

Dudzic, M. 2020. *On Medicare for all: fight for what we want, not what we think we can get*. Labor Notes. https://labornotes.org/blogs/2020/08/medicare-all-fight-what-we-want-not-what-we-think-we-can-get (Accessed 28 September 2021).

The Economist. The pandemic's true death toll. https://www.economist.com/graphic-detail/coronavirus-excess-deaths-estimates (Accessed 22 April 2022).

Eguia, R.T., Crawford, K.H.D., Stevens-Ayers, T., Kelnhofer-Millevolte, L., Greninger, A.L., Englund, J.A., Boeckh, M.J., and Bloom, J.D. 2021. A human coronavirus evolves antigenically to escape antibody immunity. *PLOS Pathogens* Vol. 17, Article e1009453. https://doi.org/10.1371/journal.ppat.1009453

Essop, T. and von Holdt, K. 2020. *COVID-19 in South Africa: Popular movements mobilise under lockdown*. The Wire. https://thewire.in/world/covid-19-in-south-africa-popular-movements-mobilise-under-lockdown (Accessed 27 September 2021).

European Commission. 2020. *Overview of the Impact of Coronavirus Measures on the Marginalised Roma Communities in the EU*. European Commission, Brussels.

Faber, R., Ashraf, S., Faber, F. Sinibaldi, S. 2020. Opinion: The coronavirus response needs local communities and faith leaders. Devex, Washington D.C. https://www.devex.com/news/opinion-the-coronavirus-response-needs-local-communities-and-faith-leaders-97147

FAO, IFAD, UNICEF, WFP and WHO. 2021. *The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*. Rome, FAO. https://www.fao.org/3/cb4474en/online/cb4474en.html#chapter-executive_summary

Ferreira dos Santos, G., Santana Ribeiro, L.C., and Barbosa de Cerqueira, R. 2020. The informal sector and Covid-19 economic impacts: The case of Bahia, Brazil. *Reg Sci Policy Pract* Vol. 12, pp. 1273–1285. https://doi.org/10.1111/rsp3.12366

Fierz, W. and Walz, B. 2020. Antibody dependent enhancement due to original antigenic sin and the development of SARS. *Frontiers in Immunology* Vol. 11, Article 1120. https://doi.org/10.3389/fimmu.2020.01120

Flaxman, S., Mishra, S., Gandy, A., Unwin, H.J.T., Mellan, T.A., Coupland, H., Whittaker, C., Zhu, H., Berah, T., Eaton, J.W., Monod, M., Ghani, A.C., Donnelly, C.A., Riley, S., Vollmer, M.A.C., Ferguson, N.M., Okell, L.C., and Bhatt, S. 2020. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature* Vol. 584, pp. 257–261. https://doi.org/10.1038/s41586-020-2405-7

Flemming, S. 2021. The pandemic has damaged youth employment: Here's how we can help. World Economic Forum. https://www.weforum.org/agenda/2021/07/pandemic-damaged-youth-employment/ (Accessed 1 October 2021).

Fukuyama, F. and López-Calva, L.F. 2021. *Pandemics and Political Performance*. Project Syndicate, New York. https://www.project-syndicate.org/commentary/pandemic-political-decay-latin-america-caribbean-by-francis-fukuyama-and-luis-felipe-lopez-calva-2021-06?barrier=accesspaylog

G20. 2021. *High Level Independent Panel urges the G20 to launch a 'global deal' to prevent catastrophic costs of future pandemics*. G20. https://www.g20.org/high-level-independent-panel-urges-the-g20-to-launch-a-global-deal-to-prevent-catastrophic-costs-of-future-pandemics.html (Accessed 5 October 2021).

Galea, S., Merchant, R.M., and Lurie, N. 2020. The mental health consequences of COVID-19 and physical distancing: the need for prevention and early intervention. *JAMA Intern Med* Vol. 180, Article 817. https://doi.org/10.1001/jamainternmed.2020.1562

Global Development Institute. 2020. *Understanding the impacts of Covid-19 on livelihoods in Bangladesh: Findings from the PPRC-BIGD Rapid Response Survey*. Global Development Institute Blog. http://blog.gdi.manchester.ac.uk/understanding-the-impacts-of-covid-19-on-livelihoods-in-bangladesh/ (Accessed 28 September 2021).

Gopinath, G. 2021. *Drawing further apart: widening gaps in the global recovery*. International Monetary Fund. https://blogs.imf.org/2021/07/27/drawing-further-apart-widening-gaps-in-the-global-recovery/ (Accessed 30 September 2021).

Gould, E. and Kassa, M. 2020. *Young workers hit hard by the COVID-19 economy: Workers ages 16–24 face high unemployment and an uncertain future*. Economic Policy Institute. https://www.epi.org/publication/young-workers-covid-recession/ (Accessed 1 October 2021).

GOV.UK. 2021. *Joint Biosecurity Centre*. GOV.UK. https://www.gov.uk/government/groups/joint-biosecurity-centre (Accessed 20 September 2021).

Gozgor, G. 2021. Global evidence on the determinants of public trust in governments during the COVID-19. *Applied Research in Quality of Life*, Vol. 17, pp. 559–578. https://doi.org/10.1007/s11482-020-09902-6

Griffin, R. 2020. *Social media and content moderation in times of Covid-19*. https://www.sciencespo.fr/public/chaire-numerique/en/2020/07/09/social-media-and-content-moderation-in-times-of-covid-19/ (Accessed 4 October 2021).

Grifoni, A., Weiskopf, D., Ramirez, S.I., Mateus, J., Dan, J.M., Moderbacher, C.R., Rawlings, S.A., Sutherland, A., Premkumar, L., Jadi, R.S., Marrama, D., Silva, A.M. de, Frazier, A., Carlin, A.F., Greenbaum, J.A., Peters, B., Krammer, F., Smith, D.M., Crotty, S., and Sette, A. 2020. Targets of T cell responses to SARS-CoV-2 coronavirus in humans with COVID-19 disease and unexposed individuals. *Cell* Vol. 181, pp. 1489–1501.e15. https://doi.org/10.1016/j.cell.2020.05.015

Gual Soler, M. and Dadlani, K. 2020. *Resetting the way we teach science is vital for all our futures*. World Economic Forum. https://www.weforum.org/agenda/2020/08/science-education-reset-stem-technology/ (Accessed 4 October 2021).

Guarascio, F. 2021. *Exclusive WHO estimates COVID-19 boosters needed yearly for most vulnerable*. Reuters. https://www.reuters.com/business/healthcare-pharmaceuticals/exclusive-who-estimates-covid-19-boosters-needed-yearly-most-vulnerable-2021-06-24/

The Guardian. 2021. The Guardian view on French Covid pass protesters: attention must be paid. The Guardian. https://www.theguardian.com/commentisfree/2021/aug/08/the-guardian-view-on-french-covid-pass-protesters-attention-must-be-paid

Guyot, K. and Sawhill, I.V. 2020. *Telecommuting will likely continue long after the pandemic*. Brookings. https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic/ (Accessed 1 October 2021).

