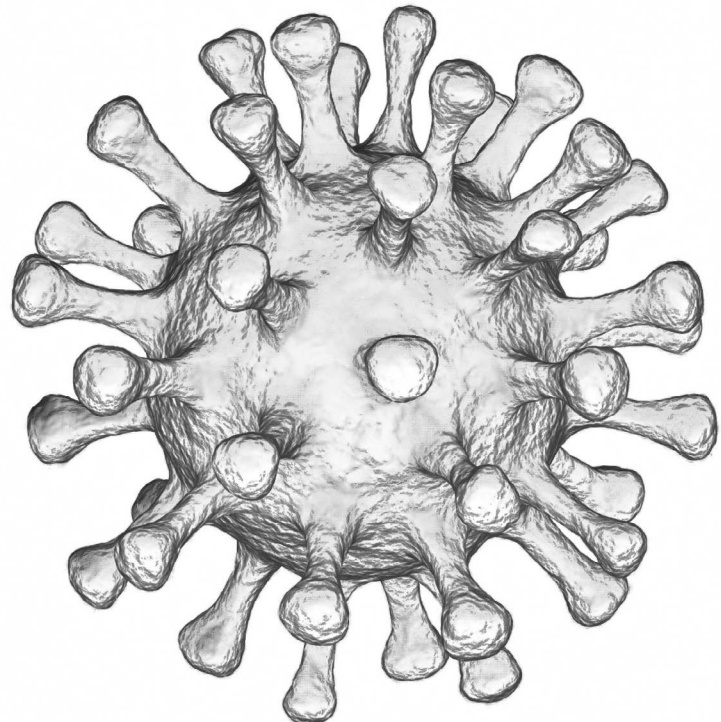# Resilience in and beyond COVID-19: Why this is a development, technology and innovation policy matter

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STEaPP Working Paper Series

Research Project Team Members and Report Authors:
Fernando García Albero, Anisha Gooneratne, Katrina Barker, Riedwaan Fakier,
Sanni Lehtonen, Lukman Oesman, Julius Mugwagwa, Yacob Mulugetta
and Shirah Zirabamuzale Mansaray, University College London,
Department of Science, Technology Engineering and Public Policy

The authors of the paper are part of a group of postgraduate alumni and staff from
the Department of Science, Technology, Engineering and Public Policy and the
Institute for Innovation and Public Purpose at University College London. The lead
authors are Fernando García Albero and Anisha Gooneratne, alumni from UCL
who undertook a Masters of Public Administration in Development, Technology
and Innovation Policy at the Department of Science, Technology, Engineering and
Public Policy (UCL). Albero and Gooneratne are currently working as researchers
at the nexus of development and technology policy.

Any questions or feedback about the content of this report is welcome and can be
addressed to its authors, who can be reached at the following e-mail addresses:

Fernando García Albero – fernando.albero.20@ucl.ac.uk

Anisha Gooneratne – anisha.gooneratne.20@ucl.ac.uk

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STEaPP Working Paper Series

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Abstract

The COVID-19 global health pandemic has exposed many vulnerabilities inherent in our societies. One of these has been the inability of many governments to effectively respond to the unfolding humanitarian emergency. The ramifications of this and other omissions have been profound and have disproportionately affected the most vulnerable collectives in society, which have become exposed to a higher risk of disease and loss of livelihoods. When looking ahead and planning for the future, it is essential that our existing decision-making systems are strengthened, building in resilience systemically to tackle future emergencies of a similar scale. Through a collection of case studies, this paper explores the view that technology and innovation can play a key role in building resilience in our existing systems and are necessary to catalyse transformative changes which foster development, thereby working towards securing the livelihoods of those most vulnerable in society.

Introduction

The COVID-19 pandemic has disrupted global health systems, often leaving those most vulnerable in society exposed to a higher risk of loss of livelihoods. This impact has been felt across the Global North and Global South alike, albeit in varying degrees of severity. Despite having access to a higher volume of resources, developed countries have nonetheless faced difficulties in responding effectively to the pandemic. Countries in the Global North such as the United Kingdom and the United States of America, both of which had previously been ranked as global leaders in the Global Health Security Index (2019), still struggled to contain the spread of the disease, despite reporting the existence of robust preparedness systems. For example, even though the United Kingdom has developed reports detailing local pandemic preparedness since 2007, the country was still unable to respond to the pandemic effectively and efficiently. This was demonstrated by the repeated shortages in personal protective equipment, ventilators and other essential medical supplies (Mellish et al., 2020). The experiences of leading countries in the Global North are an indication that there were other factors at play that affected agile and effective responses to COVID-19.

It is precisely these factors that this paper aims to explore. In order to understand why and how our seemingly resilient systems failed, it is important to understand what factors could have played a role in better managing the pandemic and its impacts on citizens. Once this question has been answered, one can then begin to consider what can be done in the future to ensure that more resilient systems are in place to protect citizens, especially those most vulnerable in society. This research question is even more pertinent in the developing context, where, if countries want to emerge from the pandemic with a form of resilience that is equitable and accessible to

all, it is essential to understand the underlying drivers that could help achieve this. Through the analysis of six case studies, the authors of this paper have been able to identify a key thread emerging, which encapsulates the importance of technology and innovation in resilience and future preparedness. Innovation and technology can take many forms. As exemplified through the case studies, whilst their presence might not always be explicit, the capabilities they build can allow for greater flexibility and adaptability in the face of emergencies and better preparedness.

As the case studies will illustrate, the key narratives that have emerged during the COVID-19 pandemic can be categorised into two broad areas. The first highlights the need to embed, or better embed, technology and innovation in our decision-making and development systems. As seen during the outbreak of COVID-19, legacy structures and frameworks struggled to adapt to the rapidly changing needs of the emergency (Kreienkamp & Pegram, 2021). The lack of innovation- and technology-embeddedness in these traditional systems made the delivery of essential services, such as healthcare and education, lack a certain degree of agility, resulting in a breakdown of service provision (Mazzucato & Kattel, 2020). Similarly, as highlighted by Gao & Yu (2020), decision-making structures within these realms also suffered a similar outcome, often exacerbating existing inefficiencies.

The second narrative that emerged is the need for a new model that moves away from viewing innovation and society in silos, but rather as an interconnected and interdependent whole. Whilst legacy systems struggled without the ability to innovate, those that embraced innovation tended to thrive (Serbulova et al., 2020). Heightened paces of innovation during this time became observable across a wide range of geographical contexts, ranging from the creation of innovative models to tackle the pandemic to innovative healthcare solutions to prevent and reduce the severity of the virus. The impact that these innovations had on the wellbeing and overall resilience of society was likely significant. Equally relevant, however, is the role that society played in driving these innovations. The societal needs that arose during this time drove innovative behaviour into both public and private realms. This represents an important lesson towards future preparedness: in order to build resilience into our systems, it is essential that innovation and society be observed as an interdependent unit, influencing each other's behaviour. This, in turn, helps build agility and resilience into our systems, resulting in better responsiveness in the face of adversity.

These two narratives spill over to all other sectors, including the private sphere and the public sphere. Particularly relevant is the latter, where the inclusion of innovation and technology does not only pose the benefit of having a transformative impact, but also helps build resilience into systems that have often been viewed as rigid and regressive. Thus, in order to drive development, it is essential that public policy embraces the role of technology and innovation and the compounded benefits they can bring. The following conceptual framework exemplifies a way of exploring these narratives.
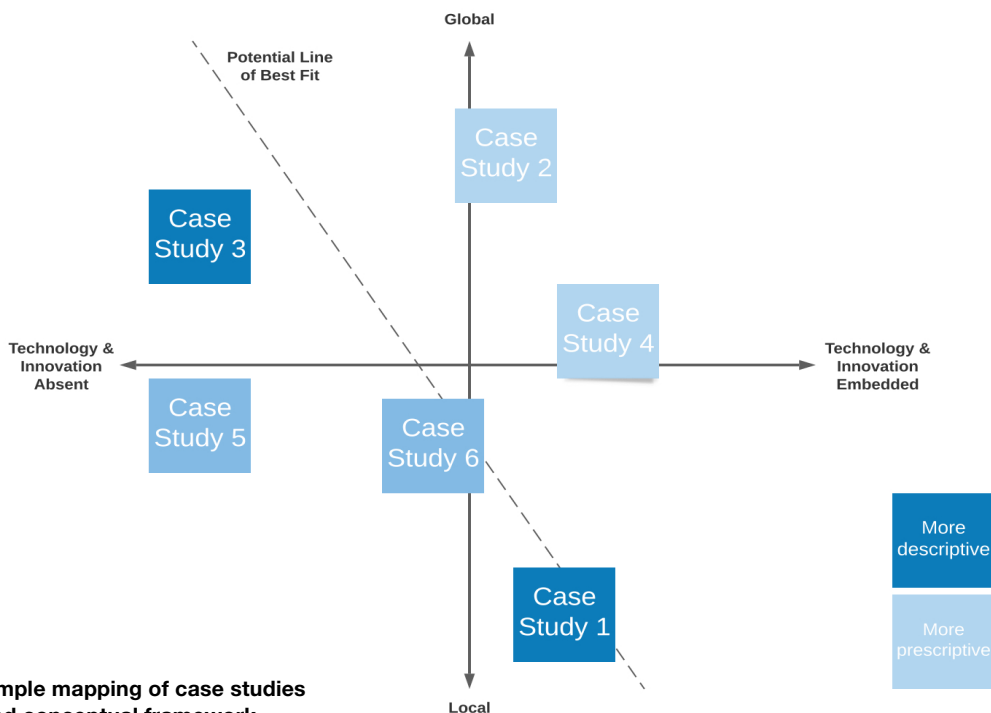
Methodology

