



The WHO Council
on the Economics of
Health for All

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The mRNA Vaccine Technology Transfer Hub: a pilot for transformative change for the common good?



World Health
Organization

EXECUTIVE SUMMARY

The World Health Organization created the mRNA technology transfer programme (mRNA TT Programme) in mid-2021 to meet requests from low- and middle-income countries (LMIC) for support in developing their local vaccine manufacturing capacity and responding to the COVID-19 pandemic. It was initially set up as a technology development Hub in South Africa, that would transfer the technology to several spokes, or technology recipients, in around 15 LMICs.

Despite its relative novelty, mRNA technology is uniquely suited for decentralized capacity building in LMICs. In addition to versatility and adaptability as a technology platform (with potential applicability in multiple disease areas), it is relatively easy to set up small- to medium-scale manufacturing infrastructure and capability, without the complexities of biological vaccines.

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This case study builds on the vision of the WHO Council on the Economics of Health for All to put health, well-being and equity at the centre of the economy, and adopts the Council's core themes of rethinking value, finance, innovation and capacity in the economy. The study puts forward a bold new value proposition that frames the mRNA TT Programme as a collective effort among participating stakeholders towards resilient epidemic preparedness and response capacity for the common good. This requires shaping health-industrial research, development and manufacturing ecosystems for health equity, doing more than just fixing the market, and putting the concept of the common good at the centre of all this.

The WHO Council on the Economics of Health for All recommends that the mRNA TT Programme is considered a common good for epidemic preparedness, driven by South-South collaboration and pursuing the shared mission of health security, centred around equity and local resilience.

Building on the still evolving nature of the mRNA TT Programme, the Council recommends to pursue a collective end-to-end approach as follows:

- **Agree among participating partners and countries, including donors, to join forces behind a common vision for a shared mRNA technology platform** to collectively develop a research and development (R&D) pipeline and deliver health technologies where and when needed to address local health needs. This requires measuring and pursuing collective success towards health security, equity and resilience as opposed to a focus on each partner's individual ability to produce or be economically viable. It also requires leveraging the strengths of all participating organizations into a common-good approach for health, and designing an appropriate governance structure to that effect.
- **Co-create a regenerative business plan based on the collectively owned knowledge and technology platform**, with clear access and user rights alongside joint investment and sharing obligations, and contractual arrangements among all partners that reflect the common-good approach. Use the collective business plan to raise the right level of funding from public and, if appropriate, private sources, and structure the financing in ways that advance public health objectives collectively.
- **Establish metrics for success that capture the end-to-end value proposition**, including the timely production of quality mRNA products through multiple small- to medium-scale units that are ready for activation when needed, to produce epidemic countermeasures at an acceptable cost-of-goods. Additionally, establish a diverse R&D portfolio that addresses local health needs.

- **Clarify and as needed take action to ensure freedom to operate without intellectual property (IP) constraints** in the development, manufacture, commercialization (including export), and use of health products based on the mRNA technology. This may require individual government action, or regional/global approaches including the use of legal tools available under international law.
- **Explore innovative financing mechanisms to create fiscal space for participating governments of low- and middle-income countries (LMIC)**, and harness public and aligned (slow, long-term) private financing for the mRNA Hub from international financing institutions and private markets (for instance, through a collective bond issue guaranteed by current mRNA donors).
- **Develop an advocacy strategy to engage participating governments and donors to support this initiative** as a timely pilot for sustainable epidemic preparedness and response for the common good. The support should include adequate financing and procurement policies and practices that are aligned with the initiative's equity, resilience and health security objectives.

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These key principles, including some that are already embedded in the evolving nature of the mRNA TT Programme, could help make the initiative a blueprint for transformative change, where technology sharing and collective intelligence become the drivers for a long-term, sustainable collaborative platform among all members of the Hub. This more ambitious version of the mRNA TT Programme can serve as a pilot towards an end-to-end ecosystem for epidemic countermeasures as global common goods, as proposed by the WHO Council on the Economics of Health for All. It is also in line with recommendations of the Independent Panel for Pandemic Preparedness and Response.

1. Introduction, objectives and framing of the case study

The coronavirus disease 2019 (COVID-19) showed the strategic importance of having control and autonomy over technological innovation and production capabilities for critical health technologies like vaccines, treatments and diagnostics to address public health crises, especially for the Global South.

In response to the highly inequitable availability of COVID-19 vaccines, multiple initiatives are underway to build or strengthen local vaccine manufacturing capacities in different regions of the world. These initiatives are expected to increase global vaccine manufacturing supply capacity and expand its geographic distribution. They range from international vaccine producers like Moderna, BioNTech and Pfizer setting up their own manufacturing facilities in Africa, to voluntary licensing deals including technology transfer to a range of other producers in LMICs (a strategy pursued by Sinopharm, AstraZeneca, Sinovac, Gamaleya, among others), and local innovation efforts in certain middle-income countries (MICs) (for example Finlay Vaccine Institute in Cuba, Bharat Biotech in India).¹

In this context, WHO created the mRNA TT Programme in June 2021 to help LMICs strengthen and develop (COVID-19) vaccine-manufacturing capacity.² The mRNA TT Programme has the unique ambition to establish and share mRNA vaccine technology as a strategic capability in participating countries in the Global South. The goal is to enable them to enhance their response to local health needs, build resilience for epidemic preparedness, and to reverse current global inequities regarding access to life-saving vaccines. The mRNA TT Programme has a technology development consortium in South Africa (the Hub), organized around Afrigen, and a network of at least 15 future mRNA (vaccine) production sites (partners, formerly referred to as “spokes”) in a range of LMICs (FIGURE 1).

While establishing and sharing the mRNA technology platform will initially focus on a COVID-19 vaccine, **the broader ambition is to create the capability to innovate, develop and/or produce other mRNA-based products that address major health needs in participating countries.**

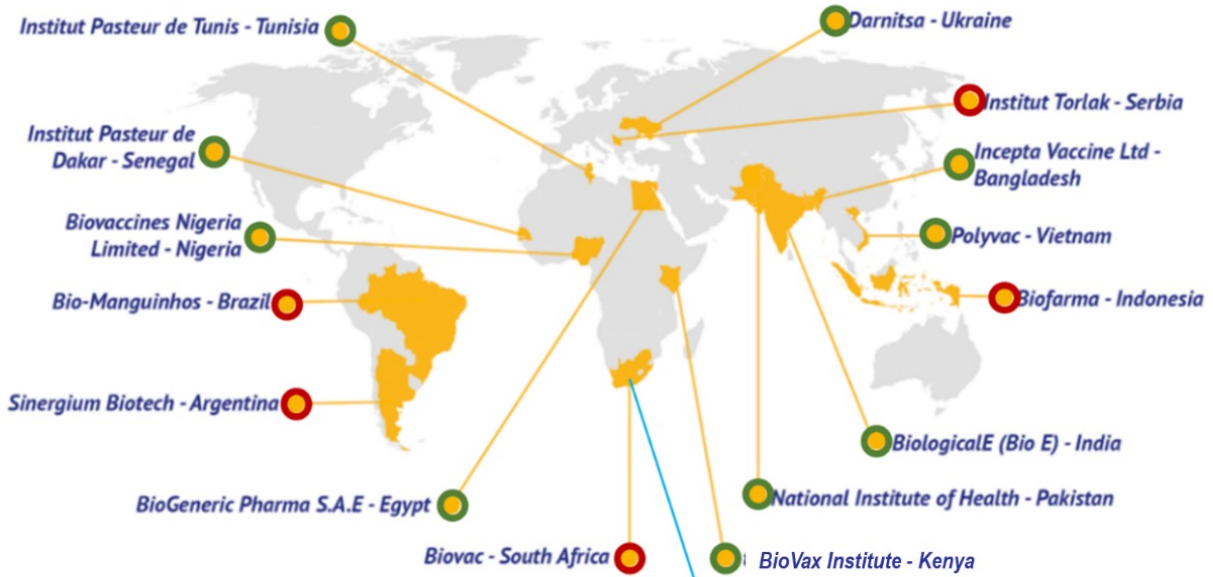
To that effect, R&D efforts are under way to explore the possibility of adapting the technology platform to other disease targets, for instance tuberculosis.

To cover the activities of the South African consortium/ Hub, the mRNA TT Programme has an initial budget of around US\$ 117 million from a group of mostly Western donors—Canada, France and the European Union (EU) provide 78% of the US\$129 million committed to date (May 2023)—and some of it is earmarked for Partners. **The mRNA TT Programme’s stated objective is to “improve health security in LMICs through sustainable regional production of mRNA vaccines,”** including exploring what it means to be sustainable in this context. As this is a WHO-coordinated technical assistance project, operational priority setting and funding decisions currently reside with WHO and its core partner, the Medicines Patent Pool (MPP), with the South African Consortium/Hub and a network of manufacturing partners as the implementing agents. The MPP is also responsible for knowledge and IP management through collaboration and technology-transfer agreements among participating partners. In practice, this means that the MPP currently “controls” (through direct ownership or license) the IP related to the mRNA vaccine platform developed by the South African consortium, and future IP that partners might generate. While the mRNA TT Programme is premised on the non-infringement of IP rights, one issue remains unresolved: whether the participating producers and countries have the freedom to operate for the future production and sale (including export) of mRNA-based products (current work proceeds under a research exemption).

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FIGURE 1.
mRNA technology transfer programme and partners
 (formerly hub and spokes)

● 15 recipients of mRNA technology from the mRNA technology transfer hub (Public, private, PPPs – with gov backing)



hub

WB classification: ○ UMI ○ LMI



Additionally, it remains unclear to what extent the R&D activities and the possible creation of other mRNA-based products are considered as: an integral part of the mRNA TT Programme (in terms of governance, financing, and sustainability), or; whether to consider them as a possible add-on for individual countries and companies to engage on in their own terms.

Current budget estimates are very modest for the ambition to set up such major infrastructure and capability, develop mRNA technology and transfer it to a network 15–20 manufacturers. For comparison, a recent study showed that the United States (US) Government invested at least US\$ 337 million in research grants related to mRNA technology pre-pandemic, and another US\$ 2.3 billion for clinical trials and supportive science. Critically in terms of sustainability, the US Government spent US\$ 29.2 billion to purchase mRNA vaccines,³ which contributed to the more-than-profitable business model that exists for health security in high-income countries (HICs). Since the launch of their COVID-19 vaccines, Moderna and Pfizer have accumulated more than US\$ 100 billion in global revenues from sales.⁴ The indicated budget for the mRNA technology transfer hub is indeed small in comparison and will no doubt need to expand.

For a more detailed description of the mRNA TT Programme, see **Annex 1**.

The WHO Council on the Economics of Health for All (WHO Economics Council) was established in 2021 by the WHO Director-General, Dr Tedros Adhanom Ghebreyesus, to bring health and well-being to the core of economic thinking around purpose, value and development. Chaired by Professor Mariana Mazzucato, it provides a new approach to shaping the economy with the objective of building healthy societies that are just, inclusive, equitable and sustainable.⁵ The key question it asks is, if Health for All is the goal, what are the structure of the economy, and the underlying policies, institutions and societal organization that can help deliver on that objective. Reframing Health for All as the public policy objective for the economy requires a mission-driven outcomes orientation.⁶ Building on the themes of Value, Financing, Innovation and State capacity, the WHO Economics Council aims to help structure national and global policies in such a way as to deliver on this goal.⁵

Developing a sustainable value proposition (aka business case) for the local production of mRNA vaccines facilitated by the mRNA TT Programme is a shared objective between the WHO Director-General and the Chair of the WHO Economics Council. This is also relevant to the WHO Science Council, which is exploring the potential of mRNA vaccine technologies to improve health and equity in LMICs from a scientific perspective.⁷

As such, this case study aims to use the WHO Economics Council's work to outline a new narrative, value proposition, and the required enabling policy environment for a sustainable end-to-end ecosystem in which this mRNA technology network can thrive as innovators and suppliers of critical health products—including for rapid-response to epidemic outbreaks—to national health systems (or on a regional basis).

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When policy makers keep this goal clearly in mind, they can design whole-of-government policies and finance to “shape” ex-ante the activities and interactions of public, private and civil society actors that together constitute an effective health-industrial ecosystem. This will advance the mission, taking into account the values that underlie it, such as equity, inclusion, the human right to health, open knowledge, supply diversity and redundancy or buffer for epidemic preparedness. Such an ecosystem will be grounded in collective intelligence for public health, and technology and know-how sharing among the participating countries and organizations, financed and governed for the common good.^{8,9}

2. A common-good approach to health innovation and equity

The COVID-19 pandemic underscored that the world cannot rely on market-based mechanisms, or fixing market failures, to provide tools to stop outbreaks when and where needed.¹⁰ Instead, it needs a shift in perspective towards understanding and governing health innovation for the common good.⁹

The traditional categorization of goods, including public and private goods, in economics fails to acknowledge that health is a collective responsibility (see **BOX 1**). It requires coordination between the public and private sectors at the local, national and international levels, with the explicit goal (as in mission, or purpose) of providing Health for All. Common goods demand greater emphasis on collective action that must be nurtured to achieve the result. As such, the emphasis is more on the process—the how—than on the what.⁸

A rights-based construction of health as a global common good recognizes that people are entitled to health, which is crucial for individual and collective well-being and a prerequisite for economic development and poverty reduction. The common-good vision recognizes the interplay between public, private and civil society stakeholders in realizing the mission. This in turn requires a proactive public sector to set the direction and establish a conducive policy framework that provides incentives for all economic actors to collaborate and innovate to solve societal problems, and thus create public value. Such active ecosystem shaping adopts a positive rather than negative framing of governmental action, instead of merely filling the gaps left by the private sector or fixing market failures.⁸

Achieving Health for All, understood as a common good, requires collaborative processes—defining the 'what', and shaping the 'how' for all actors to work collaboratively towards that collective societal goal. In the context of vaccines, the objective is not only to create and produce vaccines, but to deliver and roll out vaccines that address health needs in their health systems' context. This makes it vital to adapt them fully to the conditions of use and make them available and accessible in a timely manner where needed.¹⁰ As such, there is an immediate link between the common good approach and the mission approach. Missions are a policy framework that can shape economic policy in an outcomes-oriented way to serve the common good.¹¹ Missions are directly related to the concept of public value—value that is created collectively and should be shared equally. Public sector actors create public value while establishing and co-shaping markets in line with public purpose.¹² The public value concept is useful because it sees citizens and other stakeholders as co-producers of value, thereby underscoring their engagement in, and contribution to the policy process.

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In the context of the mRNA TT Programme, the mission is global health security with equity and resilience at its core. Once the mission is defined, it is necessary to lay out a framework and structure the conditions and governance mechanisms that shape the capabilities, tools, institutions, and partnerships needed to take concrete action and build an end-to-end ecosystem (from R&D and clinical trials to manufacturing, to access and service delivery), designed as a collective response for global public health.

BOX 1: COMMON GOODS FOR HEALTH

The WHO Council on the Economics of Health for All has been developing a common good approach to innovation, as described in its Innovation Brief.⁹

This builds on a market or ecosystem-shaping rather than market-fixing approach.¹³ This is an approach that considers the common good is an objective where the 'how' is as important as the 'what', unlike the prevailing approach that has framed the public good as a correction.⁸ Scholars have often defined health as either a private good or a public good, with the 'commons' being somewhere in the middle. The private vision holds that vaccines and medicines accessed by one individual cannot be accessed by others, which makes such products excludable and rivalrous, and goods that the market can provide. This view limits governments' role to creating conditions for the markets to function properly to deliver health as a commodity. Indeed, most countries have a mix of public and private health providers, banking on the assumption that certain segments of the population are able or willing to pay higher prices for (better, or priority) health products or services. The public vision, in contrast, sees health and equitable access to health technologies as a market failure resulting from their non-excludability and non-rivalrous nature.

