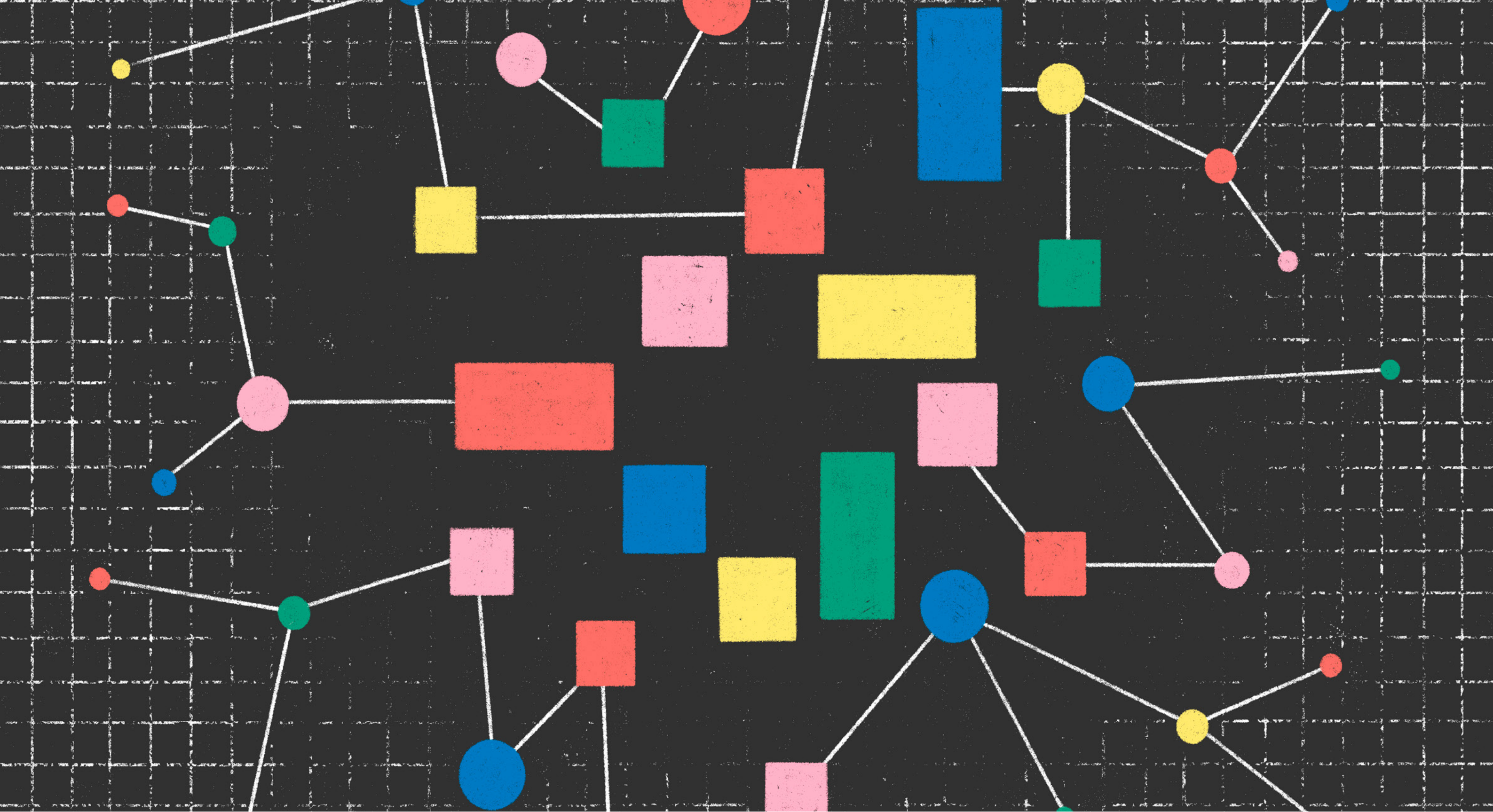




Using Innovation to Transform Human and Planetary Health

Dr. Ebele R. I Mogo



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Executive Summary

The increasing impact of human activities on the planet's ecosystems have earned this geologic time period the name, the Anthropocene (National Geographic, 2019). These activities, including rapid unsustainable urban growth, population growth, and climate change have been identified as a growing contributor to forced displacement. How? Mounting pressure on rapidly depleting resources, threats to livelihoods that depend on the earth's ecosystems, natural disasters, conflicts between nomadic and sedentary populations, and health risks associated with living in low-income and environmentally vulnerable settings, are just a few of the ways these activities fuel forced displacement. The impacts of these challenges are more profound in emerging economies who bear them disproportionately (United Nations, 2019). For example, if rapid action is not taken, over 85 million Africans will be displaced as a consequence of climate change by 2050 (Africa Centre for Strategic Studies, 2019). In a continent that already accounts for over a third of the world's forcibly displaced people (UNHCR, 2021), these prospects are worrisome.

The same anthropocentric pressures behind forced displacement escalate a harmful feedback loop between infectious diseases such as pandemics and non-communicable diseases such as diabetes. **Both the field of forced displacement and the field of health, which will be in conversation in this brief, require collaboration across a vast array of stakeholders from various disciplines to solve these challenges. Additionally, in both the fields of forced displacement and health, actors are tasked with the challenge of addressing urgent matters of "life and death", while intervening in their complex drivers if they will ever be sustainably stemmed.** The COVID-19 pandemic has indeed popularized the notion of "flattening the curve"—acting in an integrated fashion upstream to prevent future downstream demands on the healthcare system.

With these parallels in mind, through this brief, we will explore innovation processes that have been applied to health issues, with a view to understanding if there are any insights it may hold for informing innovation in the field of displacement. Particularly, we will explore:

- What we can learn from the historical role of innovation in improving global health
- Case studies of adaptive innovations, approaches to respond to current crises
- Case studies of anticipatory innovations, approaches to address emergent trends and risks in order to stem future crises
- Whether innovation in global health can hold insights for the work of the United Nations High Commissioner for Refugees' (UNHCR)'s Innovation Service and UNHCR in general

List of Acronyms

CHO	Community Health Officer
CHV	Community Health Volunteer
GDP	Gross Domestic Product
GIS	Geographic Information System
HIV	Human Immunodeficiency Virus
HPV	Human Papillomavirus Virus
LTK	Learner Treatment Kit
NDOH	National Department of Health
PII	Preventive Oncology International, Inc.
RTD	Rapid Diagnostic Test
SMS	Short Message Service
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
USSD	Unstructured supplementary service data
UVC	Ultraviolet C Light
WHO	World Health Organization

The Complexity and Uneven Distribution of 21st Century Challenges

It is important to start off by presenting an overview of some of the challenges that shape human and planetary health, and in many ways will define human life in this century. Prominent among these dynamics are rapid urbanization, globalization, climate change, and changing health patterns. Over two-thirds of the world’s population is expected to live in cities by 2050 (Emmanuel, 2020), and countries in Africa and Asia will account for 90% of this growth in city-dwellers. While cities aggregate human, technological, and information capital, in many cases, their growth has also been characterized by unequal distribution of essential resources (Murphy & Carmody 2017). In a phenomenon which has been dubbed “hidden cities” by the World Health Organization (2010), urban settings tend to have huge contrasts in health and wellbeing outcomes for their populations, with some populations accessing the very best resources and thus outcomes, and others experiencing the worst of them.

