PANDEMIC PREPARATION AND RESPONSE: ENSURING EQUITABLE ACCESS TO ESSENTIAL COUNTERMEASURES

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LIECHTENSTEIN INSTITUTE ON SELF-DETERMINATION AT PRINCETON UNIVERSITY

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EXECUTIVE SUMMARY

This policy report summarizes insights from a conference organized by the Liechtenstein Institute on Self-Determination (LISD) and Global Health Impact's Pandemic Health Equity Working Group on February 28, 2025. The conference, titled "Pandemic Preparation and Response: Ensuring Equitable Access to Essential Countermeasures," examined structural and legal limitations to pandemic response in light of the World Health Organization (WHO)'s Pandemic Agreement. The conference was held under the Chatham House Rule, although many panelists waived anonymity, and was cosponsored by the Center for Health and Wellbeing, the Office of Population Research, and the Program in Law and Public Policy.

The event brought together public health experts, former government officials, legal scholars, and ethicists, with the aims of:

- discussing intellectual property (IP) solutions to enhance progress toward readiness to combat future pandemics and to secure equitable access to essential countermeasures;
- examining how downstream service delivery can be addressed to further strengthen and identify gaps in the Pandemic Agreement; and
- proposing solutions toward the development of an agreement and medical countermeasures platform that is equitable and responsive to the needs of all people on the globe.

The conference opened with a keynote from Dr. Pedro Conceição, director of the UN Human Development Report. This was followed by a panel on IP barriers, focusing on how to promote innovation, transparency, and equitable access. The conversation then shifted to health systems in low-resource countries, with a keynote from Dr. Agnes Binagwaho, former minister of health of Rwanda, on the country's transition toward health system efficiency. The subsequent panel discussion focused on health system responses and pandemic service delivery.

Participants highlighted both legal and structural barriers that hinder efficient, effective, and equitable pandemic response. Individuals emphasized the inequities embedded in the World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), particularly regarding global medicine distribution. IP rights were noted to raise the cost of pandemic-related health technologies, limit supplies, and result in inequitable distribution. IP rights can also disincentivize needed-but-low-profit innovations, and can hinder biopharmaceutical production capacity in lower-income countries. These dynamics not only limit equitable access in low-income countries, but also undermine global health security by slowing pandemic-related research. As potential solutions, participants emphasized the importance of, among others, compulsory licensing as a means of circumventing IP rights and stronger partnerships between high-income countries (HICs) and low- and middle-income countries (LMICs)—as well as among LMICs themselves—to ensure effective technology transfer. Article 11 of the Pandemic Agreement adopts proposals aligned with those raised

at the conference, underscoring the urgency for IP reform. In the health systems panel, participants identified several structural limitations in low-income regions, including poor governance, inefficient medicine distribution, workforce shortages, insufficient financing, lack of preventive health infrastructure, and an overreliance on high-income countries. Recommendations included rebuilding health systems from the bottom up, investing in preventive infrastructure, and leveraging innovation in artificial intelligence (AI).

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INTRODUCTION

The global response to the COVID-19 pandemic was characterized by delayed and inequitable access to protective personal equipment, vaccines, diagnostics, and therapeutics that may have shortened the pandemic and lessened its health, social, and economic impacts. There were many drivers of inequity: a lack of public health preparedness, products ill-adapted for use in resource-limited poor settings; inadequate and inequitable resource mobilization and allocation; disparities in health system capacity and social supports; weaknesses in global health governance; delays in guidance and regulatory processes, and other drivers. The now-concluded negotiations of the Intergovernmental Negotiation Body (INB) of the WHO attempt to address equity as a central element of the global health architecture to prepare for future pandemics. The INB, which initially hoped to provide the text for a binding agreement to the World Health Assembly in May 2024, was forced to expand its work to settle remaining disagreements among the parties and to turn principles into agreed-upon text. This conference, held on February 28, 2025, gathered public health experts to discuss equitable measures for pandemic preparedness and response. Although the negotiations concluded in April 2025, the agreement will not enter into force until 60 member States have ratified it, and significant challenges with implementation will persist beyond that date. The insights from panelists and other contributors at the workshop thus remain relevant.