Hannah, E., Scott, J., Trommer, S., and Harman, S. 2021. *TRIPS waiver: US support is a major step but no guarantee of COVID-19 vaccine equity*. The Conversation. http://theconversation.com/trips-waiver-us-support-is-a-major-step-but-no-guarantee-of-covid-19-vaccine-equity-160638 (Accessed 30 September 2021).

Hanushek, E.A. and Woessmann, L. 2020. *The Economic Impacts of Learning Losses*. Paris, OECD.

Harvey, W.T., Carabelli, A.M., Jackson, B., Gupta, R.K., Thomson, E.C., Harrison, E.M., Ludden, C., Reeve, R., Rambaut, A., Peacock, S.J., and Robertson, D.L. 2021. SARS-CoV-2 variants, spike mutations and immune escape. *Nat Rev Microbiol* Vol. 19, pp. 409–424. https://doi.org/10.1038/s41579-021-00573-0

Hawrilenko, M., Kroshus, E., Tandon, P., and Christakis, D. 2021. The association between school closures and child mental health during COVID-19. *JAMA Netw Open* Vol. 4, Article e2124092. https://doi.org/10.1001/jamanetworkopen.2021.24092

High Level Panel of Experts on Food security and Nutrition. 2020. *Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic*. FAO, Rome. doi:10.4060/cb1000en

Hillis, S.D., Unwin, H.J.T., Chen, Y., Cluver, L., Sherr, L., Goldman, P.S., Ratmann, O., Donnelly, C.A., Bhatt, S., Villaveces, A., Butchart, A., Bachman, G., Rawlings, L., Green, P., Nelson, C.A., and Flaxman, S. 2021. Global minimum estimates of children affected by COVID-19-associated orphanhood and deaths of caregivers: a modelling study. *The Lancet* Vol. 398, pp. 391–402. https://doi.org/10.1016/S0140-6736(21)01253-8

Holford, M. and Morgan, R. 2020. *4 ways science should transform after COVID-19*. World Economic Forum. https://www.weforum.org/agenda/2020/06/4-ways-science-needs-to-change-after-covid-19-coronavirus/ (Accessed 4 October 2021).

Hotez, P.J., Batista, C., Amor, Y.B., Ergonul, O., Figueroa, J.P., Gilbert, S., Gursel, M., Hassanain, M., Kang, G., Kaslow, D.C., Kim, J.H., Lall, B., Larson, H., Naniche, D., Sheahan, T., Shoham, S., Wilder-Smith, A., Sow, S.O., Strub-Wourgaft, N., Yadav, P., and Bottazzi, M.E. 2021. Global public health security and justice for vaccines and therapeutics in the COVID-19 pandemic. *EClinicalMedicine* Vol. 39. https://doi.org/10.1016/j.eclinm.2021.101053

Huang, A.T., Garcia-Carreras, B., Hitchings, M.D.T., Yang, B., Katzelnick, L.C., Rattigan, S.M., Borgert, B.A., Moreno, C.A., Solomon, B.D., Trimmer-Smith, L., Etienne, V., Rodriguez-Barraquer, I., Lessler, J., Salje, H., Burke, D.S., Wesolowski, A., and Cummings, D.A.T., 2020. A systematic review of antibody mediated immunity to coronaviruses: kinetics, correlates of protection, and association with severity. *Nat Commun* Vol. 11, Article 4704. https://doi.org/10.1038/s41467-020-18450-4

Human Rights Watch. 2021. *Mexico: Abuses against asylum seekers at US border*. Human Rights Watch. https://www.hrw.org/news/2021/03/05/mexico-abuses-against-asylum-seekers-us-border (Accessed 1 October 2021).

IATA. 2021. *2020 worst year in history for air travel demand*. https://www.iata.org/en/pressroom/pr/2021-02-03-02/ (Accessed 21 April 2022).

Ibrahim, H., Liu, X., Zariffa, N., Morris, A., Denniston, A. 2021. Health data poverty: an assailable barrier to equitable digital health care. *The Lancet Digital Health*, Vol. 3, No. 4, pp. e260–e265. doi:10.1016/S2589-7500(20)30317-4

ICT Moscow. 2020. *COVID-Tech in Russia: technologies against the pandemic*. https://ict.moscow/en/news/covid-tech-technologies-against-the-pandemic/ (accessed 29 September 2021).

Ienca, M. and Vayena, E. 2020. On the responsible use of digital data to tackle the COVID-19 pandemic. *Nature Medicine*, Vol. 26, No. 4, pp. 463–464. doi:10.1038/s41591-020-0832-5

IFPMA. 2021. As COVID-19 vaccine output estimated to reach over 12 billion by year end and 24 billion by mid-2022, innovative vaccine manufacturers renew commitment to support G20 efforts to address remaining barriers to equitable access. https://www.ifpma.org/resource-centre/as-covid-19-vaccine-output-estimated-to-reach-over-12-billion-by-year-end-and-24-billion-by-mid-2022-innovative-vaccine-manufacturers-renew-commitment-to-support-g20-efforts-to-address-remaining-barr/

Iftekhar, E.N., Priesemann, V., Balling, R., Bauer, S., Beutels, P., Calero Valdez, A., Cuschieri, S., Czypionka, T., Dumpis, U., Glaab, E., Grill, E., Hanson, C., Hotulainen, P., Klimek, P., Kretzschmar, M., Krüger, T., Krutzinna, J., Low, N., Machado, H., Martins, C., McKee, M., Mohr, S.B., Nassehi, A., Perc, M., Petelos, E., Pickersgill, M., Prainsack, B., Rocklöv, J., Schernhammer, E., Staines, A., Szczurek, E., Tsiodras, S., Van Gucht, S., and Willeit, P. 2021. A look into the future of the COVID-19 pandemic in Europe: an expert consultation. *The Lancet Regional Health - Europe* Vol. 8, Article 100185. https://doi.org/10.1016/j.lanepe.2021.100185

Igoe, M. and Chadwick, V. 2020. *After the pandemic: How will COVID-19 transform global health and development?* Devex. https://www.devex.com/news/sponsored/after-the-pandemic-how-will-covid-19-transform-global-health-and-development-96936 (Accessed 5 October 2021).

IHME. 2021. *COVID-19 projections*. Institute for Health Metrics and Evaluation. https://covid19.healthdata.org/ (Accessed 30 September 2021).

ILO. 2016. *Políticas de formalización del trabajo doméstico remunerado en América Latina y El Caribe*. OIT/ International Labour Organization, Lima.

ILO. 2018. *Women and Men in the Informal Economy: A Statistical Picture*. International Labour Office, Geneva.

ILO. 2020. *Preventing Exclusion from the Labour Market: Tackling the COVID-19 Youth Employment Crisis*. Policy Brief. Geneva, ILO.

ILO. 2021a. *Fewer women than men will regain employment during the COVID-19 recovery says ILO*. http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_813449/lang--en/index.htm (Accessed 1 October 2021).

ILO. 2021b. *ILO Monitor: COVID-19 and the world of work. Seventh edition*. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/briefingnote/wcms_767028.pdf (Accessed 21 April 2022).

