GPMB
GLOBAL PREPAREDNESS MONITORING BOARD

EXPANDING PANDEMIC RISK ASSESSMENT

AN ANNEX TO THE GPMB 2024 REPORT

THE CHANGING FACE OF PANDEMIC RISK

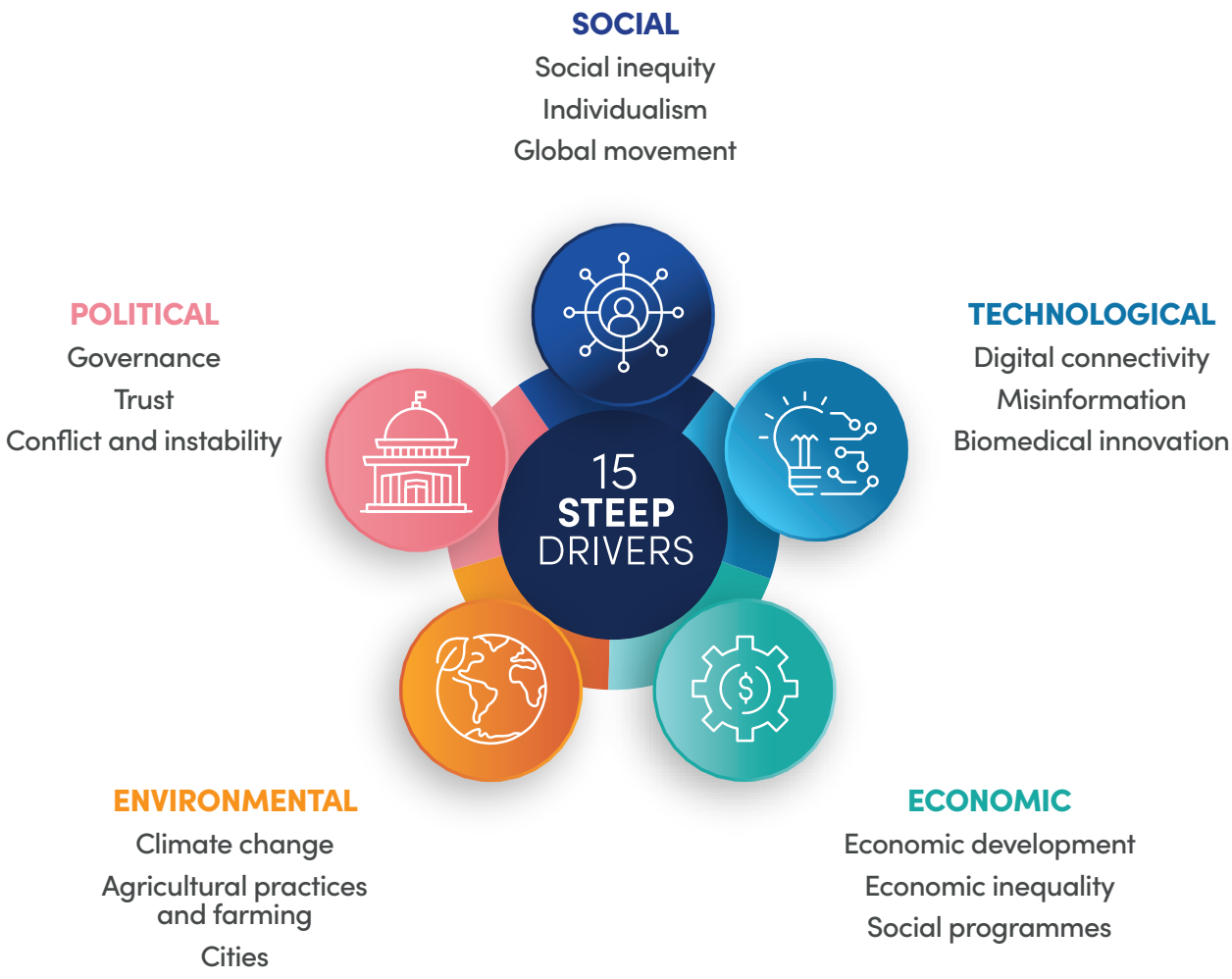
Contents

Introduction

This technical report presents the detailed evidence and analysis underpinning the 2024 GPMB Report *The changing face of pandemic risk*. As part of a comprehensive effort to understand the complex factors contributing to future pandemic threats, this technical report consolidates data from a wide range of sources to identify and evaluate key drivers of pandemic risk. A key feature of the analysis is the pandemic risk heatmap, which provides a visual summary of the most critical drivers. The heatmap serves as a critical tool for highlighting areas of greatest concern at global level.

While the recommendations in the 2024 GPMB report *The changing face of pandemic risk* are organized under three strategic pillars: ADAPT, PROTECT, and CONNECT, in this technical report each individual driver in the heatmap is accompanied by targeted recommendations. These actionable insights provide specific guidance to mitigate risks and reduce vulnerabilities, making this technical report an essential resource for decision-makers seeking evidence-based strategies to prevent and manage future pandemics.

Figure 1. Drivers of pandemic and epidemic risk, based on the GPMB Monitoring Framework



Background and methodology

This technical report provides a comprehensive overview of the 2024 GPMB assessment of the 15 drivers of pandemic risk, as identified in the GPMB Monitoring Framework.

The GPMB Monitoring Framework, first published in May 2023, provides a multisectoral, whole-of-society assessment of prevention, preparedness and resilience globally, using a risk-based approach. In order to understand pandemic and epidemic risk, the first section of the framework has been designed to monitor 15 key factors that act as (i) drivers of emergence, such as factors that increase the likelihood of a spillover event, (ii) drivers of amplification, such as factors that increase the probability that a pathogen will spread more rapidly and widely, and (iii) factors that reduce the capacity to respond effectively, thus aggravating the impact of pandemics on health and livelihoods.

In October 2024, the GPMB is publishing for the first time a report on pandemic risks, to help policy-makers understand key global factors that influence pandemic and epidemic threats. The report assesses 15 drivers grouped into five categories — **social**, **technological**, **economic**, **environmental** and **political** (STEEP) — as outlined in the GPMB Monitoring Framework. These include drivers such as global mobility, misinformation, climate change, and economic inequality, which are identified as having the most significant impact on pandemic emergence, disease transmission, and amplification. The drivers are not linked to any specific pathogen, although with certain diseases the driver may have more influence on the course of an epidemic or pandemic (for example, global warming and cholera).

The assessment of each driver's influence on pandemic risk was based on quantitative indicators proposed in the GPMB Monitoring Framework, with evaluations conducted at both global and regional levels (see Table 1 below). This quantitative analysis was complemented by qualitative insights from experts, in recognition of the limitations of a purely quantitative approach when dealing with complex, interrelated drivers that often exert synergistic influences on pandemic risk. Expert input was gathered during five technical consultations held in June 2024, as well as through a consultation held in August 2024 with civil society organizations, including networks from the world of work and faith-based organizations (see Annex). Additionally, a literature review was conducted across the 15 drivers. The experts also provided advice on relevant data sources, additional indicators and publications.

The drivers vary in their impact on pandemic prevention, preparedness, and response: some influence the risk of disease emergence or amplification, others affect response capacity, and some affect all of these (See figure 2). For each STEEP risk driver, this technical report outlines the driver's role in pandemic emergence, amplification, or reduction in response capacity; provides relevant data and trends; and assesses the driver's overall influence on epidemic and pandemic risk. The assessment considered:

- trends for each driver (for example, increasing, decreasing, or diverse trends in different contexts);
- the driver's relative influence on pandemic risk, ranging from low to very high compared to other drivers, rather than on an absolute scale;
- the need for and feasibility of urgent action to mitigate these risks.

Figure 2. 15 STEEP drivers of pandemic and epidemic risk and their mechanisms of action

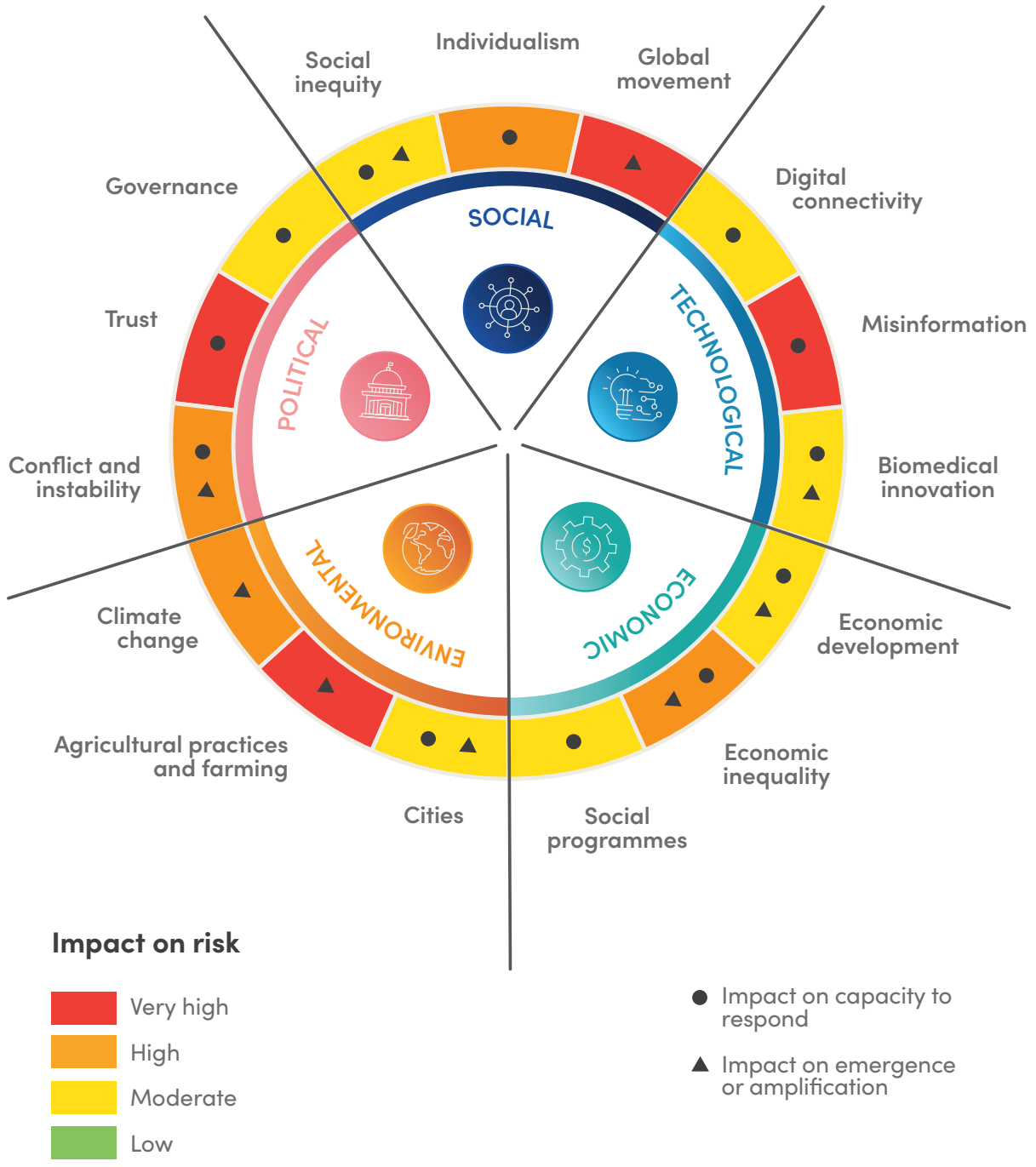
		Exposure/vulnerability to pandemic (virus emergence and amplification)	Reducing capacity to respond
SOCIAL	Social inequity	✓	✓
	Individualism		✓
	Global movement	✓	
TECHNOLOGICAL	Digital connectivity		✓
	Misinformation		✓
	Biomedical innovation	✓	✓
ECONOMIC	Economic development	✓	✓
	Economic inequality	✓	✓
	Social programmes		✓
ENVIRONMENTAL	Climate change	✓	
	Agricultural practices and farming	✓	
	Cities	✓	✓
POLITICAL	Governance		✓
	Trust		✓
	Conflict and instability	✓	✓

Source: GPMB

2024 GPMB assessment of pandemic risk

Assessing the 15 risk drivers of the GPMB Monitoring Framework

Figure 3. Impact of drivers on global pandemic and epidemic risk in 2024, based on GPMB and expert analysis (heatmap)



State of global pandemic risk in 2024

Of the 15 pandemic risk drivers assessed by the GPMB in 2024, four impact the level of risk the most: global movement, agricultural practices and farming, misinformation, and trust. The GPMB has observed that these drivers are rapidly increasing and are the most likely to contribute to the emergence and amplification of new outbreaks and epidemics, and to impact our capacity to respond to current ones, if no action is taken soon to address them. The 2024 GPMB Pandemic Risk Report *The changing face of pandemic risk* provides recommended actions to strengthen prevention, preparedness and response in light of these emerging pandemic risk drivers.

- **Global movement** through travel, trade and migration is at a record high and is likely to continue to increase in the coming years. Global movement is becoming a major amplifying factor of epidemics and pandemics. Countries with high mobility (for example, those with international travel hubs, strong livestock trade or with a high number of internally displaced people and refugees) are likely to become more vulnerable.
- **Agricultural practices and farming**: The number of livestock overall has increased dramatically. We are already observing the impact of this driver on the rapid spread of H5N1 globally. As global demand continues to increase, and biosecurity and surveillance measures remain inconsistently applied, the overall risk of spillover and amplification caused by agricultural practices and farming is very high.
- **Misinformation**: Access to and use of social media is on the rise everywhere, and individuals are increasingly exposed to false and misleading content. Public health organizations and governments are struggling to keep pace with information needs, to respond to misinformation in a timely manner, and to prevent mistrust.
- **Trust**: There has been a decline in trust in many countries, distrust in institutions is growing, and trust in the multilateral system is at risk. This is impacting our collective capacity both to tackle health emergencies and to find multilateral solutions to protect the world. However, trust-building strategies can be developed to overcome the challenges of pandemic preparedness and response in low-trust environments.

Four other drivers have been assessed as having a high impact on pandemic risk (**climate change**, **individualism**, **economic inequality**, and **conflict and instability**), and these should also be closely monitored in the future.

Quantitative regional analysis of risk drivers

The table below shows data averaged per World Health Organization (WHO) region for the 15 drivers identified in the GPMB Monitoring Framework. Regions are highly diverse, and a regional analysis will not capture nuances and differences between countries. However, given that a central objective of the GPMB is to inform and support policy-makers, the Board has decided to use the WHO regions as a framework for targeting outreach and advocacy activities.[1]

Table 1. Quantitative analysis of the 15 GPMB Monitoring Framework Risk drivers by WHO region

			WHO REGIONS					
	Driver	Data source	The Americas	African	Eastern Mediterranean	European	South-East Asian	Western Pacific
SOCIAL	Social inequity	2023 Global Multidimensional Poverty Index[2]	0.03	0.24	0.11	0.00	0.08	0.05
SOCIAL	Individualism	Hofstede index I, Individualism score[3]	33.91	20.11	24.71	57.33	24.28	39.36
SOCIAL	Global movement	Net migration -	Data (number of people entering/exiting country)	13,987	-9,165	-48,347	24,203	-29,426	1,422
TECHNOLOGICAL	Digital connectivity	2022 Inclusive Internet Index[4]	71.23	52.74	70.94	79.20	70.82	77.24
TECHNOLOGICAL	Misinformation	Statista (social media users per capita)	0.65	0.17	0.59	0.82	0.45	0.65
TECHNOLOGICAL	Biomedical innovation	2023 Global Innovation Index (GII)[5]	28.02	17.99	29.46	41.81	27.97	40.51
ECONOMIC	Economic development	GDP per capita (current US $)	15739	2571	16425	35660	4090	16846
ECONOMIC	Economic inequality	Gini index[6]	44.34	41.91	33.99	31.13	32.67	35.43
ECONOMIC	Social programmes	2022 ILO World Social Protection Data, Spending on social protection (% GDP)	5.23	2.26	4.42	13.69	3.02	4.49
ENVIRONMENTAL	Climate change	2022 ND-GAIN Index Vulnerability Score[7]	0.41	0.51	0.45	0.34	0.49	0.46
ENVIRONMENTAL	Agricultural practices and farming	2022 FAO Livestock Patterns, Livestock density (livestock unit per hectare)	1.16	0.43	1.12	0.77	0.99	4.17
ENVIRONMENTAL	Cities	2018 Urban Population (% total population living in cities)	65.04	45.89	69.85	71.12	39.90	58.24
POLITICAL	Governance	World Bank Government Effectiveness index[8]	45.6	26.75	33.69	68.13	40.71	61.76
POLITICAL	Trust	2024 Edelman Trust Barometer [9] Government trust (index)	38.33	37.67	85.00	43.43	71.00	58.67
POLITICAL	Conflict and instability	2023 Global Peace Index[10]	2.13	2.27	2.45	1.79	2.13	1.71

DRIVERS

1 The GPMB is aware that using the WHO regions introduces complexity into the analysis, as these regions reflect certain political and historical borders that are not always consistent with geography.

2 The higher the score, the more deprived individuals are in these countries.

3 The higher the score, the more individualistic a country is ranked on the index.

4 The higher the score, the more inclusive the internet is in these countries.

5 The higher the score, the greater the innovation capacity.

6 A higher score means greater in-country inequality.

7 A higher score on the index means greater vulnerability i.e. greater country exposure, greater sensitivity and reduced ability to adapt to the negative impacts of climate change.

8 A higher score on the index indicates greater government effectiveness.

9 A higher score indicates a higher level of trust.

10 A higher score indicates a higher level of conflict and instability.

1

SOCIAL DRIVERS

Social inequity

Individualism

Global movement

Monitoring Framework Indicator:
A.1.1.3 Social inequity

SOCIAL INEQUITY

Impact on pandemic risk

Driver description

- Social inequity exists when an individual or a group's opportunities are determined by their socioeconomic status and other circumstances beyond their control, such as their race, ethnicity, gender, migration status, age or education level. Because of these factors, some communities suffer discrimination and are excluded from many political, economic and legal institutions, and are therefore more vulnerable to different shocks and crises.

- Social inequity plays an important role in the emergence and spread of and mortality from infectious disease. It not only causes greater mortality and morbidity during epidemics and pandemics in groups who suffer discrimination, but it also contributes to the persistence of pockets of disease transmission, which are likely to spread further across the rest of society.

- Social inequity acts at several stages of an epidemic or pandemic, both as a driver of emergence and amplification by making populations more vulnerable, and in making these vulnerable populations harder to reach and limiting their access to medical countermeasures, which decreases countries' capacity to respond and control disease transmission.

Key points

- Populations or communities who suffer from social inequity tend to be more vulnerable to the spread of infectious disease: they may suffer from comorbidities or ill health; they may have more limited access to preventive health care due to discrimination or barriers to access; they may be food insecure or live in conditions that increase their exposure to infection, including overcrowded and shared housing or homelessness. Due to their vulnerable status in society, these populations or communities may be employed in higher risk jobs, delivering essential services that require close contact with people (for example, cashiers or health workers) that increases their exposure to pathogens, or more physically demanding work that impacts their health. During a health emergency, they may struggle to access vaccines, tests or treatments, information or other means to protect themselves. They are also more likely to mistrust public health authorities and health information.

- Groups who suffer from discrimination and social inequities tend to be less represented in leadership and decision-making related to pandemic preparedness and response. This results in policies and responses that do not address their needs or vulnerabilities, and major gaps in the response to health emergencies.

- Some forms of discrimination are legally sanctioned in some countries, and result in certain groups being unable to access health systems, due to financial barriers or fear of identification and persecution (for example, LGBTQA+ people in countries where homosexuality is illegal).

- Groups who suffer from discrimination and social inequities are often underrepresented in research. This leads to a lack of data or limited information on the safety and efficacy of treatments or vaccines for these particular groups (who may differ in terms of biology and genetics), and a lack of prioritization of health risks or diseases specific to them. Because of this, these groups' access to medical countermeasures is further limited.

- Communities who suffer discrimination are less likely to have access to social safety nets, and are more likely to lose employment or fall into poverty during epidemics and pandemics, further increasing their vulnerability.

- The impact of racial discrimination on the risk of epidemics and pandemics has been observed during many health emergencies. For example, during the COVID-19 pandemic, ethnic minorities were at higher risk of catching the SARS-CoV-2 virus and at higher risk of worse outcomes in many countries. "In the UK, from 1 September 2020 to 22 May 2021, Asian communities experienced up to double the rate of infection compared to those from White British backgrounds."[11] Almost all individuals from ethnic minorities faced higher risk of death after contracting COVID-19 compared with White British individuals.[12]

- Gender inequality can also have an important impact. During several previous epidemics and the COVID-19 pandemic, women were often more vulnerable, especially in relation to the indirect impacts of epidemics and pandemics. For example, the 2013–2016 Ebola virus disease (EVD) outbreaks showed a higher risk of exposure for women and a higher vulnerability to the indirect health, social and economic impacts of the disease.[13] Maternal and reproductive health services are often disrupted during health emergencies. "For instance, maternal deaths increased in the three West African countries most affected during the EVD outbreak."[14] Beyond maternal health outcomes, measures to prevent the spread of disease tend to have a disproportionate impact on women: they have led to more gender-based violence against women and have affected women's economic status. In many societies, women's role as carers, including as health workers, has made them more vulnerable to infection. On the other hand, men are often more vulnerable to the effects of infectious disease and experience higher fatality due to poorer health and health habits, such as smoking and alcohol consumption, and certain types of employment that put them at greater risk.

11 Oskrochi Y, Jeraj S, Aldridge R, Butt J, Miller A. Not by choice – the unequal impact of the COVID-19 pandemic on disempowered ethnic minority and migrant communities. London: Race Equality Foundation; 2023 (https://raceequalityfoundation.org.uk/wp-content/uploads/2023/07/Not-by-choice.pdf, accessed 20 September 2024).

12 Ibid.

13 Binagwaho A, Mathewos K. Infectious disease outbreaks highlight gender inequity. Nat Microbiol. 2022;7:361–362. doi:10.1038/s41564-022-01075-2.

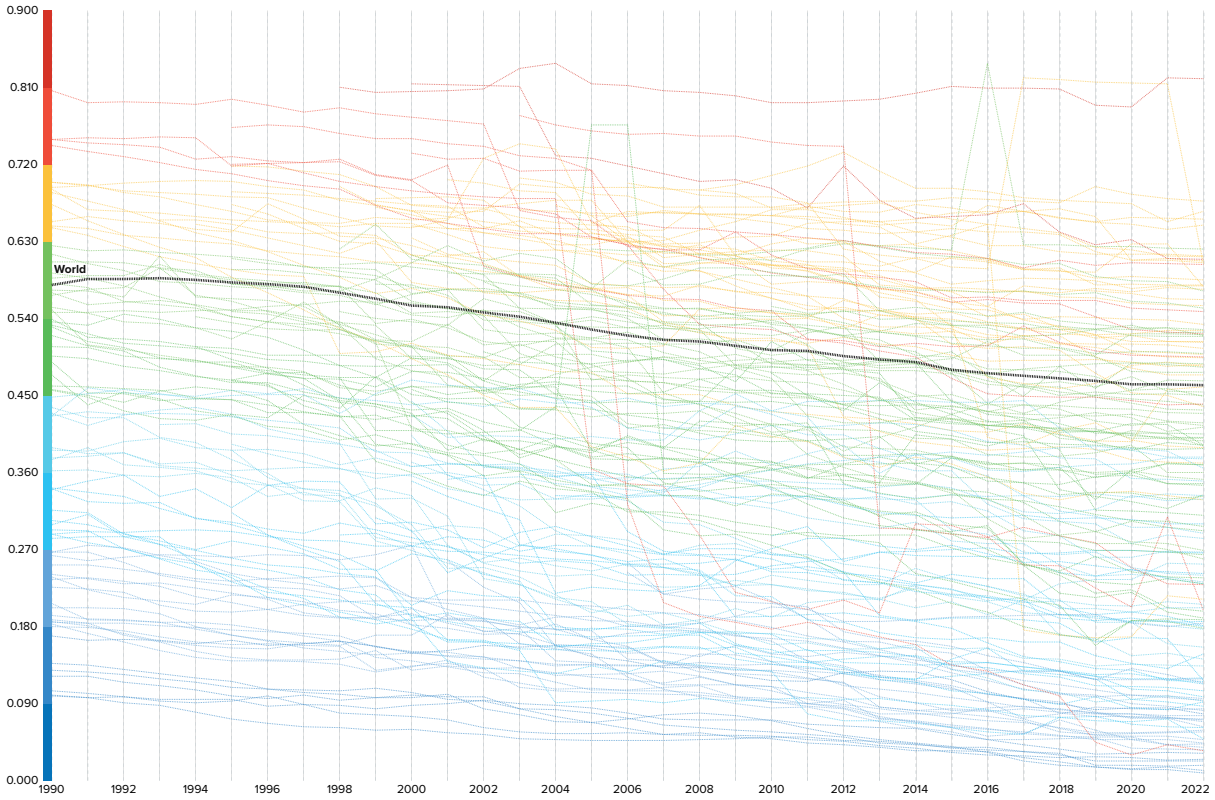
14 Ibid.

Data and trends

- According to data on Sustainable Development Goal (SDG) 10, close to one in six people globally experience discrimination based on any grounds. Among both women and men, racial discrimination, rooted in factors such as ethnicity, colour or language, is among the most common grounds.[15]

- There has been a slow improvement in certain dimensions of social inequity, such as gender equity, over recent decades. For example, the Gender Inequality Index score (Figure 4) has improved from 0.579 in 1990 to 0.462 in 2022.[16]

Figure 4. Gender Inequality Index scores 1990—2022



Source: United Nations (UN) Development Programme Human Development Reports. https://hdr.undp.org/data-center/thematic-composite-indices/gender-inequality-index#/indicies/GII

- However, there was a notable increase in social inequity during the COVID-19 pandemic. For example, the Global Gender Gap Index[17] shows that there was a decrease of 0.6% in the average distance to parity following the pandemic. The World Justice Project Rule of Law Index also reported a rapid decrease in equal treatment and absence of discrimination since the COVID-19 pandemic, putting a stop to recent progress (Figure 5). A similar impact was seen during the Ebola outbreaks in West Africa in 2015-2016. The Multidimensional Poverty Index (MPI), which tracks poverty beyond economic deprivation and inequalities in poverty, reported a dip in MPI value in Sierra Leone during the outbreaks.[18]

15 Sustainable Development Goal 10: Reduce inequality within and among countries. In: United Nations (UN)/Sustainable Development Goals [website]. New York: Division for Sustainable Development Goals, UN Department of Economic and Social Affairs (UN DESA); 2024 (https://sdgs.un.org/goals/goal10#progress_and_info, accessed 20 September 2024).

16 Gender Inequality Index (GII). In: UN Human Development Programme/Human Development Reports [website]. New York: Human Development Reports Office, UN Development Programme (UNDP); 2023 (https://hdr.undp.org/data-center/thematic-composite-indices/gender-inequality-index#/indicies/GII, accessed 20 September 2024).

17 Global Gender Gap Report 2023. Cologny/Geneva: World Economic Forum; 2023 (https://www.weforum.org/publications/global-gender-gap-report-2023/in-full/benchmarking-gender-gaps-2023, accessed 20 September 2024).

18 2020 Global Multidimensional Poverty Index (MPI): Charting pathways out of multidimensional poverty: Achieving the SDGs. New York: UNDP; 2020 (https://hdr.undp.org/content/2020-global-multidimensional-poverty-index-mpi, accessed 20 September 2024).

- Certain indices report an improvement in social inequity after the COVID-19 pandemic to pre-pandemic levels, however the rate of progress is slower than it was before COVID-19. For example, the Global Gender Gap reports that, while there was an increase in the number of countries registering at least a marginal improvement in 2023, such progress is mitigated by an increase in the number of countries with declining scores steeper than one percentage point (from 12 in 2022 to 35 in 2023).[19]

Opportunities/Challenges

- Addressing the impact of social inequity starts with identifying groups who suffer discrimination and vulnerable groups; the risk factors they face; the gaps in health coverage they experience; and the barriers that limit their access to health care or social protection measures before and during a health emergency.

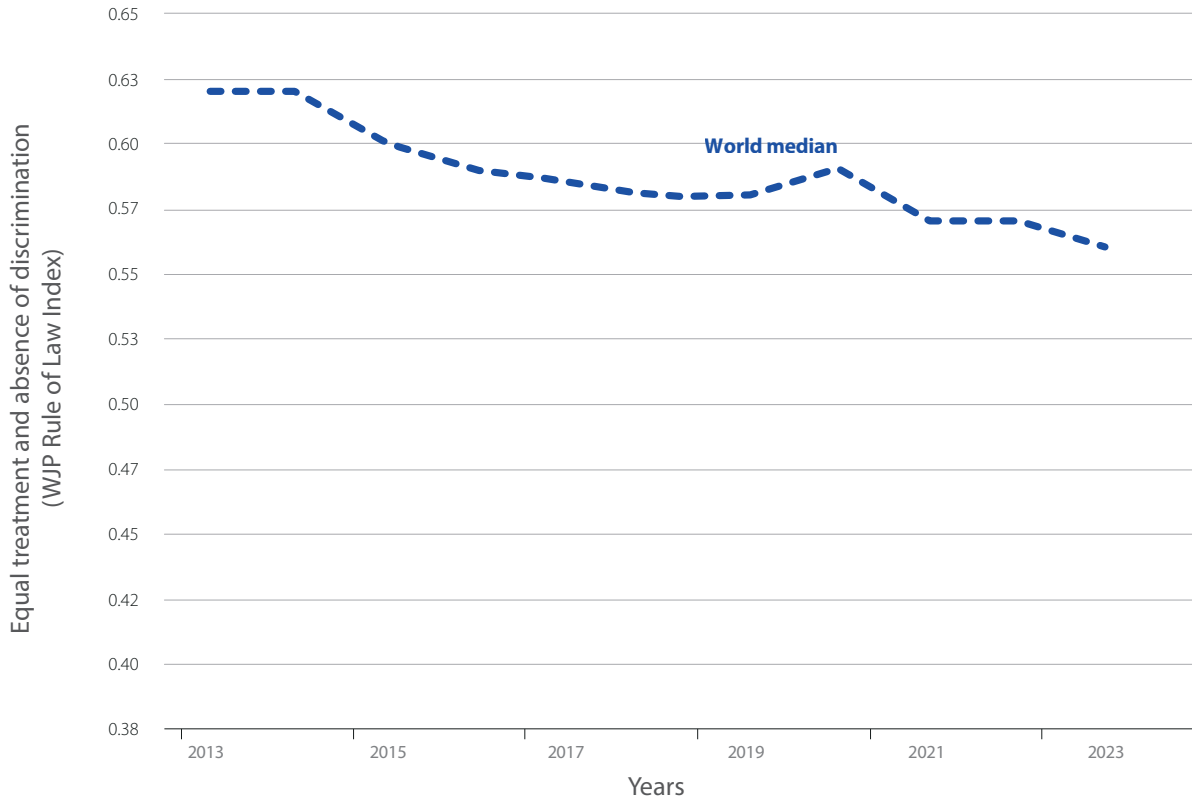
- Implementing measures to mitigate inequity during an epidemic or pandemic will only have a limited impact on stopping transmission and preventing mortality and morbidity. Transformative societal changes are needed to address vulnerabilities, gaps and barriers.

Assessment

- **Trend:** Social inequity has been slowly decreasing over recent decades, but the COVID-19 pandemic reversed these positive trends. This negative trend is currently turning around. However, the increase in the number of health emergencies and other geopolitical crises is likely to increase future social inequities.

- **Impact:** A higher level of social inequity makes countries more vulnerable to the impact of pandemics. Certain dimensions of social inequity are improving or have received more awareness. However, as seen during COVID-19 and mpox, social inequity still remains an important challenge, both in preventing the occurrence of epidemics and pandemics, and in mitigating impacts of health crises.

Figure 5. Decrease in equal treatment and absence of discrimination since the COVID-19 pandemic



Source: World Justice Project Rule of Law Index, Prosperity Data360, World Bank. https://prosperitydata360.worldbank.org/en/indicator/WJP+ROL+4+1

19 Global Gender Gap Report 2023. Cologny/Geneva: World Economic Forum; 2023 (https://www.weforum.org/publications/global-gender-gap-report-2023/in-full/benchmarking-gender-gaps-2023, accessed 20 September 2024).

Actions

- **Social protection programmes can mitigate the impact of social inequities.** Governments should identify vulnerable groups and proactively ensure that social programmes are in place in advance of a health emergency, and that these programmes cover and are accessible to vulnerable groups and groups suffering discrimination.
- **Countries should also implement universal health coverage** and ensure that all groups who suffer discrimination can have access to health care without experiencing financial barriers.

Monitoring Framework Indicator:
A.1.1.1 Individualism

INDIVIDUALISM

Impact on pandemic risk

Driver description

- Individualistic societies are those "in which the ties between individuals are loose: everyone is expected to look after himself or herself and his or her immediate family".[20] Meanwhile, collectivistic societies are those "in which people from birth onwards are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty".[21]

- Emerging evidence highlights the importance of individualism as a driver of risk in contrast to social cohesion and collectivism – a cultural construct that values the group over the individual and promotes collaboration and interdependence.