BACKGROUND: UNDERSTANDING GLOBAL HEALTH FRAMEWORKS

Health as a Public Good

Dr. Conceição discussed the concept of global public goods—resources that benefit all of humanity—as a dominant framework in public health discourse. He observed that this framework should foster solidarity and interdependence between countries, but that the framework is often ignored to the detriment of low-resource nations during disease outbreaks. Specifically, the reliance on high-resource countries for access to public goods has strained global relationships and revealed structural inequities. Conceição argued that before framing pandemic preparedness as a global public good, we must first recognize the differences in how such goods are implemented and accessed across contexts.

To illustrate this, he compared global public goods across domains: although climate change mitigation requires coordinated global effort, other challenges, such as preventing an asteroid impact, may depend on the capabilities of a single nation. Pandemic prevention, he emphasized, falls firmly in the former category, demanding robust collective action. Regardless of how

resilient a single country's health system may be, no one is truly safe unless the most vulnerable nations, that is, the "weakest links," are also protected. As such, Dr. Conceição proposed that identifying and supporting these weak links should be a priority in global health.

Although international agreements can incentivize countries to invest in global public goods, the greatest barrier remains financing. Despite the clear global benefits, wealthy nations have been reluctant to fund health initiatives in LMICs. This reluctance is compounded by unpredictable domestic political shifts within countries critical to global health governance, making sustained international cooperation and negotiation even more difficult.

DRIVERS OF INEQUITABLE ACCESS TO MEDICINES

Intellectual Property

A major driver of inequitable medicine distribution during the pandemic was the WTO's Agreement on TRIPS, which set minimum standards for IP protection globally, including patents on medicines and vaccines. Dr. Els Torreele, a global health scholar, critiqued the WTO TRIPS Agreement for perpetuating global inequality. According to Dr. Torreele, TRIPS consolidated the power of HICs while keeping LMICs economically dependent. Under TRIPS, HICs were positioned as "value creators" that controlled IP and innovation, while LMICs were relegated to the role of "commodity producers." This disparity was especially evident during financial crises: whereas countries like the United States could print money to alleviate debt, LMICs had to borrow at high interest rates, deepening their economic vulnerability.

Also according to Dr. Torreele, IP rights presented the greatest challenge to cooperation during the pandemic due to a "winner-takes-all" reality. In the scientific and medical fields, value is created through ownership of intellectual products. Although many institutions collaborate and share research to develop vaccines, only the individuals who create the final product are financially rewarded for their work.

Similarly, she argued that as a result of the IP framework, clinical trials for drugs benefit pharmaceutical companies, rather than primarily consumers. Although proponents claim that the public health knowledge gained from clinical trials helps the broader community, the real value lies in the scientific data companies obtain from these trials, often at the expense of the health workers and subjects who participate.

Prof. Brook Baker, professor emeritus at Northeastern School of Law, agreed with Dr. Torreele's sentiment on the global order's unfair structure, adding that with US President Donald Trump's withdrawal from the WHO and his dismantling of the US Agency for International

Development (USAID) and the President's Emergency Plan for AIDS Relief (PEPFAR), the lives of many people who used to work in solidarity have been destroyed. Clinics are no longer providing treatment, and the essential progress made by NGOs is being lost.

Prof. Baker also argued that the current trade system prioritizes profit over collaboration, limiting opportunities for cooperation among researchers. Due to commercial incentives that favor competition, researchers are reluctant to test treatment regimens against one another or to combine medications, even when doing so could enhance outcomes. Moreover, instead of investing in pandemic preparedness, both the private sector and government agencies continue to fund more profitable research.