This vision argues that people can't be excluded from health's global benefits or negative impacts, such as exposure to a pandemic or global herd immunity. Therefore, it is the government's responsibility to step in and fix market failures when they occur. Evidently health, including access to health technologies, contains elements of private and public goods, which, by definition, makes either concept insufficient to define health and assess its true value for well-being. Unlike the public good, the common good is an objective to reach collectively, not a correction (with one party filling the gap left by the other). Furthermore, the emphasis is on the collective action that must be nurtured to achieve the result.⁸

3. Moving beyond tinkering in the margins of the market

3.1 Vaccines: from critical public health tools to market commodities

Vaccination against infectious diseases has transformed global public health, saving millions of lives every year, and providing major benefits to society as a whole.¹⁴ While early immunization efforts date back a few centuries, scientific advances in infectious diseases, immunology, public health and vaccinology during the 20th century gave rise to a range of breakthrough vaccines that dramatically impacted human longevity and health.¹⁵ In 1974, WHO established the Expanded Programme on Immunization (EPI, now the Essential Programme on Immunization) driving child-vaccination programmes throughout the world to protect children against diphtheria, measles, polio, tetanus, tuberculosis and pertussis. By 1980, smallpox had become the first disease to be eradicated through global vaccination.¹⁶ The EPI later expanded to include rubella, mumps, chickenpox, haemophilus influenza b, hepatitis A and hepatitis B. The availability of COVID-19 vaccines that could protect against severe disease and death likely saved some 20 million lives

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in the first year alone, despite limited access in large parts of the world.¹⁷

Despite vaccination's well-established public-health and whole-of-society impact, compelling governments, especially in the Global South, to invest adequately in ensuring access to EPI for all children remains challenging. A specific framework, the full vaccine value assessment (FVVA), was developed to make the case for the

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value of vaccines. It takes into account individual health benefits and includes the broader socioeconomic and indirect impact(s) that the vaccine could have.¹⁸

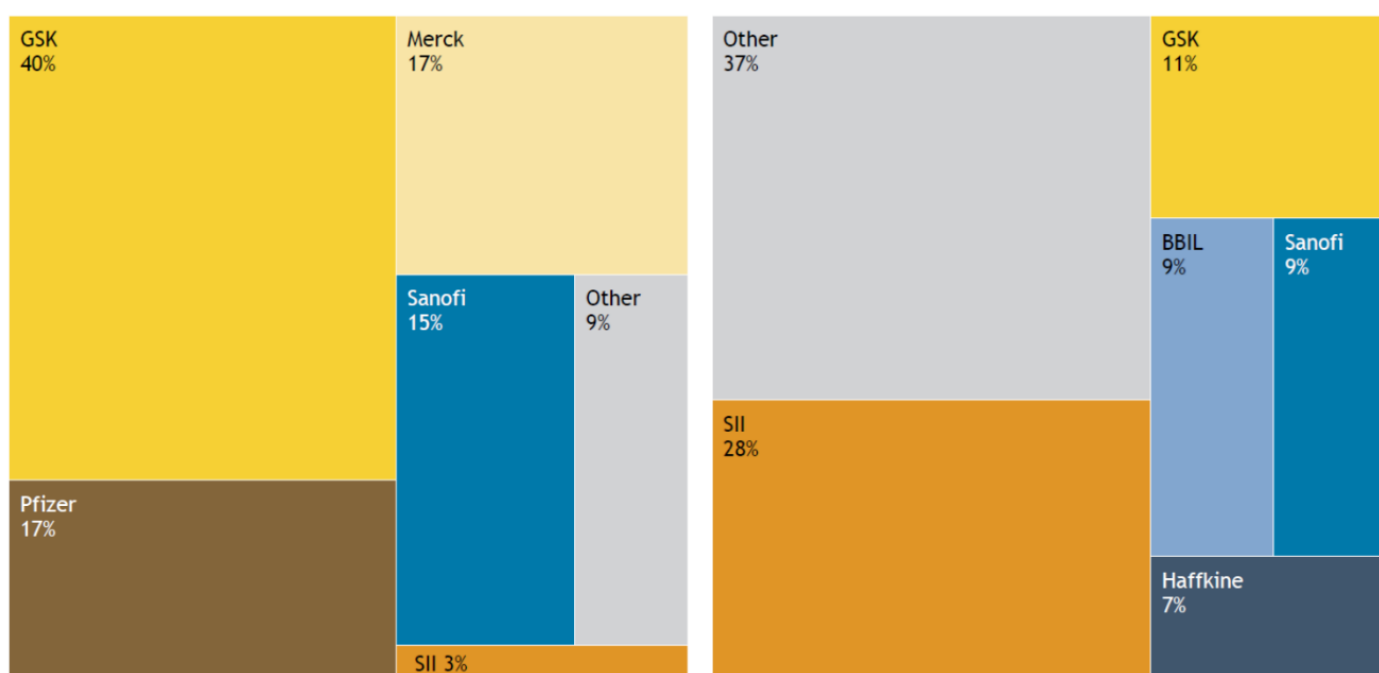
Because of vaccines' importance for public health, many countries—from Brazil, Cuba, France, Indonesia and Japan to the Netherlands, Sweden, South Africa, Senegal and Thailand—**previously established government-owned vaccine production facilities to supply their public health systems directly with critical vaccines.** With a few exceptions including Brazil, Indonesia and Cuba, most of that State-owned capacity was privatized in the successive rounds of privatization that occurred in the 1980s in many market economies. After a consolidation of the global pharmaceutical industry in the ensuing years, the vaccine market became highly concentrated, with four multinational corporations controlling nearly 90% of the global vaccine market by value in 2019. They supplied mostly to HICs and some MICs, with developing-country vaccine manufacturers (DCVM) being the biggest suppliers for the rest of the world (**FIGURE 2**).¹⁹ The Serum Institute of India was the largest global producer

by volume (28% of the market) yet it captured only 3% of the total market value in 2019.¹⁹ This consolidation is also reflected in the capacity to bring new vaccines to the market, which largely reside among producers in HICs.

For many years, the dominant market model for vaccine availability was based on large-scale production at relatively low cost, and supply to governments at modest profitability margins for mass vaccination through EPI or eradication campaigns as in the case of smallpox and polio.²⁰ In comparison to the market size of pharmaceuticals, vaccines only represent a small fraction (1.5% of global sales in 2001).²⁰ With most vaccine producers historically based in HICs, a tiered pricing model was adopted with even lower prices for LMICs as they increasingly joined global immunization efforts. As demand for low-cost vaccines expanded, including through donor-supported vaccination programmes in the low- and lower middle-income countries (see section 3.4), DCVM increasingly supplied the “low value-adding” LMIC markets, in particular for EPI vaccines, with HIC producers placing priority on the higher-profit markets.

In recent years, pharmaceutical corporations have increasingly shifted their vaccine business model towards higher profitability margins, charging considerably higher prices for new vaccines, for instance the human papillomavirus vaccine and the pneumococcal conjugate vaccine that have become blockbuster products.^{21, 22} Together with the new rotavirus vaccine, the three vaccines represented 86% of the total cost of vaccinating a child, with many LMICs facing major challenges of affordability and access to the latest vaccines.²³ The unprecedented profits that Moderna, Pfizer and BioNTech made with mRNA COVID-19 vaccines during the pandemic (US\$ 75 billion in the 2021–2022 period),²⁴ show that the notion of vaccines as critical public health tools, rather than profitable market commodities, is long gone. This is the case despite the pandemic and massive public investments and de-risking.

FIGURE 2.
Global vaccine market by value and by volume in 2019,
from WHO’s Global vaccine market report 2020.¹⁹



3.2 The global vaccine market—an unhealthy balance?

The global vaccine market is structurally segmented, with different business models governing the high-end and low-end markets. In HICs, governments pay high prices, and profit margins for pharmaceutical products are large, supporting the sustainability and prosperity of their national pharmaceutical industry that in turn contributes to gross domestic product (GDP), offers jobs, and is expected to deliver continued innovation. At the other end of the spectrum is the subsidized vaccine market for LICs and some lower MICs. Here donors adopt market push and pull mechanisms to balance making vaccines available and keeping the price the lowest possible but still viable for vaccine producers (see section 3.4).

Before COVID-19, the vaccine market was considered balanced enough in terms of market demand-supply to fulfil vaccine orders, with a total of 5.5 billion doses produced and purchased in 2019, representing a market value of US\$ 33 billion (2% of the global pharmaceutical market).¹⁹ However, the market was highly unbalanced in terms of value distribution, with 68% of the market value captured in HICs for just 13% of doses. Self-procuring MICs,²⁵ including the People’s Republic of China and India, represented 25% of the market by

value for 49% of the doses. The procurement for LICs and certain LMICs that is subsidized by Gavi, the Vaccine Alliance, and the United Nations Children’s Fund (UNICEF), represented 33% of all doses but only 2.7% of the value.

In 2021, 16 billion doses of vaccine were produced and procured, of which 10.8 billion were for COVID-19 alone (representing a market value of US\$ 99 billion). Of this, a mere 0.54 billion doses worth US\$ 2.9 billion passed through Gavi/UNICEF subsidized procurement. The rest of the non-COVID-19 vaccine market (5.3 billion doses worth US\$ 42 billion) remained roughly unchanged, with some growth in HIC and MIC markets and the same unequal distribution between the global market by value versus volume (FIGURE 3).²⁶

Meanwhile, major gaps linger in vaccination coverage in low- and lower-middle-income countries,²⁷ even for routine vaccines that are part of the EPI and available at very low price. Vaccine inequities are far greater for the newer-generation, significantly more expensive vaccines, such as pneumococcal conjugate, human papillomavirus and rotavirus vaccines.²³ This underscores the fact that a “balanced market” in terms of market supply and demand is not a meaningful metric for public health or vaccine coverage. Moreover, the market balancing act remains precarious, especially for outbreak vaccines with limited and unpredictable markets, as demonstrated by recent shortages of cholera vaccines, after one of the only three remaining producers pulled out at a time of increased frequency in cholera outbreaks.²⁸

FIGURE 3. Top 10 vaccine manufacturers by value and volume (excluding COVI -19) in 2021, adapted from WHO’s Global vaccine market report 2022.²⁶



3.3 Shaping a profitable vaccine market for HIC in the name of public health

While vaccines became increasingly profitable market commodities over the past decades, it is important to understand that this didn't happen in a vacuum. **Governments in HICs have created a highly conducive policy environment for pharmaceutical companies that develop and produce vaccines. Indeed, the “entrepreneurial State” has often funded and otherwise supported the most high-risk phases of vaccine development and production.**²⁹ This includes public investments in the education of doctors and scientists who engage in vaccine R&D activities or vaccination programmes. It involves public subsidies to basic research and applied R&D activities including clinical trials, and the granting of broad IP monopolies including through data protection and trade secrets. It includes favourable tax and other regimes for producers willing to establish facilities in given countries. In addition, the vaccine market is largely subsidized in HICs: many governments directly purchase vaccines to supply their public health systems, or organize third-party payer (health insurance) systems to cover much of the cost (often without the transparency needed for competitive market forces to play out effectively). **By actively “shaping” the vaccine R&D and manufacturing ecosystem and creating profitable market opportunities for companies,** such policies have created “sustainable” (and, frankly, highly profitable) vaccine business models and a vibrant health-industrial sector in HICs.³⁰ However these are highly shaped and subsidized markets—as opposed to free markets that rely solely on supply and demand dynamics. They come at a price HIC that leaders—with the support of their population—seem willing to pay to ensure vaccine supply, innovation, and a prosperous pharmaceutical industry sector that contributes to the domestic economy.

As seen during COVID-19, in the event of a health crisis there is a surge in public interventions to support and de-risk pharmaceutical companies in HICs. IP protections, regulatory incentives and liability protections, covered by secrecy, have created a massively profitable business case for the companies that developed and produced COVID-19 vaccines and medicines for the US and European markets. They did this by building on years of publicly supported research, additional public subsidies to R&D and at-risk scale-up of manufacturing capacity by the private sector,

alongside advance market commitments.³¹ Problematically, such extensive government interventions were not designed to ensure the best outcomes for global public health, and did not contain safeguards to protect the public interest. Charging high prices that did not take into account the subsidies that went into their development, companies were allowed to extract massive profits from the sales of their products. Companies were allowed to exploit their IP and know-how monopolies instead of sharing them, thereby blocking equitable availability and access to critical health technologies in other parts of the world.³²

COVID-19 is not an exception. The USA, through its Biomedical Advanced Research and Development Authority (BARDA),³³ has long invested in a generously subsidized medical innovation ecosystem for American health security.³⁴ It combines R&D subsidies, IP and regulatory incentives, advance market commitments, and/or stockpiles to harness a lucrative business model for small- and medium-sized companies willing to develop medical countermeasures for the American Government. This has, for example, allowed the development of a vaccine and two treatments for Ebola disease, and both a treatment and vaccine for mpox (originally developed to protect the USA from smallpox). However, in both cases, the vaccines and treatments are primarily available as American health security stockpiles, not necessarily where and when needed for outbreak in countries where the diseases are most prevalent.^{35,36}

Overall, the health-industrial R&D and manufacturing ecosystem that has worked well to build a prosperous pharmaceutical industry and deliver health innovation in HICs is far from a free market environment. It fundamentally relies on a conducive, and generously subsidized, enabling environment spanning public R&D capacity and investments, IP and regulatory incentives, and very elastic purchasing powers that are willing to pay high prices for pharmaceutical products, including for domestic stockpiles in the event of health security concerns. But because it was designed to primarily serve economic interests, rather than global public health, the ecosystem has failed to deliver equity or innovation that effectively responds to priority health needs. The lack of R&D efforts in critical areas like emerging infectious diseases primarily affecting the Global South, or AMR, clearly illustrates this.³⁷

3.4 Market “fixing” paradigm for health technologies in LMICs—lessons learnt

The crisis of unequal access to AIDS-medicines between the late 1990s and the early 2000s, when millions continued to die in LMICs while lifesaving medicines had turned HIV/AIDS into a chronic manageable disease in wealthy countries, put a spotlight on the structural inequities that exist around access to health technologies and on the way the pharmaceutical market operated.³⁸ **The insufficient purchasing power of people and governments in LMICs that prevented them from buying medicines at prices charged by pharmaceutical companies was considered a market failure, suggesting the need to find market-based remedies, as opposed to health rights-based solutions.**

As a result, since the early 2000s, the dominant narrative and strategy adopted within the global health architecture has been to fix or shape the market, with a strong focus on better matching supply with demand and using donor funds to optimize markets and increase access to health products in LMICs. Spearheading the strategy are: the Bill and Melinda Gates Foundation; the United States Agency for International Development; Gavi, the Vaccine Alliance, the Global Fund to Fight AIDS, Tuberculosis and Malaria; the Clinton Health Access Initiative; Unitaid and like-minded organizations.^{39,40,41} However, such efforts consider the market as a given reality out there, within which one can act to overcome perceived failures ex-post, rather than ex-ante designing the overall market ecosystem with the purpose of delivering Health for All.⁴²

As Padmashree Gehl Sampath wrote in a 2021 paper on market shaping in the global vaccine market: “There is now a strong consensus amongst actors working in public health that this [market shaping] could offer a way to promote healthier competition on a global scale, especially in markets where one or a few buyers persist. [...] Thus far, these market shaping efforts have focused **on interventions aimed at ironing out market imperfections that dominantly impact pricing and access.**”⁴³ The (implicit) underlying assumption is that competitive markets promote the supply of the right type of health products at the best price, and that “improving market dynamics” directly helps improve the health and well-being of people globally. This leaves notions such as equity, autonomy, inclusiveness and resilience largely by the wayside.

Unlike the comprehensive and well-financed health-industrial ecosystem built in HICs, market shaping or fixing for vaccine availability in LMICs is based on comparatively miniscule donor investments, including philanthropic funds. Such market shaping largely focuses on matching demand with supply through better market information for predictability, pooled procurement and competitive tendering by donor-supported initiatives like Gavi, the Vaccine Alliance and UNICEF. **It aims to maximize the number of doses procurable with donor funds, without much concern for the broader context, such as resilience and autonomy.** The bulk of the production of quality-assured EPI vaccines destined for use in LMICs are now being procured at close to production-cost prices. Donor support and technical assistance helped make this possible by

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building the industrial capabilities of a few DCVMs to optimize the number of suppliers and maximize economies of scale.⁴⁴ This is considered a cost-effective use of donor funds in terms of increasing access to vaccines in some countries. Even so, it has left little space for DCVMs to expand their industrial capabilities, develop R&D capacity or invest in product portfolios to better respond to local health needs that the donor community might overlook. **The singular focus on low-cost production and economies of scale hinders the emergence of a more diverse set of small- and medium-scale producers, or a local innovation ecosystem, that could address the local or regional health needs which the global market continues to overlook.** For this to happen, LMIC governments would need to play an active role in shaping a conducive policy environment for such activities.

With notable exceptions such as Brazil and Indonesia that have fostered domestic manufacturing capacity to supply their health systems with critical pharmaceuticals,⁴⁵ many LMIC governments have become accustomed to receiving donations or subsidized pharmaceutical procurement programmes. Additionally, some of them **lack the fiscal space and capability to undertake substantial policy shaping towards a needs-driven health-industrial ecosystem. As a result, they remain dependent on the wealthy country-driven pharmaceutical market for innovation** with, at best, delayed access to even critical health technologies, or else at a considerable price, if at all.

It is worth noting that philanthropic organizations with a large footprint in global health such as the Bill & Melinda Gates Foundation, and more recently, Wellcome, have contributed to entrenching the market-fixing paradigm. They have done this by supporting the overall vision of unmet health needs as market failures that can be fixed through market mechanisms, and by filling the gaps created through the failure of governments to adequately shape the broader health innovation ecosystem.

Taken together, 20 years of market fixing approaches and philanthropy in global health have failed to create a pharmaceutical ecosystem that is fit for purpose, in other words, serving global public health and equity in a resilient way. Market failures continue to multiply, with lifesaving technologies being out of reach for an ever-increasing number of populations who need them, even for 100-year-old drugs like insulin,⁴⁶ and even in wealthy countries.⁴⁷ There are a few significant successes, such as increased access in certain countries to drugs for AIDS, malaria, tuberculosis and hepatitis C, and to childhood vaccines. These aside, there is a growing list of health technologies to which equitable access remains elusive. Additionally, many health needs remain unmet, because they are not lucrative enough to attract private sector R&D efforts.⁴⁸ Inequitable access to COVID-19 vaccines, treatments and diagnostics has underscored the limitations of market fixing approaches, even in times of health crises.⁴⁹

It is a public health priority and responsibility to provide epidemic countermeasures, which calls for significant and sustained investment in an effective health security ecosystem. This in turn requires funding and dedicated science, economic, industrial and health policies that create the enabling environment for such an ecosystem to flourish. Examples of this exist in the context of national or regional health security, for instance the American Government's BARDA,^{33,34} and the more recently created British Government's Advanced Research and Invention Agency (ARIA)⁵⁰ and the European Commission's Health Emergency Preparedness and Response Authority (HERA).⁵¹ Similarly, following the devastating Ebola virus disease outbreak in West-African, the Coalition for Epidemic Preparedness Innovation (CEPI) came into being to support vaccine R&D efforts. It primarily channelled donor funds to HIC companies willing to engage in vaccine R&D efforts for epidemic preparedness.⁵² However, these are largely HIC initiatives that build on existing technological capabilities for pharmaceutical innovation in wealthy countries, with the risk that in times of crisis, domestic health security would take precedence over global health, equity, and solidarity.