The extremely diverse set of phenomena that the COVID-19 pandemic has precipitated inherently calls for a methodological approach that is equipped to deal with both contextual range and conceptual complexity. To accommodate for this, a series of case studies were selected to represent a small sample of the plethora of effects COVID-19 has had on our societies. The authors independently conducted research on a policy realm which they deemed to specifically demonstrate a range of COVID-19 impacts. This methodology was selected precisely because of its ability to show a wide variety of pandemic-induced policy challenges and, potentially, solutions. The resulting case studies, indeed, not only provide a significantly diverse set of these policy challenges, but they also exhibit the different impacts of the pandemic, in terms of varying form, severity and uniqueness.

However, and in line with the goal of this study to produce more generalisable learnings that could be applied across contexts, a conceptual framework was envisioned as an overarching mapping of these individual case studies. The framework initially plots the case studies along a vertical scale, from the global domain of COVID-19 to the local arena. This visualisation helps each individual case study illustrate how development, technology and innovation (DTIP) elements manifest differently across multiple levels of governance. This is particularly important, firstly, to be able to adequately portray the degree of context specificity typical of DTIP, and, secondly, to bring forward the narratives that materialise only when DTIP is looked at in a cross-sectoral manner. This is further evidenced by the second, horizontal dimension, which directly reflects how closely the first narrative is being realised in each of the case studies. The framework also attempts to differentiate the case studies in terms of whether they are descriptive or prescriptive in terms of policy learnings. This is done in an attempt to examine potential trends that could suggest whether certain contexts or levels of governance lend themselves more readily to ideating policy solutions. More importantly, however, this is done as an incentive to initiate greater discussion on the literature on how to think of humanitarian emergencies in DTIP terms, and what learnings can emerge from it. A sample framework is illustrated in Figure 1.

Figure 1: Sample mapping of case studies into proposed conceptual framework

The development and use of this conceptual framework alongside the individual case studies was specifically meant to help establish a methodology that could facilitate the extraction of information from the latter. The case studies, by themselves, as the following pages demonstrate, contain ample information and insights that are highly context-specific. The conceptual framework is a necessary methodological tool to amalgamate the learnings from each case study into a comprehensive body of knowledge from which trends and generalisation can be made. In addition, the choice of axis within this framework, namely level of governance and technological embeddedness, are also geared towards exploring the information contained within the case studies in a way that readies it for application in other contexts. In other words, this two-step methodological approach is particularly apt for both the comprehensive exploration of a thematically broad phenomenon and for its analysis in ways that lend to cross-boundary learnings. In doing so, this methodology could be said to be highly salient and effective for the purposes of answering the established research question.

Case Studies

1 The urgent need to strengthen higher education institutions in the least-developed countries for pandemic response and post-pandemic recovery

The year 2021 marks fifty years since the establishment of the Least Developed Countries (LDC) category by the UN General Assembly in 1971. Since then, the number of LDCs have continuously grown from 25 in 1971 to 52 in 1991, and out of these 52 states, only six managed to graduate from the category (UNCTAD, 2021). Unfortunately, the long process of understanding the need for special support measures for these countries has since brought very limited progress. Even though the GDP of LDC's today has grown five times, its shares remain only one per cent of the global GDP or at the same level in 1971 (UNCTAD, 2021). The United Nations Conference on Trade and Development (UNCTAD) even highlighted that LDCs today continue to be marginalised in international trade and experienced frequent growth collapse[1]. These conditions were the case even prior to the COVID-19 pandemic.

One particular reason that continues to marginalise the LDCs from the international trade and supply chain is their lack of technological capabilities that hinder their ability to adapt to the global value chains disruptions that are currently taking place (Committee for Development Policy, UN, 2021). Therefore, the importance of expanding the technological capabilities has been far greater in the context of LDCs development in the post-pandemic world, and higher education's role in this regard is very important. However, COVID-19 has further hampered the already limited capability of higher education institutions in the LDCs to be a catalyst of innovation in their country.

The issue is critical considering higher education institutions' role as the backbone of a country's innovation capabilities to support development (The World Bank, 2017). Not just in preparing a skilled workforce, but also in supporting technology adoption and innovation through the university's research capability. Higher education holds the key to many elements that impact the ability of LDCs to face the pandemic and prepare a post-pandemic recovery process. The report by the United Nations (Committee for Development Policy, UN, 2021) on the Impact of COVID-19 on the Least Developed Country Category concluded that there is an urgent need to support more spending on science, technology, and innovation for LDCs post-pandemic recovery plan. Unfortunately, the report did not specify areas that need to be prioritised to strengthen the key institutions like universities.

The idea of strengthening higher education institutions in LDCs has often been neglected for so long, even before the pandemic, stretching back to the establishment of the LDC category itself in 1971. From fifteen LDCs indicators (See Table 1) recognised by the United Nations in 2021, none of the criteria focuses on higher education. Instead, indicators on education are mostly focusing on primary and secondary education. While it is arguably understood that the level of qualified input to tertiary education might still be very small in the LDCs – and therefore greater focus should be put on primary and secondary education – the limited capability of higher education institutions to improve their linkages with secondary education institutions has also contributed to the lack of admission to higher education institutions (World Bank, 2017).

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[1] According to UNCTAD, The Least Developed Countries Report 2021, LDCs stand out for having experienced more frequent instances of growth collapses than other groups of countries: between 1971 and 2019, collapses represented 16% of the total country-year observations in the case of LDCs, as compared with 10% for other developing countries, and just 2% for developed countries (UNCTAD, 2021)

Table 1: Criteria for the least developed countries by the United Nations

GNI per capita **Human assets index (HAI)**
• Under-five mortality rate • Prevalence of stunting • Maternal mortality ratio • Gross secondary school enrolment ratio • Adult literacy rate • Gender parity index of gross secondary school enrolment
Economic and environmental vulnerability index (EVI)
• Remoteness and land-lockedness • Merchandise export concentration • Share of agriculture, forestry and fishing in GDP • Instability of exports of goods and services • Share of population in low elevated coastal zones • Share of population living in drylands • Victims of disasters • Instability of agricultural production

Source: (United Nations Department of Economic and Social Affairs, 2021)

Today, the COVID-19 pandemic has exposed higher education in LDCs to an even more challenging situation, to improve their teaching and research capability. A problem that was present even before the pandemic; the disparity of research grants in higher education in LDCs remains limited. For instance, in the health sector, the 10/90 phenomenon[2] continues to be the relevant case for LDCs, especially in a region like Sub-Saharan African where weak institutional infrastructures and the absence of a viable research community has led to an inadequate research capacity (Chan et al., 2006). The state's capability in supporting higher education institutions is also minimal due to their limited financial capacity. On average, LDCs only invested 0.23 per cent of their gross domestic product in research and development in 2016, significantly below the world average of

1.86 per cent (McKie et al., 2020). Furthermore, poor research capabilities have made higher education institutions in LDCs to be heavily dependent on external partners on an ongoing basis.

Now, the pandemic has further worsened already limited financial capabilities of states to fund development in their countries. The hope for these institutions to improve their research capabilities remains uncertain. The situation is exacerbated by major donors' decision to cut their development funding as part of their economic recovery process, which includes the United Kingdom. Therefore, the importance of improving the research capacity of LDCs has become more important than ever. It holds the key not just to the recovery, but also to ensuring these countries are resilient in facing future challenges.

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2   10/90 phenomenon refers to how just 10% of the world's health research and development expenditure is used to conduct research into 90% of the world's health problems.