Even when clinical trials were conducted for essential medicines, Prof. Baker contended that they were rarely inclusive or effective. Rather than serving public health needs, these trials primarily catered to the interests of IP owners who were focused on maximizing profit. As an example, he pointed to the 2008–2012 oral pre-exposure prophylaxis (PrEP) trials for HIV. These studies aimed to assess the effects of PrEP on men who have sex with men and transgender women who have sex with men, overlooking the significant HIV burden faced by African women.

Prof. Baker stated that such trials were not designed with equitable access to medicines in mind. This concern reflects a broader flaw in the current IP framework, which often fails to support the development of technologies suited to low-resource settings and the needs of the most vulnerable populations. Instead, IP protections frequently hinder both the innovation and distribution of medicines tailored for these contexts, leaving LMICs disproportionately burdened by disease.

He also highlighted that IP holders were disincentivized from stockpiling medicines—a key tactic in pandemic preparation because only HICs could afford to purchase vaccines and other medicines— and worried that fewer countries would be able to afford essential technology due to less international aid, further exacerbating inequitable medicine distribution.

Proposed Structural IP Reforms for Equitable Access

The global health economy is largely shaped by a few dominant actors, with the US historically playing the most influential role. This dynamic excludes LMICs from accessing the most recent drugs at a reasonable price, leaving many countries instead with older, lower-quality technologies. To address this, Dr. Torreele advocated for more regionalized manufacturing capabilities and for sharing technology. An example of this approach could be seen in countries like South Korea, China, and Cuba, which have established regional stations for medicine development. According to Dr. Torreele, regional distribution, rather than reliance on technology transfer during crises, is a more effective and efficient way to distribute medicines and to prepare for pandemics. Resource-limited countries have repeatedly expressed that they do not wish to compete with Western corporations—they simply want access to medicines.

She envisioned a future characterized by a more robust and equitable partnership between the Global North and South in advancing technological innovation. In her view, the Global South should no longer be seen merely as a source of extraction, but as an essential partner in driving technological progress and innovation.

Prof. Baker proposed that countries in the Global South should prioritize building South-South partnerships rather than waiting for cooperation from the Global North. Governments in HICs have shown little interest in supporting LMICs, so LMICs should focus on developing technology on their terms. One potential strategy, according to Prof. Baker, would be the use of compulsory licensing, in which a government permits the use of patented technology without the patent holder's consent. But Prof. Baker understood that compulsory licensing has limitations, particularly during a pandemic. To block these licenses, technology owners often secure patents for every individual component of a medicine. For instance, antiretrovirals may have had over 800 separate patents, making it extremely difficult for a new manufacturer to gain authorization for production.

Dr. Viviana Muñoz Tellez, policy expert at the South Centre, agreed that overcoming IP rights is central to pandemic preparation and her work tries to refocus research and development to target the demands of the Global South. However, she affirmed that private-public partnerships are essential to research and development, citing the historical role public research had played in fostering intellectual property in the private sector.

During the pandemic, voluntary licenses—the commercial practice of IP holders granting licenses to their patents—were used to increase access to new COVID-19 therapeutics in low-income countries. Although useful, Dr. Muñoz Tellez opposed voluntary licensing as the primary means to bypass IP contracts, arguing that it lacked transparency and often failed to provide essential information promptly. More broadly, she criticized the IP framework itself for not offering the flexibility needed to navigate technology distribution in times of urgency.

Another panelist expressed support for compulsory licensing, but hesitated to prioritize it at the expense of broader structural reform. Solutions that target improving supply chains and ensuring equitable distribution of medicines, she remarked, are more valuable than compulsory licenses.

An additional solution provided to LMICs during the pandemic was the use of COVID-19 IP waivers, which temporarily suspended IP protections. Typically, Europe adopts a slightly more left-leaning stance on IP conflicts than the US, aiming to avoid retaliation from international partners who criticize Western trade policy. However, to the surprise of European leaders, U.S. President Joe Biden supported an IP waiver on COVID-19 vaccines. The panelist called on Europe to assume a more active role in global health technology distribution.