» It is an opportune time to extend the capabilities across the globe, taking into account the needs for local specificity. «

Having learnt that no one is safe until everyone is safe, the world must build back better following COVID-19 including by creating greater self-reliance and autonomy to respond to outbreaks in all regions of the world. **It is an opportune time to extend the capabilities across the globe, taking into account the need for local specificity. This means empowering local and regional R&D hubs to explore and develop solutions that are the best fit to address their needs, and not necessarily pursuing one-size-fits-all solutions.** The mRNA TT Programme can serve as a pilot project for such an endeavour.

3-5 Fixing the global vaccine market—the wrong response to vaccine inequity

While creating business opportunities for vaccine manufacturers when that can serve the purpose of public health is important, **public health cannot wait for the right business opportunities to materialize.** In particular, pandemic preparedness is not a profitable business as it is premised on preparing for market opportunities that do not yet exist and may never exist. Waiting to respond to epidemics rather than preventing them comes at great cost to human and planetary health.¹⁰ Timely, equitable and affordable access to appropriate health technologies, and epidemic preparedness must drive the pharmaceutical ecosystem and its success metrics, not profitability and the economic sustainability of companies.

» Public health cannot wait for the right business opportunities to materialize. «

Most discussions on how to improve pandemic preparedness and response and overcome inequitable access to health technologies focus on increasing manufacturing capacity for critical vaccines, treatment and diagnostics. For instance, Article 7 of the zero-draft of the possible Convention or Accord being negotiated by WHO Member States reads: “The Parties recognize that inequitable access to pandemic-related products (including but not limited to vaccines, therapeutics and diagnostics) should be addressed by increased manufacturing capacity that is more equitably, geographically and strategically distributed.”⁵³

Several recent studies have analysed the need for market shaping towards building healthy or sustainable markets, and opportunities to do so, in order to make these new initiatives viable in economic terms.^{44,54} The studies lay out the mammoth task ahead, and propose a raft of ex-post market interventions focused on more appropriate matching of supply with demand and creating viable business cases for manufacturers. The interventions include: product-specific market segmentation and donor-funded pooled procurement for the “recipient” countries; market demand and supply forecasting; technical assistance to help meet pre-specified quality targets; fostering economies of scale

and volume-based price negotiations for the lowest price with guaranteed quality. As with most market-fixing approaches, they fail to put Health for All as the ultimate objective at the core of the market-shaping efforts and design.

Concentrating on fixing market failures (including building competitive markets and focusing on the bottom-line of companies) carries the risk of side-lining the ultimate goal of improving people’s health outcomes and public health, leading to failures in public health. Ebola treatments are a case in point. Despite the successful development of two new treatments that are now registered by the Food and Drug Administration, American health security-focused market-fixing incentives, including American Government stockpiles, have kept the treatments largely out of the reach of countries at risk of Ebola outbreaks.³⁵ Similarly, while the risk of Zika virus outbreaks lingers, no vaccine exists to protect the world against the devastating health consequences of the virus, especially for pregnant women and their infants.⁵⁵ The reason is partly because it is not an attractive enough business proposition for commercial companies to invest in vaccine development for outbreak diseases with uncertain market prospects, especially for populations with limited ability to pay.

While market-fixing strategies for LMICs are considered a cost-efficient use for donor funds, and undoubtedly helped increase access to certain medicines and vaccines in the LICs and the (lower) MICs that could benefit from such schemes, this donor-driven global health architecture is often criticized for **not addressing the root causes of current health inequities.**⁴⁸ In particular, these approaches also:

- ➔ maintain a highly concentrated marketplace, in which a handful of wealthy multinational corporations control the vaccine market by value, and thus remain the main driver (and priority setter) for R&D to bring new vaccines to market, and; play the principal role in deciding which vaccine to develop for which diseases, how much to produce and to whom the products will be sold and at what price (including carefully crafted market segmentation strategies to maximize returns from each segment);
- ➔ contribute to establishing India as the pharmacy of the developing world, especially for cheap generic medicines and routine vaccines, in a business model that is driven largely by economies of scale to obtain the lowest possible price (under pressure from HIC donors buying for LMICs), leaving little financial space to diversify or invest in R&D;

- ➔ do little to create sustainable, diverse and resilient manufacturing ecosystems to supply LMICs; or foster local (small- and medium-) scale production, or; create space for locally driven innovation efforts, including by establishing adequate regulatory capacity to oversee the R&D activities from the lab to clinical trials, and ensure timely approvals based on solid evidence, and;
- ➔ maintain the status quo in the health dependency of LMICs, with donors controlling both the finance and the governance structures of such mechanisms, and international companies controlling much of the know-how and technological resources (through IP or regulatory monopolies).

Indeed, efforts to kickstart local manufacturing capacity face huge challenges without targeted government support. The reason is that high initial investment costs inhibit competition on price and market access with companies that have already achieved significant economies of scale, and that have well-established marketing and distribution channels. In the long run however, the only way to place priority on Health for All is to change the structural patterns of dependence and inequity that currently define the pharmaceutical ecosystem. Yet, many LMIC countries have difficulty in creating and using the policy space needed for an industrial policy that prioritizes their populations' health and their development needs. The recent proposal by the African Group in the World Trade Organization to rebalance trade rules illustrates this.⁵⁶ Countries face difficulties with access to technologies, fiscally constrained budgets, little access to capital markets, competing pressing social priorities in dire need of intervention and funding, and domestic policy aims that might contravene obligations in international free-trade and investment agreements.

3.6 Equity throughout, not just as an ex-post (market) correction

Most policy proposals related to medical countermeasures for epidemic response consider increasing manufacturing capacity in LMICs the key intervention to overcoming past access inequities. Some international vaccine producers like Moderna, BioNTech and Pfizer have started building local manufacturing facilities in LMICs, while others like AstraZeneca and Sinovac have increased voluntary licensing deals that include technology transfer to a range of DCVMs.

Increased manufacturing capacity can certainly help improve the response to a future pandemic. However, **reducing the lack of equitable access to only a matter of limited manufacturing capacity, is misguided. It assumes that equity is a technical issue rather than one of justice and human rights, and therefore a political choice.** It also overlooks the critical fact that the best way to combat pandemics is by stopping small and local outbreaks before they spill over and become pandemics in the first place.¹⁰ Vaccine manufacturing is never a goal in and of itself. It is one step in a broader goal of either vaccinating and protecting a population against disease, or establishing a stockpile for epidemic preparedness, both in the context of Health for All.

Therefore, establishing equity in the end-to-end ability to rapidly respond to and contain outbreaks as they happen is crucial. It includes researching, developing, locally producing and swiftly rolling out the required diagnostics and treatment and vaccines. A case in point is mpox. The world could have dealt decisively with recurrent outbreaks in the Central African Republic, the Democratic Republic of the Congo or Nigeria. Instead of keeping the treatment and vaccine developed (against smallpox) as part of the American Health Security programme stockpile, the world could have made them available, when and where needed. This might have averted the spillover into a public health emergency of international concern in 2022, affecting over 85,000 people in more than 100 countries.^{57,58} Moreover, relying on single suppliers for such health products, who turned out to be unwilling to rapidly scale up or share their monopoly over the technologies, created a scramble for the few available supplies, which was reminiscent of the jostling for COVID-19 vaccines.

The highly unequal health innovation ecosystem that favours the development of products for profit, rather than for public health will remain intact, if efforts to address inequity in access concentrate on scaling up manufacturing as the key lever. Additionally, the power imbalance caused by uneven control over technological (knowledge, IP) and financial resources will remain unshaken.

The mRNA technology transfer hub is a unique opportunity to radically transform the existing model of vaccine development and production for public health. It is imperative now to avoid recreating inequalities in production and access in the new architecture of pandemic preparedness and response.

4. The mRNA TT Programme: a pilot towards transformative change?

While sustainability is an agreed-upon objective for the mRNA TT Programme, interviews with different stakeholders suggest a range of interpretations of what sustainability means to different people. A minimalistic interpretation views **the establishment of mRNA capacity building through the programme as a one-off catalytic investment (with international donor funds) in each “spoke/manufacturer,”** who will then acquire the capacity and empowerment to integrate this technology platform into their operations. The manufacturers may then choose to produce mRNA-based vaccines and compete in the regular vaccine market as manufacturer/supplier in response to market opportunities at the national (or even regional) level. Sustainability (and success) is then measured and evaluated by each partner’s individual ability to produce and be economically viable.

Building on previous experience with the influenza vaccine Technology Transfer Initiative,⁵⁹ a WHO team is exploring possible “sustainable” business models for individual manufacturers to optimize opportunities within existing market dynamics. The team’s work is based on the econometric modelling of capital investment expenditures and operational expenditures for different types of products and markets.⁶⁰ The business models likely also assume some degree of market fixing/shaping aimed at ex-post matching demand with supply to build a minimally profitable commercial case for a given company, for instance through procurement policies that favour locally produced vaccines. However, as outlined in a recent survey of African manufacturers about barriers and opportunities,⁶¹ “the business case for vaccine manufacturing in Africa is certainly not straightforward, as African manufacturers will struggle to be competitive,” and the same may hold true for other relatively small or new manufacturers.

An alternative and more ambitious view of economic sustainability towards Health for All would be to consider the collaborative network of hub and manufacturing partners as the operational entity that delivers public health purpose. The continued development and sharing of technology serves as the core asset around which to articulate a sustainable value proposition for the development and production of epidemic countermeasures for the common good. It is this perspective that the case study is pursuing, responding to the following question:

If the mission is to empower and prepare countries to rapidly respond to epidemic outbreaks, by helping them adopt mRNA technology to develop and/or produce vaccines that will be available to the local health system when and where needed, what is the appropriate design (structure, organization, governance and finance) for such an endeavour and what policies and practices should be put in place to achieve that sustainably?

WHO Economics Council recommendations:

The proposed mission/purpose of the mRNA TT Programme is to make available safe, effective, and appropriate epidemic countermeasures equitably where and when needed in participating countries and regions.

To that end, all partners must:

- **Consider mRNA Programme as a common good for epidemic preparedness,** driven by South-South collaboration and pursuing health security with equity and resilience at its heart
- **Co-create a long-term collaborative, collectively governed platform** for mRNA-technology based R&D and manufacturing for the common good, to serve public health goals and equity
- **Define sustainability through an end-to-end value proposition for the common good,** adopting a collective portfolio approach for health

4.1 An end-to-end approach to epidemic preparedness and response for the common good

The mRNA Technology Transfer Programme was initially set up as a WHO-led technological capacity-building project for individual LMIC manufacturers. However, **achieving this broader mission will require moving towards a more ambitious, and transformative approach that can steer action towards an end-to-end ecosystem for epidemic countermeasures as common goods.** This is in line with the WHO Economics Council's work on health innovation⁹ and with suggestions made by the Independent Panel for Pandemic Preparedness and Response in their initial report,⁶² and elaborated in two recent Lancet comments.^{10,49} From this perspective, the world must invest in coordinated, sustained and networked regional research, development, and manufacturing hubs, operated and staffed by a local, skilled workforce. There will be a need to guarantee the freedom to operate around critical technology platforms for vaccines, treatments and diagnostics, to allow for their rapid adaptation to emerging health threats.

Adopting a mission-oriented approach¹¹ and aligning the interrelated areas of value, finance, innovation and capacity as pursued by the WHO Economics Council,⁵ **countries engaged in the mRNA TT Programme, and donors, can work together to design an ex-ante end-to-end ecosystem** able to deliver for public health, including through epidemic preparedness and response.

» Achieving this broader mission will require moving towards a more ambitious, and transformative approach that can steer action towards an end-to-end ecosystem for epidemic countermeasures as common goods. «

This would mean **building a collective value proposition in which participating LMICs foster their public and private research and manufacturing capabilities to collectively drive the public health mission of providing equitable and affordable access to health technologies for their populations, when and where needed.** It would be a major shift from the current, unsatisfactory system that relies on ex-post/post-hoc redistribution of technologies created and owned by a profit-driven and largely HIC-based pharmaceutical industry that puts market sales and profit opportunities above public health. It would require new types of business models for health, sustainable and regenerative business models based on needs-driven innovation. The innovation would involve knowledge and technology sharing, creating value for health, and reinvesting into initiatives to improve health, without seeking to extract profit or pursuing growth *per se*.⁹

4.2 Co-creating a collective mRNA vaccine R&D and manufacturing effort

For the mRNA TT Programme, this would mean moving towards a truly co-created collective approach in which participating vaccine manufacturers agree to join forces (vision, knowledge, resources) around the shared and collectively owned technology platform that serves as the core asset around which to build the value proposition. Leveraging the strengths of the participating organizations, they would collectively develop an R&D pipeline/portfolio and production capacity to address unmet health needs of relevance to the countries, equitably sharing risks, benefits and rewards towards the shared objective. This means developing incentives to foster collaboration and collective intelligence to serve public health purposes, rather than competition between proprietary products for a market share.^{8,63}

It would also mean establishing a different governance structure for this initiative and co-creating a value proposition among participating entities. There would be a need to build collective leadership around a shared vision for epidemic preparedness and response for the common good, with equity, knowledge sharing and regional resilience at its core. The shared mRNA knowledge and technology platform, including a portfolio of R&D projects that respond to collective health needs, would then represent the common asset around which to: build sustainability for the purpose of public health (not market competitiveness), and; attract public financing

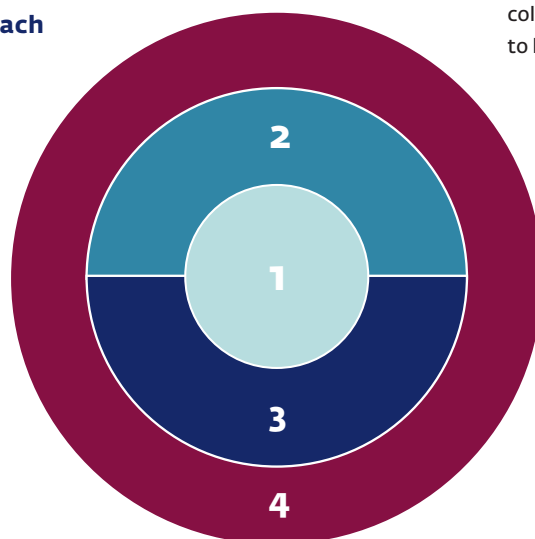
as well as donors and investors keen to use collective intelligence, and knowledge and technology sharing to support epidemic preparedness for the common good (FIGURE 4, Building blocks of the value proposition). Instead of pursuing profit generation to reward investors, it is vital to pursue a **regenerative business model based on agreed-upon driving principles. Among them are equity, inclusion, the human right to health, open knowledge, and supply diversity and redundancy or buffer for epidemic preparedness. The value generated (knowledge, monetary, capabilities, partnerships and so on) is reinvested in the collective to enable it to continue pursuing its mission.**

The key objectives of this approach are improved health outcomes, health security and a degree of self-reliance for critical health technologies. It also promises other benefits, such as increased technological capacity with the associated job opportunities, less brain drain, investment flows, opportunities for local small and medium-sized businesses to contribute, less vaccine hesitancy (if the government can earn and maintain trust) and many others.

FIGURE 4. Building blocks for a sustainable value proposition for mRNA technology based epidemic preparedness and response, inspired by the West Africa Lassa Fever Consortium value proposition for Lassa fever drug development⁶⁴

1 ↗ Common good approach

A common good approach to health innovation builds on whole-of-government leadership and dedicated policies towards the shared goal of Health for All and greater health security and resilience against epidemic outbreaks.



↗ 4 End to end

An end-to-end approach links investments in the mRNA platform, technology sharing and a portfolio of R&D projects to clinical assessment, manufacturing, availability, and equitable access when and where needed and into a regenerative business model for health.

↗ 2 Shared mRNA technology platform

Investment in the development of an mRNA technology platform and its sharing among collaborating centres, will increase the LMIC capacity for collaborative innovation and manufacturing in response to local health needs when and where needed.

↗ 3 Needs-driven R&D portfolio

The versatility of the mRNA technology platform is well-suited to adapt to different disease targets, using collective intelligence and building a portfolio of R&D projects that address local needs, and that can be evaluated in public health-focused clinical trial networks.