IMF. 2021. *World Economic Outlook, April 2021: Managing Divergent Recoveries*. Washington, DC, International Monetary Fund.

Intergovernmental Science-Policy Platform On Biodiversity And Ecosystem Services (IPBES). 2020. *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)*. Zenodo. doi:10.5281/ZENODO.4147317

International Commission on the Futures of Education. 2020. *Education in a post-COVID world: Nine ideas for public action*. Paris, UNESCO. https://en.unesco.org/sites/default/files/education_in_a_post-covid_world-nine_ideas_for_public_action.pdf (Accessed 22 April 2022).

International Science Council. 2021. *Opening the record of science: making scholarly publishing work for science in the digital era.* Paris, International Science Council. doi: 10.24948/2021.01

IPPPR. 2021. *COVID-19: Make it the last pandemic*. Independent Panel For Pandemic Preparedness & Response. https://theindependentpanel.org/wp-content/uploads/2021/05/COVID-19-Make-it-the-Last-Pandemic_final.pdf

Jensen, E., Jensen, A., Pfleger, A., Kennedy, E., Greenwood, E. 2021. *Has the pandemic changed public attitudes about science?* Impact of Social Sciences, 12 March. https://blogs.lse.ac.uk/impactofsocialsciences/2021/03/12/has-the-pandemic-changed-public-attitudes-about-science/ (Accessed 4 October 2021).

Jubilee USA Network. 2021. *Most countries to lose a decade of development progress says United Nations as global COVID crisis continues*. Jubilee USA Network. https://www.jubileeusa.org/pr_unctad_report (Accessed 28 September 2021).

Jungkunz, S. 2021. Political polarization during the COVID-19 pandemic. *Frontiers in Political Science* Vol. 3, Article 6. https://doi.org/10.3389/fpos.2021.622512

Kahn, L.B. 2010. The long-term labor market consequences of graduating from college in a bad economy. *Labour Economics* Vol. 17, pp. 303–316. https://doi.org/10.1016/j.labeco.2009.09.002

Karlinsky, A. and Kobak, D. 2021. Tracking excess mortality across countries during the COVID-19 pandemic with the World Mortality Dataset. *eLife* Vol. 10, Article e69336. https://doi.org/10.7554/eLife.69336

Kentor, R.A. and Kaplow, J.B. 2020. Supporting children and adolescents following parental bereavement: guidance for health-care professionals. *The Lancet Child & Adolescent Health* Vol. 4, pp. 889–898. https://doi.org/10.1016/S2352-4642(20)30184-X

Khambule, I. and Siswana, B. 2020. *How inequalities undermine social cohesion: a case study of South Africa*. G20 Insights. https://www.g20-insights.org/policy_briefs/inequalities-undermine-social-cohesion-case-study-south-africa/ (Accessed 24 September 2021).

Kharas, H. 2020. *The impact of COVID-19 on global extreme poverty*. Brookings. https://www.brookings.edu/blog/future-development/2020/10/21/the-impact-of-covid-19-on-global-extreme-poverty/ (Accessed 30 September 2021).

Klasen, S. 2002. Low schooling for girls, slower growth for all? Cross-country evidence on the effect of gender inequality in education on economic development. *The World Bank Economic Review* Vol. 16, pp. 345–373. https://doi.org/10.1093/wber/lhf004

Kleinfeld, R. 2021. *Do Authoritarian or Democratic Countries Handle Pandemics Better?* Carnegie Endowment for International Peace, Washington D.C. https://carnegieendowment.org/2020/03/31/do-authoritarian-or-democratic-countries-handle-pandemics-better-pub-81404

Kumar, C., Oommen, E., Fragapane, F., and Foresti, M. 2021. *Beyond Gratitude: Lessons Learned from Migrants' Contribution to the COVID-19 Response* (Working paper). Overseas Development Institute, London. https://odi.org/en/publications/beyond-gratitude-lessons-learned-from-migrants-contribution-to-the-covid-19-response/

Kurowski, C., Evans, D., Hoang-Vu Eozenou, P., Schmidt, M., Irwin, A., and Postolovska, I. 2021. *Health financing rifts mean growing risks for a global recovery*. World Bank Blogs. https://blogs.worldbank.org/health/health-financing-rifts-mean-growing-risks-global-recovery (Accessed 1 October 2021).

Kustin, T., Harel, N., Finkel, U., Perchik, S., Harari, S., Tahor, M., Caspi, I., Levy, R., Leshchinsky, M., Ken Dror, S., Bergerzon, G., Gadban, H., Gadban, F., Eliassian, E., Shimron, O., Saleh, L., Ben-Zvi, H., Keren Taraday, E., Amichay, D., Ben-Dor, A., Sagas, D., Strauss, M., Shemer Avni, Y., Huppert, A., Kepten, E., Balicer, R.D., Netzer, D., Ben-Shachar, S., and Stern, A. 2021. Evidence for increased breakthrough rates of SARS-CoV-2 variants of concern in BNT162b2-mRNA-vaccinated individuals. *Nat Med* Vol. 27, pp. 1379–1384. https://doi.org/10.1038/s41591-021-01413-7

Kwok, A.H., Doyle, E.E.H., Becker, J., Johnston, D., and Paton, D. 2016. What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand. *International Journal of Disaster Risk Reduction* Vol. 19, pp. 197–211. https://doi.org/10.1016/j.ijdrr.2016.08.013

Kwon, D. 2020. How swamped preprint servers are blocking bad coronavirus research. *Nature*, Vol. 581, No. 7807, pp. 130–131. doi:10.1038/d41586-020-01394-6

Laborde, D., Martin, W. and Vos, R. 2021. Impacts of COVID-19 on global poverty, food security, and diets: Insights from global model scenario analysis. *Agricultural Economics*, Vol. 52, No. 3, pp. 375–390. doi:10.1111/agec.12624

The Lancet (ed.). 2021. Addendum: competing interests and the origins of SARS-CoV-2. *The Lancet*, Vol. 397, No. 10293, pp. 2449–2450. doi:10.1016/S0140-6736(21)01377-5

The Lancet Infectious Diseases (ed.). 2021. COVID-19 vaccine equity and booster doses. *Lancet Infect Dis* Vol. 21, Article 1193. https://doi.org/10.1016/S1473-3099(21)00486-2

Larkin, H. 2021. Navigating attacks against health care workers in the COVID-19 era. *JAMA* Vol. 325, pp. 1822–1824. https://doi.org/10.1001/jama.2021.2701

Leach, M., MacGregor, H., Scoones, I., and Wilkinson, A. 2021. Post-pandemic transformations: How and why COVID-19 requires us to rethink development. *World Dev* Vol. 138, Article 105233. https://doi.org/10.1016/j.worlddev.2020.105233

Lee, J. 2020. Mental health effects of school closures during COVID-19. *The Lancet Child & Adolescent Health* Vol. 4, Article 421. https://doi.org/10.1016/S2352-4642(20)30109-7

