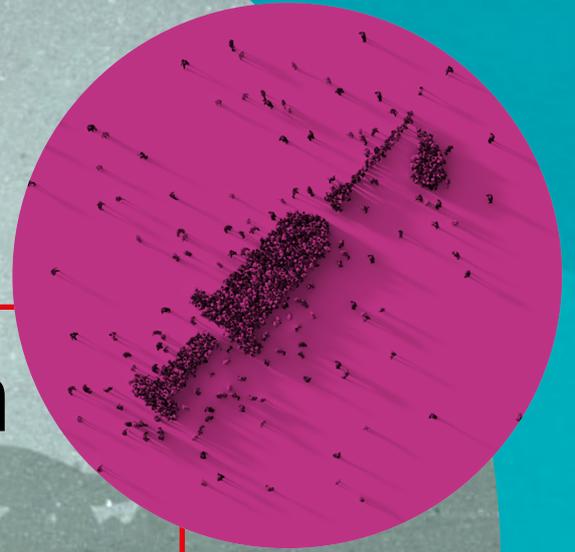


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Immunisation Readiness:

analysis of policies promoting availability,
access and administration across 30 countries



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About this report

The objective of this report is to present the findings and analysis from the Immunisation Readiness Index. The Index examines thirty countries to evaluate their current readiness to harness the full potential of vaccines for all diseases that are amenable to prevention or treatment by vaccination. By developing comparable country-level assessments, the research team identified trends and best practices, as well as gaps in capacity, to provide insights into the prioritisation of pathways for improvements at both national and global levels. In-depth discussions were held with experts on the Advisory Council to supplement and validate the findings and to incorporate the latest thinking and expertise of those working directly within this arena.

The team is truly grateful for the time, dedication and commitment of the Advisory Council throughout this exploration of The Vaccine Ecosystem. Members of the Council are, in alphabetical order:

- **Thomas Cueni**, Director-General, International Federation of Pharmaceutical Manufacturers and Associations (IFPMA)
- **J Peter Figueroa**, OJ, BSc, MBBS, DPH, PhD, FFPH, Professor of Public Health, Epidemiology and HIV/AIDS, University of the West Indies
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- **Laura H Kahn**, MD, MPH, MPP, Co-founder, One Health Initiative
- **Nigel Lightfoot**, CBE, MBBS, FRCPath, MSc, FFPH, Former Director, Emergency Response and Former Head, Influenza Planning UK Health Protection Agency
- **Patrick Osewe**, MD, MPH, Chief, Health Sector Group, Asian Development Bank.

Thanks are also due to various stakeholders working within the vaccine ecosystem for many informal conversations and opportunities to share ideas. Specifically, gratitude is expressed to the experts who attended virtual roundtable discussions on the formulation of the Index, and discussions to review the overall approach. They are, in alphabetical order:

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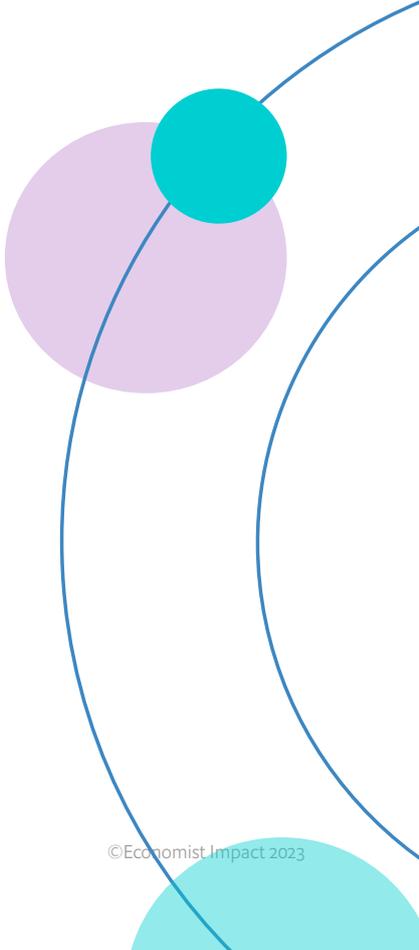
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Work on the first iteration of the Immunisation Readiness Index was completed in July 2023.

The findings and views expressed in this report do not necessarily reflect the views of these sponsors, and Economist Impact retains full editorial control over it and is solely responsible for the content.

The Economist Group’s Vaccine Ecosystem Initiative was led by Dr Mary Bussell. The Immunisation Readiness Index is an important component of the work, and was undertaken to understand, analyse and address the development, deployment and uptake of vaccines throughout the world. Research on the Index was coordinated and compiled by Miranda Baxa. The report was written by Michael Guterbock, Miranda Baxa and Mary Bussell (with contributions and assistance from Dr Vivek Muthu) and was edited by Maria Carter. Barinder Chauhan managed the project. Appreciation is given also to Michael Paterra, Marcela Casaca, Mateus Getlinger, Alan Lovell, David Humphreys and William Shallcross who contributed to the development of the Index.



Foreword

After many years spent gaining experience in global health security and developing plans, policies and strategies to protect public health, it has been an honour to be a member of The Economist Group's Vaccine Ecosystem Advisory Council, and a privilege to work with like-minded experts at such a pivotal time.

Vaccines are the cornerstone of public health measures to prevent and control infectious diseases. They are unique in delivering health benefits to individuals, communities, populations, and society in general, and help provide a stable platform for economic development and prosperity. Our duty, whether we work in human or animal health, or in economic development or government, is to ensure that the progress of an effective vaccine ecosystem continues to be stimulated.

We have witnessed the successful eradication of smallpox through ring vaccination and painstaking detection of the final cases, and are in the final (difficult) stages of achieving the eradication of polio. Childhood vaccination programmes continue to prevent diphtheria, whooping cough, tetanus, measles, mumps, rubella and tuberculosis, and there have been enormous strides in the protection of children. However, vaccination coverage against these diseases has fallen in recent years, along with public confidence in vaccines. There is an urgent need for routine vaccine catch-up programmes to address an eight-fold increase in the number of children paralysed by polio in 2019–2021, and a doubling of measles cases in 2022 from the preceding year. No one will be safe until *everyone* is safe because these diseases travel alongside population movements, resulting in outbreaks of disease in parts of the world that were previously disease free, such as the surge of polio in New York State and diphtheria in the UK.

Vaccines are harboured within an extensive ecosystem that comprises many factors. The term 'ecosystem', borrowed from the field of ecology, implies an interconnected situation whereby many complex factors, from the vaccine development process to vaccine delivery, are influenced by and dependent on each other. This ecosystem must be nurtured to maintain current successes and fulfil future needs.

In addition to the scientific research required for developing vaccines, there are five domains that provide essential support for a successful vaccine ecosystem. These domains were closely examined in the process of creating the Immunisation Readiness Index:

(1) Planning, (2) Regulation, (3) Procurement, (4) Delivery and (5) Outreach.

Without successful implementation of the actions contained within these domains, vaccines will not be available to populations at a local level. The Economist Impact team carefully examined published reports and policies from thirty countries across a geographical and economic spectrum, and applied a quantitative banding system to explore individual country performance in each of the domains. The goal was to identify key areas in which improvements might be made by policymakers. Although the performance of individual countries was not formally ranked, their relative performances and trends were revealed.

New vaccine technologies, such as mRNA and adenovirus vector vaccines, were under development as potential cancer treatments for several years before the start of the covid-19 pandemic, and translational research then facilitated the rapid development of specific vaccines against the infection.

Although work on their safety and efficacy progressed swiftly, the initial global response to the pandemic is viewed as a failure because of the slow progress of programmes that promoted equity and access to mitigation efforts – including the distribution of vaccines when they became available for public use.

These new vaccines transformed the response to the pandemic and contributed to the saving of many lives, but there were still concerns about equitable access to them. By December 2022, for instance, only a quarter of populations in low-income countries had received a single dose, yet high-income countries had nearly completed their vaccination programmes, with vaccination rates of 67%. The pandemic highlighted the fact that high-income countries can no longer put their needs above those of low-income countries and wait for much-needed resources to ‘trickle down’. For example, it was encouraging to see how Africa took significant steps to develop its own vaccine ecosystem for ensuring future preparedness. Under the Africa CDC, the Partnerships for African Vaccine Manufacturing has been established and the World Health Organization (WHO) has created a hub for mRNA vaccine technology in South Africa, called Afrigen Biologics. The future for Africa looks hopeful.

It is clearer than ever that a fully functioning vaccine ecosystem is essential for combating the effects of communicable diseases and protecting populations all over the world. The Immunisation Readiness Index, and its accompanying Report, is available for use by all countries. It is not intended as an indicator of individual achievements, but as a stimulus to review country policies and plans and to learn from other countries, because sharing information and building partnerships is always beneficial. Furthermore, Economist Impact and its Advisory Council is available to help individual countries commence their reviews and draw up roadmaps—because immunisations save lives.

*Professor Nigel Lightfoot, CBE
Advisory Council Member*

Prologue

Vaccinations play a vital role in combating infectious diseases, which have plagued humanity throughout history, as well as contending with threats posed by novel pathogens that possess epidemic potential.

Innovations in the field of vaccinology have progressed at an exceptional pace since the genetic sequence of the SARS-CoV-2 virus was identified in January 2020. The pandemic caused by this virus starkly demonstrates how close the links are between science, One Health,^{*} health protection, human capital, economic growth and global security. Indeed, a wide range of stakeholders came together in ways not seen previously, powerfully underlining the need to invest in and apply the best possible science and evidence to such challenges.

Public discourse on the development of covid-19 vaccines often centres around the exceptional pace with which they were developed. Of course, research and development (R&D) is critical for such progress, but it is only the first step towards ensuring that public health benefits from vaccines globally. Lessons were learned from the pandemic response, yet much remains to be achieved to ensure that effective vaccines are not only safely and rapidly developed but also accepted by, available and administered to populations all around the world, in a timely manner. It is this continuum, from the science of vaccinology to achieving public health protection through immunisation, that we term *the vaccine ecosystem*.

In our intimately interconnected modern world, diseases continue to threaten global security and global development. The protection provided by immunisations extends beyond the health of individual people to the health of entire communities and humanity as a whole. Therefore, investment in the immunisation arena is an investment in national health, national economic wellbeing and global health security. Far more must be done to generate political will, to ensure adequate, equitable investment and access to vaccines, as well as build public confidence in their use. The covid-19 pandemic revealed significant inequalities in access to immunisations across high-, middle- and low-income countries, and this situation must be addressed urgently, with greater efforts made to inspire impactful global and national leadership capable of eliminating longstanding inequities that prevent universal access to health and universal health protection.

As became all too clear during the covid-19 pandemic, the economic wellbeing of countries is severely impacted by national lockdowns. The effects extend beyond national borders, influencing international trade, travel and transport. More action must be taken to make sure health-security experts are aligned with their counterparts in the business and finance sectors, which is necessary for sound decision-making and thus for maximising the full benefits of immunisations for populations globally. The prioritisation of and investment in the vaccine ecosystem must be endorsed by strong leadership across countries and in all sectors.

The overarching aims of The Vaccine Ecosystem Initiative are to engage multiple stakeholders across the ecosystem to encourage meaningful dialogue, spark ideas and motivate stakeholders to form effective collaborations. Among these stakeholders are virologists, vaccinologists and other scientists, engineers and manufacturers, regulators, public health officials, policy experts and government

* One Health is an integrated, unifying approach that works to sustainably balance and optimise the health of people, animals and the environment. For more information, see https://www.who.int/health-topics/one-health#tab=tab_1.

ministers, and distribution and logistical experts. The covid-19 pandemic provided a unique opportunity to stimulate enduring changes that can profoundly improve public health.

Since its inception, The Vaccine Ecosystem Initiative endeavoured to explore the possibilities for both radical and incremental changes that foster improved preparedness in health systems and across broader society to harness the full potential of current and future vaccines. Since 2020, there have been efforts to impose a meaningful structure on what is a somewhat amorphous construct, resulting in five interdependent core 'pillars' of The Vaccine Ecosystem, namely:

- research and development (R&D)
- manufacturing
- procurement, pricing and finance
- distribution, logistics and supply chain management
- user acceptance and uptake

The Immunisation Readiness Index then built on this work, quantitatively and qualitatively mapping policies developed by individual countries in order to suggest opportunities for enhancing preparedness. There is no room for complacency when it comes to vaccine-preventable disease. By working together, we can build a more resilient vaccine ecosystem in which countries can make use of scientific knowledge to maximise the health and wellbeing of their population, while increasing global health security through the equitable use of vaccinations. Taken together, The Vaccine Ecosystem Initiative and the Immunisation Readiness Index provide evidence-based, specific and actionable insights that stakeholders can implement.



Executive summary

The Economist Group's Vaccine Ecosystem Initiative

This initiative was established in November 2020 to support the sustainability of this truly vital component of public health and global health security. It has identified the components of the vaccine ecosystem and produced evidence-based research on how to maximise the utility of vaccines and promote equitable access to them, for people worldwide. Part of the process involved breaking down the critical aspects of the ecosystem into more easily understood elements, using global experiences from the covid-19 pandemic as entry points to wider discussions. Then, by considering all aspects of the vaccine ecosystem, it was possible to explore the potential for both incremental and radical changes that might improve global preparedness and responses within health systems and across societies. The Initiative's first report, *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*,¹ provided the framework for the Initiative and describes four overarching themes in which there is room for improvement. The Vaccine Ecosystem Initiative encourages us to:

- focus on political will
- enhance global leadership and collaborations across sectors, represented by the different components of the vaccine ecosystem
- foster and facilitate vibrant innovation efforts to increase system-wide preparedness
- nurture trust in vaccines

The relevance of these themes is reinforced by the Immunisation Readiness Index. Creation of this innovative tool was driven by the urgency of the pandemic caused by SARS-CoV-2. However, the Index is not intended to be an assessment of a country's covid-19 response. Instead, it focuses on system-wide readiness in more general terms, analysing the systems and policies a country has in place for addressing public health threats that are amenable to prevention or treatment through immunisations, including newly emerging infectious diseases. The findings of the Index research are important for understanding a country's state of readiness for dealing with such threats, and serves to highlight disparities that must be addressed, as a matter of urgency.

The Immunisation Readiness Index

The Immunisation Readiness Index considers the enabling environment for both routine *and* emergency vaccination programmes across thirty countries. Not only does the Index analyse country-level readiness to respond to public health emergencies, but it also considers the ways in which routine immunisation programmes can be maintained or improved to meet global vaccination goals to counter common infectious diseases.

The Index uses the principles and ecosystem framework established by The Vaccine Ecosystem Initiative and translates them into a tool that is both qualitative and quantitative. Fifty indicators across all six domains were used to explore each country's national policies, processes and approaches to getting vaccinations to its population. This is a stepwise process, from developing a national immunisation plan and approving new vaccines, to ensuring vaccines can be procured, delivered and

administered to the public by qualified health professionals. The research involved close examination of concepts relating to building public trust in vaccinations and reaching all eligible members of the population through outreach measures, as well as the governance and societal context of each country. Contextualising the findings helps us understand how a country's unique conditions contribute to its overall readiness level. The analysis was limited to the existence of published policies – not their operationalisation – mapping out a broad range of countries with highly variable governance and societal contexts.

The primary goal of the Index is to highlight where substantive and specific actions are needed to bring about policy improvements in a particular country. The decision was made not to rank countries formally, recognising that like-for-like comparisons between countries are not the best way to encourage meaningful improvements. It is our hope that identifying gaps and opportunities for improvement will help governments around the world create a future that is more resilient to threats from existing and novel pathogens that are amenable to prevention or treatment through vaccination.

This report presents the findings relating to country-specific readiness, building on the original Framework Report¹ and series of policy briefing papers²⁻⁶ to further analyse opportunities for strengthening global health security.



Recommendations arising from the Index

The Index is a statistically significant predictor of a country's healthy life expectancy (HALE), which reinforces its value for understanding how improvements in immunisation readiness can improve health outcomes. The degree of readiness across countries varies widely: no country performed to the highest level for overall performance, and only three countries were in the second-highest tier. In general, the opportunities for improvement are greater in low-income countries.

In general, countries performed well in the first two domains (Planning and Regulation), which relate to the legal and regulatory structures underlying national immunisation plans and the policy and planning mechanisms governing immunisation efforts. All thirty countries have national immunisation strategies or plans for guiding vaccine programming, but they often fall short in the domains that relate to policies guiding operationalisation of such plans. Not all countries with national plans have developed steps to guide implementation, and countries tended to demonstrate lower performance in Domains 3, 4 and 5 (Procurement, Delivery and Outreach, respectively). The lowest levels of performance were seen in Procurement and Outreach, clearly highlighting where the greatest attention is needed.

The following themes and recommendations emerged from the analysis.

Domain 1: Planning

The Planning domain examines national immunisation plans, including mechanisms for coordination, monitoring and evaluation to ensure sufficient vaccine doses are available to immunise the population.

While the thirty countries performed well overall, more can be done to ensure that their plans are equitable and inclusive, so that any marginalised groups are not overlooked. All the countries have national plans or strategies for guiding vaccine programming, but some have not operationalised them successfully. Such plans should extend to the support and use of robust epidemiological surveillance systems, alongside contingencies with sufficient flexibility to allow adaptation to changing events in real time. Some countries struggle to implement and maintain the immunisation programmes set out in their national plans, suggesting that greater efforts are needed to ensure they are adequately financed, monitored, tested and evaluated.

Domain 2: Regulation

The Regulation domain covers the laws that govern the licensure and manufacture of vaccines within a particular country, and the way it evaluates vaccine data and R&D and manufacturing information from external agencies and sources.

Index countries demonstrated efficient and rigorous regulatory agencies with national processes for approving vaccines for use against routine infectious diseases (as well as public health emergencies), but making sure they remain effective requires active review and investment. Streamlining data-sharing among countries can speed up the dissemination of accurate knowledge on vaccine effectiveness and safety during the approval process. Addressing opportunities for improvement within this domain will ensure that countries keep pace with the rollout of innovative vaccines.

Domain 3: Procurement

The Procurement domain includes indicators relating to the procurement and financing of vaccines and vaccination programmes, including budgeting and procurement strategies.

National immunisation plans often overlook the importance of forecasting and dedicated budgets, even though good forecasting is a critical part of all downstream planning, budgeting and operationalisation. Our experts believe that the use of a five-year forecast is the minimum timeframe

that allows adequate planning for the protection of the public from endemic diseases and public health emergencies.

Domain 4: Delivery

The Delivery domain addresses the infrastructure for delivering vaccines, ranging from mechanisms to track vaccine stockpiles through to staffing and frontline facilities for maintaining accurate vaccination records.

Further actions are required to help countries improve their performance in this domain. Reliable infrastructure is vitally important for improving preparedness, and includes both physical and health-related infrastructure that is needed to create and support a healthcare workforce of sufficient size and ability, while also maintaining vaccine storage and transportation capabilities.

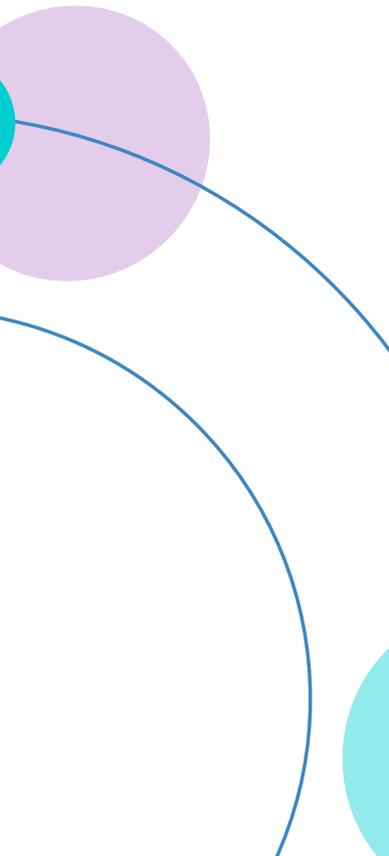
Domain 5: Outreach

The Outreach domain addresses public education and outreach, with reference to risk-communication strategies, health literacy programmes, and surveys of public perceptions of vaccines.