These patterns have an impact on population health and wellbeing. In many emerging economies, as well as in underserved subpopulations around the world, access to basic services such as electricity, housing, primary healthcare, and water still remain a major challenge, as well as poor stewardship of ecosystems (UNDP, 2018 & AHPSR, 2020). For example, Asia and the Pacific generate over 60% of the growth in plastic production globally (Alisjahbana, 2019), with South and Southeast Asia contributing over half of the plastic in the world’s oceans (Kaplan, 2020), which endangers food sources and harms marine life. In Kenya, the use of forests and wetlands for agriculture has reduced the capacity in the Upper Tana River, increased costs of water treatment, and contributed to water scarcity (Erickson-Quiroz, 2016). In Cape Town, water demand is expected to exceed supply by 2021 (The Nature Conservancy, 2018).

These challenges fuel multiple negative feedback loops that affect the livelihoods, health, and resilience of communities. Rising ocean temperatures coupled with unsustainable use of mangroves contributes to the decline of marine habitats, and threatens the livelihoods of communities who depend on them for sustenance. Spiraling population growth encroaches into wild forests, threatening biodiversity, and leading to heightened risks for new infections such as pandemics. Pandemics such as COVID-19 continue to weaken already overburdened healthcare systems (Nakaliti, 2020), and interact with pre-existing chronic illnesses to worsen health outcomes and increase socioeconomic vulnerability and food insecurity (Njie, 2020). In Somalia, for example, drought fuels displacement, which collides with historical and political fractures, leading to more violence, which in turn fuels more forced displacement (UNHCR, 2019). The conditions of forced displacement also contribute to worsening health outcomes, putting displaced communities at risk of developing illnesses and worsening underlying conditions (Da Silva, 2020).

While ecological changes fuel conflict and forced displacement patterns, migration patterns and armed conflicts also drive ecological changes. In Colombia, there is a relationship between forced displacement particularly from armed conflict and increasing demographic and ecological changes due to rural-urban migration (Ahsan, 2019). Displacement of coastal communities due to climate change in Bangladesh contributes to socioeconomically and environmentally precarious urban growth (Ahsan, 2019). As people are displaced due to factors that range from erosion, to changing agricultural patterns, to forced conflict and

political factors, this contributes to chaotic urbanization patterns and increased pressure on already scarce resources.

It is certain that these intertwined challenges cannot be addressed by one sector alone. For example, health improvements cannot be attained without interventions that involve planners, businesses, educators, technologists, environmentalists and community leaders. For this reason, there have been several calls for coordinated solutions to link decision-making at the regional, national, and local levels to adequately address these challenges (Ahsan, 2011 & Adger, 2020). Indeed, **through system-spanning solutions, we may be able to stunt the logics behind unsustainable development, and also create new opportunities – new logics and directions of growth that fuel better human and planetary health. However, seeking these solutions also requires us to widen our vision beyond our typical tools, whether they are siloed approaches to funding or the top-down or bottom-up dichotomy of problem solving; to bring up valuable approaches that suit the dynamic nature of these challenges. This is where innovation comes in.**

In the context of this brief, we are using the working definition of **innovation as tools, processes and ways of thinking that allow for more effective problem solving and value creation**. Innovation has historically enabled leaps in value creation that cannot simply be accounted for by more input of labour and capital (Ezeanya-Esiobu, 2019). It is therefore vital to consider the role of innovation in enabling us to “leapfrog” towards accelerated and unprecedented impact. At the same time, as we will discuss in more detail in the next portion, without adequate consideration given to factors such as access, affordability and safety, innovation can also take place in ways that create significant inequities in communities (Akinyemi, 2021). These issues also require consideration to make sure that innovation truly adds value to the context where it takes place.

The question becomes – how can innovation processes address challenges in system spanning ways that can contribute not only to stemming their immediate symptoms but also creating desired long-term outcomes? However, to look forward, we will first look back at history, to see how innovation has contributed to the challenge of improving health and life expectancy. After this, we will look at case studies of contemporary applications of innovation to human and planetary health challenges. Finally, we will reflect on these scenarios to understand how best to put innovation to use in placing communities on the path to healthy, inclusive and sustainable development.

Working Definitions

- Anticipatory Innovations:** approaches to address emergent trends and risks in order to stem future crises.
- Adaptive Innovations:** attempts to address already existing health crises.
- Planetary health:** the impact of activities on the health of humans and ecosystems.
- Innovation:** tools, processes and ways of thinking that allow for more effective problem solving and value creation.
- Directionality of innovation:** decisions around where to focus innovation efforts, including where resources will be invested and where they will also be divested.
- Demand-side innovations:** levers that shape markets, norms and systems to stimulate innovation efforts around specified goals
- Supply side innovations:** innovations that can improve the fit between existing innovations and their target population e.g. through functionality, pricing, and service delivery

The Opportunity: Can Innovation Lead to Leaps in Health and Wellbeing?

“Within 250 yards of the spot where Cambridge Street joins Broad Street, there were upwards of 500 fatal attacks of cholera in 10 days... As soon as I became acquainted with the situation and extent of this irruption (sic) of cholera, I suspected some contamination of the water of the much-frequented street-pump in Broad Street” – John Snow

Available records indicate that at the beginning of the 19th century, most people died at ages that would be considered young today (Roser et al., 2019). There are indications that on average life expectancy stayed at about 40 years for millennia. In those days, almost half of the children born died before adulthood. Today, the average life expectancy globally is 73 although it is as high as 85 in Japan and as low as 53 in the Central African Republic. So what happened?

The above quote, in which John Snow speaks of September 7, 1854 when he took his research on an ongoing cholera outbreak to local officials, provides a hint (Barton, 2018). In those days, the miasma theory of disease which attributed cholera infections to “bad air” was common. Being skeptical of this theory, Snow took to methodical investigation to examine his alternate hypothesis – that it was in fact the sewage dumped into cesspools and rivers that was contaminating water sources. He interviewed local residents and cross-linked information from the hospital and public records to identify which residents had drunk water from a public water pump he suspected to be the source of the disease. Using a dot map, he

illustrated a cluster of cholera cases around that particular pump. By relaying these findings and convincing local officials to remove the handle of the pump and thus stopping people from drawing water from it, he was able to end the outbreak in his community.

Available information suggests that by the 20th century, there were marked improvements in how we understood the spread of diseases. A systematic approach to investigating outbreaks, which we may view as an innovation in defining the problem space, has played a key role in the control of diseases, enabling innovations in water purification, food safety, and housing safety and has resulted in significant health gains (Rovner, 2020). This understanding was translated to non-pharmaceutical interventions e.g. social distancing, tobacco cessation, as well as pharmaceutical interventions e.g. the use of vaccines, oral rehydration therapy for diarrhoea, and freeze-dried serums (Global Research Programme on Inequality, 2020). The application of these approaches sparked a significant health transition around the world.

As similar types of innovations became more accessible, they were also able to provide significant health gains at reduced comparative cost. By 1950, wealthier countries in North America and Europe had increased their populations' average life expectancy to over 60 years, but a divide opened with life expectancy being as low as 27 in countries like Mali. In the next 50 years that followed, the gaps began to narrow down. On average, global life expectancy has gone from about 29 to 73 years in less than two centuries.

While these leaps in health and wellbeing are inspiring, regional gaps in their impact on life expectancy in the 20th century and currently are also worth noting (Roser et al., 2019). In Oceania, life expectancy increased from 35 at the beginning of the 19th century to 79 in 2019. In Asia, it increased from 27.5 to 73.6. In the Americas, it went from 35 to 77. In Africa, it went from 26 to 63. Additionally, while the health transition began around 1870 in Oceania, records indicate that it only began in the 1920s in Africa. It is important to note that innovations can exist for a long period of time without making the needed impacts on the health of the population.