Later in the conference, representatives from the Africa Centres for Disease Control and Prevention (Africa CDC) emphasized that Africa no longer wishes to depend on Western manufacturing for vaccines and essential health technologies. During the COVID-19 pandemic,

Germany, despite not pre-ordering vaccines, gained access to vaccine technology before many African countries, highlighting the unfair dynamics between Western nations and Africa. Lessons from the pandemic and the current Mpox crisis have inspired leaders of various African countries to push for more local manufacturing facilities. South Africa President Cyril Ramaphosa has publicly emphasized the importance of local vaccine production and distribution and is expected to support the expanded production of vaccines within South Africa. Similarly, Morocco is preparing to launch domestic vaccine production, and the Africa CDC is actively collaborating with pharmaceutical companies to strengthen vaccine development and manufacturing across the continent. However, building sustainable local manufacturing infrastructure will require significant time, investment, and coordination.

The WHO Pandemic Treaty Negotiations

Mr. James Love, director of Knowledge Ecology International (KEI), provided comments on the negotiation process of the WHO INB toward a pandemic agreement. The negotiations had a promising start in the immediate wake of the COVID-19 pandemic, with policymakers regretful about mistakes that were made during the health crisis. Policymakers recognized that they had been insufficiently prepared and that equity needed to be prioritized. But over time, fatigue grew among the negotiating parties. Mr. Love considers this unfortunate, because it is an important and complex agreement. Negotiations in Geneva went on for weeks, putting financial pressure on attendees. The start of the negotiations was also characterized by a high degree of secrecy. Decision-making stalemates emerged, and many actors scaled back their ambitions, with the discussion largely returning to resemble that of a typical panel on industrial policy. The language used in the document became loose, impotent, and nonspecific, with little focus on accountability.

Mr. Love gave an example of one heated debate: whether to define technology transfer as a process that must occur on mutually agreed terms versus *voluntary* mutually agreed terms. Voluntary in this case pertains to the rights of private corporations to their IP and products. This framing was largely driven by the G7 countries. The debate briefly moved from mutually agreed *terms* to mutually agreed *processes*, but that strongly deviated from conventional usage and was ultimately abandoned. As Mr. Love sees it, any actions defined as voluntary should be considered *without prejudice* in relation to alternative, nonvoluntary pathways that a State might consider. At stake is whether a State can mandate any sort of technology transfer. This is important for developing countries, which will otherwise be last in line.

He added that the European Union (EU) and the US intended to pressure developing countries, but that there is precedent in EU regulations for the sharing of IP and know-how during emergencies. The EU Defense Production Pact allows States to pursue voluntary licenses, and, if not possible, involuntary licenses. KEI worked to make sure that all negotiators were aware of the EU regulations.

At the time of the conference, the EU had indicated that there should be no pressure on parties with respect to technology transfer and that technology transfer could not be a condition of procurement. The obligations of technology transfer in the agreement are not prejudiced to other measures that member States can take to advance preparedness.

Mr. Love remarked that the EU negotiators were dissatisfied with this outcome; they wanted to avoid plain language to enable future manipulation at the expense of those who cannot fully parse the minutiae of the text. The EU does not want to take the blame for the failure to reach an agreement, but with the US withdrawing from the WHO, they cannot pass the blame to the US.

Mr. Love correctly anticipated that the Pandemic Agreement could be finalized before May 2025, given the current level of consensus reached across all articles under consideration. The final agreement is extremely broad-ranging. With the US withdrawn from the agreement, the EU held immense power to veto any amendments that arose. The EU insisted that it should be able to vote on behalf of all of its members, even if States are absent. In practice, this means that the EU had enough votes to block amendments, annexes, and protocols. Hence, Mr. Love also foresaw that any final form would have to bend to the interests and demands of the West.