Countries must prioritise investment in programmes and systems that optimise the acceptance and uptake of vaccinations in their population, by hesitancy, mistrust and other concerns. Outreach measures and activities should be culturally appropriate in order to engage effectively with groups of the population who are marginalised or have a history of poor immunisation uptake. Trusted leadership is also essential and may rely on drawing leaders from international, national, local and community settings to improve understanding and dispel myths and misinformation.

Common to all of these recommendations is the need to build stronger partnerships between a broad range of stakeholders. Forging alliances between ministries of health and public health, finance, social services and education, health professionals and cross-sector leaders at community, national and international levels, is strongly encouraged.

The Vaccine Ecosystem Initiative acknowledges that more work must be done and therefore invites wider discussions aimed at promoting a sustainable, global vaccine ecosystem, by examining and reimagining elements critical for vaccine development, deployment and adoption. This continued work will underpin the fundamental tenet: no one is safely protected until *everyone* is safely protected.



The Vaccine Ecosystem

Every major historical event reorganises society in some way. After the Second World War, United Nations (UN) and the World Health Organization (WHO) were established, with the goals of maintaining international peace and promoting health and wellbeing worldwide. Likewise, the start of the HIV/AIDS pandemic saw the formation of UN AIDS and the Global Fund. In future years, historians will write about the impact of the covid-19 pandemic of the 2020s and how societies around the world weathered its effects. Our hope is that the legacy of this pandemic will be a more robust, resilient, accessible and equitable global vaccine ecosystem.

WHO declared the outbreak of covid-19 a Public Health Emergency of International Concern on 30 January 2020, and as a pandemic on 11 March 2020.⁷ Approximately three years later, on 5 May 2023, its Emergency Committee for Covid-19 advised the director general, Dr Tedros Adhanom Ghebreyesus, that while the virus is an ongoing health issue, it no longer constitutes “a public health emergency of international concern”.⁷ The emergency phase is over, but the virus is here to stay.

This pandemic reinforced the vital role of public health, returning it to the centre of political and economic discussions, debates and deliberations, and underscoring its impact on national and global economic wellbeing. Public health is not solely the concern of health departments. Ministers of health across the world had to work closely with their counterparts in the ministries of finance, trade and international affairs. They participated in nuanced discussions on the most effective ways to protect the health of the population and to collaborate on ways to protect economic health. This renewed focus on public health provided the foundation for assuring a more prominent role for health promotion in the future, with improved cross-governmental partnerships and recognition of their impact across the entire vaccine ecosystem.

In the early days of the covid-19 pandemic, the spread of the virus began to shatter routine life and economies around the world. No one knew whether it could be controlled by vaccines, but through the extraordinary collaborative efforts of countless specialists across diverse sectors – virology, vaccinology, engineering, manufacturing, regulatory, logistics, transport and supply chains – we witnessed the discovery, production, distribution and administration of safe and effective vaccines against it. Just 320 days following publication of its genetic sequence, the first vaccine was granted permission for emergency use in the UK. This was on 2 December 2020. The same occurred in the US on 11 December that year, then in the European Union (EU, through the European Commission) on 21 December.⁸⁻¹⁰ The largest immunisation programme in human history was underway – less than a year after the WHO China Country Office announced the emergence of “a pneumonia of unknown origin” in the city of Wuhan.¹¹ The rollout of these vaccines took place at remarkable speed. However, access to them was – and still is – uneven around the world.

The Decade of Vaccines (2011–2020)

WHO’s Decade of Vaccines was bounded by two pandemics: the 2009 Influenza A (H1N1) pandemic was declared to be over just as the decade began, and the decade finished just as the SARS-CoV-2 pandemic was announced. WHO member states unanimously endorsed the Global Vaccine Action Plan in May 2012, acknowledging the importance of vaccines for protecting public health, and calling for a world free of vaccine-preventable diseases.¹²

The partnerships that nurtured the production of the covid-19 vaccines require a high degree of cooperation and considerable financial investment by governments, industry, international agencies and foundations. But success does not come without challenges. The pandemic highlighted a lack of preparedness and a need to make improvements to build a stronger, more resilient and adaptive vaccine ecosystem, one capable of being more responsive to urgent needs. Addressing any challenges that arise can only be achieved through a combination of evidence-based insights, cross-sector dialogue and actionable recommendations enhanced by stakeholder collaboration and committed leadership.

The Vaccine Ecosystem, through the Immunisation Readiness Index, took the first step in identifying whether countries have adopted national policies and processes for getting vaccinations to their populations. The research examines the steps of the immunisation pathway, starting with the development of a national immunisation plan and the approval of new vaccines, through ensuring those vaccines can be procured, delivered and, finally, administered to the public by qualified health professionals.

Immunisations are a cost-effective way to promote national wellbeing

The protection provided by vaccines relates to more than just the health of individuals; it encompasses entire communities. Healthy populations are economically productive populations. The movement and interaction of people underpin the functioning of societies. Yet both are threatened by communicable diseases. This is why immunisations are one of the greatest public health achievements and why they must be recognised as investments in health and as drivers of economic growth and development. Thus investments in vaccinology are investments in national health – as well as national economic wellbeing and global health security. Economic analyses demonstrate that the return on investment (ROI) for each dollar invested in vaccine development over a decade yields a 16-fold return,¹³ there is a 44-fold return on the costs of vaccination in terms of broader economic and societal benefits.¹³

Fostering a sustainable vaccine ecosystem

In the wake of the covid-19 pandemic, there is a once-in-a-generation opportunity to forge long-lasting improvements in public health. Our Initiative breaks down the critical elements of the entire vaccine field, using covid-19 as an entry point, with the aim of promoting a sustainable and equitable vaccine ecosystem by examining and reimagining elements that are essential for vaccine development, deployment and adoption on a global scale.

Since its inception in 2020, the Initiative has published several evidence-based outputs. The Framework Report, *Towards a Stronger Vaccine Ecosystem: Building resilience beyond covid-19*,¹ defines the components of the vaccine ecosystem. In addition, a series of policy briefing papers examines opportunities for making improvements in each of the ecosystem's five pillars.²⁻⁶ Now, the Initiative has developed a country-specific benchmarking tool, the Immunisation Readiness Index, that allows us to look far beyond the laboratory to understand how well particular countries around the world are able to maximise the availability (and therefore utility) of vaccines for people within their borders. This Index is the result of extensive efforts to identify the level of immunisation preparedness of individual countries, and it accompanies the foundational work of the Initiative in defining the components of the vaccine ecosystem.

When exploring the performance of the vaccine ecosystem in a particular country, the incidence of diseases that can be prevented by vaccination is a significant indicator of how well its health system is performing (as long as its surveillance systems are comprehensive). Obtaining point-in-time data on disease rates provides a snapshot of how their vaccine ecosystem is performing at that point, and can be useful if the infrastructure of the vaccine ecosystem is robust. It should be noted that a country may have a low incidence of vaccine-preventable disease, but may not be capable of successfully addressing unforeseen pressures within its overall vaccine ecosystem.

There has been remarkable progress in the use of childhood vaccinations around the world in recent decades, due to increased development, distribution and administration of immunisations, resulting in fewer children not receiving a single routine vaccination (so-called 'zero-dose' children). However, the covid-19 pandemic set us back significantly. According to UNICEF, 67 million children did not receive their routine immunisations between 2019 and 2021; of these, 48 million did not receive a single routine vaccination.¹⁴ Overall immunisation coverage rates decreased in 112 countries.¹⁴ In the three-year period from 2019 through 2021, there was an eight-fold increase in the number of children paralysed by polio compared to the previous three years. In fact, this number increased by 16% between 2021 and 2022, and the number of measles cases more than doubled.¹⁴ Zero-dose children tend to be found in the most marginalised communities in the remotest and poorest areas of low- and middle-income countries.

UNICEF data have also identified countries in which the vaccine ecosystem was unable to withstand unanticipated challenges during the pandemic, despite generally low rates of vaccine-preventable diseases.¹⁴ Only a strong vaccine ecosystem is capable of withstanding threats posed by all vaccine-preventable diseases, and more work is needed to reach this goal.

The Immunisation Readiness Index assesses the extent to which national immunisation policies are able to leverage the potential of vaccines (both now and in the future), allowing the development of a roadmap that promotes more effective immunisation systems. The Index does not directly evaluate the operationalisation or implementation of national immunisation policies, but examines them and reviews how well they respond to changes in epidemiology, disruptions in distribution and supply chains, vaccine hesitancy in the population, and the emergence of new endemic diseases or novel pathogens with the potential to cause epidemics. Understanding a country's strengths and weaknesses provides valuable information on what can be done to build a stronger vaccine ecosystem, capable of meeting today's needs and tomorrow's challenges.

Framework

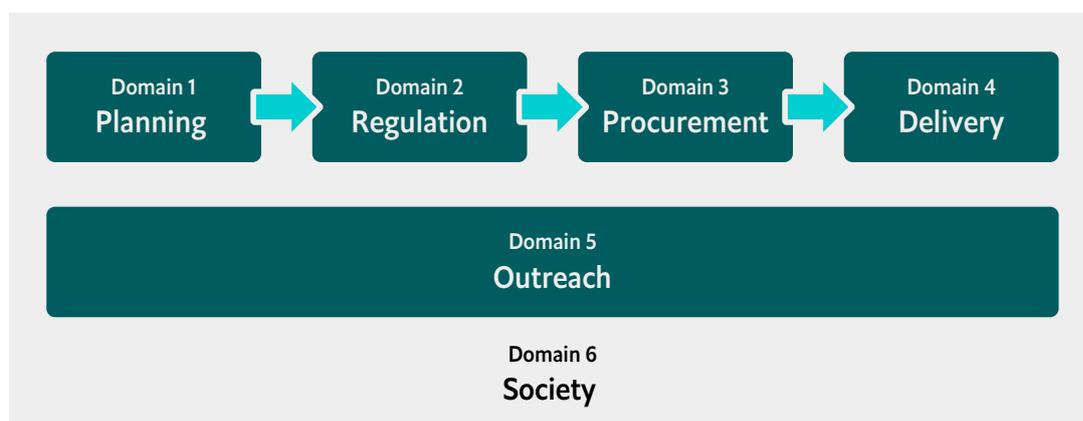
The Immunisation Readiness Index measures fifty indicators across six domains. Each domain provides a broad thematic view of the policies and plans that govern a country’s preparedness to immunise their populations against diseases that are amenable to prevention or treatment through vaccination. Each domain is comprised of a series of sub-domains covering topics of relevance. The major themes of each domain are described in Table 1. Figure 2 shows how these domains are inherently interconnected.

Table 1. The six domains of the Immunisation Readiness Index

Domain	Key themes
1. Planning	National immunisation plans; mechanisms for coordination, monitoring and evaluation that support and enable adequate availability of vaccines to immunise the population
2. Regulation	The laws governing licensure and manufacture of vaccines within a country; how the country evaluates vaccine data, R&D and manufacturing information from outside agencies and foreign sources
3. Procurement	The procurement and financing of vaccines, including budgeting and procurement strategies
4. Delivery	The physical and public health infrastructures for delivering vaccinations, from mechanisms for tracking vaccine stockpiles through staffing and frontline facilities to the maintenance of accurate vaccination records
5. Outreach	Public education and outreach, including risk-communication strategies, health literacy programmes and surveys of public perceptions of vaccines
6. Society	Quality governance and favourable socioeconomic conditions as the basis of a strong health system for supporting immunisation over the life course

For a complete list of the indicators within each domain, see Appendix C.

Figure 2. The interconnectedness of the domains established for analysis in the Immunisation Readiness Index



The indicators in Domains 1–4 relate to the policies and processes involved in the development of a national approach to getting vaccinations to a country’s population. These four domains reflect a sequence, from developing an immunisation plan (or strategy) and approving new vaccines, to ensuring they can be delivered within the correct temperature-controlled environment and then administered to the population by qualified health professionals. Domain 5 relates to building public trust in vaccines and reaching all members of the population through outreach.

Domain 6 represents the governance and societal context, providing context to a country’s overall findings, but the indicators do not necessarily reflect a country’s level of readiness. Rather, the information included in Domain 6 provides context, revealing the unique conditions within a country and how they contribute to the overall situation, thus providing a more nuanced understanding of the indicators in Domains 1–5. The findings from this domain provide insights into the other five domains, but were not analysed separately.

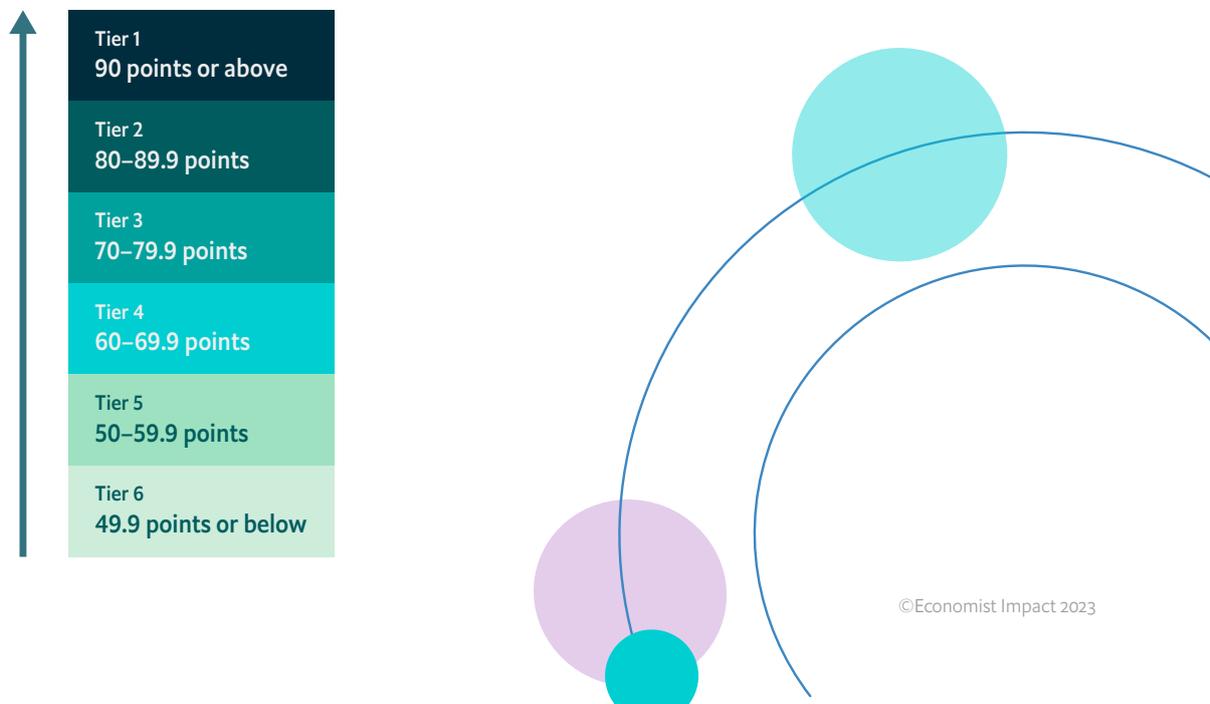
The first five domains are examined individually later in this report to highlight specific recommended actions that individual countries can take to strengthen their national vaccination programmes and improve their level of readiness.

Gauging performance in the Index

Performance bands

The thirty Index countries are at varying stages of development and immunisation readiness. A key goal of this research was to identify where improvements might be made by policymakers. To focus attention on the substance of the Index and on constructive actions, the Immunisation Readiness Index team chose not to formally rank countries. Instead, countries are collated into categories, or performance bands, based on their relative performance. A quantitative banding system was used to assess country performance based on a 100-point scale for each domain, where higher numerical scores indicate better performance and, therefore, better immunisation readiness. Then, countries were collated into six bands, ranging from ‘least ready’ (Tier 6) to ‘most ready’ (Tier 1) as shown in Figure 3.

Figure 3. Performance bands for the countries in the Immunisation Readiness Index



Assessing system-wide readiness for *all* immunisations—not just covid-19 vaccines

The covid-19 pandemic had an enormous impact on the global immunisation landscape, and the response to it demonstrated the important challenges faced by the global vaccine ecosystem, which aims to ensure universal protection against current and future diseases that are amenable to prevention or treatment through vaccination. During work on the Index, the research team sought to differentiate between actual performance (i.e. effectiveness or ineffectiveness) of the covid-19 vaccine rollout and the scoring for some indicators in the Index.

This report also discusses insights into individual countries' immunisation readiness and covid-19 vaccination coverage during 2022 because of the unique impact of the pandemic on global health security and how it underscores the need to improve all aspects of the vaccine ecosystem.

It is important to note that the Index is not a measure of the effectiveness of individual covid-19 vaccination programmes, but rather, relates to the *policies* that support systems addressing all vaccine-preventable public health threats. For instance, a country that performed well when rolling out covid-19 vaccines, and achieved excellent results, might not have systems for addressing other ongoing or future threats. Conversely, a country with lower rates of covid-19 vaccination coverage (perhaps because of vaccine hesitancy or vaccine unavailability) may have more robust systems for licensing, purchasing and delivering vaccinations. The key message is that the Index should not be regarded as a measure of performance of covid-19 vaccination programmes, but of the state of a country's system-level capacity to deal with novel and existing vaccine-preventable diseases.

It is our intention that the Index will be used as a tool to understand the extent to which national immunisation policies, systems and practices are able to leverage the potential of vaccines to prevent and/or treat diseases now and in the future. As such, any measure of immunisation readiness must consider the particular challenges that countries faced in responding to the covid-19 pandemic. Thus, great care has been taken to account for covid-specific actions in the following contexts:

- We studied how each country implemented long-lasting policies or practices because of, or during, the covid-19 pandemic. Points were allotted to countries for indicators where there was evidence that the policy or practice would continue beyond the pandemic.
- We considered policies or practices that were implemented only in direct response to the covid-19 pandemic but without evidence of consideration of future vaccination needs. For indicators where there was insufficient evidence that the policy or practice would continue, or could be harnessed in the future, countries were not given points. We recognise that some countries demonstrated an ability to mobilise resources to respond to covid-19 without having pre-existing mechanisms in place. For this reason, information about covid-specific policies and practices has been included in our Data Dashboard.

Example: scoring policies related to covid-19 Emergency financing mechanism in Iran

We determined whether countries have a dedicated emergency financing mechanism or fund that can be accessed when faced with a public health emergency to procure vaccines (Indicator 3.2.2). Iran, for example, was able to allocate funds to purchase covid-19 vaccines, but there was insufficient evidence of a dedicated funding mechanism that could be used to purchase vaccines in future emergencies. Thus, Iran was given 0 out of 100 for this indicator. More information about the funding used for Iran's covid-19 vaccine procurement is available in the Notes for Iran for Indicator 3.2.2 in the Data Dashboard.

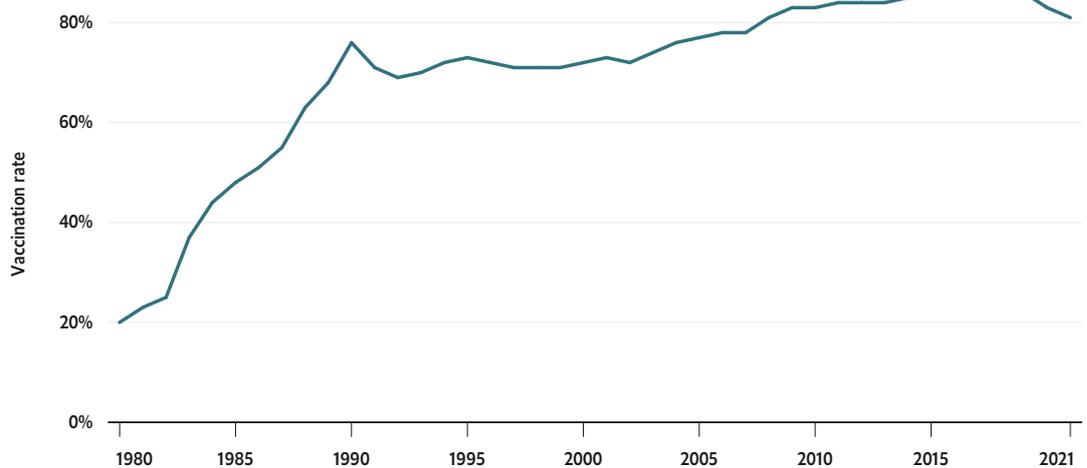
Highlighting the need to address routine vaccine-preventable diseases

The Index considers the enabling environment for both routine *and* emergency vaccination programmes. It is important to consider not only readiness to respond to a new public health threat but also ways to improve and maintain routine immunisation programmes to combat routine and/or endemic diseases. This is why the Index includes indicators related to policy levers and similar inputs associated with the success of both routine *and* emergency immunisation efforts; it does not measure outputs or outcomes like vaccination rates.