- This driver impacts our capacity to respond to epidemics and pandemics, as it makes individuals less likely to comply with public health measures, such as vaccination or social distancing. Societies with higher levels of individualism therefore struggle more to contain epidemics and pandemics.

Key points

- Countries and communities with higher levels of individualism generally struggle more to contain outbreaks through public health and social measures. In these societies, individuals in the community are less willing overall to comply with government measures (from lockdowns to vaccination) or to adopt behaviours to protect their community, and governments are less likely to implement stringent public measures.[22] During the COVID-19 pandemic, several studies demonstrated the correlation between individualism and poorer outcomes. Some studies found for example that "social distancing and mobility restriction policies [were] not effective in tackling COVID-19 in high individualism countries."[23]

- According to recent social research, collectivist societies tend to be more consensus-driven, have strong social compliance mechanisms, and are less open to economic and social interactions with outsiders. They place greater emphasis on conformity and have less respect for individual liberties. They are therefore more likely to comply with public health measures and less likely to spread pathogens more widely.[24,25]

20 Hofstede G. Dimensionalizing Cultures: The Hofstede Model in Context. Online Readings in Psychology and Culture. 2011;2(1). doi:10.9707/2307-0919.1014.

21 Hofstede, G. Cultures and Organizations: Software of the Mind, 55. London: McGraw-Hill; 1991.

22 Aysegul E, Medeiros M. Exploring the Effect of Collective Cultural Attributes on Covid-19-Related Public Health Outcomes. Front Psychol. 2021;12. doi:10.3389/fpsyg.2021.627669.

23 Huang L, Li OZ, Wang B, Zhang Z. Individualism and the fight against COVID-19. Humanit Soc Sci Commun. 2022;9:120. doi:10.1057/s41599-022-01124-5.

24 Morand S, Walther BA. Individualistic values are related to an increase in the outbreaks of infectious diseases and zoonotic diseases. Sci Rep 8, 2018;3866. doi:10.1038/s41598-018-22014-4.

25 Erman A, Medeiros M. Exploring the Effect of Collective Cultural Attributes on Covid-19-Related Public Health Outcomes. Front. Psychol. 2021;12:627669. doi:10.3389/fpsyg.2021.627669.

Data and trends

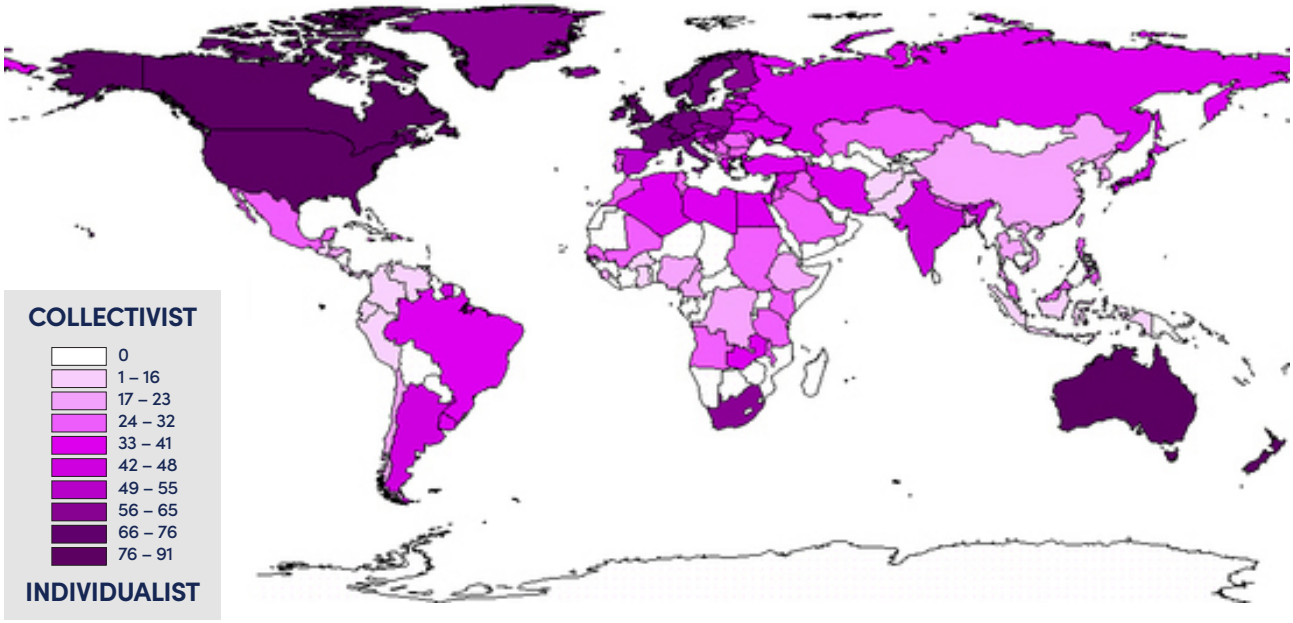
- The map in Figure 6 provides a global overview of country rankings along the Hofstede Collectivism—Individualism spectrum. Countries in dark purple have higher individualism levels. Regionalized data from the Hofstede index is also provided in Table 1 above.

- This cultural trait varies very slowly over time; however there has been a trend towards increased individualism over recent decades in most countries of the world.[26] The graphics in Figure 7 show the evolution of levels of individualist practices and values across countries over time, showing a clear trend towards greater individualism.

Opportunities/Challenges

- Individualism or collectivism are core cultural traits of societies. Addressing this driver is not about changing these traits but rather about recognizing them and adapting public health strategies accordingly. For instance, religious communities, professional groups (such as seafarers) or sports supporter communities can be identified to create more social cohesion and solidarity, and to encourage public health-driven behaviours and better compliance with public health recommendations. Adaptation of risk communication strategies may also be needed: for instance, messages related to self-protection and health security may be more effective in individualistic communities.

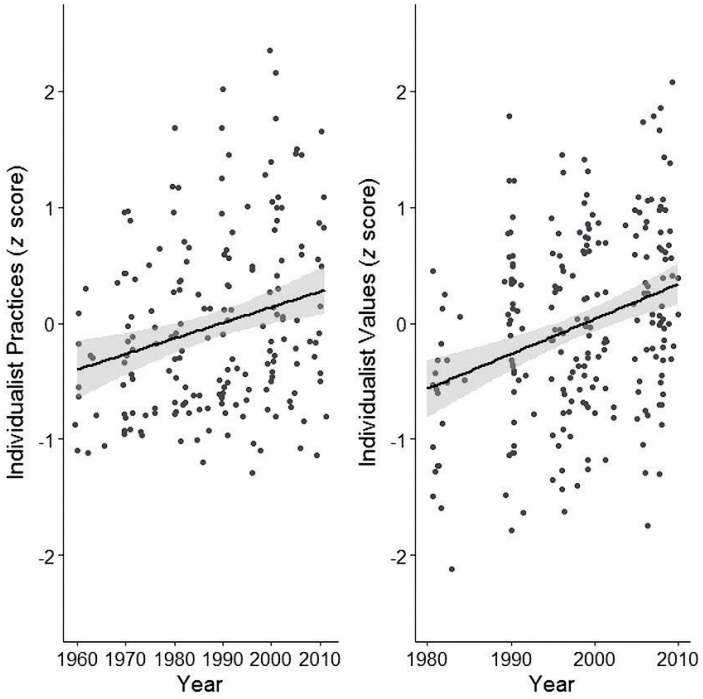
Figure 6. Collectivism—individualism world map



Note: White—no data
Source: Hofstede G. The 6-D model of national culture, 2015 https://geerthofstede.com/research-and-vsm/dimension-data-matrix/

26 Santos HC, Varnum MEW, Grossmann I. Global Increases in Individualism. Psychol Sci. 2017;28(9):1228-1239. doi:10.1177/0956797617700622.

Figure 7. Changes in individualistic practices and values 1960—2010



Source: Santos HC, Varnum MEW, Grossmann I. Global Increases in Individualism. Psychol Sci. 2017;28(9):1228–1239. doi:10.1177/0956797617700622.

Assessment

- **Trend:** There is generally a trend for more countries to move towards the individualist end of the spectrum. Currently, more than one-third of countries globally have societies that are more individualistic, and most of these are higher-income countries.

- **Impact:** While individualism and associated social and cultural values are only increasing slowly at a global level, COVID-19 demonstrated that individualism represents a significant driver of infectious disease spread, which has yet to be properly addressed. The impact of this driver is therefore assessed as high.

Actions

- **Policy-makers should identify communities and groups within society that can support the public health response** in advance of a health emergency and encourage a more collectivist/solidary response. These can be religious groups or trusted community workers.

- **Policy-makers should adopt messages that are culturally appropriate** before and during a health emergency. For example, in high-individualism countries, messages that focus on self-protection may be more effective.

Monitoring Framework Indicator:
A.1.1.2 Global movement and connectedness

GLOBAL MOVEMENT

Impact on pandemic risk

Driver description

- When humans move, pathogens move with them. Human mobility, including travel, trade and migration, is an important factor in the rate of spread of pathogens, especially in the early phases of an epidemic or pandemic. Due to population mobility, emerging and re-emerging pathogens, and some diseases that are endemic in certain settings, can quickly become epidemic in a newly infected population with no immunity against the disease.

- Global movement acts as a driver of pandemic risk by facilitating the rapid spread and amplification of emerging viruses. Higher levels of global movement are associated with greater pandemic risk.

Key points

- Global movement and connectedness have grown significantly in recent decades. In countries with high mobility (for example, with international travel hubs, strong livestock trade or with a high number of internally displaced people and refugees), epidemic-prone diseases are more likely to spread faster and further.

- Mobility acts as an amplifier of the spread of infectious disease, allowing pathogens to travel with humans, animals or goods across borders – often undetected – so that they can reach new regions and populations. Depending on a pathogen's nature, mode of transmission and incubation period, it can travel across the globe or reach thousands of people in a matter of days and cause a pandemic. The Omicron variant of SARS-CoV-2 led to thousands of cases across a dozen countries in a matter of days.[27]

- Through livestock trade, pathogens can be exported across countries, spreading rapidly across farms and causing thousands of new animal infections. Pathogens in livestock can sometimes spread to humans, causing localized zoonotic outbreaks that can potentially lead to pathogen adaptation and human-to-human transmission. Recent analysis has demonstrated that "commercial livestock imports are systematically related to infectious diseases in associated animal species".[28] At the same time, measures to stop the spread can also lead to great expense for farmers and the entire agricultural industry.

- The increasing scale and frequency of movements of goods means pathogens can travel around the world in days, whether through cattle trade or passengers on international flights. Consequently, a pathogen with pandemic potential can spread across all continents in just a few weeks.

- Migrants do not necessarily represent a greater risk of spread than other types of travellers. However, forced migrants, such as refugees fleeing war and persecution, may be more at risk of infectious disease due to their vulnerable status and their living conditions. Studies have found a higher incidence of vaccine-preventable disease and sexually transmitted disease in areas with higher inflows of forced migrants.[29]

27 Chatterjee S, Bhattacharya M, Nag S, Dhama K, Chakraborty C. A Detailed Overview of SARS-CoV-2 Omicron: Its Sub-Variants, Mutations and Pathophysiology, Clinical Characteristics, Immunological Landscape, Immune Escape, and Therapies. Viruses. 2023;15(1):167. doi:10.3390/v15010167.

28 Ibid.

29 Ibáñez AM, Rozo SV, Urbina MJ. Forced migration and the spread of infectious diseases. J Health Econ. 2021;79:102491. doi:10.1016/j.jhealeco.2021.102491.

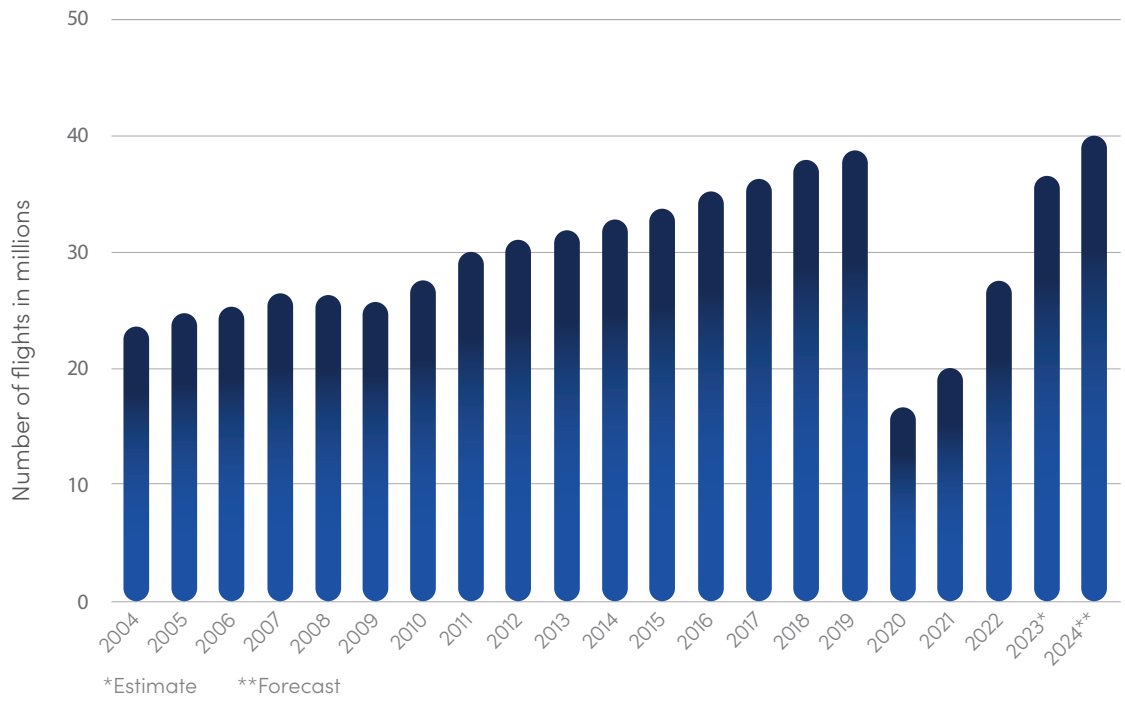
- Over recent decades, globalization and developments in the aviation and tourism industries have meant that certain international hubs are more interconnected than cities within the same country. Studies have found that these international hubs can be critical in the early global spread of epidemics.[30]

Data and trends

- In 2023, 36.8 million flights took place globally, carrying more than four billion passengers. While there was a considerable dip in travel during the COVID-19 pandemic, international travel has consistently increased over the past decade. Forecasts estimate that 2024 will have the highest number of flights on record. This increase is seen for the vast majority of countries across all economic levels and levels of vulnerability, albeit at much higher levels in higher-income countries.[31]

- In 2022, the global trade value of goods exported throughout the world amounted to approximately 24.9 trillion US dollars, compared to approximately 6.45 trillion US dollars in 2000.[32] "As of 2022, world trade volume and value have expanded 4% and 6% respectively on average since 1995, when the WTO [World Trade Organization] was first established".[33] Global trade in livestock has grown significantly in the past two decades. "The number of traded livestock doubled from one to two billion units between 2007 and 2017 and traded animals are traveling ever-longer distances."[34] The DHL Global Connectedness Index indicates that the world's overall level of globalization (as measured by the depth and breadth of international flows of trade, capital, information and people) reached a record high in 2022, and remained at roughly the same level in 2023.[35]

Figure 8. Number of flights performed by the global airline industry 2004—2023, with forecast for 2024



Source: International Air Transport Association; International Civil Aviation Organization; Statista, 2024. https://www.statista.com/statistics/564769/airline-industry-number-of-flights/

30 Tsiotas D, Tselios V. Understanding the uneven spread of COVID-19 in the context of the global interconnected economy. Sci Rep. 2022;12:666. doi:10.1038/s41598-021-04717-3.

31 Tuite AR, Bhatia D, Moineddin R, Bogoch II, Watts AG, Khan K. Global trends in air travel: implications for connectivity and resilience to infectious disease threats. J Travel Med. 2020;27(4):taaa070. doi:10.1093/jtm/taaa070.

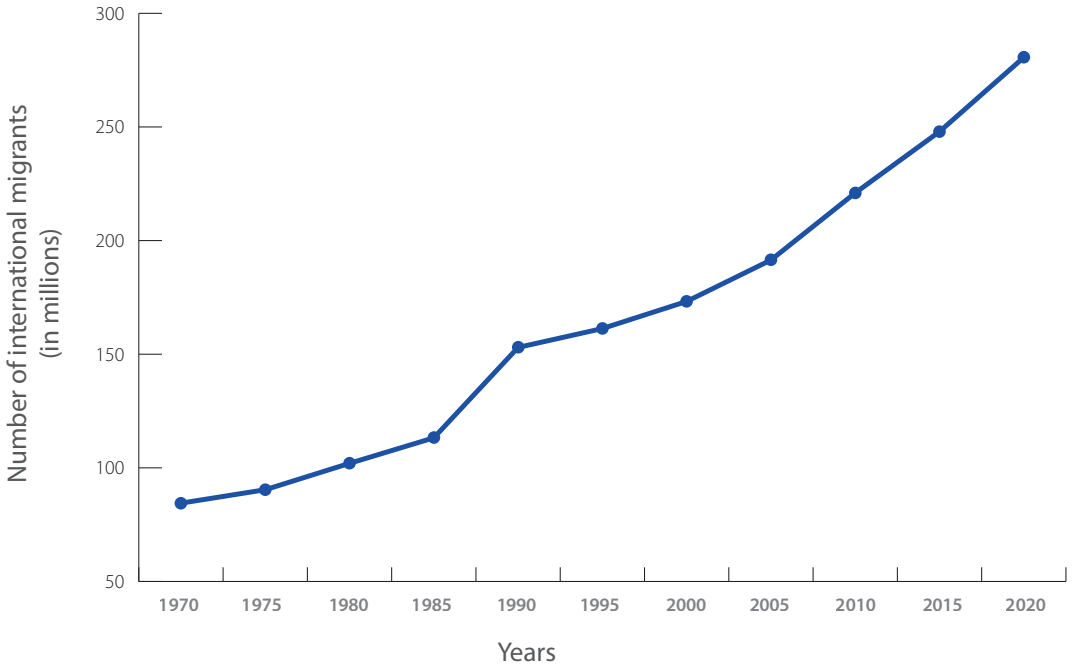
32 Merchandise: Total trade and share, annual. In: UNCTADstat [website]. Geneva: UNCTAD; 2024 (https://unctadstat.unctad.org/datacentre/dataviewer/US.TradeMerchTotal; accessed 9 October 2024).

33 Evolution of trade under the WTO: handy statistics. In: WTO [website]. Geneva: WTO; 2022 (https://www.wto.org/english/res_e/statis_e/trade_evolution_e/evolution_trade_wto_e.htm, accessed 21 September 2024).

34 Beverelli C, Ticku R. Global Livestock Trade and Infectious Diseases: Working Paper. Fiesole: European University Institute; 2023 (https://cadmus.eui.eu/bitstream/handle/1814/75333/RSC%20WP%202023_09.pdf, accessed 21 September 2024).

35 Altman SA, Bastian CR. DHL Global Connectedness Report 2024: An in-depth analysis of the state of globalization. Bonn: DHL Group; 2024 (https://www.dhl.com/content/dam/dhl/global/delivered/documents/pdf/dhl-global-connectedness-report-2024-complete.pdf, accessed 21 September 2024).

Figure 9. Growth in international migrants 1970—2020



Source: McAuliffe, M. and A. Triandafyllidou (eds.) World Migration Report 2022. International Organization for Migration (IOM), Geneva, 2021. https://publications.iom.int/books/world-migration-report-2022

- According to the Population Division of the United Nations Department of Economic and Social Affairs (UN DESA), as of 1 July 2020 the global number of international migrants was estimated to be 281 million. In 2020, international migrants comprised 3.6% of the global population, compared to 2.8% in 2000 and 2.3% in 1980 (see Figure 9). While we have little data on the volume of 'irregular migrants' (i.e. those who do not have official permission to enter a country or legal status allowing them to stay or work), it is thought that globally they considerably outnumber regular migrants, with some estimates putting the figure of undocumented migrants at 30–40 million in 2020.[36]

- The increasing number of conflicts leads to massive flows of populations, in particular of forced displaced people (FDPs). According to the UN Refugee Agency (UNHCR), the number of FDPs both within countries and across borders as a result of persecution, conflict, or generalized violence has grown by over 50% in the last 10 years.[37]

Opportunities/Challenges

- Very few countries have measures in place to control the spread of pathogens through mobility, such as detection at airports or in cattle. Fragile countries are especially vulnerable.

- Controlling the spread of pathogens through travel or trade has proven extremely challenging and has often involved uncoordinated and poorly evidenced restrictions, with sometimes devastating effects on the economies and populations of affected countries.

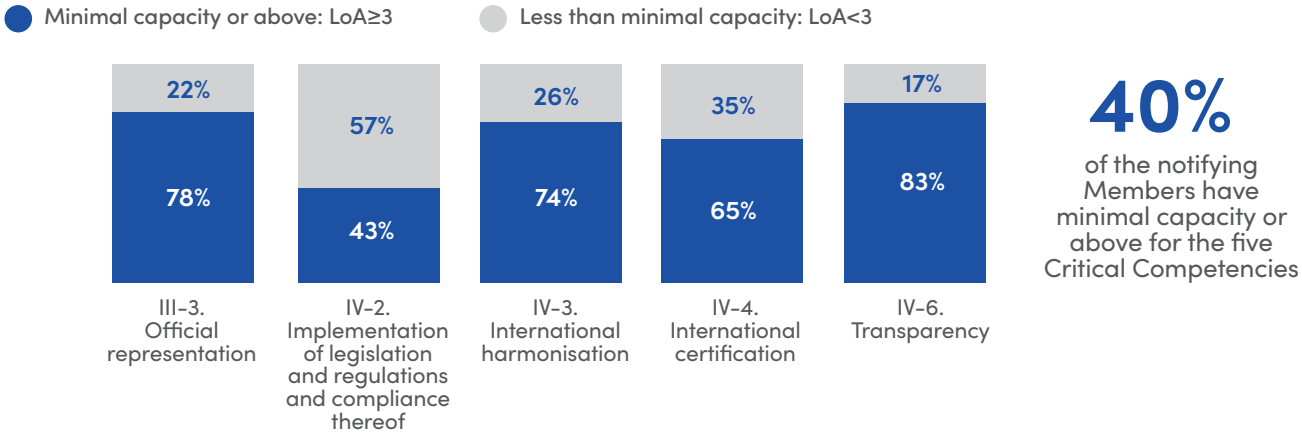
36 Spencer S, Triandafyllidou A. Irregular Migration. In: Scholten, P. (ed.) Introduction to Migration Studies. IMISCOE Research Series. Cham: Springer; 2022. doi:10.1007/978-3-030-92377-8_12.

37 Kim J, Mur MJRM, Dahlgren E, Valladares RC, Kallergis A, Guyot L. The Impact of COVID-19 on Forced Displacement. Reference Paper for the 70th Anniversary of the 1951 Refugee Convention. Geneva: UN Refugee Agency; 2021 (https://www.unhcr.org/people-forced-to-flee-book/wp-content/uploads/sites/137/2021/10/Julie-Kim-et-al_The-Impact-of-COVID-19-on-Forced-Displacement.pdf, accessed 21 September 2024).

- In accordance with the WTO SPS Agreement (Agreement on the Application of Sanitary and Phytosanitary Measures), trade in animals and animal products should transparently conform to World Organisation for Animal Health (WOAH) standards. Since the SPS Agreement was ratified and implemented, 77 WTO members (47%) have made 2,594 notifications describing their requirements for trade in animals and animal products, and 60% of these notifications come from only 10 countries. According to WOAH Performance of Veterinary Services (PVS) Evaluations, members who notify score consistently higher on related critical competencies than members who do not notify. Improving compliance with WTO SPS Agreement and WOAH standards is critical to managing risks during trade and requires capacity development of relevant government authorities focused on relevant competencies[38] (see Figure 10 below).

Figure 10. Percentage of Members with minimal capacity or above (Level of Advancement of 3 or more, in blue), for each of the five Critical Competencies related to trade as assessed in PVS missions between 2016 and 2021, in two groups of Members: Members that have submitted at least one notification to the WTO (top) and Members that did not submit any notification to the WTO (bottom)

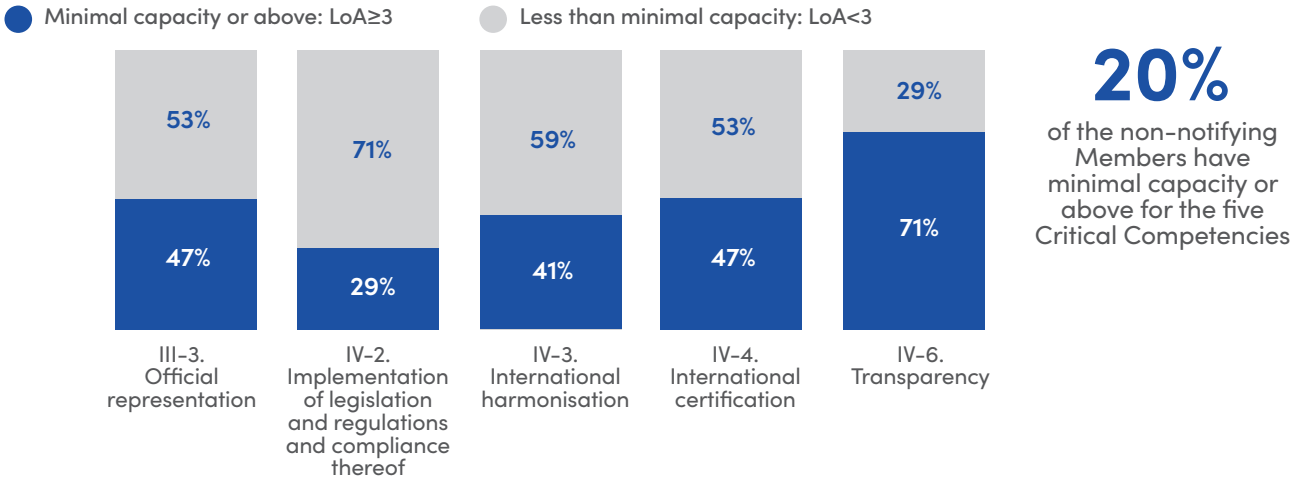
Notifying Members



40%

of the notifying Members have minimal capacity or above for the five Critical Competencies

Non-notifying Members



20%

of the non-notifying Members have minimal capacity or above for the five Critical Competencies

Source: Implementation of WOAH standards: the Observatory Annual Report Publication Series, World Organisation for Animal Health; 2022. doi:10.20506/obs.3339

38 Implementation of WOAH standards: the Observatory Annual Report Publication Series. Paris: World Organisation for Animal Health; 2022. CC BY-SA 3.0 IGO. doi:10.20506/obs.3339.

Assessment

- **Trend:** Despite decreases during COVID-19, global movement and connectedness are at a record high. There is no sign of a sustained downturn in either of these; rather, it is likely that they will continue to increase in the coming years. The risks linked to global mobility and connectedness, especially as a major amplifying factor, are therefore likely to continue to increase substantially. Countries with high mobility are likely to become more vulnerable to this driver, unless measures are taken to control the spread of pathogens through mobility.

- **Impact:** Recent outbreaks (for example, COVID-19, mpox, H5N1) have demonstrated that global movement is currently exerting a major influence on the spread of disease. This driver's influence is growing and it has the capacity to cause an exponential spread of disease in a matter of days or weeks. Therefore, the impact of this driver on pandemic risk is assessed as very high.

Actions

- **Countries should implement the International Health Regulations (IHR) (2005)** and develop options to ensure safe movement in line with the IHR. This will require close collaboration with the veterinary and transportation sectors.

- **During a health emergency, any border control measures or travel restrictions should be carefully assessed** to maximize public health impact and minimize direct and indirect negative impacts on countries and communities. Development and implementation of these measures will require strong collaboration and cooperation between countries and between sectors. Establishing this collaboration in advance of a health emergency will be essential.

- **Countries should adopt the WOAH international animal health and welfare standards**, and respect requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) when trading animals and animal products. Pathways and vulnerabilities that increase infectious disease risks, including in informal or illegal channels of trade, should be understood and mitigated.

2

TECHNOLOGICAL DRIVERS

Digital connectivity

Misinformation

Biomedical innovation

Monitoring Framework Indicator:
A.1.2.2 Digital connectivity

DIGITAL CONNECTIVITY

Impact on pandemic risk

Driver description

- Digital connectivity encompasses aspects of research and development, regulation, procurement, and the adoption of digital technologies that support routine activities in health care, education, and the economy. It includes access to digital hardware[39] (which involves both affordability and availability) as well as access to digital software[40] to support access to telehealth, e-learning or remote working. Availability involves ensuring high quality and inclusive tools. Accessibility involves ensuring that everyone has access, including vulnerable people, those with disabilities, or people who speak minority languages. It also involves ensuring that the technology connects the right sectors, experts and populations.

- Digital connectivity and technologies are crucial at every stage of epidemic and pandemic prevention, preparedness and response, from surveillance and detection to health care delivery, as well as in implementing public health measures, such as lockdowns and school closures. Digital technologies present both opportunities and challenges for pandemic risk management. They greatly enhance our ability to function and respond to a pandemic by enabling faster sharing of data, better planning of resources, modelling the disease spread and severity, facilitating access to services and fostering innovation. Therefore their absence, unavailability, or poor design hampers social resilience and collective public health responses.

- Digital technologies are vulnerable to cyber threats. This can lead to reduced effectiveness of the public health response and loss of trust among people who fear having their private information stolen or sold. Either way, lack of access to safe and effective digital technologies will result in widening inequities and hampering pandemic response.

Key points

- Over the past four decades, digital technologies to connect people and information have emerged and developed extremely quickly, allowing us to inform, analyse, or react far more rapidly than ever before. These technologies also enable us to connect geographically, socially or economically diverse nations and communities, leading towards the creation of a 'global community'.

- When it comes to pandemic management, the potential of digital connectivity is enormous[41], offering greatly improved surveillance and detection capacities, transformed risk communication and community engagement capabilities, and near-universal access to critical public services, as well as the possibility of multisectoral and whole-of-society responses, unhampered by distance, socioeconomic status or language.

- Artificial intelligence (AI) also presents a promising new way to improve pandemic preparedness and response by enhancing real-time data analysis, improving disease surveillance, and accelerating decision-making and response. Large language models have the potential to process vast amounts of health-related information from diverse sources (for example, medical reports, social media content, or scientific literature) to identify patterns and generate insights that will enable the detection of early warning signs of outbreaks and help public health officials to respond swiftly. Other AI technologies offer the potential to improve infectious disease forecasting and to optimize resource allocation, for example through improved supply chain management.

39 Such as cellphones, computers and networking hardware

40 Such as platforms for telehealth, e-commerce and payments, e-learning, teleconferencing and other types of applications designed for public health use

41 Bowsher G, El Achi N, Augustin K, Meagher K, Ekzayez A, Roberts B, Patel P. eHealth for service delivery in conflict. Health Policy Plan. 2021;36(6):974-981. doi:10.1093/heapol/czab042.

- The COVID-19 pandemic greatly accelerated progress and innovation of digital technologies and connectivity, as demonstrated by the development of new crowdsourcing platforms such as HIVE; AI-based social listening tools to assess public sentiment and needs; the emergence of multiple new e-health platforms for clinical management and health information management in conflict settings; and the development of remote working, teleconferencing and online education platforms.