4.3 Towards a new value proposition for the mRNA TT Programme

In order to achieve its public health mission, the WHO Economics Council recommends that the mRNA TT Programme pursues a **new value proposition** in which participating vaccine developers and manufacturers in LMICs, supported by their governments, agree to join forces in a **collective end-to-end approach for the common good. It means co-creating a collectively owned and governed mRNA technology platform and a needs-driven R&D portfolio as critical shared assets for public health. It also involves pursuing a regenerative business model for sustainability, and measuring success collectively in terms of health objectives instead of economic viability for individual partners.**

In practice, this means:

- creating and sharing the capacity to produce COVID-19 mRNA vaccines locally, and readiness to supply local health systems when needed;
- retaining technological capacity and skills in readiness to manufacture other mRNA-vaccines, to respond to emerging health threats (preparedness);
- building on the versatility of the mRNA technology, and creating a collective and collaborative pipeline of needs-driven R&D projects to develop and produce RNA-based technologies that address unmet health needs among participating countries, with a high priority placed on epidemic threats;
- developing and adopting collective measures of success, and exploring incentives that help leverage the strengths of each partner towards the common goals, while ensuring an equitable distribution of investments, risks and rewards, based on solidarity and public health goals;
- attracting additional investments from public and private sources that share the vision and mission to deliver equitable epidemic preparedness and response when and where needed;
- leveraging such investments to also pursue broader health needs as appropriate, including to keep the R&D and manufacturing facilities operational beyond outbreak and epidemic response periods, and;
- by defining access and user rights and commitments in the collective management of resources for the common good, linking access to the shared mRNA technology platform (the collective asset) with: commitments for continued technology and knowledge sharing; investments in the platform, and; guaranteed availability and equitable access when and where needed.

To make such an end-to-end platform for epidemic preparedness sustainable, the countries and regions hosting and supporting it must design ex-ante a conducive policy environment for it to achieve its goals.

This includes: procurement policies that can commission the production of needed epidemic countermeasures, for stockpiling or rollout, as required, to optimally protect public health; adequate financing for research at universities and within the platform, towards building the pipeline; flexible and pro-health intellectual policy rules and practices that can establish the freedom to operate, for epidemic countermeasure R&D, manufacturing and commercialization, including export; access to affordable capital, including for rapid response in the event of epidemics, and; a conducive regulatory environment with the capacity and incentives to guide local R&D and manufacturing efforts, while ensuring timely approvals based on solid evidence. The measures of success for any such policy must be steered towards achieving the mission of equitable access collectively, and not be based on the market viability or competitiveness of single vaccine producers.

Moving from a technological capacity-building project for individual LMIC manufacturers to a collaborative endeavour for public health will require a radical change towards a truly collective governance structure. In such a structure, collaborating research centres, developers and manufacturers, supported by WHO and the MPP, and ideally the communities that stand to benefit from this effort, take collective decisions, including on priority setting and financing, to realize this common good vision. Such a collective ownership structure can take a variety of forms. It has also been referred to as “generative ownership” that puts control firmly in the hands of people that have a vested interest in the outcomes and sustainability of the project.⁶⁵ Governments hosting the manufacturers must create conducive policy frameworks to facilitate such collective ownership for public health.

The World Health Organization, through its norm setting and technical support to Member States has catalysed the establishments of this initiative and should continue to play a critical support role. This includes fostering long-term political support at the country and regional levels, advocating adequate international finance, with technical assistance as needed. It is possible to seek additional financing for the longer term from the Pandemic Fund⁶⁶ and similar future initiatives, (regional) development banks, and other sources needed to complement domestic financing by the countries engaged in the mRNA TT Programme.

Using its technical expertise in IP landscapes and management, including licensing agreements, the MPP **can continue advising and guiding the collective knowledge management of the mRNA TT Programme, in line with the overall mission and sustainability of the initiative.** The MPP is the current “controller” (through direct ownership or licence) of the IP related to the mRNA vaccine platform developed by the South African consortium, and future IP to be developed by partners. As such, it would remain the legal entity responsible for this on behalf of the mRNA TT Programme **until a more suitable legal structure was set up that reflected the collective ownership and governance, exploring creative models for generative ownership.**

If the mRNA TT Programme is to become a sustainable, long-term technology-sharing platform beyond the initial technology transfer, its design needs to consider the interests of all its members. It must ensure appropriate incentives to fit the different realities members face, for instance in terms of their ownership structure (public, private, mixed), size, existing technological capacity and maturity in the vaccine R&D and manufacturing ecosystem. A case in point is choosing the type of incentives that would compel private developers or manufacturers to continue engaging with the mRNA TT Programme, and invest in technology development to be shared with others, if that risked undermining the potential market for their products, especially for producers on the same continent. The mRNA TT Programme must provide value to members with established capacity since they will be more capable of innovating and may find themselves constantly sharing their technology without receiving similar value in return. Such value propositions must go beyond monetary metrics, and can include reputational benefits, access to skilled workforces and training opportunities, international exposure and membership of a recognized international collective effort.

» Moving from a technological capacity-building project for individual LMIC manufacturers to a collaborative endeavour for public health will require a radical change towards a truly collective governance structure. «

To further encourage membership of the collective knowledge- and technology-sharing platform, governments can provide incentives for and reward the adoption of regenerative and distributive business models as an alternative to the continued growth and pursuit of profit-driven business models.^{67,68} Regenerative business models create and deliver value at multiple stakeholder levels. Such value includes public health, nature, societies, businesses, communities, shareholders and investors, and employees, delivered through activities that promote regenerative leadership, co-creative partnerships with nature, and justice and fairness.⁶⁹

5. From market fixing to shaping the health-industrial ecosystem for health equity

It is possible to articulate an ambitious policy framework to support the mRNA TT Programme as a pilot for transformative change. This can be done by expanding the vision laid out by the WHO Council on the Economics of Health for All to build an economy for health, using its four workstreams of Value,⁷⁰ Finance,⁷¹ Innovation⁹ and Capacity as guidance.⁷² It would focus on how value in health is measured, produced and distributed across the economy, how innovation is governed, the ability of LMICs to invest in initiatives such as the Hub, and the capacity, both public and private, to make it happen. The case study will next outline the desired macro-systemic changes towards a conducive ecosystem, followed by specific recommendations for the mRNA TT Programme.

5.1 Valuing what matters

The current economic system is prey to the myth that the price of a good represents its value. Therefore, initiatives whose real value is hard to quantify and monetize lack the required funding, even when they represent immense benefits for society.⁷³ For instance, the value of a vaccine includes individual health benefits and broader socioeconomic and indirect impact(s) that the vaccine, or vaccination might have. As noted earlier, the concept also features in the 'Full Vaccine Value Assessment' or FVVA, a critical analysis to inform priority setting for investment and eventual uptake.¹⁸

But the societal value of health technologies goes beyond individual products. For epidemic preparedness and response in particular, countries or regions' capacity to rapidly develop and make available critical health technologies, to control outbreaks when and where they occur, is a critical asset for health security and needs to be valued per se. Such capacity protects other countries and regions from the harms caused by the further spread of epidemics or pandemics. Other critical drivers for local resilience and equity are in the form of technological capability and autonomy to carry out innovation for health in order to address local health needs. They too deserve recognition. In climate change, for example, novel mechanisms have been proposed to equalize the price of carbon sinks to the value they create for human existence so that communities, usually

indigenous, that steward and safeguard natural areas and thus help protect all humanity, can benefit from their action.⁷⁴

For the mRNA TT Programme to succeed, participating countries and stakeholders must consider it **valuable to establish and continuously invest in the capability of a R&D and manufacturing network in LMICs that can deliver (mRNA-based) vaccine technologies for equitable access as a strategic asset for collective health security and resilience.** Providing epidemic countermeasures is a priority for public health. It is important to reflect this by way of significant and continued investments in an effective health security ecosystem. This involves funding and dedicated science, in addition to economic, industrial and health policies that create the enabling environment for such an ecosystem to flourish. Examples of this exist for national or regional health security (see [section 3](#)).

It is necessary to rethink the role of private companies, including as "value creators", in societies. Producing COVID-19 vaccines in record time was a formidable achievement and a demonstration of how cooperation between public and private actors over years, and in times of crisis, collectively brings value to society. Yet private companies like Pfizer and Moderna earned tens of billions of dollars in profits, while large parts of the world suffered from highly inequitable access to the vaccines and governments were charged prices that were 10 to 50 times higher than estimated production costs. This both extracts monetary value from the epidemic response ecosystem and puts it into the pockets of investors, shareholders and company executives, while undermining efforts from developers in the Global South to adopt the mRNA technology to improve health outcomes in their communities and create value for health.

There are increasing calls for businesses to shift roles and become catalysts for decreasing inequality and protecting the collective well-being of humans within planetary boundaries. Governments can provide incentives for and reward the adoption of regenerative and distributive business models as an alternative to current business models driven by continued growth and (short-term) profit maximization.^{65,67,68} As is the case with any market behaviour and institutional design, it is possible for governments to design more sustainable or desirable business models. They can do this through appropriate regulations, taxation, subsidies, conditionalities linked to financing and by fostering new alliances and innovation programmes to promote sustainable and social business practices. Ways of fostering innovation programmes include increased transparency, environmental, social and governance issues, reporting, carbon pricing, and extended producer responsibility.

Recommendations for the mRNA TT Programme

In the current, essentially supply-driven pharmaceutical R&D and manufacturing system, measures of success focus on the end deliverable: a product that has received marketing authorization and is sold in the market. **Sustainability is then defined as the commercial success of an individual company/product in the marketplace.** According to the new value proposition, the mRNA TT Programme should adopt an end-to-end approach in which public, private, academic and civil society actors can work together productively. This can be through bottom-up collaborations and along the value-chain of product development all the way to marketing authorization and access, culminating in the delivery of epidemic countermeasures where and when needed to people and health systems.

» According to the new value proposition, the mRNA TT Programme should adopt an end-to-end approach in which public, private, academic and civil society actors can work together productively. «

The transition towards an end-to-end approach implies distributing value and success throughout the product value chain. It starts with early research capability and progresses to designing epidemic countermeasures and establishing their clinical benefit through independent public health trials. The next phase involves registering the product in countries that need it, producing it in the required quantities (even if small), and making it available to health systems to address health needs when and where needed. Therefore, in addition to the establishing the FVVA for individual products, it is important to also value the investments in infrastructure, skills, operational capacity (including cold chains if required) and, as needed, stockpiles or surge capacity as critical assets for health security. As such, it is important to measure success not just in terms of their potential to generate revenue

streams, or of products successfully competing in the market based on price. Instead, metrics of success for such a strategic and end-to-end ecosystem for countermeasures can comprise a mix or scorecard that includes:

- communities of practice that bring together researchers, developers, manufacturers and health care providers to co-create vaccine candidates against an emerging health threat, adopting common good principles, technology sharing and collective intelligence;
- ability to produce vaccines and related products and obtain national regulatory approval within a reasonable time frame (for instance one–two years for manufacturing existing vaccines, three–five for new vaccines); this can include the ability to produce raw materials locally/regionally;
- multiple small- to medium-scale production units that have the ability to produce epidemic countermeasures at acceptable cost-of-goods, and stand poised for activation when needed;
- a diverse R&D portfolio that covers countermeasures addressing priority health needs for emerging infectious diseases;
- ability to establish reserve capacity that can be rapidly activated in case of need, or to supply stockpiles;
- ability to live up to the right to health, and ensure citizens have timely access to life-saving technologies when needed;
- increased access to relevant vaccines, and adequate and timely coverage;
- the number of developers/producers that join the collective effort, share knowledge and technology, and productively contribute to delivering vaccines equitably to the population, and;
- the number of people and geographical clusters that the production of vaccines would cover in the event of a pandemic or health threat.

As success is measured in terms of what the ecosystem will achieve, it will be important to specify the respective tasks and responsibilities of each of the actors. This includes governments from participating and donor countries, which play an essential role in setting conducive policies and design the way they work together in pursuit of the collective goal. Doing this will make it possible to build appropriate accountability mechanisms around the specified roles and responsibilities.

5.2 Financing what is valued

If both the societal value of vaccines (through FVVA) and the strategic value of an end-to-end ecosystem for epidemic preparedness and resilience achieve recognition, it is imperative to use the appropriate channels to mobilize the required finance and make it available.

However, many LMICs struggle to invest in health and other social priorities because the rules and power dynamics governing the global financial architecture are not designed to create the fiscal space to invest in health. Instead, budgets often need to comply with stringent criteria for fiscal discipline that limit governments' capacity to invest in present and future well-being (**BOX 2**), pushing investments in pandemic preparedness or health resilience to the backburner.

The companies in the mRNA TT Programme require substantial and continued investments in developing infrastructure, technology and skills, in retaining workforces, in the R&D pipeline and in operations. While initial donor funds can amortize some of that, the programme needs a longer-term financing plan that goes beyond charity to support the value proposition laid out in **section 4.3**. A first pre-requisite would be to increase access to affordable capital for LMICs, in particular to support their investments into capacity development for epidemic preparedness and response activities and for enhancing health security and resilience. The 2022 Bridgetown Initiative for the reform of global financial architecture⁷⁵ has the potential to unleash substantial funding for LMICs to invest in sustainable development, including for pandemic prevention and preparedness and health equity. Furthermore, as one is only safe when everybody else is safe, there is a need for a global concerted effort to invest towards health security everywhere. As part of a transformed ecosystem for epidemic preparedness and response, a globally and regionally pre-negotiated financing system has been proposed. It involves international and regional financial institutions playing a key role, and an increase in domestic financing.⁴⁹

» As one is only safe when everybody else is safe, there is a need for a global concerted effort to invest towards health security everywhere. «

As outlined in **section 3.4**, BARDA, ARIA, HERA and CEPI can serve as examples of national, regional or collaborative international funding sources, respectively, that have epidemic preparedness R&D and health security as objectives. However, their inability to effectively deliver equitable, timely and affordable access where and when needed during the COVID-19 pandemic, must serve as a lesson. This was partly due to their mandate being restricted to national security (BARDA), or failure to design the financing with conditions that would ensure equitable global access or timely technology sharing (CEPI).

BOX 2. MACROECONOMIC BARRIERS TO INVESTMENTS IN HEALTH RESILIENCE FOR DEVELOPING COUNTRIES

As of July 2021, the fiscal support provided in response to the COVID-19 pandemic by governments in low-income countries amounted to 2.2% of GDP; in advanced economies, governments provided much higher levels of support of around 28.7% of GDP.⁷⁶ The macroeconomic situation facing developing countries has become even more perilous today, with slow growth, high inflation and high degrees of debt distress. Average global inflation remains high and persistent, increasing from 4.7% in 2021 to 8.8% in 2022.⁷⁷ Central banks in advanced economies are raising interest rates to tackle inflation, which increases the debt servicing burden in developing countries. In 2021, developing countries paid US\$ 400 billion in debt service, more than twice the amount they received in official development aid.⁷⁸ The situation is further compounded by rapidly depreciating currencies, with those of developing countries depreciating by 6% on average in 10 months in 2022, and some depreciating by as much as 30%.⁷⁹ The Governments of Ghana and Sri Lanka are already in debt default, while those of other developing countries are on the verge of debt distress.

It is therefore imperative to (re)design existing and new financing streams, such as the Pandemic Fund⁶⁶ and the Africa Epidemics Fund,⁸⁰ in ways that organize and formalize the collaboration between stakeholders for the common good, with binding commitments around knowledge and technology sharing, R&D priorities and equitable access. Regional development banks and other international financing institutions could play an instrumental role in establishing R&D and the manufacturing infrastructure. It is crucial to place a high priority on investments into health-industrial capacity for better epidemic preparedness. It is worth noting that a few hundred million dollars can go a long way in emerging economies, and that working as a collaborative effort in a not-for-profit or small-scale business context does not require the same multi-billion-dollar budgets that big international corporations require for large-scale capabilities and related business models.^{60,81}

Recommendations for the mRNA TT Programme

The initial financing for this initiative—US\$ 129 million committed so far—came through grant funding from mostly international donors who consider this as support for a WHO-led technical capacity-building project. In particular the donors see it as an investment in the technological capacity of the South African Hub (estimated budget as of May 2023: US\$ 117 million, not yet fully funded). Selected partners also contributed to the initial financing. Equipping the whole network of manufacturers with state-of-the-art infrastructure for efficient small- to medium-scale production will require additional investments, which may receive additional donor funding and domestic finance (especially if governments can access capital affordably). Regional development banks keen to invest in the capability may also provide finance (as long as they are willing to invest in a common-good approach to health resilience). Additionally, there will be a need for funds to build the R&D pipeline that can supply the mRNA TT Programme with development candidates, and to conduct the necessary clinical trials. While no specific budget projections have been made public, the total investment need will likely amount to a few hundred million dollars over the next five years.

It will be critical to direct and condition funds to finance an end-to-end approach for health security, based on the value proposition outlined in **section 4.3**. The idea is to avoid merely de-risking the private sector partners and investors so that they can achieve business-as-usual objectives. This is particularly the case where public funding is mobilized, either through R&D or development cooperation grants, investments, or (concessional) loans. Private partners and investors must commit to the shared mission of the mRNA TT Programme, with contractual arrangements that reflect both rights and obligations towards achieving the agreed objectives. This will require an end-to-end governance mechanism that mobilizes and values each input (financial, knowledge, operational and infrastructure) and risk taking throughout the value chain, towards collectively achieving the goal of epidemic preparedness and resilience, and equity.