Although immunisation programmes have successfully reduced the spread and severity of vaccine-preventable diseases, saving millions of lives every year,¹⁵ there have been variations in routine vaccination coverage rates over the past 40 years for childhood diseases such as diphtheria, tetanus and pertussis (DTP; Figure 4) and measles (MCV; Figure 5).¹⁶ Progress towards immunisation targets has not been consistent or linear either at country or global levels.¹⁶ Furthermore, UNICEF estimates that more than 67 million children worldwide missed one or more of their routine vaccinations due to disruption caused by the covid-19 pandemic.¹⁴

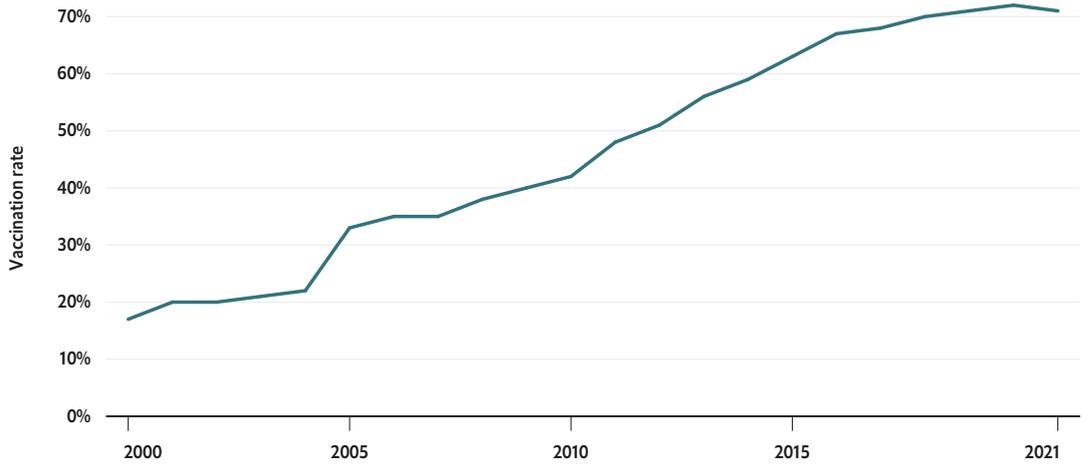
In combination, these trends (i.e., inconsistent progress in vaccination rates between 1980 and 2019 and decreased vaccination coverage in 2020–2021 due to covid-19) make comparative analysis between the Immunisation Readiness Index and immunisation rates for the countries we have studied complicated and potentially unfair, as detailed below. However, vaccination rates are a critical outcome measure for understanding progress towards immunisation goals. To demonstrate the efforts countries have made in this regard, we include coverage rates by country for many of the routine vaccines in our interactive Data Dashboard, subject to the availability of data from international vaccination databases (e.g., WHO, UNICEF).

Figure 4. Global coverage for vaccines against diphtheria, tetanus and pertussis (third dose) (DTP3) among 1-year-olds, 1980-2021¹⁶



Source: WHO; UNICEF (2022)

Figure 5. Global coverage for vaccines against measles (second dose) (MCV2) among children, 2000-2021⁶



Source: WHO; UNICEF (2022)

Comparing routine vaccination rates with the Immunisation Readiness Index

A critical step in the creation of any new index tool like the Immunisation Readiness Index is an analysis of its ‘convergent’ and ‘divergent’ validity. Such analysis validates any of the tool’s findings (inputs) by comparing with the associated outcomes (outputs). Because this Index measures inputs related to immunisation, the logical outcome measures are immunisation rates. However, as mentioned previously, trends in vaccination coverage mean it is challenging to make such comparisons. More information about the trends and the potential pitfalls of comparative analysis are given below.

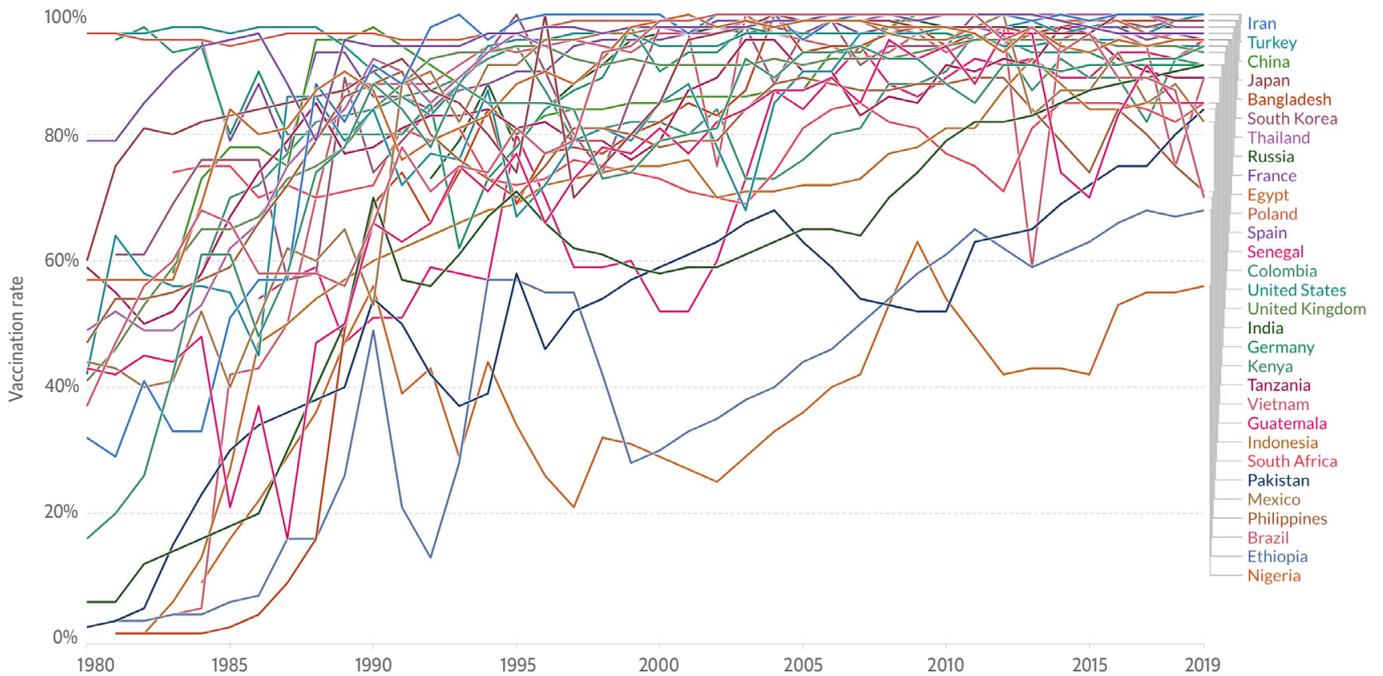
Decline in vaccinations for childhood illnesses due to disruptions caused by the covid-19 pandemic

The pandemic led to an alarming decline in the number of children receiving routine immunisations, whereby over 67 million children did not receive them between 2019 and 2021.¹⁴ As a result, global vaccination rates for DTP3 and MCV2 vaccines decreased by 5% between 2019 and 2021.¹⁶ The most recent data on routine vaccination rates for 2021 do not precisely describe the uptake of immunisations for these diseases in the Index countries; rather, they relate generally to the impact of covid-19 disruptions on routine vaccinations. The lack of specificity in these data means we cannot use the information for comparative analysis.

While these data were insufficient to confirm convergent validity of the Index, our research found that data from the year *before* the covid-19 pandemic began (i.e., 2018–2019) could be used to establish the relationship between the Index and related immunisation outcomes. Therefore, to demonstrate efforts countries have made in this area, reported vaccination rates for 2018-2019, subject to availability, are included in our interactive Data Dashboard for many of the routine immunisations mentioned in our Index.

Figure 6. Coverage for vaccines against diphtheria, tetanus and pertussis (DTP3) (third dose) among 1-year-olds in 1980-2019 in the 30 countries of the Immunisation Readiness Index¹⁶

The data included in this figure are intended to illustrate the high level of variation in vaccination rates across all 30 Index countries for the time period shown. For more information about changes in vaccination coverage for individual Index countries, see ourworldindata.org



Source: WHO; UNICEF (2022)

Inconsistent progress in vaccination coverage within individual countries between 1980 and 2019

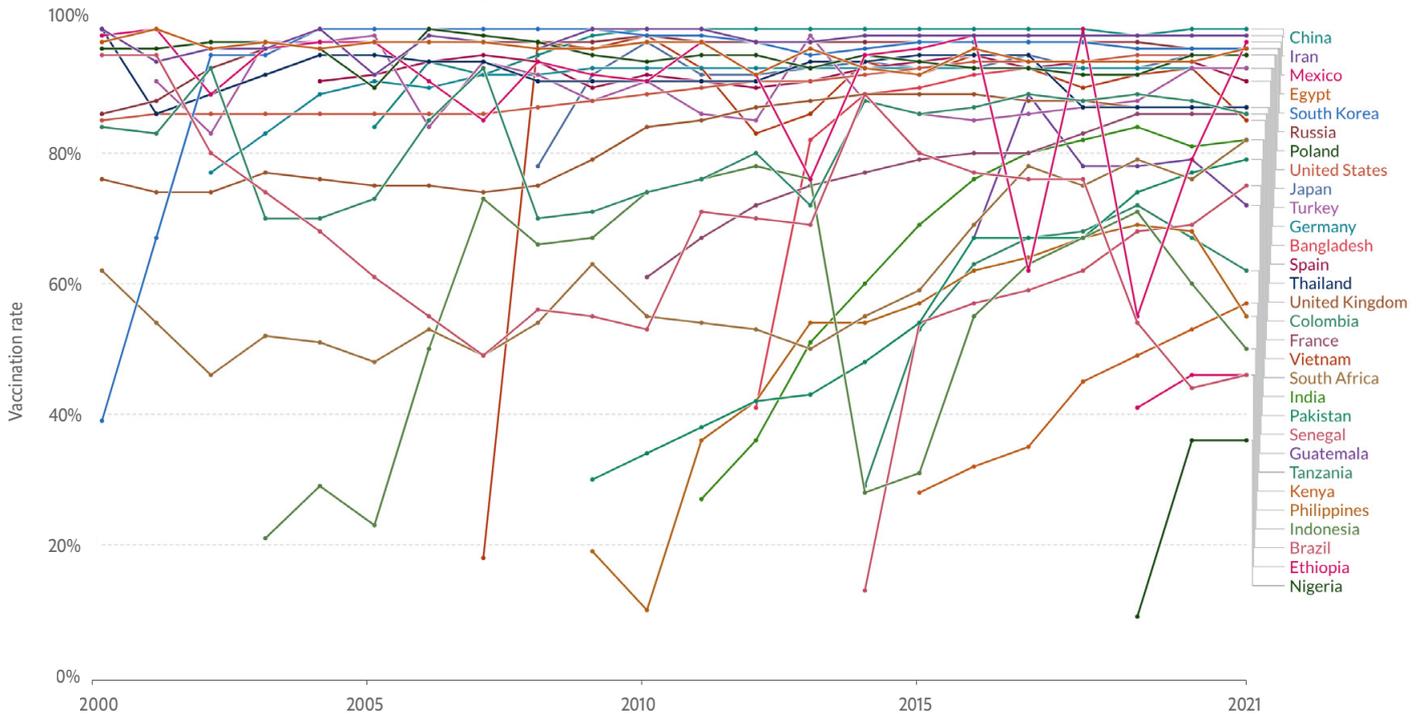
While there has been a general upward trend in vaccination coverage over the past 40 years, there has been notable variation in routine immunisation coverage rates for childhood vaccines, such as DTP and MCV (see Figures 6 and 7).¹⁶ Most of the countries in the Index struggle to make steady, consistent progress towards immunisation goals and experienced fluctuations in coverage during that time (i.e., the 40-year period). The non-linear nature of routine vaccination coverage is not specific to a particular region or income group, but is part of the global trend in vaccination coverage (although there are some exceptions). Table 2 shows inconsistencies in vaccination coverage for the DTP3 vaccine between 1980 and 2019 (before the covid-19 pandemic) for the highest-performing country in each of the geographical regions represented in the Index. The information in Table 2 describes a subset of data from Figures 6 and 7 to highlight the non-linear nature of vaccination coverage over this time.

Table 2. Variations in vaccination coverage rates for diphtheria, tetanus and pertussis (DTP3), 1980–2019 (before the start of the covid-19 pandemic) for the highest-performing country in each region studied in the Immunisation Readiness Index¹⁶

Geographical region	Country	Changes in DTP3 vaccination coverage
Americas	USA	In 1980, the reported vaccination rate was 96%, with little change in coverage until 1988. Rates then began declining, reaching 83% in 1992, before increasing to 88% and 94% in 1993 and 1994, respectively, then plateauing. Between 1994 and 2019, there was little variation; rates fluctuated between 94% and 96%. In 2019, the USA reported 94% coverage.
East Asia and Pacific	Indonesia	In the period 1980–1982, the reported vaccination rate was 1%, which increased to 47% by 1986. It continued increasing, slowly, until 2001, when it reached 76%. It fell to 70% in 2002, before rising to an all-time high of 92% in 2013. Rates decreased in 2014 (88%) and 2015 (84%), and coverage from 2015 to 2019 fluctuated between 84% and 85%.
Europe and Central Asia	France	In the period 1980–1982, the reported vaccination rate was 79%, which increased to 96% by 1986. In 1987, the rate decreased to 88%. In 1988, it was 79%. The rate recovered in 1989, increasing to 95% before plateauing. Between 1989 and 2019, it varied between 94% and 99%, and in 2019 was reported to be 96%.
Middle East and North Africa	Iran	In 1980, the reported vaccination rate was 32%, which dropped to 29% in 1981. It rose to 41% in 1982, but went down to 33% in 1983, which was sustained during 1984. The rate increased sharply between 1984 and 1986, resulting in 57% coverage, which was sustained in 1987. It rose again to 88% in 1988, but between 1988 and 1993 the rate was irregular: 82% in 1989, 91% in 1990 and 88% in 1991, before rising to 97% in 1992. Coverage was at an all-time high in 1993 (99%), and has remained relatively consistent ever since, between 98% and 99%, although decreases occurred in 1994 (95%), 2001 (96%) and 2005 (95%). In 2019, coverage was reported to be 99%.
South Asia	Bangladesh	The reported vaccination rate was 1% until 1984, when it began to rise exponentially, reaching 74% in 1991. It decreased to 66% in 1992 before increasing in 1993 to 74% and reaching 84% in 1994. In 1995, it dropped to 69% and partially recovered in 1996 (77%). It remained relatively steady until 1998, then increased to 85% in 2001. A small drop followed in 2002, to 83%, and it reached an all-time high of 99% in 2004. The rate went down again in 2005 (93%) but rose to 97% in 2009. Between 2009 and 2019, it fluctuated between 94% and 98%, and in 2019 was reported to be 98%.
Sub-Saharan Africa	Ethiopia	The reported vaccination rate in 1980 was 3%. This increased to 49% by 1990, but suddenly dropped to 21% in 1991, and yet further in 1992 to 13%. Between 1992 and 1995, it rose to 57%, with another decrease to 28% in 1999. A steady increase from 1999 saw a rate of 68% in 2011. It varied between 2011 and 2019 and was reported to be 68% in 2019.

Figure 7. Coverage for vaccines against measles (MCV2) (second dose) among children, 2000-2021 in the 30 countries of the Immunisation Readiness Index¹⁶

The data included in this figure are intended to illustrate the high level of variation in vaccination rates across all 30 Index countries for the time period shown. For more information about changes in vaccination coverage for individual Index countries, see ourworldindata.org



Source: WHO; UNICEF (2022)

There has been great variation in vaccination coverage rates within individual countries over the last 40 years, which means that no single year between 1980 and 2019 accurately reflects the progress made towards immunisation goals for *all* countries simultaneously. Point-in-time comparisons tend to favour countries with longstanding vaccination programmes (typically, higher-income countries) and fail to acknowledge the considerable progress made by lower-income countries over a shorter time frame. Thus, vaccination rates for specific years up to 2019 were not appropriate for making direct comparisons.

Inconsistent progress in vaccination coverage between countries between 1980 and 2019

Figures 6 and 7 illustrate that higher-income countries tended to have higher vaccination rates at the start of this period, in the 1980s, with smaller improvements over time compared to low- and lower-middle-income countries, primarily due to the inequities in access to vaccines and other necessary supplies in the 1980s and 1990s. For example, in France and the USA, the coverage rates for DTP3 vaccinations began to plateau in 1989 and 1994, respectively, which is in contrast to Bangladesh and Ethiopia, where vaccination rates began to plateau about 20 years later, in 2009 and 2011, respectively.

As such, the rate of change in vaccination coverage, which generally demonstrates progress over time, is much lower in higher-income countries than those with lower incomes. A direct comparison of immunisation readiness and change in vaccination rates over time (i.e. *any* period of years between 1980 and 2019) would not fairly characterise progress towards immunisation goals for all Index countries. More specifically, this method would not properly credit higher-income countries with long-established vaccination programmes for introducing new immunisation strategies or novel policies that contribute to the equitability or sustainability of immunisation programmes after vaccination rates plateau. Consequently, the rate of change in vaccination coverage does not sufficiently describe progress towards immunisation goals for the Index countries, and was not used for making comparative analyses.

Overarching findings from the Index

Readiness varies widely among countries

Overall, the countries in the Index still need to improve their capacity to harness the power of vaccines to prevent the spread of diseases and achieve immunisation goals. As can be seen in Figure 8, most countries fall into Tier 4, with Tier 5 close behind. No country achieved Tier 1 status. Clearly, every country would benefit from making improvements.

Figure 8. Country performance in the Immunisation Readiness Index

Improving readiness

Tier 6	Tier 5	Tier 4	Tier 3	Tier 2	Tier 1
Guatemala Nigeria Pakistan Senegal	Egypt Guatemala India Kenya Philippines South Africa Tanzania Thailand	Bangladesh Brazil China Ethiopia Iran Japan Russia Spain Vietnam	Colombia Indonesia Mexico Poland South Korea Turkey USA	France Germany UK	

Disparities exist between Index performance and real-world performance

While our work examines the vaccine ecosystem and state of immunisation readiness beyond the impact of covid-19, the pandemic has provided an extremely valuable gauge for assessing countries' responses to acute health threats. Progress continues towards delivering global vaccinations against covid-19, yet there continue to be disparities in vaccine availability, access and uptake. In our report, *Towards a Stronger Vaccine Ecosystem: Building resilience beyond covid-19*,¹ we present the framework for our work, noting that while the global community has made progress since the emergence of SARS-CoV-2, a significant amount of work needed to be done to adequately and equitably confront the pandemic, and that work continues.

Disparities exist between the Index and real-world performance against covid-19

Since the battle against covid-19 began, there has been no room for complacency. The inequality in global access to immunisations became glaringly obvious throughout the pandemic, and this had to be urgently addressed, involving even greater efforts to inspire impactful global and national leadership that was capable of eliminating the longstanding inequities that prevent universal access and health protection.

Useful insights can be gleaned by comparing the situation within individual Index countries with their real-world response to covid-19. For example, covid-19 vaccination coverage in the African nations was disproportionately low (in terms of the number of doses delivered and the number of people who were fully vaccinated) compared with their performance in the Index. Discrepancies like this are troubling but consistent with reports on the limitations of the Covid-19 Vaccines Global Access (COVAX) facility.

COVAX was initiated by several parties: Gavi, the Vaccine Alliance, the Coalition for Epidemic Preparedness Innovations (CEPI) and WHO with UNICEF as a delivery partner.¹⁷ COVAX is a worldwide initiative that aims to ensure equitable access to covid-19 vaccines to all populations. Initially it allocated around US\$7 billion for market preparation and manufacturing. The potential benefits of COVAX investment, in minimising risks for vaccine manufacturers and to help improve the vaccine access rate, was discussed in *Towards a Stronger Vaccine Ecosystem: Building resilience beyond covid-19*¹. Overall, covid vaccination coverage was poor – not because of a lack of good purchasing systems or a lack of funds, but because of a lack of vaccine stock. In many cases, vaccines were purchased in bulk in the early stages of the pandemic by higher-income countries.