- However, COVID-19 also provided examples of what happens when the population or first responders are excluded from critical response networks or cannot access critical information.[42] One study found that, in the United States, counties with a higher percentage of digitally excluded populations had seen higher COVID-19 case and death rates throughout the pandemic, and lower vaccination rates by late 2021 and early 2022.[43]

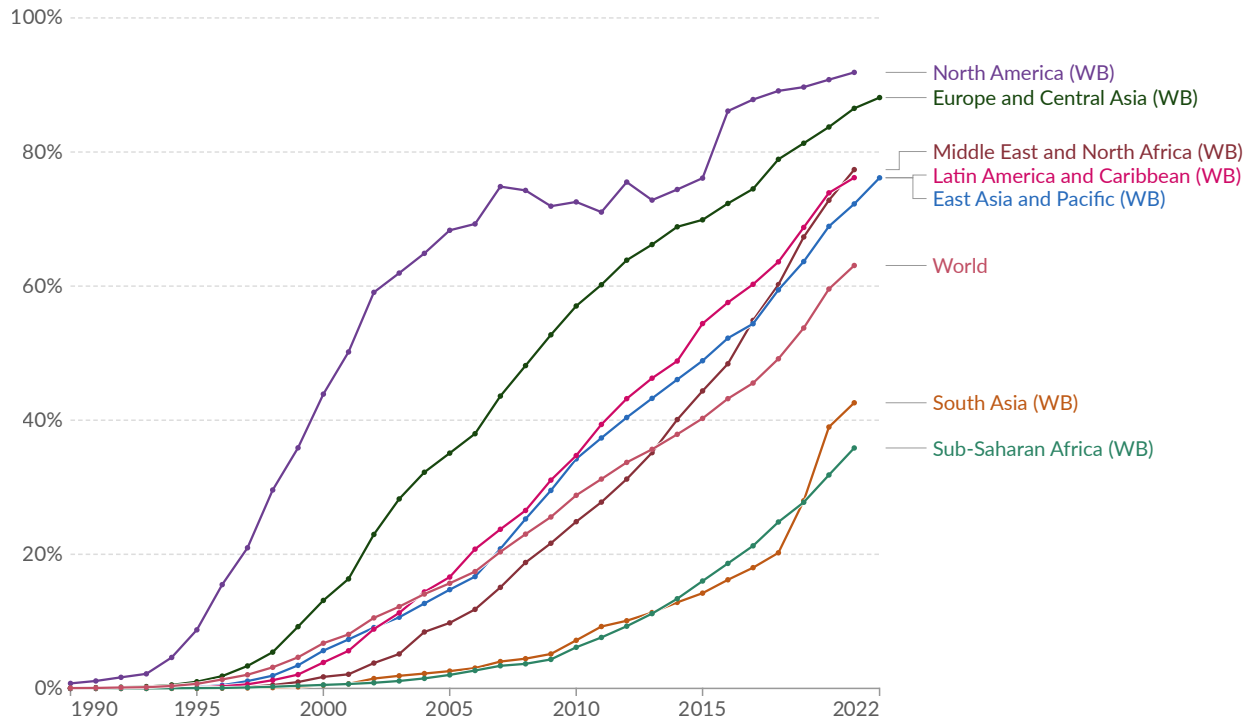
- Digital technologies come with specific risks.[44] Cyber threats, for instance, pose a serious risk. Health systems, which are reliant on interconnected digital infrastructure, are vulnerable to cyber attacks that can disrupt services and impede response efforts. Privacy concerns also arise alongside digital contact tracing, surveillance or community engagement efforts, as data can be stolen and put to harmful use. At the very least, fear of or actual cyber attacks can lead people to withhold information or mistrust the entities collecting it.

Data and trends

- Digital technologies and applications have grown exponentially over recent decades, along with access to those technologies (see Figure 11). During and after the COVID-19 pandemic, technologies applicable to public health, education and remote working developed exponentially. This applies to all countries and communities.[45]

- At the same time, this rate of growth and progress in access to digital technologies remains unequally distributed across income groups (see Table 1 Inclusive Internet Index data and Figure 12).

Figure 11. Share of the population using the internet 1990–2022



Source: Our World in Data. https://ourworldindata.org/grapher/share-of-individuals-using-the-internet

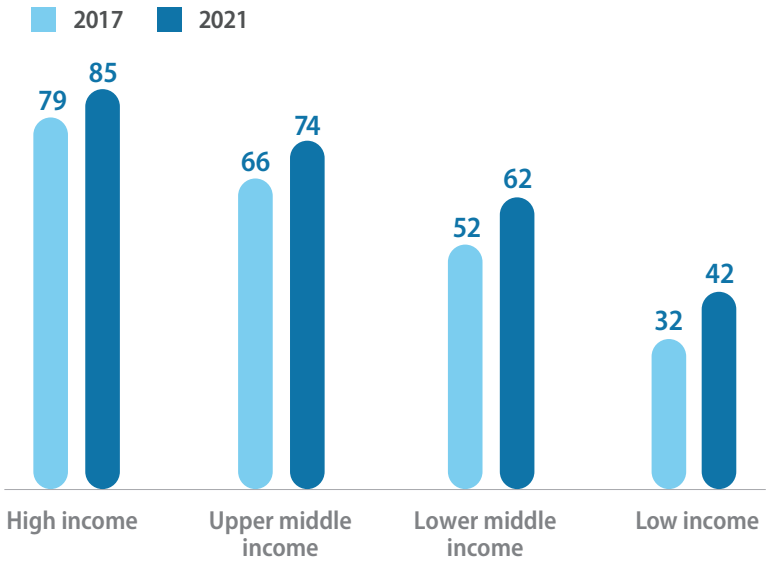
42 Fei L. Disconnected in a pandemic: COVID-19 outcomes and the digital divide in the United States. Health Place. 2022;77:102867. doi:10.1016/j.healthplace.2022.102867.

43 Ibid.

44 Budd J, Miller BS, Manning EM, Lampos V, Zhuang M, Edelstein M et al. Digital technologies in the public-health response to COVID-19. Nat Med. 2020;26:183–1192. doi:10.1038/s41591-020-1011-4.

45 The Inclusive Internet Index: Five-year lookback report, p.8. London: Economist Impact; 2022 (https://impact.economist.com/perspectives/sites/default/files/ei-meta_3i_5yr_lookback_report_0.pdf, accessed 22 September 2024).

Figure 12. The Inclusive Internet Index: Five-year lookback report 2017–2021



Source: The Inclusive Internet Index: Five-year lookback report, Economist Impact; 2022. https://impact.economist.com/perspectives/sites/default/files/ei-meta_3i_5yr_lookback_report_0.pdf

- There is a strong correlation between lack of digital access and economic vulnerability in both directions, potentially leading to compound inequities.[46] Access to digital technologies brings individuals many economic, development, social, and educational opportunities, which are lost to those who do not have access. In addition, access to digital technologies has an important impact on countries' economic growth, which is also lost to those with more limited access to digital technologies. This makes individuals and communities less resilient and reduces their capacity to prepare and respond to epidemics and pandemics.

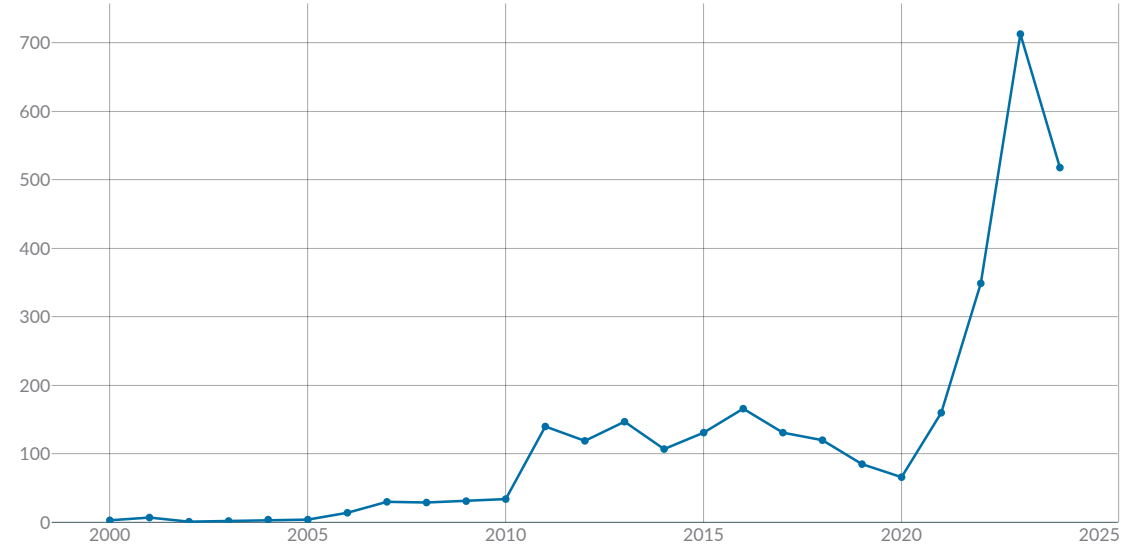
According to the International Telecommunication Union (ITU)[47]:

- "In Africa, an increase of 10 per cent in mobile broadband penetration can increase GDP by 2.5 per cent per capita.
- In the Arab states, a 10 per cent increase in digitization can result in a 2.49 per cent growth in GDP by capita.
- In North and South America, an increase of 10 per cent in fixed broadband penetration can result in a 1.9 per cent growth in GDP per capita.
- A 10 per cent increase in digitization in Europe may result in a 1.4 per cent growth in GDP per capita.
- In the Asia-Pacific region, a 10 per cent increase in fixed broadband penetration may result in a 0.8 per cent growth in GDP per capita."

46 Roper, W. Internet Access Low Among Economic Vulnerable. Statista [website]. 8 September 2020. (https://www.statista.com/chart/22837/internet-access-among-economic-vulnerable/, accessed 21 September 2024).

47 Cyber Incident Dashboard. European Repository of Cyber Incidents; 2024 (https://eurepoc.eu/dashboard/, accessed 22 September 2024)..

Figure 13. Number of cyber incidents across all countries 2000—2024



Source: Cyber Incident Dashboard. European Repository of Cyber Incidents; 2024. https://eurepoc.eu/dashboard/

- In terms of the quality of digital networks and platforms used by governments, researchers, and first responders for managing disease detection and response, the inclusion of all relevant sectors and population groups—along with their empowerment to take action—remains significantly inadequate.

- The risks engendered by digital technologies are increasing and making health systems more vulnerable. For example, in May 2017, "the global WannaCry ransomware attack disrupted more than a third of hospital trusts across NHS England and nearly 7000 appointments were cancelled. Medical staff could not access any data, were unable to deliver medical care, and outpatient services had to be cancelled."[48] Cyber attacks have also led to personal data theft and can cause major financial losses for health systems providers. 20.8% of cyber attacks on critical infrastructure reported in the European Repository of Cyber Incidents targeted health systems.[49]

Opportunities/Challenges

- Due to its important benefit for economies and markets, digital inclusiveness has grown and will continue to grow significantly in the future. Moreover, cross-sectoral and multistakeholder collaboration have received a welcome amount of attention in policy- and decision-making circles, especially in areas that focus on One Health.

- In terms of digital platform regulation, several global legal frameworks are attempting to regulate digital risks within a human rights approach, presenting promising models for authorities in other countries to follow.[50]

- Cyber attacks, and capacities to deter them, are increasing concurrently and will continue to do so.

- In terms of multi-country, multisectoral collaboration, concerns about digital sovereignty pose challenges for platform interoperability and regulation, requiring greater international trust and willingness to collaborate.

48 Cyberattacks on health care — a growing threat. Lancet Editorial. 2024;403(10441):2263. doi:10.1016/S0140-6736(24)01074-2.

49 Cyber Incident Dashboard. European Repository of Cyber Incidents; 2024 (https://eurepoc.eu/dashboard/, accessed 22 September 2024).

50 Afina Y, Buchser M, Krasodomski A, Rowe J, Sun N, Wilkinson R. Towards a global approach to digital platform regulation: Preserving openness amid the push for internet sovereignty. Research Paper, London: Royal Institute of International Affairs; 2024. doi:10.55317/9781784135935.

Assessment

- **Trend:** Digital connectivity has improved steadily and has become a priority for many countries. Fortunately, experts predict that the digital divide will close in the next two decades. On the other hand, cyber threats are increasing in tandem with the growing sophistication and use of technologies.
- **Impact:** Digital connectivity and technologies are crucial to pandemic prevention, preparedness and response. Access remains very uneven and inequitable, and continues to impact public health responses negatively, but much progress is being made in improving this driver.

Actions

- **Countries should continue to invest in high-risk and vulnerable areas** to minimize the digital divide, focusing on digital hardware as well as software, digital literacy, and the inclusiveness of public health platforms and networks.
- **Government regulation of digital technologies should ensure safety** and be aligned with human rights values, transparency and inclusiveness.

Monitoring Framework Indicator:
A.1.2.1 Exposure to misinformation through social media

MISINFORMATION

Impact on pandemic risk

Driver description

- Social media is an important tool for public health, facilitating the rapid dissemination of public health information to enable a faster response and better implementation of public health and social measures. However, social media also enables the rapid spread of misinformation and disinformation, particularly in the absence of trusted/expert information. This can have important impacts on health-related knowledge, behaviours and attitudes.

- Misinformation refers to false or misleading information that is spread without necessarily any intention to deceive or mislead. Disinformation is false or misleading information that is spread with the deliberate intention to deceive or mislead.

- Mis- and disinformation operate as pandemics in their own right, leading not only to mistaken beliefs, anger and/or confusion about life-saving measures, but ultimately to broader social and political challenges, such as the erosion of trust in science and public health, insecurity for first responders or political polarization.

- Mis- and disinformation influence the capacity to respond to epidemics and pandemics. They reduce communities' willingness to adopt public health measures, to accept preventive measures such as vaccination or to seek health care.

Key points

- Social media platforms present a number of important opportunities for pandemic management due to their particular nature and characteristics[51,52]: they are far more democratic and inclusive than more static media platforms or websites, allowing for greater reach; their different formats, languages and number allow for much better targeting of information to specific populations[53]; their open nature also facilitates more complete, rapid and specific monitoring of attitudes, beliefs, or needs, allowing for much more local, targeted and contextualised responses, as a number of successful surveillance initiatives show.[54] Last but not least, social media platforms can facilitate a sense of connectedness and support, especially during periods when physical presence is prohibited.[55]

51 Potter C, Nagar A, Fink E, Grégoire V, Malaty Rivera J, Zhu A et al. Checklist to Build Trust, Improve Public Health Communication, and Anticipate Misinformation During Public Health Emergencies. Baltimore, MD: Johns Hopkins Center for Health Security; 2024 (https://centerforhealthsecurity.org/sites/default/files/2024-07/2024-07-12-checklist.pdf, accessed 22 September 2024).

52 Venegas-Vera AV, Colbert GB, Lerma EV. Positive and negative impact of social media in the COVID-19 era. Rev Cardiovasc Med. 2020;21(4):561-564. doi:10.31083/j.rcm.2020.04.195.

53 Turuba R, Cormier W, Zimmerman R, Ow N, Zenone M, Quintana Y et al. Exploring How Youth Use TikTok for Mental Health Information in British Columbia: Semistructured Interview Study With Youth. JMIR Infodemiology. 2024;4:e53233. doi: 10.2196/53233.

54 Park GS, Bae J, Lee JH, Yun BY, Lee B, Shin EK. Integrated Infodemic Surveillance System: The Case of COVID-19 in South Korea. Stud Health Technol Inform. 2021;281:1036-1040. doi:10.3233/SHTI210342.

55 Turuba R, Cormier W, Zimmerman R, Ow N, Zenone M, Quintana Y et al. Exploring How Youth Use TikTok for Mental Health Information in British Columbia: Semistructured Interview Study With Youth. JMIR Infodemiology. 2024;4:e53233. doi: 10.2196/53233.

- At the same time, these same characteristics present significant risks[56], including the accidental or deliberate sharing of erroneous information[57], and their rapid spread. Frequently anonymous or not subject to identity checks, social media can facilitate the expression of negative feelings such as anger or scorn, or deliberate attacks on groups or individuals, including health experts or public authorities. This may amplify mistrust, fear or polarization, thereby undermining the ability to put in place strong public health measures or to provide health care.

- The infodemic — an overwhelming surge of both accurate and inaccurate information — has emerged as a critical challenge during pandemics. In the digital age, misinformation and disinformation spread rapidly, often undermining public health responses, eroding trust in authorities, and fuelling fear and confusion. Managing an infodemic is essential because, unlike a virus, it cannot be fully eliminated. With the proliferation of social media and other communication platforms, attempting to completely suppress the flow of information is unrealistic and could have negative consequences. Instead, effective management requires a proactive approach that emphasizes timely dissemination of accurate, clear, and consistent information, based on active social listening to a population's concerns. Building public trust in science and health authorities, fostering media literacy, and collaborating with technological platforms to curtail the spread of falsehoods are essential strategies for reducing the impact of an infodemic, helping to ensure that sound public health guidance prevails during crises.[58,59]

- Although rumours and misinformation have also characterized epidemics of the past, there are specific mechanisms linked to social media that explain the importance of this phenomenon: viral sharing and amplification due to social media algorithms, influencers and confirmation bias, echo chambers and filter bubbles, bots and automated accounts, clickbait and financial incentives, and manipulated media and deep fakes disseminating AI-fabricated images, videos and audio.

- These risks are particularly significant when they occur in an information void, that is, when there is a lack of targeted, relevant, and rapidly available information from organizations, authorities or trusted experts.[60] Even in countries where the population is familiar with these technologies and authorities are well versed in digital communications, such as the US, some health information, including official information provided by the health authorities, remains inaccessible to vulnerable people.

- Paying greater attention to these platforms is a necessity for people and organizations involved in public health and pandemic response.[61,62] This is essential in order to promote credible information sources[63] and to rapidly respond to people's information needs and concerns,[64] but also as a means to monitor and address the nature and quality of information that people are sharing on these platforms.

- A comprehensive research agenda has also been developed to guide the development of countermeasures and best practices to help countries better manage infodemics, including misinformation.[65]

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56 Venegas-Vera AV, Colbert GB, Lerma EV. Positive and negative impact of social media in the COVID-19 era. Rev Cardiovasc Med. 2020;21(4):561-564. doi:10.31083/j.rcm.2020.04.195.

57 Baker SA, Walsh MJ. "Memes Save Lives": Stigma and the Production of Antivaccination Memes During the COVID-19 Pandemic. Soc Media Soc. 2024;10(1). doi: 10.1177/20563051231224729.

58 Health Topic: Infodemics. In: WHO [website]. Geneva: WHO; 2024 (https://www.who.int/health-topics/infodemic#tab=tab_1, accessed 9 October 2024).

59 Gruzd A, De Domenico M, Sacco PL, Briand S. Studying the COVID-19 infodemic at scale. Big Data & Society. January 2021. doi:10.1177/20539517211021115.

60 Purnat T, Nguyen T, Briand S. (eds.) Managing Infodemics in the 21st Century: Addressing New Public Health Challenges in the Information Ecosystem. Cham: Springer; 2023. doi:10.1007/978-3-031-27789-4.

61 Potter C, Nagar A, Fink E, Grégoire V, Malaty Rivera J, Zhu A et al. Checklist to Build Trust, Improve Public Health Communication, and Anticipate Misinformation During Public Health Emergencies. Baltimore, MD: Johns Hopkins Center for Health Security; 2024 (https://centerforhealthsecurity.org/sites/default/files/2024-07/2024-07-12-checklist.pdf, accessed 22 September 2024).

62 Purnat T, Nguyen T, Briand S. Managing Infodemics in the 21st Century: Addressing New Public Health Challenges in the Information Ecosystem. Cham: Springer; 2023. doi:10.1007/978-3-031-27789-4.

63 Chong M, Park HW. COVID-19 in the Twitterverse, from epidemic to pandemic: information-sharing behavior and Twitter as an information carrier. Scientometrics. 2021;126:6479–6503. doi:10.1007/s11192-021-04054-2.

64 Baker SA, Walsh MJ. "Memes Save Lives": Stigma and the Production of Antivaccination Memes During the COVID-19 Pandemic. Soc Media Soc. 2024;10(1). doi: 10.1177/20563051231224729.

65 WHO public health research agenda for managing infodemics. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

Data and trends

- In July 2024, there were 5.17 billion social media users in the world, which represents approximately 65% of the global population.[66] Using social media platforms is one the most popular internet activities with the highest user engagement.

- Social media platforms are fast replacing traditional media platforms, such as radio or news channels, as a source of information, particularly among younger people[67] (see Figure 14 and Table 1 regional data on social media users per capita). Moreover, research shows that this is particularly true in cases of natural disasters and crises, when information must be shared quickly.

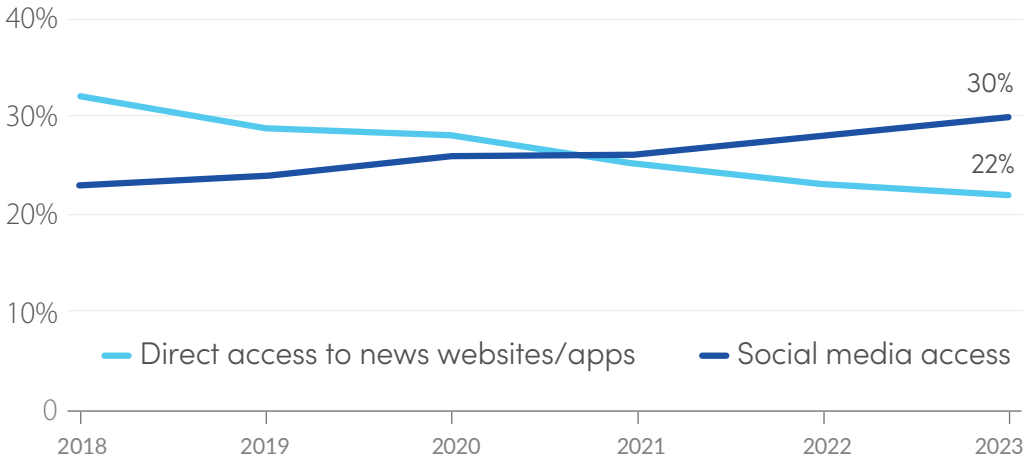
- Individuals are increasingly exposed to false or misleading information (see Figure 15).

- A 2022 study found that health misinformation distributed on social media was present in 1–51% of posts associated with vaccines, 0.2–28.8% of posts associated with COVID-19, and 4–60% of posts associated with pandemics. According to the study, "approximately 20–30% of the YouTube videos about emerging infectious diseases contain[ed] inaccurate or misleading information".[68]

- People and organizations involved in public health and pandemic management are not keeping up with information needs or engaging sufficiently on social media, either in terms of quantity or quality. This may be because they underestimate the relevance and impact of social media; they misunderstand how people produce or consume social media content; or they are unable to keep up with the speed required by this medium. Organizational requirements related to fact-checking or to senior management approvals can also be time-consuming. This results in critical gaps in quality (verified, tailored) information, which may themselves lead to mistrust or perceptions of lack of transparency.

- Social media use will only increase, although there are also signs that people are starting to turn away from social media as a source of news, due to fear of misinformation and disinformation, as well as 'news fatigue'.[69]

Figure 14. Proportion of individuals who access news through news websites/apps versus social media 2018—2023



Source: Digital News Report 2023. Reuters Institute for the Study of Journalism; 2023. doi:10.60625/risj-p6es-hb13

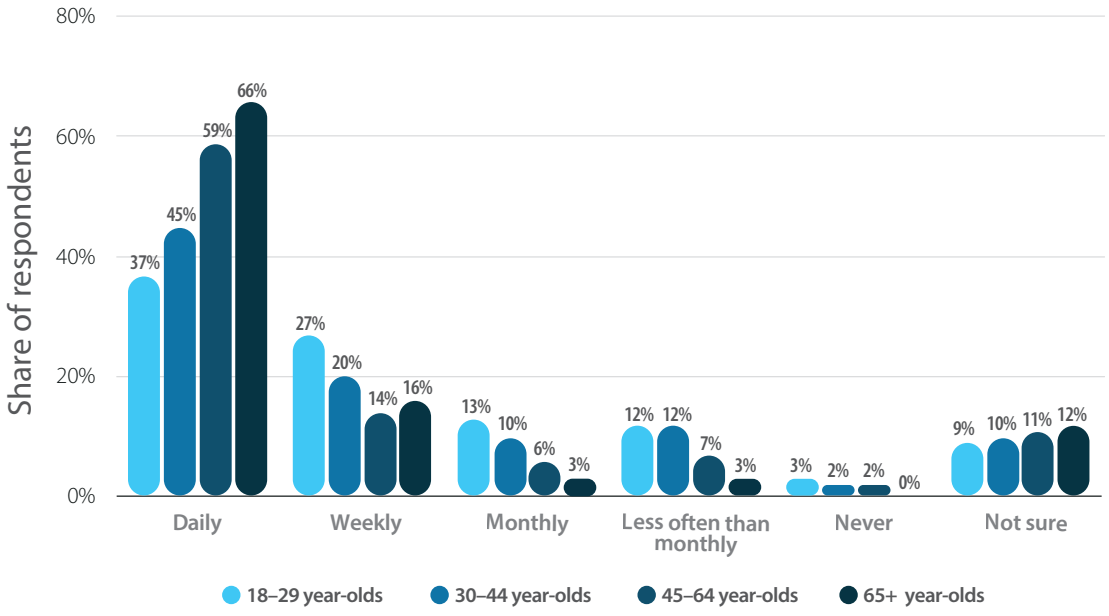
66 Digital 2024: July Global Statshot Report. DataReportal; Meltwater; We Are Social, July 2024 (https://datareportal.com/?utm_source=Statista&utm_medium=Data_Citation_Hyperlink&utm_campaign=Data_Partners&utm_content=Statista_Data_Citation, accessed 9 October 2024).

67 Newman N, Fletcher R, Eddy K, Robertson CT, Nielsen RK. Digital News Report 2023. Oxford: Reuters Institute for the Study of Journalism; 2023. doi:10.60625/risj-p6es-hb13.

68 Borges do Nascimento IJ, Pizarro AB, Almeida JM, Azzopardi-Muscat N, Gonçalves MA, Björklund M, Novillo-Ortiz D. Infodemics and health misinformation: a systematic review of reviews. Bull World Health Organ 2022;100(9):544–561. doi: 10.2471/BLT.21.287654.

69 Digital News Report 2023. Reuters Institute for the Study of Journalism. Oxford: Reuters; 2023. doi:10.60625/risj-p6es-hb13.

Figure 15. Frequency of seeing false or misleading information among adults in the United States, April 2023



Source: YouGov, 2023. https://www.statista.com/statistics/1462057/false-news-consumption-frequency-us-by-age/

Opportunities/Challenges

- On the positive side, there is a growing awareness among public health authorities and practitioners of the critical roles of risk communication, social listening, and trust building, even if this understanding has not yet transformed into action in most places. Moreover, digital technologies are improving our ability to conduct social media listening, though few platforms exist that are interoperable and capable of collating that data on a large scale. Unfortunately, public health experts and authorities have failed to seize the many listening opportunities afforded by social media platforms, which allow for systematic and coordinated monitoring of fears, needs, and beliefs. This means that public health measures are rarely adapted to highly localized epidemic circumstances.

- While some countries have chosen to address misinformation and disinformation with tight control and regulation of social media platforms — a technique that often backfires by increasing mistrust among the population — experts have shown that not only is this technique counterproductive, it is also extremely resource-intensive, making it an approach that only a handful of countries can follow.

- On the negative side, there is no one-solution-fits-all. Good social media practices are highly local and require very localized and target-specific research. Furthermore, large organizations may not be particularly well suited to the rapid response times required by social media if they do not put in place much clearer, nimbler, adapted communication guidelines, and do not invest in the human resources required to cover a multiplicity of evolving digital spaces.

- The void left by trusted sources of information remains significantly under addressed.[70]

70 Some solutions have been proposed. See for example: Purnat T, Vacca P, Czerniak C, Ball S, Burzo S, Zecchin T et al. Infodemic Signal Detection During the COVID-19 Pandemic: Development of a Methodology for Identifying Potential Information Voids in Online Conversations. JMIR Infodemiology 2021;1(1):e30971. doi:10.2196/30971.

Assessment

- **Trend:** Access to and use of social media platforms, and ability to generate social media content, especially using artificial intelligence, are on the rise everywhere. Individuals are increasingly exposed to false and misleading content. Unfortunately, governments and institutions have struggled to keep pace with these changes and are therefore not providing enough timely information to mitigate these trends. Misinformation contributes to a growing lack of trust in institutions as well as in public health measures. Recent health emergencies have highlighted that it is extremely challenging to respond effectively in environments with low public trust and widespread misinformation.

- **Impact:** Misinformation will significantly undermine pandemic response capacities by spreading inaccurate information, eroding public trust in health authorities, and hindering compliance with effective preventive and curative measures. Misinformation is leading to distrust of well-established public health interventions, including vaccine hesitancy; promotion of unproven treatments and fake cures; and conspiracy theories. It is also affecting individuals' willingness to use and trust health care systems; inform authorities about zoonotic or human cases; or adopt measures that will stop the spread of disease. The influence of this driver is assessed as very high on the capacity to respond to epidemics and pandemics.

Actions

- **Health authorities and experts need to better understand the new information ecosystem in which they operate**, and to develop more efficient strategies to manage an infodemic and reduce misinformation in times of crisis.

- **Health authorities should develop mechanisms to listen to the population's concerns, needs, fears and beliefs** in order to adapt public health responses and communication strategies more effectively.[71,72]

71 Tangcharoensathien V, Calleja N, Nguyen T, Purnat T, D'Agostino M, Garcia-Saiso S et al. Framework for Managing the COVID-19 Infodemic: Methods and Results of an Online, Crowdsourced WHO Technical Consultation. J Med Internet Res 2020;22(6):e19659. doi:10.2196/19659.

72 Calleja N, AbdAllah A, Abad N, Ahmed N, Albarracin D, Altieri E et al. A Public Health Research Agenda for Managing Infodemics: Methods and Results of the First WHO Infodemiology Conference. JMIR Infodemiology 2021;1(1):e30979. doi:10.2196/30979.

Monitoring Framework Indicator:
A.1.2.3 Biomedical innovation

BIOMEDICAL INNOVATION

Impact on pandemic risk

Driver description

- Biomedical innovations cover a wide range of technologies, products and tools that can be used in pandemic prevention, preparedness and response. They include medical technologies and products — vaccines, treatments, personal protective equipment (PPE) or diagnostic tools — as well as pharmaceutical and non-pharmaceutical interventions (for example, contact tracing platforms, community surveillance, or genomic sequencing platforms).

- Biomedical innovations can also be organized according to whether they are pathogen-specific, that is, that they work on a single or limited range of viruses (for example, PCR diagnostic tests, vaccines) or pathogen-agnostic, that is, that they will be effective against a broad range of pathogens (for example, PPE, oxygen or hydroalcoholic gel).

- Biomedical innovations are at the heart of efforts to prevent, prepare for and respond to epidemics and pandemics. They enable the development of higher quality and more effective tools (for example, better treatments that can reduce mortality), faster interventions (for example, rapid diagnostic tests), and increased access to and coverage of products and services (such as telemedicine). Ultimately, biomedical innovations save millions of lives.

- Evidence shows that countries and regions with greater biomedical innovation capacity have lower pandemic and epidemic risk, as they have greater capacity to innovate rapidly in response to emerging threats. On the other hand, biomedical innovations also increase risks related to biosafety and biosecurity, which can make a country more vulnerable to deliberate or accidental release of pathogens.

Key points

- Much progress has been made in our capacity to develop biomedical innovations, especially following the COVID-19 pandemic. However, this capacity is not distributed equally.

- Equitable access to biomedical innovations is a major problem.[73,74] Many barriers to access remain due to market forces, geographic accessibility, donor funding agendas, health systems' capacity, or acceptability of the innovations to the populations receiving them.[75] Lack of access to biomedical innovation leads to higher levels of preventable deaths, and enables further spread and amplification of infectious disease.

- Biorisks[76], such as the accidental or deliberate release into the environment of pathogens with pandemic potential, have increased over the past two decades due to the natural acceleration of certain types of research[77]; the emergence of new laboratories; the open access to genetic sequence data of dangerous pathogens, allowing for a potential biosynthesis of viruses with pandemic potential; and the increasing challenge of monitoring biomedical research and conducting risk assessments.[78] While the likelihood of such an event is still relatively small, its consequences could be catastrophic.

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73 Agrawal G, Conway M, Heller J, Sabow A, Tolub G. On pins and needles: Tracking COVID-19 vaccines and therapeutics. McKinsey and Company; 2021 (https://www.mckinsey.com/industries/life-sciences/our-insights/on-pins-and-needles-will-covid-19-vaccines-save-the-world, accessed 23 September 2024).

74 A Roadmap to End the COVID-19 Pandemic. 2021 Annual Meetings Event, Washington DC: International Monetary Fund; 2021 (https://www.imf.org/en/News/Seminars/Conferences/2021/10/18/a-roadmap-to-end-the-covid-19-pandemic, accessed 23 September 2024).

75 Boro E, Stoll B. Barriers to COVID-19 Health Products in Low-and Middle-Income Countries During the COVID-19 Pandemic: A Rapid Systematic Review and Evidence Synthesis. Front Public Health. 2022;10. doi:10.3389/fpubh.2022.928065.