2 Vaccine nationalism: Symptom or disease?

With five vaccine candidates having received the World Health Organization's (WHO) approval for emergency use under the COVAX programme (World Health Organization, 2021a), it would be reasonable to assume that the biggest hurdle to overcoming the pandemic, namely producing safe, effective vaccines, has been overcome. Yet, in the face of global shortages, speculative purchases for domestic distribution have trumped global vaccination efforts (Katz et al., 2021), causing low-resource countries to be systemically deprived of the therapeutics to drive their own immunisation efforts. This worrying trend of vaccine nationalism has been augured not just as a failure of international diplomacy and cooperation, but also as exemplary of our repeated short-sighted attempts at dealing with global health emergencies (Chohan, 2021). This is because a state-centred response towards healthcare provision and vaccine distribution, as evidenced by the ongoing pandemic, is perfectly unsuitable towards catalysing collective immunity and, thereby, resisting and overcoming the pandemic. Like the President of the European Commission noted, "none of us will be safe until everyone is safe" (Ghebreyesus & Von Der Leyen, 2020).

Yet, while vaccine nationalism is often portrayed as responsible for our inability to pool resources towards fighting the pandemic, the question must be asked of whether this attitude is the actual cause of our fallacious strategy, or a symptom of it. The persistence of the phenomenon would point towards the latter and, in particular, of our current flawed understanding of global health: for as long as low-resource countries rely on global value chains that operate under conditions that inherently bias against them, these countries will remain exposed to systemic health vulnerabilities. Yet, when we extend development scholars' understanding of resilience to global health, one may identify an opportunity for developing countries to focus on healthcare innovation by fostering endogenous capacity building. This process of diversification could assist low-resource countries make themselves "immune" to vaccine nationalism, chiefly by readying their domestic technology and innovation markets to assist and upgrade their healthcare infrastructures

and pharmaceutical manufacturing. And yet, even if vaccine nationalism were to be deemed an isolated occurrence, this reframing of global health will, in all likelihood, still help improve the healthcare systems of countries which are, even today, being excluded from the global narratives.

This is not to say, however, that simple investments in innovation and manufacturing would suffice in achieving meaningful improvements in the endogenous capacities of low and lower-middle income countries. Evidence suggests increases in investment need to be adequately accompanied by specific interventions that improve the interaction between research-oriented and productive agents in a specific context (Fonseca et al., 2021). The tools for this purpose can vary, and a context-specific approach might be best equipped at devising the most effective solutions. Yet, an important lesson remains. Rethinking global health is likely tightly intertwined with how we perceive and manage science, technology and innovation at a sub-national level, suggesting once again how significantly the current narratives might need reframing to confront today's and tomorrow's humanitarian crises.

3 Digital exclusion in the arenas of health, education and food provision during COVID-19 and the need to factor innovation and technology capabilities into resilience building strategies for the future

In the wake of the COVID-19 pandemic, as governments imposed regional and nation-wide lockdowns in order to mitigate the spread of COVID-19, many essential services changed the method of delivering their services. The provision of health, education and food by both the public and private sector which predominantly relied on in-person interaction, were forced to shift to digital channels in many countries. Worldwide, education moved to remote learning, where many children, adolescents and adults had to use digital devices to access learning online (Daniel, 2020). In countries that had more advanced digital infrastructure, healthcare provision took place through tele-medicine facilities (Vidal-Alaball et al., 2020), and access to food was dependent on online grocery platforms (Alaimo et al., 2020). Whilst the pandemic highlighted our reliance

on digital technology to access the most essential of services, this sudden shift to online service provision disproportionately affected those who did not have access to digital devices and infrastructure to procure these services. Thus, in order to ensure more inclusive and equitable access to essential services in future emergencies, it is essential that innovation and technology capabilities are factored into resilience building strategies.

According to Aissaoui (2021a) the digital divide can be simply defined as the "divides of access and use of the internet," where citizens are unable to access the internet for a myriad of reasons that could include cost, infrastructure and skills, to name a few. Over the past few years, national dialogues reflected a narrative where digital divides were a thing of the past and no longer a reason for worry given the progressively increasing rates of digital literacy and digital access (Santos & Rosser, 2021). However, the COVID-19 pandemic proved otherwise, leaving many of those experiencing the digital divide unable to access essential services. Globally, in 2020, 3.6 billion people did not have access to the internet (Sepúlveda, 2020), and only one in five people in LDCs are able to use the internet, with less than 5% of the population in most developing countries using online to purchase goods and services (UNCTAD, 2020). These statistics highlight the magnitude of those being left behind, especially during a national crisis, when access to essential services is not only necessary but paramount.

This digital divide manifested in different ways across different policy arenas, in different developmental contexts. Worldwide, access to education was hampered with 1.6 billion children being out of school owing to national lockdowns and school closures (UNICEF, 2020). The corresponding shift to remote learning using digital tools meant that many could not access education as a result, with UNICEF (2020) identifying that 31% of children worldwide were unable to access remote learning due to lack of devices, infrastructure or misdirected policies.

In the Global South, access to food, was also hampered as a result of the digital divide. In Mexico, where information and services were disseminated online during the pandemic, fisherman often found that they did not know the latest guidelines under which they could fish for food (Lopez-Ercilla et al.,

2021). This, in turn, not only affected their access to food, but also disrupted the supply of food into the national economy. Additionally, as many local vendors started selling produce online, this excluded those that did not have access to the internet to be able to procure food without physical interaction (Lopez-Ercilla et al., 2021). Thus, the digital divide not only impacted access to food, but in some instances, also impacted the supply of food.

The digital divide is not only endemic to the Global South but was also experienced in more developed economies. For example, in the Global North where telemedicine is widely used, many were unable to access healthcare in a dire time of need. America is one such example where 21 million people lack access to broadband, which limits their access to telemedicine (Eruchalu et al., 2021; Federal Communications Commission, 2019). This is synonymous with findings by Ramsetty and Adams (2020) who identified internet availability as one of six key drivers of the digital divide in telemedicine. Thus, we see how the digital divide manifests globally, irrespective of policy arenas or development status, often leaving the most vulnerable at risk.

The digital divide has significantly disrupted the provision of essential services and poses the risk of many being left behind. Looking forward, it is essential that policy practitioners take into account the reliance on digital technology the pandemic has highlighted, and those that are excluded from it. In the short term, it is imperative to understand the underlying drivers of the digital divide which may not be uniform globally, and rather endemic to particular contexts, and build strategies to address these. In the long term, access to digital technologies and infrastructure needs to be factored as a key pillar of access to these essential policy arenas to ensure adequate future preparedness strategies. Alongside these, it is imperative that we keep looking at innovative ways to ensure no one is excluded. For example, in Nigeria, given that the internet penetration is only 42% (Kemp, 2021), the government was able to supplement this deficit by distributing educational content via national radios, allowing education provision to reach more children than it would have been able to through more modern means (Idowu Mary Mogaji, 2020). Their agility to be innovative, with existing technologies, enabled many more to access education, as a result.

The combination of technology and innovation can have a significant impact on how we address some of the inequalities that have evolved as a result of the pandemic. Thus, in order to transform the development agenda, it is essential that we integrated technology and innovation capabilities to build stronger and more resilient policy arenas, to be able to withstand future humanitarian crises.

4 Outcomes and opportunities of the mental health crisis during COVID-19: Accessibility and inclusive innovation in rural areas and LMICs

Mental health in a global crisis

COVID-19 is not only a threat to physical health but to mental health, too. The financial and social uncertainty, fear, and isolation the pandemic has brought upon many individuals' lives has increased psychological stress and mental health issues, such as anxiety, depression, PTSD, and suicidal ideation (Czeisler et al., 2020; Wu et al., 2021). Looking at the long-term psychological impacts of previous virus outbreaks, we can predict that the mental health issues caused by COVID-19 pandemic will arguably have lasting impacts on population health for years to come (Kamara et al., 2017; Lee et al., 2007).

It is necessary to note, however, that we were already going through a global mental health crisis pre-pandemic. Over 790 million people suffer from a mental illness – psychological stress related somatic illnesses are the leading cause of death and mental issues are the leading cause of disability globally (Dimsdale, 2008; Ritchie & Rosser, 2018; Whiteford et al., 2016). Despite the seriousness of mental health issues, they have often been neglected in budgeting for national healthcare and developing infrastructures. Access to mental healthcare is alarmingly poor – only about 20% of the world's population had access to mental health services pre-pandemic, low- and middle-income countries (LMICs) having the poorest access (Saxena et al., 2007). Lack of access to information, poorly crafted and implemented policy, scarcity of services and staff, lack of resources, and lack of local research are some of the major factors in decreasing the chance to receive treatment, and disproportionately affect LMICs. The pandemic will likely continue to have negative effects on individual mental health, but it has also brought these vulnerabilities of the system into the spotlight, and built capacity around accessibility, innovating more effective ways to make use of digital technology.