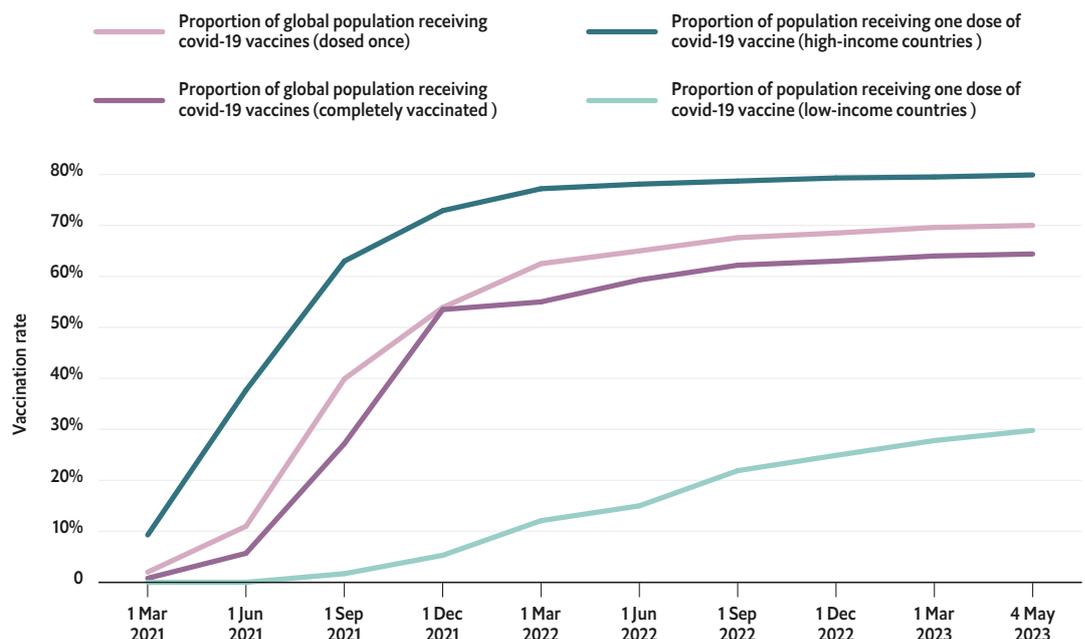
So-called vaccine hoarding and vaccine nationalism contributed to serious inequities in the distribution of covid-19 vaccines and led to low levels of participation in COVAX by high- and upper-middle-income countries. In some cases, higher-income countries chose not to join COVAX, and instead chose to purchase stocks directly from the manufacturers.

The data in Figure 9 illustrate how access to covid-19 vaccines in lower-income countries consistently lagged behind the rest of the world.¹⁸ By December 2021, a year after the UK and US initiated their vaccination programmes, 5.3% of people in lower-income countries had received just one dose of a covid-19 vaccine, compared with 53.9% of people globally. In higher-income countries, this figure was 72.9%. A year later, in December 2022, around a quarter of people in lower-income countries had received a single dose – but this level was reached by the rest of the world in the middle of 2021 (Figure 9).¹⁸

On 5 May 2023, WHO declared an end to the covid-19 emergency.⁷ Vaccination rates in lower-income countries continued to lag behind those with higher incomes, a situation that highlights the continuing unequal distribution of vaccines. This situation is a risk for worldwide immunisation readiness in the face of a pathogen that constantly mutates as it spreads. No country can be adequately protected against viruses such as SARS-CoV-2 until every country is adequately protected.

The data in Figure 9 show the progress in covid-19 vaccination rates from 1 March 2021 to the last day of the global covid-19 public health emergency (4 May 2023). However, covid-19 vaccination rates from May 2023 are given in the Data Dashboard.

Figure 9. Global coverage of covid-19 vaccines 2021–2023¹⁸



Equity is central to a healthy vaccine ecosystem

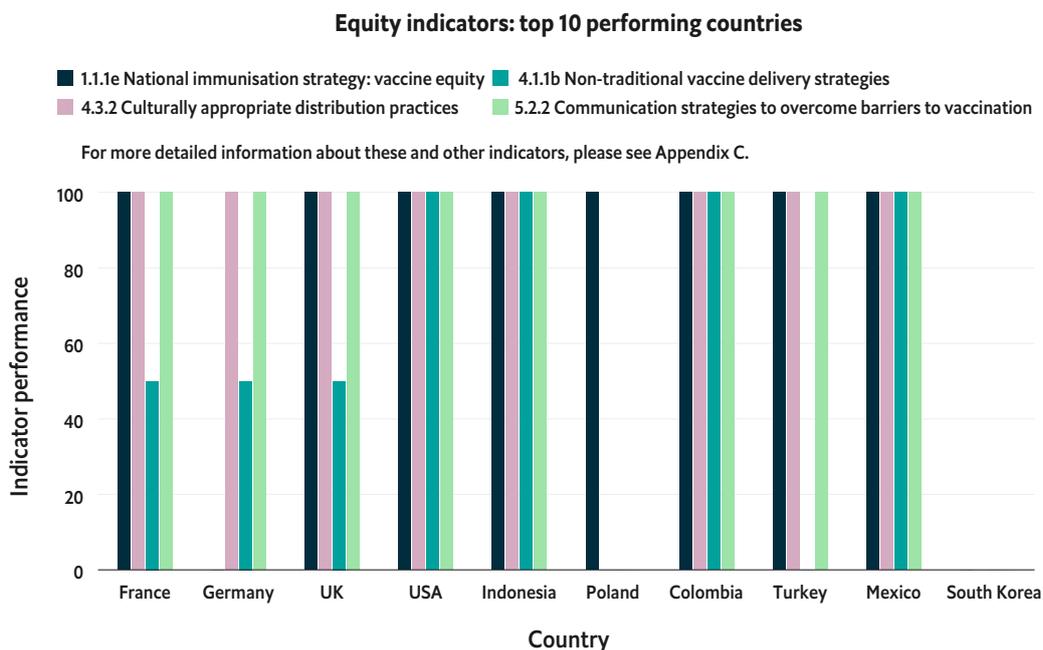
The overriding principles of public health are sometimes referred to as the ‘3 Ps’, which are health promotion, health protection and prevention of ill health. Ensuring equitable access to vaccines and related supplies is paramount to achieving each of these principles. WHO’s 2030 Immunization Agenda aims to “to extend the benefits of vaccines to everyone, everywhere” and includes vaccine equity as one of its strategic priorities.¹⁹ Four equity indicators were therefore highlighted to help countries benchmark their progress towards achieving equitable immunisation for all (Table 3).

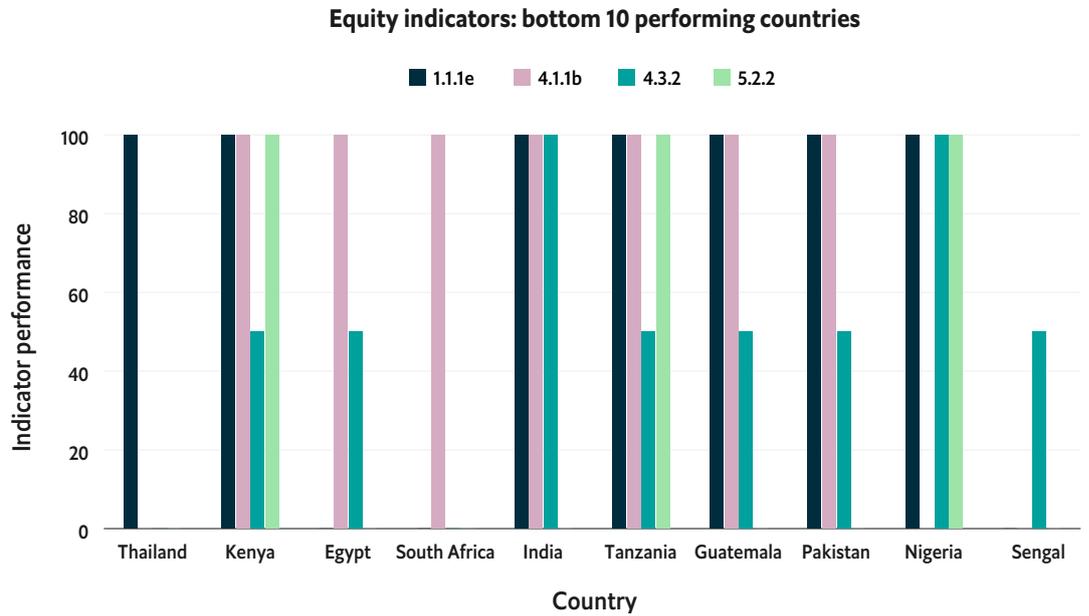
Table 3. Indicators of ‘equity’ included in the Immunisation Readiness Index

Indicator	Description
1.1.1e	National immunisation strategy/plan: vaccine equity
4.1.1b	Non-traditional delivery strategies
4.3.2	Culturally appropriate distribution practices
5.2.2	Communication strategies to overcome barriers to vaccination

The Index underscores the centrality of equity and its importance within the vaccine ecosystem, whereby the top ten performing countries demonstrate a greater dedication to equity in their vaccination programmes than the bottom ten (Figure 10). Of the thirty countries included in this analysis, only South Korea does not prioritise equity in policy and activities, as described by one or more of our equity indicators.

Figure 10. Cluster analysis of four indicators relating to vaccine equity among the top and bottom ten performing countries in the Immunisation Readiness Index

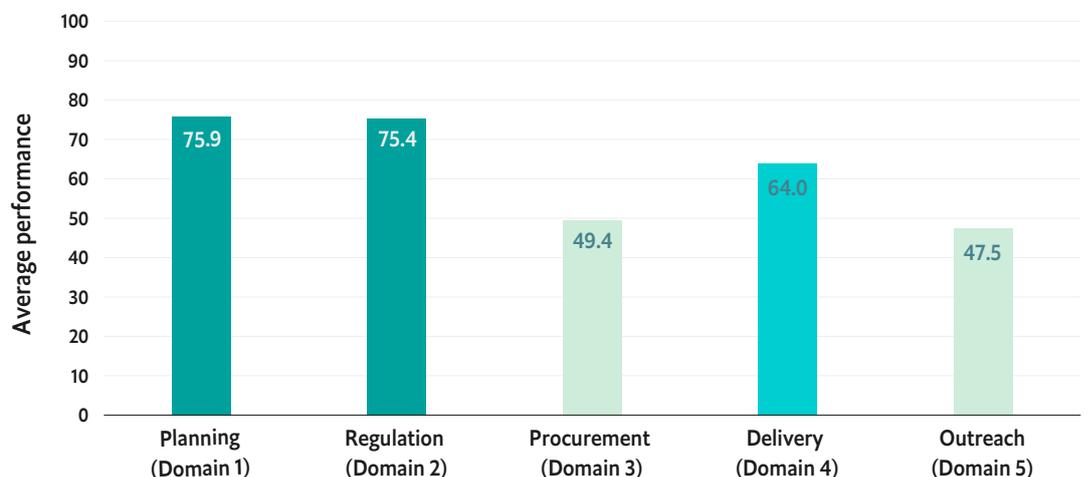




Even though policies exist, their operationalisation requires improvement

Overall, countries performed well in the first two domains, which cover the legal and regulatory structures underlying national immunisation plans (Figure 11). Together, Domains 1 and 2 outline the policy and planning mechanisms that govern immunisation efforts. All Index countries have a national immunisation strategy/plan for guiding vaccine programming. Domain 1 (Planning) has the highest average performance (75.9 on a 100-point scale), and Domain 2 (Regulation) is close behind (75.4). The Index shows that, in general, the countries fall short in domains relating to the policies guiding operationalisation of immunisation plans. While the countries may have national immunisation plans in place, some have not developed steps for guiding the implementation of such plans, thus performance was generally lower for Domain 3 (49.4), Domain 4 (64.0) and Domain 5 (47.5). Domains related to Procurement (Domain 3) and Outreach (Domain 5) show the lowest levels of country performance, indicating that these aspects of immunisation readiness are in need of the greatest attention overall.

Figure 11. Overall readiness of countries in the Immunisation Readiness Index, showing average performance within analysed domains



Immunisation readiness is associated with better health outcomes

Vaccinations can improve health outcomes by protecting against serious and life-threatening diseases and reducing disease severity for infected people. Overall immunisation readiness performance, as calculated in this research, was positively associated ($r = 0.75$) with healthy life expectancy (HALE).²⁰ Countries with greater immunisation readiness tend to have a greater HALE (Figure 12), as evaluated by simple regression analysis.

To better understand the relationship between HALE and immunisation readiness performance, multiple linear regression analysis was used to determine whether readiness, along with income (GDP per capita) and hygiene levels (access to drinking water and sanitation), were significant predictors of HALE. The fitted regression model was statistically significant ($R^2 = 0.85$, $F[4,25] = 16.6$; $p = <0.000$).

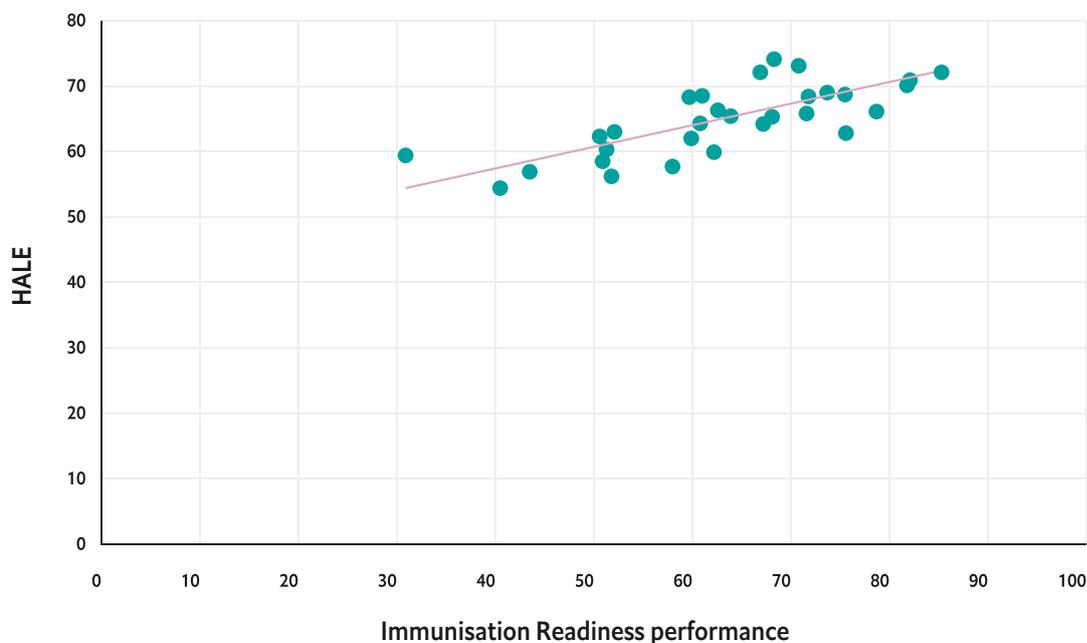
Furthermore, the analysis indicated that immunisation readiness is a statistically significant, independent predictor of HALE ($\beta = 0.16$; $p = 0.026$). GDP per capita, access to drinking water and access to sanitation do not confound the relationship between HALE and immunisation readiness performance (Table 4).

Taken in combination, these findings demonstrate the value of the Immunisation Readiness Index to predict differences in HALE for specific Index countries.

Table 4. Results of multivariate analysis estimating the relationship between Immunisation Readiness performance and potential confounders

	β value	p
Access to drinking water	-0.0259	0.8326
Access to sanitation	0.1093	0.1397
GDP per capita	0.0000	0.3017
Immunisation readiness	0.1619	0.0210

Figure 12. Healthy life expectancy (HALE) of the populations of the thirty Index countries vs their overall immunisation readiness performance²⁰



Using the Index to improve country readiness levels

Overall immunisation readiness varied widely among the Index countries. Some countries have low rates of diseases that can be prevented by immunisations, however their vaccine ecosystems cannot withstand unanticipated health pressures; this was evidenced by the increase in the number of children worldwide who missed their routine immunisations due to the covid-19 pandemic, which can result in an increased incidence of the diseases that vaccinations would have prevented.

The Index was specifically designed to examine the inputs (policies) to determine how well a country is able to respond to changes in epidemiology or disruptions in distribution and supply chains, vaccine hesitancy and the emergence of epidemics of endemic diseases (and novel pathogens with the potential for causing epidemics). Looking at disease rates at any point in time gives a snapshot of how the vaccine ecosystem is performing, which can be useful if the infrastructure of the vaccine ecosystem is known to be robust. A strong vaccine ecosystem should be able to withstand the threats posed by vaccine-preventable diseases, but our understanding of the vaccine ecosystem indicates that this point has not been achieved – yet.

Attention must be paid to the disparities between countries in terms of domains and Index performance and real-world performance. The Index assesses a country’s ability to respond to threats that are amenable to vaccination, and these findings can aid understanding of how individual countries can improve immunisation readiness.

One goal of this research was to identify substantive actions that policymakers can undertake to make improvements. The assessment of overall performance of countries across all domains revealed that no country performed at the highest level and only three achieved the second-highest tier. In addition, opportunities for improvement were the greatest in low-income countries.

The following chapters examine the findings relating to each domain, providing insights into which country policies worked well and suggesting opportunities for improvement.

Domain 1: Planning

The Planning domain examines national immunisation plans—including mechanisms for coordination, monitoring and evaluation—to support and facilitate adequate availability of vaccines to immunise the population. Because diseases do not recognise national borders, a concerted national and global effort is necessary for ensuring control of communicable diseases. Such planning requires years of work and foresight from national governments, in collaboration with partners, to build resilient and robust vaccination strategies. Partners might include global organisations and non-governmental organisations, such as WHO, and industry.

The Immunisation Readiness Index includes fourteen indicators for analysing the current ability of the Index countries to implement sufficient planning and coordination (Table 5). All indicators were weighted equally. The review of planning revolved around the extent to which a country has a national immunisation strategy or plan and whether it has explicitly defined targets for vaccination coverage. The Index measures whether there is an established national taskforce with dedicated budgets for funding the implementation of the plan to meet defined goals. The Index also measures the extent to which a given country has active monitoring and evaluation policies and procedures for measuring the level of disease surveillance and identifying adverse vaccination events. The Index only notes whether these strategies or plans were in place; it did not measure the impact or outcomes of the policies, highlighting the need for further research.

“Plans are essential but we must remember that they are living documents ... they need to be tested often, looking at small manageable sections. From these exercises, lessons need to be learned and incorporated into an updated plan. Then you can be sure that they will always work when you need them.”