» It is worth noting that a few hundred million dollars can go a long way in emerging economies. «

It is important to keep in perspective that a few hundred million dollars represent a relatively modest investment (too modest?) for setting up a state-of-the-art mRNA pharmaceutical infrastructure and capability, an R&D pipeline, and a network of up to 15 manufacturers that can supply critical health products to their countries' health systems. For comparison, the American Government invested at least US\$ 337 million in research grants related to mRNA technology pre-pandemic, and has invested another US\$ 2.3 billion for clinical trials and supportive science for mRNA vaccines since 2020.⁸² Critically, in terms of sustainability, the American Government spent US\$ 29.2 billion to purchase mRNA vaccines. All this contributed to the highly profitable business model that exists for health security in HICs. Moderna and Pfizer/BioNTech have accumulated more than US\$ 100 billion in global revenues from COVID-19 vaccine sales,⁸³ with profits largely extracted to provide financial return for investors, shareholders and senior company executives, and only minimally feed back into the R&D ecosystem.

5-3 Governing innovation for the common good

The shortcomings of the current commercial health innovation system to serve public health objectives are well documented,⁹ and particularly manifest for epidemic preparedness and response.¹⁰ With IP monopolies as the main incentive towards maximizing financial returns, R&D priorities are geared to pursue market opportunities rather than health needs. Meanwhile new health products command increasingly high prices, despite a majority showing no, or, little clinical benefit compared to the products that already exist.⁸⁴ In addition, they involve massive public investment all along the value chain. Health needs that do not represent a lucrative enough market are considered market failures, to be addressed by (additional) government interventions in the form of “market push and pull mechanisms” (see section 4). However, such mechanisms overlook the fundamental misalignment between the presumed purpose of health innovation (improving people’s health outcomes, equity, and global public health and well-being) and the main drivers of the commercial pharmaceutical R&D ecosystem, given that the IP system does not steward public investment towards health, equity or well-being. In addition to leaving many important health needs unmet, the benefits of public investments are privatized, while the risks and costs are socialized.⁹ In the context of the COVID-19 pandemic, this led to underinvestment in preparedness or in solutions that are well-adapted to the needs of communities in developing countries. At the same time, private companies like Moderna, BioNTech and Pfizer managed to secure billions of dollars in profits, while refusing to share the know-how and technologies to strengthen pandemic preparedness and response in LMICs.⁸³

» There is a need to redesign the health innovation ecosystem to be better fit-for-purpose. «

There is a need to redesign the health innovation ecosystem to be better fit-for-purpose. This means rethinking how to set priorities to address health needs (directionality), taking into account the health system context where people seek health care. It also means structuring the collaborations between the various stakeholders (public, private, civil society or scientific community) to that end.⁸⁵ **It requires shaping the health R&D ecosystem and designing contracts and knowledge-management arrangements for the common good.**⁸ There will be need for: technology sharing; collective intelligence; rapid-response capacity, including versatility and the transferability of the technology, and; diversity in approaches. These are key drivers towards the purpose of timely and equitable availability of countermeasures, and local resilience. **Redesigning the ecosystem includes exploring new, regenerative business models that focus on the sustainability of the collective assets to create public health value, rather than generating and extracting financial value.**

In the aftermath of the COVID-19 pandemic, a lot of focus and investment are directed to establishing local and regional manufacturing capacity. However, the **capacity to support the innovation process is what will truly bring regional resilience and equity.** This will require access to knowledge, know-how and technologies, and freedom to operate, so as to adapt a range of critical technology platforms to emerging epidemic threats when and where they occur. Ideally, this calls for regional R&D hubs that can establish a shared portfolio of R&D projects which address regional needs for epidemic preparedness. The preparedness should involve different approaches complementing each other for the best possible health outcomes (and mitigating the risk of failure collectively).¹⁰ This means levelling the playing field, or even tilting it to empower scientists everywhere to use science and technology to protect their communities from epidemics. Stopping outbreaks when and where they occur is the most effective way to prevent them from spilling over into bigger epidemics or pandemics. This is in everybody’s interest, and as such, should be encouraged and supported locally, regionally and globally.

Recommendations for the mRNA TT Programme

In order to establish the mRNA TT Programme as a collectively owned research and technology platform for epidemic preparedness and response, that is managed for the common good, it is imperative to design an appropriate legal structure and organizational form and present them to the participating entities and supporting countries for endorsement. As outlined in the value proposition (**section 4.3**), there is a need to consider the shared technology platform and R&D portfolio as critical shared assets for public health. Access and user rights should be defined around the technology platform and R&D portfolio, and linked to: commitments for continued investments in sustainability, and; ensuring equitable access to the resulting health products when and where needed. Funding, investment and partnership agreements must reflect this common-good approach, with clear conditionalities and mechanisms for accountability.

A critical aspect for the success of the mRNA TT Programme lies in clarifying and, as needed, taking measures to ensure freedom to operate without IP constraints in developing, manufacturing, commercializing (including export) and using health products produced with the mRNA technology. This may require individual government action, or regional/global approaches, including the use of legal tools available under international law where advocacy pressure and good-faith negotiations fail to secure essential tools for public health.

Lastly, there is a need to increase research funding and investments in health-industrial development, and provide clear direction towards addressing unmet health needs. These include: epidemic preparedness for maximal health impact, and; incentives to favour open science, collective intelligence, and collaboration over secretive competition between proprietary technologies.

5.4 Building government and people's capacity for health equity

Designing and driving mission-oriented policies for health equity, including piloting the end-to-end R&D ecosystem's epidemic preparedness and response makes it necessary to boost the capacity of States, and of individuals working within the R&D ecosystem.

This includes all the functions related Value, Finance and Innovation mentioned above, and more. It involves building a skilled and motivated local workforce through **education and skill building** in (public) health as well as science, technology, engineering, and mathematics, and ensuring a **conducive working environment and labour policies so as to retain workers** (and avoid the brain drain). It includes building capacity for **health policy making and roll-out**, for instance vaccination programmes. It involves the regulation of **medicines**, including the capacity to oversee research and clinical trials, and ensuring the timely authorization of adapted health products based on solid evidence. Lastly, it includes the use of **procurement policies** to drive public health and a health-industrial policy that is responsive to needs and delivers equity, and **trade rules** that do not hinder access to technologies, know-how or health products.

» Building a conducive environment often needs action in many different areas, hence the need for a whole-of-government approach toward building health security and equity. «

Building a conducive environment often needs action in many different areas, hence the need for a **whole-of-government approach toward building health security and equity**. A good example is Brazil, which is using a combination of public research, and public and private local manufacturing capacity to supply its public health system. To define R&D priorities and the future of industrial policy in the health sector, it uses public options, centralized

procurement, innovative Productive Development Partnerships that exchange market access for technology transfer, and coordination mechanisms involving research, health, finance, science and technology.⁴⁵

While it is vital to enhance individual countries' capacities to design and implement rules and policies that foster and support an end-to-end ecosystem for the common good, it is also important **to establish coordination and synergy within the international network, regionally and globally**. It is the collective responsibility of countries to **build coalitions of the willing and capable**, and foster collaborations between public, private, academic and civil society sectors towards the shared purpose of developing and manufacturing epidemic countermeasures for health security. This may require negotiations at the regional or global levels, as is for instance the case around finance and IP reform. At a minimum, HIC governments should step up to impose conditionalities around the sharing of technology and know-how, and access to and pricing for the R&D efforts towards which they contribute.

Recommendations for the mRNA TT Programme

Countries that host a local manufacturer participating in the mRNA Hub have in principle committed to support them. Concrete ways to do so include: ensuring their IP laws include the necessary TRIPS flexibilities to overcome possible IP barriers to protecting public health, and the willingness to use them if need be; strengthening regulatory oversight and authorization capacity, and the ability to make judgements about benefits or risks based on the local context, including for emergency-use authorizations (or building international collaborations to support this function); ensuring the timely adoption of evidence-based vaccination guidelines, and close coordination with vaccine procurement (locally, internationally); investing in building local R&D capacity and creating opportune ties for researchers to pursue local health needs-driven research; promoting national and regional collaboration and open science initiatives, and; mobilizing domestic and international finance to support the mRNA Hub project as investment in both local and global health security, and equity.

» It is the collective responsibility of countries to build coalitions of the willing and capable, and foster collaborations between public, private, academic and civil society sectors. «

6. Transformation requires challenging conventional economic wisdom about markets for health

In order to create a sustainable ecosystem that delivers needs-driven R&D and manufacturing of critical health products, and equitable access where and when needed, it is necessary to debunk economic myths that have been the cornerstone of policy design and implementation in recent decades. Current global market dynamics, including for pharmaceuticals, are anchored to conventional economic theory and models based on efficiency, natural monopolies, economies of scale, winner-takes-it-all market logic, and a positive relationship between patents, innovation and economic growth. The same thinking is adopted in current market-fixing or shaping efforts to overcome market failures, in response to health crises and inequitable access to health technologies. However, using the same theory to inform new policy will not yield new outcomes. To produce fundamentally different results, it is necessary to move beyond traditional economic theory and narratives, and challenge some of their assumptions.

» To produce fundamentally different results, it is necessary to move beyond traditional economic theory and narratives, and challenge some of their assumptions. «

6.1

The efficiency paradigm

Since the 1960–70s, efficiency has become the central doctrine for economic thinking and policymaking about how to best allocate scarce resources. Along with this is the belief in the power of markets to efficiently allocate resources to achieve a given objective (or at least more efficiently than a government or other actor can).⁸⁶ Efficiency in this context means that, among the policy interventions that achieve a certain objective, it is always desirable to choose the lowest-priced option. This assumption has two additional and interrelated corollaries. Firstly, it confines governments' role to providing the minimum conditions for markets to function properly, because efficiency will then come by virtue of the market (while governments are deemed unable to act efficiently). Secondly, it implies that desirable or optimal outcomes will follow if society achieves its goals in a cost-effective way. This set of beliefs has helped enshrine efficiency as the ultimate objective of policymaking. And it leaves little room to pursue other goals, such as equity, well-being, the preservation of nature, income redistribution, the creation of local capacity to manufacture essential health supplies, or the preservation of small, local businesses. The narrative of efficiency as the prime driver of economic activity reflects a failure by economists and policymakers to recognize that efficiency is but another value among many others that they could prioritize.

In the health sector, an excessive focus on efficiency has meant placing a high priority on healthcare interventions that provide populations with more benefits per dollar than other interventions. There is little concern about how the benefits are distributed among different sectors of society, or the broader impact within the health-socioeconomic ecosystem. The result is, for instance, underinvestment in epidemic preparedness and resilience, or neglect of equitable access to knowledge and technology. Cost-benefit analysis often assumes that a benefit to one compensates for a loss to others and, as a generalization, that it is morally desirable to maximize in the aggregate while being insensitive to important questions of distributive justice and equity.⁸⁷

Such focus on efficiency in the health sector risks overlooking the goal or objective that one is trying to achieve, ideally in an "efficient" way. For instance, in the context of a low-probability event such as a pandemic, the world failed to achieve epidemic preparedness in the most efficient way; by eliminating it at its source. To do so, it should have invested more in prevention and preparedness, for

example addressing the root causes of potential spillovers of viruses from animals to humans,⁸⁸ increasing surveillance capacity, and establishing stockpiles of essential drugs and vaccines. In fact, many activities that are critical for epidemic preparedness, or preventive health and health security in general, are considered inefficient in a strictly economic sense.⁸⁹ They require short-term expenditures that, if successful, avert future catastrophic expenditures but only the former show up in budget or balance sheets. They also run counter to the short-term political mandates during which policy makers, and their voters, can see the benefits of their actions. However, as evidenced by the COVID-19 pandemic, the costs of the pandemic were 300 times higher than the required additional international and domestic investments to prevent the next pandemic.⁹⁰

6.2

Market concentration and winner-takes-it-all power dynamics

The global innovation and production capacity of pharmaceutical supplies is unequally distributed.

Innovation capacity is concentrated in a small number of HICs, that currently own or host most of the infrastructure, capability, skilled labour force, and a conducive business environment for medical innovation as profitable business. This (dis)equilibrium enjoys vigorous protection through stringent intellectual property laws that favour those with technological capacity, and that became global in 1995 by way of the World Trade Organization's TRIPS agreement,⁹¹ which entrenched the gap in knowledge and technological capacity.⁹² At the same time, the constant quest for lower production costs has led to the creation of (large-scale) generic-drug manufacturing and vaccine fill-and-finish centres in many LMICs, with the production of active pharmaceutical ingredients and their building blocks concentrated primarily in the People's Republic of China and India. So, while there's ample capacity for the low-cost production of existing products, either off-patent or under licence from "originator" companies, the capacity to innovate remains concentrated among a small group of countries and their pharmaceutical industry, benefiting from a conducive business environment (see **section 4.3**). Driven by continued growth prospects, including in emerging markets, they seek to maintain and strengthen their monopolies, leaving entire regions dependent on goodwill and voluntary licences for access to critical health technologies. In other technology-intensive sectors like telecom, extensive cross-licensing is the norm and promotes continued rapid follow-on innovation.

» Many activities that are critical for epidemic preparedness, or preventive health and health security in general, are considered inefficient in a strictly economic sense. «

By contrast, the pharmaceutical sector's business model still largely relies on proprietary technology platforms that are actively enforced to prohibit others from using them, including through anti-competitive patent thickets.⁹³ In recent years, a string of mergers and acquisitions have moreover resulted in a highly consolidated market place, with a small number of global corporations controlling the majority of the market by value, especially for proprietary products, as well as technology platforms.

Market concentration is reinforced by procurement policies focused on buying the largest number of health products per dollar, especially for LMICs. The COVID-19 pandemic reminded the world about the importance of national and regional pharmaceutical manufacturing capacity for resilience, autonomy and health security. Worldwide discussions on industrial policy, re-shoring and near-shoring attest to this. However, LMICs in particular are under fiscal pressure to strictly implement the efficiency paradigm and buy at the lowest possible price, especially when using donor funding. This leaves little room for additional objectives, such as local production, diversification of sources and supply security, or for products to be optimally suited for local health contexts. The result is further concentration of one-size-fits all suppliers who seek to maximize economies of scale to win competitive tenders, based on the lowest price, often through winner-takes-it-all tendering processes that leave little opportunity to build diversity and resilience in supply chains.

6.3 Natural monopolies and economies of scale

According to conventional economic theory, “natural monopolies” are the most efficient market structure in a market with high fixed costs or barriers to entry,⁹⁴ such as the pharmaceutical market, because of the significant capital investments needed before the production stage. The higher the production output, the less relevant initial fixed costs become when calculating the cost per unit. As such, one market player can supply the good at lower costs than two or more competitors can. When an industry or company has reached the stage where its fixed costs are sufficiently spread over its production, it has achieved economies of scale. The pharmaceutical market is both skill- and capital-intensive, with a higher density of both in what is called the “originator” companies, compared to the generics

» International checks and balances are either non-existent or not effective enough to limit the market power of international producers. «

manufacturers. Therefore, according to conventional theory, the most efficient market structure is to have a few dominant players that can supply at the lowest costs. This rationale has underpinned a lot of the “market shaping” efforts in global health for instance by Gavi, the Vaccine Alliance (see [section 3](#)). In theory, this rationale looks harmless. In practice, however, international checks and balances are either non-existent or not effective enough to limit the market power of international producers. This leaves the door open for monopolistic pricing, especially in a market that is known for flexible pricing and uneven market power between seller and buyers (patients in need of medicines may be willing to overpay). Moreover, such markets are highly vulnerable to disruption and failure, for instance if one of the producers is no longer able or willing to supply. This can lead to life-threatening shortages, which is now the case with cholera vaccines,²⁸ and happened during the COVID-19 pandemic when Serum Institute of India could no longer supply vaccines outside of India in the midst of the

Delta wave.⁹⁵ Finally, the fact that countries enacted various forms of export controls and restrictions during COVID-19 for nationalistic reasons—from face masks to antibiotics and even food products—showed the vulnerability of the global trade regime to supply constraints.⁹⁶

In the context of vaccine manufacturing, the presence of economies of scale has led to an oligopolistic market with preference for a small number of one-size-fits-all large-scale producers for each vaccine. Accordingly, if products are not needed in large volumes, for instance because the disease is affecting relatively few people (the so called “neglected diseases”, or emerging infections with limited geographical footprint like Ebola or Lassa fever), current market dynamics are unable to sustain the products’ availability and affordability. This results in de facto market failures that market push and pull mechanisms cannot fix, given the known limitations (see [section 3](#)).