Ms. Rachel Cohen, senior advisor at Drugs for Neglected Diseases Initiative (DNDi), explained DNDi's involvement in Article 9 of the agreement on research and development, which Mr. Love asserted had some of the better language in the agreement. Consensus was reached—the article was greenlighted—by the time of the workshop, and this is the first time that an international agreement requires States to put in place terms and conditions for research and development funding to ensure equitable provision. There are provisions that speak about affordability and technology transfer, and that would help ensure a sufficient supply of medicine and health tools. Such measures would encourage more equitable and sustainable distribution and transfer mechanisms, especially in publicly owned research. But currently there are no binding obligations requiring corporations or governments to share information.

Ms. Cohen emphasized that the reason DNDi cares about the highly detailed footnotes in the Pandemic Agreement is because it determines access to lifesaving medical care. Now that the member States have successfully concluded negotiations, the Pandemic Agreement has been a bright spot, showing that multilateralism is still alive. But these policies will still need to be implemented at the national level.

Crucially, nothing in this agreement can undermine other international agreements. States should not feel that they only have the option of voluntary licenses when the reality is that there are many nonvoluntary mechanisms to pursue population health. In today's context, every dollar of national funding will need to stretch farther than possible to ensure population health, and DNDi is thus particularly concerned with articles in the Pandemic Agreement that support assurance of affordable, accessible health services.

HEALTH SYSTEMS AT COMMUNITY, REGIONAL, AND NATIONAL LEVELS

Rebuilding Rwanda's Healthcare System

Dr. Binagwaho reflected on Rwanda's emergence from the 1994 genocide, during which approximately one million people out of a population of 7 million were killed, often by neighbors or even family members. In the aftermath, no family was untouched by loss or guilt.

Rwanda was left without a functioning health system or public trust. Rebuilding was extraordinarily difficult. The genocide had decimated the country's human capital—doctors, nurses, and other health professionals were either killed or had fled. With a population in deep psychological distress and only 20 doctors for 6 million people, the healthcare system was nearly nonexistent. After the genocide, Rwanda's leadership became dedicated to the wellness of the people, ensuring that any initiatives to improve the wellbeing of the population received strong government support.

The first objective after the genocide was to fight fear of the opposing tribes and of retribution. Rwanda President Paul Kagame was then head of the army, and he announced that going forward, those who killed would be the first to face justice. The death penalty was ultimately abolished in Rwanda.

While she was in government, Dr. Binagwaho decided that to rebuild, the country had to prioritize equitable access to healthcare as a strategy. By law, 13 percent of the budget of the health sector has to cover healthcare for the 20 percent poorest, who receive services free of charge. Dr. Binagwaho stressed the importance of making good ideas into law, as legal commitments are far harder to reverse.

Rwanda also needed a self-sustaining healthcare system. One key community effort implemented was the Umuganda, meaning "coming together in common purpose," an event held on the last Saturday of every month. On this day, all able-bodied people between 18 and 65 years of age come together. Each village of about 200 houses (it also occurs in urban areas) elects a head of the village for three years. He or she is there to make sure that everyone in the village eats every day, has a place to stay, and that children, many of whom are orphans, are taken care of. Umuganda was instrumental in building health centers—allowing the country to function despite limited resources—because "we do things for ourselves." Today, over 90 percent of Rwandans have healthcare.

When Dr. Binagwaho and her team were working to establish a healthcare system and universal health insurance system, they faced resistance from the US and the United Kingdom, whose officials argued that health was not a priority for a post-conflict nation emerging from genocide. But Dr. Binagwaho understood that health equity was essential. Despite pressure from USAID

and Virgin Corporation to implement their own programs, she declined, choosing instead to build on existing health programs already established in other parts of the country. This was important for fostering unity, given that there had been regional inequities before.

Without a national census and with income levels hard to assess, determining healthcare tax contributions was also challenging. Therefore, the government needed public buy-in, especially from people who did not previously trust the healthcare system. Some people were so fearful that they would not visit a hospital. Moreover, the majority of the population were farmers and women working in the fields, neither of whom had close access to healthcare facilities. Improving access was imperative because women with young children could not afford to travel more than a day to seek healthcare.