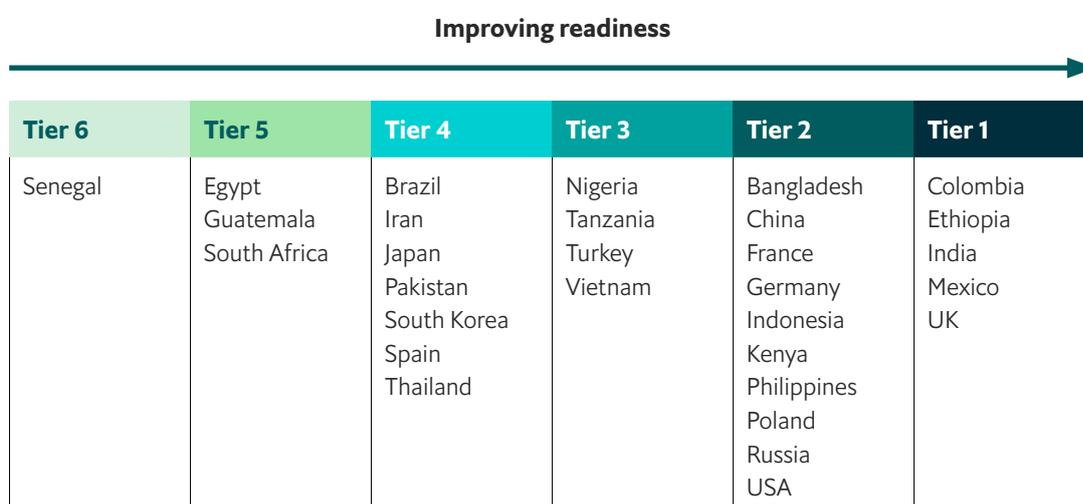
Nigel Lightfoot, CBE
Advisory Council Member

Table 5. Indicators in Domain 1: Planning of the Immunisation Readiness Index

Sub-domain	Indicator
Strategy and planning	1.1.1a Existence of a national immunisation strategy/plan
	1.1.1b National immunisation strategy: vaccine coverage targets
	1.1.1c National immunisation strategy: evidence-based rollout strategy
	1.1.1d National immunisation strategy: inclusiveness
	1.1.1e National immunisation strategy: vaccine equity
	1.1.1f National immunisation strategy: dedicated budget
	1.1.1g National immunisation strategy: contingency plans
Coordination and engagement	1.2.1 National task force
	1.2.2 National immunisation technical advisory group (NITAG)
	1.2.3 Health sector coordination
Monitoring and evaluation	1.3.1 Surveillance of vaccine-preventable diseases
	1.3.2 Health management committee
	1.3.3 Pharmacovigilance
	1.3.4 Commitment to surveillance data-sharing

Overall, countries performed better in Domain 1 than in the other domains. More countries (ten out of thirty; 33%) achieved Tier 2 performance in this domain than in any other domain. For Domain 1, the minimum level of performance was 37.3 (out of 100) and the maximum was 97.6, with an average of 75.9. In general, the best-performing countries share similar features, such as having comprehensive national immunisation strategies/plans, long-term mechanisms for disease surveillance, and well-established monitoring and evaluation processes.

Figure 13. Country performance in Domain 1: Planning



Key findings

Having a national immunisation plan shows a country recognises the importance of vaccinations—but the plan must have a dedicated budget

The highest-performing indicator in the planning and coordination domain (all-country average 100) looked at the existence of a national vaccine strategy or plan. All of the Index countries have national vaccine plans or strategies to guide their approaches to immunisation readiness, and the best-performing countries in this domain have comprehensive national immunisation plans in place, indicating that their governments recognise the importance of planning and have taken steps to organise national approaches.

Many countries design plans with the entire population of their country in mind, recognising that their populations are heterogeneous in terms of ethnicity, language and religion, among other factors. Their strategies often contain specific ways to promote equity so that immunisations reach everyone. The routine and emergency vaccination plans require specific planning and coordination that countries must budget appropriately. Indeed, the most effective plans include a budget for routine vaccinations, which is distinct from plans for public health emergencies such as epidemics.^{21,22}

Planning for contingencies promotes responsiveness

The indicator yielding the poorest country performance in Domain 1 considers contingency plans for public health emergencies. The average country score was 43.3. To improve, countries must have contingency plans that provide guidance and insights enabling them to adapt to changing events in real time.²² Better-performing countries are better able to anticipate and address problems; for example, Ethiopia's National Expanded Programme on Immunisation has contingency plans for public health emergencies that aim to effectively integrate immunisation programmes into humanitarian emergency responses as part of its efforts to "to save lives and reduce morbidity, disability and mortality due to vaccine-preventable diseases".²³

Supplementary immunisation initiatives are critical parts of contingency plans. They involve pooling resources and capacities, and have been used for outbreaks of polio and measles in several regions.²³

Robust epidemiological surveillance systems improve readiness

Countries that perform better in Domain 1 have mechanisms in place for robust disease surveillance systems covering the entire country, and including multiple sources of data collection. Such mechanisms were associated with Tier 1 performance (as opposed to Tier 2). For a country to move from Tier 6 to Tier 1, it must develop disease surveillance systems that incorporate all regions, sub-regions and municipalities in the country and collect data from all jurisdictions. Only one Index country did not have a surveillance system in place for monitoring the occurrence of vaccine-preventable disease. Improvement in surveillance systems includes having the ability to detect the emergence of new pathogens; currently, seventeen of the thirty countries (57%) conduct this type of horizon scanning.

Constant and consistent monitoring and evaluation of surveillance systems improves flexibility, thus allowing adaptation to emerging information. Countries performing well in this domain have established national and sub-national mechanisms for planning, evaluating, adjusting and implementing strategies to strengthen the breadth and accessibility of their vaccination plans. They also revise their immunisation programmes according to surveillance data. Separate surveillance systems that track adverse events related to immunisations (similar to the Vaccine Adverse Events Reporting System in the US) also improve overall performance.²⁴

Examples of best practices

The research uncovered many examples of best practices that lead to good performance; the following initiatives encompass unique and innovative approaches for addressing the issues within Domain 1 and can be adapted for use by other countries to improve their performance in this domain.

PAKISTAN—Mobile services

The National Expanded Program on Immunisation and Strategic Guidelines (revised 2015) places an emphasis on socially disadvantaged and marginalised communities. Its measures include mobile vaccination services for reaching underserved and vulnerable populations.²⁵

UK—Equity impact assessments

A key theme of the National Immunisation Programme is equity, with objectives such as helping to 'reduce health inequalities'. It mandates Health Equity Impact Assessments of immunisation programmes, relating to equality characteristics, socioeconomic factors and local vulnerable populations, and these were used to make recommendations for programme improvement.²⁶

Actions to improve performance in Planning

This domain covers the breadth of work that should be included in effective national immunisation plans or strategies, including mechanisms for coordination, monitoring and evaluation to support vaccine availability and enable population-wide immunisation. Planning and coordination must be equitable, adaptable, far-sighted and regularly evaluated to accommodate emerging needs. To achieve Tier 1 performance in this domain, it is necessary to have a national vaccination plan with protected budgets and goals to obtain population equity, coordination across the health sector and strong monitoring and evaluation of the national vaccination plan. Most index countries perform well in this domain. Performance can be improved by:

- ensuring plans have adequate ring-fenced budgets that ensure they can be effectively operationalised
- strengthening responsiveness by planning for contingencies
- increasing readiness by having robust epidemiological surveillance systems

These improvements are important for making sure national immunisation plans are fit-for-purpose and can be implemented effectively, thus meeting the needs for vaccinations to prevent endemic diseases and public health emergencies.

Domain 2: Regulation

Regulation relates to the laws governing the approval of vaccines in a country, whether those vaccines are manufactured within that country or imported. It also covers how a country evaluates vaccine data, R&D and manufacturing information from outside agencies and foreign sources. Concerted efforts at national and global levels are necessary to ensure that regulatory standards are streamlined in order to create a regulatory environment that allows for timely yet safe responses to spreading communicable diseases.

There are five indicators for analysing the ability to develop and utilise regulatory standards in the Index (Table 6). They look for the presence of a specific agency tasked with vaccine approvals, for mechanisms for adopting regulations based upon universally recognised standards developed by expert organisations (such as WHO), for an expedited approval process for vaccines required during a public health emergency, for an agency responsible for monitoring vaccine manufacturing. The indicator relating to the latter (2.1.1a) is especially important – whether or not the country has its own manufacturing capability – because it demonstrates an understanding of the manufacturing process.

The Index also studies the extent to which a country engages with the wider global community to coordinate vaccine regulations and standards, specifically seeking evidence of agreements with outside organisations on data-sharing for vaccine approval and of engagement between national regulatory agencies and vaccine developers and manufacturers.

“Thoughtful, coordinated and robust regulatory practices—driven by science—must be a cornerstone of the vaccine ecosystem, enabling acceleration of R&D, appropriate and timely review of product safety and efficacy, and the ongoing oversight of vaccines post-approval so as to ensure quality, monitor risks and benefits, and support appropriate use.”

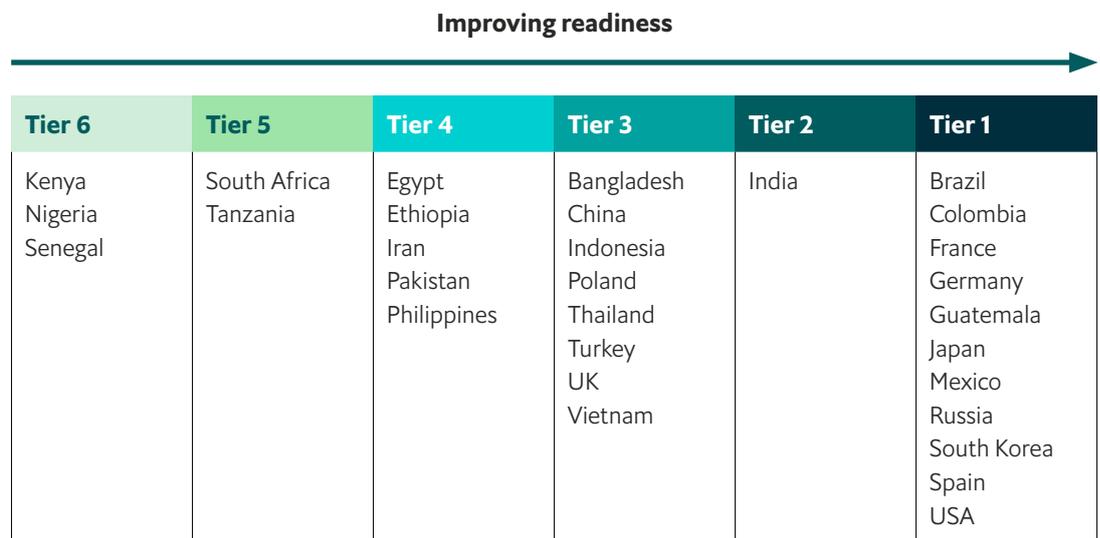
Dr Margaret Hamburg
Advisory Council Member

Table 6. Indicators in Domain 2: Regulation of the Immunisation Readiness Index

Sub-domain	Indicator
Regulatory approval and standards	2.1.1a Regulatory approval mechanism for new human vaccines
	2.1.1b Expedited approval process for public health emergencies
	2.1.2 Oversight of vaccine manufacturing standards
Engagement	2.2.1 Regional or international data-sharing related to the vaccine-approval process
	2.2.2 Engagement with vaccine R&D companies and/or manufacturers

Overall, countries recognise the importance of regulation as evidenced by good performance in this domain. More countries (eleven of thirty; 37%) achieved Tier 1 status in this domain than in any other. The minimum level of performance was 12.5 (out of 100) and the maximum was 100 (all-country average 75.4). The best-performing countries generally have efficient and rigorous regulatory agencies and national processes for approving vaccines for routine immunisations (and public health emergencies) and engage with the international community, with R&D and with manufacturers.

Figure 14. Country performance in Domain 2: Regulation



Key findings

Vaccine regulatory processes were in place

All thirty countries maintain policies for routine vaccine approval. This indicates that all of the national governments understand the importance of regulatory vaccine-approval mechanisms. The best-performing indicator (2.1.1a) in this domain, with an all-country average of 100 out of 100, examines the existence of regulatory mechanisms for approving new vaccines for human use. However, regulatory processes must be actively reviewed, with continued investment, to ensure they are adequately maintained and up-to-date. Exploring the operationalisation of these processes was beyond the scope of the Index, but may benefit from further research.

Data-sharing accelerates vaccine approval and rollout

Only fourteen of the thirty Index countries (47%) had existing agreements to participate in data-sharing. This indicator (2.2.1) is the lowest performing in the domain, suggesting that there is significant room for improvement. A lack of transparent data-sharing can cause unnecessary bottlenecks in the vaccine approval process in many countries, and ultimately slows the rollout of vaccinations. The covid-19 pandemic saw an unprecedented level of data-sharing across the global scientific community and regulators, and this encouraged rapid progress in research and emergency authorisation for use of the new vaccines. When governments, manufacturers and other stakeholders communicate and share data, they can expedite the authorisation process, which is especially important during public health emergencies. Progress on this indicator is indicated by transparent evidence of how a government works with manufacturers and other stakeholders.

Examples of best practices

The following examples are highlighted because they demonstrate unique and innovative approaches for addressing the issues within Domain 2 and they can be adapted by other countries to improve their performance.

INDONESIA—Engagement with R&D and manufacturers

In April 2021, Indonesia provided various supports for vaccine R&D initiatives during the covid-19 pandemic, including the publication of ‘vaccine development tools’ at research facilities like the Institute for Molecular Biology Eijkman (where the national Red and White vaccine research initiative originated). This support extended to directly overseeing the development of a vaccine by domestic vaccine and serum manufacturer, Bio Farma,²⁷ showing how government and private companies can coordinate and, thereby, benefit from R&D investment.

USA—Vaccine development guidance

The USA has a history of engaging with R&D manufacturers, but nothing to the extent seen during the covid-19 pandemic. Early on, the US Food and Drug Administration provided guidance for accelerating vaccine development, enabling the use of data from research on other vaccines that use identical platforms, which helped expedite research while ensuring vaccine safety and efficacy.^{28,29}

Actions to improve performance in Regulation

The Regulation domain analyses the comprehensiveness of vaccine regulatory standards, the agencies responsible for those standards and what steps can be taken to improve the efficiency of the vaccine-approval process. In order to achieve Tier 1 in this domain, countries must have regulatory approval standards for routine and emergency approvals along with regular engagement, including data-sharing between R&D and regulatory bodies at national and international levels. Overall, the analysis found significant room for improvement in:

- ensuring the maintenance of effective, rigorous vaccine regulatory processes and creating active review and continued investment
- streamlining data-sharing to allow quicker and more accurate characterisation of effectiveness and safety to improve efficiency of the approval processes

Taking such opportunities can help countries keep pace with the need for immunisations to prevent endemic diseases and improve performance during public health emergencies. Furthermore, by building and maintaining effective and rigorous regulatory processes and streamlining data-sharing, countries can work together to combat vaccine-preventable diseases.



Domain 3: Procurement

The Procurement domain covers mechanisms for procuring and financing vaccinations. Every country must be able to procure and finance vaccines and ancillary supplies, such as needles and syringes. In the past, procurement was a slow and uneven process. Streamlined and efficient vaccine procurement mechanisms, along with adequate and reliable financing, are critical for obtaining sufficient vaccine supplies, and improvements here will ensure populations are adequately protected.

Five indicators have been used to assess vaccine procurement and financing (Table 7), and served to determine whether a country has annual demand projections for national vaccine requirements to develop both short- and long-term forecasts, whether sufficient annual budgets were allocated and maintained for delivering the vaccines recommended in the national immunisation plan, and to what extent a country has a dedicated emergency financing mechanism for procuring vaccines during public health emergencies.

“It is hard to overstate the benefits of vaccination to public health and global development. In many ways, vaccination programmes have been victims of their own success. By committing many diseases to distant collective memory, vaccination has made it all too easy to forget that those diseases - not to mention diseases that we have not yet encountered - remain a grave threat to human flourishing.”

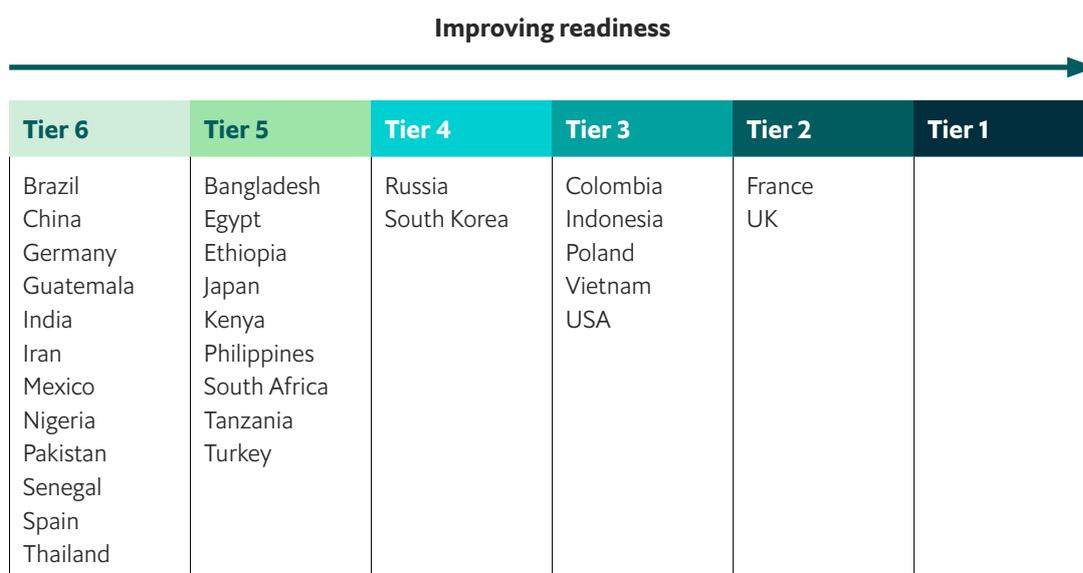
Dr Vivek Muthu
Academic Advisor

Table 7. Indicators in Domain 3: Procurement of the Immunisation Readiness Index

Sub-domain	Indicator
Procurement mechanisms	3.1.1 Demand forecasts for national vaccine requirements
	3.1.2 Procurement strategy that considers factors other than price
Financing	3.2.1 Sufficient budget for procurement and delivery
	3.2.2 Dedicated emergency vaccine financing mechanism
	3.2.3 Current Health Expenditure (CHE) per capita

There is room for improvement in this domain for all countries in the Index. None fulfil all the criteria, although some perform better than others and appear to understand the need for strong procurement and financing mechanisms (of course, many countries do understand this need but may be unable to implement or prioritise development in the area). No country achieved Tier 1 status and most were clustered in Tier 6. The lowest-performing country scored 16.7 out of 100 and the highest scored 83.3 (average 49.4). National immunisation strategies must include dedicated budgets to ensure procurement and delivery of vaccines and sufficient financing during public health emergencies. However, more of the countries had dedicated funds for vaccines for use in public health emergencies than for vaccines to counter routine childhood and adult diseases.

Figure 15. Country performance in Domain 3: Procurement



Key findings

Dedicated budgets must be part of the national immunisation plan

Interventions to improve procurement must consider vaccines that are used during public health emergencies, as well as those for preventing infectious childhood and adult diseases, and both must be properly funded. Improved financing often leads to equitable and timely access to vaccines, which is necessary for achieving immunisation goals. Proper planning and budgeting are also required for vaccines and ancillary supplies (e.g. needles, syringes, alcohol swabs, personal protective equipment) to support all of a country's immunisation programmes, whether routine or emergency.

Only seventeen of the Index countries (57%) were found to have a sufficient annual budget for procuring and delivering the vaccines included in their national strategy or plan (Indicator 3.2.1). In thirteen of them (43%), there was misalignment between the goals set out in the strategy and the budget allocated for implementation.

Dedicated emergency financing mechanisms for securing vaccines during public health emergencies were present in twenty-four of the countries (80%). Indicator 3.2.2 had the highest average country performance (80.0), partly because public health emergencies receive more public attention and generate greater political will, even though funding for routine immunisation programmes is just as important for public health.

National immunisation strategies must include dedicated budgets, and it is important to consider the costs of vaccines and ancillary supplies when budgeting, planning and implementing programmes, to enhance overall readiness. If funding is inadequate, then planning is a theoretical exercise. Improvements in this area require full funding of immunisation strategies and their associated programmes to properly support vaccination efforts against routine disease threats and public health emergencies.

In some higher-income countries, high costs affect the ability to fund immunisation programmes equitably and can prevent some communities from having adequate access to necessary vaccines. Therefore, to ensure success, procurement strategies must consider factors other than price. For Indicator 3.1.2, twenty-one of the thirty countries (70%) considered such factors when making procurement decisions, such as equity, safety and place of manufacture, as demonstrated by South Africa – one of the top ten performers in Domain 3 with its five-pillar procurement strategy (see Best Practices below).

The Index does not explore complex issues related to budgeting and pricing beyond this indicator, but points this out as an important area for further research. Similarly, further research is required on the policies for procurement of ancillary supplies (such as needles and syringes) to enable vaccine administration.

Forecasting improves procurement

When government officials and policymakers understand the processes involved in forecasting vaccine demand, they are more likely to use limited budgets more efficiently and make better decisions about the quantity and frequency of the procurement of vaccines and ancillary supplies. According to Gavi, the Vaccine Alliance, demand forecasting is important for understanding markets and planning annual immunisation programmes.³⁰ For this reason, Gavi creates forecasts spanning periods of up to 20 years.³⁰ Without proper forecasting, vaccination supplies can either be insufficient or can exceed the required demand; in either scenario, valuable vaccines are wasted or the population is not adequately protected.