COVID-19 addressing systemic deficiencies in mental health services

The pressure COVID-19 has put on almost every nation to innovate both socially and technologically has the potential to lead to a systemic shift in the mental health sector, that has for a long time suffered from technological and institutional lock-in. Due to COVID-19 restrictions disrupting MHS provision, governments have been forced to take on novel methods for delivering treatment to clients, and the worldwide, sudden implementation of these technologies have presented us with a unique opportunity to get encompassing and contextually rich data on how successful these technologies are as means of treatment. The data gathered pre-pandemic was relatively small-scale and scattered, and this perceived lack of comprehensive evidence has been a major factor why the adaptation of the technology had been so sluggish (Lazuras & Dokou, 2016; Naslund et al., 2017). Thus, as seen from Figure 2, the data gathered from implementing these novel solutions during this COVID-crisis could be a breakthrough for MHSs to escape
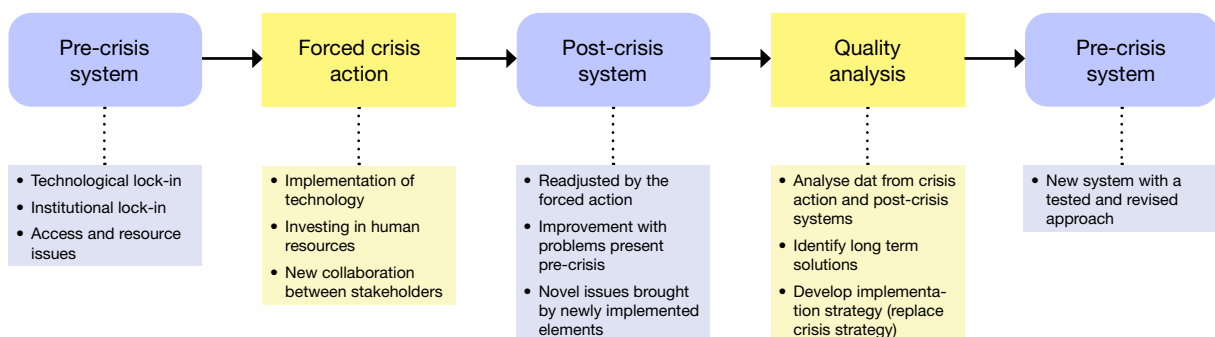

Figure 2: Innovation and development through crisis (Author, 2021).

the lock-ins they were in pre-pandemic. The results gathered during the pandemic have been promising; a study examining the transition to digital MHS found that online sessions did not affect the quality of care, patients showed significantly improved health and the sessions had fewer cancellations compared to traditional ones (Frank et al., 2021).

Perhaps the most momentous implication of use of virtual and remote solutions for treatment delivery the huge potential of increased accessibility to MHS. Especially people living in rural areas who previously were outside the scope of care, now have highly improved access to MHS via different technology solutions, such as a mobile-assisted help or tele-psychotherapy (Rodriguez-Villa et al., 2020). The measures LMICs have taken to tackle the MHS access issues brought by COVID-19 restrictions have largely been technological, from simple mobile-assisted helplines to using artificial intelligence to predict and detect psychological issues (Kola et al., 2021). Many of these developments have the potential to improve the quality of mental health services beyond the pandemic, by improving accessibility to information and treatment, and making training new staff more effective. Digital solutions are an attractive choice for mental health services, especially in LMICs, as they are scalable, cost-effective, have a wide reach, and do not necessarily require highly specialised staff. Digital solutions could also promote deinstitutionalisation of MHS and give more power to community-level solutions, as well as provide informative, preventive services that could increase agency over one's mental health and reduce stigmatisation in the community.

To ensure we can effectively continue implementing the digital technology for MHS beyond the pandemic, we must now invest in data gathering and examine the effectivity, benefits, and novel issues of the services. It is important we do comprehensive analysis that considers contextual differences, such as digital divide causing new and disparate access issues and inequalities, as some do not have access to a mobile-device or internet. Successful implementation of the digital MHS would examine the unique questions in every specific context, such as cultural perspectives on how mental illness is viewed and expressed, mental health literacy, and access to technology.

5 Patient-centric mental health architecture

Mental illnesses are increasingly recognised as a leading cause of disability worldwide, yet many countries have outdated mental health policy and physical infrastructures. The COVID-19 pandemic has disrupted and, in some cases, halted critical mental health services in 93% of countries worldwide (World Health Organisation, 2020c). Yet the demand for mental health services is increasing, as highlighted in the WHO survey and underscores the urgent need for increased funding, technological innovation and policy interventions that advance the role of the built environment and integrated capabilities in improving mental health for citizens.

Global costs associated with mental disorders are expected to rise to US$ 6.0 trillion by 2030, while depression alone affects 280 million people in all communities across the world and represents the third leading contributor to the global disease burden (GACD, 2021; World Health Organisation, 2021b). At the heart of effective treatments for people with mental health conditions are health delivery facilities and policies that underpin them, and their adequacy for the grown burden is the subject of much academic, policy and practice contestation. This case study wades into this arena by advocating for an integrated approach to the way mental health inpatient facilities are conceived and deployed. The proposed framework for this integrated approach is 'Sustainable and Responsible Innovation in Mental Health (SRIMH)' which affords an opportunity to investigate the feasibility and utility of healthcare policies and architectures that on one hand promote mental health through patient-centric designs and design inclusivity, and on the other through sustainable and thoughtful environmental design embedding regenerative and adaptive reuse/preservation strategies.

This framework recognises and further interrogates the interconnections, interfaces, relationships and dependencies of each component of the SRIMH framework. The different spatial elements underpinning sustainable, responsible and innovative architectural design in mental health treatment settings requires an integrated approach to advance resilient and patient-centric environments. Evidently, decision makers have an important role to play in

reimagining mental health architecture to ensure principles of sustainability, responsibility and inclusivity are integrated in both delivery models and holistic treatment plans.

Several holistic treatment models have been researched and reported on by academics in order to develop healthcare environments using a relationship-based philosophy (Stichler, 2008). For instance, founded in 1978, Planetree's mission was simple: "inspiring caregivers to make patients true partners in their care, meeting their human needs and improving outcomes" (Planetree International Inc, 2021). By placing an emphasis on personalising, demystifying, and humanising the patient experience, the organisation works closely with patients, family members, treatment staff and relevant stakeholders to "reclaim for patients the holistic, patient-centred focus that medicine arguably has lost". Furthermore, by distinctly involving patients in the design of healthcare environments and studying everything that touches the patient from their perspective, the organisation promotes inclusive design and innovation by using that insight to influence not the 'what' of healthcare (the medicine or the science), but the 'how' of healthcare (the spatial, design and patient-centred care model).

Consequently, healthcare environments should develop from processes of shared decision-making, design inclusivity, and patient-centred care. Similarly, the built environment surrounding mental health care inpatient facilities should reflect this holistic and integrated approach, acknowledging the importance of factors like patient access to natural environments, natural lighting, views of natural landscapes, transitional space between indoors and outdoors and garden-based interventions (Connellan et al., 2011; Douglas & Douglas, 2005; Hickman, 2009; Lawson et al., 2003; Ulrich et al., 2008).

Similarly, Shukor et al. (2012) recommends the provision of transitional space between indoors and outdoors, and shelter to allow use in different seasons, variety and choice including different seating types and sensory stimuli (Shukor et al.,

2012). Interestingly, garden-based interventions have proven therapeutic and beneficial to mental health patients and academics conducted a critical review of research evaluating gardening-based interventions in mental healthcare and found that all reviewed studies reported positive benefits of the interventions, which included significant reductions in symptoms of anxiety and depression (Clatworthy et al., 2013). Evidently, sensory elements, rooms and stimuli play an interesting role in creating soothing and supporting service user de-escalation (Champagne & Stromberg, 2004; Costa et al., 2006; Lloyd et al., 2014; S. Smith & Jones, 2014).

Therefore, with the above building design factors considered beneficial in treatment and palliative care of mental health patients, emphasis should be placed on frameworks and integrated approaches that advance these. Markedly, with an emphasis on sustainable, responsible and innovative methods to the design of mental health inpatient settings, the SRIMH approach could further promote this integration. In conclusion, this case study explores the need to reimagine mental health treatment settings and builds a case for patient-centred, sustainable and responsible innovation in mental health service delivery. However, there is a need for concerted efforts from academics, industry and policy makers to address the local and global burdens of mental illness as a result of COVID-19 as we continue to grapple with inadequate infrastructure, inefficient architecture and lack of sufficient data to advise on implementation efforts and inform policy direction. In the meantime, operational realities and tensions between the current infrastructure, architecture and the built environment continue to constrain sustainable mental health service delivery efforts. Equally, scarcity of resources, deep uncertainty around funding and effective treatment measures, political uncertainty and disjointed community care efforts must all be promptly addressed to combat the fragmented treatment and depletion of current mental health resources.