Lee, T.-L. 2020. Legal preparedness as part of COVID-19 response: the first 100 days in Taiwan. *BMJ Global Health*, Vol. 5, No. 5, Article e002608. doi:10.1136/bmjgh-2020-002608

Lindholt, M.F., Jørgensen, F., Bor, A., and Petersen, M.B. 2021. Public acceptance of COVID-19 vaccines: cross-national evidence on levels and individual-level predictors using observational data. *BMJ Open* Vol. 11, Article e048172. https://doi.org/10.1136/bmjopen-2020-048172

Lund, C., De Silva, M., Plagerson, S., Cooper, S., Chisholm, D., Das, J., Knapp, M., and Patel, V. 2011. Poverty and mental disorders: breaking the cycle in low-income and middle-income countries. *The Lancet* Vol. 378, pp. 1502–1514. https://doi.org/10.1016/S0140-6736(11)60754-X

Macías, V.D. 2021. La pandemia del COVID-19 en el discurso antimigratorio y xenófobo en Europa y Estados Unidos. *Estudios Fronterizos* Vol. 22. https://doi.org/10.21670/ref.2103066

Makridis, C.A. and Wu, C. 2021. How social capital helps communities weather the COVID-19 pandemic. *PLoS* ONE 16(9): e0258021. https://doi.org/10.1371/journal.pone.0245135

Mallapaty, S. 2020. Popular preprint servers face closure because of money troubles. *Nature* Vol. 578, No. 7795, pp. 349–349. Doi:10.1038/d41586-020-00363-3

Maxmen, A. 2021. Has COVID taught us anything about pandemic preparedness? *Nature* Vol. 596, pp. 332–335. https://doi.org/10.1038/d41586-021-02217-y

Mazzucato, M. 2021. Build Back the State. Project Syndicate, New York. https://www.project-syndicate.org/commentary/biden-lessons-from-us-moonshot-by-mariana-mazzucato-2021-04/french?barrier=accesspaylog

Medina, L. and Schneider, F. 2019. *Shedding Light on the Shadow Economy: A Global Database and the Interaction with the Official One* (SSRN Scholarly Paper No. ID 3502028). Social Science Research Network, Rochester, NY.

Mehra, M.R., Ruschitzka, F. and Patel, A.N. 2020. Retraction—Hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis. *The Lancet*, Vol. 395, No. 10240, p. 1820. doi:10.1016/S0140-6736(20)31324-6

Mesa, O., Hogan, A., Watson, O., Charles, G., Hauck, K., Ghani, A., and Winskill, P. 2021. *Report 43: Quantifying the Impact of Vaccine Hesitancy in Prolonging the Need for Non-Pharmaceutical Interventions to Control the COVID-19 Pandemic*. Imperial College London. https://doi.org/10.25561/87096

Meyer, B. 2020. *Pandemic Populism: An Analysis of Populist Leaders' Responses to Covid-19*. Tony Blair Institute for Global Change, London. https://institute.global/policy/pandemic-populism-analysis-populist-leaders-responses-covid-19

Minkin, R. 2021. *Which industries are now teleworking and what are the challenges?* World Economic Forum. https://www.weforum.org/agenda/2021/01/teleworking-remote-working-pandemic-covid-19-industry/ (Accessed 1 October 2021).

Modéer, U., Petri Gornitzka, C., and Pieper, R. 2021. *Global solidarity in the face of COVID-19*. United Nations Development Programme. https://www.undp.org/blog/global-solidarity-face-covid-19 (Accessed 30 September 2021).

Mullan, Z. 2021. Peer reviewer identity under the microscope. *The Lancet Global Health*. Epub ahead of print 20 September 2021. doi:10.1016/S2214-109X(21)00443-5

Murthi, M. 2020. The World Bank's response to COVID-19: Protect and invest in people. World Bank Blogs. https://blogs.worldbank.org/voices/world-bank-response-covid-19-protect-and-invest-people (Accessed 1 October 2021).

Mustasilta, K. 2020. From bad to worse? The impact(s) of Covid-19 on conflict dynamics. European Union Institute for Security Studies. https://www.iss.europa.eu/content/bad-worse-impacts-covid-19-conflict-dynamics

Myeong, S. and Seo, H. 2016. Which type of social capital matters for building trust in government? Looking for a new type of social capital in the governance era. *Sustainability* Vol. 8, Article 322. https://doi.org/10.3390/su8040322

Nafilyan, V., Humberstone, B., Mehta, N., Diamond, I., Coupland, C., Lorenzi, L., Pawelek, P., Schofield, R., Morgan, J., Brown, P., Lyons, R., Sheikh, A., Hippisley-Cox, J. 2021. An external validation of the QCovid risk prediction algorithm for risk of mortality from COVID-19 in adults: a national validation cohort study in England. *The Lancet Digital Health*, Vol. 3, No. 7, pp. e425–e433. doi:10.1016/S2589-7500(21)00080-7

Nature (ed.). 2021. Greece used AI to curb COVID: what other nations can learn. *Nature*, Vol. 597, No. 7877, pp. 447–448. doi:10.1038/d41586-021-02554-y

Ngerng, R. 2020. *Taiwan's digital response to Covid-19: Impressive, but is privacy respected?* The News Lens International Edition. https://international.thenewslens.com/article/133095 (Accessed 6 October 2021).

O'Connor, H., Hopkins, W.J. and Johnston, D. 2021. For the greater good? Data and disasters in a post-COVID world. *Journal of the Royal Society of New Zealand*, Vol. 51, Suppl. 1, pp. S214–S231. doi:10.1080/03036758.2021.1900297

OECD. 2020. *Youth and COVID-19: Response, Recovery and Resilience*. Paris, OECD.

OECD. 2020. *Foreign Direct Investment Flows in the Time of COVID-19*. Paris, OECD.

OECD. 2020. *Stocktaking Report on Immediate Public Procurement and Infrastructure Responses to COVID-19*. Paris, OECD.

OECD. 2020. *The territorial impact of COVID-19: Managing the crisis across levels of government*. OECD Policy Responses to Coronavirus (COVID-19). https://doi.org/10.1787/d3e314e1-en

OECD. 2021. Science advice in times of COVID-19. OECD. https://www.oecd.org/sti/science-technology-innovation-outlook/Science-advice-COVID/ (Accessed 29 September 2021).

OECD. 2021. *Towards Gender-Inclusive Recovery*. Paris, OECD.

OECD. 2021. *Supporting Young People's Mental Health through the COVID-19 Crisis*. Paris, OECD.

OECD. 2021. Enhancing Public Trust in COVID-19 Vaccination: The Role of Governments. Paris, OECD.

Opere, W.M. 2021. Negative impacts of the current COVID-19 crisis on science education in Kenya: How certain can we be about the efficacy of the science learning framework online?, *Journal of Microbiology & Biology Education*, Vol. 22, No. 1, p. 22.1.62. doi:10.1128/jmbe.v22i1.2559

Our World in Data. Total confirmed COVID-19 deaths. Data published by COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. https://ourworldindata.org/grapher/covid-deaths-income

Overseas Development Institute. 2021. *Youth-led (digital) innovation and resilience during Covid-19: experiences from the African continent*. ODI: Think change. https://odi.org/en/publications/youth-led-digital-innovation-and-resilience-during-covid-19-experiences-from-the-african-continent/ (Accessed 1 October 2021).