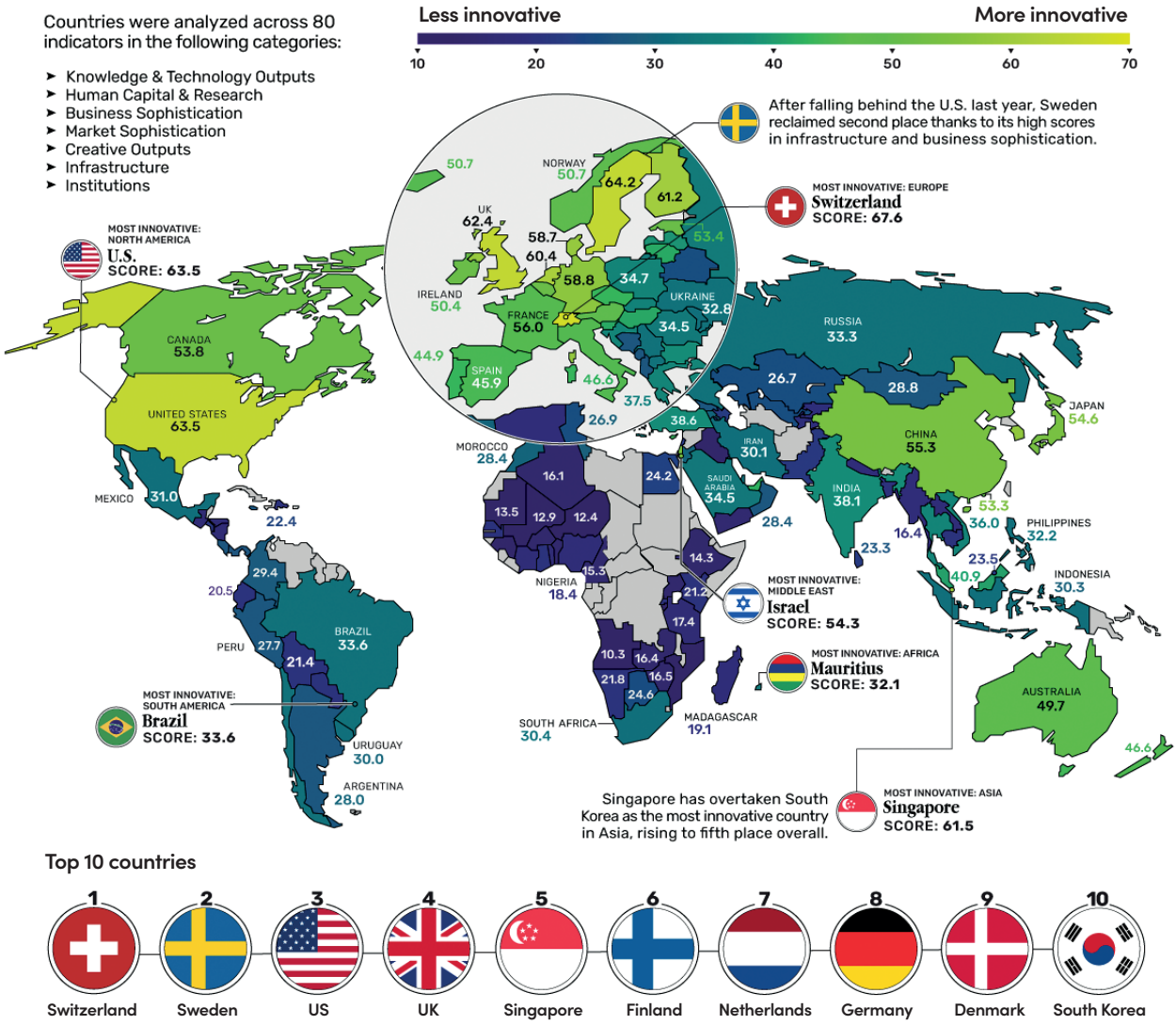
76 Klotz L, Sylvester EJ. The unacceptable risks of a man-made pandemic. Bulletin of the Atomic Scientists. 2012 (https://thebulletin.org/2012/08/the-unacceptable-risks-of-a-man-made-pandemic/, accessed 23 September 2024).

77 Willman D, Warrick J. Research with exotic viruses risks a deadly outbreak, scientists warn. The Washington Post. 10 April 2023 (https://www.washingtonpost.com/investigations/interactive/2023/virus-research-risk-outbreak/, accessed 2 October 2024).

78 de Waal. Lab Leaks. The London Review of Books. 2 December 2021; vol. 43, no. 23 (https://www.lrb.co.uk/the-paper/v43/n23/alex-de-waal/lab-leaks, accessed 24 September 2024).

Data and trends

Figure 16. Global Innovation Index 2023



Source: Visual Capitalist, 2023, based on Dutta S, Lanvin B, Rivera León L, Wunsch-Vincent, S. Global Innovation Index 2023: Innovation in the face of uncertainty. Geneva: WIPO; 2023. doi:10.34667/tind.48220

- The capacity to innovate remains geographically concentrated in a few higher income countries. Figure 16 shows country rankings under the World Intellectual Property Organization's (WIPO) Global Innovation Index (see also Table 1 for regional data from the 2023 Global Innovation Index). Globally, in 2023, "10 manufacturers alone provide 75% of vaccine doses (excluding COVID-19 vaccines) and capture 85% of the global value of vaccines, with more than 80 manufacturers serving the remaining market."[79]

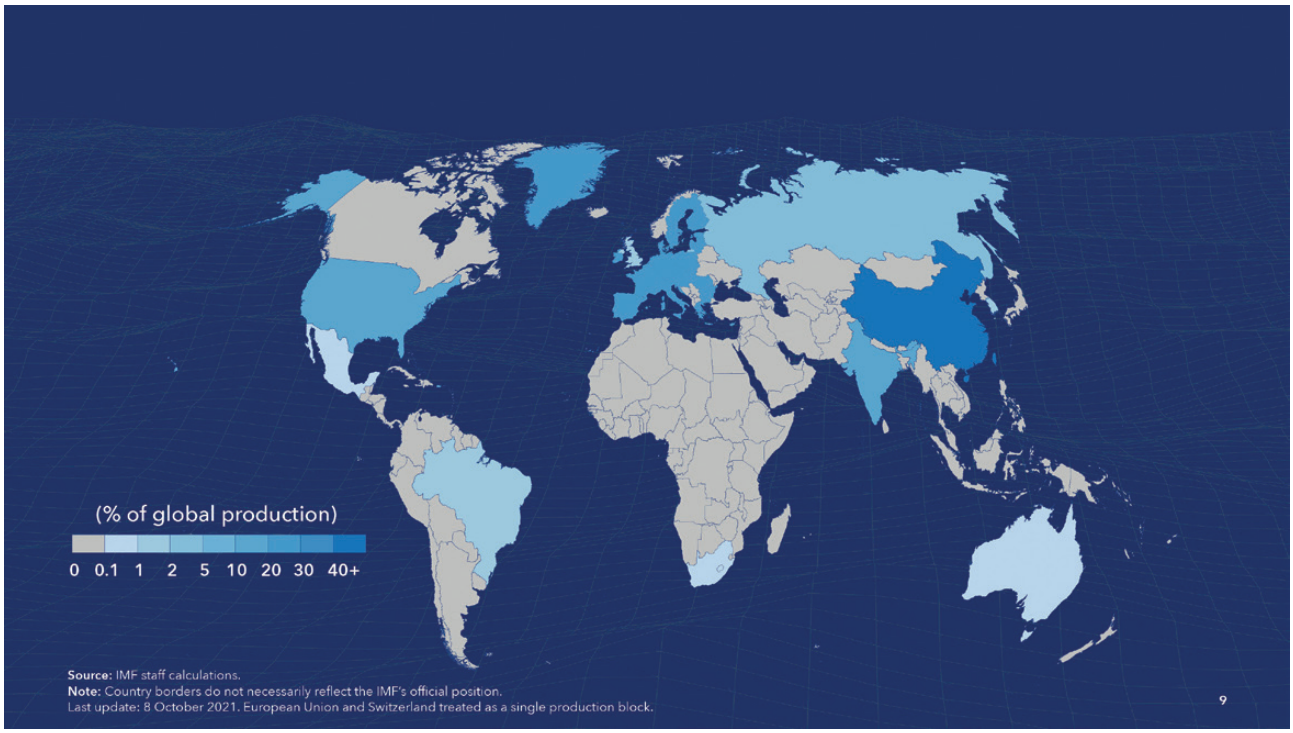
- In part due to this unequal capacity, many parts of the world remain unable to access biomedical innovations, despite enormous progress in recent decades in the speed required to develop these innovations, especially vaccines. There is a clear correlation between vaccine production centres and vaccination rates (see Figures 17[80] and 18[81]).

79 Global vaccine market report: 2023 Update. Geneva: WHO/MI4A Vaccines; December 2023 (https://cdn.who.int/media/docs/default-source/immunization/mi4a/who_gat_008_global_vaccine_market_report_march_12.pdf, accessed 2 October 2024).

80 Dutta S, Lanvin B, Rivera León L, Wunsch-Vincent, S. Global Innovation Index 2023: Innovation in the face of uncertainty. Geneva: WIPO; 2023. doi:10.34667/tind.48220.

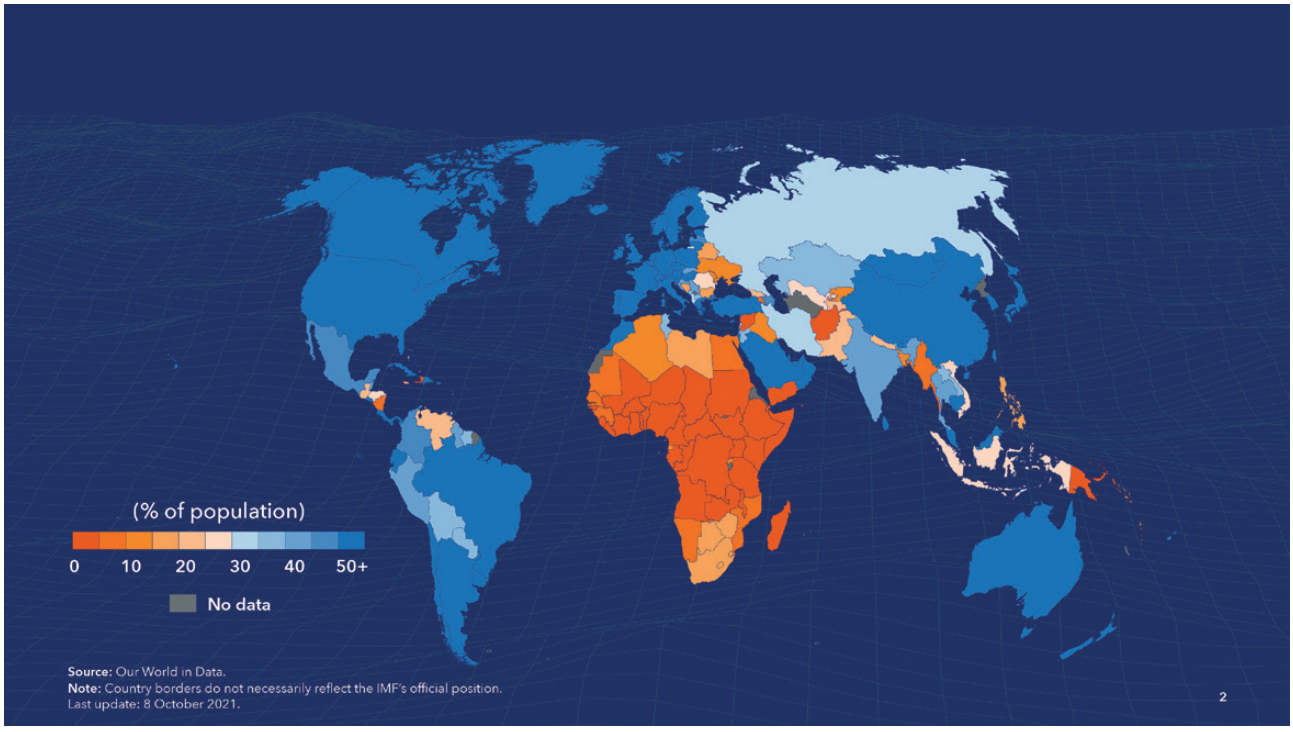
81 A Roadmap to End the COVID-19 Pandemic. 2021 Annual Meetings Event, Washington DC: International Monetary Fund; 2021 (https://www.imf.org/en/News/Seminars/Conferences/2021/10/18/a-roadmap-to-end-the-covid-19-pandemic, accessed 23 September 2024).

Figure 17. Proximity to vaccine production affects vaccination rates



Source: International Monetary Fund, 2021. https://www.imf.org/en/News/Seminars/Conferences/2021/10/18/a-roadmap-to-end-the-covid-19-pandemic

Figure 18. Vaccine inequity is exacerbating the divergence



Source: International Monetary Fund, 2021. https://www.imf.org/en/News/Seminars/Conferences/2021/10/18/a-roadmap-to-end-the-covid-19-pandemic

Opportunities/Challenges

- On the positive side, the past decade has seen enormous growth in biomedical innovations applied to public health, and disease outbreaks in particular. These include important vaccine advances, new treatments, rapid diagnostic tests and genomic sequencing, the development of several new e-health platforms to reach remote populations, and better PPE. Several initiatives have been established to build biomedical innovation capacity across the world, including promising initiatives on the African continent.[82]

- The COVID-19 pandemic illustrated the catastrophic impact of inequity on access to these new technologies, but also the need to develop innovative products that can be used in any kind of setting, given, for example, the limited usability of vaccines that require an ultracold chain.

- Growth in the volume of research and the number of laboratories able to perform sensitive work on pathogens comes with a higher risk of accidents, which can only be countered by greater oversight, transparency and accountability, according to biothreat experts.

- During pandemics, the development of innovative medical countermeasures often outpaces the capacity of regulatory authorities to assess the quality and safety of these products using standard protocols. This urgency can create challenges in maintaining rigorous oversight while ensuring timely access to critical treatments and vaccines, highlighting the need for adaptable regulatory frameworks that balance speed with safety during public health emergencies.

- To support greater biosafety, especially in laboratories, several organizations have developed or revised their practical and ethical guidelines to promote transparency, standardized risk assessment and responsible life sciences research.[83,84]

- Given the unpredictable nature of the next pandemic, it is necessary to expand the scope of biomedical innovations from a focus on pathogen-specific medical interventions to a broader scope of pandemic-related innovations, such as PPE, supportive care and risk communication tools, which are pathogen-agnostic and cover medical and broader health-related interventions, including public health research on acceptance of new technologies.

Assessment

- **Trend:** There have been great improvements in global capacity to produce biomedical innovations. However, there are profound inequities in the distribution of this capacity. Lack of access remains the principal threat related to biomedical innovations and has yet to show improvements. However, several initiatives, such as the negotiations of the Pandemic Agreement and regional investments in manufacturing capacity, have the potential to improve access in the coming years.

- **Impact:** Lack of access to biomedical innovations costs lives and contributes to the further spread of infectious disease. This lack of equity contributes to mistrust and adds fuel to disinformation campaigns, further widening existing inequities and making the response to health emergencies more challenging. Fortunately, recent progress in building research and development (R&D) capacity and upcoming initiatives have the potential to lead to improvements of this driver in the coming years. The risk emerging from biothreats is currently relatively small but is growing.

82 Appendix to the 2023 Report on State of the World's Preparedness. Geneva: GPMB; 2023 (https://www.gpmb.org/reports/m/item/appendix, accessed 2 October 2024).

83 Laboratory biosecurity guidance. Geneva: WHO; 2024. (https://www.who.int/fr/publications/i/item/9789240095113; accessed 23 September 2024).

84 Responsible life sciences research for global health security: A guidance document. Geneva: WHO; 2010 (https://www.who.int/publications/i/item/WHO-HSE-GAR-BDP-2010.2, accessed 23 September 2024).

Actions

- **Governments should reduce inequities in access** through the following actions:
  - **Consideration of the end-to-end process when addressing barriers to access** is critical, from genomic sequencing to product use in the community — including development, testing, manufacturing, importing, stocking, distribution and delivery into communities — and human factors, such as building trust and collaboration systems well in advance of a crisis.
  - **Greater investment in regional manufacturing initiatives and technology transfer**, building on existing capacities and capabilities, partnerships and political will. It is crucial to bear in mind that producing complex pharmaceuticals is not simply a matter of building the required production line or hardware; it also involves a complex manufacturing process, a large team of experts, considerable time, many detailed steps, the appropriate regulatory registrations, and an existing market — all to the highest quality standards.
  - **More investment in pathogen-agnostic innovations**, including non-pharmaceutical ones, in particular those that are less time sensitive and easier to stock (for example, masks, PPE and syringes).
- **Governments should place greater emphasis on regulating biotechnologies** to enhance biosafety and biosecurity, while also safeguarding innovation and ensuring rapid access to these advancements for populations in need.

3

ECONOMIC DRIVERS

Economic development

Economic inequality

Social programmes

Monitoring Framework Indicator:
A.1.3.1 Economic development

ECONOMIC DEVELOPMENT

Impact on pandemic risk

Driver description

- Economic development is the process by which an economy grows to become more advanced and fairer, and leads to improved economic well-being and quality of life for a country or community.

- Economic development influences pandemic and epidemic risks through multiple pathways. There is a link between the risk of infectious disease spread and transmissibility on the one hand, and a country's wealth and capacity to pay for resources on the other. At the population level, countries with higher levels of income and a greater fiscal space capacity have more assets to distribute (should they choose to do so). At the individual level, life expectancy is observably higher among those on the higher rungs of the economic ladder. Economic development also influences a country's capacity to buy and distribute medical countermeasures, provide health care and mount a public health response to health emergencies.

Key points

- Economic development affects a country's capacity to prevent, prepare for and respond to epidemics and pandemics in many ways. Simply put, countries with more limited economic resources generally struggle to make adequate investments in prevention and preparedness, and in their health systems, and can therefore be more vulnerable to epidemics and pandemics. In general, the higher a country's GDP per capita, the higher its health spending.[85] Lower economic development levels are also associated with an exodus of health care workers to higher income countries, further weakening the health system.

- In a context of competition and finite resources, countries with greater financial resources can better compete and secure access to medical resources. A market-based approach to accessing medical countermeasures means that those with a greater ability to pay can access diagnostics, vaccines and treatments first and monopolize the majority of resources, while others struggle to access medical countermeasures and cannot protect their population as effectively from infectious disease.

- Economic development does not automatically correlate with better health and a lower risk of infectious disease. Poorer countries can invest in their health systems and develop first-rate systems, reducing their risks. Some rich countries may neglect certain populations or regions, and have pockets where risks are higher, increasing their overall risks. But having the financial resources to make the right investments makes an important difference.[86]

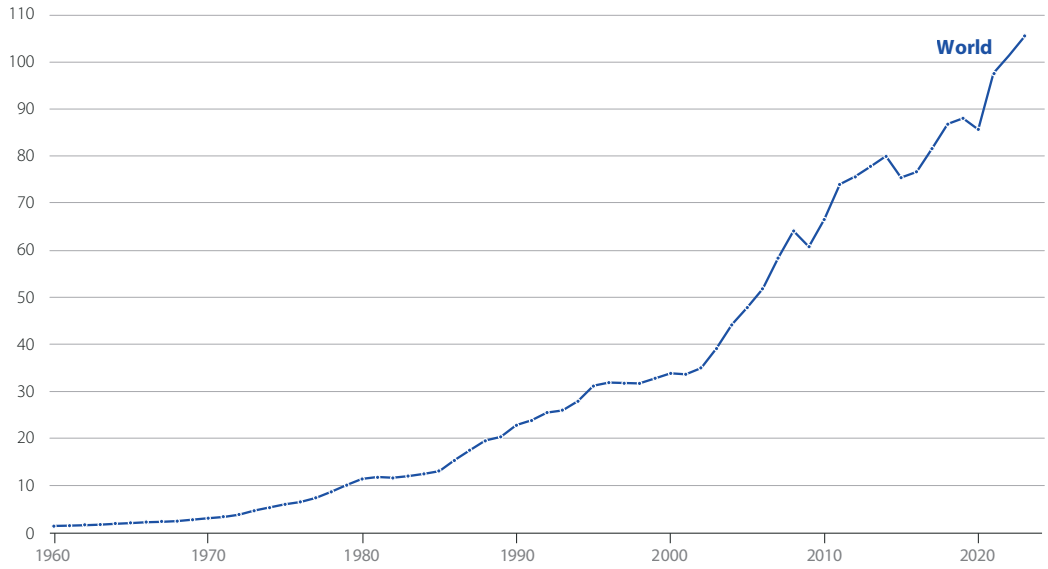
- The privatization of health services is exposing countries to more vulnerabilities, notably inequity in access and outcomes, especially for vulnerable groups, and underfunded public health systems.

85 Kurowski C, Evans DB, Tandon A, Eozenou PH, Schmidt M, Irwin A, Cain JS et al. From Double Shock to Double Recovery – Implications and Options for Health Financing in the Time of COVID-19. Technical Update 2: Old Scars, New Wounds. Washington, DC: World Bank; 2022 (https://openknowledge.worldbank.org/server/api/core/bitstreams/76d5786b-9501-5235-922a-caa71f99f0fc/content?_gl=1*1spz4iv*_gcl_au*NzEyMDEyNTk5LjE3MTc3NDg4MTA, accessed 24 September 2024).

86 Bloom DE, Canning D. Epidemics and Economics: Working Paper. Boston: Harvard University; 2006 (https://www.hsph.harvard.edu/wp-content/uploads/sites/1288/2013/10/BLOOM_CANNINGWP9.2006.pdf; accessed 23 September 2024).

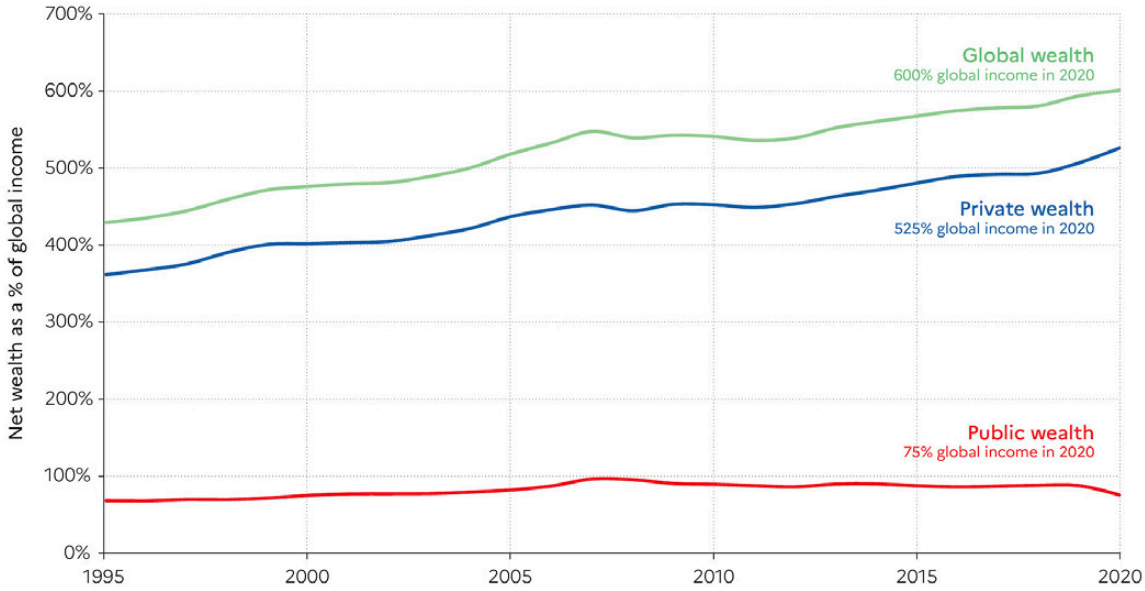
Data and trends

Figure 19. GDP per capita 1960—2023 (current US dollars)



Source: World Bank Group, 2024. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Figure 20. Global public and private wealth—income ratio 1995—2020



Source: World Inequality Report 2022, World Inequality Lab, 2022. https://wir2022.wid.world

- Most countries have seen tremendous increases in economic development over the past 100 years (see Figure 19, showing growth in GDP per capita from 1960 to 2023). However, this growth has been unequal across regions and countries, making some regions and countries more vulnerable, with weaker infrastructures, and leaving many behind (see Table 1 for regional data on GDP per capita). Over the past decade, great progress has been made and the number of people living in extreme poverty has fallen by 40%.[87] Between-country inequality has decreased but is still very high. Since 2019 however, this progress has stalled in many countries.

87 2023 in Nine Charts: A Growing Inequality. In: World Bank/News [website]. Washington DC: World Bank; 2023 (https://www.worldbank.org/en/news/feature/2023/12/18/2023-in-nine-charts-a-growing-inequality, accessed 20 September 2024).

- In many countries, economic growth in recent years has been associated with a great increase in private wealth and an important decrease in public wealth (see Figure 20). This has also been associated with an increase in national debt and slower economic growth, magnified by the COVID-19 pandemic, which has left countries at all income levels with less capacity to invest in their health systems and social programmes.[88] This trend has accelerated in the past five years. In many countries, this has led to the privatization of public services, including health care. This privatization of health could have an important impact on the capacities of countries to mount a cohesive response, based on seamless collaboration between public and private sector health services.

- The COVID-19 pandemic has led to a major drop in GDP globally. Close to 100 million additional people fell into extreme poverty and one in three countries receiving International Development Association (IDA) support have become poorer than before the pandemic.[89] The World Bank reports that, during the COVID-19 pandemic, fiscal space narrowed sharply, government debt sustainability worsened, and global government debt rose to a record high of 99% of GDP in 2020.[90] Figure 21 below shows how government debt as a share of economic output has steadily risen since 2010.

- Since the COVID-19 pandemic, the world has experienced a slow recovery. However, countries remain under fiscal constraints and have less revenue to invest in health systems. Economic growth rates are expected to remain well below pre-pandemic levels for a considerable time, with low- and middle-income countries facing the most significant challenges. This will continue to make it challenging for countries to invest in their health systems.

Opportunities/Challenges

- Countries with lower levels of economic development are more vulnerable to epidemics and pandemics because they have fewer resources to invest in prevention, preparedness and response. However, rich countries should challenge the perception that their wealth protects them from epidemics and pandemics: unless the right investments are made, even the richest countries will not be safe.

- Many lower income countries are spending more on debt repayments than on their health system.[91]

- Health spending is associated with higher economic growth.[92,93] Countries that invest in their health systems therefore contribute to their economic development.

Assessment

- **Trend:** Indicators show that economic growth has undergone a slow recovery globally, but that progress towards economic development has stalled in some countries following the COVID-19 pandemic and other geopolitical crises in recent years, especially in the poorest countries. Inequality in economic growth between countries remains high.

- **Impact:** While progress in economic development remains fragile and slower than pre-pandemic levels, it is improving. However, despite improvements in economic indicators, countries continue to significantly reduce investment in their health systems and social programmes, which now receive much lower levels of spending than before the pandemic. This leaves countries more vulnerable to the next pandemic and increases the pandemic risk level.[94] The impact of this driver on pandemic risk levels is currently assessed as moderate but could increase over the coming years.

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88 Chancel L, Piketty T, Saez E, Zucman G. World Inequality Report 2022. Paris: World Inequality Lab; 2022 (https://wir2022.wid.world/www-site/uploads/2023/03/D_FINAL_WIL_RIM_RAPPORT_2303.pdf, accessed 24 September 2024).

89 Sustainable Development Goal 1: End poverty in all its forms everywhere. In: UN/Sustainable Development Goals [website]. New York: UN DESA; 2021 (https://unstats.un.org/sdgs/report/2022/goal-01; accessed 23 September 2024).

90 Kose MA, Kurlat, Ohnsorge F, Sugawara N. A cross-country database of fiscal space. J Int Money Finance. 2022; 128:102682. doi:10.1016/j.jimonfin.2022.102682.

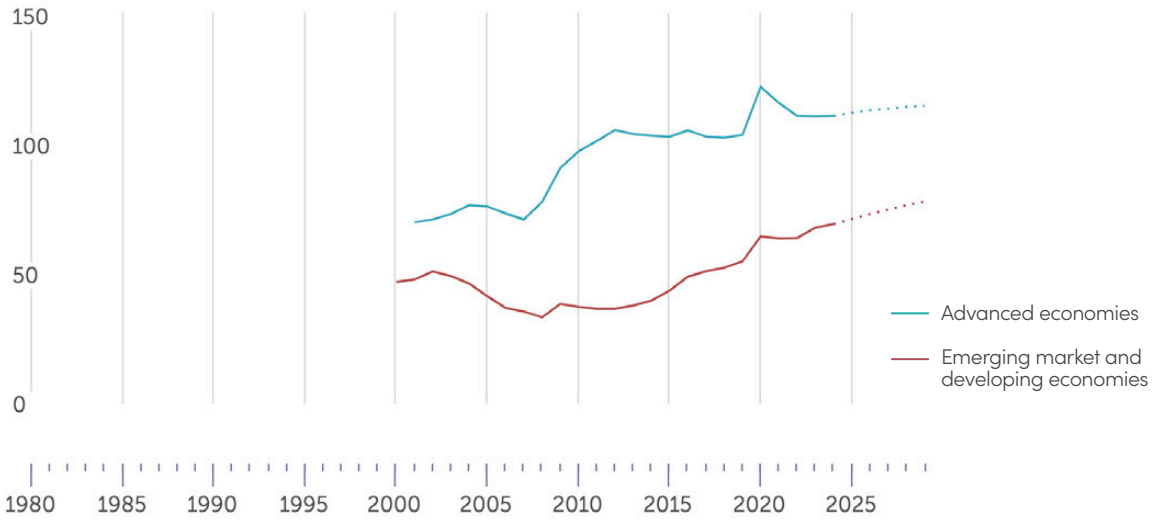
91 Debt at a glance: A World of Debt Dashboard. In: UN Trade and Development (UNCTAD) [website]. Geneva: UNCTAD; 2024 (https://unctad.org/publication/world-of-debt/dashboard; accessed 23 September 2024).

92 Celik EU, Omay T, Tengilimoglu D. Convergence of economic growth and health expenditures in OECD countries: Evidence from non-linear unit root tests. Front. Public Health. 2023;11:1125968. doi: 10.3389/fpubh.2023.1125968.

93 Hu Q, Wang L. Economic growth effects of public health expenditure in OECD countries: An empirical study using the dynamic panel threshold model. Heliyon; 2024;10(4):e25684. doi:10.1016/j.heliyon.2024.e25684.

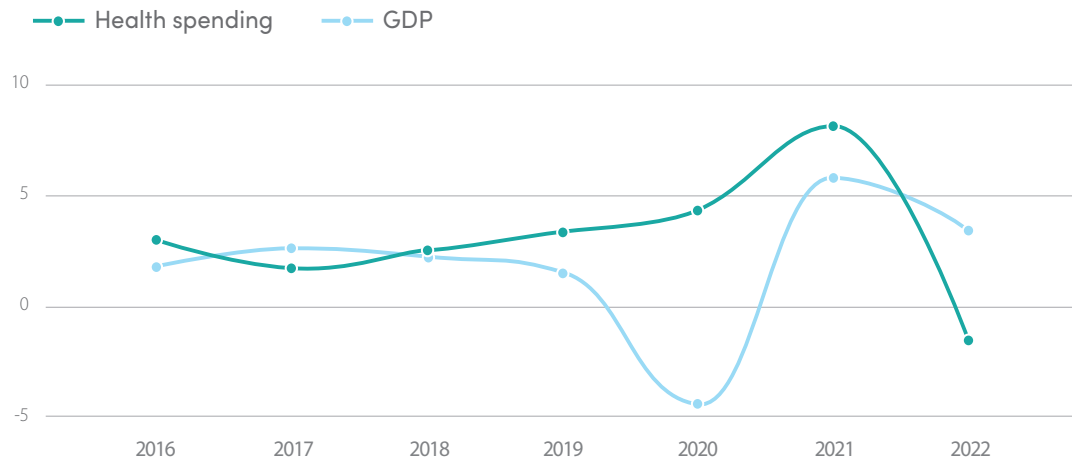
94 Health spending and financial sustainability. In: Organisation for Economic Co-operation and Development (OECD) [website]. Paris: OECD; 2024 (https://www.oecd.org/en/topics/policy-issues/health-spending-and-financial-sustainability.html, accessed 23 September 2024).

Figure 21. Government debt as a share of economic output 2000—2024, % of GDP



Source: International Monetary Fund World Economic Outlook, 2024. https://www.imf.org/external/datamapper/GGXWDG_NGDP@WEO/OEMDC/ADVEC/WEOWORLD

Figure 22. Annual real growth in health expenditure and GDP, % growth per capita, OECD average, 2016—2022



Source: Organisation for Economic Co-operation and Development (OECD) Health Statistics, 2022, doi:10.1787/health-data-en

Action

- **Countries can, and should, prioritize and invest in their health systems and health workforce** as well as in social programmes, regardless of their economic development levels and despite current geopolitical and economic challenges.

Monitoring Framework Indicator:
A.1.3.2 Economic inequality

ECONOMIC INEQUALITY

Impact on pandemic risk

Driver description

- Economic inequality refers to the extent to which income is unevenly distributed within a population.
- Economic inequality is an important driver of epidemic and pandemic risk, acting as a driver of virus emergence and amplification, and reducing the capacity to respond to outbreaks. It makes populations more vulnerable to infectious disease and limits their capacity to access health care.
- The Gini index is a commonly used measure of economic inequality. There is strong evidence that countries with higher Gini index measures (indicating greater inequality) experienced more COVID-19 deaths, and that greater wealth disparity was linked to higher COVID-19-related mortality.

Key points

- Greater inequality puts populations at greater risk of mortality and morbidity during epidemics and pandemics because of increased poverty, more comorbidities, and poorer access to health care.
- In countries with higher economic inequality, the more privileged segments of the population tend to be healthier, have better access to health care and to safe and effective medical countermeasures, and tend to be prioritized due to greater political visibility.[95] Limited access to testing, vaccines and treatments, as well as health services, on the part of less privileged segments of the population leads to greater mortality and morbidity during epidemics and pandemics in those groups, and also means that the virus remains unchecked and can continue to spread across all populations. In addition, more individuals may find themselves in vulnerable, high-exposure situations, such as certain types of employment or living conditions, and have less access to social programmes or education services. All these factors play an important role in the emergence and development of epidemics and pandemics, especially within less privileged and more vulnerable communities, such as migrants and informal workers.