6.4 Innovation, monopolies and growth

Endogenous economic-growth models have long emphasized the relationship between innovation, patents and economic growth. Conventional economic theory holds that patents provide incentives for innovation by artificially creating and protecting market power so that the private sector invests in risky ventures. This, in turn, fosters economic growth. This linear causality, however, is in contrast with the fact that privatizing knowledge limits collective intelligence and the positive spillovers it can have along the innovation chain.⁶ At the same time the privatization overlooks the fact that IP is ill-designed to foster directionality in the innovation process, for instance towards global health benefits. Additionally, strengthening patent protection has contrasting effects on economic growth at different stages of development.⁹⁷ Evidence suggests that, in certain sectors, stronger IP protection can foster domestic innovation and increased technology diffusion in developing countries with sufficient capacity to innovate. However, it has little impact on innovation and diffusion in countries without such capacity and may impose additional costs, especially for the least developed countries that are precluded from using imitation as a means to develop innovative capacity.⁹⁸ In fact, **developing countries are increasingly pushing back against the intellectual property regime imposed on them, arguing that the current IP regime entrenches historic inequalities and constitutes a barrier to their economic development and well-being**.^{99, 100}

» The current patent regime that rewards (chemical) novelty and inventiveness independently of clinical value largely fails to direct medical innovation towards therapeutic advances. «

Critically, from a health perspective, the current patent regime that rewards (chemical) novelty and inventiveness independently of clinical value largely fails to direct medical innovation towards therapeutic advances. As a result, the majority of new products provide no clinical benefit. At the same time, monopoly pricing on medicines and other health technologies poses significant challenges for equitable access to the products of medical innovation, even in wealthy countries.¹⁰¹ There is growing consensus that the singular focus on economic growth based on production, consumption and resource use is not sustainable and alternative narratives for human prosperity are emerging, including the doughnut economy.^{67, 102}

This an important consideration worth mentioning: **technological innovation can be an effective way to alter, or disrupt the dynamics of a market, for instance break monopolies or oligopolies that rely on economies of scale.** Examples of this type of innovation abound in the private sector, from streaming to digital retail and service delivery (think Netflix, Amazon, Airbnb). Because of its versatility, and the fact that it easy to produce and handle, the mRNA technology may have a similarly disruptive effect (**BOX 3**). Certain types of innovations can fundamentally change the organization and power dynamics of a market, even if that does not necessarily result in better outcomes for the overall public interest. Notably, the growth of the gig-economy has undermined labour rights and increased precarious employment for many. Elsewhere, the shift in real estate use from long-term housing to short-term hospitality business rentals, has undermined affordability in the housing market and transformed city centres into tourist accommodation. However, appropriate regulation and governments policies could shape the direction of such disruptive innovation to better serve the public interest.¹⁰³

BOX 3:

INNOVATION AS A MEANS TO BREAK MONOPOLISTIC POWER: CAN MRNA TECHNOLOGY DO THE SAME?

The mRNA vaccine technology platform may show promise as a wedge to break the current oligopolistic vaccine market for LMICs that is based on economies of scale and large production facilities. On top of the possible health benefits that mRNA vaccines and related products may bring about, they have several unique characteristics that show great promise as a versatile health technology with a broad range of possible applications. It is possible to easily and affordably produce vaccines and related products at low and medium scale, and do so more rapidly than conventional vaccines.^{104, 105} The next-generation of mRNA vaccines, with a self-amplifying component that allows lower dosing, promise further reductions in capital investment and operational expenditure. In addition, if the mRNA platform proves useful for a range of disease targets, it will be easier to keep research and manufacturing facilities running by developing and producing multiple products targeting local diseases and for national immunization programmes.

It is essential to have a policy framework to enable such disruption to take off, and to direct it towards improving global public health. The framework should provide broad access to the technology platform through knowledge and technology sharing and the training of a skilled workforce. It should provide access to capital, and a conducive health regulatory structure to guide the swift development and approval of safe and effective new products. Additionally, investments must support sustainability, even when demand is low, by creating and sustaining stockpiles for outbreaks or by supporting investments in R&D and manufacturing capacity that can tolerate and survive low demand and yet still allow surges in manufacturing when needed.

7. Conclusion and recommendations

There is a need to shift fundamentally from business as usual in order to ensure health equity in LMICs by establishing resilient global health security infrastructure, capability for R&D and the manufacturing of critical health technologies.

This requires re-thinking the collective definition of sustainability and the shaping of the health-industrial ecosystem for health equity. It involves moving beyond the concept of fostering competitive markets and market-fixing to enable individual producers to thrive as a business. It is imperative, instead, to adopt a new narrative and value proposition that focuses on “economic sustainability for health” from a country, regional and global perspective. There is a need, therefore, to consider a whole range of inputs, policies and operational mechanisms to achieve the desired outcomes for health. They include (access to) suitable technologies and know-how, adequate finance, skilled human resources, South-South collaboration and coordination. Collectively they will shape an end-to-end approach to research and technological development that addresses priority health needs and can deliver adapted supplies to the health system when and where needed, with equity and resilience at its core.

Recommendations to reshape the health-industrial ecosystem for health equity:

- Consider countermeasures and other critical health technologies as common goods rather than market commodities, with technology sharing and collective intelligence— rather than competition between proprietary monopolies—as driving forces behind their development.
- Value the creation of distributed technological capacity for health R&D and manufacturing in LMICs as a strategic asset for collective health security, equity and resilience, and finance it accordingly. In addition, measure the health value of countermeasures by their full socio-economic impact, not just in monetary or market terms.
- Move from profit-driven to health purpose-driven, regenerative business models to deliver equity by shifting what humanity values and design an enabling environment to that effect. Do that through adequate financing and knowledge governance (shaping the ecosystem), including by setting the right R&D priorities for health (directionality), and organizing the way public, private and civil society actors work together towards shared public health objectives.
- Increase access to affordable capital to invest in health and epidemic preparedness and response in LMICs through reforms to the global finance architecture (for example the 2022 Bridgetown Initiative), and ensure that existing and new pandemic funding streams support collaborations between public and private stakeholders for the common good.
- Invest in skilled labour forces and infrastructure for health R&D and manufacturing as well as health care professionals to strengthen the overall health system environment, including by taking measures to retain these talents.
- Foster a whole-of-government approach towards strengthening productive capacity for health, with adequate investments in education, infrastructure, the workforce, R&D, the regulation of medicines, and health care, alongside conducive policies and the creation of synergies between the policy areas of health, finance, trade, science and technology, public procurement, labour and the environment.

Specifically for the mRNA TT Programme:

- Agree among participating entities and countries, including donors, to join forces behind a common vision for a shared mRNA technology platform to collectively develop a R&D pipeline and deliver health technologies where and when needed to address local health needs. Leverage the strengths of the participating organizations into a common-good approach for health, and design an appropriate governance structure to that effect.
- Co-create a regenerative business plan based on the collectively owned knowledge and technology platform, with clear access and user rights alongside collective investment and sharing obligations, and contractual arrangements, all partners, that reflect the common-good approach. Use the business plan to raise the right level of funding from public and, if appropriate, private sources, and structure the financing in ways that advance public health objectives.
- Establish metrics for success that captures the end-to-end value proposition, including: manufacturing quality mRNA products in a timely way through multiple small- to medium-scale production units with the ability to produce epidemic countermeasures at an acceptable cost-of-goods, and being ready to activate when needed, and; establishing a diverse R&D portfolio that addresses local health needs.
- Clarify and as needed take action to secure the freedom to operate without IP constraints to the development, manufacture, commercialization (including export), and use of health products based on the mRNA technology. This may require individual government action, or regional and global approaches, including the use of legal tools available under international law.
- Explore innovative financing mechanisms to create fiscal space for participating LMIC governments, and harness public and aligned (slow, long-term) private financing for the mRNA Hub from international financing institutions and private markets (for example through a collective bond issue guaranteed by current mRNA donors).
- Develop an advocacy strategy to engage participating governments and donors to support this initiative as a timely pilot for sustainable epidemic preparedness and response for the common good, including with adequate financing and procurement policies and practices that are aligned with its equity, resilience and health security objectives.

» It is imperative to adopt a new narrative and value proposition that focuses on “economic sustainability for health” from a country, regional and global perspective. «

Annex 1: Description of the mRNA TT Programme

This section describes the mRNA TT Programme based on publicly available information the research team was able to access during the research period (October 2022–April 2023), supplemented by information obtained through interviews with stakeholders and partners (see Annex 2); it does not represent the official programme description. Given that the programme is still evolving and growing in terms of partners participating in it, funding, scope and governance, some aspects of it also underwent modifications during the research period. For instance, while the programme was initially promoted and built as a hub and spoke model (technological capacity was to be built at one site, to be transferred to spokes or recipients), it has since been reframed as a partnership programme with multidirectional sharing among partners, and terminology has changed accordingly.

“The mRNA technology transfer programme is a global initiative that aims to improve health and health security by establishing sustainable, locally owned mRNA manufacturing capabilities in and for low- and middle-income countries (LMICs).

The programme is based around a technology transfer “hub” Afrigen, which is located in South Africa. They will provide the technology development, training and technology transfer, and 15-20 “spokes” in LMICs across the world, will receive training and technology from the hub and then produce and sell products commercially. Its core concept is empowerment.

Initially the programme will focus on mRNA vaccines against COVID-19. However, the programme is designed to encourage the development of other mRNA vaccines and therapeutics against important diseases that threaten LMICs, thereby ensuring the capacity built by the project is sustained and available to combat the next pandemic.”

Cited from the website of the MPP;¹⁰⁶ the World Health Organization’s operational partner in managing and overseeing the programme (March 2023).

1.1

Set-up, governance and funding

The World Health Organization established the mRNA vaccine technology transfer programme within the scope of the highly inequitable availability of COVID-19 vaccines. This was a response to requests from LMIC countries to acquire the capacity to manufacture vaccines locally and reduce their reliance on the benevolence of multinational companies and/or wealthy governments to respond to the pandemic.¹⁰⁷ Building on the Organization’s previous experience with a technology transfer initiative for influenza vaccines,¹⁰⁸ the chosen strategy was to establish the technological capacity at one centre of excellence and training (the mRNA vaccine technology transfer Hub, a consortium of organizations around Afrigen in South Africa). From the Hub, the idea was ultimately to transfer the technology or share it with a network of manufacturers (spokes, or technology recipients, renamed as partners in April 2023) in LMICs. There are 15 of them (see **FIGURE 1, section 2 & TABLE 1**).

TABLE 1.

Current partners (previously “spokes”) of the mRNA TT Programme (April 2023),
based on publicly available information on company websites

COMPANY	COUNTRY	OWNERSHIP	PRODUCTION CAPACITY
➤ Sinergium	Argentina	Private	Has a production capacity of 30 million doses of different vaccines, including seasonal influenza, pneumococcal, and HPV.
➤ Bio-Manguinhos	Brazil	Public	On average, they deliver 120 million doses of vaccines annually to the National Immunization Program. The vaccines produced include those for diphtheria, tetanus, pertussis, Hib, yellow fever, polio, and rotavirus, among others.
➤ BioGeneric Pharma SAE	Egypt	Private	Production capacity under construction, to be operational in 2023
➤ Biovaccines Nigeria Ltd	Nigeria	Public-Private Partnership: 49% Federal Government of Nigeria and 51% May & Baker Nigeria Pie	New manufacturers, set up initially in 2017. Have not yet commenced production of vaccines. The priority is the production of vaccines for yellow fever and measles. Targeted capacity to vaccinate 10 million people annually, as per the Government’s immunization strategy.
➤ Institut Pasteur de dakar	Senegal	Private non-profit foundation, recognized as a public utility	Produce yellow fever vaccines. Capacity for the production of 20 million doses annually
➤ Institut Pasteur de Tunis	Tunisia	Public Health Establishment under the supervision of the Ministry of Health. Private, non-profit foundation.	Produce BCG vaccines and therapeutic serums.
➤ Incepta Vaccine Ltd	Bangladesh	Private	Annual installed capacity of 180 million doses. Produce a wide range of vaccines for measles, mumps, rubella, rotavirus, diphtheria, tetanus, HPV, Hepatitis B, Pneumococcal, Meningococcal.
➤ Biofarma	Indonesia	Public	Large portfolio of vaccines produced. They already have a COVID-19 vaccine as part of their portfolio, developed in collaboration with the Baylor College of Medicine (Texas). Have large-scale manufacturing capacity, with a projected annual capacity of 250 million doses of this COVID vaccine.
➤ BiologicalE	India	Private	Large scale production facility that produces a wide range of vaccines, including pentavalent and tetanus vaccines, among others. Have their own COVID-19 vaccine. As per their website, they have supplied 2 billion vaccine doses in the last decade
➤ National Institute of Health	Pakistan	Public	Produce polyvalent anti-snake venom serum and anti-rabies serum. Tetanus and Diphtheria vaccines to be produced soon. Producing 3 million doses of COVID-19 vaccines in partnership with Cansino Bio (China) in new Islamabad plant.
➤ Institut Torlak	Serbia	Public	Large-scale production facility that produces a wide range of vaccines, including vaccines for influenza, Tuberculosis, Diphtheria and Tetanus. Also has partnerships to produce the Sputnik V and Sinofarm COVID-19 vaccines.
➤ BioVac	South Africa	Public Private Partnership	Has the existing capacity to produce 15 million doses annually. Produce vaccines for tuberculosis, measles, pneumonia, hepatitis B, Tetanus, and the Hexavalent vaccine.
➤ Darnitsa	Ukraine	Private	Not a vaccine producer. Part of the hub to produce a drug like Pfizer’s Paxlovid. Large-scale pharmaceutical producer of 180 products, the largest in Ukraine by scale.
➤ Polyvac	Viet Nam	Public	Produce Measles-Rubella vaccine, among others. Has partnership to produce Sputnik V COVID-19 vaccine

The Hub at Afrigen is developing a COVID-19 mRNA vaccine candidate designed from the original sequence of the Wuhan strain, published by Stanford University and used by Moderna for their SpikeVax vaccine, to validate the technology platform. Once the proof of principle for the COVID-19 vaccine AfriVac 2121 (named after Africa/Afrigen and the date 21 June 2021 when the mRNA Hub in South Africa was formally set up) is established, the technology platform will be transferred to 15 LMICs to build capacity and capabilities to produce mRNA vaccines. A clinical utility for AfriVac 2121 is unlikely by the time it is available. As such, its greatest value is the validation of a technology platform to be transferred to LMICs for epidemic and pandemic preparedness, as well as for the development and manufacturing of vaccines (or other mRNA products) targeting the burden of disease in these countries.

Spearheaded by WHO as a technical assistance project to support LMICs, the mRNA TT Programme is co-managed by WHO and the MPP,¹⁰⁹ a Swiss foundation. The latter is in charge of contracts, including IP arrangements, as well as funding agreements with the Hub and its research partners, and with the donors. A governance structure is in place for the mRNA TT Programme, with a Steering Committee supporting the WHO secretariat and a Scientific Advisory Committee that provides technical input.¹¹⁰ The Steering Committee was recently renamed as STeRCo (for Scientific and Technical Review Committee), and its membership is still evolving (April 2023). The mRNA TT Programme operates in close cooperation with the Biomanufacturing training initiative, coordinated by WHO and the WHO Academy, to align training needs for both Hub and spokes/partners (manufacturing, good practices, technology transfer) with training opportunities. The project currently receives its funding from a group of mostly Western donors, headed by France (see table below). It has a total of around €118 million or US\$ 129 million in commitments, with 73% allocated to the South African Consortium (Hub) around Afrigen, BioVac and the South African Medical Research Council and 27% to the partner companies (as of May 2023).¹¹¹

Publicly available documents do not disclose the precise decision-making mechanisms within the governance structure, however, operational priority setting and funding decisions within the project seem to reside with WHO and/or the MPP, through which most donor funds are channelled. The South African Consortium/Hub and network of manufacturers are the implementing agents. Donors also appear to have some leeway in deciding where and for what purpose their funds will be used. It is worth noting that so far funding requests to the American Government have remained unsuccessful,¹¹² even though there is in-kind support through research collaboration between the National Institute of Allergy and Infectious Diseases and Afrigen.¹¹³

TABLE 2.
Funding committed by donor for the mRNA TT Programme as of May 2023

(source: WHO/MPP personal communication)

FUNDER	AMOUNT (in million US\$)
French Government	54.4
Canadian Government	33.9
European Commission	12
German Government	6.6
African Union	7
South African Government	4.5
Belgian Government	4.3
Norwegian Government	4.5
Other	1.7
TOTAL	129

Initially, a budget of US\$ 117 million was estimated to cover the needs of the South African consortium/Hub, with no budget foreseen for the manufacturers who would receive the technology. Spoke companies and their governments were expected to have sufficient skin in the game, and leverage—given that they are the recipients of mRNA technology through their participation in the project—to raise the financing needed to set up production facilities and develop and produce the vaccine. This is not necessarily happening, or not sufficiently, and additional funds have meanwhile been made available to also invest in the network of manufacturers, for instance for the purchase of equipment. In any case, the budget estimates are very modest for the ambition of developing mRNA technology, and transferring it to a network 15–20 manufacturers. In fact, the budget does not fully cover the manufacturers' needs related to the reception of the technology and demonstration of its the successful transfer.

Status in April 2023:

- a prototype COVID-19 vaccine was developed that shows good in vitro results;
- animal safety and immunogenicity studies are under way;
- a phase I/II clinical trial to demonstrate initial human safety and immunogenicity is scheduled to start in the first quarter of 2024 in South Africa;
- training/technology transfer has started for different manufacturers, and;
- on the R&D front, work has started at the South African consortium on a tuberculosis mRNA vaccine.

1.2

Technology sharing and knowledge management

While initially the expectation was that either Moderna or BioNTech/Pfizer would share the mRNA vaccine technology under a voluntary licence, negotiations to that effect failed. Therefore, instead of establishing vaccine production capacity in about six months, the mRNA TT Programme was forced to re-engineer the technology and make a “Moderna look-alike” vaccine based on publicly available information, in principle without infringing patents¹¹⁴ or relying on confidential know-how (even though the Moderna vaccine was developed in partnership with the US National Institute of Health, a public institution). In practice, this means that it will take at least two years before a ready-to-use vaccine can be developed. This takes into account clinical trials to confirm safety and efficacy, obtaining marketing authorization and ensuring production at scale. It is highly probable that this would be too late to contribute towards the supply of COVID-19 vaccines to fight the ongoing pandemic. **Accordingly, the project’s priority shifted from contributing to the COVID-19 response to a longer-term mRNA vaccine technology capacity-building project to increase pandemic preparedness and response and technological resilience.** Beyond COVID-19 and epidemics, it would also allow LMICs to regain some sovereignty around both epidemic preparedness and response, and the capacity to develop and produce vaccines more broadly, especially given the expected versatility of mRNA technology.