So, the government created a system whereby your neighbor decides how much you need to pay in taxes. The indigent were given the agency to make sure that the system runs smoothly. This approach fostered a strong communitarian spirit, in which people took ownership of their responsibilities. The head of each village was accountable for ensuring that all community functions operated smoothly; any shortcomings fell under their responsibility. Heads of villages frequently meet to discuss their problems, which builds the community's knowledge. Rwanda created a system of self-reliance: people own their communities and know one another, which creates accountability and trust. Today, each Rwandan can access healthcare close to home, an achievement that was unimaginable in the past. As Dr. Binagwaho said, "The country brings health to all people."

Although Rwanda is still classified as a low-income country and faces challenges from migration, the nation has one of the highest life expectancies in sub-Saharan Africa. Infectious diseases like malaria and tuberculosis have been brought under control through the widespread use of vaccines and antibiotics. Rwanda is also the world's most highly vaccinated country against human papillomavirus, with 90 percent of girls receiving the vaccine. Today, the country's biggest health challenges lie in managing the rise of noncommunicable diseases.

Dr. Torreele asked about Rwanda's approach to local manufacturing, innovation, and IP. Dr. Binagwaho responded that Rwanda supports protecting knowledge, because research is expensive and knowledge has value. But she disagrees with policy that limits manufacturing to dire times, such as a pandemic. She proposes that the industry and wealthier countries share manufacturing, so that factories elsewhere can produce medical countermeasures and charge others.

Dr. Binagwaho explained that Rwanda's pandemic preparedness stemmed from its efficient vaccine delivery system. During the COVID-19 pandemic, some wealthy nations offered nearly expired vaccines to many low-income countries. Most nations had reasonably denied this offer, as a time frame of three weeks was too short to administer millions of vaccines. But Rwanda, having built a strong healthcare delivery system, accepted the vaccines. When the planeload of vaccines arrived in Rwanda, the military used transport trucks to facilitate their efficient distribution. Radio broadcasts were consistently sent to inform citizens about upcoming vaccine drives. At-home vaccination options were made available to people who could not attend

drives. Beginning with health professionals and high-risk groups, the Rwandan health ministry vaccinated nearly its entire population in four days. According to Dr. Binagwaho, that type of efficiency would not have been possible in the US, because there is low trust in the government given its history of harmful medical research on minorities.

Ultimately, Dr. Binagwaho emphasized that ensuring equitable access should be the primary objective for countries preparing for future pandemics. Rather than focusing solely on a top-down health system approach, efforts should prioritize equity across multiple scales—regional, continental, and global.

Smallpox Eradication in Afghanistan

Ms. Kristina Engstrom and Ms. Jill Vickers reflected on their work with the Peace Corps on WHO's smallpox vaccination program in Afghanistan in the late 1960s. They recalled cultural differences, language barriers, poverty, and logistical challenges in fulfilling their duties, as well as the generosity of the Afghans they met.

People knew about smallpox and its severity: one-third of patients died and survivors often suffered from blindness and disfigurement, yet for various reasons not many were vaccinated. The major role of the female Peace Corps vaccinators in Afghanistan was to reach women, who would not ordinarily allow men to see a bare arm much less inject them with a vaccine. In 1967, when the WHO made the eradication of smallpox its goal, the work of all vaccinators began to receive more support. In Afghanistan, the government mandated that all people were to be protected against smallpox. Many other countries collaborated; for example, all the vaccines and some supervisory personnel came from the Soviet Union. The US assigned two small groups of Peace Corps women to Afghanistan, mostly young women with a liberal arts education, but also a few nurses, a phlebotomist, and a woman with a Ph.D. in physics, to join teams of male vaccinators from the Afghan Ministry of Health.