Indicator 3.1.1 examines demand forecasts for national vaccine requirements and has the lowest all-country average (23.3). Fourteen of the Index countries (just under half; 47%) develop annual demand forecasts for required vaccines. Our experts consider a five-year forecast to be the minimum time frame for long-term planning, but no countries routinely create a forecast of this length to inform immunisation readiness, reducing their ability to make long-term projections for national vaccine requirements for routine immunisations. Thus, substantial improvements are needed in this area to better prepare for future vaccination needs.

Examples of best practices

These examples of best practices are given because they offer unique and innovative approaches to address issues encompassed by Domain 3 and can be usefully adapted by other countries to improve their performance in this domain.

EGYPT—Emergency financing

In 2014, Egypt initiated an account for public funding. One of the main focuses of the Long Live Egypt Fund is a disaster and crisis response programme. From the start of the covid-19 pandemic, it provided medical equipment to health facilities, financially supported poor families and crowdfunded to expand covid-19 vaccine coverage.³¹

SOUTH AFRICA—A procurement strategy that actively promotes equity

South Africa is among the top ten performers in Domain 3 with its five-pillar procurement strategy. The Government General Procurement Guidelines prescribe a minimum set of standards: value for money, open and effective competition, ethics and fair dealing, accountability and reporting, and equity. The guidelines are supplemented by individual accounting officer's procurement procedures issued under the general authority contained in the Public Finance Management Act 1999.³² As outlined on the Department of Health website, the department 'always awards bids in accordance with the treasury's procedures'.³³

Actions to improve performance in Procurement

The Procurement domain relates to mechanisms for ensuring the efficient supply of vaccinations for routine and emergency vaccination efforts. Streamlined and efficient procurement mechanisms, along with adequate and reliable financing, are critical for ensuring sufficient supplies of all available vaccines. To be in Tier 1 for this domain, a country must have a strong procurement strategy, demand forecasting and sufficient financing allotted to cover both routine and emergency procurement. Performance for all thirty Index countries could be enhanced by:

- improving the budgeting process to ensure national immunisation plans include sufficient dedicated resources for all vaccinations, whether for routine use or public health emergencies
- improving forecasting to promote effective procurement

Domain 4: Delivery

The Delivery domain encompasses many factors involved in creating and maintaining robust systems to enable population-wide vaccination efforts. Countries must have an appropriate public health infrastructure, including mechanisms to track vaccine stockpiles and vaccine distribution and maintain accurate vaccination records. A sufficient number of properly trained personnel is required to implement vaccination campaigns, with enough flexibility to shift to the provision of immunisations during public health emergencies. In any country, the percentage of the population with access to vaccinations is significant, including hard-to-reach populations. Also of concern is whether any difficulties stem from challenges in geography or poor health literacy.

There are fourteen indicators in the domain (Table 8), which assess, for example, individual country infrastructure, personnel and distribution systems for vaccination delivery, integration with the primary healthcare system, digitalisation of vaccination records, vaccine inventory management systems, and access to healthcare (access affects the potential to reach immunisation goals). Each country's healthcare workforce and national training mechanisms for health workers who administer vaccines were also reviewed. This domain captures the extent to which countries have culturally appropriate distribution practices in place and notes whether the functionality of distribution systems was tested via a functional exercise.

“This report describes how effective vaccination demands attention to an interconnected system of policy instruments, technological and scientific innovation, complex logistics and sophisticated sociological interventions. It also describes - in very concrete and specific ways - how this system can be improved. Ultimately, I hope that this report, and the initiative of which it forms a part, helps to ensure that vaccination remains an active global priority, demanding political attention and investment, which is rightly regarded as central to securing and sustaining a brighter future for all.”

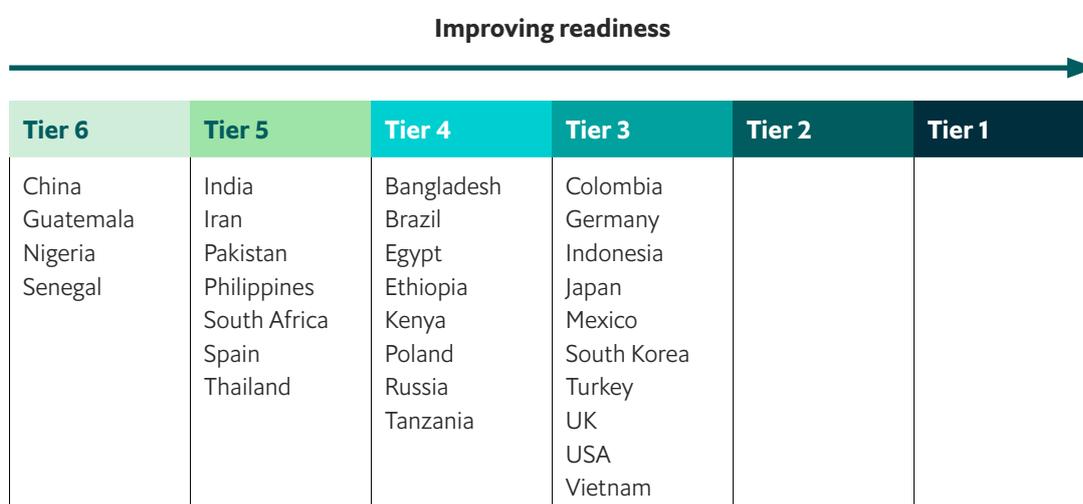
Dr Vivek Muthu
Academic Advisor

Table 8. Indicators in Domain 4: Delivery of the Immunisation Readiness Index

Sub-domain	Indicators
Health system infrastructure	4.1.1a National immunisation infrastructure integration
	4.1.1b Non-traditional vaccine delivery strategies
	4.1.2 Digital vaccination records (integrated with national health information system)
	4.1.3 Vaccine inventory management
Access to healthcare	4.2.1 Universal Health Coverage (UHC) Service Coverage Index
	4.2.2a General medical practitioners (GPs)
	4.2.2b Pharmacists
	4.2.2c Nurses and midwives
	4.2.3a Data on health-worker competency in immunisation
	4.2.3b National health-worker training programme for immunisation
	4.2.3c Emergency workforce strategy for public health emergencies
Distribution systems	4.3.1 Vaccine delivery and storage infrastructure (cold chain)
	4.3.2 Culturally appropriate distribution practices
	4.3.3 Delivery system testing

Overall, there is room for improvement in every Index country. Most of the countries (ten; 33%) were in Tier 3, with none in Tiers 1 or 2. The lowest-performing level in this domain was 43.4 out of 100, and the highest was 85.2 (all-country average 64.0). A common feature of the best-performing countries in this domain is a reliable physical and health infrastructure that is integrated with the primary healthcare system.

Figure 16. Country performance in Domain 4: Delivery



Key findings

Infrastructure is a prerequisite for effective immunisation delivery

The best-performing indicator in this domain was 4.1.1a, relating to national integration of the immunisation infrastructure into the public health system. All of the countries met this goal (all-country average 100). The term 'physical infrastructure' relates to internet access, cellphone networks, roads and electricity grids, while 'health infrastructure' relates to clinics, hospitals and health institutions that are key to vaccination delivery. A reliable infrastructure (comprising both these aspects) allows public health systems to successfully deliver immunisations to the population. Every country demonstrated this ability to some extent, but the reliability and resilience of the physical infrastructure were not examined (e.g. digital networks or road quality). This was beyond the scope of the Index and offers an opportunity for further research.

Health personnel require training for effective vaccine delivery

Countries that perform well in this domain make efforts to maintain an adequate health workforce and a robust vaccine distribution system. There is comprehensive training for health workers, which typically covers vaccinology and injection training, and ways to improve delivery strategies and address public concerns. Sub-domain 4.2 looks at access to healthcare and national health systems with the personnel required to immunise their populations. High-performing countries train healthcare personnel in vaccine delivery for both routine diseases and public health emergencies, and they also provide continuing and up-to-date training regarding best practices for vaccine delivery. Indicator 4.2.3a, the lowest-performing indicator in the domain, considers the availability of data on health worker competency in vaccine administration (all-country average 13.3) through the collection and publication of figures on the number of health workers trained to administer vaccines. Only four of the countries (13%) made this information available to the public. Most do not collect or publish the data. Countries can improve in this indicator by making information about their healthcare workforce publicly available.

Delivery systems must be sufficiently robust and well maintained

National immunisation plans and strategies for delivering immunisations are of little value unless they can be properly operationalised and adapted to meet specific needs. A well-developed system will deliver vaccines to all areas of a country. Indicator 4.3.1 focuses on the ability to meet and maintain the temperatures required to transport and store vaccines safely to at least 80% of districts. Only nineteen of the thirty countries (63%) demonstrated the ability to ensure that vaccines were kept within their required temperature-controlled environments, so these delivery systems must be expanded and updated. Plans must also be validated regularly, by testing and evaluation, with updates and revisions made as needed. Note that nationwide exercises, such as the WHO Joint External Evaluation, had been conducted in 90%²⁷ of the countries; good performance on this indicator (4.3.3) should be maintained to prevent readiness levels from falling, and countries are encouraged to conduct regular monitoring of vaccine delivery systems via functional exercises to maintain – or improve – performance in this area.

Examples of best practices

The following three countries demonstrate unique and innovative approaches for addressing the issues in Domain 4, which can be usefully adapted by other countries to improve their performance. Brazil worked to improve the delivery of vaccines among hard-to-reach communities; France worked to broaden the range of health workers able to administer immunisations during public health emergencies; and Iran worked to provide training to community health workers.

BRAZIL—Culturally appropriate vaccine distribution

Operation Droplet promotes the ability of vaccination programmes to be offered in socioeconomically disadvantaged, hard-to-reach geographic areas, including indigenous areas such as the Amazon, Amapa, Para and Acre. Supported by the Division of Public Health for indigenous populations, the programme aims to vaccinate people in communities using non-traditional delivery strategies and culturally appropriate practices.³⁴

FRANCE—Extended range of healthcare providers for administering vaccines during public health emergencies

The wide range of health professionals authorised to administer vaccines during public health emergencies now includes vets, dentists and firefighters, meaning there are far more people who can administer injections to expedite vaccine rollout throughout the population.³⁵

IRAN—Training programme for health personnel

Part of Iran's national community healthcare programme relates to remote rural and small urban communities, and a key component of the public health system is the use of trained community health workers to provide or supplement primary healthcare services in these communities.³⁶ A 2018 WHO study noted that rural communities are at the core of primary healthcare delivery, and that community health workers provide 'a broad range of services, including annual censuses, health education, family planning, maternal and child healthcare, care for elderly populations, oral healthcare and occupational health'.³⁷

Actions to improve performance in Delivery

In order to achieve Tier 1 in this domain, which analyses how vaccines are delivered by examining health system infrastructure, personnel capacity and vaccine distribution systems, a country needs a reliable infrastructure (both physical and health aspects), sufficiently trained health personnel, and a robust vaccine distribution system (with temperature-controlled environments and culturally appropriate delivery methods). Performance in this area can be improved by:

- improving the reliability of the national infrastructure
- ensuring health personnel are adequately trained to deliver vaccines
- ensuring ongoing validation of immunisation plans through active evaluation and maintenance so they can be effectively operationalised and adapted to meet changing needs
- creating and maintaining vaccine distribution systems capable of delivering vaccines to all areas, equitably and sustainably

Immunisation readiness depends on effectiveness in each of these areas, whereby maintaining and improving performance enhances the efficiency of vaccine delivery, to achieve better vaccine uptake for endemic diseases and ensure preparedness for dealing with novel pathogens.

Domain 5: Outreach

The Outreach domain involves public education and outreach measures to provide insights into the receptiveness of a particular population to a recommended vaccine. Adequate public awareness leads to increased knowledge and transparency, which is key because no matter how well a particular country performed in Domains 1–4, it is meaningless if the population refuses to be immunised.

The Index includes four indicators on immunisation education programmes and public outreach activities (Table 9) that look for publicly funded health literacy programmes, including digital health literacy, and risk communications strategies for vaccines and vaccine-preventable diseases. The indicators consider the aspects of such strategies that are intended to overcome barriers to vaccination and reflect national efforts to understand public attitudes towards vaccination, using measures such as surveys of public opinion.

“Public trust is essential for any successful vaccination campaign. The Economist Group’s Vaccine Ecosystem materials are comprehensive, extensive and include important information regarding informed decision-making and public communication and are vital for policymakers responsible for public health.”

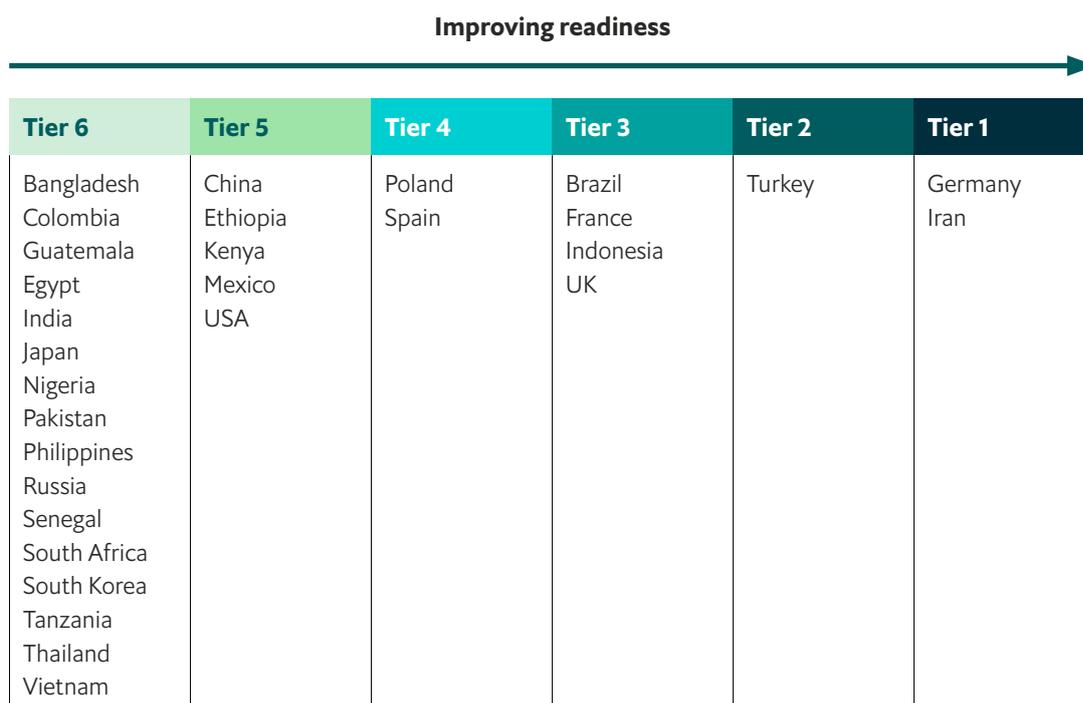
Dr Laura Kahn
Advisory Council Member

Table 9. Indicators in Domain 5: Outreach of the Immunisation Readiness Index

Sub-domain	Indicator	
Education programmes	5.1.1	Public education programme on immunisation
Public outreach	5.2.1	Risk-communications strategy
	5.2.2	Communication strategies to overcome barriers to vaccination
	5.2.3	Research into public attitudes towards vaccines

Overall, there is significant room for improvement across the Index countries in Domain 5. This domain has the greatest spread in performance, covering the entire range of possibilities (from zero to 100; all-country average 47.5), with sixteen countries (53%) falling into Tier 6. The highest-performing indicator in this domain (5.2.1) relates to the existence of a risk-communications strategy specifically for vaccine-preventable diseases (all-country average 63.3). The indicator for public education programmes that support immunisation (5.1.1) showed the lowest level of performance (average 38.3). Taken together, these findings reflect a significant disconnect between the existence of policy and its successful operationalisation into actionable effective results. Public health communications should be improved in all countries to ensure that no one is disenfranchised and that everyone has access to clear and easily understandable information. In general, the best-performing countries for this domain share characteristics such as long-term public communication strategies that aim to overcome inequities, vaccination-focused public education campaigns and clear strategies for gauging attitudes towards vaccination.

Figure 17. Country performance in Domain 5: Outreach



Key findings

Optimising uptake requires specific investment, expertise and strategies

To make improvements in this domain, governments must prioritise investment in programmes and systems that optimise public acceptance and uptake, such as vaccination literacy programmes. Investment must be increased in a few key areas, such as identifying groups who may be marginalised or have a history of poor vaccination uptake, and working to address their needs. Culturally targeted outreach measures allow public health organisations to engage with communities and explain the rationale behind vaccination, which is especially relevant where there is vaccine hesitancy, that often arises due to a lack of information and understanding – or mistrust – of the health system. According to Indicator 5.2.3, sixteen of the Index countries (53%) have conducted surveys to gauge attitudes towards vaccines in the last five years.

Improving health literacy through comprehensive programmes that address structural and societal barriers that impede participation in health decision-making, leads to more effective education and outreach programmes. There were funded public education programmes on immunisation to improve health literacy (Indicator 5.1.1) in eighteen countries (60%), but only five of them (17%) include digital health literacy in their programmes.

Efforts to improve public communications, and thus shared decision-making, must address the complexities associated with vaccines and vaccination programmes. There were risk-communication strategies for vaccine-preventable diseases in nineteen of the thirty countries (63%) (Indicator 5.2.1).

Strategies specifically aimed at overcoming socioeconomic inequalities, geographic barriers, cultural differences and other obstacles to vaccination (Indicator 5.2.2) were found in sixteen countries (53%). It is important for all vaccine-related information to be clear and comprehensive but concise and culturally appropriate, and delivered in multiple formats using appropriate and accessible language. It is also best if community leaders and trusted organisations work in alignment with public health efforts to deliver messages about vaccination, thus promoting understanding and uptake.

To improve in this area, the needs and concerns of specific population groups must be addressed, and it is essential to have communication techniques that incorporate active listening, as well as disseminating evidence-based information. While there was evidence that countries conducted surveys to gauge attitudes and had programmes for improving health literacy and developing risk communications, the impact of these surveys and programmes on outreach and vaccine uptake was beyond the scope of this Index, providing a further opportunity for research.

Impactful and trusted leadership can improve immunisation uptake

Strong and effective leadership from government, key stakeholders and policy experts at international, national and community levels is essential for achieving robust education and outreach. Indicators relating to the quality of governance are important for context and were included in Domain 6: Society. They relate to government effectiveness, political stability and corruption. None of the Index countries were in Tier 1 for this domain, but it is acknowledged that the effectiveness of leadership and governance is an ongoing requirement of successful vaccination programmes, and key to better performance in this area.

To positively impact immunisation, effective leadership must come from all levels of government (international, national, regional and local). Clear communication about infectious disease threats and vaccination programmes must be based on scientific evidence, which promotes trust. Elected officials must be informed, engaged and prepared to lead effective emergency responses and motivate their constituents to participate in life-saving vaccination programmes.³⁸ To ensure equity in vaccination outreach and education, such programmes must involve a broad range of trusted and influential stakeholder groups to act as ambassadors, including politicians, government leaders, professional organisations, health workers, religious and traditional community leaders, among other respected

community members.⁶

Examples of best practices

These examples showcase unique and innovative approaches for addressing the issues in this domain and can be adapted by other countries to improve in this area.