Recent examples reiterate this point. Despite antiretroviral drugs for Human Immunodeficiency Virus (HIV) entering the market in the mid 1990s, the high cost of these drugs made access infeasible for African countries. Estimates say that about 12 million Africans died waiting for them to reach the continent between 1997 and 2007, while these drugs were already being used to reduce deaths in the richer regions of the world (Nkegasong, 2020). The situation did not change until a specific focus was shifted towards improving access. During the emergence of a strain of pandemic flu in 2009, richer countries pre-ordered large doses of vaccines, while reneging on their commitments to donate vaccines. More recently, there have been concerns around equity in the distribution of coronavirus vaccines.

History gives us valid lessons: 1) that innovation can make remarkable improvements in the conditions of our lives 2) that it can take a long period of time to harness the impact of existing innovations 3) and that there can be unequal effects in access to and thus the impact of innovations. Below, we will review case studies of attempts to innovatively address key challenges that affect health and wellbeing through the lens of adaptive innovations and anticipatory innovations. Our focus in this instance are the processes behind some of these efforts. For the purpose of this brief, we are using the following proposed definition of these innovations: i) adaptive innovations as approaches to attend to already existing health challenges and ii) anticipatory innovations as approaches to pre-empt future health

challenges by dealing with emergent trends and risks. In looking at these case studies, we will reflect on the themes that these examples could hold for innovating in other complex, systemic challenges, such as in the work of the UNHCR Innovation Service, and the UNHCR in general.

Do Cases of Innovation in Health Matter for Innovating in Forced Displacement?

Forced displacement, along with health challenges such as the rise of pandemics, the rise of chronic non-communicable diseases, the goal of attaining universal health coverage, amongst others share features that can classify them as systemic challenges. One of these is that while they are thematically similar, they cannot be discretely defined (Batie, 2008). For example, forced displacement within countries in Asia, and between countries in Asia and South America can have very different specificities, and so defy a black-and-white characterization. The same applies for health issues. While in a laboratory we may pinpoint the clinical pathway leading to a specific form of cancer, on a population level the problem space attributable to rising levels of cancers in the United States when compared to Sweden for example will depend on a variety of factors – e.g the built environment, access to insurance and preventive care – that make the solution space different.

Both dynamics in the field of population health and displacement do not have a clear template that guarantees solutions, do not have single-bullet approaches to fixing them and are symptoms of other, often larger, and systemic problems. Were we to continue along with our earlier analogy, it becomes clear that the boundaries of such challenges are not clean. For example, not long before trying to address rising cancer rates will we see that the discipline of health will need to work with the environmental sector to reduce pollution levels, or with the agricultural sector to ensure that people can access healthy meals. Similarly, in the field of displacement, not too long in dealing with challenges will we realize that we need to work with the field of housing to address access to accommodation for displaced populations, with the field of health to ensure access to healthcare for refugees, and with the field of governance to understand underlying conflicts and socioeconomic pressures that contribute to displacement.

It has been argued that success at innovating on systemic challenges is not only a function of getting specialized skill sets in our own fields as may be thought, but exploring problems of a similar nature from diverse disciplines (Epstein, 2019). Exposure to similar kinds of problems from different disciplines enables us to refine **“how” we approach them, a question that is arguably more important for systemic challenges than “what” to think and do.** Being exposed to similar kinds of problems also allows us to translate and transpose groundbreaking ideas from other fields to our own field while freeing us of the trappings of siloed thinking (Harvard Business Review, 2021).

Within the limits of its scope, this project has also attempted to offer a range of case studies that may allow the reader to gain fresh insights on how to approach challenges in forced displacement. To do so, a couple of factors were given consideration in selecting case studies. One of these was consideration to represent both upstream and downstream entry points

for addressing challenges, that is, identifying challenges that deal with an ongoing health challenge (adaptive innovations), as well as those that were intervening on emergent trends that create the risk for future health challenges (anticipatory innovations).

Another element considered was the representation of a range of contexts. Given that there are a significant number of examples of innovation on complex challenges that have focused on Europe and North America, the case studies were focused on other regions of the world, particularly those whose economies are considered emerging, to bring a set of diverse perspectives in how we typically think about innovation. Within these, care was taken to have examples from a range of countries and continents. Another consideration given, was the source of case studies which included academic sources (e.g Google Scholar) and grey literature (e.g Google and information shared in public domains e.g Twitter).

Eventually seven case studies were selected: **case study 1** focuses on increase in access to community health services in Ghana, **case study 2** on Rwanda's green villages, **case study 3** looks at scaling up a COVID-19 prevention initiative in Hong Kong Special Administrative Region (SAR) of China, **case study 4** considers building monitoring capacity for future pandemics in Thailand, **case study 5** investigates uptake of malaria diagnostics in Malawi, **case study 6** delves into improving screening for human papillomavirus in Peru, and **case study 7** examines antenatal care coverage in South Africa. Thirty-five more examples are briefly mentioned (see Appendix) without going into depth in this particular brief. It is certainly hoped that by viewing examples of innovation being applied to challenges from a different field which shares similar system-wide characteristics to the kind of problem that forced displacement is, the reader will have fresh insights for the field of innovation in humanitarian contexts and forced displacement.

Case Studies of Anticipatory Innovation

Case Study 1: Transforming Access to Community Health - Ghana

While the ideal doctor-patient ratio recommended by the World Health Organization (WHO) is one doctor for every 1,000 people, over 44% of WHO member states fall short of this goal for many reasons. For one, doctors tend to live in cities and towns, rather than in rural areas. Secondly, specific social, cultural and gender norms make people less likely to seek care, e.g. in cases where women need to seek their husband's permission before seeing a doctor. Thirdly, many people face logistical and infrastructure barriers to seeking care like access to good roads, stable housing and reliable transportation. An additional reason is the phenomenon of brain drain, as many skilled doctors in low-income countries become socio economic migrants to richer countries, who have a high need for healthcare practitioners given their aging populations and higher ability to pay for healthcare services.

Ghana is one of several countries who face this pernicious problem. In an attempt to improve access to primary healthcare in spite of this challenge, the Government took an innovative approach to healthcare provision that has since become globally lauded – bringing healthcare to villages rather than requiring communities to go to hospitals (Alliance for Health Policy and Systems Research, 2021). This would make sure that healthcare services could be available

even in the most inaccessible parts of the country. However, this approach required some adaptation. For one, it required a reorientation of services towards prevention: treatment would constitute a significant but minimal component of improving community health, while the majority of services would focus on health education, immunization, referral, health promotion and community meetings. In 2000, the Government instituted a Community-based Health Planning and Services (CHPS) policy. The core components of the implementation of this policy were i) the use of community health officers, ii) community engagement and iii) the use of embedded research.

To meet the challenges of doctor shortages, the Government made use of Community Health Officers (CHOs), specially trained nurses who were posted to rural areas and embedded in each community so that they could provide support in a hands-on fashion, including during emergencies. These CHOs worked closely with trained community members called Community Health Volunteers (CHVs). While CHOs travelled to clients, and supported frontline provision of routine services like immunization, family planning, maternal and child health services, and the referral of emergency cases, CHVs served as mediators between the health service and their communities, making use of structured guides to check on their neighbours, particularly neighbours who were pregnant and/or new parents. This approach of taking health care to the villages helped the health service understand communities' needs, while CHVs were perfectly suited for helping to communicate health campaigns to their communities.