6 COVID-19 and Non-communicable Diseases (NCDs): The rise of technology and innovation to maintain vital health services

COVID-19 greatly impacted health systems globally, causing disruptions to vital services, including those dedicated to non-communicable diseases (NCDs). NCDs are chronic in nature, with timely diagnoses critical to improving prognosis and repeated interactions with health systems required during the course of care. Through a 2020 WHO study involving 155 countries, 94% reported that ministry of health officials working on NCDs had been either "partially or fully reassigned to support COVID-19" (World Health Organisation, 2020a), while approximately half of the countries reported disruptions to vital screening services and treatment for NCDs including hypertension, diabetes and cancer. Further, one in five countries reported discontinuation of services due to shortages of "medicines, diagnostics and other technologies" (World Health Organisation, 2020a). This is cause for concern, as NCDs already account for 70% of annual deaths worldwide and have been found to predispose individuals to more severe cases of COVID-19.

In order to drive forth rapid and sustainable solutions, countries have had to turn to innovation and technology such as telemedicine and m-health modalities to maintain vital care. Specific country examples include Thailand's development of infection control measures at hospital facilities to protect NCD patients, innovative ways to dispense medicines, and the introduction of a telemedicine initiative – the LINE application – for online consultations, prescriptions, and medicine distribution (World Health Organisation, 2020b), which involved collaboration between government, community volunteers, the private sector and the health sector. In Jordan, the Ministry of Health, University of Jordan and WHO Regional Office collaborated to collect data on patients and home delivery services to "create a digital record for people living with NCDs to facilitate future coordination" (WHO EMRO, 2021) and improve home delivery services for timely access to NCD medications. Rwanda expanded its use of drone technologies to deliver medicine for NCDs to hospitals and patients in remote locations, an initiative driven by partnership between the government, health sector and a US-based private sector robotics organisation, Zipline (The East African, 2020).

To develop, implement and scale these solutions, multi-sectoral collaborations have been critical. As indicated in the case studies above, different stakeholders – both within national and transnational boundaries – have worked in partnership towards solving major challenges around sustained and equitable access to vital health services, including those specific to NCDs during the COVID-19 pandemic. In many ways, the pandemic has necessitated the acceleration of health technologies and innovation in countries around the world. In preparation for subsequent – and inevitable – health crises, countries must invest in establishing national innovation systems which are governed by collective action and therefore are agile, efficient and adaptable to present and future circumstances.

Discussion

The pandemic has revealed many frailties and fault-lines in the development, technology and public policy agendas. As illustrated by our cases, development agendas and frameworks, while highly varied in form and function, are indeed pervasive in nature, affecting multiple dimensions within society and extending far beyond purely technological or healthcare arenas. In observing these variations, the case studies presented illustrate some of the common threads that highlight the strengths, weaknesses and opportunities of developmental agendas across different sociopolitical and policy contexts. By utilising the conceptual framework introduced earlier in the paper, these threads can be organised and structured in such a manner that key lessons may be inferred both within and across regulatory regimes. In doing so, these case studies not only bring specific contributions to their specific areas, but, more broadly, they also help contribute to our understanding of the interaction between development, technology and innovation during humanitarian crises. The narratives, or common threads, that will be highlighted in the forthcoming paragraphs will illustrate how different countries and communities may be lacking, and could develop, the necessary productive capacities for the requirements of different sectors and for dealing with the overlaps between sectors.

Common narratives

One of the most prevalent issues highlighted by the case studies involves the notion of disruption of essential services as a result of the pandemic. The specific mechanism in which a disruption may have occurred varies by context, yet they often involve disturbances to the global value chain that are not strictly under the domain of the service being delivered itself. The case study on digital exclusion illustrated this point by highlighting how subpar digital infrastructure, part of the larger digital divide phenomenon, had significant ramifications to the provision of education, among other services. The case studies on patient-centric mental health architecture and non-communicable diseases more narrowly focused on the interruption of continuity of care for patients suffering from chronic conditions. In all of these instances, one can observe a COVID-19-induced isolated event spilling over into other dimensions of society and causing cascading deleterious effects on the lived experiences of communities. Furthermore, and perhaps more importantly, in each of these events, the authors concur, technology and innovation systems could have either prevented the spillover or mitigated its effects. This shows the importance of having technological systems in place that both have the capacity to be scaled from the local to national or transboundary operations, and which can also integrate well across complementary arenas. Indeed, this phenomenon poses important questions in relation not just to what role technology and innovation have in development and resilience, but how specifically they are to be implemented such that they are available and accessible when and where they are needed. This is the argument echoed by the case study on outcomes and opportunities of mental health crises during COVID-19. This case study explains how COVID-19 has amplified pre-existing mental health issues and the systemic lack of accessibility of support services, a form of disruption to continuity of care. The case goes on to argue how this situation has exposed a very clear opportunity for using technology and innovation to build capacity around accessibility.

As such, these case studies could be said to collectively illustrate the importance of using technology and innovation as a means to mitigate for and adapt to some of the negative externalities that propagate from humanitarian crises. However, the case study on vaccine nationalism goes one step further to caution how the availability of technology, by itself, may be insufficient to achieve the desired resilience. This case argues how good technology may be incapable of helping build endogenous capacity if it is not adequately supported by sound distribution and regulatory frameworks. To resolve this, it is important to consider and build technology and innovation capacity at the local level, to build systemic resilience through endogenous flexibility and diversification. In other words, this case, and the others, present a narrative that calls for placement of technology and innovation, and their supporting policy systems, at the very centre of the development agenda. However, the narrative extends further to highlight the need to embed, or more closely link, technology and innovation into our societal decision-making and development systems. Only by doing this, we believe, can the benefits that technology and innovation confer be effectively reaped not just at a time of need, but also as part of a long-term process of development.

The case studies presented also take a look at the policy environment and attempt to understand the ways in which technology and innovation policy could be deployed sustainably to support development. As part of this examination, integration appears as a particularly prominent strategy to facilitate this process. The case study on patient-centric mental health architectures specifically proposes the integration of responsible innovation into the core of healthcare system architectures in order to achieve a sustainable solution to mental health service delivery. This perspective is further echoed in the case study on digital exclusion, which analyses the digital divide and suggests that the strong interlinkages between technology and innovation elements and the lived experiences of communities inherently entail the need to evaluate them in conjunction with each other. This proposal based on a unified assessment of technology and innovation as integral to society is further echoed in the case study on access to mental health services. This case reinforces the notion of the promising results that closer integration between these elements tends to advance in the collective wellbeing of society. Thus, it could be said that the case studies concur on a need for a new model that moves away from viewing innovation and society in silos, but instead as an interconnected and interdependent whole.

The reason and advantages for this narrative, however, are further explored in the case study on vaccine nationalism and the one on communicable and non-communicable diseases. The phenomenon of vaccine nationalism, in our view, is the result of a flawed policy making system and understanding of global health. This case study proposes that a collective assessment, one that views technology and innovation as integral not just to development, but to the wellbeing and resilience of a society, is the only effective way to tackle humanitarian crises of the scale and scope of COVID-19. The case study on communicable and non-communicable diseases reinforces this idea and adds that the integration of these realms should also be context-specific, so as to respond best to the needs of the local communities. In other words, according to the case studies, conceiving of technology, innovation and society as a single entity is beneficial for the purposes of building resilience into systems that have otherwise, during the pandemic, been viewed as rigid and unable to respond to the rapidly changing needs of society. Figure 3 is our visualisation of where we locate the case studies on the continua between local and global, and between conditions of technology and innovation being absent or in development agendas.
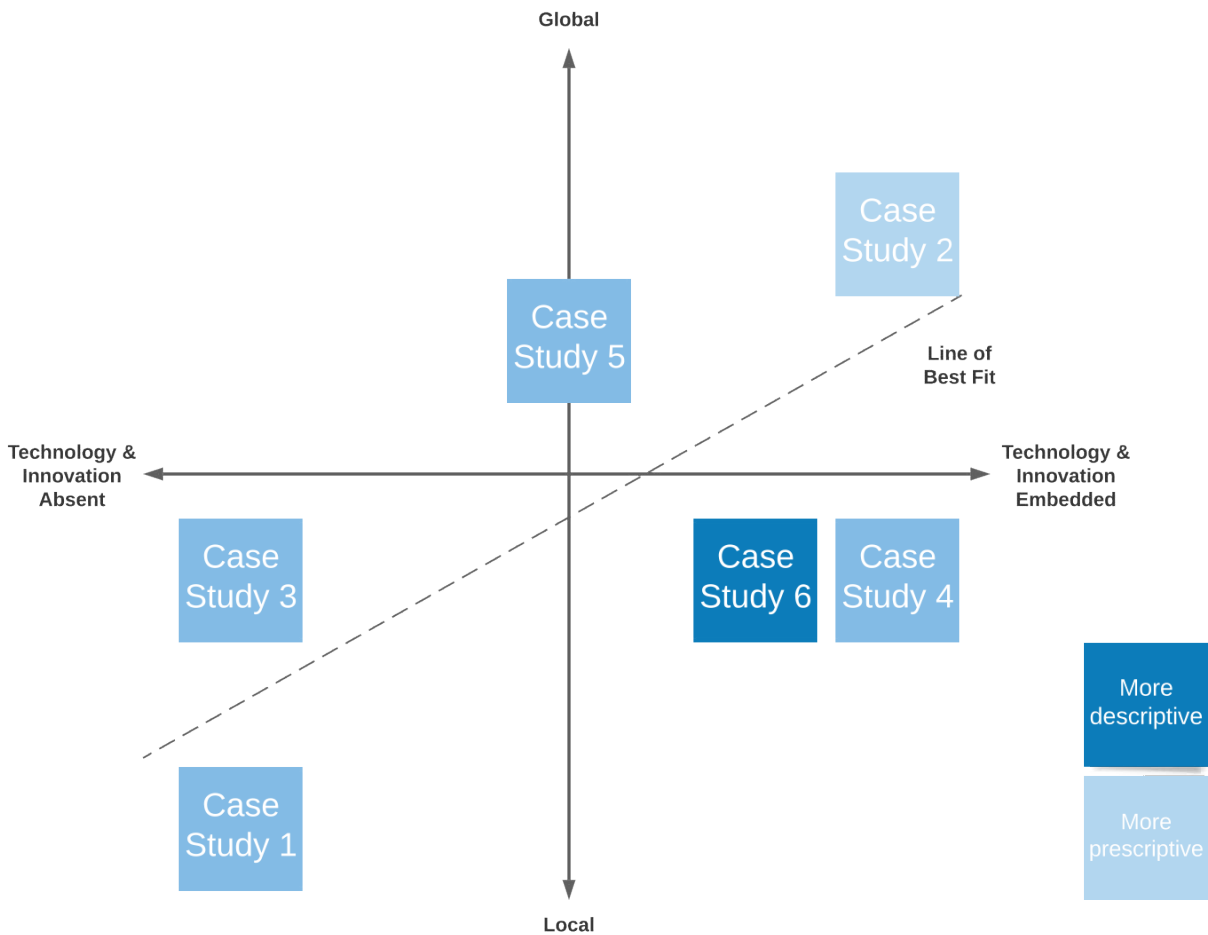
Figure 3: Mapping of case studies onto conceptual framework[3]