KENYA—Cultural considerations in risk communications

The National Policy Guidelines on Immunisation (2013) include communications strategies specifically aimed at overcoming socioeconomic inequalities, geography, cultural and linguistic differences, or gender barriers to vaccination. Health workers are mandated to conduct outreach in areas known to have 'high numbers of unreached children and pregnant women', and all communication strategies and supplemental immunisation activities include cultural considerations.³⁹ In 2021, the Ministry of Health recruited religious leaders to widen the campaign against covid-19.⁴⁰

PHILIPPINES—Community engagement

A risk-communication strategy for vaccine-preventable diseases can be found in Booklet 8 of the National Immunisation Programme Manual of Procedures, which discusses engaging with the community to raise awareness about the risks of not getting children vaccinated, and the use of interviews, focus groups and print media, for example, to encourage behaviours relating to routine immunisations, with clear behavioural objectives.⁴¹ The National Deployment and Vaccination Plan for Covid-19 Vaccines contains a chapter on a risk-communication strategy and crisis management. It specifies the creation of a Task Group for Demand Generation and Communications that is responsible for activities such as advocacy, ongoing community engagement, trust building, active hesitancy prevention, regular national assessment of vaccine concerns and crisis-response planning.⁴²

Actions to improve performance in Outreach

Vaccines are a major public health achievement, but the full benefits of immunisation cannot be obtained without proper education and outreach. Greater knowledge helps to mitigate apprehension and unease that some people feel about being vaccinated or getting their children vaccinated, and higher health literacy levels improve knowledge and competencies, making it easier for people to find, understand, assess and apply information, thus allowing better interactions with the health system.⁴³ Effective activities in these areas lead to better acceptance of vaccinations and result in a higher percentage of fully immunised people. In order to be in Tier 1 of this domain, a country needs strong outreach to improve public understanding of vaccinations, robust immunisation outreach campaigns and a well-articulated disease risk-communication strategy. Many countries performed poorly in this domain, but there are several ways in which their performance can be improved, such as by:

- making greater investment in programmes to optimise vaccine uptake in disenfranchised and one word, no hyphen populations
- strengthening trust in all levels of leadership (international, national, regional and local) to increase vaccine uptake

To have a meaningful impact on vaccine uptake, governments must invest in communication programmes aimed at improving understanding, knowledge, and trust, while also attempting to dispel myths associated with immunisation.

Improving immunisation readiness: building a resilient future

Two decades ago, the US Centers for Disease Control and Prevention (CDC) declared vaccinations one of the major public health achievements of the twentieth century, placing them first in the top ten of its public health achievements.⁴⁴ Vaccinations reduce the burden of disease in humans and lower morbidity and mortality rates on a huge scale.

The Immunisation Readiness Index was conceived to take the principles and framework established by The Vaccine Ecosystem Initiative and translate them into a qualitative and quantitative tool. Policies across thirty Index countries were researched and analysed to identify any gaps or opportunities for improvement as governments around the world look to become more resilient to threats posed by diseases that are amenable to prevention or treatment through vaccination. The analysis of the findings from the Index build upon a previous report, *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*,¹ and several policy briefing papers²⁻⁶ that consider ways to improve structural approaches for strengthening global health security.

The aim of the Index is to highlight variability and inequalities across countries while providing clear and actionable insights with potential for making improvements, that can also promote dialogue between countries and help them learn from each other. The discrepancies observed between countries help to identify important gaps that would benefit from more work. The Index allows us to look beyond research laboratories and understand how different countries can maximise the availability, and therefore the utility, of vaccines for people living within their borders.

Since it began, The Vaccine Ecosystem Initiative endeavoured to explore the possibilities for both radical and incremental changes that might improve health-system preparedness and work across broader society to harness the full potential of current and future vaccines. A meaningful structure has been developed since 2020, to define what was initially an amorphous construct into five interdependent core pillars, including research and development; manufacturing; procurement, pricing and finance; distribution, logistics and supply chain management; and user acceptance and uptake. The Immunisation Readiness Index builds on this work by quantitatively and qualitatively mapping actions taken by individual countries in the field of immunisation, to identify opportunities to enhance preparedness.

Immunisation Readiness Index demonstrates need for improvement across all countries and all domains

The Index is a statistically significant predictor of a country's healthy life expectancy, highlighting how improvements in immunisation readiness can enhance health outcomes. It reveals that none of the thirty countries studied performed to the highest level across all domains – clearly indicating that each one still has room to improve.

The countries performed well in the first two domains, covering the legal and regulatory structures underlying national immunisation plans or strategies, and examining the policy and planning mechanisms that govern immunisation efforts. All the Index countries have a national immunisation

strategy/plan for guiding vaccine programming. In general, the domains related to policies guiding operationalisation of such plans are where the countries fell short, because they may not have developed the steps that guide implementation. Consequently, performance was lower overall for the three domains on Procurement, Delivery and Outreach. The lowest levels of performance related to Procurement and Outreach, thus revealing that these aspects of immunisation readiness require the greatest attention.

“The need for building stronger partnerships, among public and private players, is common to all domains analysed in the Immunisation Readiness Index and this report. We need to work as partners towards a sustainable vaccine ecosystem to restore and strengthen immunisation programmes with primary healthcare along the life course.”

Mr Thomas Cueni
Advisory Council Member

All of the Index countries recognised the importance of planning, as evidenced by good performance in **Domain 1: Planning**. However, they need to strengthen their national immunisation plans or strategies to ensure they have the capacity and capability to address routine endemic diseases as well as emerging disease threats. Mechanisms for coordinating, monitoring and evaluating vaccine availability and promoting population-wide immunisation must be part of the national approach, and planning and coordination must be equitable, far-sighted, regularly evaluated and flexible enough to accommodate emerging needs. Active evaluation, maintenance and funding of the strategy is required to maximise immunisation readiness.

Within **Domain 2: Regulation**, all countries were found to have regulatory authorisation mechanisms for approving new vaccines for human use. Streamlining the sharing of data enhances the speed and accuracy with which information on vaccine effectiveness and safety can be disseminated and assessed during the vaccine-approval process, which can be particularly helpful during public health emergencies. Further research opportunities include analysing the operationalisation of regulation processes to ensure that they meet evolving needs.

More can also be done regarding **Domain 3: Procurement**, to prioritise mechanisms for vaccine procurement to protect population health. National immunisation plans and strategies often overlook the inclusion of forecasting and dedicated budgets, but good forecasting is critical for all downstream planning, budgeting and operationalisation. No plan can be operational unless it has a dedicated source of funding. Our experts considered a five-year forecast as the minimum time frame for adequate planning to protect public health from diseases, whether those diseases are routine or the cause of a public health emergency. Note that a more thorough understanding of pricing and its impact on budgeting, planning and procurement was beyond the scope of the Index, but such knowledge might help countries improve vaccine availability and access.

Domain 4: Delivery demonstrates that better operationalisation of national immunisation strategies improves readiness because it helps ensure the resilience of a country's physical and health infrastructure. National plans for delivering immunisations are of little value unless they can be properly utilised and adapted to meet specific needs. They must be regularly validated through testing and evaluation, and require updating and revisions as appropriate.

Information on the competency of health workers to administer immunisations is helpful for assessing readiness. All countries met the indicator criteria on infrastructure, but measuring the reliability of the infrastructure would be even more valuable and presents an opportunity for further research. Note that responsiveness requires investment and validation to ensure national immunisation plans can be effective.

Countries must prioritise investment in programmes and systems that optimise public acceptance and uptake of vaccinations by addressing health literacy, vaccine hesitancy, mistrust and other concerns. This situation is explored in **Domain 5: Outreach**. Outreach must be culturally appropriate to facilitate engagement with groups who may be marginalised or may have a history of poor vaccine uptake. Trusted leadership is key to this and is best when drawn from international, national, local and community stakeholders. Trust improves understanding and knowledge and dispels health myths. Countries showed evidence of surveys conducted to gauge attitudes, of programmes for improving health literacy and of risk-communication strategies, but their impact on outreach and immunisation uptake was beyond the scope of the Index. Further research in this area is recommended.

A strengthened vaccine ecosystem

Overall, the Index has highlighted the need to build stronger partnerships and involve a broader range of stakeholders, such as forging alliances between ministries of health and public health, finance, social services and education, health professionals and cross-sector leaders at community, national and international levels. There is much more work to be done and wider discussion is invited as part of the ongoing Vaccine Ecosystem Initiative, to examine and reimagine elements that were critical for vaccine development, deployment and adoption, and thus promote a sustainable vaccine ecosystem. The key message remains: none of us is safely protected until everyone is safely protected.

“Every year, vaccines prevent 4-5 million deaths in all age groups and have the potential to fight some of the biggest threats to global public health. During the covid-19 pandemic, health systems administered more vaccines than in any year in history and we are now seeing the largest decline in vaccination coverage in a generation.”

Mr Thomas Cueni
Advisory Council Member

Appendices



Appendix A: The pillars of The Vaccine Ecosystem Initiative

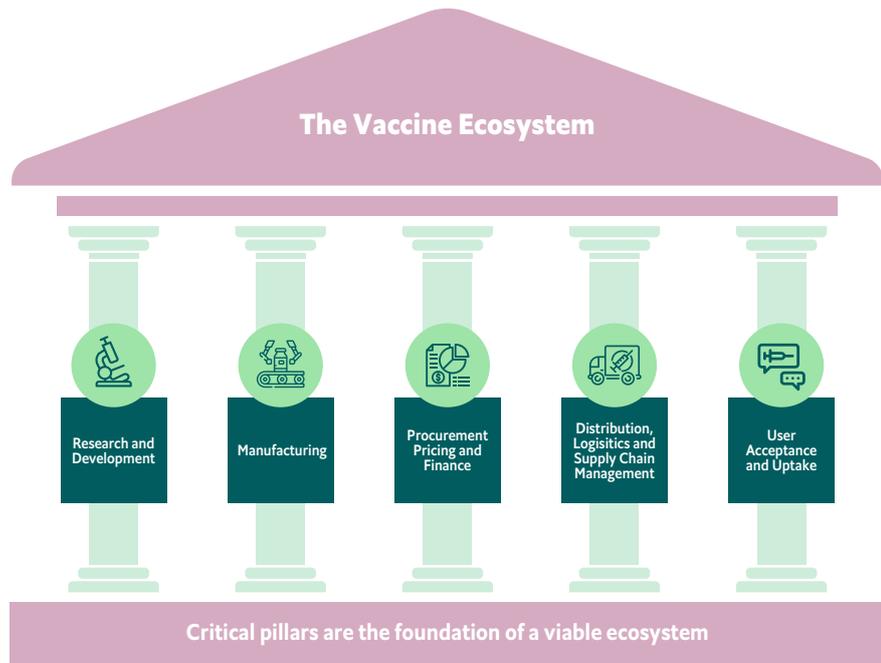
The Immunisation Readiness Index is just one part of an overarching research programme called The Vaccine Ecosystem Initiative. The Initiative was established in November 2020 to promote a sustainable global vaccine ecosystem by examining and reimagining elements that are critical for vaccine development, deployment and adoption. This involved extensive research on how to maximise the utility of and equitable access to vaccines in order to promote the availability of immunisations for people worldwide.

To operationalise the cross-cutting themes within the ecosystem, working with experts in the Initiative's Advisory Council, five key pillars of the vaccine ecosystem were identified: research and development (R&D); manufacturing; procurement, pricing and finance; distribution, logistics and supply chain management; and user acceptance and uptake. The pillars represent the key stages in the life cycle of a vaccine, from surveillance and research to administration to individual people. Although each pillar has been examined individually, they are not 'silos'— any progress or failure in just one of them has an impact on the others. For example, information gaps in the R&D process can lead to the spread of unintended (or deliberate) misinformation that influences public uptake of a vaccine.

Great efforts have been taken to break down the critical aspects of the entire system into more easily understood elements by applying recently lived-experience of the covid-19 pandemic. This was the entry point to wider discussions of all aspects of the vaccine ecosystem, and it allowed exploration of the potential for both radical and incremental changes capable of improving global preparedness within health systems and across societies. The work has always centred on systemic readiness rather than covid-19 response.



Figure A1. Framing The Vaccine Ecosystem: five pillars support a successful vaccine ecosystem



The following paragraphs describe what the five pillars entail. They are further defined in the Framework Report *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*.¹



Pillar 1: Research and development (R&D)

R&D incorporates the vaccine research process from the earliest stages of laboratory research through to Phase III (human) clinical trials. It covers the regulatory oversight necessary for supporting vaccine development and innovations that can improve the characteristics of existing vaccines. It also addresses the type of R&D needed for supporting the delivery of vaccine services, including disease surveillance and monitoring, as well as the enabling policies, infrastructure, investments and partnerships that can promote success.²



Pillar 2: Manufacturing

The second pillar relates to the factors involved in manufacturing vaccines and ancillary equipment in a timely fashion, together with regulatory oversight and the use of good manufacturing practices at a scale necessary to meet demand. It covers the infrastructure, human resources and conditions required to manufacture vaccines and the strict quality-control standards that must be met to ensure production of safe and effective vaccines.³



Pillar 3: Procurement, pricing and finance

This pillar focuses on the policies, mechanisms and partnerships involved in the purchasing and pricing of vaccines, as well as the financing of both vaccine R&D and the implementation of immunisation programmes. It deals with procurement, pricing and finance systems that promote quicker and more equitable access to vaccines globally, not only by supporting the development and production of vaccines, but also by meeting global immunisation needs.⁴



Pillar 4: Distribution, logistics and supply chain management

The fourth pillar covers the mechanisms that enable safe distribution of vaccines from manufacturing facilities to the sites where the vaccinations are administered. It encompasses the logistics, infrastructure and systems required to distribute vaccines both within and between countries, and recognises that consistently strong and resilient distribution networks, logistics capabilities and global supply chain management are needed to ensure equitable and rapid worldwide protection of populations against vaccine-preventable diseases.⁵



Pillar 5: User acceptance and uptake

The fifth pillar covers the factors that encourage individuals to choose to be vaccinated and the factors that enable them to get vaccinated easily. It includes health literacy, education and awareness, and the ways in which improvements can be made at each point to improve public trust in vaccines. It examines vaccination programmes and the services that aim to combat these challenges, as well as the reasons for delays in vaccine uptake.⁶

Creating the Immunisation Readiness Index

Having defined the components of The Vaccine Ecosystem, the Immunisation Readiness Index analyses the policies and systems within a country that have been established to address public health threats that are amenable to prevention or treatment through immunisation. It explores the enabling environment for equitable and sustainable immunisation across a total of thirty countries by collecting information across six domains, consisting of a total of fifty indicators. In this way, the Index enables us to understand system-wide readiness within individual countries for dealing with disease threats and highlights the need to address disparities urgently.

The development of the Index was driven by the creation of a theoretical framework, informed by The Vaccine Ecosystem Initiative report *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*.¹ This described the concept for the entire Initiative. While the five pillars of the Initiative encompass aspects of the *global* vaccine ecosystem, the first five of the six domains of the Index capture the *country-specific* policy levers and mechanisms that can be used to develop, implement and maintain immunisation strategies to achieve immunisation readiness. These five domains were distilled from the five pillars to include only the components necessary for an individual country to achieve immunisation readiness (see example below). Thus, the domains of the Index are distinct from the pillars of the overarching Initiative, but they are intentionally aligned.

Manufacturing (Pillar 2) of The Vaccine Ecosystem Initiative and Regulation (Domain 2) of the Immunisation Readiness Index

Manufacturing relates to the factors involved in manufacturing vaccines and ancillary equipment in a timely fashion, together with regulatory oversight and the use of good manufacturing practices at a scale necessary to meet demand. Country-level immunisation strategies often rely on regional or international manufacturing processes to create the vaccines and related supplies required to carry out national immunisation efforts. However, it is not necessary for an individual country to build and maintain its own manufacturing facilities. Thus, Domain 2 of the Index focuses on the ability to regulate the manufacture of vaccines and engage with manufacturers; it does not assess a country's capacity or ability to manufacture vaccines domestically.

Appendix B: Methodology

The following details the methods used to develop and construct the composite scores of the Immunisation Readiness Index (including domains, sub-domains and indicators). We invite suggestions and observations related to the project's methodology (contact the Economist Impact team at vaccineecosystem@economist.com). Although this is the first iteration of the Index, we hope that future versions will expand the countries studied: thus any feedback can be used to make adjustments as necessary. The specific stages of the Index research programme were as follows:

Literature review: a pragmatic review to identify conceptual indicators with a sound intellectual basis for assessing the immunisation readiness of individual countries

Expert engagement: the selection of appropriate experts for a roundtable discussion on project scope and methods and preliminary findings from the literature

Framework creation: the creation of an initial framework for the Index, involving the definition of specific indicators and the selection of countries

Data collection: the identification of key sources of information, generating and reviewing justifications for qualitative measures, and gathering relevant data to develop the Index and support the analysis

Country outreach: confirmation of findings with the health ministries (or comparable agencies) of every Index country to validate the research findings

Index construction and analysis: building the Index, conducting further analysis and presenting the findings via an interactive Data Dashboard, a white paper and visualisation for The Vaccine Ecosystem website.

Literature review

The literature review informed the overarching work of The Vaccine Ecosystem Initiative and the Immunisation Readiness Index. Its findings, and the methods described below, can be found in our Framework Report, entitled *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*.¹

The original research questions were:

- How did the vaccine ecosystem facilitate such rapid development of vaccines against covid-19?
- What unexpected obstacles were there to the rapid development of these vaccines?
- What gaps in the vaccine ecosystem hinder more equitable vaccination efforts across the world?
- Which approaches within the vaccine ecosystem are successful and might be adapted for long-term use to help maintain its structural integrity?
- Which foundations within the vaccine ecosystem require improvement?

A multi-pronged approach was adopted with a focus on indexed databases such as Medline and EMBASE, as well as the grey literature, and supplemental searching of Google Scholar, Scopus and other resources. The websites of key organisations were searched for relevant media releases, including government, regulatory and industry agencies such as WHO, ECDC, CDC, Gavi (the Vaccine Alliance), CEPI and the Bill and Melinda Gates Foundation.

Given the wide variety of search terms – and databases – there was no central search taxonomy; thus a structured triangulation approach was applied across a set list of search terms. The search was conducted and filtered down by three individual researchers to make sure the most accurate and up-to-date information was captured. Furthermore, in-depth discussions with experts in diverse areas were held to supplement and validate the findings of the literature review.

The search produced over 600 relevant results, of which 170 sources included in the report. Not all of them were cited in the Framework Report,¹ but they were all reviewed extensively in the creation of the evidence review and were useful as the research progressed.

Limitations and mitigations

The objective of this research was to obtain an overview of the key aspects of the covid-19 pandemic response from the point it began, as well as the key components of the entire vaccine ecosystem. The Framework Report¹ was largely compiled in the first nine months of 2021, amid the rapidly evolving situation and the urgent development and rollout of many different vaccines throughout the world. Great efforts were made to ensure the timely nature of the research used to inform this work and keep abreast of developments, which was challenging because new information and evidence were emerging constantly.

The original research questions, as outlined above, were not suitable for conducting a rigid systematic literature review, which meant that some relevant literature may not have been identified. To mitigate this problem, the search was supplemented by seeking expert opinion. Furthermore, there was a lack of relevant systematic reviews on the subject, which may have provided more certainty on some issues and been a useful ‘sense check’, although this was not surprising given the broad field and the rapidly changing situation.

Expert engagement

Since its inception, a variety of experts have been involved in the Index, which has always sought to engage key opinion leaders, to facilitate dialogue with policymakers and health professionals and provide actionable insights that stakeholders can use globally to improve immunisation strategies. The Advisory Council first convened in March 2021 and was instrumental in guiding the development of both the Initiative and the Index. For the Index, we engaged seven subject-matter experts to participate in a roundtable in September 2021. Their contributions related to the scope, framework and findings of the Index. They also reviewed the choice of indicators and data sources and provided input on the construction of the Index. Follow-up meetings were conducted at critical project milestones in July 2022 and April 2023.

Framework creation

The development of the Index was driven by the creation of a theoretical framework, as informed by The Vaccine Ecosystem Initiative report *Towards a stronger Vaccine Ecosystem: Building resilience beyond covid-19*,¹ which underpinned the concept of the research programme, with indicators that demonstrate the policies governments can use to develop, implement and maintain immunisation strategies to improve readiness. The top level framework includes six core domains (Planning, Regulation, Procurement, Delivery, Outreach, Society); the resulting framework combines fifteen sub-domains, broken down into fifty indicators of which thirteen were quantitative and thirty-seven were qualitative) (see Table B1).

Table B1. Domains and sub-domains of the Immunisation Readiness Index

Domain 1 Planning	Domain 2 Regulation	Domain 3 Procurement	Domain 4 Delivery	Domain 5 Outreach	Domain 6 Society
Strategy and planning	Regulatory approval and standards	Procurement mechanisms	Health system infrastructure	Education programmes	Access to education
Coordination and engagement	Engagement	Financing	Access to healthcare	Public outreach	Communications infrastructure
Monitoring and evaluation			Distribution systems		Quality of governance

Domains 1–4 include indicators relating to policies and processes relevant to the development of a national approach to getting vaccinations to the population. These domains reflect a chronological process, from developing an immunisation strategy and approving new vaccines, to ensuring the vaccines can be delivered under the correct temperature-controlled environment and be administered by a qualified health professional.