Key to this project was a particular kind of research approach called embedded research – research integrated into the process of its implementation, designed along with communities, and used to transform parts of its implementation. In fact, the entire project was catalyzed by an initial research project run in Navrongo, northern Ghana, to evaluate how best to structure the implementation of primary care in its rural areas (Binka et al., 2007). This project experimented on the use of four different approaches to primary care provision: i) providing no intervention, that is, having no nurse or volunteers in the community ii) placing only a trained volunteer in the community iii) placing only a nurse in the community and iv) including a trained nurse and a trained volunteer in the community. Approach “iv” provided superior results and so it became the singular approach of the programme.

One of the challenges the research project soon revealed about the project was that even though it had spread impressively, its implementation was uneven. One factor that the challenge of uneven implementation has been attributed to is community engagement (Kweku et al., 2020). When this step was overlooked, it limited the roll-out of the project. This has led to the establishment of three learning sites in Ghana to track the success of the program and ensure it is tailored to the needs of communities. Meanwhile, policymakers, local researchers such as staff from the University of Health and Allied Sciences, policymakers, and the community all play a role in shaping the research questions and methods used, while findings are shared as soon as they are available, to enable the programme to be adjusted and to respond to emerging priorities. This shapes the quality of care delivered at the frontlines, while making it possible to identify new innovations to improve service delivery, and for new challenges to be identified and dealt with. The CHPS approach has been ongoing for 20 years.

Case Study 2: Rwanda's Green Villages

Especially after the Rwandan genocide which created a massive setback in life expectancy in Rwanda, the country made significant progress in life expectancy. However, it still faces climate change related challenges such as droughts and floods which compromise health and livelihoods; high poverty rates affect about 40% of its population; and about 40% of its population suffers chronic malnourishment (UNDP, 2018). This inspired a partnership to use an integrated approach to address these socioeconomic challenges, while making sure to intersect natural resource challenges, education, food security, and housing.

In 2011, Rwanda piloted its first ever green village in Rubaya village, Rwanda. This project was the product of the Poverty-Environment Initiative, a partnership between the national Government, the United Nations Development Programme (UNDP, 2018), and the United Nations Environment Programme (UNEP), which set out to ensure that Rwanda would be a middle-income country by 2030. To address housing shortages, iron-roofed houses were constructed as part of the village, along with improved sanitation measures to make sure people would be safe and less likely to have waterborne diseases. The iron roofs also allowed communities to harvest rainwater. To ensure that children did not have to walk long distances from the village to school and to increase school attendance, schools were constructed. To address water scarcity as a result of drought and to ensure water availability throughout the year and thus safeguard people's health and livelihoods, water reservoirs were created in the village. To improve soil fertility and agricultural productivity and thus food security, community members were trained in improved agricultural practices like agro-forestry, terracing, and soil-erosion-control techniques.

Finally, each household in the green village was given a cow, as a means to improve the family's food security, economic stability via income from the sale of milk, and improved soil fertility. Cows' wastes were collected around the village and fed into biogas digesters to provide clean cooking fuels. This ensured that people did not have to cut down trees to retrieve firewood and also that they could breathe clean air instead of burning firewood. The biogas digester provided manure for crop cultivation, cooking fuels, and also reduced the pollution of water sources with waste. This all helped to reduce the prevalence of waterborne diseases, reduce air pollution, and ensure access to electrical power.

A study of one of these green villages, called Kabeza village, found the measures to be cost-effective, considering their social and environmental benefits. The study also found that the scale-up of these villages could help to reduce poverty. This model was taken up by the Government and other donors who created about 44 green and model villages by the beginning of 2018. The success of the project has inspired the Government to set a target of creating at least one green village in the country's 416 sectors by 2024.

Case Study 3: Rapidly Scaling-up an Initiative to Prevent COVID-19 in Low-income Communities, Hong Kong Special Administrative Region (SAR) of China

The city of Hong Kong borders mainland China, where the first outbreak of the COVID-19 coronavirus occurred. While being a wealthy city, its high levels of inequality placed low-income communities at a very high risk of contracting COVID-19, while also making purchasing hand sanitizers and masks infeasible in the same communities. To address these needs, a collaboration named Project Ultra Violet was initiated by a group of academics, medical practitioners, social workers, and engineers to improve sanitation (Chui & Ko, 2020).

The project combined principles of social innovation with asset mapping (Chui & Ko, 2020). It started off by mapping community resources to understand what tangible and intangible assets existed in these communities. The tangible assets they considered were disinfection technologies. They evaluated available technologies according to humanitarian technology dimensions including maturity, reliability, availability, configurability, costs to install, operate and maintain, durability, and reliability (Chui & Ko, 2020). In the process, they chose ultraviolet germicidal irradiation as the most suitable tool to achieve their goals.

The engineers in the partnership went to work, developing 40 ultraviolet C light UVC devices for disinfecting housing units. Given that the technology was affordable and available, it was easy to produce it on a large scale and to deploy it rapidly. Features of the technology were also suited for the target population, from lightweight parts which made it portable, to its ability to be installed upright, which made it easy to use in tight spaces e.g. in cleaning toilet surfaces and slippages, and the short time (of about thirty minutes) needed to complete the disinfection process, as well as the use of motion and light sensors which would ensure users' safety. All these features enabled them to scale up the technology and reach a great number of families in a short time period.

The intangible assets in the community were the existing networks of community stakeholders, social workers and organizations who had a track record of advocating for their needs and providing support services. These networks supported the project by providing invaluable knowledge about the location, characteristics of the housing units of low-income communities, the psychological and socioeconomic needs of these communities, and volunteers to support the implementation of the project. Project officers worked with social workers to train 50 volunteers on how to safely use the UVC devices, with a focus on helping them to understand each step of the project and the goal of keeping the communities of interest safe from COVID-19.

The insider understanding of community norms that the stakeholders provided was an intangible asset that helped in training project volunteers. One of such norms is the cultural emphasis on self-reliance which can hamper help-seeking. In consideration of this, the sensitivity training emphasized that volunteers needed to contribute to developing an atmosphere of mutual respect, while ensuring that the individuals living in subdivided units were trained in operating the prototypes, thus building a sense of ownership. The implementation of the project began in the middle of April 2020, and over 260 households signed up to receive the service within two days of its launch.

Case Study 4: Building Capacity for Detecting Future Pandemics - Thailand

After the avian flu outbreak of 2004, Ending Pandemics¹ together with a Bangkok-based technology social enterprise called Opendream, and the Faculty of Veterinary Medicine of Chiang Mai University, and public health and veterinary officials in Chiang Mai Province partnered to address the risk of future outbreaks (Crawley & Divi, 2020). The product of this collaboration was an initiative – PODD, read as poh-dee-dee in Thai, meaning “look closely and you will see”. PODD is a community-driven disease detection platform to increase the detection of zoonotic diseases in animals and humans, so that they could be contained while their spread was low and thus reduce human and livestock losses.

A key component of this intervention was the use of digital tools to enable communities to notice and report any health events in humans and animals to veterinary and public health experts so that they could respond to them. The PODD smartphone app was designed by Opendream, with an emphasis on usability, and a survey revealed that 89% of the app’s users could use it effectively. Residents were educated about PODD, and encouraged to report human and animal health events that could be relevant to trained volunteers who had been selected by leaders of local governments and some of whom had been sourced from Thailand’s Village Health Volunteer network. These volunteers would then enter this information into the PODD smartphone app.