Panchal, N. and Kamal, R. 2021. *The implications of COVID-19 for mental health and substance use*. KFF. https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/ (Accessed 1 October 2021).

Paradies, Y., Ben, J., Denson, N., Elias, A., Priest, N., Pieterse, A., Gupta, A., Kelaher, M., and Gee, G. 2015. Racism as a determinant of health: a systematic review and meta-analysis. *PLoS ONE* Vol. 10, Article e0138511. https://doi.org/10.1371/journal.pone.0138511

Passos, A.M. and Acácio, I. 2021. The militarization of responses to COVID-19 in democratic Latin America. *Rev. Adm. Pública* Vol. 55, pp. 261–272. https://doi.org/10.1590/0034-761220200475

Patterson, L. and Dhaliwal, M. 2021. *Vaccine equity will define socio-economic recovery from COVID-19*. UNDP SDG Integration. https://sdgintegration.undp.org/vaccine-equity-will-define-socio-economic-recovery-covid-19 (Accessed 1 October 2021).

Paunov, C. and Planes-Satorra, S. 2021. *What future for science, technology and innovation after COVID-19?* OECD. doi:10.1787/de9eb127-en

Phillips, N. 2021. The coronavirus is here to stay — here's what that means. *Nature* Vol. 590, pp. 382–384. https://doi.org/10.1038/d41586-021-00396-2

Piot, P. and Spencer, J. 2021. Towards societies living with COVID-19. *China CDC Weekly* Vol. 3, pp. 144–145. https://doi.org/10.46234/ccdcw2021.041

Pleyers, G. 2020. The pandemic is a battlefield. Social movements in the COVID-19 lockdown. *Journal of Civil Society* Vol. 16, pp. 295–312. https://doi.org/10.1080/17448689.2020.1794398

Power, K. 2020. The COVID-19 pandemic has increased the care burden of women and families. *Sustainability: Science, Practice and Policy* Vol. 16, pp. 67–73. https://doi.org/10.1080/15487733.2020.1776561

Puig, B., Blanco-Anaya, P. and Pérez-Maceira, J.J. 2021. 'Fake news' or real science? Critical thinking to assess information on COVID-19. *Frontiers in Education*, Vol. 6, p. 92. doi:10.3389/feduc.2021.646909

Quresh, U. 2020. *Women and girls must be at the center of Pakistan's COVID-19 recovery*. World Bank Blogs. https://blogs.worldbank.org/endpovertyinsouthasia/women-and-girls-must-be-center-pakistans-covid-19-recovery (Accessed 30 September 2021).

Rahman-Shepherd, A., Clift, C., Ross, E., Hollmann, L., Patel, C., and Yates, R. 2021. Solidarity in response to the COVID-19 pandemic. Chatham House, The Royal Institute of International Affairs, London. https://www.chathamhouse.org/2021/07/solidarity-response-covid-19-pandemic

Ravelo, J.L. 2021. *Can the new WHO hub in Berlin build trust for data sharing?* Devex. https://www.devex.com/news/sponsored/can-the-new-who-hub-in-berlin-build-trust-for-data-sharing-101527 (Accessed 5 October 2021).

Reid, M., Abdool-Karim, Q., Geng, G., Goosby, E. 2021. How will COVID-19 transform global health post-pandemic? Defining research and investment opportunities and priorities. *PLOS Medicine*, Vol. 18, No. 3, Article e1003564. doi:10.1371/journal.pmed.1003564

Rella, S.A., Kulikova, Y.A., Dermitzakis, E.T., and Kondrashov, F.A. 2021. Rates of SARS-CoV-2 transmission and vaccination impact the fate of vaccine-resistant strains. *Sci Rep* Vol. 11, Article 15729. https://doi.org/10.1038/s41598-021-95025-3

Repucci, S. and Slipowitz, A. 2020. *Democracy under lockdown*. Special Report 2020. Freedom House. https://freedomhouse.org/report/special-report/2020/democracy-under-lockdown (Accessed 30 September 2021).

Ritchie, H., Mathieu, E., Rodés-Guirao, L., Appel, C., Giattino, C., Ortiz-Ospina, E., Hasell, J., Macdonald, B., Beltekian, D. and Roser, M. *Coronavirus (COVID-19) vaccinations*. Our World In Data. https://ourworldindata.org/covid-vaccinations (Accessed 21 February 2022).

Robertson, E., Reeve, K.S., Niedzwiedz, C.L., Moore, J., Blake, M., Green, M., Katikireddi, S.V., and Benzeval, M.J. 2021. Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain Behav Immun* Vol. 94, pp. 41–50. https://doi.org/10.1016/j.bbi.2021.03.008

Roelen, K., Archibald, E., and Lowe, C. 2021. Covid-19: crisis as opportunity for urban cash transfers? Overseas Development Institute, London. https://odi.org/en/publications/covid-19-crisis-as-opportunity-for-urban-cash-transfer/

Rothwell, J., and Reeves, R.V. 2020. *Class and COVID: How the less affluent face double risks*. Brookings. https://www.brookings.edu/blog/up-front/2020/03/27/class-and-covid-how-the-less-affluent-face-double-risks/ (Accessed 1 October 2021).

Ruckert, A., Zinszer, K., Zarowsky, C., Labonté, R., and Carabin, H. 2020. What role for One Health in the COVID-19 pandemic? *Can J Public Health* Vol. 111, pp. 641–644. https://doi.org/10.17269/s41997-020-00409-z

Rydyznski Moderbacher, C., Ramirez, S.I., Dan, J.M., Grifoni, A., Hastie, K.M., Weiskopf, D., Belanger, S., Abbott, R.K., Kim, C., Choi, J., Kato, Y., Crotty, E.G., Kim, C., Rawlings, S.A., Mateus, J., Tse, L.P.V., Frazier, A., Baric, R., Peters, B., Greenbaum, J., Ollmann Saphire, E., Smith, D.M., Sette, A., and Crotty, S. 2020. Antigen-specific adaptive immunity to SARS-CoV-2 in acute COVID-19 and associations with age and disease severity. *Cell* Vol. 183, pp. 996-1012.e19. https://doi.org/10.1016/j.cell.2020.09.038

Salg, G.A., Ganten, M.-K., Bucher, A.M., Kenngott, H.G., Fink, M.A., Seibold, C., Fischbach, R.E., Schlamp, K., Velandia, C.A., Fervers, P., Doellinger, F., Luger, A., Afat, S., Merle, U., Diener, M.K., Pereira, P.L., Penzkofer, T., Persigehl, T., Othman, A., Heußel, C.P., Baumhauer, M., Widmann, G., Stathopoulos, K., Hamm, B., Vogl, T.J., Nikolaou, K., Kauczor, H.-U., and Kleesiek, J. 2021. A reporting and analysis framework for structured evaluation of COVID-19 clinical and imaging data. *npj Digit. Med.* Vol. 4, pp. 1–9. https://doi.org/10.1038/s41746-021-00439-y

Sánchez-Páramo, C. 2020. *COVID-19 will hit the poor hardest. Here's what we can do about it*. World Bank Blogs. https://blogs.worldbank.org/voices/covid-19-will-hit-poor-hardest-heres-what-we-can-do-about-it (Accessed 1 October 2021).