As the project evolved, it became increasingly clear that the development and manufacturing of a COVID-19 vaccine would primarily serve as a technology development test case.¹¹⁵ It would serve to establish the capability of mRNA vaccines at the Hub and within the network of manufacturers, and demonstrate that technology transfer to multiple partners is a feasible and effective way of rapidly sharing capability (in preparation for a future health crisis). This is also why the capacity building and technology sharing will not only focus on the manufacturing stage, but encompasses the capability to adapt the technology, and develop novel mRNA vaccines against disease targets of choice. To that effect, WHO is now also fostering a network of research organizations around the participating manufacturers that are interested in developing their R&D capability. It supports their exploration of potential disease targets that represent local unmet needs which the mRNA technology could address.¹¹⁶ The WHO Science Council is also undertaking a study to identify diseases areas relevant for LMICs that could present particular promise for mRNA technology.⁷ For the time being it remains unclear to what extent the R&D capacity and portfolio building is considered an integral part of the mRNA TT Programme (in terms of governance and financing), or rather a possible add-on for individual countries and spokes to engage in on their own terms. It is also uncertain whether financing is being channelled to support such activities.

The management of knowledge and intellectual property is a critical aspect of the design and operation of the mRNA TT Hub. This includes both access and user rights to existing knowledge resources that are under proprietary control (for instance under patent protection by Moderna or others, or secretly held know-how). It also includes the management of new knowledge resources that will be generated collectively at the Hub, or by the network of producers once they start adapting the shared technology platform for new applications. According to the MPP, the mRNA hub is premised on the non-violation of the patents on mRNA vaccine technology held by Moderna, Pfizer/BioNTech, and other companies.¹¹⁷ It capitalizes on freedom to operate around existing patents in the countries that are part of the mRNA TT Hub to create a Moderna-look alike (even if this remains a major point of uncertainty, see below).

Through the chosen governance design and structure of the funding arrangements, the licencing rights to IP, know-how and knowledge of the mRNA technology platform, created by Afrigen and its partners in the South African Consortium, will reside with the MPP. (The MPP receives donor funds, and issues funding to the South African Consortium/Hub and other parties through grant agreements.) The MPP will subsequently be responsible for out-licensing the technology to the participating manufacturers in the broader mRNA TT Hub network. The template technology-transfer agreement between the MPP and the manufacturers stipulates that any further improvements to the technology (new IP) will be licensed back to the MPP for collective use within the mRNA TT Programme.¹¹⁸ In May 2023, 13 out of the 15 participating manufacturers had signed this agreement.

However, unaddressed questions and uncertainties linger about knowledge management within the mRNA TT Programme. They will become increasingly critical as product development progresses, and commercial production and sales become a reality.

- 1 At this stage, the extent of freedom to operate around the adopted mRNA technology, including the lipid nanoparticle compositions, remains unclear given pending patents, patent litigations and the variation in the IP regimes in the different countries.^{119, 120} While current work can benefit from a research exception, this will change when a product gets developed and produced at scale for actual clinical use or commercialization.
- 2 In addition, many of the existing promises to not enforce intellectual property rights, for instance by Moderna, are typically limited to the COVID-19 pandemic, and/or to COVID-19 vaccines, and most importantly are non-binding in nature.¹²¹
- 3 At least one of the partners in the mRNA TT Programme is developing its own mRNA technology (not aiming to copy the Moderna vaccine, having designed a different construct—with potentially fewer IP issues), rather than receive technology from the South African Hub through the Programme. They have yet to finalize a suitable agreement with the MPP related to IP and technology sharing within the Programme.

- 4 The project's overall objective has evolved from a manufacturing capacity-building project to now include the possibility of developing novel vaccines or mRNA products. Nevertheless, there seems to have been no discussion among all participants about whether or how to collectively manage the IP/knowledge of such new applications and their underlying knowledge base. Additionally, the issue about freedom to operate could become even bigger.
- 5 While the licensing agreement between MPP and the spokes/partners lays out the sharing of IP, know-how and knowledge, there are no conditionalities about ensuring equitable access to products developed through the shared technology.¹¹⁸

1.3 Sustainability

The stated objective of the mRNA TT Programme is to “improve health security in LMICs through sustainable regional production of mRNA vaccines.” However there is no definition of sustainability beyond the idea of no longer being dependent on donor funding past a certain date (perhaps 2026?). Additionally, it was not possible to obtain clear (specific, measurable, achievable, relevant and time-bound) success parameters for the overall project beyond short-term technical goals, including moving targets in terms of scope and objectives (see above). It is also unclear which organization and governance structure is accountable for the success of this project (or what success would look like, for the Hub, at the individual spoke level, or the programme overall). Regulatory capacity strengthening and building skilled workforces for biomanufacturing more generally are important aspects of sustainability that clearly fall outside the scope of the specific mRNA technology transfer Hub project, but that are within the remit of WHO (**FIGURE 5**).

In the original design of the project, five working groups were created to support the mRNA TT Programme project, including one on business model and financing (**FIGURE 2**). From conversations with WHO colleagues working on this issue, the conceptualization of sustainability primarily focused on financial and commercial sustainability, or the economic viability of the (future) local vaccine producers within the global, or regional vaccine market. It is therefore important to gain a better understanding of the nature of this market and its particularities.

FIGURE 5.

Partners and pillars of the mRNA TT Programme

Tech innovation, IP, and product dev.	Product and process dev. incl. clinical dev. & Tech Transfer (hub & spokes)	Regulatory strengthening	Business model & financing	Funding & Governance	Biomanufacturing Training Hub
Evaluate & select target technologies for transfer, analyze IP landscape, launch EOIs, inform the selection of hub /spoke, and initiate field manufacturer responses to inform approach	Coordinate product and process dev. at hub, plan TT, and develop content, support site & infrastructure design, assess and communicate workforce needs	<p>A. GMP guidance and strengthening (CMC) Support manufacturers in achieving GMP on-site</p> <p>B. NRA strengthening to provide guidance to local authorities on regulatory processes.</p>	Estimate costs to implement, determine inter-pandemic sustainable business models, develop market-shaping & policy strategy to enable sustainability, and support mobilization of finance	Secure funding & design hub governance model, including coordination of operations during and between pandemics. Coordination of access to licences, coordination of access to capacity, etc.	Identify workforce training needs for both hub(s) and spokes (manufacturing / GMP base training) and identify experts to set up and lead the training programme

Note in addition, the Technical Advisory Panel (PDVAC) with expertise across topic areas (from industry, academia, etc.) reviews workstream proposals and provides input and recommendations to shape the final solution on hubs/spokes network.

Annex 2: Acknowledgments

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- Patrick Tippoo, BioVac, South Africa
- Mina Adel, BioGeneric Pharma SAE, Egypt
- Abdul Muktedir and Mainul Ahasan, Incepta Vaccines, Bangladesh
- Neni Nurainy and Adrian, BioFarma, Indonesia
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We recognise that this programme, the overall landscape and debates, are dynamic. This case study reflects analyses and writing up to mid-2023.

References

- Vaccines' Investment Mapping. mRNA Technology Transfer Hub Programme. Medicines Patent Pool, 2022 (https://medicinespatentpool.org/uploads/2022/11/20221108_Investment-Mapping_v7_web.pptx) Accessed: 8 October 2023.
- The mRNA vaccine technology transfer hub. World Health Organization. (<https://www.who.int/initiatives/the-mrna-vaccine-technology-transfer-hub>) Accessed: 8 October 2023.
- Lalani H S, Nagar S, Sarpatwari A, Barenie R E, Avorn J, Rome B N et al. US public investment in development of mRNA covid-19 vaccines: retrospective cohort study. *BMJ*. 2023;380:e073747 doi:10.1136/bmj-2022-073747.
- Roy V (2023). Financing Covid-19 mRNA vaccines. *BMJ* 380:p413 doi:10.1136/bmj.p413.
- WHO Council on the Economics of Health for All. Manifesto. Geneva: World Health Organization; 2021 (https://cdn.who.int/media/docs/default-source/council-on-the-economics-of-health-for-all/eh4a_manifesto_24092021.pdf).
- Mazzucato M. Mission oriented innovation policy: challenges and opportunities. *Industrial and Corporate Change*. 2018;27 (5): 803–815 (<https://doi.org/10.1093/icc/dty034>).
- WHO Science Council. mRNA technology for improving global health: Draft for public consultation. Geneva: World Health Organization; 2023 (https://cdn.who.int/media/docs/default-source/research-for-health/23-04-01-mrna-draft-report_for-public-consultation.pdf?sfvrsn=c10572d2_6).
- Mazzucato, M. A collective response to our global challenges: a common good and 'market-shaping' approach. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2023-01). London: University College London; 2023 (<https://www.ucl.ac.uk/bartlett/public-purpose/wp2023-01>).
- WHO Council on the Economics of Health for All. Council brief no. 1: Governing innovation for the common good. Geneva: World Health Organization; 2021 (<https://www.who.int/publications/m/item/governing-health-innovation-for-the-common-good>).
- Torreele E, Kazatchkine M, Liu J, Dybul M, Cárdenas M, Singh S, Quigley HL, et al. Stopping epidemics when and where they occur. *Lancet*. 2023;12;401(10374):324-8.
- Mazzucato, M. Mission Economy. A moonshot guide to changing capitalism. London: Penguin, Allen Lane-Penguin; 2021.
- Mazzucato M, Ryan-Collins J. Putting value creation back into "public value": from market-fixing to market-shaping. *Journal of Economic Policy Reform*. 2022;25:4, 345-360.
- Mazzucato M, Li HL. A Market shaping approach for the biopharmaceutical industry: governing innovation towards the public interest. *Journal of Law, Medicine & Ethics*. 2021;49(1): 39–49. <https://doi.org/10.1017/jme.2021.8>.
- Piot P, Larson HJ, O'Brien KL, Nkengasong J, Ng E, Sow S, Kampmann B. Immunization: vital progress, unfinished agenda. *Nature*. 2019;575, 119–129.
- Plotkin S. History of Vaccination. *PNAS*. 2014;111 (34): 12283-12287.
- WHO. History of the smallpox vaccine. Geneva: World Health Organization (<https://www.who.int/news-room/spotlight/history-of-vaccination/history-of-smallpox-vaccination>).
- Watson OJ, Barnsley G, Toor J, Hogan AB, Winskill p, Ghani AC (2022). Global impact of the first year of COVID-19 vaccination: a mathematical modelling study. *Lancet Infectious Diseases*. 2022;22(9): 1293-1302.
- Hutubessy RCW, Lauer JA, Giersing B, Sim SY, Jit M, Kaslow D, Botwright S. (2021) The full value of vaccine assessments (FVVA): a framework to assess and communicate the value of vaccines for investment and introduction decision making. Available at SSRN: <https://ssrn.com/abstract=3841999> or <http://dx.doi.org/10.2139/ssrn.3841999>.
- WHO. WHO Global vaccine market report 2020. Geneva: World Health Organization; 2020 (<https://www.who.int/publications/m/item/2020-who-global-vaccine-market-report>).
- Institute of Medicine (US) Committee on the Evaluation of Vaccine Purchase Financing in the United States. Financing vaccines in the 21st Century: assuring access and availability. Chapter 5, Vaccine supply. Washington (DC): National Academies Press (US); 2003 (<https://www.ncbi.nlm.nih.gov/books/NBK221811/>).
- Gardasil gains blockbuster status in its first year on the market (2007). Pink Sheet (<https://pink.pharmaintelligence.informa.com/PS065237/Gardasil-Gains-Blockbuster-Status-In-Its-First-Year-On-The-Market>) Accessed: 8 October 2023.
- Levin J. (2013) Prevnar is model for blockbuster vaccines. Fierce Pharma. (<https://www.fiercepharma.com/vaccines/prevnar-model-for-blockbuster-vaccines>) Accessed: 8 October 2023.
- Médecins Sans Frontières. The right shot. Bringing down barriers to affordable and adapted vaccines. Geneva: Médecins Sans Frontières; 2015 (https://www.msf.org/sites/default/files/2018-06/VAC_report_TheRightShot2ndEd_ENG_2015.pdf).
- SOMO. Pharma's pandemic profits. Amsterdam: SOMO; 2023 (<https://www.somo.nl/big-pharma-raked-in-usd-90-billion-in-profits-with-covid-19-vaccines/>).
- A term referring to countries that are not eligible for, or opt out of, donor-funded pooled procurement mechanisms such as GAVI, the Vaccine Alliance and UNICEF.
- WHO Global vaccine market report 2022. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/m/item/global-vaccine-market-report-2022>).
- Chard AN, Gacic-Dobo M, Diallo MS, Sodha SV, Wallace AS. CDC Routine vaccination coverage—worldwide, 2019. *MMWR Morb Mortal Wkly Rep*. 2000;69(45):1706–1710.
- Mazzucato M. The Entrepreneurial State: debunking public vs. private sector myths. Ch. 3 specifically on the health sector. London: Anthem Press; 2013.
- Roth C. Why is the world experiencing a cholera vaccine shortage. *DW*. 2022 <https://www.dw.com/en/why-is-the-world-experiencing-a-cholera-vaccine-shortage/a-63639495>
- New analysis finds large drugmakers could lose \$1 trillion in sales and still be the most profitable industry. Washington (DC): West Health Policy Center; 2019 (<https://www.westhealth.org/press-release/new-analysis-finds-large-drug-makers-could-lose-1-trillion-in-sales-and-still-be-the-most-profitable-industry/>).
- See for example: Ball P. The lightning-fast quest for COVID vaccines—and what it means for other diseases. *Nature New Feature*, 18 December 2020; Matt Apuzzo M, Gebrekidan S. Governments Sign Secret Vaccine Deals. Here's What They Hide. *New York Times* 28 January 2021; Dolgin E. The tangled history of mRNA vaccines, *Nature New Feature*, 14 September 2021.
- Hassan F, Yamey G, Abbasi K. Profiteering from vaccine inequity: a crime against humanity? *BMJ*. 2021;374:n2027.
- The USA Biomedical Advanced Research and Development Authority. Washington (DC) (<https://medicalcountermeasures.gov/barda/advancing-innovation/>).
- See description of BARDA and how it represents a market shaping example in: UCL Institute for Innovation and Public Purpose. The people's prescription: re-imagining health innovation to deliver public value. IIPP policy report, 2018–10. IIPP. Global Justice Now, Just Treatment, STOPAIDS. London: University College London; 2018 (<https://www.ucl.ac.uk/bartlett/public-purpose/wp2018-10>).
- Torreele E, Boum Y 2nd, Adjaho I, Alé FGB, Issoufou SH, Harcsi G, Okonta C, Olliaro P. Breakthrough treatments for Ebola virus disease, but no access—what went wrong, and how can we do better? *Lancet Infect Dis*. 2023;Jan 19;S1473-3099(22)00810-6.
- Cheng M, Asasu C. As monkeypox drops in the West, still no vaccines for Africa. *AP News*. 14 September 2022.
- Fisher LM. When free markets fail ... and maybe you die. Santa Monica: Milken Institute Review; 2022 (<https://www.milkenreview.org/articles/when-free-markets-fail-and-maybe-you-die>).