Once filed by volunteers, analysts at Chiang Mai University (usually graduate students of epidemiology and staff of Chiang Mai University) would validate the reports by using automated processes or by asking follow-up questions. These reports would be triaged and sent to local livestock officials and public health officials who would then implement measures to contain the outbreak such as testing, vaccination, community education and treatment.

Six months after the launch of PODD in selected districts of Chiang Mai, the number of animal diseases reported in those districts was more than those that had been reported in the whole of Chiang Mai in the past year. Early detection reduces the resources that need to be invested in containment, and PODD helped to support an early response to a 2016 incidence of foot and mouth diseases in 2016. It is estimated that this intervention saved the local economy about four million USD. Additionally, as a result of the use of PODD, 27% of new poultry outbreaks were contained in nearby villages, while 73% of them were contained in their villages of origin. The success of PODD led more local governments to pay for it, and in these cases over half of the local governments fund it. PODD has been scaled in the past five years, and has now been adopted in 410 local governments and in 30 of the 76 provinces of the country, with its highest coverage in Khon Kaen, Chiang Rai and Chiang Mai provinces.

1 <https://endingpandemics.org>

Case Studies of Adaptive Innovation

Case Study 5: Increasing the Uptake of Malaria Diagnostics - Malawi

In Malawi, an estimated 60% of school-age children have malaria infections, many of which go undiagnosed and untreated. The WHO has recommended the use of rapid malaria testing before initiating malaria treatment, however access to tests is limited in rural areas. Despite several preventative measures to control it, the incidence of malaria and deaths caused by the disease continue to increase, especially in children, who are often missed by anti-malaria programs. This is because efforts to scale up access to diagnostics typically focus on drug shop owners and community health workers. While these efforts increase detection in the population as a whole, they do not bridge the diagnostic gap for malaria detection in school-age children. The Learner Treatment Kit (LTK), an intervention in rural Malawi, aimed to address this gap (Srinivas et al., 2020).

The LTK project was a partnership between the London School of Hygiene and Tropical Medicine, the University of Malawi, the Malawi Ministries of Health and Education, and funded by Save the Children. The novel approach in this case was i) the use of schools, which have a high rate of enrolment, as an entry point to improve access to point of care diagnostics, ii) the use of trusted teachers as care providers and iii) the use of LTKs, first aid kits which include rapid diagnostic tests for malaria that would be provided to primary school children during their school hours.

The project was implemented between November 2013 and April 2015 as a pragmatic observational study, during which 58 schools in rural Malawi were enrolled in the study. 29 of the enrolled schools were involved in the intervention. For this arm, two teachers in each of the 29 enrolled schools went through a seven-day training to build their capacity to provide LTK. As part of this training, they were taught how to use Rapid Diagnostic Tests (RDTs) and underwent a mentorship programme at a health center locally. Once they completed this program, parents and students were made aware that these teachers could support the students’ health and encouraged to visit them when they were sick. During such visits, the teacher would administer a RDT and refer the student via their parent or guardian to a local health center for follow up, while providing information on the reason for referring the student to the health center.

The evaluation of the project by way of interviews with school, district and national stakeholders, as well as teachers, parents and guardians and school age children suggested that the project helped to increase access to malaria diagnostics and treatment. Every time the intervention was evaluated, the teachers who had been trained remained aware of the proper way to diagnose and treat simple cases of malaria. Additionally, the project increased the likelihood of students seeking care when they were sick, led to a reduction in health-related school absences, as well as a reduction in school drop-outs and grade repetitions. Finally, teachers, parents and students expressed trust in the program, while healthcare workers said that the program reduced the number of unnecessary visits they had to deal with.

Case Study 6: Detecting Cervical Human Papillomavirus Virus - Peru

There are higher rates of cervical cancer in Peru compared to other Latin American countries (Srinivas et al., 2020). While cervical Human Papillomavirus Virus (HPV) testing is effective at detecting and managing HPV early on, which helps to prevent cervical cancer, a key challenge is the access to HPV screening. Primary reasons for this are the low availability of exams, low referral rates, and the difficulty of delivering kits in remote and low-income areas.

The Peruvian Cervical Cancer Screening Study, funded by Merck, Inc., Preventive Oncology International, Inc. (POI), and the Fogarty International Clinical Research Fellows Program developed a model for cervical cancer screening and vaccination to try to solve this challenge of access, which they tested in a remote village as well as in a suburban and low-income village close to the Amazon (Abuelo et al., 2014). The project was grounded in principles of community-based, participatory research, and involved community health workers in distributing self-collection kits for women in resource poor areas. The use of self-collection kits and community health workers eliminated the need for referrals for HPV screening and for medical examinations.

Each woman enrolled in the study was provided with a self-collection HPV testing kit, which contained illustrated instructions on how to provide samples themselves, a brush to collect samples, and a specimen card. The specimens would be collected at home, and the women would return their cards to community health workers (CHW), who would then send the specimen to a centralized laboratory for them to be tested for HPV. After the HPV tests, CHWs would relay the tests to the women, while referring those who tested positive for HPV to regional health clinics for more assessments and for treatment.

The ease of distributing and collecting the kits increased access to screening diagnostics for HPV for remote and low-income communities, while improving referral of those who tested positive to additional care. 98.3% of the women, which is 632 of the 643 women who registered for the study returned their samples to community health workers. 68 of these women tested positive for HPV, and 86.8% of them followed up with their treatment and evaluation referral at a regional health center. When assessed, 81.4% of the women indicated a preference for self-collection instead of traditional clinic-based examination. Given the success in increasing self-testing, the project was scaled up to also refer adolescent women to begin HPV vaccination. Countries such as Argentina, Haiti, and Uganda have also successfully used similar screening strategies for HPV.

Case Study 7: Improving Antenatal Care Coverage - South Africa

Only a handful of the many text message-based health innovations targeting low-resource settings have reached over one million recipients, globally. They include mMitra and Kilkari in India, Wazazi Nipendeni in Tanzania, MomConnect in South Africa, and Aponion in Bangladesh (Peter 2018). Of these five, MomConnect stands out for achieving the highest population coverage globally, reaching more than 60% of the women attending their first antenatal appointment in 2017. MomConnect is a South-African based text messaging initiative that equips expectant mothers with health information, encourages them to seek antenatal care, connects them to the country's healthcare system through SMS-based information delivery, a helpline, and allows them to provide any feedback they might have.

The implementation of MomConnect is the product of a collaboration between over 20 organizations including the Government, donors, academic organizations, for-profit and nonprofit organizations. Technical partners involved in implementation built MomConnect using South Africa's Health Normative Standards Framework (Peter 2018). Using this framework, the partners involved made sure that the initiative would be interoperable with health informatics systems that were already in place, inclusive and also scalable nationally. Unstructured supplementary service data (USSD) and short message service (SMS) were chosen as the means for messaging because these technologies were already familiar to the population, they were affordable, accessible on all handsets, and suited to the high adult literacy rate of the population. Through SMS, users are provided with health information tailored to the age of their infant or the gestational age of their fetus, as well as parenting support and information on the development of their fetuses. Through a help-desk, geo-located data on users' experiences with the healthcare system, related complaints or feedback, as well as data on confirmed pregnancies, are aggregated, and complaints swiftly addressed and used to improve processes.