Data and trends

- Inequalities within countries are now even greater than the significant inequalities observed between countries.[96] Income and wealth inequalities within countries have been on the rise almost universally since the 1980s. "The gap between the average incomes of the top 10% and the bottom 50% of individuals within countries has almost doubled, from 8.5x to 15x."[97] During the same period, between-countries inequality has been declining (see Figure 23).
- Since the COVID-19 pandemic, global within-country inequality seems to have plateaued or increased only slightly. Some research indicates that fiscal stimulus packages adopted during the pandemic may have contributed to mitigating the drop in GDP that was observed during the pandemic.[98] However, the pandemic and recent economic and geopolitical crises are expected to have a long-term impact on inequalities, which can already be observed in the Human Development Index (see Figure 24).

95 Chancel L, Piketty T, Saez E, Zucman G. World Inequality Report 2022. Paris: World Inequality Lab; 2022 (https://wir2022.wid.world/www-site/uploads/2023/03/D_FINAL_WIL_RIM_RAPPORT_2303.pdf, accessed 23 September 2024).

96 Chancel L, Piketty T, Saez E, Zucman G. World Inequality Report 2022. Paris: World Inequality Lab; 2022 (https://wir2022.wid.world/www-site/uploads/2023/03/D_FINAL_WIL_RIM_RAPPORT_2303.pdf, accessed 23 September 2024).

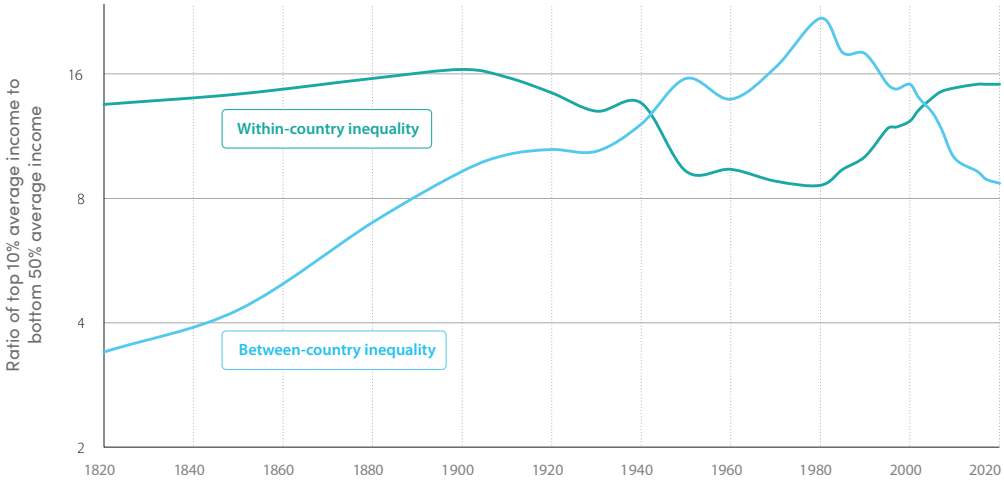
97 Ibid.

98 Darvas Z. Income inequality hardly changed during the COVID-19 pandemic. In: Bruegel [website]. Brussels: Bruegel, 8 February 2024 (https://www.bruegel.org/analysis/income-inequality-hardly-changed-during-covid-19-pandemic, accessed 23 September 2024).

- Country inequalities have been consistently associated with worse health outcomes from both communicable and non-communicable diseases.[99,100,101] For COVID-19 for example, a one-point increase in the Gini coefficient was associated with a 32.3% increase in the number of cases.[102]

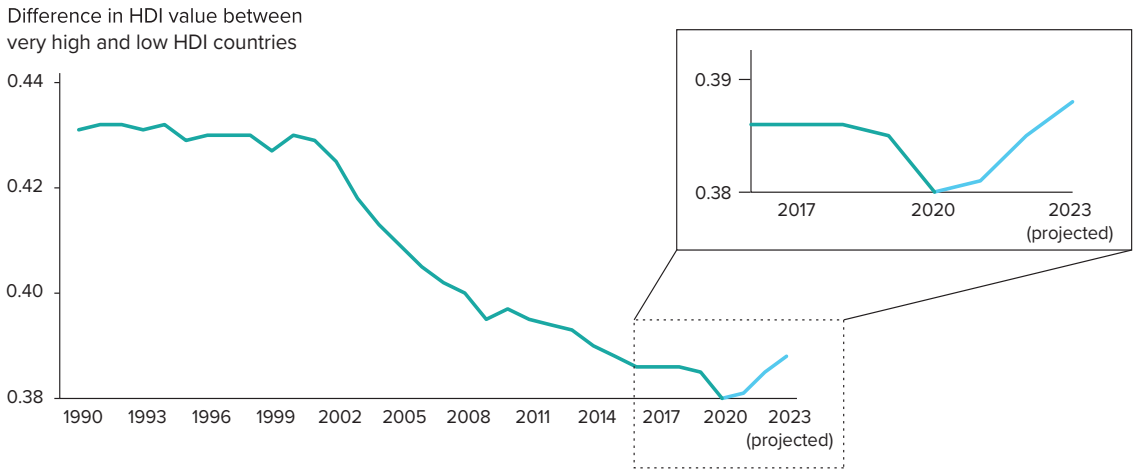
- In countries with a high level of inequality[103], economically disadvantaged groups often struggle to access quality health services due to financial and geographic barriers, even when investments are made in public health, especially when there is no universal health care. Figure 25 shows age-adjusted excess deaths for 2020 and 2021 globally in relation to Gini coefficient scores. Countries with a high level of inequality have higher numbers of excess deaths.[104]

Figure 23. Global income inequality: between-country versus within-country inequality



Source: World Inequality Lab, 2021. https://wir2022.wid.world

Figure 24. Inequality between very high Human Development Index (HDI) and low HDI countries is increasing



Source: Human Development Report, 2020. https://hdr.undp.org/content/human-development-report-2020

99 Gaspar RS, Rossi L, Hone T, Dornelles AZ. Income inequality and non-communicable disease mortality and morbidity in Brazil States: a longitudinal analysis 2002-2017. Lancet Reg Health Am. 2021;2:100042. doi:10.1016/j.lana.2021.100042.

100 Ataguba JE, Birungi C, Cunial S, Kavanagh M. Income inequality and pandemics: insights from HIV/AIDS and COVID-19 — a multicountry observational study. BMJ Glob Health. 2023;8(9):e013703. doi:10.1136/bmjgh-2023-013703.

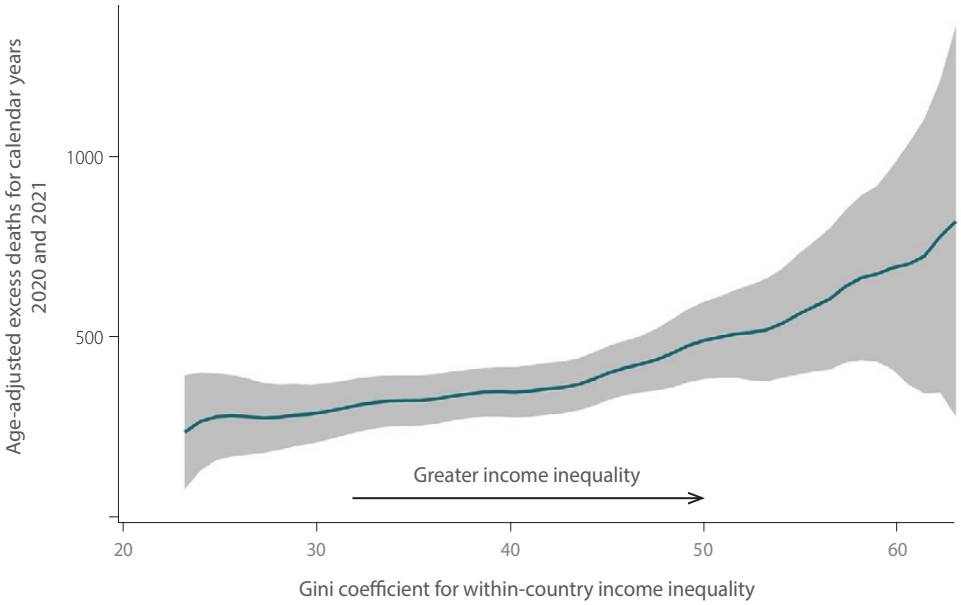
101 Truesdale BC, Jencks C. The Health Effects of Income Inequality: Averages and Disparities. Annu Rev Public Health. 2016;37:413-430. doi:10.1146/annurev-publhealth-032315-021606.

102 von Chamier P. Inequality, Lockdown, and COVID-19: Unequal Societies Struggle to Contain the Virus. New York: Center on International Cooperation; 2021 (https://cic.nyu.edu/resources/inequality-lockdown-and-covid-19-unequal-societies-struggle-to-contain-the-virus, accessed 23 September 2024).

103 See Table 1 regional data from the Gini index.

104 Varkey S, Kandpal E, Neelsen, S. Why addressing inequality must be central to pandemic preparedness. BMJ Glob Health. 2022;7(9): e010453. doi:10.1136/bmjgh-2022-010453.

Figure 25. Age-adjusted excess deaths 2020 and 2021



Source: Varkey S, Kandpal E, Neelsen, S. Why addressing inequality must be central to pandemic preparedness. BMJ Glob Health. 2022;7(9): e010453. doi:10.1136/bmjgh-2022-010453; Economist; World Development Indicators Database.

Opportunities/Challenges

- Universal health care has been shown to be an important social measure to combat inequality, and is essential to the prevention of and response to epidemics and pandemics. In countries where there is universal access to health services, it is easier to protect the whole population and control the spread of disease. Regardless of the health provision in place during the interpandemic period, it is critical to ensure access to care during pandemic periods (free or tiered pricing scheme).

Assessment

- **Trend:** Economic inequality has increased consistently over the past 40 years. Within-country inequality has reached levels not seen since before the financial crash of 1929. While this increase seems to have plateaued in the past few years, new data shows that inequality is rising again, further increasing the risk of epidemics and pandemics.

- **Impact:** The influence of economic inequality on health indicators has consistently been shown to be profound. Countries with higher levels of economic inequality, especially those above 0.5 on the Gini index, are more vulnerable to the emergence, development and impact of epidemics and pandemics. Even when countries have the financial resources to build the required systems, these resources do not always reach the communities that need them most. Current global levels of economic inequality have left many communities behind. The impact of this driver on pandemic risk is therefore currently assessed as high.

Actions

- **Countries and leaders should identify the more economically disadvantaged segments of their population**, including less visible communities such as workers in the informal economy and migrants, **and put in place social programmes that effectively target them and address their health needs** more proactively. These programmes should include:
  - Investment in primary health care;
  - Implementation of universal health care, including free access to vaccines, diagnostics and treatments during epidemics and pandemics;
  - Adoption of an income security scheme with paid sick leave.
- **Pandemic plans and policies should be designed expressly to address inequalities and to create greater equity**. These plans and policies should include the adoption of metrics to measure income-differentiated health outcomes.
- In the long term, countries should address wealth distribution.

Monitoring Framework Indicator:
A.1.3.3 Social programme availability and financing

SOCIAL PROGRAMMES

Impact on pandemic risk

Driver description

- Social programmes refer to government initiatives that aim to improve the health and well-being of communities and societies. Relevant social programmes include measures to ensure affordable access to health care, and ensure income security and protect jobs, including paid sick leave and income protection.

- Social programme availability and financing influence the capacity to respond to epidemics and pandemics. Evidence demonstrates that social programme and public health spending is often linked to better health outcomes during epidemics and pandemics. This is partly because social programme availability and financing is critical during the preparedness and prevention stage to ensure that countries are better placed to respond to a health emergency from the outset (as opposed to much later, when some measures lose effectiveness).

Key points

- Social programmes are a crucial safety net during health emergencies. During epidemics and pandemics, social protection programmes can ensure that sick employees stay home until they have fully recovered, protecting their own health and the health of others, and vulnerable individuals have the resources to limit their exposure to infectious disease. During the COVID-19 pandemic, countries relied heavily on a range of non-pharmaceutical interventions, such as lockdowns and isolation, which were possible and most effective in countries with the capacity to invest in social protection programmes. Social protection programmes must therefore be a core strategy of a good pandemic preparedness plan.

- Social programmes help mitigate the socioeconomic impact of epidemics and pandemics. Without social protection, many individuals in countries facing a major epidemic or a pandemic risk falling into poverty. Social protection programmes can ensure that income is protected, even during lockdowns, or that those who suffer from disability due to disease receive support while they recover and cannot work.

- Social protection programmes must be designed and in place before an epidemic or pandemic, because they are not as effective when established during a crisis. Countries that already have comprehensive systems in place covering large sections of their populations, including more vulnerable groups as well as those working in the informal economy, can more rapidly use and adapt existing programmes and delivery mechanisms to facilitate access to health care, ensure income security and protect jobs. During the COVID-19 pandemic, the International Labour Organization (ILO) estimated that social protection needs increased by 30% due to increased need for health care services, income security measures and reduction in GDP. However, many countries struggled to reach vulnerable and marginalized communities.[105] Building and implementing social protection measures at the onset of a health emergency is not as effective and is more expensive.

105 Abay KA, Yonzan N, Kurdi S, Tafere K. Africa might have dodged a bullet, but systemic warnings abound for poverty reduction efforts on the continent. World Bank Blogs. 18 September 2022 (https://blogs.worldbank.org/en/developmenttalk/africa-might-have-dodged-bullet-systemic-warnings-abound-poverty-reduction-efforts, accessed 23 September 2024).

Data and trends

- Over the past 20 years, access to social protection schemes has significantly increased globally. As of 2022, 46.9% of the world's population is covered by at least one social protection scheme, including unemployment benefits and childcare support.[106] This means that the majority of the world's population still does not have access to a single social benefit scheme. Disaggregating this number by income level reveals dramatic variations: high-income countries reach 85.4% coverage, while low-income countries only have 13.4% coverage (see Table 2).

- These gaps in coverage are due in large part to a significant underinvestment in social protection. Countries globally spend approximately 12.9% of their GDP on social protection (see Table 1 above for regional data on social protection spending). In low-income countries, however, only 1.1% of GDP is spent on social protection. Meanwhile, low-income countries spend 1.6% of GDP on interest payment on debt.[107]

- 66% of the world's population is affiliated to a social health protection scheme, and the ILO estimates that 62% of the global labour force, representing 39% of the working-age population, is legally entitled to some income security via paid sick leave through an employer's liability, sickness benefits (provided by social insurance or assistance) or a combination of both mechanisms (as of 2022). Many workers are excluded from these schemes, including those in part-time and temporary employment, the self-employed, jobseekers, and those working in the informal economy. In many parts of the world therefore, most workers cannot afford to stay at home when they are infected or sick, or for isolation or a lockdown. Not only does this mean they cannot rest and recover, but this contributes to further transmission of the pathogen.[108]

Table 2. Population covered by at least one social protection benefit by economic grouping

World	**46.9**
Low income	13.4
Lower-middle income	24.9
Upper-middle income	64.0
High income	85.4

Source: World Social Protection Report 2020–22. Geneva: ILO, 2021 https://digitallibrary.un.org/record/3939919?v=pdf

106 World Social Protection Report 2020–22: Social protection at the crossroads – in pursuit of a better future. Geneva: ILO; 2021 (https://www.social-protection.org/gimi/Media.action?id=7368, accessed 23 September 2024).

107 Debt at a glance: A World of Debt Dashboard. In: UNCTAD [website]. Geneva: UNCTAD; 2024 (https://unctad.org/publication/world-of-debt/dashboard; accessed 23 September 2024).

108 World Social Protection Report 2020–22: Social protection at the crossroads – in pursuit of a better future. Geneva: ILO; 2021 (https://www.social-protection.org/gimi/Media.action?id=7368, accessed 23 September 2024).

Opportunities/Challenges

- The underinvestment in social protection in low- and lower-middle income countries is considerable and would require a substantial investment, which these countries may not be able to make without additional support. The ILO estimates that "to guarantee at least a basic level of social security through a nationally defined social protection floor, lower-middle-income countries would need to invest an additional US$362.9 billion and upper-middle-income countries a further US$750.8 billion per year, equivalent to 5.1 and 3.1 per cent of GDP respectively for the two groups, while low-income countries would need to invest an additional US$77.9 billion, equivalent to 15.9 per cent of their GDP."[109]

Assessment

- **Trend:** While almost all countries have a social protection scheme, less than 50% of the world's population is covered. Overall, very little progress has been made in improving coverage during the last few years, with certain areas of the world even losing coverage.

- **Impact:** Current underinvestment in social protection and low coverage for social health protection programmes, especially sick leave and sickness benefits, make countries more vulnerable to epidemics and pandemics because they increase individuals' vulnerability to infectious disease, amplify transmission in the workplace and make countries less prepared and less able to respond to health emergencies. In low and lower-middle income countries, a large majority of people are not receiving any social protection coverage.

Actions

- **Countries should increase their domestic investments in social protection** and put in place social protection measures to address the impact of epidemics and pandemics in advance of a health emergency. This should include identifying vulnerable groups, including those working in the formal economy (such as health workers and other frontline responders) and the informal economy.

- **The global community and multilateral development banks should support domestic social protection investments**.

109 World Social Protection Report 2020–22: Social protection at the crossroads – in pursuit of a better future. Geneva: ILO; 2021 (https://www.social-protection.org/gimi/Media.action?id=7368, accessed 23 September 2024).

4

ENVIRONMENTAL DRIVERS

Climate change

Agricultural practices and farming

Cities

Monitoring Framework Indicator:
A.1.4.1 Climate change and natural disasters

CLIMATE CHANGE

Impact on pandemic risk

Driver description

- Climate change has been identified as a major global-scale driver of infectious disease emergence and amplification, due to modification at the human—animal—environment interface and increased human migration to find better living environments. Due to climate change, the world experiences changing weather patterns, with more or less heat and precipitation, depending on geography. It affects both terrestrial and marine environments, including animals and plants living within them. Climate change acts as a risk multiplier by increasing the frequency and intensity of natural disasters and extreme weather events (for example, droughts, wildfires, extreme heat, floods, cyclones, extreme cold), destabilizing ecosystems, shifting weather and animal migration patterns, and increasing food and water insecurity.

Key points

- Climate change shifts the geographic patterns of disease and affects the extent and timing of outbreaks. This means that regions that have not been affected by certain pathogens, such as mosquito-borne diseases including dengue or malaria, can suddenly experience outbreaks of these diseases, or seasonal patterns of transmission can change.

- Land use changes, deforestation and reforestation, loss of habitat and changes in water ecosystems impact species distribution, migration patterns and the ecology of pathogens, as well as bringing changes in the human—animal—environment interface.

- Areas around the world where humans, animals, and the environment interact closely are changing rapidly. These areas are becoming new hotspots for the emergence of novel diseases, which can turn into epidemics if the virus is capable of spreading between humans.

Data and trends

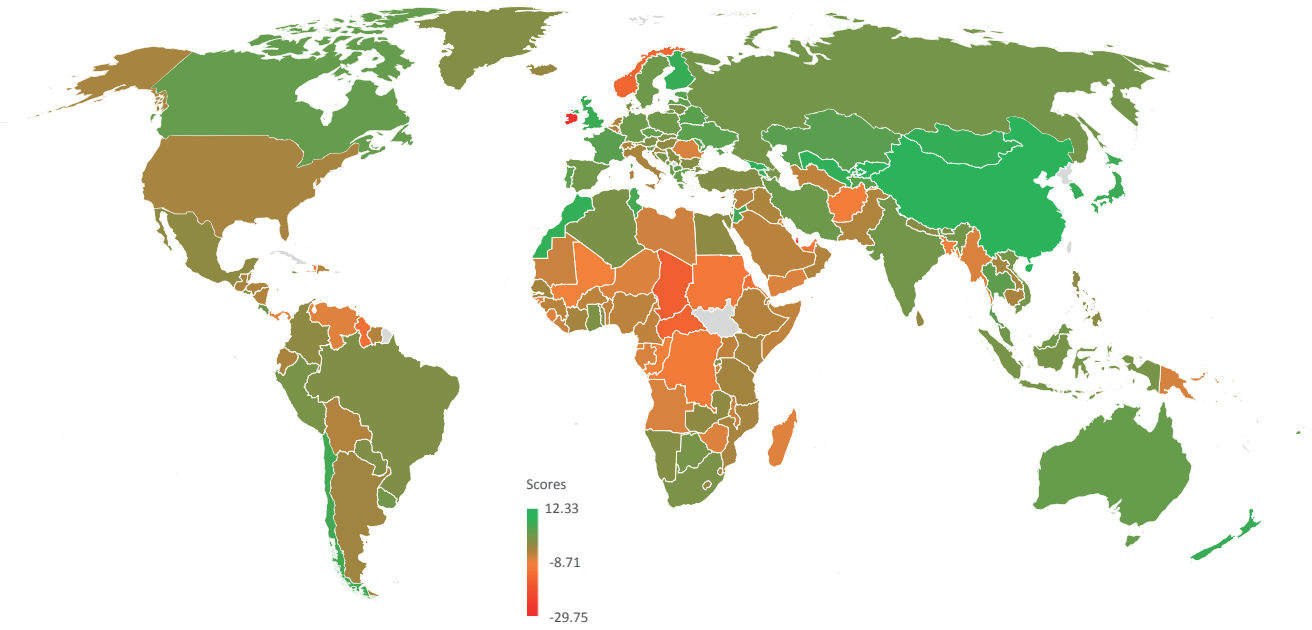
- The map in Figure 26 below shows 2024 GDP-adjusted ND-GAIN scores and illustrates vulnerability and resilience to climate change across the world. While ND-GAIN rankings have not changed considerably over time, recent versions of the index have shown a general decline in ND-GAIN scores, driven by an overall decline in readiness and an increase in vulnerability, especially among the highest-ranking countries[110] (see Table 1 for regional data from the ND-GAIN country index vulnerability score).

- There is a 47% likelihood that the global temperature averaged over the entire five-year 2024—2028 period will exceed 1.5°C above the pre-industrial era, according to the World Meteorological Organization (WMO) Global Annual to Decadal Update — up from 32% from the 2023 report for the 2023—2027 period.[111] Figure 27 below highlights the important increase in global land–ocean temperature over the last 100 years.

110 Beasley B. Climate-prepared countries are losing ground, latest ND-GAIN index shows. In: University of Notre Dame [website]. Notre Dame: University of Notre Dame; 2022 (https://news.nd.edu/news/climate-prepared-countries-are-losing-ground-latest-nd-gain-index-shows, accessed 23 September 2024).

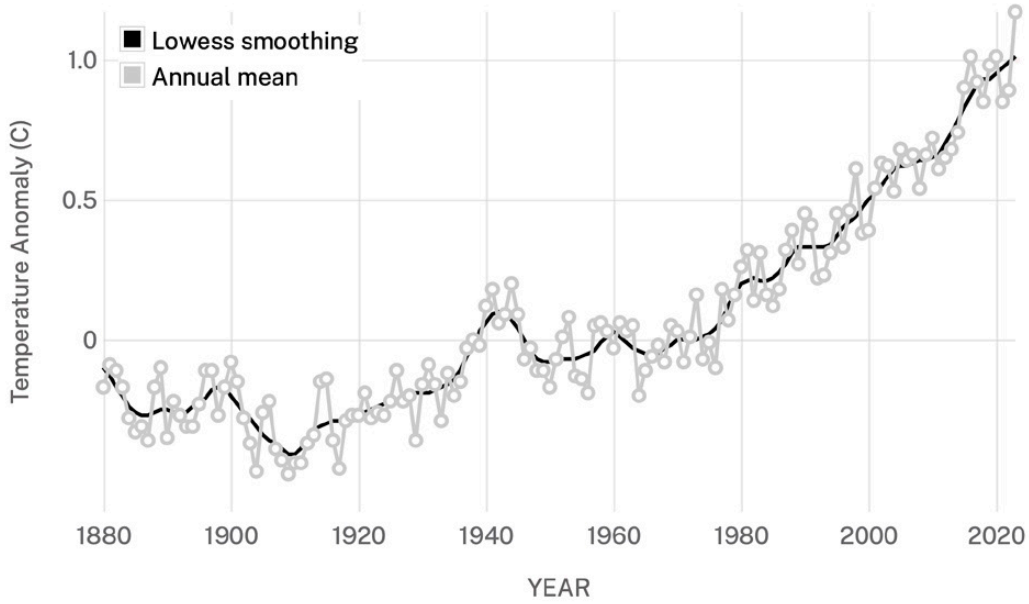
111 WMO Global Annual to Decadal Climate Update (2024-2028). Geneva: World Meteorological Organization (WMO); 2024 (https://library.wmo.int/records/item/68910-wmo-global-annual-to-decadal-climate-update, accessed 23 September 2024).

Figure 26. GDP-adjusted ND-GAIN Country Index Scores 2024



Source: Notre Dame Global Adaptation Initiative Country Index (ND-GAIN); University of Notre Dame; 2024, https://gain.nd.edu/our-work/country-index/download-data/

Figure 27. Global land–ocean temperature index 1880—2022



Source: NASA/GISS, 2022, https://climate.nasa.gov/vital-signs/global-temperature/?intent=121

Opportunities/Challenges

- There is increasing global awareness of the impact of climate change on the risk of infectious diseases which may lead to better collaboration across sectors and faster finding of risk mitigation measures.
- However, the linkages between climate change and pandemic risks are not yet clearly articulated. More research and investments are needed to obtain further evidence and identify the areas that are particularly vulnerable to increased disease risk due to climate change. It is also critical to develop better metrics to assess the risk of infectious diseases due to climate change and other ecological anthropogenic changes.
- At the global level, the climate Conferences of the Parties (COPs) and ongoing efforts to reform the global health architecture — Intergovernmental Negotiating Body (INB) and IHR processes — provide an opportunity to better address the interface between climate change and infectious disease risks, and strengthen the One Health approach.
- Climate change is having a disproportionately severe impact on populations that are already vulnerable. These populations deserve increased protection.
- All countries should envisage and plan for the occurrence of unusual outbreaks on their territories (for example, epidemics of arboviruses in southern Europe).

Assessment

- **Trend:** Climate change is increasing at great speed, causing important changes to ecosystems, impacting temperatures and changing weather patterns. Climate change is modifying the nature, patterns, and seasonality of disease outbreaks.
- **Impact:** Climate change is increasing pandemic risk, forcing health authorities to carefully consider this driver in their preparedness plans. It is affecting all countries, but is disproportionately impacting the most vulnerable. The influence of climate change on pandemic risk is therefore assessed as high.

Actions

- **Countries need to anticipate the impact of climate change** on the risk of epidemics and pandemics: this means adapting preparedness plans to these new risks, while strengthening health systems to respond to unusual epidemics.
- **Health and environmental sectors need to set up global networks for early detection and research** that can quickly characterize risks and accelerate the development of countermeasures.
- **Countries, academia and the scientific community should develop adequate indicators to monitor and assess risks** at the human—animal—environment interface, to inform policy-making.

Monitoring Framework Indicator:
A.1.4.2 Agricultural practices and farming

AGRICULTURAL PRACTICES AND FARMING

Impact on pandemic risk

Driver description

- Agriculture and farming produce many human—environment interactions. Mass populations of livestock create conditions that drive zoonotic spillovers through the continued introduction of pathogens into an animal population, leading to infections that can sometimes spill over to humans. Agriculture requires land development and changes in land use, which entail deforestation and the alteration of natural habitats. This severally disrupts reservoir host environments.

- Intensive farming and agriculture practices act as an important driver of emergence and amplification, increasing pandemic risk.[112]

Key points

- Farming practices are rapidly evolving to address the needs of populations and in response to technological developments. Global demand for livestock is increasing.

- The development of intensive agriculture and farming, paired with globalization and trade in animal products, is increasing the risk of the spread of novel animal pathogens, which calls for increased surveillance and regulation at the human—animal—environment interface.

- Smaller-scale agricultural and farming practices, such as livestock husbandry and backyard farming, are also contributing to the risk of epidemics and pandemics. To address this risk, timely access to countermeasures and socioeconomic protection measures are essential.

Data and trends

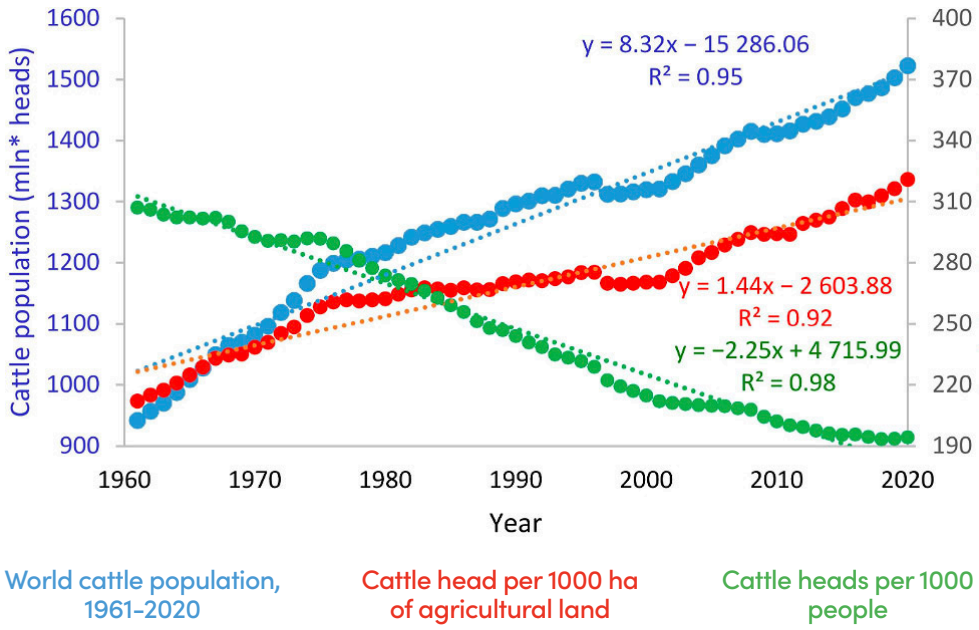
- Figure 28 below shows the significant increase in both livestock patterns and livestock density over the past 60 years. Table 1 also provides regional data on livestock density.

- In 1961, the global cattle population was approximately 942 million. In 2020, it had reached around 1,523 million heads. When plotting the changes in the number of cattle over time, the average annual increase is approximately 8.3 million. The increase in the cattle population correlates with the rise in cattle density, represented as the number of cattle heads per 1,000 hectares (ha) of agricultural land.

- Among all livestock animals, poultry meat production rose the most, from 8.95 million tons in 1961 to 139.22 million tons in 2022 (see Figure 29). Poultry is particularly at risk of avian influenza – as poultry livestock is increasing, the threat of the spread of avian influenza is therefore greater.

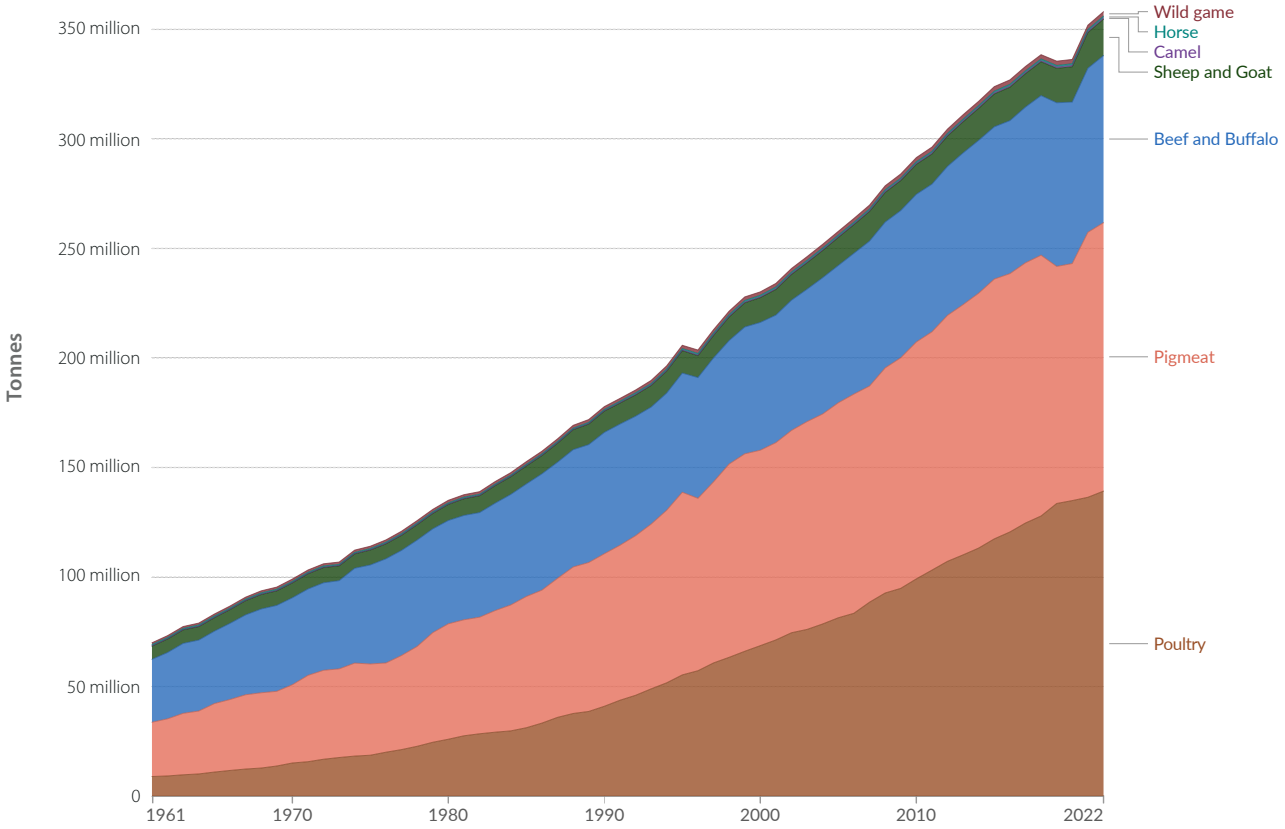
112 UN Environment Programme and International Livestock Research Institute. Preventing the Next Pandemic: Zoonotic diseases and how to break the chain of transmission. Nairobi: UNEP; 2020 (https://www.unep.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and; accessed 2 October 2024).