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3   **Case Study Key:**
   1.   The impact of COVID-19 on higher education institutions research capability in the least-developed countries.
   2.   Vaccine nationalism: Symptom or disease?
   3.   Digital exclusion in the arenas of health, education and food provision during COVID-19 and the need to factor innovation and technology capabilities into resil-ience building strategies for the future.
   4.   Outcomes and opportunities of the mental health crisis during COVID-19: Accessibility and inclusive innovation in rural areas and LMICs.
   5.   Patient-centric mental health architecture
   6.   COVID-19 and Non-Communicable Diseases (NCDs): The rise of technology and innovation to maintain vital health services.

Case study mapping

The narratives illustrated thus far converge in highlighting how development agendas and frameworks which take a palliative approach are not sufficient. There is a need to rethink and deploy development programmes from a structural transformation perspective, one that is capable of collectively assessing the relevant dimensions to produce systemic, albeit context-specific, changes which foster resilience and adaptability. However, understanding how to adopt that structural transformation perspective may prove a more challenging endeavour. For these purposes, the following sections will critically articulate our mapping of the case study into the conceptual framework. This is done in an attempt to not just illustrate how the different case studies fit into the aforementioned narratives, but also in the hope to identify any potential trends that might become visible when acquiring this perspective. Such trends, if any, could suggest whether certain contexts of levels of governance lend themselves more readily to ideating structural transformation in policy solutions. Overall, however, this mapping is carried out to incentivise greater discussion on the literature on how to think of humanitarian crises from the lens of the development, technology and innovation policy, and what learnings may emerge from it.

The mapping of the case studies along the dimensions of relevance in *Figure 3*, namely the level of governance and the presence of technology and innovation in the policy arena, reveals interesting information. Primarily, there seems to be a loose correlation between the level of governance and the level of technological embeddedness, such that case studies that explore more regional and global scenarios tend to be more technologically-ready. However, it is important to acknowledge the weakness of this potential correlation. The case studies included in this paper tackle a wide range of topics which, collectively, help achieve an initial understanding of the status of technology and innovation during humanitarian emergencies. However, this initial exploration is not necessarily comprehensive about the entire range of possible scenarios in which these discussions are relevant. Furthermore, with only six case studies included, the mapping should neither be perceived as representative of that same range

of scenarios. Nevertheless, the correlation observed may be sufficient to spark a debate around how development, technology and innovation policy elements manifest differently across multiple levels of governance. In particular, and as indicated in the case study on vaccine nationalism, the pandemic has revealed systemic imbalances in global technological and innovation-readiness, imbalances which have resulted in low- and lower-middle income countries being deprived of the therapeutics to drive their own immunisation efforts. This understanding seems to be echoed in the mapping of the case studies, as the health frameworks may have been more technologically-ready at a global scale. This could be evidenced by the transnational value chains specifically created for the production and distribution of COVID-19 vaccines, as this phenomenon is indicative of an at least partially functioning technology and innovation system on the global landscape (Brown & Bollyky, 2021). However, as the global healthcare value chain is systemically biased against low-resource countries, then the local technology and innovation systems must come into play to offset the imbalance. The case studies that explore these specific local scenarios, nevertheless, all seem to point towards the lack of the readiness of the domestic innovation systems. For most of them, as the digital exclusion and access to higher education cases point out, the potential for benefit that these systems could confer towards endogenous resilience is clear, and in some instances, as the access to mental health services highlights, the potential has already been proven.

The mapping of the case studies would, therefore, seem to suggest a constant yet ever-so-urgent need to rethink and readjust policy frameworks around technology and innovation to focus on structural transformation. In doing so, it is beneficial to understand 'policy' both as a general term to describe a formal decision or plan of action adopted by actor to achieve a particular goal, but also as 'public policy,' or a more specialised undertaking for formal decisions or plans of actions taken by or involving a state organisation (M. J. Smith & Richards, 2022). The pandemic has illustrated the tensions, as well as opportunities, in policy's location as a two-way street between

the government and the public – a sense-making framework for tools, direction, knowledge capabilities, linkages and incentives for action. The cases presented illuminate some of these tensions and opportunities, and their pervasive nature from the global to the local in different settings. This is specifically visualised in the mapping through the assessment of the degree of policy prescriptiveness of each of the case studies. All but one of the case studies could be said to be policy prescriptive, meaning that the authors, after identifying and analysing a technology and innovation policy challenge, have determined that certain policy solutions are already available and potentially worthy of executing. This should be understood as a positive trend in the context of COVID-19, as it appears to be symptomatic of a policy context that has already acknowledged the value of integrating technology and innovation into decision-making and policy structures. This is, indeed, one of the key narratives brought forward by the case studies, and which consolidates what is perceived to be a path forward. In other words, the tendency towards policy prescriptiveness is indicative of a general understanding and good reception of the role of policy as a means to purposing innovation systems into generating systemic resilience and communal wellbeing. Thus, while policymakers and other key stakeholders need to be deliberate in their approach to pursuing technology and innovation, this is not say that obstacles to implementation do not exist. On the contrary, these vary by context, and could involve significant departures from a country's policy trajectory, such by working with informal economies or establishing links with local or national innovation systems. Yet, and in order to uphold context-specificity, these obstacles have to be assessed in their respective environments for appropriate resolutions.

Overall, the case studies, in their conjunction, present a comprehensive understanding of the key narratives that have emerged during the COVID-19 pandemic: primarily, the need to embed technology and innovation into our decision-making and development systems, and the need to move to conceptualising innovation and society as party of interconnected whole. The mapping of these case studies onto the proposed conceptual framework has helped visualise the heightened need for innovation across a multitude of geographical contexts and levels of governance. These have ranged from the opportunities of creating innovative models to tackle to the pandemic to new avenues for innovative healthcare solutions to prevent and treat the disease. The studies have coalesced on the significant impact that these innovation systems, and the technologies that may be developed therein, have on the wellbeing and overall resilience of society. Equally relevant is the role that society played in driving these innovations, and the central role that policy takes in building the enabling framework for these solutions to evolve and develop. This represents an important lesson towards future preparedness: in order to build resilience into our systems, it is essential that innovation and society be observed as an interdependent unit, influencing each other's behaviour. This, in turn, helps build the agility and responsiveness essentially to adapt for current and future humanitarian emergencies in the developing context.

Conclusion

Thinking about science, technology and innovation and, in particular, the institutional arrangements, processes, and decisions to ensure that they benefit everyone in society is an extremely important endeavour. Yet, the pandemic has stress-tested the attainment of this goal (Hunt, 2010), presenting an opportunity for readjustment and optimisation. The pandemic presents an important, real-life backdrop for evaluating whether technology and innovation policies are ensuring that countries benefit from innovation and its by-products for economic growth, social development and structural transformation (Mmamoloko Kubayi-Ngubane, 2018).