The WHO-supported program was slow to get off the ground, but as transportation improved and money arrived for drivers, fuel, and Afghan vaccinators, work accelerated. With their teams of Afghan health workers, one or two volunteers met with local leaders and then walked door to door and village to village. Since bringing their food with them was insulting to Afghan villagers, whose hospitality is famous, they depended on the people for food, shelter, and protection. They found that, especially during outbreaks, delivering vaccinations to the places where people lived was more effective than expecting people to travel to them. To communicate with counterparts in Farsi and to rely on counterparts to persuade local leaders were also key ingredients for success.

These women showed that foreigners could vaccinate Afghans and that communication skills, in the broadest sense, were paramount: they did not need to be native speakers but had to care about everyone they met. They found a close connection, especially with the women of Afghanistan, noting that, "When we look in someone's eyes, we can recognize each other."

Over time, the Afghan Ministry of Health changed its strategy from mass vaccinations to targeting problem areas based on surveillance activities. The Peace Corps vaccinators did assessment and surveillance work and finished their tours by the early 1970s. At the end of that decade all-Afghan teams of vaccinators, the great majority of which were made up of men, had vaccinated enough men, women, and children to warrant a certification of smallpox eradication.

IMPROVING HEALTH INFRASTRUCTURE AND MEDICINE DELIVERY

Limitations in Health Infrastructure

Ms. Amanda Banda, global health advocate, emphasized how the COVID-19 pandemic exposed critical inefficiencies in health systems across LMICs—particularly the chronic underinvestment in supporting healthcare workers. Globally, Ms. Banda noted, health systems are often viewed as costs rather than long-term investments critical to economic growth. This perspective limits long-term investment in healthcare, negatively impacting equitable access to quality healthcare and workforce. As populations in LMICs continue to grow, the ratio of patients to healthcare workers becomes increasingly unmanageable, stretching already fragile systems to the breaking point.

Ms. Banda pointed to the pandemic as an example of this overburden. During the pandemic, many LMIC health workforce were severely strained due to limited access to tools and equipment and a lack of mental health services. This worsened the brain drain, prompting additional healthcare workers to seek employment opportunities abroad. Although some countries responded with community-based recruitment and volunteer programs to bolster the workforce, these efforts proved insufficient. She expressed deep concern over the unethical recruitment of health care workers without any compensating investments in the health workforce and systems capacities in LMICs. Instead, many wealthy nations continue to recruit healthcare workers from poorer countries, further exacerbating the healthcare shortage in LMICs. Ms. Banda cited Malawi as an example, noting that the country in the early 2000s had more Malawian doctors living and working in Manchester, England, than in Malawi. Although the situation has improved now, the doctor-to-population ratio remains high and the government is unable to spend more on its health budget due to its high debt burden, among other reasons.

Equity and Leadership in National Health Systems

Dr. Alyssa Sharkey, lecturer at Princeton University, commented on the role of equity and the limitations of top-down, bottom-up approaches in pandemic preparedness. Rather than national leadership, she explained, countries should prioritize regional leadership. Currently, at

the regional level, needs are not being met. Dr. Sharkey highlighted that in Afghanistan, , public health officials only distributed smallpox vaccines, failing to provide other essential needs like food and water. Without fulfillment of basic needs, Sharkey asserted that building public health trust would be difficult.

Dr. Sharkey also emphasized the pivotal role of political leadership in advancing public health, pointing to Rwanda's historic milestone as the first country in the world to eliminate cervical cancer. She noted that Rwanda's success was not driven by the largest budget, but by strong leadership and a commitment to health equity.