Figure 28. Livestock density and livestock patterns 1961—2020



Source: Kozicka K, Žukovskis J, Wójcik-Gront E. Explaining Global Trends in Cattle Population Changes between 1961 and 2020 Directly Affecting Methane Emissions. Sustainability. 2023;15(13):10533. doi:10.3390/su151310533; UN FAOSTAT

Figure 29. Global meat production by livestock type, 1961–2022



Source: United Nations Food and Agriculture Organization (FAO); Our World in Data, 2023 https://ourworldindata.org/meat-production

Opportunities/Challenges

- The risk of infectious disease emergence in both intensive and smaller-scale agriculture and farming should be an incentive for policy-makers to pursue surveillance and awareness-raising efforts.

- Strategies to reduce the risk of emergence of novel pathogens differ in large and small farming practices.

    - In the context of intensive agriculture and farming, biosecurity measures and regulations play a major role in lowering the risk of emergence and amplification in animal populations. Protection of workers is critical to reduce the risks of spillover.

    - In smaller-scale agricultural and farming communities, animal disease outbreaks can directly threaten both livelihoods and food security, as animals are vital sources of protein and income. When livestock fall ill, this represents not only a financial loss but also a nutritional challenge for the community. Disease control measures, such as the culling of poultry flocks to contain avian influenza, can further exacerbate these issues, particularly in the absence of compensation programmes. Furthermore, emerging diseases often arise in regions with limited access to health care, veterinary services, and disease countermeasures. To address these vulnerabilities, health ministries and relevant authorities can play a pivotal role in raising awareness, improving primary health care and veterinary services in high-risk areas to enhance early detection and containment, ensuring equitable access to countermeasures, and developing social safety nets to support farmers facing economic losses during epidemics or pandemics.

- Preparedness requires continued efforts and monitoring. Health, agriculture and environment ministries, working with relevant authorities, should identify and assess risks specific to different agricultural and farming sectors, practices and models, and tailor preparedness plans accordingly (for example, the risks from the intensive farming industry are different from the risks posed by smaller-scale farming practices).

- Rapid detection and reporting mechanisms need to be in place to quickly address the emergence of a disease when it arises. Hotspots of emergence are places where novel pathogens are more likely to jump the species barriers due to the close interface between humans, animals and environment (for example, hunting of wild monkeys leading to Ebola outbreaks).

- Live and wet markets in cities continue to be potential hotspots for disease emergence and amplification due to the proximity of various animal species, and sometimes mixing with wild animals. The implementation of better hygiene and disinfection measures is needed to address this risk. Health ministries and relevant authorities need to work with communities and traders to develop solutions to improve safety and hygiene practices.

Assessment

- **Trend:** The number of livestock overall has increased dramatically over the past 60 years. As global demand and movement of animals continues to increase, and biosecurity and surveillance measures remain inconsistently applied, the overall risk of spillover and amplification is also increasing proportionally.

- **Impact:** Changes in agricultural practices and farming are directly linked to several ongoing outbreaks, and measures to address this driver have been insufficient to effectively contain these outbreaks. Avian influenza currently represents a major risk. Poultry is at high risk from the continued circulation and spillover of A(H5N1) viruses from wild birds. Increasingly, cases of the A(H5N1) virus have been detected in non-avian species, including wild and domestic mammals and marine mammals. This includes large outbreaks in goats and dairy cattle in the United States over the last year. The intense circulation of the virus in animal populations, in particular mammals, provides more opportunities for viral reassortment and the emergence of strains that are more transmissible in human populations. These developments are concerning. The impact of this driver is therefore assessed as very high.

Actions

- **Human, animal and environmental health services and agencies should collaborate on One Health approaches** to prevention, preparedness and response to epidemic diseases, and ensure that these are integrated into national emergency management mechanisms.
- **Countries need to ensure biosecurity measures and regulations, along with safety protocols**, are implemented in large-scale farming practices and facilities.
- **Countries need to dedicate specific attention to backyard farming and smaller-scale farming practices**, as these farmers may be less aware of disease risks, and ensure preventive measures, social programmes, and adequate health services and countermeasures are in place, in particular in hotspots of emergence.
- **Countries, scientists and communities need to regularly monitor the epidemic and pandemic risk at the human—animal—environment interface**, to identify new hotspots of emergence, understand the social, economic and political drivers of emerging diseases in different settings, and measure the effectiveness of interventions to prevent pandemics.
- **Countries should take into consideration social and economic inequities** and the needs of vulnerable populations to increase the likelihood that animal-to-human spillover is detected early and to control the outbreak at source.

Monitoring Framework Indicator:
A.1.4.3 Built environment

CITIES

Impact on pandemic risk

Driver description

- Urbanization is one of the main drivers of the amplification of epidemics into pandemics. Cities, and in particular megacities (cities with more than 10 million inhabitants), are characterized by a high population density with intense internal population movements.

- The built environment, especially in cities, is also a major driver of pandemic risk. Housing conditions linked to crowding and indoor air quality are established determinants of the emergence and spread of infectious diseases. High-density work environments and crowded public transportation directly facilitate human-to-human disease transmission and spread of infectious diseases.

Key points

- Cities are hubs of national and international transportation, and commuting. High population density combined with intense human mobility is exacerbating human-to-human transmission of infectious diseases.

- Fast-growing cities in lower income countries are home to millions of people living without access to basic services, such as safely managed water and sanitation services. The convergence of housing, population density, air quality, and water and sanitation conditions amplify the spread of infectious disease. For example, contaminated water and inadequate sanitation facilities contribute to the spread of water-borne diseases, such as cholera. Improper waste management and water collections in green areas and parks can provide breeding sites for mosquitoes and facilitate vector-borne epidemics.

- Cities often host international mass gatherings, such as concerts and religious gatherings, which increase both human density and mixing, and therefore increase the risk of contamination and disease spread.

- However, cities often offer better access to health care, therefore patients with severe conditions can experience better outcomes. This explains why some outbreaks starting in remote rural areas rapidly become urban: because patients come to large cities to seek better care (for example, Ebola in West Africa 2014).

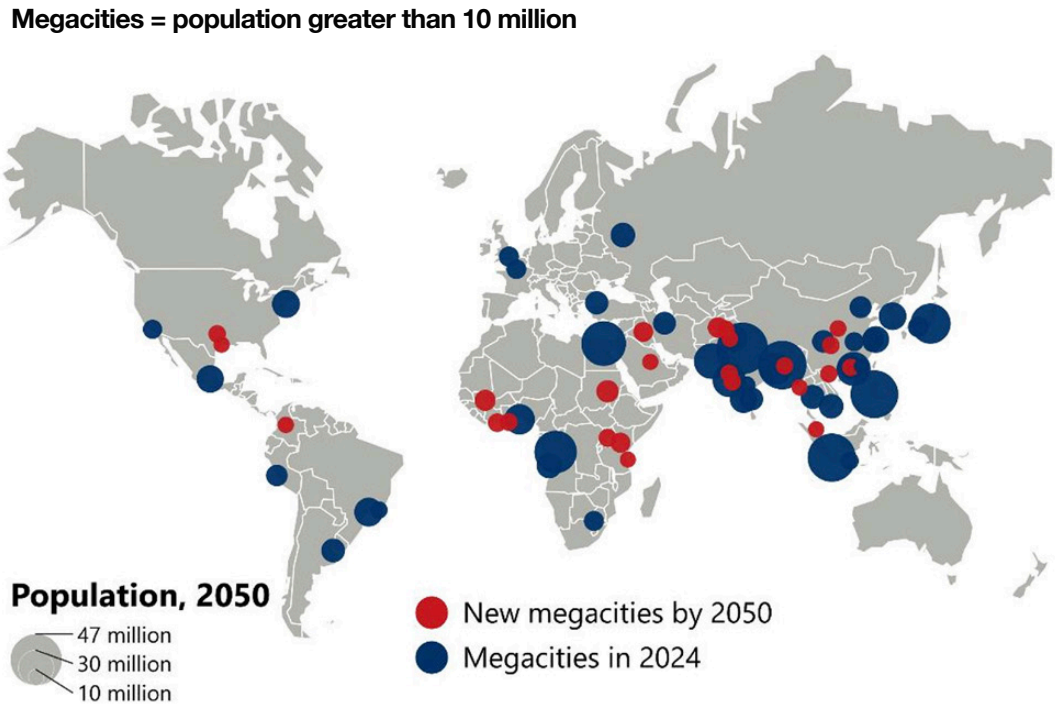
- Risk of disease emergence and amplification is often high in peripheral urban areas, due to direct or indirect contact with the wild environment and animals; less access to services and infrastructures; higher human density; and economic vulnerabilities.

- With limited affordable housing options and demand outpacing supply, unplanned slums and informal settlements are expanding. These areas are often overcrowded and lack the infrastructure for adequate water, sanitation, and health care. They embody nearly all the key drivers of pandemic risk.

Data and trends

- The number of megacities has grown from approximately 7 in the 1970s to 44 today, and is expected to continue to grow rapidly in the coming decades (Oxford Economics estimates that there will be 67 megacities by 2050[113], see Figure 30).

Figure 30. Megacities in 2024 and 2050



Source: Oxford Economics Global Cities, 2023. https://www.oxfordeconomics.com/wp-content/uploads/2024/01/Rise-of-new-megacities-will-drive-global-urban-growth.pdf

- Currently, about 57% of the global population lives in urban settings (see figure 31 and also Table 1 for regional data on urbanization rates).

- The proportion of the urban population living in slums declined slightly, from 25.4% to 24.2% between 2014 and 2020, but the total number of slum-dwellers continues to rise with increasing urbanization. In 2020, an estimated 1.1 billion urban residents lived in slums or slum-like conditions[114] (see figure 32).

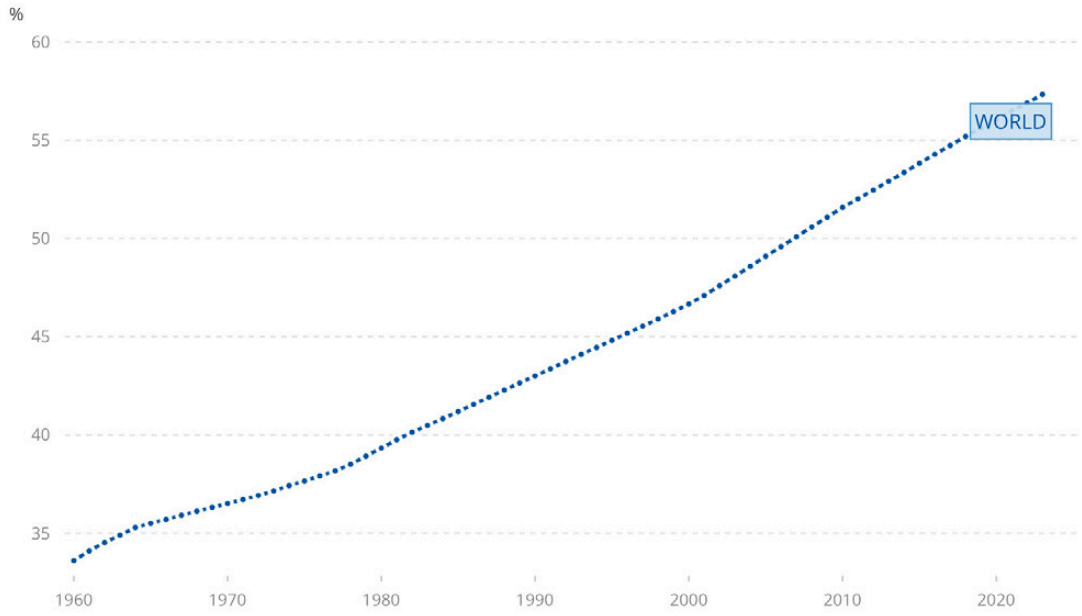
- In the past decade, there has been global improvement in air quality and exposure to pollution, including in cities, although this improvement is more significant in high-income countries. While access to safe water has also improved in cities, there have been increasing water shortages, due to higher demand and the effect of climate change. Generally, cities have improved access to infrastructures compared with rural areas.

- In many cities in lower income countries, uncontrolled growth has put waste management systems under strain due to rapid urbanization, lack of infrastructure, and growing populations.

113 McEwan S. Rise of new megacities will drive global urban growth. Oxford: Oxford Economics; 26 January 2024 (https://www.oxfordeconomics.com/wp-content/uploads/2024/01/Rise-of-new-megacities-will-drive-global-urban-growth.pdf, accessed 23 September 2024).

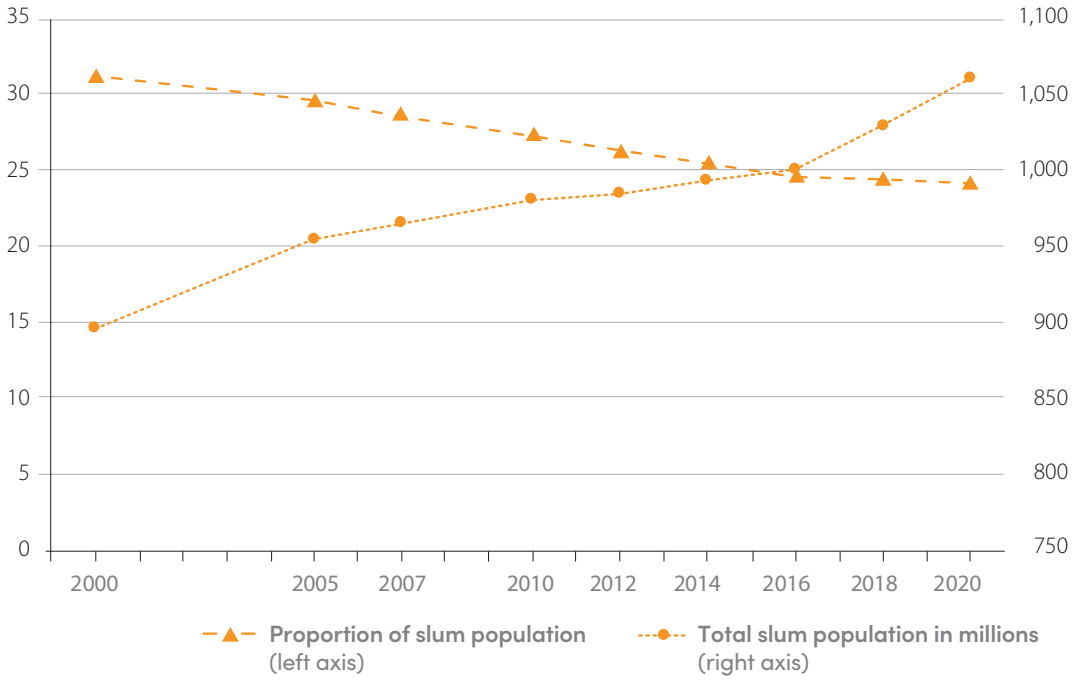
114 Sustainable Development Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable. In: UN DESA [website]. New York: UN DESA; 2024 (https://unstats.un.org/sdgs/report/2023/goal-11, accessed 23 September 2024).

Figure 31. Urban population as percentage of total population 1960—2023



Source: UN Population Division, 2023. https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

Figure 32. Proportion of global urban population living in slums (percentage) versus total slum population 2000—2020



Source: UN DESA, 2024. https://unstats.un.org/sdgs/report/2023/goal-11

Opportunities/Challenges

- By understanding drivers of epidemics and pandemics in cities and improving livelihoods accordingly, including access to water, sanitation and hygiene (WASH), health infrastructure and services, cities can significantly mitigate the risk of amplification of infectious diseases.
- Mass transportation in cities and megacities poses specific challenges. Planning the management of large movements of populations in the event of an epidemic and pandemic in cities or megacities that are hubs for many transportation modes is particularly challenging. In this context, testing and preparing implementation strategies for public health and social measures during peace time will be particularly helpful.
- Peri-urban areas require specific attention as their risk drivers might be different from those in long-standing urbanized areas.

Assessment

- **Trend:** The number of cities and megacities as well as the ratio of urban versus rural inhabitants is continuing to grow rapidly. However, living conditions in many cities are improving.
- **Impact:** Urbanization is increasing pandemic risk, acting as a driver of amplification and complexifying the ability of cities to respond effectively to crises due to their size and vast populations flows. However, this is balanced by better access to care and improvements in the built environment of many cities.

Actions

- **Cities need to develop specific pandemic preparedness planning based on a thorough assessment of their risk drivers**. For instance, urban pandemic planning will differ in temperate versus tropical cities. While epidemics due to respiratory viruses are more likely to occur in winter in temperate countries, epidemics due to vector-borne disease are more likely in tropical cities.
- **Cities should conduct comprehensive risk assessment and develop cross-sectoral preparedness plans** to ensure early detection and early containment, while mitigating the negative impact of public health and social measures on people and the economy.
- **When implementing nature-based solutions and greening programmes, cities should consider potential risks of emergence and amplification of diseases**, especially diseases that are vector-borne.

5

POLITICAL DRIVERS

Governance

Trust

Conflict and instability

Monitoring Framework Indicator:
A.1.5.1 Government effectiveness

GOVERNANCE

Impact on pandemic risk

Driver description

- Governance refers to all processes of governing, the institutions, processes and practices through which issues of common concern are decided upon and regulated.[115] The United Nations Committee of Experts on Public Administration (CEPA) has outlined 11 principles of effective governance, categorized into three groups: group one focuses on effectiveness (competence, sound policy-making, and collaboration), group two focuses on addressing accountability (integrity, transparency and independent oversight) and group three focuses on inclusiveness (leaving no one behind, non-discrimination, participation, subsidiarity and intergenerational equity).

- During a health emergency, good governance principles include whole-of-society and whole-of-government approaches, cross-sectoral engagement, community engagement, rapidity, equity, medical ethics, risk communication, and policy adaptation throughout the crisis.

- Government effectiveness is also a key component of good governance during epidemics and pandemics. It is defined as "perceptions of the quality of public services, the quality of the civil service, and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies".[116]

- Government effectiveness has an important influence on countries' capacity to respond to epidemics and pandemics. Elements such as cross-level data-sharing systems; mechanisms to resolve policy conflicts across levels and branches of government, especially at the One Health interface; mechanisms to coordinate limited resources; and whole-of-government policies and strategies are all crucial to countries' capacity to identify spillovers, contain outbreaks at source, prevent further transmission, and respond to epidemics and pandemics.

Key points

- When facing risk of epidemics or pandemics, governments are exposed to an unprecedented situation of business disruption at different levels, from decision-making processes to administrative processes and service delivery. To ensure an effective response, speed and responsiveness appropriately take centre stage. Resources must be well planned and used, and there must be trust in the government and adequate coordination across levels of government.

- As pandemics are global events, the capacity of governments to take part in global cooperation and coordination efforts (for example, through the International Health Regulations) is an essential element of governance for preparedness.

- Several studies have shown that countries with higher government effectiveness had lower COVID-19 mortality.[117]

- There were several examples of good governance and government effectiveness during COVID-19 (see Case study below).

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115 About good governance: OHCHR and good governance. In: United Nations Office of the High Commissioner for Human Rights [website]. Geneva: United Nations; 2024 (https://www.ohchr.org/en/good-governance/about-good-governance, accessed 23 September 2024).

116 Kaufmann D, Kraay A, Mastruzzi M. The Worldwide Governance Indicators: Methodology and Analytical Issues. World Bank Policy Research Working Paper No. 5430; 2010 (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682130, accessed 8 October 2024).

117 See for example: Pant DP, Acharya B, Kattel MR. Association of government effectiveness, logistics performance, IT systems and income with COVID-19 mortality. Heliyon. 2023;9(4):e15214. doi:10.1016/j.heliyon.2023.e15214.

Case study

The diversity of responses to COVID-19: an illustration of political and governance choices, independent of economic or social development levels

Differences in the stringency and timing of COVID-19 responses across countries have not only reflected different epidemiological, demographic and geographical contexts, but also different political regimes and levels of socioeconomic development. These policies proved to vary between countries, independently of their level of economic and social development.

During the first wave of the pandemic in the first half of 2020, some national governments (for example, the United States and Sweden) chose not to shut down their economies entirely. Other governments (for example, the United Kingdom) went into lockdown but only after delaying their response. In contrast, the governments of Taiwan and New Zealand took decisive actions early on (for instance, strict travel and screening measures and effective contact tracing), avoiding or reducing the length of lockdown.

Among other developed countries, New Zealand, Japan and Australia all sustained remarkably low fatalities during 2020: this was partly explained by the fact that they are island nations, and their use of extensive testing and advanced information and communication technologies for public information sharing and contact tracing.[118] Many East Asian countries weathered the pandemic remarkably well despite being hit early with the virus. Overall, the region benefited from strong crisis management systems, drawing on the experiences from previous epidemics, such as Severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). Many of the region's governments responded swiftly, with strict control of in- and outbound travel, which allowed for efficient and comprehensive contact tracing.[119]

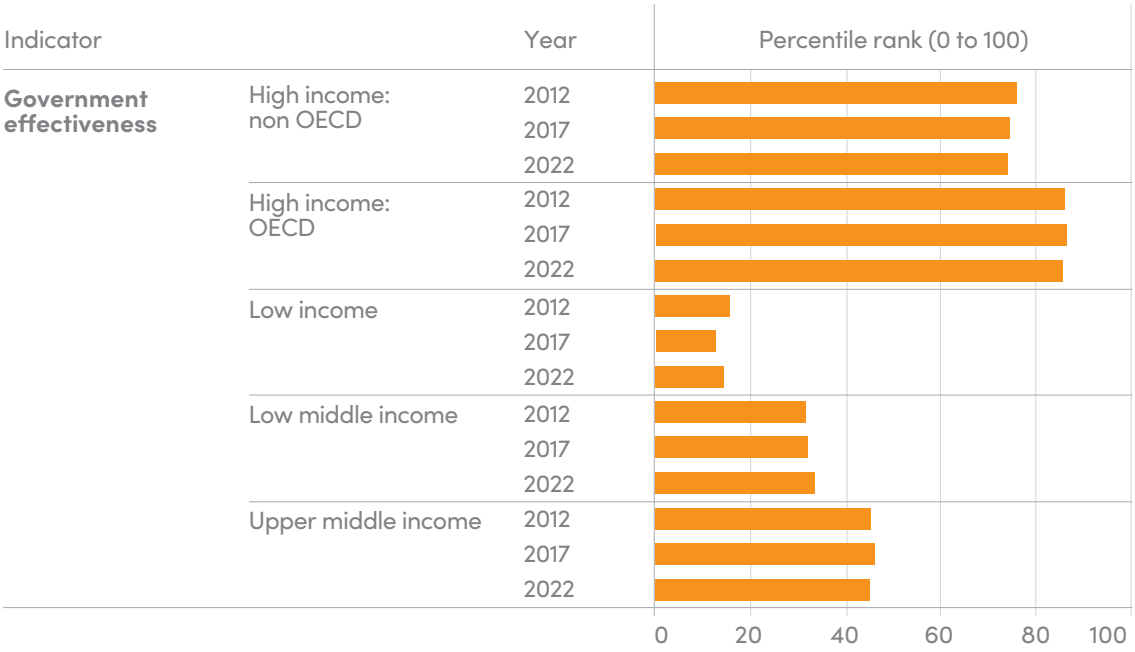
Data and trends

- The World Bank's Government Effectiveness indicator captures the quality of public services, the capacity of the civil service and its independence from political pressures, and the quality of policy formulation and implementation. The indicator includes metrics such as the efficiency of government services, bureaucratic quality, and the effectiveness of the health care and education systems. Figure 33 shows World Bank Government Effectiveness scores across income groups for 2012, 2017 and 2022. It highlights the large variation between groups. The overall trend in government effectiveness shows a decrease by one point over a decade, suggesting a small but steady loss in government effectiveness over time. Table 1 also provides Government Effectiveness scores per WHO regions.

118 Pitterle I, Niermann L. The COVID-19 crisis: what explains cross-country differences in the pandemic's short-term economic impact? DESA Working Paper No. 174. New York: UN DESA, 2021 (https://www.un.org/en/desa/covid-19-crisis-what-explains-cross-country-differences-pandemic%E2%80%99s-short-term-economic-impact, accessed 23 September 2024)

119 Ibid.

Figure 33. Government effectiveness scores across income groups: 2012, 2017 and 2022



Source: Kaufmann D, Kraay A. Worldwide Governance Indicators, 2023 Update http://www.govindicators.org

Opportunities/Challenges

- By applying a whole-of-society and a whole-of-government approach, policy-makers have an opportunity to include all parts of society and government in preparedness and response efforts: this includes paying specific attention to vulnerable populations and consideration of the appropriate level at which to manage infectious disease risks (for example, national, regional or local levels).

- Many critical ethical questions arise in pandemic planning, preparedness and response. Ethics do not provide a prescribed set of policies; on the contrary, they are often shaped by the local context and cultural values. It is therefore beneficial for governments to develop ethical frameworks for pandemic preparedness ahead of a crisis to identify key areas where ethical issues are likely to arise.

- Effective communication, and citizen engagement and participation, backed by preparedness to enforce behaviour, are critical to sustain trust and to ensure that decisions and guidelines are conveyed swiftly and clearly to the intended audience. A good chain of command and clear communication channels are key.

- Some groups are particularly at risk of exposure to a new disease because their living conditions make them prone to higher transmission. These groups should be identified and engaged early on, and during the preparedness phase. Indigenous communities, marginalized communities, refugees, forcibly displaced groups, health care workers, home caregivers, economically disadvantaged people and institutionalized populations are amongst those at particularly high risk.[120]

- Political boundaries rarely correspond to the boundaries of populations and risk factors. As research agendas evolve and the epidemiology of disease advances, policy-makers need to be attuned to the latest scientific developments, and take their decisions based on the best available evidence. Policies will need to be constantly adapted and tailored to populations' and public health needs.

120 Pitterle I, Niermann L. The COVID-19 crisis: what explains cross-country differences in the pandemic's short-term economic impact? DESA Working Paper No. 174. New York: UN DESA, 2021 (https://www.un.org/en/desa/covid-19-crisis-what-explains-cross-country-differences-pandemic%E2%80%99s-short-term-economic-impact, accessed 23 September 2024).

Assessment

- **Trend:** Indicators suggest a slight decrease in government effectiveness worldwide in recent years.
- **Impact:** Disaggregated data shows that lower income countries have lower government effectiveness scores, which is likely impeding their capacity to plan, organize, coordinate, fund and implement an effective response to health emergencies.

Actions

- **Countries need to prepare themselves for epidemic and pandemic risks, in line with government effectiveness principles**. In particular, governments should ensure coordination across ministries and sectors, in line with a One Health approach, leaving no one behind.
- As pandemics are global events and effective governance at the global level plays a key role in countries' ability to respond to a crisis and access countermeasures in a timely manner, **countries need to participate in multilateral cooperation and in ongoing efforts to strengthen the global health architecture**.
- **More international support is needed** to boost preparedness and core capacity building, including government effectiveness, in lower income countries.

Monitoring Framework Indicator:
A.1.5.2 Public trust in government

TRUST

Impact on pandemic risk

Driver description

- Trust is central to ensure cohesive pandemic prevention and response, thus mitigating and reducing the risk of pandemics and epidemics. It must be present before, during and after a health emergency.
- There are several dimensions of trust that are crucial to pandemic prevention, preparedness and response: trust in government and institutions, trust in health care and science, interpersonal trust, trust in the pharmaceutical industry and other private sector actors, trust in the global community and other nations, and others.
- The impact of trust is broad: lack of trust can act as a driver of emergence, making individuals less willing to report zoonotic events due to fear of repercussions; and a driver of amplification, with individuals refusing to comply with public health and social measures such as quarantine, or refusing treatments and vaccination, leading to greater transmission and health impacts.

Key points

- Higher levels of trust between people and different actors (for example, governments, community leaders, health professionals, scientists, religious leaders) have been associated with greater adoption of public health measures and better health outcomes in health emergencies. A study during the COVID-19 pandemic found that "high levels of government and interpersonal trust, as well as less government corruption, were associated with higher COVID-19 vaccine coverage among middle-income and high-income countries where vaccine availability was more widespread, and lower corruption was associated with greater reductions in mobility."[121]
- When confronted with a novel virus for which there is no pre-existing treatment or vaccine, the most effective way for a government to protect its citizens is to convince them to comply with public health and social measures to protect themselves and one another. Trust in government shapes the confidence that communities have in the legitimacy of public health and other governmental institutions and in public health interventions.
- High levels of trust in one country can be eroded by high levels of mistrust in other countries, and the interconnectedness of countries and continents can amplify mistrust, fuelled by social media.
- Trust in government is closely linked to an individual's perception of being able to influence their government, as well as to government effectiveness and corruption levels. Trust in government is therefore closely linked to good governance.

121 Bollyky TJ, Hulland EN, Barber RM, Collins JK, Kiernan S, Moses M, et al. Pandemic preparedness and COVID-19: an exploratory analysis of infection and fatality rates, and contextual factors associated with preparedness in 177 countries, from Jan 1, 2020, to Sept 30, 2021. The Lancet. 2022;399,10334:1489-1512. doi:10.1016/S0140-6736(22)00172-6.

Ebola outbreaks in Guinea, Liberia and Sierra Leone: examples of trust challenges faced by health workers, including stigmatization and the issue of safe and dignified burials

- During the Ebola outbreaks in Guinea, Liberia and Sierra Leone, it was reported that when engaging new workers outside the communities in which they were deployed, the work of these workers proved problematic and ineffective due to community mistrust and, at times, the violent rejection of outsiders.
- Community health workers reported experiencing stigmatization as potential 'Ebola carriers', as well as anger from their family and community for not fulfilling responsibilities such as farming and harvesting due to Ebola-related work.
- Strategies to 'demystify' Ebola and increasing trust in the response were subsequently adopted, including the organization of community visits to Ebola treatment units to observe patient care, and recruiting survivors to share their experiences and encourage early care seeking.
- Other testimonies show that the decision to order the cremation of all dead bodies caused a breakdown of trust in the authorities. Cremation created a separation from the dead that was traumatic for people who viewed burials as 'a cure for [the grief of the] living', and as a way of preparing the dead to join the ancestors.[122]

Data and trends

- Overall, trust in all institutions across countries increased steadily from 2012 to 2020 and reached a high point at the beginning of the COVID-19 pandemic.[123] Trust was quickly lost due to the difficult global response to COVID-19 and the economic challenges that followed. In 2024, the Edelman Trust Barometer reported a decrease in trust in government, with government leaders being the most distrusted group of leaders.[124] In Organisation for Economic Co-operation and Development (OECD) countries, trust has decreased moderately since 2021, especially among women and people with lower education levels.[125] See Table 1 for Edelman Trust Barometer data for WHO regions.
- Trust levels vary highly between income levels, with higher income populations more likely than lower income groups to trust institutions. Countries with lower GDP and/or with higher economic inequality levels tend to have lower trust levels.[126,127] In addition, there are higher levels of trust in highly-informed groups than in the general population.
- A recent survey found that individuals across 68 countries have high levels of trust in science. Scientists have a strong trust capital compared to governments.[128] Studies on vaccine hesitancy have shown high levels of trust in scientists and vaccines in many low-income countries, but low trust and greater hesitancy in some high-income countries.[129,130]

122 Brown H, Marí Sáez A. Ebola separations: trust, crisis, and 'social distancing' in West Africa. J R Anthropol Inst. 2021;27:9–29. doi:10.1111/1467-9655.13426.

123 This is supported by data from the Edelman Trust Barometer and the World Values Survey.

124 2024 Edelman Trust Barometer Global Report. Edelman Trust Institute; 2024 (https://www.edelman.com/trust/2024/trust-barometer; accessed 2 October 2024).

125 OECD Survey on Drivers of Trust in Public Institutions – 2024 Results: Building Trust in a Complex Policy Environment. Paris: OECD Publishing; 2024. doi:10.1787/9a20554b-en.