The cases presented have raised the need for countries to have capabilities to tackle public health challenges from multiple angles, harnessing the wealth of expertise across disciplines from social sciences, humanities and law to engineering and physical sciences and the built environment, as well as biomedical sciences. By integrating and galvanising disciplines, sectors and actors within and beyond national boundaries, appropriately designed and resources development, technology and innovation policy agendas will encourage innovative perspectives in research, education, industry and markets to ensure a healthy present and future for all. Yet, and as the case studies have specifically ascertained, this integration is achieved only through a structural reframing of the decision-making and public policy landscape. This reframing is marked by the integration of technology and innovation into our decision-making and development systems, and by the conceptualisation of innovation and society as part of an interconnected and independent whole. Through this new paradigm, public policy can more effectively translate technological innovations into tangible improvements towards societal resilience and wellbeing.

Bibliography

Aissaoui, N. (2021). The digital divide: A literature review and some directions for future research in light of COVID-19. *Global Knowledge, Memory and Communication*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/GKMC-06-2020-0075

Alaimo, L. S., Fiore, M., & Galati, A. (2020). How the COVID-19 Pandemic Is Changing Online Food Shopping Human Behaviour in Italy. *Sustainability*, *12*(22), 9594. https://doi.org/10.3390/su12229594

Brown, C., P., & Bollyky, T. J. (2021). *How COVID-19 vaccine supply chains emerged in the midst of a pandemic*. Social Science Research Network. https://papers.ssrn.com/abstract=3902082

Champagne, T., & Stromberg, N. (2004). Sensory approaches in inpatient psychiatric settings: Innovative alternatives to seclusion & restraint. *Journal of Psychosocial Nursing and Mental Health Services*, *42*(9), 34–44.

Chan, L., Kirsop, B., & Subbiah, A. (2006). Open Access Archiving: The Fast Track to Building Research Capacity in Developing Countries. *Esocialsciences.Com, Working Papers*.

Chohan, U. W. (2021). *Coronavirus & vaccine nationalism*. Centre for Aerospace and Security Studies. https://ssrn.com/abstract=3767610

Clatworthy, J., Hinds, J., & M. Camic, P. (2013). Gardening as a mental health intervention: A review. *Mental Health Review Journal*, *18*(4), 214–225. https://doi.org/10.1108/MHRJ-02-2013-0007

Committee for Development Policy, UN. (2021). *Comprehensive study on the impact of COVID-19 on the least developed country category.* https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/CDP_Comprehensive_Study_2021-1.pdf

Connellan, K., Due, C., & Riggs, D. (2011). *Gardens of the Mind. In Diversity and unity: Proceedings of IASDR2011, the 4th World Conference on Design Research* (pp. 2–13).

Costa, D., Morra, J., Solomon, D., Sabino, M., & Call, K. (2006). Snoezelen and sensory-based treatment for adults with psychiatric disorders. *OT Practice*, *11*(4), 19–23.

Czeisler, M. É., Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., Weaver, M. D., Robbins, R., Facer-Childs, E. R., Barger, L. K., Czeisler, C. A., Howard, M. E., & Rajaratnam, S. M. W. (2020). Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic—United States, June 24–30, 2020. *MMWR. Morbidity and Mortality Weekly Report*, *69*(32), 1049–1057. https://doi.org/10.15585/mmwr.mm6932a1

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *PROSPECTS*, *49*(1–2), 91–96. https://doi.org/10.1007/s11125-020-09464-3

Dimsdale, J. E. (2008). Psychological Stress and Cardiovascular Disease. *Journal of the American College of Cardiology*, *51*(13), 1237–1246. https://doi.org/10.1016/j.jacc.2007.12.024

Douglas, C. H., & Douglas, M. R. (2005). Patient-centred improvements in health-care built environments: Perspectives and design indicators. *Health Expectations*, *8*(3), 264–276. https://doi.org/10.1111/j.1369-7625.2005.00336.x

Eruchalu, C. N., Pichardo, M. S., Bharadwaj, M., Rodriguez, C. B., Rodriguez, J. A., Bergmark, R. W., Bates, D. W., & Ortega, G. (2021). The Expanding Digital Divide: Digital Health Access Inequities during the COVID-19 Pandemic in New York City. *Journal of Urban Health*, *98*(2), 183–186. https://doi.org/10.1007/s11524-020-00508-9

Federal Communications Commission. (2019). *2019 Broadband Deployment Report*. https://docs.fcc.gov/public/attachments/FCC-19-44A1.pdf

Fonseca, E. M. da, Shadlen, K. C., & Bastos, F. I. (2021). The politics of COVID-19 vaccination in middle-income countries: Lessons from Brazil. *Social Science & Medicine*, *281*, 114093. https://doi.org/10.1016/j.socscimed.2021.114093

Frank, H. E., Grumbach, N. M., Conrad, S. M., Wheeler, J., & Wolff, J. (2021). Mental health services in primary care: Evidence for the feasibility of telehealth during the COVID-19 pandemic. *Journal of Affective Disorders Reports*, *5*, 100146. https://doi.org/10.1016/j.jadr.2021.100146

GACD. (2021). *An Alliance for Health Research Funders, 2021; 'Call for research proposals*. Global Alliance for Chronic Diseases. https://www.gacd.org/funding/calls-for-proposals/mental-health/call-for-research-proposals

Gao, X., & Yu, J. (2020). Public governance mechanism in the prevention and control of the COVID-19: Information, decision-making and execution. *Journal of Chinese Governance*, *5*(2), 178–197. https://doi.org/10.1080/23812346.2020.1744922

Ghebreyesus, T. A., & Von Der Leyen, U. (2020). A global pandemic requires a world effort to end it—None of us will be safe until everyone is safe. *World Health Organisation*. https://www.who.int/news-room/commentaries/detail/a-global-pandemic-requires-a-world-effort-to-end-it-none-of-us-will-be-safe-until-everyone-is-safe

Global Health Security Index 2019. (2019). https://www.ghsindex.org/wp-content/uploads/2019/10/2019-Global-Health-Security-Index.pdf

Hickman, C. (2009). Cheerful prospects and tranquil restoration: The visual experience of landscape as part of the therapeutic regime of the British asylum, 1800—60. *History of Psychiatry*, *20*(4), 425–441. https://doi.org/10.1177/0957154X08338335

Hunt, M. R. (2010). 'Cholera and Nothing More'. *Public Health Ethics*, *3*(1), 55–59. https://doi.org/10.1093/phe/php027

Idowu Mary Mogaji. (2020). Understanding Educational Responses to School Closure During the COVID-19 Pandemic: A Case for Equity in Nigeria. *International Studies in Educational Administration*, 59–65.

Kamara, S., Walder, A., Duncan, J., Kabbedijk, A., Hughes, P., & Muana, A. (2017). Mental health care during the Ebola virus disease outbreak in Sierra Leone. *Bulletin of the World Health Organization*, *95*(12), 842–847. https://doi.org/10.2471/BLT.16.190470

Katz, I. T., Weintraub, R., Bekker, L.-G., & Brandt, A. M. (2021). From Vaccine Nationalism to Vaccine Equity—Finding a Path Forward. *New England Journal of Medicine*, *384*(14), 1281–1283. https://doi.org/10.1056/NEJMp2103614

Kemp, S. (2021). *Digital 2021: Nigeria*. Hootsuite & We are Social. https://datareportal.com/reports/digital-2021-nigeria

Kola, L., Kohrt, B. A., Hanlon, C., Naslund, J. A., Sikander, S., Balaji, M., Benjet, C., Cheung, E. Y. L., Eaton, J., Gonsalves, P., Hailemariam, M., Luitel, N. P., Machado, D. B., Misganaw, E., Omigbodun, O., Roberts, T., Salisbury, T. T., Shidhaye, R., Sunkel, C., … Patel, V. (2021). COVID-19 mental health impact and responses in low-income and middle-income countries: Reimagining global mental health. *The Lancet Psychiatry*, *8*(6), 535–550. https://doi.org/10.1016/S2215-0366(21)00025-0

Kreienkamp, J., & Pegram, T. (2021). Governing Complexity: Design Principles for the Governance of Complex Global Catastrophic Risks. *International Studies Review*, *23*(3), 779–806. https://doi.org/10.1093/isr/viaa074

Lawson, B., Phiri, M., & Wells-Thorpe, J. (2003). *The architectural healthcare environment and its effects on patient health outcomes: A report on an NHS Estates Funded Research Project.* Stationery Office. https://www.artshealthresources.org.uk/docs/the-architectural-healthcare-environment-and-its-effects-on-patient-health-outcomes/