Sarabipour, S. 2018. Preprints are good for science and good for the public. *Nature*, Vol. 560, No. 7720, pp. 553–553. doi:10.1038/d41586-018-06054-4

Sasse, T. 2021. *Covid-19 futures: Implications for policy makers*. Institute for Government. https://www.instituteforgovernment.org.uk/sites/default/files/publications/Covid-19-futures.pdf (Accessed 21 April 2022).

Save the Children. 2020. *Save Our Education: Protect every child's right to learn in the COVID-19 response and recovery*. Resource Centre. https://resourcecentre.savethechildren.net/library/save-our-education-protect-every-childs-right-learn-covid-19-response-and-recovery (Accessed 30 September 2021).

Scudellari, M. 2020. How the pandemic might play out in 2021 and beyond. *Nature* Vol. 584, pp. 22–25. https://doi.org/10.1038/d41586-020-02278-5

Secretariat of the Convention on Biological Diversity. 2011. *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*. United Nations Environment Programme. https://www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf (Accessed 21 April 2022).

Sehmi, G.S. 2020. Three ways COVID-19 is reshaping how we collect and use data in transport. World Bank Blogs, 14 November. https://blogs.worldbank.org/transport/three-ways-covid-19-reshaping-how-we-collect-and-use-data-transport (Accessed 5 October 2021).

Serikbayeva, B., Abdulla, K., and Oskenbayev, Y. 2021. State capacity in responding to COVID-19. *International Journal of Public Administration* Vol. 44, pp. 920–930. https://doi.org/10.1080/01900692.2020.1850778

Shen, Y., Powell, G., Ganser, I., Zheng, Q., Grundy, C., Okhmatovskaia, A., Buckeridge, D. 2021. Monitoring non-pharmaceutical public health interventions during the COVID-19 pandemic. *Scientific Data*, Vol. 8, No. 1, p. 225. doi:10.1038/s41597-021-01001-x

Shirish, A., Srivastava, S.C. and Chandra, S. 2021. Impact of mobile connectivity and freedom on fake news propensity during the COVID-19 pandemic: a cross-country empirical examination. *European Journal of Information Systems*, Vol. 30, No. 3, pp. 322–341. doi:10.1080/0960085X.2021.1886614

Simon, F., Watson, H., Meynard, J.-B., de Santi, V.P., and Tournier, J.-N. 2021. What chikungunya teaches us about COVID-19. *The Lancet Infectious Diseases* Vol. 21, pp. 1070–1071. https://doi.org/10.1016/S1473-3099(21)00272-3

Skegg, D., Gluckman, P., Boulton, G., Hackmann, H., Karim, S.S.A., Piot, P., and Woopen, C. 2021. Future scenarios for the COVID-19 pandemic. *Lancet* Vol. 397, pp. 777–778. https://doi.org/10.1016/S0140-6736(21)00424-4

Skelly, D.T., Harding, A.C., Gilbert-Jaramillo, J., Knight, M.L., Longet, S., Brown, A., Adele, S., Adland, E., Brown, H., Medwar LaboratoryTeam, Tipton, T., Stafford, L., Johnson, S.A., Amini, A., OPTIC Clinical Group, Kit Tan, T., Schimanski, L., Huang, K.-Y.A., Rijal, P., … James, W.S. 2021. Two doses of SARS-CoV-2 vaccination induce more robust immune responses to emerging SARS-CoV-2 variants of concern than does natural infection. (preprint). In review. https://doi.org/10.21203/rs.3.rs-226857/v2

Solender, A. 2021. GOP Senators introduce bills banning mask and vaccine mandates. Forbes. https://www.forbes.com/sites/andrewsolender/2021/08/10/gop-senators-introduce-bills-banning-mask-and-vaccine-mandates/?sh=6c57b4703aac

Sonmez, M. 2020. *How personal data could help contribute to a COVID-19 solution*. World Economic Forum. https://www.weforum.org/agenda/2020/03/covid-19-personal-data-new-commodity-market/ (Accessed 5 October 2021).

Stamatatos, L., Czartoski, J., Wan, Y.-H., Homad, L.J., Rubin, V., Glantz, H., Neradilek, M., Seydoux, E., Jennewein, M.F., MacCamy, A.J., Feng, J., Mize, G., De Rosa, S.C., Finzi, A., Lemos, M.P., Cohen, K.W., Moodie, Z., McElrath, M.J., and McGuire, A.T. 2021. mRNA vaccination boosts cross-variant neutralizing antibodies elicited by SARS-CoV-2 infection. *Science* Vol. 372, pp. 1413–1418. https://doi.org/10.1126/science.abg9175

Starr, T.N., Greaney, A.J., Addetia, A., Hannon, W.W., Choudhary, M.C., Dingens, A.S., Li, J.Z., and Bloom, J.D. 2021. Prospective mapping of viral mutations that escape antibodies used to treat COVID-19. *Science* Vol. 371, pp. 850–854. https://doi.org/10.1126/science.abf9302

Stroud, P. 2020. *Poverty during the Covid-19 crisis*. Legatum Institute. https://li.com/reports/poverty-during-the-covid-19-crisis/ (Accessed 30 September 2021).

Sturgis, P., Brunton-Smith, I. and Jackson, J. 2021. Trust in science, social consensus and vaccine confidence. *Nature Human Behaviour,* Vol. 5, pp. 1528–1534. doi:10.1038/s41562-021-01115-7

Subbaraman, N. 2020. Sputnik moment or budget breaker: How will the pandemic alter research funding? *Nature*, Vol. 582, No. 7811, pp. 164–165. doi:10.1038/d41586-020-01519-x

Suleman, S., Garber, K.D., and Rutkow, L. 2018. Xenophobia as a determinant of health: an integrative review. *J Public Health Pol* Vol. 39, pp. 407–423. https://doi.org/10.1057/s41271-018-0140-1

Talebian, S. and Kemp-Benedict, E. (2020). A breakdown in globalization or a world committed to sustainability? Five scenarios for exploring the post-COVID-19 world. LeadIT Brief. 7. http://www.industrytransition.org/insights/scenarios-exploring-post-covid-world

Tarke, A., Sidney, J., Methot, N., Yu, E.D., Zhang, Y., Dan, J.M., Goodwin, B., Rubiro, P., Sutherland, A., Wang, E., Frazier, A., Ramirez, S.I., Rawlings, S.A., Smith, D.M., Antunes, R. da S., Peters, B., Scheuermann, R.H., Weiskopf, D., Crotty, S., Grifoni, A., Sette, A., 2021. Negligible impact of SARS-CoV-2 variants on CD4 + and CD8 + T cell reactivity in COVID-19 exposed donors and vaccinees. Preprint. bioRxiv. 2021;2021.02.27.433180. doi:10.1101/2021.02.27.433180

Times Higher Education (THE). 2020. *What shape will UK research take after Covid and Brexit?* https://www.timeshighereducation.com/hub/huawei/p/what-shape-will-uk-research-take-after-covid-and-brexit (Accessed 6 October 2021).