126 Interpersonal trust vs. GDP per capita. In: Our World in Data [website]; 2023 (https://ourworldindata.org/grapher/share-agreeing-most-people-can-be-trusted-vs-gdp-per-capita, accessed 2 October 2024).

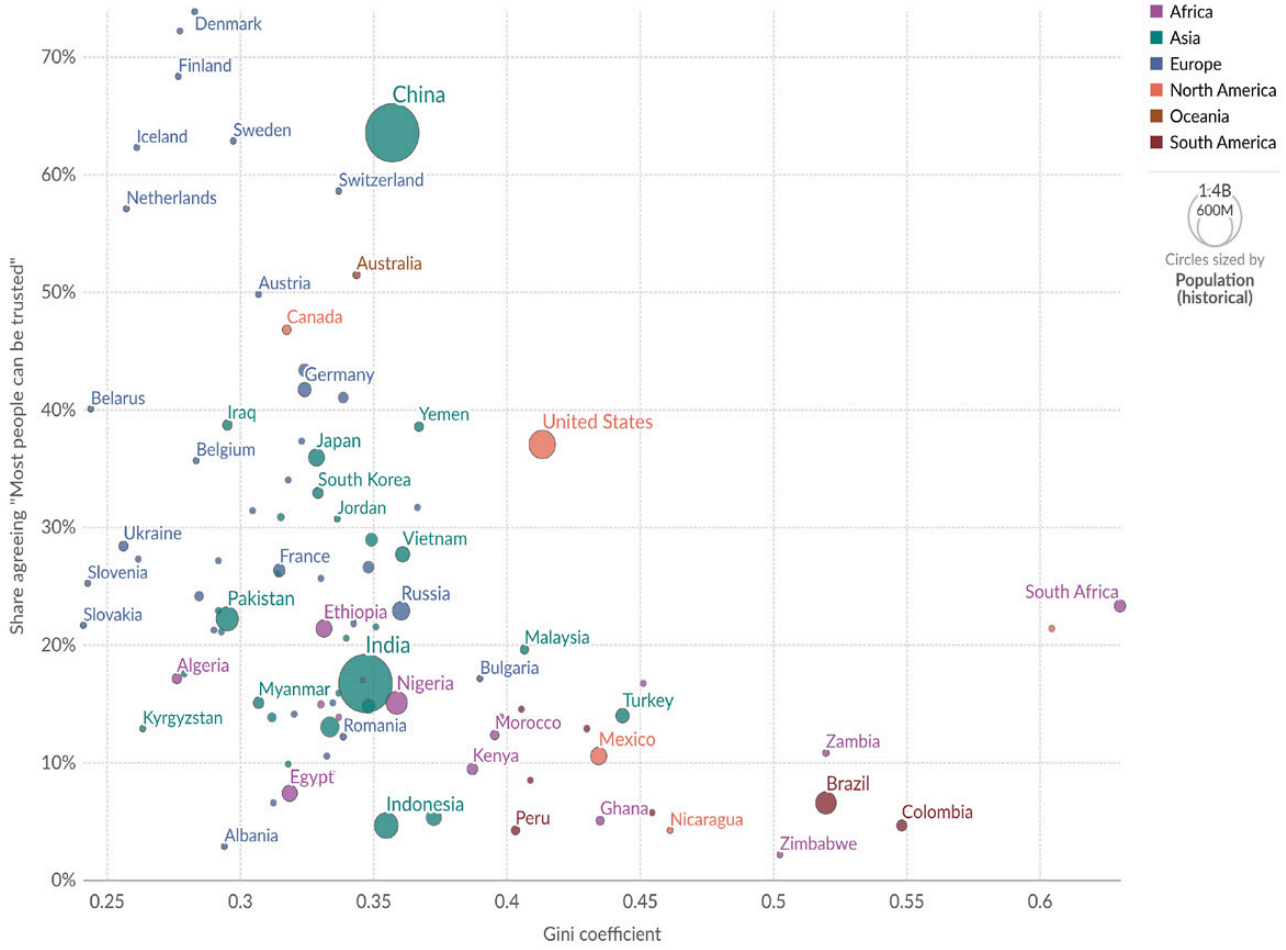
127 Interpersonal trust vs. income inequality. In: Our World in Data [website]; 2024 (https://ourworldindata.org/grapher/interpersonal-trust-vs-income-inequality, accessed 2 October 2024).

128 Cologna V, Mede NG, Berger S, Besley J, Brick C, Joubert M et al. Trust in scientists and their role in society across 68 countries. OSF Preprints; 2024. doi:10.31219/osf.io/6ay7s.

129 de O. Cata-Preta B, Wehrmeister FC, Santos TM, Barros AJD, Victora CG. Patterns in Wealth-related Inequalities in 86 Low- and Middle-Income Countries: Global Evidence on the Emergence of Vaccine Hesitancy. Am J Prev Med. 2021;60(1),1:S24–S33. doi:10.1016/j.amepre.2020.07.028.

130 COVID-19 Vaccine Acceptance and Hesitancy in Low- And Middle-Income Countries. In: Innovations for Poverty Action [website]; 16 July 2021 (https://poverty-action.org/publication/covid-19-vaccine-acceptance-and-hesitancy-low-and-middle-income-countries, accessed 2 October 2024).

Figure 34. Interpersonal trust versus income inequality 1984–2022



Source: Integrated Values Surveys/World Bank Poverty and Inequality Platform/Our World in Data, 2024 https://ourworldindata.org/grapher/interpersonal-trust-vs-income-inequality

- However, the trust deficit is having an increasing effect on polarization in societies.[131,132,133] The World Economic Forum (WEF) Global Risks Report[134] identifies societal polarization as the third greatest risk to the world in 2024; misinformation and disinformation are in second place. Both of these dimensions are closely linked to a lack of trust.

- Trust in the multilateral system and trust between countries have declined in many countries due, in part, to the COVID-19 pandemic, and several conflicts and geopolitical crises that are challenging the effectiveness of the system. Figure 35 shows changes in confidence level in the United Nations from 2005–2009 to 2017–2022.

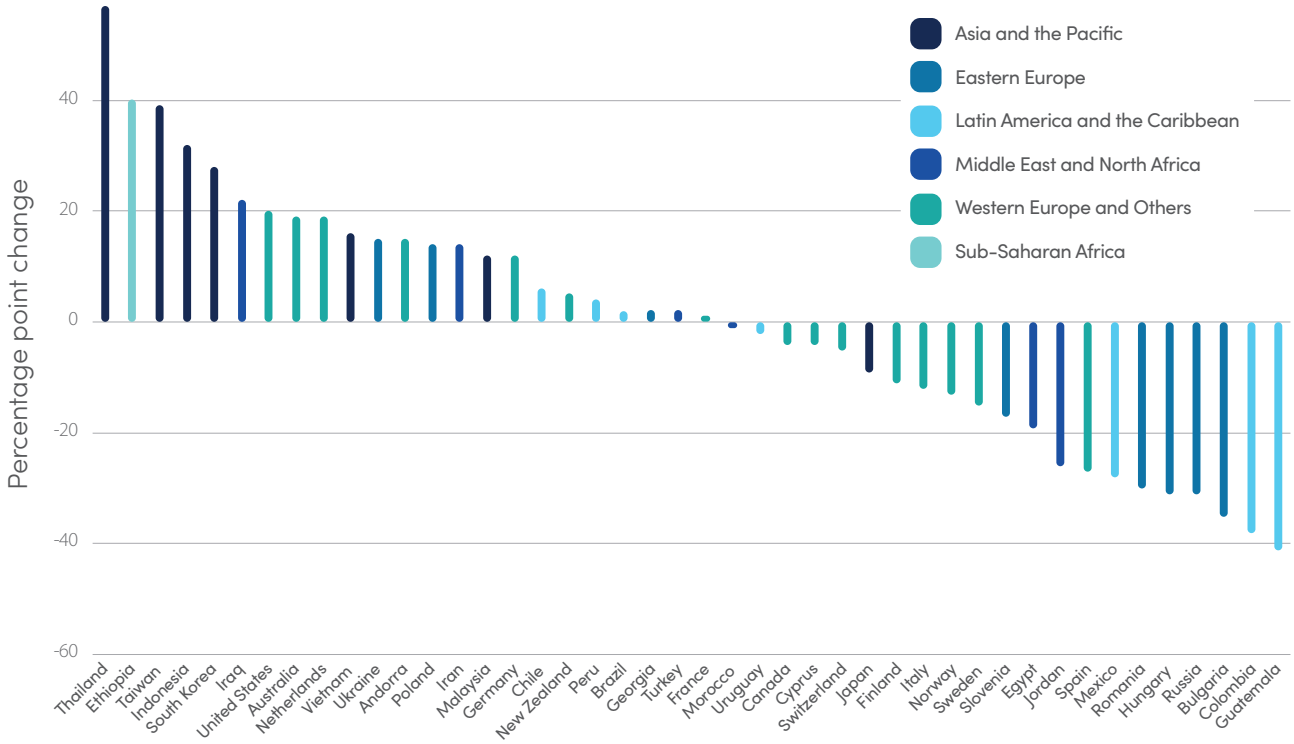
131 Fagan M. Most people in 35 countries see the UN favorably, but views have dipped in some places. Pew Research Center. 5 September 2024 (https://www.pewresearch.org/short-reads/2024/09/05/most-people-in-35-countries-see-the-un-favorably-but-views-have-dipped-in-some-places, accessed 23 September 2024).

132 Trithart A, Case O. Do People Trust the UN? A Look at the Data. IPI Global Observatory, 22 February 2023 (https://theglobalobservatory.org/2023/02/do-people-trust-the-un-a-look-at-the-data, accessed 23 September 2024).

133 Trust: Confidence in the United Nations, part of Ortiz-Ospina E, Roser M, Arriagada P. Trust (2016). Data adapted from Integrated Values Surveys (https://ourworldindata.org/grapher/confidence-in-un-wvs, accessed 23 September 2024).

134 The Global Risks Report 2024: 19th edition insight report. Cologny/Geneva: World Economic Forum; 2024 (https://www.weforum.org/publications/global-risks-report-2024, accessed 23 September 2024).

Figure 35. Change in net confidence in the UN (2005–2009 to 2017–2022)



Source: European Values Study and World Values Survey. Joint EVS/WVS 2017–2022 Dataset, 2022. World Values Survey: Wave 5 (2005–2009), Inglehard et al. (eds). 2018. https://ourworldindata.org/grapher/confidence-in-un-wvs

Opportunities/Challenges

- There is an overall lack of recognition of the importance of trust, and lack of knowledge about interventions that can be implemented to build trust. And yet, trust is a commodity in pandemic times, as important as countermeasures such as vaccines. It is important to build, invest in and focus on building trust during peace time.

- Health care workers are often good and trusted ambassadors during health crises, in particular for medical countermeasures. It is important for policy-makers to involve and empower health care workers, who are already trusted by communities, to convey public health messages and support the implementation of response interventions.

- In the case of low-trust environments, the implementation of response interventions should be adapted to prevent the risk of failure (for instance, vaccination) and tailored to the context (for example, providing economic incentives, engaging ambassadors from communities, and local leaders).

- Health care workers are rarely trained in risk communications and the implementation of measures in low-trust environments. In some instances during the COVID-19 pandemic, health workers suffered from violence from patients and communities in addition to the heavy workload and the stress resulting from providing care during a crisis. Health or community workers need to be adequately trained and equipped to face the challenges of mistrust during pandemics.

- Ongoing multilateral discussions, including with the revised package of amendments to the International Health Regulations (2005) recently adopted by WHO Member States and the continuation of the INB process to draft and negotiate a Pandemic convention, agreement or other international instrument under the Constitution of the World Health Organization, represent important avenues for advancing trust globally.

- There are limited metrics to measure trust in health. In addition, when indicators are available, they often mask the specificities of certain groups (for instance, socioeconomic groups or minorities, or gender bias). More research is needed to better understand this driver and measure the effectiveness of interventions to build trust.

Assessment

- **Trend:** Overall trust has decreased in many countries following the COVID-19 pandemic. Distrust in institutions is growing, and trust in the multilateral system is at an all-time low. This is compounded by the increasing reach of dis- and misinformation.
- **Impact:** Decreasing trust is impacting countries' capacity to prepare and respond to epidemics and pandemics. It is leading to mistrust in public health interventions, including vaccine and treatment hesitancy, and impacting communities' willingness to adopt public health measures, such as reporting zoonotic cases (e.g. H5N1 in cattle). It is also undermining our collective capacity to tackle health emergencies, and to find solutions that will protect the world, including the negotiations for the WHO Pandemic Agreement. For these reasons, the impact of this driver is assessed as very high.

Actions

- **Countries need to build trust before an epidemic or pandemic strikes**. This is particularly important as epidemics and pandemics usually erode trust over time.
- **Countries need to dedicate specific attention to low-trust environments**, where adaptation of response strategies is key. In such environments, countries need to identify appropriate ambassadors and train health workers to interact with the community, listen to population concerns, convey public health messages and implement medical and non-pharmaceutical interventions.
- **Countries need to participate in ongoing efforts to strengthen the global health architecture and global cooperation**, as these will be beneficial in addressing mistrust at the global level.

Monitoring Framework Indicator:
A.1.5.3 Conflict, instability, violence

CONFLICT AND INSTABILITY

Impact on pandemic risk

Driver description

- Conflict, instability and violence can cause important deficits in determinants that are conducive to guaranteeing the health of populations, and therefore contribute to the emergence and spread of infectious disease outbreaks. Political unrest and conflicts may hinder the response to epidemics and pandemics by disrupting services, causing physical barriers to access or by affecting levels of trust in authority. Unrest may also engender massive population movements, unsanitary living conditions, destruction of vital infrastructure (medical, sanitation, roads, for example), or affect authorities' ability to coordinate, share information or effectively cooperate with others.

Key points

- Populations in conflict situations present increased incidence of infectious diseases as a result of a multitude of risk factors that precipitate disease emergence and transmission. These risk factors include massive population movements; the presence of refugee camps; vulnerability of health facilities and health workers; and poor access to infrastructure, basic health, water and sanitation services.
- Many studies have shown a close link between cholera and other disaster-related factors such as unplanned overcrowding, internally displaced people, poor water and sanitation, poor nutritional status, poor personal hygiene, limited access to health care and low coverage of vaccination (see Example below).
- Disruptions of health systems and government functions lead to delays in the detection, response and containment of an infectious disease.[135]
- Many health care providers die during armed conflicts due to direct or indirect violence, thus even further reducing access to health services. Attacks on health care in situations of armed conflict have been reported at alarming levels over the past two decades.
- Access to medical resources and countermeasures is also more challenging in situations of conflict and instability. Medical personnel, supplies and personal protective equipment struggle to reach areas of active conflict or where internally displaced people have taken refuge.

135 Marou V, Vardavas CI, Aslanoglou K, Nikitara K, Plyta Z, Leonardi-Bee J et al. The impact of conflict on infectious disease: a systematic literature review. Confl Health. 2024;18,27. doi:10.1186/s13031-023-00568-z.

Example

2016 cholera epidemic in Yemen: an example of multiple factors affecting disease emergence and amplification in conflict settings[136]

Yemen was affected by a major cholera epidemic in 2016, while a civil war, which has devastated the country since March 2015, has exacerbated the humanitarian situation. War and civil war in Yemen led to massive population movements, an intensified shortage of water resources and related hygiene problems, and disruption of services, including health services. The intensity and extended length of the current conflict hindered the vast majority of the population in obtaining easy access to basic services – particularly the most vulnerable groups of children and women, with 39% of suspected cholera cases in children under five years old.[137]

With almost two-thirds of the Yemeni population without access to a clean water supply and sanitation[138], the lack of safe water and sanitation exacerbated the risk of cholera outbreaks in human populations, while a fragile health system increased the likelihood of high mortality, due to limited access to care, in particular early rehydration.

Data and trends

- The number of armed conflicts has increased dramatically over the past decade. Figure 36 shows a 50% increase in armed conflicts since 2013. In 2023, 34 countries were involved in active armed conflicts.[139]
- Globally, countries are also increasingly fragile. Figure 37 below shows that fragility has reached its highest point in the last 10 years. According to the OECD, "fragility increased worldwide from 2020 to 2021, highlighting the systemic and multidimensional impact of the COVID-19 crisis."[140] See also Table 1 for Global Peace Index scores per WHO region.
- This dramatic increase in conflict and fragility in the past 10 years is also associated with the highest number of forcibly displaced persons of all time. Figure 38 shows that 0.8% of the world population has been forcibly displaced.
- The number of attacks on health care has increased by 25% from 2022 to 2023[141], and is likely to be even higher in 2024 (see Figure 39).

136 World Health Assembly agreement reached on wide-ranging, decisive package of amendments to improve the International Health Regulations. In: WHO [website]. Geneva: WHO; 1 June 2024 (https://www.who.int/news/item/01-06-2024-world-health-assembly-agreement-reached-on-wide-ranging--decisive-package-of-amendments-to-improve-the-international-health-regulations--and-sets-date-for-finalizing-negotiations-on-a-proposed-pandemic-agreement, accessed 23 September 2024).

137 Dureab F, Shibib K, Al-Yousuf R, Jahn A. Yemen: Cholera outbreak and the ongoing armed conflict. J. Infect. Dev. Ctries. 2018;12(5):397-403. doi:10.3855/jidc.10129.

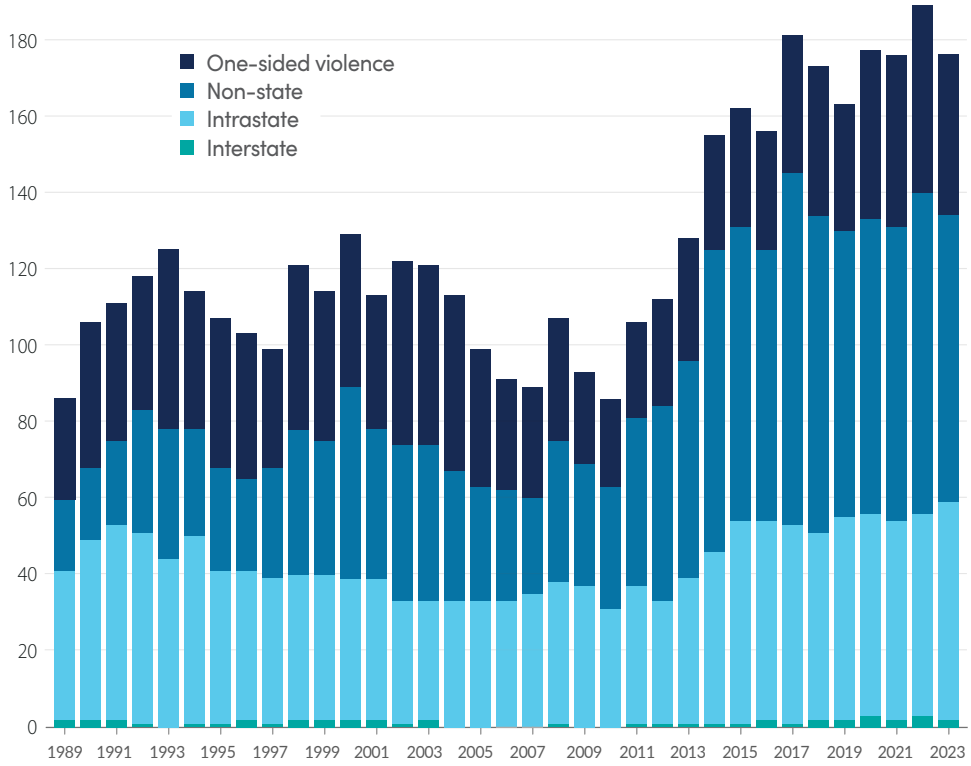
138 Dureab F, Shibib K, Yé Y, Jahn A, Müllera O. Cholera epidemic in Yemen. Lancet Glob. Health. Correspondence. 2018; 6,(12): e1283. (https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30393-0/fulltext, accessed 23 September 2024).

139 New data shows record number of armed conflicts. In: Peace Research Institute [website]. Oslo: Peace Research Institute. 10 June 2024 (https://www.prio.org/news/3532, accessed 23 September 2024).

140 Fragility in an age of crises. In: States of Fragility 2022. Paris: OECD; 2022 (https://www.oecd-ilibrary.org/sites/c7fedf5e-en/1/3/1/index.html?itemId=/content/publication/c7fedf5e-en&_csp_=ed992425c7db5557b78226a6c98c6daf&itemIGO=oecd&itemContentType=book, accessed 23 September 2024).

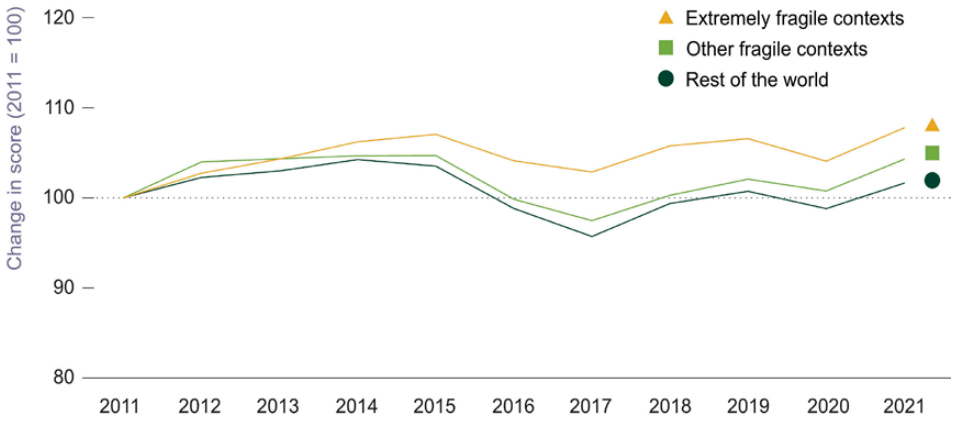
141 2023 Attacks on Health Care in War Zones Most Ever Documented: Safeguarding Health in Conflict Coalition (SHCC) Report. In: Physicians for Human Rights [website]. New York: Physicians for Human Rights. 22 May 2024 (https://phr.org/news/2023-attacks-on-health-care-in-war-zones-most-ever-documented-safeguarding-health-in-conflict-coalition-shcc-report, accessed 23 September 2024).

Figure 36. Number of armed conflicts worldwide 1989—2023



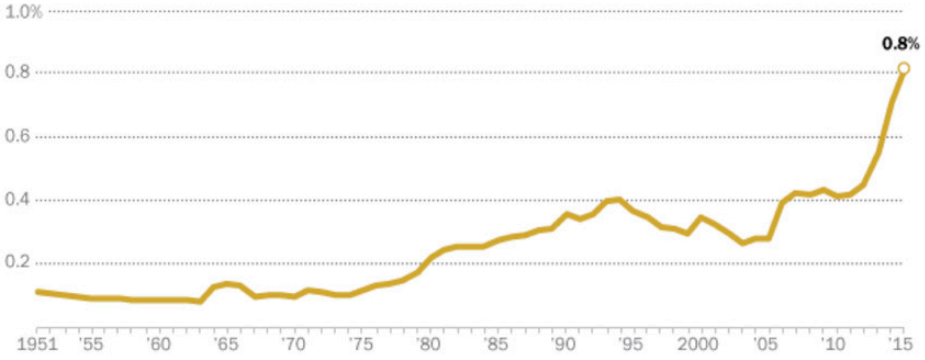
Source: Uppsala Conflict Data Program, Our World in Data, 2024 https://ourworldindata.org/grapher/number-of-armed-conflicts

Figure 37. Fragility increased worldwide 2020—2021, reaching a ten-year high in extremely fragile contexts



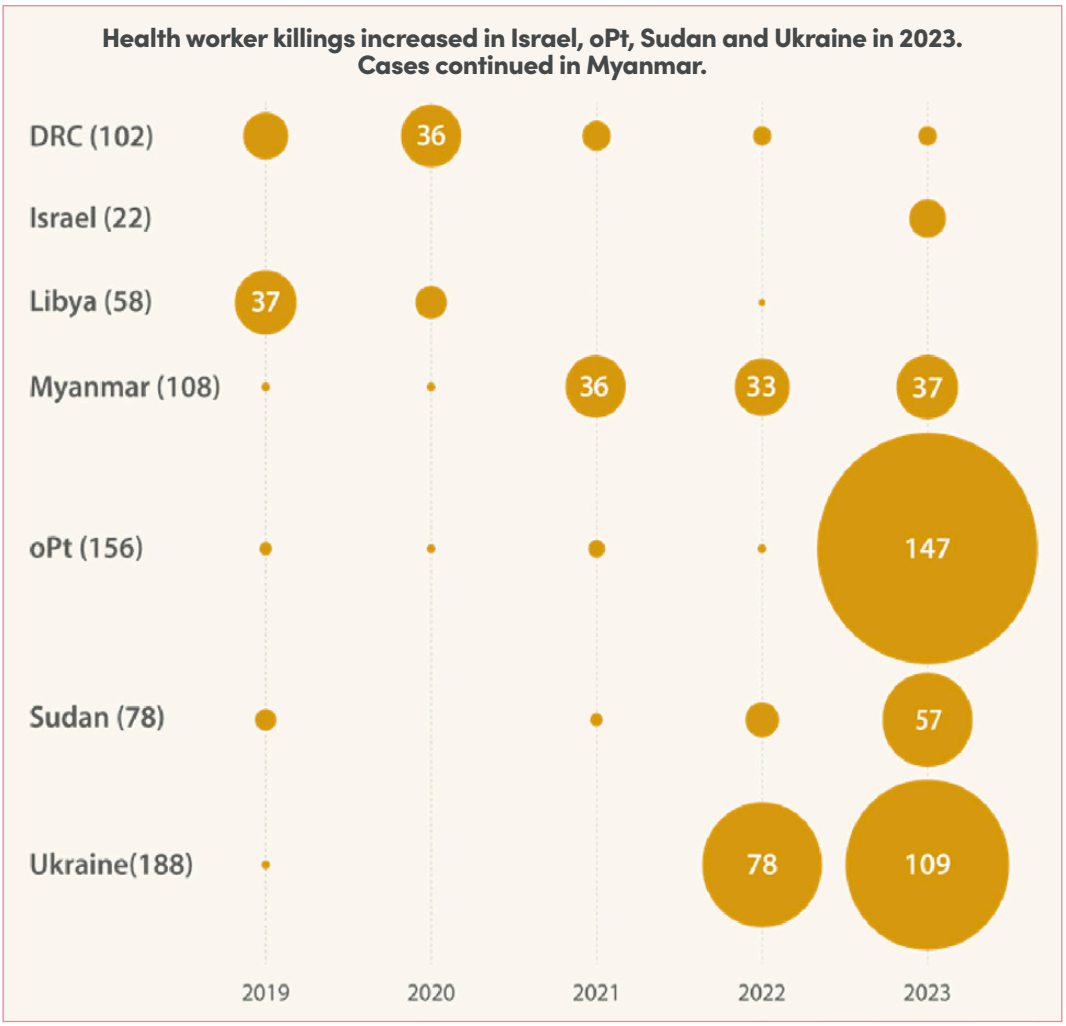
Source: States of Fragility 2022, OECD https://www.oecd-ilibrary.org/sites/c7fedf5e-en/1/3/1/index.html?itemId=/content/publication/c7fedf5e-en&_csp_=ed992425c7db5557b78226a6c98c6daf

Figure 38. A record-high share of the world's population is displaced from their homes in 2015



Source: Pew Research Center, 2016 https://www.pewresearch.org/short-reads/2016/10/05/key-facts-about-the-worlds-refugees/

Figure 39. A dramatic increase in health worker killings in 2023



Source: Safeguarding Health in Conflict Coalition/Insecurity Insight, 2023 https://insecurityinsight.org/wp-content/uploads/2024/05/2023-SHCC-Critical-Conditions.pdf

Opportunities/Challenges

- Medical personnel, humanitarian actors, community workers and other stakeholders providing care should be closely involved in the response to the complex crises brought on by conflict and instability, and adequately trained in the specificities of providing care in refugee camp settings or conflict areas during epidemics and pandemics.

- Conflict and instability lead to an increase in population density, especially in refugee camps; unsanitary living conditions; and the destruction of vital infrastructure (medical, sanitation and roads, for example), which hampers access to basic health services and systems. Authorities also need to implement measures to reduce overcrowding in camps and camp-like settings and, wherever possible, to readjust site planning to lower the risk of infection and community transmission, taking into account broader public health considerations.[142] Preventive measures such as vaccination are critical to reduce the likelihood of vaccine preventable diseases.

- Attacks on health care in situations of armed conflict have been reported at alarming levels over the past two decades. This is a particularly concerning situation, and compliance with international humanitarian law and the Geneva Conventions is critical to ensure the safety of health workers and health facilities.

142 Reducing the Impact of the COVID-19 Pandemic on Internally Displaced People (IDPS). Geneva: International Federation of Red Cross and Red Crescent Societies and International Committee of the Red Cross; 2020 (https://www.ifrc.org/sites/default/files/Reducing-the-impact-of-the-COVID-19-pandemic-on-internally-displaced-people-IDPsPDF2.pdf, accessed 23 September 2024).

Assessment

- **Trend:** The number of conflicts is increasing globally, and global fragility indicators are worsening. This is leading to a dramatic increase in displaced persons. Health systems and health care workers have become more vulnerable to attacks.

- **Impact:** Ongoing conflicts and instability across the world, such as in Ukraine[143], Israel and the occupied Palestinian territory[144], Yemen[145,146] and Sudan[147,148], are acting as an important driver of emergence, and even more so of amplification of infectious diseases such as cholera, influenza and polio. Ongoing conflicts and instability are making it challenging for countries to respond to the public health needs of populations due to the collapse of health systems, the destruction of infrastructure, and shortages of staff, funds, electricity, medicines and equipment. Vulnerable populations are increasingly facing multiple risks and poor living conditions. This driver currently represents a high risk.

Actions

- **Countries need to be aware of the risk of the emergence and amplification of epidemics in conflict situations**, and to address the specific and basic needs of vulnerable populations, in particular of refugees and those in densely populated areas.

- **Countries need to collaborate to ensure global availability of medical countermeasures and health commodities**, and to ensure populations at risk have timely access to critical medical health products during conflict.

- **Countries should comply with international humanitarian law obligations**, particularly in relation to the safety of health workers and the protection of health facilities.

143 Ukraine emergency. In: WHO [website]. Geneva: WHO; 15 August 2024 (https://www.who.int/emergencies/situations/ukraine-emergency, accessed 2 October 2024).

144 Conflict in Israel and the occupied Palestinian territory. In: WHO [website]. Geneva: WHO, 1 October 2024 (https://www.who.int/emergencies/situations/conflict-in-Israel-and-oPt, accessed 2 October 2024).

145 Yemen Health Emergency. In: WHO [website]. Geneva: WHO, 11 April 2024 (https://www.who.int/emergencies/situations/yemen-crisis, accessed 2 October 2024).

146 Yemen Situation Report. In: UN Office for the Coordination of Humanitarian Affairs (UN OCHA) [website]. Geneva/New York: UN OCHA, 12 May 2024 (https://reports.unocha.org/en/country/yemen, accessed 2 October 2024).

147 Sudan emergency. In: WHO [website]. Geneva: WHO, 1 October 2024 (https://www.who.int/emergencies/situations/sudan-emergency, accessed 2 October 2024).

148 New cholera outbreak threatening refugees and displaced communities amid ongoing war and flooding in Sudan. In: UN Refugee Agency (UNHCR) [website]. Geneva: UNHCR, 23 August 2024 (https://www.unhcr.org/news/briefing-notes/new-cholera-outbreak-threatening-refugees-and-displaced-communities-amid, accessed 2 October 2024).

ANNEX

Technical consultations on pandemic drivers

Consultation on drivers of epidemics and pandemics with civil society organizations and faith-based organizations

Technical consultations on pandemic drivers

INTRODUCTION

Consultations with independent, external experts from a wide range of sectors are a central part of the GPMB's assessments and reports. These consultations serve a range of purposes, from elaborating on quantitative findings with more nuanced, qualitative assessments to helping the Board refine its assessment methodology. They also help to ensure that a diversity of sectors and stakeholders from all regions compare their research and contribute to the GPMB's conclusions.

This year's report, which focuses on 15 key drivers of pandemic risk, was no exception. Once the GPMB had gathered the quantitative data for each driver and indicator, it organized five consultations in June to reflect on the five pillars of the GPMB Monitoring Framework (itself based on the STEEP framework: Social, Technological, Economic, Environmental and Political pillars of risk).

In total, 56 experts were invited from the five WHO regions, of whom 27 were able to participate, along with Board Members and experts from WHO. Additional experts were consulted via email or online meetings. The majority were academic experts, but many also regularly advise governments or intergovernmental processes. They include economists, environmental and climate experts, political scientists, veterinarians, public health experts, humanitarians, social scientists, transport and logistics experts, and representatives of many more areas of expertise. All contributed their time voluntarily to the consultations.

Objectives: The experts were asked to look at the description of each pillar (and its three drivers), the corresponding indicators, and the quantitative data on each indicator arranged by WHO region. They were asked:

- whether the data reflected their own research;
- how each driver increases or decreases pandemic risk, and how the drivers interact with one another;
- which actions they felt might help mitigate the risk.