38. Von Schoen-Angerer T, Ford N, Arkininstall J. Access to medicines in resource-limited settings: The end of a golden decade? *Global Advances in Health and Medicine*. 2012;1(1):52-59.
39. Market shaping. Gavi, The Vaccine Alliance. Geneva: Gavi, The Vaccine Alliance (<https://www.gavi.org/our-alliance/market-shaping>).
40. Market shaping strategy. The Global Fund. Geneva: The Global Fund (<https://www.theglobalfund.org/en/sourcing-management/market-shaping-strategy/>).
41. A market shaping primer. Washington (DC) USAID; 2014 (<https://ccpsh.org/sites/default/files/tools/USAID-Market%20shaping%20primer.pdf>).
42. Mazzucato M (2016). From market fixing to market-creating: a new framework for innovation policy. Special issue of *Industry and Innovation*. *Innovation policy—can it make a difference?* 2016;23 (2) (<https://www.tandfonline.com/doi/full/10.1080/13662716.2016.1146124>).
43. Gehl Sampath P (2021). Market shaping and market access in the global vaccines market: approaches for the future. Paper prepared for the Deutsche Gesellschaft für Internationale Zusammenarbeit, funded by the German Federal Ministry for Economic Cooperation and Development. Bonn: Deutsche Gesellschaft für Internationale Zusammenarbeit; 2021 (<http://dx.doi.org/10.2139/ssrn.3945668>).
44. Wellcome-Biovac-BDG report January 2023. Scaling up African vaccine manufacturing capacity: perspectives from the African vaccine-manufacturing industry on the challenges and the need for support. Brooklyn/Cape Town/ New York: Wellcome/Biovac/BDG; 2023 (https://cms.wellcome.org/sites/default/files/2023-01/Wellcome-Biovac-BCG-Scaling-up-African-vaccine-manufacturing-capacity-report-2023_0.pdf).
45. The WHO Council on the Economics of Health for All (2023). Changing the narrative through mission-oriented industrial policy: the case of Brazil. Geneva: World Health Organization; 2023 (forthcoming).
46. Beran D, Lazo-Porras M, Mba CM, Mbanya JC (2021). A global perspective on the issue of access to insulin. *Diabetologia*. 2021;64(5):954-962. doi: 10.1007/s00125-020-05375-2.
47. Human Rights Watch (2022). US—unaffordable insulin endangers lives. New York: Human Rights Watch; 2022 (<https://www.hrw.org/news/2022/04/12/us-unaffordable-insulin-endangers-lives>).
48. Krikorian G, Torrelee E (2021). We cannot win the access to medicines struggle using the same thinking that causes the chronic access crisis. *HHRJ*. 2021;Vol 23/1, pp. 119–127.
49. Torrelee E, McNab C, Adeyi O, Bonnell R, Dhaliwal M, Hassan F, Kazatchkine M, et al. (2023). It is time for ambitious, transformational change to the epidemic countermeasures ecosystem. *Lancet*. 2023 ([https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(23\)00526-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)00526-3/fulltext)).
50. Advanced research and invention agency (2022). Government of the United Kingdom. (<https://www.gov.uk/government/organisations/advanced-research-and-invention-agency> Accessed: 8 October 2023).
51. Directorate-General for health emergency preparedness and response authority (2021). European Commission. (https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/health-emergency-preparedness-and-response-authority_en) Accessed: 8 October 2023.
52. Preparing for future pandemics (2023). Coalition for Epidemic Preparedness Innovation - CEPI. (<https://cepi.net/>) Accessed: 8 October 2023.
53. WHO. Zero draft of the WHO CA+ for the consideration of the Intergovernmental Negotiating Body at its fourth meeting. Geneva: World Health Organization; 2023 (https://apps.who.int/gb/inb/pdf_files/inb4/A_INB4_3-en.pdf).
54. Gavi, the Vaccine Alliance: Gavi white paper June 2022. A new era of vaccine manufacturing in Africa. Geneva: Gavi, the Vaccine Alliance; 2022 (<https://www.gavi.org/sites/default/files/covid/covax/new-era-vaccine-manufacturing-in-africa-wp.pdf>).
55. Dawes BE, Smalley CA, Tiner BL, Beasley DWC, Milligan GN, Reece LM, Hombach J. Research and development of Zika virus vaccines. *Npj Vaccines*. July 28 2016 (<https://www.nature.com/articles/npjvaccines20167>).
56. WTO. Policy space for industrial development—a case for rebalancing trade rules to promote industrialization and to address emerging challenges. Geneva: World Trade Organization; 2023 (<https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/GC/W868.pdf&Open=True>).
57. Gleeson D (2022). Monkeypox—the next global vaccine equity failure? *The Conversation*. 30 August 2022 (<https://theconversation.com/monkeypox-the-next-global-vaccine-equity-failure-189045>).
58. World Health Organization. WHO 2022–2023 Mpox (monkeypox) outbreak: Global trends. Geneva: World Health Organization; 2023 (https://world-healthorg.shinyapps.io/mpx_global/).
59. Chadwick C, Friede M, Moen A, Nannei C, Sparrow E (2022). Technology transfer programme for influenza vaccines—lessons from the past to inform the future. *Vaccine* 40(33):4673–4675. doi: 10.1016/j.vaccine.2022.06.057.
60. Nicholson M. WHO mRNA Technology Transfer Programme: Business models for sustainable mRNA vaccine manufacturing. Geneva: World Health Organization; 2023 (https://cdn.who.int/media/docs/default-source/immunization/mrna-tfp/april-2023/4_nicholson_businessmodels.pdf?sfvrsn=35720bae_1).
61. See p.6 in Wellcome-Biovac-BCG report noted in reference 44.
62. The Independent Panel for Pandemic Preparedness and Response (2021). Covid-19: make it the last pandemic. Geneva: Geneva: World Health Organization; 2021 (https://theindependentpanel.org/wp-content/uploads/2021/05/COVID-19-Make-it-the-Last-Pandemic_final.pdf).
63. Torrelee E. Collective intelligence, not market competition, will deliver the best Covid-19 vaccine. *First Opinion*. STAT. June 2020 (<https://www.statnews.com/2020/06/10/collective-intelligence-not-market-competition-deliver-best-covid-19-vaccine/>).
64. Kelly M. Owing our future: the emerging ownership revolution. San Francisco: Berrett-Koehler Publishers; 2012.
65. Torrelee E, Scatagliani M, Greenhill N, Oliario P. Developing a value proposition for sustainable R&D and availability of Lassa fever therapeutics in West Africa. *WALC*; 2022 (https://isaricdev.wpenginepowered.com/wp-content/uploads/2023/03/WALC_Value-Proposition.pdf).
66. <https://www.worldbank.org/en/programs/financial-intermediary-fund-for-pandemic-prevention-preparedness-and-response-ppr-fif/overview>.
67. Raworth K. Doughnut Economics Action Lab (<https://www.kateraworth.com/deal/>).
68. Radjou N. Beyond sustainability: the regenerative business. *Forbes*. 24 October 2020 (<https://www.forbes.com/sites/naviradjou/2020/10/24/beyond-sustainability-the-regenerative-business/>).
69. Konietzko J, Das A, Bocken N. Towards regenerative business models: a necessary shift? *Sustainable Production and Consumption* (in press). <https://doi.org/10.1016/j.spc.2023.04.014>.
70. WHO Council on the Economics of Health for All. Council brief no. 3: Valuing Health for All: rethinking and building a whole-of-society approach. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/m/item/valuing-health-for-all-rethinking-and-building-a-whole-of-society-approach---the-who-council-on-the-economics-of-health-for-all---council-brief-no.-3>).
71. WHO Council on the Economics of Health for All (2021). Council brief no. 2: Financing Health for All: Increase, transform and redirect. Geneva: World Health Organization; 2021 (<https://www.who.int/publications/m/item/council-brief-no-2>).
72. WHO Council on the Economics of Health for All. Council brief no. 4: Strengthening public sector capacity, budgets and dynamic capabilities towards Health for All. Geneva: World Health Organization; 2022 (<https://www.who.int/publications/m/item/strengthening-public-sector-capacity--budgets-and-dynamic-capabilities-towards-health-for-all---the-who-council-on-the-economics-of-health-for-all---council-brief-no.-4>).

73. Mazzucato M. *The Value of everything: making and taking in the global economy*. London: Penguin Books Limited; 2018.
74. Nature. *The Nature Conservancy and Environmental Finance (2019). Investing in nature: private finance for nature-based resilience*. London: Nature; 2019 (https://www.nature.org/content/dam/tnc/nature/en/documents/TNC-INVESTING-IN-NATURE_Report_01.pdf).
75. *The 2020 Barbados Agenda. The 2022 Bridgetown Initiative for the Reform of the Global Financial Architecture*. 23 September 2022 <https://pmo.gov.bb/wp-content/uploads/2022/10/The-2022-Bridgetown-Initiative.pdf>
76. IMF. *World Economic Outlook*. Washington (DC): IMF; 2022 (<https://www.imf.org/en/Publications/WEO/Issues/2022/10/11/world-economic-outlook-october-2022>).
77. Grynspan R. *The World lacks an effective global system to deal with debt*. *Financial Times*. 2023 (<https://www.ft.com/content/d767580d-2db3-43f2-a509-2b29eb81003a>).
78. Gopinath G, Gourinchas P. *How countries should respond to the strong dollar*. IMF Blog. Washington (DC): IMF; 2022 (<https://www.imf.org/en/Blogs/Articles/2022/10/14/how-countries-should-respond-to-the-strong-dollar>).
79. Jerving S. *South African president to lead fundraising for new AU epidemics fund*. Washington (DC): Devex; 2023 (<https://www.devex.com/news/south-african-president-to-lead-fundraising-for-new-au-epidemics-fund-105056>).
80. IMF. *Fiscal Monitor Database of Country Fiscal Measures in Response to the COVID-19 pandemic*. Washington (DC): IMF; 2021 (<https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19>).
81. ISARIC. *Key features of technology platforms for R&D to rapidly respond to new outbreaks*. Webinar, 23 Feb 2023. ISARIC. (<https://isaric.org/psi-hosted-technology-platforms-webinar/>).
82. Lalani H S, Nagar S, Sarpatwari A, Barenie R E, Avorn J, Rome B N et al. *US public investment in development of mRNA covid-19 vaccines: retrospective cohort study* *BMJ* 2023;380:e073747 doi:10.1136/bmj-2022-073747.
83. Roy V. *Financing covid-19 mRNA vaccines* *BMJ* 2023;380:p413 doi:10.1136/bmj.p413.
84. Angelis A, Polyakov R, Wouters O J, Torreele E, McKee M. *High drug prices are not justified by industry's spending on research and development* *BMJ*. 2023;380:e071710
85. Mazzucato M. *Getting drug development right*. Prague: Project Syndicate; 2023 (<https://www.project-syndicate.org/commentary/drug-development-health-innovation-public-funding-needs-more-conditions-by-mariana-mazzucato-2023-04>).
86. Berman, E. *Thinking like an economist: how efficiency replaced equality in US public policy*. Princeton: Princeton University Press; 2022.
87. Daniels N. *Distributive justice and the use of summary measures of population health status*. In: Field M, Gold M, editors. *Summarizing population health: directions for the development and application of population metrics*. Washington (DC): National Academic Press; 1998. 58–71; 1998. (<https://pubmed.ncbi.nlm.nih.gov/25101456/>).
88. Bernstein A, Ando A, Loch-Temzelides T, Vale MM, Li BV, Li H et al. *The costs and benefits of primary prevention of zoonotic diseases*. *Science Advances*; 2022 (<https://www.science.org/doi/10.1126/sciadv.abl4183>).
89. Olliaro P, Torreele E. *Global challenges in preparedness and response to epidemic infectious diseases*. *Molecular Therapy*. 2022;30(5): 1801-9. <https://doi.org/10.1016/j.ymthe.2022.02.022>.
90. *Pandemic Financing. G20 High Level Independent Panel. A global deal for our pandemic age*. Pandemic Financing; 2021 (<https://pandemic-financing.org/report/>).
91. WTO. *World Trade Organization's agreement on trade related aspects of intellectual property rights (TRIPS)*. Geneva: World Trade Organization; (https://www.wto.org/english/tratop_e/trips_e/trips_e.htm).
92. Fox DM. *Technology transfer and the TRIPS agreement are developed countries meeting their end of the bargain? Hastings Science and Technology Law Journal*. 2019;10(1). (https://repository.uchastings.edu/hastings_science_technology_law_journal/vol10/iss1/2).
93. I-MAK. *Overpatented, overpriced. Curbing patent abuse: tackling the root of the drug pricing crisis*. I-MAK; 2022 (<https://www.i-mak.org/wp-content/uploads/2022/09/Overpatented-Overpriced-2022-FINAL.pdf>).
94. Ulbrich H. *Natural monopoly in principles textbooks: a pedagogical note*. *The Journal of Economic Education*. 1991;22,(2):179-182. <https://www.jstor.org/stable/1182423>.
95. Smith A. *Covid-19: How India's crisis is inflaming global vaccine inequality*. NBC News. 30 April 2021 (<https://www.nbcnews.com/news/world/covid-19-how-india-s-crisis-inflaming-global-vaccine-inequality-n1265968>).
96. WTO (2020). *WTO report finds growing number of export restrictions in response to COVID-19 crisis*. Geneva: World Trade Organization; 2020 (https://www.wto.org/english/news_e/news20_e/rese_23apr20_e.htm).
97. Wang X, Kou Z, Chu A. *Effects of patents on the transition from stagnation to growth*. *Journal of Population Economics*. 2020;33:395–411 (<https://link.springer.com/article/10.1007/s00148-019-00753-6>).
98. Falvey R, Foster . *The role of intellectual property rights in technology transfer and economic growth: theory and evidence*. Berlin: ResearchGate; 2006 (https://www.researchgate.net/publication/228778702_The_Role_of_Intellectual_Property_Rights_in_Technology_Transfer_and_Economic_Growth_Theory_and_Evidence).
99. Stiglitz J, Baker D, Jayadev A. *Intellectual property rights for the twenty-first century economy*. Project Syndicate; 2017 (<https://www.project-syndicate.org/commentary/intellectual-property-21st-century-economy-by-joseph-e-stiglitz-et-al-2017-10?barrier=accesspaylog>).
100. WTO. *Policy space for industrial development—a case for rebalancing trade rules to promote industrialization and to address emerging challenges*. Geneva: World Trade Organization; 2023 (<https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/GC/W868.pdf&Open=True>).
101. Rajkumar SV. *The high cost of prescription drugs: causes and solutions*. *Blood Cancer J*. 2020;10, 71 (<https://doi.org/10.1038/s41408-020-0338-x>).
102. European Environment Agency (2021). *Growth without economic growth*. Copenhagen: European Environment Agency; 2021 (<https://www.eea.europa.eu/publications/growth-without-economic-growth>).
103. Van Waes A, Smink M, van Est R, Frenken K (2018). *Safeguarding public interests in the platform economy*. London: CEPR; 2018 (<https://cepr.org/voxeu/columns/safeguarding-public-interests-platform-economy>).
104. Kis Z, Kontoravdi C, Shttock R, Shah N. *Resources, production scales, and time Required for producing RNA vaccines for the global pandemic demand*. Bethesda: National Library of medicine; 2021 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7824664/>).
105. Kowalzik F., Schreiner D, Jensen C, et al. (2021). *MRNA-based vaccines*. *Vaccines* 9(4), 390. (<https://www.mdpi.com/2076-393X/9/4/390>) Accessed: 8 October 2023.
106. *Global mRNA Technology Transfer Programme - MPP (2023) Medicines Patent Pool*. (<https://medicinespatentpool.org/covid-19/mrna-technology-transfer-hub-programme>) Accessed: 23 March 2023).
107. *Call for expression of interest to: Contribute to the establishment of a COVID-19 mRNA vaccine technology transfer hub (2021)*. World Health Organization. (<https://www.who.int/news-room/articles-detail/call-for-expression-of-interest-to-contribute-to-the-establishment-of-a-covid-19-mrna-vaccine-technology-transfer-hub>) Accessed: 23 March 2023.
108. Friede M, Palkonyay L, Alfonso C, Pervikov Y, Torelli G, Wood D, Kieny MP (2011). *WHO initiative to increase global and equitable access to influenza vaccine in the event of a pandemic: Supporting developing country production capacity through technology transfer*. *Vaccine*. 2011;29(suppl 1): p A2-A7 (<https://www.sciencedirect.com/science/article/pii/S0264410X11003276>).
109. *MPP home - The medicines patent pool (2023)*. Medicines Patent Pool. (<https://medicinespatentpool.org/>) Accessed: 8 October 2023.
110. *Global mRNA Technology Transfer Programme - MPP (2023) Medicines Patent Pool*. (<https://medicinespatentpool.org/covid-19/mrna-technology-transfer-hub-programme>) Accessed: 8 October 2023).

111. mRNA funders - MPP (2023). Medicines Patent Pool. (<https://medicine-patentpool.org/what-we-do/mrna-technology-transfer-programme/mrna-funders>) Accessed: 08 October 2023.
112. Activists urge Biden to fund miRNA Technology Transfer Hub Program (2023). Public Citizen. (<https://www.citizen.org/article/activists-urge-biden-to-fund-mrna-technology-transfer-hub-program/>) Accessed: 8 October 2023.
113. Peachey C. (2022) Afrigen to collaborate with NIAID on miRNA vaccine research, except from European Pharmaceutical Review. (<https://www.europeanpharmaceuticalreview.com/news/173105/afrigen-to-collaborate-with-niaid-on-mrna-vaccine-research/>) Accessed: 8 October 2023.
114. Moderna has pledged not to enforce their patents for Covid-19 vaccines during the pandemic in 92 LMICs including South Africa. See below for more detailed analysis on the IP issues.
115. There will unlikely be supply needs for this first-generation vaccine (against Wuhan strain).
116. WHO is organizing a three-day meeting in Cape Town on 19–21 April during which the Hub and spokes will review the potential of mRNA technology for other indications.
117. Gaviria M, Kilic B. A network analysis of COVID-19 mRNA vaccine patents. *Nat Biotechnol.* 2021;39, 546–548 (<https://doi.org/10.1038/s41587-021-00912-9>).
118. Programme agreements - MPP (2023). Medicines Patent Pool. (<https://medicinepatentpool.org/what-we-do/mrna-technology-transfer-programme/agreements#pills-span-stylecolor0080C6Spoke-Agreementspan>) Accessed: 8 October 2023.
119. There a lack of transparency around patent status, including the time lag between patent applications and approvals, and possibly variation in the final claims, which may also differ between countries. This makes it very difficult to ascertain the exact freedom to operate (which, in any case, is often the subject of protracted court battles that may take years to resolve).
120. Shores D. The current mRNA/LNP Patent Litigation landscape (2022). JDSUPRA. Available at: (<https://www.jdsupra.com/legalnews/the-current-mrna-lnp-patent-litigation-9579521/>) Accessed: 8 October 2023.
121. Contreras JL. No take-backs: Moderna's attempt to renege on its vaccine patent pledge. Cambridge, Massachusetts: Harvard University; 2020 (<https://blog.petrieflom.law.harvard.edu/2022/08/29/no-take-backs-modernas-attempt-to-renege-on-its-vaccine-patent-pledge/>).

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