Tollefson, J. 2020. Why deforestation and extinctions make pandemics more likely. *Nature*, Vol. 584, No. 7820, pp. 175–176. doi:10.1038/d41586-020-02341-1

UNDESA. 2012. Perspectives on social cohesion – the glue that holds society together. New York, United Nations Department of Economic and Social Affairs.

UNDP. 2020. *COVID-19 could push the number of people living in extreme poverty to over 1 billion by 2030, says UNDP study*. United Nations Development Programme. https://www.undp.org/press-releases/covid-19-could-push-number-people-living-extreme-poverty-over-1-billion-2030-says (Accessed 30 September 2021).

UNDP. 2021. Impact of COVID-19 on the Sustainable Development Goals, SDG Integration. https://sdgintegration.undp.org/accelerating-development-progressduring-covid-19

UNDRR. 2015. Sendai Framework for Disaster Risk Reduction 2015–2030. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

UNDRR. 2016. *Build back better*. https://www.undrr.org/terminology/build-back-better (Accessed 30 September 2021).

UNDRR. 2021. *Building Resilience During COVID-19: Lessons Learned from Disaster Risk Reduction Programming*. UNDRR. https://www.undrr.org/publication/building-resilience-during-covid-19-lessons-learned-disaster-risk-reduction-programming

UNESCO. 2020. Adverse consequences of school closures. UNESCO. https://en.unesco.org/covid19/educationresponse/consequences (Accessed 30 September 2021).

UNFPA. 2020. *Impact of the COVID-19 Pandemic on Family Planning and Ending Gender-based Violence, Female Genital Mutilation and Child Marriage*. UNFPA. https://www.unfpa.org/resources/impact-covid-19-pandemic-family-planning-and-ending-gender-based-violence-female-genital

UN High Commissioner for Refugees (UNHCR), The Impact of COVID-19 on Stateless Populations: Policy recommendations and good practices on vaccine access and civil registration, 3 June 2021, available at: https://www.refworld.org/docid/60b8d6d84.html

UNICEF. 2020. Children in monetary poor households and COVID-19. UNICEF Technical Note. https://data.unicef.org/resources/children-in-monetary-poor-households-and-covid-19/ (Accessed 30 September 2021).

UNICEF. 2020. *Estimating the Impact of COVID-19 on Child Poverty in Georgia Using a Micro-Simulation Model*. UNICEF, New York. https://www.unicef.org/georgia/media/4871/file/COVID-19_impact_on_child_poverty_in_Georgia.pdf

UNICEF. 2020. *The Impact of COVID-19 on the Mental Health of Adolescents and Youth*. UNICEF, New York. https://www.unicef.org/lac/en/impact-covid-19-mental-health-adolescents-and-youth

UNICEF. 2021. *In-person Schooling and COVID-19 Transmission*. UNICEF, New York. https://www.unicef.org/documents/in-person-schooling-covid-19-transmission-review-of-evidence

UNICEF. 2021. *COVID-19: A threat to progress against child marriage*. UNICEF data. https://data.unicef.org/resources/covid-19-a-threat-to-progress-against-child-marriage/ (Accessed 30 September 2021).

UNICEF. 2021. *10 million additional girls at risk of child marriage due to COVID-19*. UNICEF press release. https://www.unicef.org/press-releases/10-million-additional-girls-risk-child-marriage-due-covid-19 (Accessed 1 October 2021).

United Nations (ed.). 2013. *Inequality Matters: Report on the World Social Situation 2013*. ST/ESA. New York, United Nations.

United Nations. 2018. *Youth and the 2030 Agenda for Sustainable Development*. United Nations For Youth. United Nations. https://www.un.org/development/desa/youth/world-youth-report/wyr2018.html

United Nations. 2020. *The Long-term Impact of COVID-19 on Poverty*. United Nations, Department of Economic and Social Affairs. https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-86-the-long-term-impact-of-covid-19-on-poverty/

United Nations. 2021a. *Domestic workers among hardest hit by COVID crisis, says UN labour agency*. UN News. https://news.un.org/en/story/2021/06/1094022 (Accessed 1 October 2021).

United Nations. 2021b. *Our Common Agenda – Report of the Secretary-General*. New York, United Nations. https://www.un.org/en/content/common-agenda-report/assets/pdf/Common_Agenda_Report_English.pdf (Accessed 22 April 2022).

United Nations. 2021c. *Sustainable development report shows devastating impact of COVID, ahead of 'critical' new phase*. UN News. https://news.un.org/en/story/2021/07/1095362 (Accessed 1 October 2021).

UN Women. 2020. *Policy Brief: The Impact of COVID-19 on Women*. UN Women, New York. https://www.unwomen.org/en/digital-library/publications/2020/04/policy-brief-the-impact-of-covid-19-on-women

UN Women. 2020. *COVID-19 and Ending Violence Against Women and Girls*. UN Women, New York. https://www.unwomen.org/en/digital-library/publications/2020/04/issue-brief-covid-19-and-ending-violence-against-women-and-girls

UN Women. 2020. *Impact of COVID-19 on Violence Against Women and Girls Through the Lens of Civil Society and Women's Rights Organizations*. UN Women, New York. https://untf.unwomen.org/en/digital-library/publications/2020/06/impact-of-covid-19-on-violence-against-women-and-girls

UN Women. 2021. *COVID-19 and its economic toll on women: the story behind the numbers*. UN Women. https://www.unwomen.org/en/news/stories/2020/9/feature-covid-19-economic-impacts-on-women (Accessed 30 September 2021).

US Centers for Medicare & Medicaid Services. 2021. *CMS will pay for COVID-19 booster shots, eligible consumers can receive at no cost*. CMS press release. https://www.cms.gov/newsroom/press-releases/cms-will-pay-covid-19-booster-shots-eligible-consumers-can-receive-no-cost (Accessed 28 September 2021).

Usher, K., Bradbury Jones, C., Bhullar, N., Durkin, D.J., Gyamfi, N., Fatema, S.R., and Jackson, D. 2021. COVID- 19 and family violence: Is this a perfect storm? *Int J Mental Health Nurs* Vol. 30, pp. 1022–1032. https://doi.org/10.1111/inm.12876

Walker, S.P., Wachs, T.D., Grantham-McGregor, S., Black, M.M., Nelson, C.A., Huffman, S.L., Baker-Henningham, H., Chang, S.M., Hamadani, J.D., Lozoff, B., Gardner, J.M.M., Powell, C.A., Rahman, A., and Richter, L. 2011. Inequality in early childhood: risk and protective factors for early child development. *The Lancet* Vol. 378, pp. 1325–1338. https://doi.org/10.1016/S0140-6736(11)60555-2

Watts, G. 2020. COVID-19 and the digital divide in the UK. *The Lancet Digital Health*, Vol. 2, No. 8, pp. e395–e396. doi:10.1016/S2589-7500(20)30169-2

The White House. 2021. *Fact sheet: President Biden's Global COVID-19 Summit: Ending the pandemic and building back better*. https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/22/fact-sheet-president-bidens-global-covid-19-summit-ending-the-pandemic-and-building-back-better/ (Accessed 5 October 2021).