Another marked feature of the deployment of MomConnect is the involvement and leadership of the Government. While the non-government partners provide capacity for its day-to-day affairs, strategic support for the project comes from the South Africa National Department of Health (NDOH) which provides technical leadership around the priorities of the initiative, and ensures the alignment between the several stakeholders involved. The project was championed by leadership of the Ministry of Health through road shows across the country used to emphasize the need for its implementation. This was also supplemented with provincial visits to follow up on data generated around registration and the use of the helpdesk and public events to celebrate when key milestones were achieved.

Within the NDOH, a senior technical assistant guides the priorities of the program, convenes partners, supervises staff at the help desk, and oversees monitoring of the program. At the provincial level, senior leaders including maternal and child health managers serve as key focal points for the programme's activities, ensuring they are integrated into other activities focused on maternal and child health while tracking registrations and opt-outs to discuss them weekly.

Within 12 months of its launch on the 25th of August, 2014, MomConnect had enrolled close to 500,000 women. While qualitative inquiries have shown that the women find the messaging helpful and empowering, they also note that in the bid to scale it up, the project did not collect baseline data, which made it difficult to demonstrate impacts on behaviour change before and after its use.

Takeaways on Applying Innovation to Human and Planetary Health Challenges

Below, we take a reflective look at what insights these seven case studies and several others (see Appendix) hold for transforming systems, especially in the context of innovation at UNHCR and in humanitarian contexts

Connecting Ecosystem Dots to Create Future States

Challenges do not occur in isolation, and neither do solutions to them. Systems spanning solutions that connect the dots between different dynamics at play are needed. For example, while several projects have focused on siloed approaches to address specific diseases, in order to create a future state of health and wellbeing, interconnected investments in staff, clinics, and laboratories are needed (Maxmen, 2019). A future orientation (Karjalainen & Heinonen 2017), which helps us think of our preferred future state for the system of interconnected players and actors and how innovation can lead us towards them, can help us with this task.

A lens on the future requires us to decide which current states need to be addressed, but also which ones we may wish to disinvest from. For example, while we may deal with rising rates of injuries due to traffic accidents, or rising rates of cancer due to tobacco use, a preferred future state could require us to transition economies towards sustainable and safe infrastructure to prevent us from needing to treat those injuries, and disinvestment from tobacco to reduce cancer rates, while fostering other sectors of the economy that can improve health and wellbeing e.g. sustainable agriculture. This means there is a **directionality to how we enable innovation especially in questions of human and planetary wellbeing** (Mazzucato & Dibb, 2020). This approach could align with already expressed aspirations for healthy, inclusive and sustainable global development. In a pandemic, we may immediately plan to import limited diagnostics, but eventually, we must think of the preferred future state of building localized research and development infrastructure and supply chains. In low-income countries, this looks like financing options to access vaccines, infrastructure to manufacture or store them, processes to procure them, platforms for vaccine distribution, to mention but a few (Nkegasong, 2020).

Creating desired future states will therefore also look more like a series of interconnected innovations attempting to shift the cycle of problems, rather than a silver bullet solution. For example, to reduce the ecological imprint of cities and impact of climate change, integrated approaches which make use of renewable energy in infrastructure and vehicles, maximise the use of non-motorized transport, reduce long-distance travel, reduce urban health islands through greenery, reduce stormwater runoff by channeling water into green spaces instead of

to sewers, and reduce energy costs are just a few solutions for one challenges (Coan, 2019). Likewise, managing plastic pollution requires these same closed loops between reducing plastic waste production, to waste handing to their recycling, to the creation of biodegradable plastics and incentives for recycling industries, along with guidelines, investment and governmental support (Oyake-Ombis, 2015).

Building Capabilities to Envision the Future

Unprecedented situations can be fertile ground for catalytic shifts in systems. The COVID-19 pandemic has triggered mass adoption of digital technologies, and sparked conversations about how to “build back better”, and what a “reset” in our systems could look like. The Food and Agriculture Organization’s ‘COVID-19 Response and Recovery Programme’ to promote the use of digital tools in agriculture (Njie, 2020), the COVID-19 ‘Vaccine Global Access Initiative’ to ensure that there is global access to the global supply of vaccines include just a few of these initiatives (Nkegasong, 2020). However, in the absence of a global impetus to change, like a pandemic, there are other practices that can build organizational and communal capabilities to think about the future. The practice of future design, which creates opportunities for stakeholders to put themselves in the shoes of future generations when making decisions on current challenges, is one of them (Discuss Japan, 2019). It is imperative that we build capabilities to plan towards desired future systems outcomes. This includes considering how we define and measure the “success” within the network of actors we belong to. Several countries are starting to incorporate future thinking and systems thinking in their policy processes with notable examples being New Zealand’s Living Standards Framework (Naik et al., 2020) which focuses on wellbeing rather than just the Gross Domestic Product (GDP) as a marker of progress, and considers a wide range of assets including social, financial, physical, human and natural capital. Another of such examples is Wales’ Wellbeing of Future Generations Act (Kumpf, 2020).

There are many new opportunities that are embedded in this practice of using innovation to create desired future states on a systems level. Integrated approaches to innovation bring the needed capital and infrastructure to create true systems shifts, creating new opportunities. For example, city rewilding can create new jobs around low emission energy sources, waste management, urban farms and managing green spaces (Mazzai, 2020). Food system redesign can lead to job opportunities, diversify the economy, create new technological opportunities (e.g. the use of sensors and data for waste management), lead to the commercialization of new products, amongst others (UNDP, 2019). Investing in protecting forestry can lead to opportunities in the use of clean energy, technology for monitoring fish catch data, diversified and improved income generation for communities that steward natural resources through carbon credits (The Nature Conservancy, 2015). Investing in walkable, people-centered cities, can lead to boosts in local economies (London, 2020). Investing in agriculture can create new markets to improve the economy, reduce reliance on imports, generate taxes, create infrastructure, human and organizational capacity that is transferable, reduce wastage, enable farmers to generate more income, and combat food insecurity (Ojomo, 2020). Our earlier case study in Thailand demonstrated how putting a pandemic preparedness strategy in place averted costs to the economy, while the case study in Rwanda showed the potential to create new opportunities for sustainable economic growth through green villages. Especially

in the context of limited resources, these “wins” are key to track and use in shaping progress towards desired future states, as they serve as bright spots of what is possible (Gould, 2020).

Reflections on Applying These Learnings to Innovation at UNHCR

1. UNHCR works “to ensure that everybody has the right to seek asylum and find safe refuge, having fled violence, persecution, war or disaster at home”. How could preferred future states be defined with regards to forced displacement?
2. What system spanning scenarios are likely to create these future states?
3. What are the opportunities that this will create?
4. What role can innovation play in creating integrated system shifts?
5. Are there opportunities that already exist to plant seeds of system shifts in our work?
6. How can we embed capabilities for futures design in our policies, processes, and incentive structures?

Expanding Our Understanding of Innovation

As earlier discussed, problems rarely exist in isolation. In each of the case studies presented, each problem was embedded in the context of other and broader societal or economic challenges. Access to healthcare in the case study from Ghana, was embedded in the context of the poor access to infrastructure in villages, global economic inequalities facilitating brain drain, and cultural factors restraining certain populations from going to the doctor. The table below, showing various kinds of innovations from several emerging economies, buttresses this point. The image that stereotypically comes to mind when we think of innovations is of new products, and these are certainly important. In emerging economies particularly, new products can help make processes more efficient while also being more cost-effective. Oftentimes, these solutions stay relevant and usable by bypassing the need for electricity, sometimes relying on clean energy sources, and using design modifications to deal with challenges communities face e.g. high temperatures, dust, lack of Internet connectivity in remote areas. We may consider the case study of self-service HPV testing kits in Peru one of such innovations.