Similarly, Mr. Peter Carrasco, former director of the International Association of Immunization Managers at Sabin Vaccine Institute, reflected on the importance of working with local leaders and building trust in communities. Smallpox, for example, was eradicated in Africa largely due to the efforts of local healthcare workers. Mr. Carrasco lamented that the world failed to learn the right lessons from the 2009 H1N1 outbreak, as critical public health structures were never adequately established. Mr. Carrasco outlined four essential circles necessary for effective pandemic preparation:

1. policies and trust in leadership;
2. digital information at the community level: for the next pandemic, we must invest so that every health center has access to the internet to manage mistrust and misinformation and messages must be sent locally;
3. health infrastructure: an assessment is needed at least every two years—many people do not have adequate access to healthcare facilities, even in the US; and
4. health industry: regional policies should be established and empowered, including for the regional production of vaccines, since countries cannot afford to wait for donors to come through.

Mr. Carrasco ended by saying that it was a question of resources as well as of political will, specifically, how governments manage tax collection, address debt burdens, and confront financial corruption among political elites.

Smart Solutions for Weak Health Systems

Dr. Benjamin Rice, postdoctoral researcher at Princeton University, continued the discussion on health systems by using an analogy to highlight the importance of implementing more preventive strategies. In his analogy, he described how Mexico City, despite significant urban growth, had failed to upgrade its outdated drainage systems. Consequently, during heavy rains, engineers could only redirect water to prevent flooding, often diverting it to the poorest neighborhoods, where residents lacked the political power to push back. Dr. Rice likened this to the COVID-19 pandemic response: countries with underresourced health systems, particularly LMICs, were unprepared and disproportionately affected, while HICs with better infrastructure and access to technology, fared far better. He proposed that instead of focusing

on pandemic response, there needs to be more focus on pandemic prevention through high-scale infrastructural improvements. In his Mexico City example, even with upgraded floodgate software the city remained vulnerable to flooding because of outdated drainage infrastructure. Likewise, granting LMICs equitable access to vaccines, while crucial, is on its own insufficient to prepare the world for future pandemics. There needs to be more investment in healthcare systems, such as routine service delivery, equitable access to data, and response speed to outbreaks. Improving high-level preventive measures, rather than response measures, Rice argued, is a more effective solution.

Dr. Niraj Jha, professor of Electrical and Computer Engineering at Princeton University, presented neural networks as promising tools to accelerate healthcare-service delivery. Prof. Jha and his team have used smartwatch sensors to detect diseases like COVID-19 and Type I and II diabetes, in addition to mental health disorders like depression, bipolarity, and schizophrenia. During COVID-19, these watches accurately predicted infections before individuals became superspreaders, with a false positive rate of 1 percent and a false negative rate of only 5 percent. Although novel, Prof. Jha suggested that these affordable watches could play an essential role in preventive healthcare. He also proposed a better way to train AI large language models (LLMs). Current LLMs tend to "hallucinate," meaning that they confidently provide incorrect or misleading information. Because these models are trained on internet data, they learn good and bad data. Instead, he proposed that fine-tuning LLMs from the bottom up using peer-reviewed databases like PubMed and Web of Science. In doing so, Prof. Jha claims that AI can streamline the research process.

CONCLUSION

Our global response to the COVID-19 pandemic faltered, with equity and solidarity more often than not losing out to vaccine nationalism and industry profiteering. The inequitable access to vaccines and therapeutics resulted in the unnecessary loss of life; Prof. Nicole Hassoun, founder of the Global Health Impact Project, stated that the WHO failed to protect everyone's health in part because no existing mechanisms—treaties, agreements, and collaborations—had the force of law. A similar reflection among stakeholders was an impetus for the WHO process to adopt a binding agreement for future pandemics. Negotiations in Geneva concluded successfully shortly after the workshop, but the new Pandemic Agreement will not enter into force until 60 member States have ratified it, which is not likely to be for a few years. Beyond that date, challenges with implementation—many of which were highlighted by panelists in their presentations—will persist: there continue to be obstacles in the form of IP regimes, manufacturing capacity, and weak health systems in LMICs. As a result, the workshop panelists and other contributors considered possible innovations at regional, state, and local levels to complement efforts at the WHO. In Prof. Hassoun's words, to overcome these remaining challenges, "We need the strength to commit, the ability to imagine, and the will to act."

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