Lazuras, L., & Dokou, A. (2016). Mental health professionals' acceptance of online counseling. *Technology in Society*, *44*, 10–14. https://doi.org/10.1016/j.techsoc.2015.11.002

Lee, A. M., Wong, J. G., McAlonan, G. M., Cheung, V., Cheung, C., Sham, P. C., Chu, C.-M., Wong, P.-C., Tsang, K. W., & Chua, S. E. (2007). Stress and Psychological Distress among SARS Survivors 1 Year after the Outbreak. *The Canadian Journal of Psychiatry*, *52*(4), 233–240. https://doi.org/10.1177/070674370705200405

Lloyd, C., King, R., & Machingura, T. (2014). An investigation into the effectiveness of sensory modulation in reducing seclusion within an acute mental health unit. *Advances in Mental Health*, *12*(2), 93–100. https://doi.org/10.1080/18374905.2014.11081887

Lopez-Ercilla, I., Espinosa-Romero, M. J., Fernandez Rivera-Melo, F. J., Fulton, S., Fernández, R., Torre, J., Acevedo-Rosas, A., Hernández-Velasco, A. J., & Amador, I. (2021). The voice of Mexican small-scale fishers in times of COVID-19: Impacts, responses, and digital divide. *Marine Policy*, *131*, 104606. https://doi.org/10.1016/j.marpol.2021.104606

Mazzucato, M., & Kattel, R. (2020). COVID-19 and public-sector capacity. *Oxford Review of Economic Policy*, *36*(Supplement_1), S256–S269. https://doi.org/10.1093/oxrep/graa031

McKie, A., Grove, J., Havergal, C., Matthews, D., Basken, P., & Ross, J. (2020). Are Research Links with the Developing World Still a One-way Street? *Times Higher Education*. https://www.timeshighereducation.com/features/are-research-links-developing-world-still-one-way-street.

Mellish, T. I., Luzmore, N. J., & Shahbaz, A. A. (2020). Why were the UK and USA unprepared for the COVID-19 pandemic? The systemic weaknesses of neoliberalism: a comparison between the UK, USA, Germany, and South Korea. *Journal of Global Faultlines*, *7*(1). https://doi.org/10.13169/jglobfaul.7.1.0009

Mmamoloko Kubayi-Ngubane. (2018). *Science & technology*. Department of Science and Technology – Republic of South Africa. https://www.dst.gov.za/images/dst_newsletter_march_2018_web.pdf

Naslund, J. A., Aschbrenner, K. A., Araya, R., Marsch, L. A., Unützer, J., Patel, V., & Bartels, S. J. (2017). Digital technology for treating and preventing mental disorders in low-income and middle-income countries: A narrative review of the literature. *The Lancet Psychiatry*, *4*(6), 486–500. https://doi.org/10.1016/S2215-0366(17)30096-2

Planetree International Inc. (2021). *Home Page | Planetree.org*. https://planetree.org

Ramsetty, A., & Adams, C. (2020). Impact of the digital divide in the age of COVID-19. *Journal of the American Medical Informatics Association*, *27*(7), 1147–1148. https://doi.org/10.1093/jamia/ocaa078

Ritchie, H., & Rosser, M. (2018). *'Mental Health', Our World in Data*. https://ourworldindata.org/mental-health

Rodriguez-Villa, E., Naslund, J., Keshavan, M., Patel, V., & Torous, J. (2020). Making mental health more accessible in light of COVID-19: Scalable digital health with digital navigators in low and middle-income countries. *Asian Journal of Psychiatry*, *54*, 102433. https://doi.org/10.1016/j.ajp.2020.102433

Santos, G. E. de los, & Rosser, W. (2021). COVID-19 Shines a Spotlight on the Digital Divide. *Change: The Magazine of Higher Learning*, *53*(1), 22–25. https://doi.org/10.1080/00091383.2021.1850117

Saxena, S., Thornicroft, G., Knapp, M., & Whiteford, H. (2007). Resources for mental health: Scarcity, inequity, and inefficiency. *The Lancet*, *370*(9590), 878–889. https://doi.org/10.1016/S0140-6736(07)61239-2

Sepúlveda, A. (2020). *The Digital Transformation of Education: Connecting Schools, Empowering Learners.* https://www.broadbandcommission.org/wp-content/uploads/2021/02/WGSchoolConnectivity_report2020.pdf

Serbulova, N., Morgunova, T., & Persiyanova, G. (2020). Innovations during COVID-19 pandemic: Trends, technologies, prospects. *E3S Web of Conferences*, *210*, 02005. https://doi.org/10.1051/e3sconf/202021002005

Shukor, S. F. A., Stigsdotter, U. K., & Nilsson, K. (2012). A Review of Design Recommendations for Outdoor Areas at Healthcare Facilities. *Journal of Therapeutic Horticulture*, *22*(2), 32–47.

Smith, M. J., & Richards, D. (2022). *Governance and public policy in the United Kingdom*. Oxford University Press.

Smith, S., & Jones, J. (2014). Use of a Sensory Room on an Intensive Care Unit. *Journal of Psychosocial Nursing and Mental Health Services*, *52*(5), 22–30. https://doi.org/10.3928/02793695-20131126-06

Stichler, J. F. (2008). Healing by Design. *JONA: The Journal of Nursing Administration*, *38*(12), 505–509. https://doi.org/10.1097/NNA.0b013e31818ebfa6

The East African. (2020). *Rwanda expands drone use to deliver medicine.* https://www.theeastafrican.co.ke/tea/news/east-africa/rwanda-expands-drone-use-to-deliver-medicine-1440756

The World Bank. (2017). *Higher Education for Development: An Evaluation of the World Bank Group's Support*. https://ieg.worldbankgroup.org/sites/default/files/Data/Evaluation/files/highereducation.pdf

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H.-B., Choi, Y.-S., Quan, X., & Joseph, A. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design. *HERD: Health Environments Research & Design Journal*, *1*(3), 61–125. https://doi.org/10.1177/193758670800100306

UNCTAD. (2020). *The COVID-19 Crisis: Accentuating the Need to Bridge Digital Divides*. https://unctad.org/system/files/official-document/dtlinf2020d1_en.pdf

UNCTAD. (2021, September). *The Least Developed Countries Report 2021: The Least Developed Countries in the Post-COVID World: Learning from 50 Years of Experience*. https://unctad.org/press-material/least-developed-countries-report-2021-least-developed-countries-post-covid-world

UNICEF. (2020). *Keeping the world's children learning through COVID-19*. https://www.unicef.org/coronavirus/keeping-worlds-children-learning-through-COVID-19

United Nations Department of Economic and Social Affairs. (2021). *Creation of the LDC category and timeline of changes to LDC membership and criteria*. https://www.un.org/development/desa/dpad/least-developed-country-category/creation-of-the-ldc-category-and-timeline-of-changes-to-ldc-membership-and-criteria.html

Vidal-Alaball, J., Acosta-Roja, R., Pastor Hernández, N., Sanchez Luque, U., Morrison, D., Narejos Pérez, S., Perez-Llano, J., Salvador Vèrges, A., & López Seguí, F. (2020). Telemedicine in the face of the COVID-19 pandemic. *Atención Primaria*, *52*(6), 418–422. https://doi.org/10.1016/j.aprim.2020.04.003

Whiteford, H., Ferrari, A., & Degenhardt, L. (2016). Global Burden Of Disease Studies: Implications For Mental And Substance Use Disorders. *Health Affairs*, *35*(6), 1114–1120. https://doi.org/10.1377/hlthaff.2016.0082

WHO EMRO. (2021). *Non-communicable diseases: Digital innovation stories during COVID-19.* http://www.emro.who.int/noncommunicable-diseases/publications/success-stories.html?format=html

World Health Organisation. (2020a). *COVID-19 significantly impacts health services for non-communicable diseases.* https://www.who.int/news/item/01-06-2020-COVID-19-significantly-impacts-health-services-for-noncommunicable-diseases

World Health Organisation. (2020b). Innovative ways to care for NCD patients in Thailand in COVID-19 time.

World Health Organisation. (2020c, October 5). *COVID-19 disrupting mental health services in most countries, WHO survey*. https://www.who.int/news/item/05-10-2020-COVID-19-disrupting-mental-health-services-in-most-countries-who-survey

World Health Organisation. (2021a). *Prequalification of Medical Products (IVDs, Medicines, Vaccines and Immunisation Devices, Vector Control).* Coronavirus Disease (COVID-19). https://extranet.who.int/pqweb/vaccines/COVID-19-vaccines

World Health Organisation. (2021b). *Factsheet 369: Depression*.

Wu, T., Jia, X., Shi, H., Niu, J., Yin, X., Xie, J., & Wang, X. (2021). Prevalence of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis. *Journal of Affective Disorders*, *281*, 91–98. https://doi.org/10.1016/j.jad.2020.11.117