However, there are other types of innovation models that are very important. Another related set of innovations are **process innovations**, which often solve problems by closing the gaps in the system; for example using technology to overcome challenges in accessing services, reducing the cost of labour by sourcing capacity in new ways, or using new business models such as leasing to make services affordable (Leen, 2019). An example of this is the case study on teacher-supported malaria detection in Uganda. By being resourceful, repurposing material, introducing a new methodology, or using new business models, these innovations are able to build bridges to help communities access services and resources.

Finally, an often-missed dimension of innovation, and yet the linchpin of the entire ecosystem, falls into a different category of innovations – innovations which stimulate demand for

solutions rather than supply them. These include the innovative investing and governance approaches that shape markets, norms and systems in the direction of the change that is needed. A good example of this is the case study on green villages in Rwanda. These **demand-side innovations** are very important, especially for transitioning towards conditions that advance human and planetary health because these transitions require entrepreneurial initiative upfront and significant divestment decisions as well. For example, while climate-friendly infrastructure projects can create new opportunities and ultimately save our lives on earth, they will likely require divestments from fossil fuel industries and supply chains for selling generators. They also require a lot of upfront capital to change our roads, streetlights, agricultural processes before their benefits can be reaped.

Demand-side innovations are particularly important in emerging economies because they spotlight gaps in infrastructure that become opportunities for an entirely new approach to development that can improve health outcomes. In the absence of demand-side innovations, innovation of these complex challenges is high risk. At their best, demand-side innovations create the incentives to shape systems and nurture solutions by de-risking initiatives that take communities on the desired trajectory of development, along with creating new ways to access funds, networking support, building strategic alliances, incentivizing innovators to co-create, wooing investors, supplying enabling infrastructure (e.g. digital payments, Internet) for innovation, and providing the technical expertise that allows process and product innovations on key problems to be successful.

Supply-side Innovations	Location
Product Innovations	
Solar powered hand-washing technology for COVID-19 prevention (Zubrinich, 2020)	Nigeria
Off-grid cold storage systems to reduce agricultural losses (Kibiti and Strubenhoff, 2019)	India
WhatsApp chatbots (Xinhua News Agency, 2020)	South Africa
Ecological charcoal bricks for cooking (UNDP, 2019)	Democratic Republic of Congo
Cheap rapid test kits for COVID-19 (Salaudeen, 2020)	Senegal
X-ray scans for COVID-19 detection (BBC, 2020)	Tunisia
Use of clean technologies e.g. insulated concrete forms and rooftop solar for city design (Coan, 2019)	India
Heat and dust resistant band for monitoring newborns' vital signs (Lieberman, 2019)	Uganda
Process innovations	
Making biocoal from household waste (UNDP, 2020)	Congo
Sourcing and delivering blood and medical products (Kazeem, 2020)	Nigeria
Linking ride hailing apps with contraceptive delivery (Songa et al., 2020)	Uganda
Repurposing polio staff, logistics and data management to deal with Ebola and other infections (Koaudio et al., 2016)	Angola, Nigeria, Ethiopia
Setting up a regional platform to coordinate vaccine and medical supply procurement (Nkengasong, 2020)	Africa
Demand-side Innovations	
Social media advocacy on global surgery (Ma, 2020)	Global
A private sector gene testing start-up launching a fund to boost local testing capacity for COVID-19 (Kazeem, 2020)	Nigeria
A private sector and government partnership to use blood delivery software to track ventilators and respirators (Kazeem, 2020)	Nigeria
An open innovation challenge to encourage city residents to identify urban innovations and work with them to implement them (UNDP, 2020)	Nigeria, Ghana, Uganda, Zimbabwe, Ethiopia

An innovation platform to engage farmers and multiple stakeholders in the adoption of climate smart agricultural practices (Osorio-Garcia, 2019)	Colombia
An energy measurement and verification program incorporating gamification to increase awareness of energy consumption and incentivize energy reduction (Coan, 2019)	India
Harmonizing country-level regulations to expedite vaccine roll out on a regional scale, and synchronizing them with national regulations (Nkengasong, 2020)	Africa
Using blended finance to restructure debt and enable a transition to sustainable marine ecosystems in small countries (Smith, 2019)	Seychelles
Using public-private partnerships to finance the use of green, nature based solutions to improve the quality and quantity of water in a water-scarce region (The Nature Conservancy, 2018)	
Creating a public-private partnership to support a pooled vaccine purchases on a regional basis (Nkengasong, 2020)	Africa
Equipping startups to use crowdfunding to finance their projects (UNDP, 2019)	Egypt
Development of frameworks to bridge national frameworks with industry reporting on the SDGs (Empea, 2018)	Global
Integrating green elements into national COVID-19 stimulus plan (Ecosperity, 2020)	Malaysia
Using foreign aid to stimulate private sector processing of tomatoes (Ojomo, 2020)	Nigeria
Establishing the world's first investment fund for addressing the plastic crisis (Kaplan, 2020)	Asia
Creating a regional vision to reduce plastic litter to zero by 2050 (Alisjahbana, 2019)	Asia and the Pacific
Using foreign aid to stimulate private sector agriculture and agri-food innovation (Bernhardt, 2020)	Africa
Establishment of private-public funds to fund climate smart and clean energy provisions (Sumaila et al, 2020)	Ghana
Creation of a finance facility for infrastructure projects and businesses focused on climate change adaptation and mitigation	South Africa

Reflections on Applying These Learnings to Innovation at UNHCR

1. What are the supply-side drivers of the expected future state of our innovation attempts?
2. What are their demand-side drivers?
3. What are the ecosystem gaps i.e. to what extent do these drivers differ from the current drivers of the status quo?
4. Where might we be well-positioned to contribute to closing the loop and catalyzing our desired future state?

Generating Systems-spanning Knowledge

Finally it is important to keep generating actionable insights that help us make sense of the system. As the case studies on embedded research for community health provision in Ghana, as well as on scaling up sanitation technologies in the Hong Kong Special Administrative Region (SAR) of China show, when research is fit for purpose, participatory and embedded in the systems it hopes to change, it can play a significant role in supporting the desired impact on systems.

Research can help us understand crucial factors such as the current state of systems, what could work when intervening in these systems, and the impact of actions on the system. This can help to track activities against long term goals in real-time (The Nature Conservancy, 2020). Such knowledge can enable improvements to be made, map system capabilities, enable planning in cooperation with decision makers, facilitate community engagement, and demonstrate returns on investments to support scale up of activities (Peter and Kyem, 2000).

Different systems approaches to data collection can help explain interactions, unexpected findings, and counterintuitive outcomes so that we can have a better sense of the space between our interventions and outcomes (Rosenthal et al., 2020). Scientific methods can be used to predict the impact of particular initiatives on the adoption of innovations, help us understand how social structures influence the use of innovations and help us identify emergent patterns that can arise when an innovation is used at scale. In Ecuador, a study used social network analysis to understand social cohesion in relation to safe water sourcing, and agent-based models to understand how social units would respond to flooding and drought in communities (Rosenthal et al., 2020). Group model-building activities can be used to support community engagement and design, identify key behaviours and how groups affect one another's engagement with a desired innovation. System dynamics models allow for modelling how economic, social, physical, and policy conditions play out over time, and then how these factors may interact to lead to the use, adoption or frustration with an innovation.