WHO. 2021a. *WHO, Germany open Hub for Pandemic and Epidemic Intelligence in Berlin*. https://www.who.int/news/item/01-09-2021-who-germany-open-hub-for-pandemic-and-epidemic-intelligence-in-berlin (Accessed 5 October 2021).

WHO. 2021b. *Poverty and social determinants*. https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/activities/poverty-and-social-determinants (Accessed 30 September 2021).

WHO. 2021c. *The impact of COVID-19 on global health goals*. https://www.who.int/news-room/spotlight/the-impact-of-covid-19-on-global-health-goals (Accessed 22 April 2022).

WHO. 2011. Pandemic Influenza Preparedness Framework. https://www.who.int/initiatives/pandemic-influenza-preparedness-framework

WHO. 2018. A checklist for pandemic influenza risk and impact management: building capacity for pandemic response. https://www.who.int/publications/i/item/9789241513623

WHO, UN, UNICEF, UNDP, UNESCO, UNAIDS, ITU, UN Global Pulse, IFRC. 2020. *Managing the COVID-19 infodemic: Promoting healthy behaviours and mitigating the harm from misinformation and disinformation*. https://www.who.int/news/item/23-09-2020-managing-the-covid-19-infodemic-promoting-healthy-behaviours-and-mitigating-the-harm-from-misinformation-and-disinformation (Accessed 4 October 2021).

Wilson-Nash, C. and Tinson, J. 2021. *How older people are mastering technology to stay connected after lockdown*. The Conversation. http://theconversation.com/how-older-people-are-mastering-technology-to-stay-connected-after-lockdown-165562 (Accessed 5 October 2021).

World Bank. 2021. *Food security and COVID-19*. World Bank. https://reliefweb.int/report/world/brief-food-security-and-covid-19Accessed 4 October 2021).

World Bank. 2020. *The COVID-19 Pandemic: Shocks to Education and Policy Responses*. World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/33696/148198.pdf?sequence=4&isAllowed=y

World Bank. 2020. COVID-19 to add as many as 150 million extreme poor by 2021. World Bank press release. https://www.worldbank.org/en/news/press-release/2020/10/07/covid-19-to-add-as-many-as-150-million-extreme-poor-by-2021 (Accessed 30 September 2021).

World Bank. 2021a. *Global Economic Prospects*, June 2021. https://doi.org/10.1596/978-1-4648-1665-9

World Bank. 2021b. *Who on Earth can work from home? A global comparison sheds light on the importance of ICT infrastructure*. World Bank. https://www.worldbank.org/en/news/feature/2020/10/22/who-on-earth-can-work-from-home-a-global-comparison-sheds-light-on-the-importance-of-ict-infrastructure (Accessed 1 October 2021).

World Bank. 2021c. The State of the Global Education Crisis: A Path to Recovery. World Bank. https://www.worldbank.org/en/topic/education/publication/the-state-of-the-global-education-crisis-a-path-to-recovery?cq_ck=1638565414093

World Economic Forum. 2020. *Jobs of Tomorrow Mapping Opportunity in the New Economy*. World Economic Forum, Geneva. https://www.weforum.org/reports/jobs-of-tomorrow-mapping-opportunity-in-the-new-economy

World Vision 2021. *Africa hunger, famine: Facts, FAQs, and how to help*. https://www.worldvision.org/hunger-news-stories/africa-hunger-famine-facts#:~:text=One%20in%20five%20people%20%E2%80%94%2021,more%20people%20compared%20with%202019 (Accessed 27 April 2022)

WTO. 2020. *The Economic Impact of COVID-19 on Women in Vulnerable Sectors and Economies*. Covid-19 Reports No. 2020/10. https://doi.org/10.30875/74a82a3d-en

WTO. 2021. *World trade primed for strong but uneven recovery after COVID-19 pandemic shock*. https://www.wto.org/english/news_e/pres21_e/pr876_e.htm (Accessed 30 September 2021).

Xiao, Y., Becerik-Gerber, B., Lucas, G., and Roll, S.C. 2021. Impacts of working from home during COVID-19 pandemic on physical and mental well-being of office workstation users. *Journal of Occupational & Environmental Medicine* Vol. 63, pp. 181–190. https://doi.org/10.1097/JOM.0000000000002097

Yang, J., Zheng, Y., Gou, X., Pu, K., Chen, Z., Guo, Q., Ji, R., Wang, H., Wang, Y., and Zhou, Y. 2020. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *International Journal of Infectious Diseases* Vol. 94, pp. 91–95. https://doi.org/10.1016/j.ijid.2020.03.017

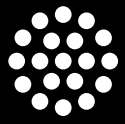
Yewande, A., Bernstein, A., Epstein, J., Espinal, M., Kakkar, M., Kochevar, D., Werneck, G. 2021. Report of the Scientific Task Force on Preventing Pandemics. https://www.hsph.harvard.edu/c-change/news/preventingpandemicsresearch/ (Accessed 4 October 2021).

You, D., Lindt, N., Allen, R., Hansen, C., Beise, J., and Blume, S. 2020. Migrant and displaced children in the age of COVID-19: How the pandemic is impacting them and what can we do to help. Migration Policy Practice. Vol. X, Number 2. https://www.unicef.org/media/83546/file/Migrant-and-displaced-children-in-the-age-of-COVID-19.pdf

Yusingco, M. and Pizarro, A. 2020. *The militarized response to the COVID-19 pandemic in the Philippines: an escalating threat to human rights*. IACL-IADC Blog. https://blog-iacl-aidc.org/2020-posts/2020/6/18/the-militarized-response-to-the-covid-19-pandemic-in-the-philippines-an-escalating-threat-to-human-rights (Accessed 28 September 2021).

V. Endnotes

1. INGSA 2021: Building Back Wiser: Knowledge, Policy and Public in Dialogue Allen K., Simon-Kumar N., Mills G. (Eds.) Access via: https://ingsa.org/ingsa2021/ (Download 'Viewpoints')
2. https://council.science/members
3. https://akomaps.com/ See tutorial: https://akomaps.com/app/course/60b702570833a37319849668/summary
4. Work on the report was substantively completed in 2022.
5. Using the total global population (i.e. people of all ages) as the denominator according to 'Our World In Data', 2021
6. Ibid.
7. https://www.who.int/news-room/questions-and-answers/item/one-health
8. https://en.wikipedia.org/wiki/Deepfake
9. https://www.ghsindex.org/
10. https://theindependentpanel.org/
11. https://theindependentpanel.org/



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