Format: In each of the two-hour consultations, the findings were presented by the GPMB Secretariat, and the discussion was moderated by Dr Gabriel Leung, a Hong Kong physician and epidemiologist, currently serving as the Executive Director (Charities and Community) of the Hong Kong Jockey Club, who was the longest-serving Dean of Medicine at the University of Hong Kong, Hong Kong's first Under Secretary for Food and Health; and fifth Director of the Chief Executive's Office in the Government of Hong Kong.

KEY POINTS ENCOUNTERED THROUGHOUT THE CONSULTATIONS

As this was the first time that the risk section of the GPMB's Monitoring Framework was used as the basis for an assessment of pandemic risk, it was an excellent opportunity to collect feedback on its usefulness for various purposes. As such, these comments on methodology could apply to the risk section of the framework as a whole, rather than to individual drivers or indicators.

Cross-sectional comments fell under five broad categories:

1) **The usefulness of using WHO regions to assess regional trends:** most experts felt that aggregating data by WHO region could be quite misleading given the disparity in cultural and economic circumstances within those regions.

2) **The usefulness of the framework's indicators for modelling or predictive purposes:** most experts felt that, given the enormous complexity of assessing interactions between the drivers, and the lack of consistency in the way the data is collected in each country and region, the framework's drivers and indicators — indeed, any collection of drivers and indicators — could not be used to predict pandemic risk.

3) **The usefulness of assessing drivers by pillar vs all together:** many experts highlighted the interactions between drivers both within and across pillars. For instance, it was felt that measures of government effectiveness (one of the political drivers) were very much related to measures of economic inequity (one of the economic drivers), and that some of the drivers (for instance, trust) were themselves 'driven' by other drivers (for example, misinformation).

4) **Whether the drivers can both increase and mitigate risk:** all experts agreed that most of the drivers can both drive risk and mitigate it. For instance, rapid urbanization can lead to increased population density, which itself can favour the rapid circulation of pathogens, especially if other services such as sanitation cannot keep pace. On the other hand, rapid urbanization may also create opportunities for risk mitigation in the form of better health care or greater availability of social protection services.

5) **How to categorize drivers by their mechanisms of action:** in several consultations, experts suggested subdividing drivers according to how they affect pandemic risk. For instance, some drivers have an impact on the emergence or re-emergence of a virus (for example, poor biosafety, which is a risk associated with biomedical innovations), while others affect the spread of a virus (for instance, lack of trust in public health authorities or access to misinformation). Other cases are far more complex, with a single driver affecting pandemic risk differently according to a multiplicity of other factors.

KEY POINTS BY STEEP PILLAR

Pillar I – Environmental drivers of pandemics

Participants:
7 external experts; 1 GPMB Board Member

Mauricio Barreto, Professor, Graduate Program in Collective Health, Institute of Collective Health, Federal University of Bahia; Senior Researcher, Gonzalo Moniz Institute, Fiocruz Bahia

Aïda Diongue-Niang, Technical Advisor, National Agency of Civil Aviation and Meteorology, Senegal; Vice-Chair, Intergovernmental Panel on Climate Change's Working Group I for the seventh assessment cycle

Serge Morand, One Health High-Level Expert Panel (OHHLEP) Member

Kris Murray, Professor in Environmental Change & Health, London School of Hygiene & Tropical Medicine

Christina Pettan-Brewer, Associate Professor, Department of Comparative Medicine, School of Medicine, University of Washington, Seattle

Marcela Uhart, Director, Latin America Program, Karen C. Drayer Wildlife Health Center

Steve Unwin, Head, World Organisation for Animal Health Collaborating Centre for Wildlife Health Risk Management, Wildlife Health Australia

Matthew Stone, GPMB Board Member

Key points:

1. **Modelling and the use of quantitative data:** There is inconsistency in the research about these drivers across regions, making it extremely challenging to aggregate data by region. Furthermore, due to the great complexity of factors and their interactions, there is currently no model available that would have predictive value globally. The models that work best are those that are very localized and pathogen-specific.

2. **Complexity and interactions:** Drivers are interconnected: we need to emphasize that they often work synchronously and interact with a multiplicity of other factors. Moreover, drivers can be both positive and negative in relation to epidemics. We could push for more research on modelling to capture this.

3. **Distinctions between types of drivers:** We need to frame the drivers better. For instance, we could talk about hazards and vulnerability and match these with emergence and amplification.

4. **Research or lack thereof:** There are many drivers of disease that we suspect play an important role, but for which we have insufficient data and no tools to address the issue, for instance, marine environments and atmospheric phenomena, fur farming, and pathogen transmission patterns in wildlife.

5. **Progress on one driver**, such as expensive biosurveillance, **may sometimes come with long-term backlashes**, such as loss of biodiversity from vertically integrated breeding. The latter could potentially lead to much more severe pandemics down the road. This is why caution must be exercised when making recommendations.

Pillar II - Social drivers of pandemics

Participants:
10 external experts; 3 WHO experts (co-convener)

Johanna Ansa Jordaan, Chief, Aviation Medicine Section, International Civil Aviation Organization

Dr Juliet Bedford, Founder and Director, Anthrologica; Adjunct Professor, College of Global Public Health, New York University

Dr Saverio Bellizzi, Technical Officer (Public Health and Migration), WHO

Rachel Hall-Clifford, author of *Underbelly*; Assistant Professor, Center for the Study of Human Health, Department of Sociology, Emory University

Dr Freya Jephcott, Postdoctoral Associate, Jesus College, University of Cambridge

Dr Mika Kawano, Country Readiness Strengthening, Health Emergencies Programme, WHO

Kelley Lee, Professor, Canada Research Chair Tier I in Global Health Governance, Simon Fraser University

Tsitsi Masvawure, Professor of Practice, Health Studies and Health Studies Program, College of the Holy Cross

Tina Purnat, Consultant, Global Health, Digital Public Health, Health Misinformation; Visiting Senior Scholar, School of Public Health, University of Memphis

Julia Smith, Assistant Professor, Health Sciences, Simon Fraser University; International Civil Aviation Organization

Priya Umachandran, WHO Consultant, Health Emergencies Programme

Robert Verbist, Acting President, International Maritime Health Association; port-physician, MEDIPORT

Haley Elizabeth West, Senior Programme Officer, Health and Emergencies, UN Migration Agency (IOM)

Key points:

- **The three drivers are quite different** in terms of their origins: the first is linked to cultural practices, the second to commercial, political or environmental phenomena and practices, and the last is driven by politics and culture.

- **On individualism:**

  - Collectivism and individualism frequently coexist to some extent within the same society (for example, regular church-going and an emphasis on free/individual choice). The GPMB Monitoring Framework tends to look at the political organization of a country.

  - Collectivist versus individualistic practices cannot be classified as either 'good' or 'bad' for pandemics. For instance, individualism can entail less compliance with a collective measure (such as a measure to ensure public health), but collectivism can also lead to measures that go against the public interest (for instance, mass gatherings or events). Some experts felt that the main difference between collectivist and individualistic societies would be effective ways of communication, for instance, by appealing to solidarity and compliance in the former and to self-interest in the latter.

  - For further research on risk, experts suggested we develop our understanding of individualism and what drives individualistic behaviours, including consideration of the impact of other STEEP drivers.

- **On mobility:**

  - This particular driver benefited considerably from inputs from non-health experts, such as sociologists, those who work on travel and logistics, and so on.

  - From an epidemiological point of view, a particular form of risk depends on the type of pathogen and its characteristics, i.e. type of transmission and mobility. It therefore makes more sense to break this driver down into types of movement (of goods, of people, of animals, or soils).

  - There is increasing mobility of all types, including forced migration, economic migration and movement of goods, as well as tourism, travel for work, and even movement of animals, and so on. The question therefore becomes not how to suppress mobility, but how to ensure safe mobility.

  - Experts felt that more work and research was needed on 1) what mobility actually means (volume/intensity/type/direction?) and 2) what can make different types of movement safer, including regulations. Intersectoral work on this particular driver is absolutely crucial.

- **Social inequity:** It is important to appreciate the difference between inequity and poverty. Some actions were proposed, including the need for social protection packages to be broadly defined, and for potential vulnerabilities to be identified ahead of time (rather than during a crisis).

Pillar III – Political drivers of pandemics

Participants:
7 external experts; 1 WHO expert (co-convener); 1 GPMB Board Member

Dr Mely Caballero-Anthony, Professor of International Relations, S. Rajaratnam School of International Studies, Nanyang Technological University, Singapore

Arush Lal, Commissioner, Chatham House Commission for Universal Health; Advisor, Primary Health Care Performance Initiative

Dr Ren Minghui, Director, Institute for Global Health, Peking University

Matthew Stone, GPMB Board Member

Priya Umachandran, WHO Consultant, Health Emergencies Programme

Andrea Vaccaro, Postdoctoral Research Fellow, Blavatnik School of Government, University of Oxford

Paola Vasco, Senior Researcher at the Peace Research Institute, Oslo

Dr Clare Wenham, Associate Professor of Global Health Policy, London School of Economics and Political Science

Hao Zha, DPhil student in Public Policy, Blavatnik School of Government, University of Oxford; Team China Lead, Oxford COVID-19 Government Response Tracker (OxCGRT)

Key points:

1) **Defining governance, government effectiveness and which parts of it matter most for PPPR:** Experts agreed that good governance is critical to pandemic preparedness and response, but voiced the need to better define which parts of governance matter most, at which point of the pandemic — before, at the onset, at the height or in the recovery phase.

2) **Overall measures of trust can mask particular vulnerabilities**, such as the perceptions of minorities within a country, or of different socioeconomic groups. As such, we must ensure that risk assessment indicators do not mask vulnerabilities, such as those related to ethnic or other minorities, or certain socioeconomic groups. **International trust also matters for pandemic risk and needs to be included in assessments**, including trust between countries and trust by/in international institutions.

3) **Conflicts are on the rise and their impact is underestimated:** Experts recommended that the GPMB emphasize this in their report, and clarify what is meant by instability. Ultimately, assessments require a picture that is much more granular, with more detail, so that every country understands what this driver can do.

Pillar IV - Economic drivers of pandemics

Participants:
6 external experts; 1 WHO expert (co-convener)

John Ele-Ojo Ataguba, Professor, Max Rady College of Medicine, Community Health Sciences, University of Manitoba

Josephine Gatua, Health Economist, Centre for Ethics and Priority Setting (BCEPS), University of Bergen-Norway and the Africa Centres for Disease Control and Prevention

Mogha Kamal-Yanni, Independent Consultant; former Policy Advisor, Oxfam

Matthew Kavanagh, Director, Center for Global Health Policy & Politics, Georgetown University

Serina Ng, Executive Head, G20 Joint Finance and Health Task Force Secretariat, WHO

Dalia Samhouri, Lead Health Specialist, Pandemic Fund

Ming Xu, Dean, Department of Global Health, School of Public Health and Associate Dean, Institute for Global Health and Development, Peking University

Key points:

1) **What GDP can capture and what it can't:** GDP is an important indicator of economic growth but cannot be used on its own when assessing pandemic risk. In isolation it is a very poor predictor, and in fact there are many other indicators that would help provide a much better idea of the relationship between economic growth and risk. GDP is very useful, however, to understand access to medical countermeasures during a crisis.

2) **The informal sector and its vulnerabilities:** An indicator on the informal sector and its vulnerabilities in times of crisis would be good to add. Social programmes that function as safety nets and mitigators of inequity also need to apply to the informal sector, which is rarely the case.

3) **Economic growth in terms of the health system:** Numbers directly related to the health system, such as the number of trained health care workers, would help to illustrate the importance of economic growth. Additionally, experts suggested a need to 1) capture how economic prosperity translates to pandemic PPR — maybe through results-based financing, and 2) be mindful that some private sector investments are financed by the public sector.

4) Experts agreed that **decision-makers must be careful of privatizing public health and social services**, because this can make it harder for government to mobilize those resources in times of crisis.

5) **Capturing the impact of inequity:** Inequity may be a better predictor of risk than GDP, in terms of assessing vulnerability. It would be useful to conduct research into the impacts of inequity on public health responses. Experts suggested that it would be a problem for policy coordination, and that inequitable contexts drive up the cost of the response. It may lead to ineffective policy responses, as well as increased mistrust and a decline in social cohesion.

6) **The financing of social safety nets:** Experts discussed how social safety nets should be financed: if financing is at the national level, will this result in leaving out poorer countries? Normally, external aid tends to focus on paying for vaccines, medicines, and so forth, which are other important components of the response — but social programmes also need to be considered as mitigation measures.

Pillar V - Technological drivers of pandemics

Participants:
4 external experts; 1 GPMB Board Member

Palitha Abeykoon, GPMB Board Member

Kevin Esvelt, Assistant Professor and Director, Sculpting Evolution group, Massachusetts Institute of Technology (MIT)

Tom Inglesby, Director, Johns Hopkins Center for Health Security, Bloomberg School of Public Health, Johns Hopkins University

Tina Purnat, Consultant, Global Health, Digital Public Health, Health Misinformation; Visiting Senior Scholar, School of Public Health, University of Memphis

Saul Walker, Interim Executive Director for Policy, Partnerships and Access, Coalition for Epidemic Preparedness Innovations (CEPI)

Key points:

- **Assessing misinformation and capturing its effects more precisely:** Experts spoke of the need for more precise indicators to assess not just the volume of misinformation but also its nature, and whether people actually pay attention to it. Experts suggested it would be a useful exercise to see how many countries in the world have developed policies related to this, but added that one of the best ways to combat misinformation and disinformation would be to suggest ways that the health sector can be more resilient in regard to this phenomenon and improve its own digital footprint.

- **Digital connectivity in the long run — risks and opportunities:** Connectivity will increase, and digital divides will eventually close. This presents opportunities, such as increasing connections between new tools and communities, better surveillance, and so on. However, it also means risks — including cyber risks — will increase. Regulation, such as for data privacy and infrastructure security, will be necessary to mitigate those risks.

- **Biomedical innovation: bridging the divide and addressing biothreats:** Experts agreed that innovations bring an incredible number of opportunities for pandemic response, but warned that the key questions are whether populations can access those innovations, and whether there are policies in place to avoid increasing risk through innovation. Experts suggested shifting/rebalancing investments towards pathogen-agnostic interventions, such as masks and PPE, especially at the very beginning of an outbreak. They also cautioned that anything that was done rapidly during COVID-19 built on years of prior work (such as mRNA technologies); this shows that research cannot wait for crises to happen but must be conducted continually.

- **Questions relating to biomedical innovations must take into account the entire product development to delivery chain:** In other words, it is not just the development of the products themselves that must be considered, but the entire ecosystem around the innovation, such as testing and approvals systems, health systems that can administer the product, transportation, legal provisions to protect consumers and producers, and customs and storage regulations. Human considerations are equally important, such as whether people have trust in the product's safety and effectiveness, whether they can accept that the most vulnerable need the product first, and so on.

Consultation on drivers of epidemics and pandemics with civil society organizations and faith-based organizations

28 August 2024

AGENDA

14:00–14:05	Welcome & introductions
14:05–14:25	Presentation of the risk drivers by GPMB Secretariat
14:25–15:25	Partner interventions (in order of interventions)
15:25–15:40	Open discussion on issues/questions/contributions/examples
15:40–16:00	Summary of discussion and next steps

INTERVENTIONS

Intervention 1

Professor Shahid Jameel. Sultan Qaboos bin Said Fellow and Principal Investigator, Project on 'Public Health, Science and Technology in Muslim Societies', Oxford Centre for Islamic Studies; Research Fellow, Green Templeton College, University of Oxford, UK

Question: Reflecting on the social and political drivers of pandemic risk, please could you provide some reflections from your perspective of how the issues of global movement and connectedness and public trust in government influence/play out as drivers of pandemic risk, and perhaps how they influence one another?

"We have the tools but not the will"

"Allow me to discuss the social and political drivers of pandemic risk with two examples: in the first, mpox has been declared a PHEIC [public health emergency of international concern] by WHO in 2024 but also in 2022. Smallpox vaccine stockpiles are available in some countries but have so far not been made available to Africa, especially DRC. There are the tools but not the will. The other example is polio. This is a good case for how conflict and trust affect risk. In some countries like India and Nigeria, the main pockets of polio were in Muslim majority areas – people had low trust in local officials and governments, and felt that the oral polio vaccine will sterilize their children.

In Western UP [Uttar Pradesh, India], the polio programme spent time educating local clergy and a prominent Muslim university became involved in outreach and vaccination efforts. This built trust and India became polio free in 2011. Preparedness is not something that happens when an outbreak happens, it is a long-term plan, and we have the tools but we don't have the political will."

Intervention 2

Professor Sanjoy Bhattacharya. Head of School of History, and Professor of Medical and Global Health Histories, University of Leeds, UK; former Head of the WHO Collaborating Centre for Global Health Histories, University of York

Question: Professor Sanjoy, reflecting on the social and political drivers of pandemic risk, please could you provide some reflections from your perspective of how the issues of conflict, instability, violence and individualism influence/play out as drivers of pandemic risk, and perhaps how they influence one another?

"When you go in better prepared, more humble, more able to talk, listen, and act contextually, you save time and money"

"Conflicts are always locally grounded in socioeconomic and political conditions. Such conflict is often regionally, internationally and globally connected. Political conditions in each national and subnational context are diverse. That diversity must be acknowledged at the outset. Global health histories show that one size does not fit all in any policy setting initiative. Any policy that operates with the assumption that one size fits all misses out on diverse needs for inclusive research, engagement and welfare.

Governance is not just the nation state, but the complexity of political structures that make up the nation state. Governments and communities are not monolithic: there are complexities marked by social, cultural and economic differences, which differ from locality to locality in each national context...this is not just a low- and middle-income country feature, but also a high-income country feature.

Self-reflection is important in this regard, and a policy initiative without self-reflection is likely to be seen as saviourism, which seeks to shame rather than help, and any effort to act as saviour — especially when not invited to save — can then stoke resistance and hesitancy. Contextual understanding, on the other hand, is inclusive and therefore leads to better and diverse engagement, and that leads to more positive impact. So then, what is key? Inclusive research while listening. Listening allows for the effective mapping of complex political, social and cultural terrain. Inclusive action follows, involving all elements of society and politics at each distinct level.

Inclusive evaluation and commemoration are also key, so that lessons learned are recorded in the broadest possible way: not as the mythology of a few saviours doing all the good work, but as inclusive teams bringing about change that helped turn a corner during pandemics. So how efficient is this? ... Some policy actors may say that this is time consuming and expensive. I would argue that it's very efficient, because when you rush in with incorrect assumptions that are sometimes racist or exclusionary, time is wasted as actions may stoke violence and hesitancy, that then takes mountains of money and a lot of time to unpick.

Multilingualism is also key. Infodemics do not occur in UN languages and this makes local sociopolitical alliances more important. And this needs political engagement as many countries have multiple languages."

Intervention 3

Rev. Dr Dorcas Chebet Juma. Minister of the Reformed Church of East Africa, Kenya; Senior Lecturer, Department of Philosophy and Religious Studies, School of Humanities and Social Sciences, Pwani University. Rev. Dorcas is active on TikTok with over 60,000 followers, and active in providing accurate information to young people in Africa on COVID-19 and other issues.

Question: Reflecting on the social drivers of pandemic risk, please could you provide some reflections from your perspective of how digital connectivity and exposure to misinformation through social media influence/play out as drivers of pandemic risk, and perhaps how they influence one another?

"Social media can be very influential"

"Many content creators are developing content to trend and one of the things that trends very fast is information that creates fear. During the pandemic, influencers created short clips and people were told not to accept the vaccines. As a result, many people feared to take the vaccine. We then influenced people to develop video clips that show that you can be vaccinated, and live. During COVID-19, even those who did not have phones took part: you would find several people looking at one phone and asking one another 'What are they saying?' They are not relying on WHO to give information, so they can read it on the internet, but are watching a clip. We need to understand who these social media influencers are and what they are saying if they have created a clip that gives information about an outbreak of a disease.

Currently, mpox is scaring people and there is a lot of misinformation about it. An influencer can get a photo of somebody who looks very serious and share it — a clip that creates fear and touches on religion, touches on values, spreads and trends very fast.

One of the things that can control the misinformation is allowing people who are informed and given the correct information to participate in countering the narratives that influence others in ways that contribute to spreading the virus. People who are informed and trusted can be partners in countering misinformation. Religious leaders can use different methods to spread accurate information: they can use sermons, they can work through the youth in the church or in the mosque. They can ask traditional leaders to create clips that will trend very fast and inform people, because you will see people asking 'What have they said, and who are they asking?' People are asking for information from social influencers."

Intervention 4

Dr Steven Ndugwa Kabwama. Epidemiologist and Research Associate, Department of Community Health and Behavioural Science, School of Public Health, Makerere University, Uganda

Question: Steven, reflecting on the social and political drivers of pandemic risk, please could you provide some reflections from your perspective of how the issues of public trust in government and social inequity influence/play out as drivers of pandemic risk, and perhaps how they influence one another?

"The relationship of public trust between citizens and government is not static"

"Trust is important, because it determines how well the public will adhere to any measures that are put in place to respond to an emergency. Where trust is low, people will come up with alternative explanations and conspiracy theories, and uptake of health interventions will be low.

Regarding social inequity and pandemic risk, it is important to recognize vulnerable groups and provide practical aid such as food and cash. Careful definition of the group is important, because if the intention is good but the execution inadequate, people feel left out. It [trust] changes, for example, at the start of the COVID pandemic in Uganda there were very high levels of trust. The public was very positive about how government could respond. But over time, whilst the government did well to respond initially, trust was lost as public expectations were not met. To build trust the government needs to be seen to suffer together with the public and to lead by example. For example, if we are putting in place restrictions on the public, then the leadership should follow them; for example, wearing masks and not hosting gatherings."

Intervention 5

Dr Christy Adeola Braham. Workers' Health Coordinator, Social Protection Programme, Senior Atlantic Fellow for Health Equity, Women in Informal Employment: Globalizing and Organizing (WIEGO), UK

Question: Reflecting on the social and economic pillars of pandemic risk, please could you provide some reflections regarding how issues related to economic inequality and social inequity influence/play out as drivers of pandemic risk, and perhaps how they influence each other?

"Many workers are excluded from almost all health and safety, legal frameworks and provisions that may exist. They are made to be extremely vulnerable."

"When it comes to income inequality, there is no starker axis than that of class and employment. Income inequality within countries determines access to health prevention, promotion and treatment resources (and access to health care more generally) to address the risks of exposure to pandemics.

When we talk about informal employment we're talking about workers such as street vendors, domestic workers, waste pickers, etc., who work without any social protection. So, for example, if they get sick or injured, there's no protection for their incomes. This is a problem if you want to control the spread of a disease. If there are no social protection measures in place, many workers are excluded from almost all health and safety, legal frameworks and provisions that may exist. They are made to be extremely vulnerable.

It's not simply income inequality, but it's also wealth inequality. We know that, for example, countries with the lowest GDPs are also the same countries with a history of colonialism, and these same countries are those that have the highest rates of informality. For example, in Africa and South Asia, perhaps with the exception of some countries in Southern Africa, there are rates of informality of 90%, and these countries have less access to the tools to fight against pandemics. And as we saw during COVID, a failure to address that issue further entrenched this wealth inequality, and widened it. This is something that really needs to be addressed.

Both income inequality and wealth inequality do have a lot of serious implications when it comes to intersectionality. We know, for example, that women and gender minorities are concentrated in the lowest paid, most vulnerable forms of employment. Certain racial groups and caste groups are also concentrated in these forms of [informal] employment, and we also know, for example, that older workers, and workers with disabilities or chronic health conditions, are also engaged in informal employment, and bear all of these added risks to their health and to their economic well-being."

Links provided by Dr Christy Adeola Braham:

Informal jobs bear the brunt of acute risks to their health precisely because of the unprotected, hyper-exploited nature of their jobs - including exposure to COVID-19, mpox and other pandemic outbreaks. Worse still, exposure to such risks also poses acute risks to workers' already precarious livelihoods — condemning many to a vicious cycle of poverty, precarity and poor health outcomes.

During COVID-19, workers in informal employment experienced loss of income due to state pandemic prevention measures being implemented without any social protections given to workers, job losses after becoming sick from COVID-19 — as well as heightened stigma and discrimination from the state, employers and the general public, who associate 'dirty jobs' with infection risk/prevalence.

Failure to address pandemic risks in poorer countries further entrenches poverty and widens wealth inequality.

Many workers in informal employment have played important roles in combating pandemic risk, despite being especially vulnerable to pandemic risks.

Intervention 6

Professor Rory O'Neill. Labour writer; Health, safety and labour standards adviser to the International Trade Union Confederation; Professor specializing in occupational health and social justice, Department of Law, Queen Mary University of London, UK

Question: Reflecting on the social and economic pillars of pandemic risk, please could you provide some reflections regarding how issues related to social programmes play out as drivers of pandemic risk?

"Without employment/income and social protections for all workers, there is no effective protective system."

"The labour constituency engaged with WHO in the early stages of the COVID-19 pandemic, however institutional torpor in the World Health Organization, which is governed by health ministries, made it difficult to translate the engagement into action. In the Pandemic Accord negotiations, language was brought forward by the International Labour Organization in consultation with employers and with trade unions, however very little was accepted in the first round of negotiation or first year of negotiations of the Pandemic Accord.

The emphasis on occupational safety, and health just being an issue of health and care, has been a recurring theme, when…in many pandemic situations, it will be health and care workers who are probably the best protected. It is recognized that the people most likely to be affected in the workplace often have the least access to protections like sick pay or furlough. Low pay and a lack of job security mean these workers are not in a position to take sick or isolation leave, and were vulnerable to dismissal or victimization. They certainly had little scope to exercise their right to refuse work that presented a serious and imminent risk to health without undue consequences (ILO Convention 155 articles 13 and 19).

Most countries failed to recognise COVID-19 as an occupational disease, or limited that recognition to health and care workers. Only a minority of workers have access to occupational health services. WHO should be emphasizing the necessity to have universal health cover, because the thing that stops the pandemic is having care before the pandemic.

Where improvements to sickness and benefit payment rules were introduced, these were frequently temporary, meaning the protections necessary to reduce the impact of future pandemic risks were compromised. In addition, the knowledge of the workplace sector was not adequately included: for example, it was known that home care workers were travelling from home to home, working for different employers, posing risk of transmission. This observance was not accounted for. WHO [COVID-19] guidelines did not reflect the views of labour experts and did not account for appropriate physical distancing guidelines in response to the risk of airborne transmission. A precautionary approach would have saved thousands of workers' lives.

There was a clear protective union effect when it came to COVID-19, which has also been demonstrated for injuries and other occupational diseases. However, many governments weakened or ignored existing labour protections. Unions can help recognise and implement preventive opportunities.

Conclusion: WHO cannot advise on occupational health and safety issues alone, including groups at risk, the nature of that risk and the measures necessary to protect them. WHO can work with the knowledge and systems of the UN tripartite process on occupational health and safety, operating under the auspices of the International Labour Organisation. Fundamental labour principles and rights at work should be part of WHO's preventive narrative."

DISCUSSION POINTS

Richard Heron

"I'm an occupational physician by training. I've looked after health in several large organizations... What short- and long-term incentives have caused stakeholders, actors to actually do something? If governments and stakeholders have switched off on actions to prepare for the next pandemic, what causes them to act? What's worked? Answering those questions would help to develop a report that drives actions."

Sanjoy Bhattacharya

"... What has, I think, worked in the past is when the [WHO] headquarters, the regional offices, and the country offices have worked together in conjunction during crises — because each commands networks of information, but also networks of dissemination communication...Making sure that the different bits of the World Health Organization come into action in concert, ensuring that their actors allow multiplicity of voices to be heard, as not all voices have to agree or say the same thing. That is the crucial bit to encounter, as in epidemics we need to be aware of a diversity of voices... our teams have to be diverse as well with multiple skills... And unless we think complexly and are prepared to act in complex ways, I don't think we're going to succeed."

Shahid Jameel

"...The real power in countries lies not in the Ministries of Health, but in the Ministries of Finance... You know how much loss happened during Covid? And how much would it cost to prevent something like that? The world listens to numbers, dollar figures."

Jimmy Obuya, Religions for Peace

"My question follows from some research we have conducted looking at the barriers and drivers of COVID-19, particularly looking for links to religious communities. What we found out is the importance of close, low-level community networks or action groups that involve everybody in that community. For example, somebody is a farmer and is in a farmers' group. At the same time, they are a teacher, and at the same time they maybe work in the security sector. So how do we make sure that within these groups we don't flood them with too much information?

We realized that for us the religious community was able to work with this and be invited to explain vaccination and immunization. By using scriptural teachings and sermons for example, it was easy for me to communicate that. These influencer groups in the community are important brokers. But how do we moderate the kind of information we give them, so that they don't start seeing themselves as experts, and maybe go to the other end and start giving this information; or they become too overwhelmed by the kind of demand that they're getting every now and then, even before they understand that. How do you break the information down and present it in very simple terms, but not make it so complex that we lose again these influencers?"

Dr Manoj Kurian, Commission for Health & Healing, World Council of Churches

"This lack of solidarity is appalling. Maybe the framework should also measure solidarity, seeing the world as one place. COVID went on and on with lack of available vaccines and their uptake, it created new strains, and the same thing is happening with mpox, I mean hardly 200,000 doses available, do you know? And do you expect the virus to stand still? I think in spite of all the complexity from the faith perspective, it's also very simple and simply the lack of solidarity. We should be able to see how we can see the other as part of us. And this is the existential question for us."

Vuyelwa Sidile-Chitimbire, Executive Director, Zimbabwe Association of Church Related Hospitals

"I support 135 institutions throughout the country...We realize that in most countries, even though there was support from partners, some commodities expired or did not reach the people, with issues to do with corruption. So how, then, do we guard against corruption moving forward, so that at least the resources actually reach the intended beneficiaries?...I can add issues to do with conflict countries where there's conflict and where there's need for support to people with the virus, conditions like the elderly, and those with disability during these pandemics, and how we can reach them, because these are some of the gaps which have experienced in the past pandemics where people were not attended to, and also they suffer the worst."

Janice Tsang, Medical Oncologist; Co-convenor, Anglican Health and Community Network; Commission for Health & Healing, World Council of Churches

"... We know how to prepare for the next pandemic or next mental catastrophe globally. But the issue is trust across all groups and disciplines, across continents, and matching size with affordability is always an issue for all kinds of chronic illnesses, from cancers, cardiovascular diseases to mental illnesses as well.

I think the issue is whether, as a faith-based community, we could put more resources and share our knowledge. There are gaps in terms of equal access to knowledge and public health education. Maybe we can do a bit more around primary prevention and calling faith leaders to put the health of everybody — body, mind, and spirit — on top of their priorities, because if you look at the teaching of the Christian faith, the body is a temple, from above. So maybe we can be a bit more proactive rather than just be responsive."

Doug Fountain, Executive Director, Christian Connections for International Health

"Are we ready? You know... Are we really ready? So, for example: Do I know who to call when I need to have the information? Do I know who to call when I have information that I want to get out there? Do I have the mechanisms to be able to share updated information about, maybe, vaccines that come along? Do I have all of those specific things readily at hand?

I recognize that in this complex world, people are not actively seeking credible health information. We're dealing with a globe of people that are not active or proactive. They are health consumers, and in many ways, passive about seeking good quality, health information... And that's where faith communities can really play a part. I hope to see more dialogues with religious leaders, national and global dialogues. I hope to see more low literacy tools created to make it easier for people to have complex conversations about pandemics... Taking that complex information and making it very real is a fundamental thing. And we can be investing in that at global levels right now. I hope to see more of that."

Sanjoy Bhattacharya

"...Governance is not monolithic...I think we have to remember that as we try to work as a global alliance that is trying to create support of local alliances that strengthen a specific goal...one of the biggest enemies, in effect, of global health is generalization. Because it is human to generalize sometimes, you know, when you're in a rush. But I think self-reflection there is key, especially when you're going into a different context. But effective listening is only possible once I've identified allies in challenging contexts who are willing to speak plainly once they trust you enough to speak plainly."

Guy Mbayo, Technical professional advisor for water sanitation and hygiene, African region, WHO

"...challenges as professionals we have, with the issue of funding, at the time of relative peace to engage on some interventions that could be built on to ensure a better preparedness.... We see sometimes in some operations it's very hard to convince to have a prepositioning of waste supplies at a time where we know in Africa... for instance, more than 20% of diseases that can turn into an epidemic are environmental related. If our governments could invest adequately and follow through their plans and avail better infrastructure for all there will be some outbreaks that could be better and swiftly handled as measure of preparedness."

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About the GPMB

The Global Preparedness Monitoring Board (GPMB) is an independent monitoring and accountability body to ensure preparedness for global health crises. Co-convened by the World Health Organization (WHO) and the World Bank Group, the GPMB comprises globally recognized leaders and experts from a wide range of sectors, including health, animal health, environment, human rights, economics, law, gender, and development. The GPMB is tasked with providing an independent and comprehensive appraisal for policy-makers and the world about progress towards increased preparedness and response capacity for disease outbreaks and other emergencies with health consequences. In short, the work of the GPMB is to chart a roadmap for a safer world.

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