Identifying Bright Spots

Research can also help us understand where the bright spots are – scenarios that show us where outcomes deviate from population averages, for example parts of a country which have much lower rates of displacement. These examples are important because they can

inspire novel approaches to dealing with problems. New methods also allow us to study these bright spots in ways that are more cost-effective and in real-time. For example, big data such as satellite imagery, sentiment analysis of social networks, remote sensing data, Geographic Information System (GIS) and mobility data can be used to understand sub-populations that have fare better than average with regard to particular outcomes, e.g. sub-populations that have lower rates of violence or better agricultural outcomes or pastoralists who have thrived despite climate change and more. These kinds of data can be used to identify solutions that can prevent further forced displacement and then assist communities to plan and protect their resources, while also helping to assess damage during conflicts, to estimate populations in settlements and to monitor human rights (Quinn et al., 2020).

Tools and practices such as these are important for organizations who invest in systems to get a better understanding of how their actions affect the system as a whole, identify positive cases, potential negative side effects that are not obvious, and also plan for the future. This is critical because investments that aim to help societies may sometimes create market failures, or create downstream challenges, or may be misused or have unintended consequences. In one example, a review of the food systems by Open Society's Foundation's Economic Justice Program had shown that upstream investments in fish farms indirectly enabled sexual exploitation, because most of the fish farms were owned by men who required sexual favours from women in exchange for fish (Palladium, 2019). This allowed the investor to then consider the value chain more thoroughly and invest in adequate solutions (Palladium, 2019).

Employing Inclusive Approaches to Knowledge Creation

In using various kinds of data to understand systems, it is important that such data are used in ways that add value to, rather than disempower communities (Kyem, 2000). Principles such as development of local capacity, use of data sources that are context appropriate, sharing of data in ethical ways, development of infrastructure and use of open-source tools can help ensure that big data is used effectively and ethically (Sarker et al., 2020). Additionally, it is important to ensure that networks of actors and communities can co-create knowledge, otherwise, it will be less likely that knowledge and subsequent solutions will be effective (Iloka, 2016).

Especially in emerging economies with formal and informal service provision, governance arrangements and infrastructure, co-creating knowledge is the best hope of getting a truer and more complete picture of the system (Akallah, 2020). **Looking for example, in a top-down way at only centralized modes of service provision misses “off grid” modes of supply, and thus limits our ability to make sense of the real landscape of infrastructure provision. Looking at technologies in terms of donors and recipients only can make us miss how communities not only use these tools and resources, but also co-produce them. Looking only at tangible assets such as financial capital, causes us to overlook the intangible assets such as networks, natural resources, and insider understanding that can limit the success of innovations.**

In addition to these considerations, in many communities, indigenous knowledge has guided planning, responses, and community mobilization to address several planetary health challenges. For example, knowledge of disaster prediction supported the Moken community

in adapting to the 2004 tsunami, enabled communities in Nigeria's Niger Delta to tackle erosions, helped communities in Eswatini to predict floods through the observation of birds, helped the Maasai tribe to improve the immunity of their livestock, allowed Sudanese communities to conserve water, and so on (Iloka, 2016). This valuable knowledge can inform more fit-for-purpose approaches to dealing with problems, but often may not be documented as it tends to be passed down through oral traditions and therefore missed out on if we limit our solution space to "traditionally" published archives as well as top-down decision-making.

Additionally, there is also the tendency to fit solutions to existing tools, rather than adequately understanding the true scope of the problem space and the solution space (Marufu et al., 2018). Research suggests that user-driven innovation not only can yield higher-quality approaches when compared to externally derived approaches, but also tends to be multi-functional, addressing several challenges e.g climate change, health and socio-economic challenges at the same time (UNDP Accelerator Labs, 2021). Therefore, without investing in participatory approaches that are inclusive to insights from communities, people innovating on the frontlines (Lee and Barnejee, 2020), this knowledge can be missed, and innovations will tend not be suitable or may indeed contribute to further marginalizing communities (Ezeanya-Esiobu, 2019). An added benefit of using participatory approaches to shape knowledge generation to guide innovation, is that this act itself can be transformative because traditionally marginalized groups such as women, indigenous communities and/or coastal communities tend to be the stewards of these very forms of knowledges (Ezeanya-Esiobu, 2020).

Reflections on Applying These Learnings to Innovation at UNHCR

1. What knowledge creation approaches currently guide our innovation processes at UNHCR and in the humanitarian innovation space?
2. What kinds of approaches would be important to help us address current challenges – identifying bright spots, understanding the problem in the context of the system, and understanding the scope of possible interventions?
3. What approaches can help us address emergent patterns that point to the future and incorporate them into our present day processes and strategies?
4. How do we explore, anticipate, and respond to potential negative impacts of our innovations?
5. What sorts of data, partnerships and voices could we be missing through our approaches to knowledge gathering and innovation and what could be the consequences of not including these voices?
6. Is the way these insights and knowledge are generated, collected and used adding value to communities? Is there room for improvement? Where and how so?

Concluding Thoughts on Innovating in Displacement

Earlier on, a case was made for exploring a range of similar kinds of problems beyond the particular problem of forced displacement in order to identify new approaches that could potentially be transposed to the field. This brief has therefore taken us around the world, to **explore the question of how innovation can guide transformative system shifts, with a lens on planetary health challenges, challenges which will define human lives on this planet in the 21st century, and which while different have intersection points with forced displacement.**

We have explored case studies of innovation in emerging economies through the lens of **adaptive innovations to address existing health challenges** as well as **anticipatory innovations to "flatten the curve" of health problems**. We have explored the **supply-side** factors of product innovations and innovations in processes and models of product and service delivery; as well as the critical **demand-side innovations** which enable them.

In innovating in forced displacement, it is important to think beyond immediate crisis responses to consider the spectrum of challenges leading to any one crisis of forced displacement as well as trends which will shape future forced displacement. It is also important to understand how the work of UNHCR in addressing forced displacement interfaces with other sectors and stakeholders. This will allow UNHCR to ensure both the problem space and UNHCR's articulated solution space for innovation are able to yield sustainable solutions. To do this, capabilities to **understand both the upstream and downstream drivers of challenges, to understand how challenges interface across systems, and innovate for sustainable solutions should ground the UNHCR's innovation processes.**

In building its institutional learning processes, UNHCR should also consider what tangible assets (e.g data collection tools) as well as intangible assets (e.g community experience

and relational capital) could help enhance its systems learning as it innovates on forced displacement. Such learning processes will allow UNHCR pinpoint areas where it can have the most leverage in innovating on the complex challenge of forced displacement. Supply side factors such as the design of products, the features of services, as well as demand side factors such as policies, incentives can all shape the fit between innovations and their target context. It is important to make sure that there is a fit in this regard. This will **avoid the use of solutions that are easy but not sustainable, have been used elsewhere but are not a fit for the population, or are the wrong lever for adequately addressing the challenge in the context.**

There are some topics that could be covered more exhaustively in the future. One of them is a more in-depth appraisal of the case studies to thoroughly understand their long-term impact. This will help us understand better what worked, why, for whom, and identify any unintended consequences. Another area that will benefit from more exploration is the financing and partnership arrangements that enable the development and sustenance of both supply-side and demand-side innovations. However, it is hoped that this brief has provided some helpful starting points to inform innovation in forced displacement and to create opportunities for thriving populations and a thriving planet.

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