Domain 5 includes concepts relevant to building the public’s trust in vaccines and reaching all members of the population through outreach activities. Because these activities take place throughout the process of national vaccine preparation, outreach is regarded as a component of the entire vaccine ecosystem, occurring simultaneously with Domains 1–4, and facilitating the specific actions that comprise these domains.

Domain 6 represents the governance and societal context, providing contextualisation to our overall findings. It enables us to develop insights that increase understanding of the unique conditions in different countries and how they contribute to overall readiness. Because the indicators in Domain 6 provide necessary context but are not necessarily indicative of a country’s level of readiness, this report focuses primarily on findings from Domains 1–5.

Country selection

Economist Impact selected the following thirty countries, which represent 76% of the global population:

- *East Asia and Pacific*—China, Indonesia, Japan, Philippines, South Korea, Thailand, Vietnam
- *Europe and Central Asia*—France, Germany, Poland, Russia, Spain, Turkey, United Kingdom
- *Americas*—Brazil, Colombia, Guatemala, Mexico, United States
- *Middle East and North Africa*—Egypt, Iran
- *South Asia*—Bangladesh, India, Pakistan
- *Sub-Saharan Africa*—Ethiopia, Kenya, Nigeria, Senegal, South Africa, Tanzania.



Data collection

A total of thirty-seven qualitative indicators were designed for this study to analyse factors for which no across-country data were readily available. These indicators were scored according to detailed criteria, carried out by researchers with expertise in the individual countries, including in-depth justification and relevant references. The data collected during the process are available in an interactive Data Dashboard, and you will find more on the indicators and the raw scoring scheme and ranges in Appendix C.

Quantitative indicators

The quantitative indicators leverage existing metrics from reputable third-party databases such as those of WHO, the World Bank and OECD, as well as academic studies, national statistical agencies and proprietary databases of The Economist Group.

Qualitative indicators

The qualitative factors relate to different aspects of each country's vaccine ecosystem. The indicators were scored according to publicly available data, and were mostly binary, whereby 'Yes' responses scored 1 and 'No' responses scored 0. This approach minimised subjectivity in the scoring, and makes it easier to make comparisons between countries. A tiered scale was used for indicators requiring more nuanced responses (Table B2).

Table B2. Types of qualitative scoring used for the Index

Type of qualitative scoring	Example questions
Binary scoring (0–1)	Is there a national immunisation strategy or plan? 1 = Yes 0 = No
Tiered scoring (0–2)	Is there a national immunisation technical advisory group (NITAG), and does it satisfy all six WHO criteria (information about which is publicly available)? 2 = Yes 1 = Yes (but the NITAG does not satisfy all six WHO criteria) 0 = No

Background indicators

Additionally, data were collected for a set of background indicators to permit correlation analysis. They are included in the interactive Data Dashboard, but were not incorporated into the Index scores. They include national vaccination rates for many of the vaccines mentioned in the Index, the prevalence of vaccine-preventable diseases and other related health-outcome indicators.

Taking covid-19 into account

The Index is intended to provide a tool to aid understanding on the extent to which national immunisation policies, systems and practices are able to leverage the potential of vaccines to prevent and/or treat diseases now and in the future. As such, any measure of immunisation readiness would be incomplete without proper consideration of the challenges faced by individual countries in their response to the spread of covid-19 infections. When scoring the indicators, great care was taken to account for covid-specific actions by:

- We studied how each country implemented long-lasting policies or practices because of, or during, the covid-19 pandemic. Points were allotted to countries for indicators where there was evidence that the policy or practice would continue beyond covid-19.
- We considered policies or practices that were implemented only in direct response to the covid-19 pandemic but without evidence of consideration of future vaccination needs. For indicators where there was insufficient evidence that the policy or practice would continue, or could be harnessed in the future, countries were not given points. We recognise that some countries demonstrated an ability to mobilise resources to respond to covid-19 without having pre-existing mechanisms in place to do so. For this reason, information about covid-specific policies and practices has been included in our Data Dashboard.

Example: Emergency financing in Iran

We examined whether individual countries have a dedicated emergency financing mechanism or fund that can be accessed in the face of a public health emergency to procure vaccines (Indicator 3.2.2). For example, Iran was able to allocate funds to purchase covid-19 vaccines, but there was insufficient evidence to indicate the presence of a dedicated fund or funding mechanism that can be used in the event of an emergency to purchase vaccines. As a result, Iran scores 0 out of 100 possible points for this indicator. More information about the funding used for Iran’s covid-19 vaccine procurement is available under the Notes for Iran for Indicator 3.2.2 in the Data Dashboard.

Calibration

Individual indicator scores were calibrated during an iterative process that allowed us to identify and correct data anomalies.

Country outreach

The Index is intended to be a rigorous collaborative tool to aid understanding of individual country readiness to achieve equitable and sustainable immunisation. To ensure that it reflects the most up-to-date information, the research team invited stakeholders from all thirty countries to participate in a feedback process and review the data ahead of publication. This included the sharing of calibrated country data and an explanation of the scoring scheme with their ministries of health (or an equivalent group). However, only two countries responded with feedback comments. We evaluated this and incorporated the information as appropriate.

Index construction and analysis

The Index incorporates composite scores, created by normalising, weighting and combining all indicators for each country by domain. A total of 50 individual indicators are weighted, reflecting their level of importance relative to other indicators. Sub-domains have been included as components of overall domains, to organise the indicators contained within each.

Normalisation of scores

All indicator scores have been presented on a normalised scale, from 0 to 100, where 100 represents the highest possible level of immunisation readiness and 0 the lowest. Normalisation allows raw data to be assessed on a common scale, allowing data points to be easily compared and aggregated. The method is simple and does not require a large sample size. Most importantly, it allows comparisons of the relative performance measures of diverse countries at both ends of the vaccine-capability spectrum. The normalisation methods were:

For qualitative datasets where countries are scored on a stepped scale, scores are normalised between the minimum and maximum possible values for each indicator.

Example

For Indicator 1.1.1, Existence of a national immunisation strategy/plan, countries were scored using a qualitative rating of zero (no strategy exists) to one (a strategy exists). On the normalised scale, countries with evidence of a national immunisation strategy receive a score of 100 and countries with no evidence of a strategy receive a zero for this indicator.

For pre-existing quantitative datasets presenting discrete, linear values, scores were normalised between the minimum and maximum values possible.

Example

For Indicator 4.2.1, Universal Health Coverage (UHC) Service Coverage Index, which provides a composite score (0-100) sourced from WHO, the minimum score (39%) is equal to 39 on the normalised scale and the maximum score (87%) is equal to 87.

For pre-existing quantitative datasets with continuous data values, scores were normalised between the minimum and maximum values for countries included in the Index. We used Tukey’s method to adjust for any outliers (information about specific outliers for each dataset can be found in our interactive Data Dashboard). With this method, the highest-scoring country (or countries) score 100.

Example

For Indicator 3.2.3, Current Health Expenditure (CHE), the minimum score (US\$ 26.7) is equal to zero on the normalised scale and the maximum score (US\$ 6,143.1) is equal to 100.

Weighting

Following normalisation, scores were compiled to create performance levels, in which:

- Sub-domain scores = weighted sum of individual indicator scores
- Domain scores = weighted sum of sub-domain scores
- Overall scores = weighted sum of domain scores

The weightings assigned to individual indicators and domains typically reflect different assumptions about their relative importance. Through consultation with the Expert Panel, it was determined that the default would be neutral weighting, which implies they are of equal importance (Table B3).

Table B3. Domain and sub-domain weighting profile

Level	Weight (%)
Domain 1: Planning	16.7%
1.1 Strategy and planning	33.3%
1.2 Coordination and engagement	33.3%
1.3 Monitoring and evaluation	33.3%
Domain 2: Regulation	16.7%
2.1 Regulatory approval and standards	50%
2.2 Engagement	50%

Domain 3: Procurement	16.7%
3.1 Procurement mechanisms	50%
3.2 Financing	50%
Domain 4: Delivery	16.7%
4.1 Health system infrastructure	33.3%
4.2 Health workforce capacity	33.3%
4.3 Distribution systems	33.3%
Domain 5: Outreach	16.7%
5.1 Education programmes	50%
5.2 Public outreach	50%
Domain 6: Society	16.7%
6.1 Access to education	33.3%
6.2 Communications infrastructure	33.3%
6.3 Quality of governance	33.3%

Limitations of the Index

This type of index has limitations, thus it should be used only as a tool for improving understanding about individual countries' vaccination capacities and their enabling environments for achieving equitable and sustainable immunisation of their populations – it is not intended to be predictive of immunisation outcomes. A variety of political, social and economic variables impact all countries' abilities to translate readiness into outcomes, and while great care has been taken to incorporate as many of these factors as possible, the indicators used in the Index are not necessarily the only relevant measures.

Appendix C: The Index framework

The Immunisation Readiness Index includes 50 indicators: 37 qualitative indicators created for this research and 13 quantitative indicators from existing sources.

Table C1. All indicators used in individual domains of the Immunisation Readiness Index

Indicator number	Indicator questions/ descriptions	Scoring scheme	Unit	Source
Domain 1: Planning				
1.1 Strategy and planning				
1.1.1	National immunisation strategy/plan			
1.1.1a	Existence of national immunisation strategy/plan	Does the country have a national immunisation strategy or plan?	0 = No 1 = Yes	0–1 Economist Impact country research
1.1.1b	National immunisation strategy/plan: vaccine coverage targets	Does the country's national immunisation strategy/plan have target rates for vaccine coverage across the life course?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes (but only one target group is included) 2 = Yes (and it includes multiple target immunisation rates across the life course)	0–1–2 Economist Impact country research
1.1.1c	National immunisation strategy/plan: evidence-based rollout strategy	Does the country's national immunisation strategy/plan have evidence-based guidelines specifying which groups should be vaccinated and when?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes	0–1 Economist Impact country research
1.1.1d	National immunisation strategy/plan: inclusiveness	Does the country's national immunisation strategy/plan have evidence of consideration of socioeconomic inequalities, geography, cultural/linguistic differences and/or gender barriers?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes	0–1 Economist Impact country research

1.1.1e	National immunisation strategy/plan: vaccine equity	Does the country's national immunisation strategy/plan have vaccine equity as a stated priority?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes	0–1	Economist Impact country research
1.1.1f	National immunisation strategy/plan: dedicated budget	Does the country's national immunisation strategy/plan identify a dedicated budget for immunisation programmes?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes	0–1	Economist Impact country research
1.1.1g	National immunisation strategy/plan: contingency plans	Does the country's national immunisation strategy/plan have contingency plan(s) for public health emergencies?	0 = No (or there is no national immunisation strategy/plan) 1 = Yes (there is a contingency plan for public health emergencies, but it is not included in the national immunisation strategy/plan or its supporting documents) 2 = Yes	0–1–2	Economist Impact country research
1.2 Coordination and engagement					
1.2.1	National task force	Does the country have a national task force (or similar) to oversee vaccine programme rollouts?	0 = No 1 = Yes	0–1	Economist Impact country research
1.2.2	National immunisation technical advisory group (NITAG)	Does the country have a National Immunisation Technical Advisory Group (NITAG)?	0 = No 1 = Yes (but it does not satisfy all six WHO criteria) 2 = Yes	0–1–2	Economist Impact country research
1.2.3	Health sector coordination	Is there evidence of coordination mechanisms/partnerships for health sector stakeholders to participate in planning, implementation and monitoring of immunisation programmes?	0 = No 1 = Yes	0–1	Economist Impact country research

1.3 Monitoring and evaluation					
1.3.1	Surveillance of vaccine-preventable diseases	Does the country have a surveillance system for vaccine-preventable diseases that includes the ability to detect outbreaks and new pathogens?	0 = No 1 = Yes (but there is insufficient evidence of a system that can detect outbreaks and new pathogens) 2 = Yes	0–1–2	Economist Impact country research
1.3.2	Health management committee	Does the country have a health management committee (or equivalent) to review immunisation performance?	0 = No 1 = Yes	0–1	Economist Impact country research
1.3.3	Pharmacovigilance	Does the country have a system to track, report and investigate vaccine-related adverse events in a timely and consistent manner?	0 = No 1 = Yes (but not in a timely or consistent manner) 2 = Yes	0–1–2	Economist Impact country research
1.3.4	Commitment to surveillance data-sharing	Has the country committed to share surveillance data on vaccine-preventable diseases with other countries?	0 = No 1 = Yes	0–1	Economist Impact country research

Domain 2: Regulation

2.1 Regulatory approval and standards

2.1.1 Regulatory approval mechanisms					
2.1.1a	Regulatory approval mechanism for new vaccines for humans	Is there a government agency responsible for approving new vaccines for humans, or a legal mechanism for adopting regulatory decisions from other countries or WHO for the use of new vaccines?	0 = No 1 = Yes	0–1	Economist Impact country research
2.1.1b	Expedited approval process for public health emergencies	Is there an expedited process for approving vaccines for human use during public health emergencies?	0 = No 1 = Yes	0–1	Economist Impact country research
2.1.2	Oversight of vaccine manufacturing standards	Is there an agency that provides oversight of manufacturing standards for vaccines used within the country?	0 = No 1 = Yes	0–1	Economist Impact country research

2.2 Engagement					
2.2.1	Regional or international data-sharing related to vaccine-approval process	Is there evidence of an agreement to participate in regional or international data-sharing related to the vaccine-approval process?	0 = No 1 = Yes	0-1	Economist Impact country research
2.2.2	Engagement with vaccine R&D companies and/or manufacturers	Is there evidence that the relevant regulatory agency that engages with vaccine R&D companies and/or manufacturers?	0 = No 1 = Yes	0-1	Economist Impact country research
Domain 3: Procurement					
3.1 Procurement mechanisms					
3.1.1	Demand forecasts for national vaccine requirements	Is there an annual demand forecast for national vaccine requirements that includes long-term forecasts extending 5 years or more?	0 = No 1 = Yes (but it does not include long-term forecasts extending 5 years or more) 2 = Yes	0-1-2	Economist Impact country research
3.1.2	Procurement strategy that considers factors other than price	Does the national procurement strategy consider factors other than price in its decision-making?	0 = No 1 = Yes	0-1	Economist Impact country research
3.2 Financing					
3.2.1	Sufficient budget for procurement and delivery	Is there a sufficient annual budget for procuring and delivering the vaccines recommended in the national strategy?	0 = No 1 = Yes	0-1	Economist Impact country research
3.2.2	Dedicated emergency vaccine financing mechanism	Is there a dedicated emergency financing mechanism or fund that the country can access to procure vaccines during public health emergencies?	0 = No 1 = Yes	0-1	Economist Impact country research
3.2.3	Current Health Expenditure (CHE) per capita	What is the current health expenditure per capita?	Quantitative indicator using existing dataset	US\$	World Bank

Domain 4: Delivery					
4.1 Health system infrastructure					
4.1.1 Delivery infrastructure for vaccines					
4.1.1a	National immunisation infrastructure integration	Is the national immunisation infrastructure integrated into primary healthcare and/or public health services?	0 = No 1 = Yes	0–1	Economist Impact country research
4.1.1b	Non-traditional vaccine delivery strategies	Is there evidence that non-traditional delivery strategies are used to deliver vaccines?	0 = No 1 = Yes	0–1	Economist Impact country research
4.1.2	Digital vaccination records (integrated with national health information system)	Are there interoperable digital vaccination records, and are they integrated with a national health information system?	0 = No 1 = Yes (but they are not integrated or interoperable) 2 = Yes	0–1–2	Economist Impact country research
4.1.3	Vaccine inventory management	Is there a national management system for monitoring vaccine stocks?	0 = No 1 = Yes	0–1	Economist Impact country research
4.2 Access to healthcare					
4.2.1	Universal Health Coverage (UHC) Service Coverage Index	What is the average coverage of essential health services? (Universal health coverage is an index based on indicators that measure reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged populations.)	Quantitative indicator using existing dataset	%	WHO: UHC Service Coverage Index
4.2.2 Healthcare workforce					
4.2.2a	General practitioners (GPs)	What is the reported number of GPs?	Quantitative indicator using existing dataset	Per 1,000 population	World Bank
4.2.2b	Pharmacists	What is the reported number of pharmacists?	Quantitative indicator using existing dataset	Per 10,000 population	WHO

4.2.2c	Nurses and midwives	What is the reported number of nurses and midwives?	Quantitative indicator using existing dataset	Per 1,000 population	WHO
4.2.3 Health workforce capacity					
4.2.3a	Data on health worker competency in immunisation	Is data collected and published on the number of health staff that are competent in immunisation?	0 = No 1 = Yes	0–1	Economist Impact country research
4.2.3b	National health worker training programme for immunisation	Is there a national health worker training programme for immunisation?	0 = No 1 = Yes	0–1	Economist Impact country research
4.2.3c	Emergency workforce strategy for public health emergencies	Is there a strategy for deploying human resources for vaccination during public health emergencies?	0 = No 1 = Yes	0–1	Economist Impact country research
4.3 Distribution systems					
4.3.1	Vaccine delivery and storage infrastructure (cold chain)	Is there evidence of sufficient vaccine delivery (the ability to meet and maintain temperatures required to transport and store vaccines) in more than 80% of counties/districts in the country?	0 = No 1 = Yes	0–1	Economist Impact country research
4.3.2	Culturally appropriate distribution practices	Is there a system for reaching marginalised and hard-to-reach populations using culturally appropriate practices, with evidence that the country recognises that training and planning are necessary to reach targeted communities?	0 = No 1 = Yes (there is a plan to reach specific marginalised communities, but it does not specify that training and planning are necessary to accomplish this goal) 2 = Yes	0–1–2	Economist Impact country research
4.3.3	Delivery system testing	Is vaccine delivery tested via a nationwide campaign or functional exercise?	0 = No 1 = Yes	0–1	Economist Impact country research

Domain 5: Outreach					
5.1 Education programmes					
5.1.1	Public education programme on immunisation	Is there a funded public education programme on immunisation for improving health literacy, including digital health literacy?	0 = No 1 = Yes (but it does not include digital health literacy) 2 = Yes	0–1–2	Economist Impact country research
5.2 Public outreach					
5.2.1.	Risk-communications strategy	Is there a risk-communication strategy for vaccine-preventable diseases?	0 = No 1 = Yes	0–1	Economist Impact country research
5.2.2	Communication strategies to overcome barriers to vaccination	Does the national immunisation strategy/plan include communication strategies specifically aimed at overcoming socioeconomic inequalities, geography, cultural/linguistic differences and/or gender barriers to vaccination?	0 = No 1 = Yes	0–1	Economist Impact country research
5.2.3	Research into public attitudes towards vaccines	Has the country conducted a survey of the population to gauge attitudes towards vaccines or vaccination in the past 5 years (2018–2022)?	0 = No 1 = Yes	0–1	Economist Impact country research
Domain 6: Society					
6.1 Access to education					
6.1.1	Adult literacy rate	What percentage of the percentage of people aged 15 and above can both read and write in their everyday life?	Quantitative indicator using existing dataset	% of population >15 years	UNESCO Institute for Statistics
6.1.2	Mean duration of schooling	What is the average number of completed years of education for those aged 25 years and above?	Quantitative indicator using existing dataset	Years	World Bank
6.1.3	Primary school attendance rate	What percentage of eligible students are enrolled in a primary school programme?	Quantitative indicator using existing dataset	% of population	World Bank

6.2 Communications infrastructure					
6.2.1	Households with Internet	What percentage of households reported access to the internet?	Quantitative indicator using existing dataset	% of households	International Telecommunication Union
6.2.2	Mobile cell-phone use	What is the total number of mobile cell-phone subscriptions?	Quantitative indicator using existing dataset	Subscriptions per 100 inhabitants	International Telecommunication Union
6.3 Quality of governance					
6.3.1	Government effectiveness	What is the country's score on the Government Effectiveness Index? (The World Bank's World Governance Indicators define government effectiveness as "capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.")	Quantitative indicator using existing dataset	Standard deviations from mean (positive = above average)	World Bank, WGI
6.3.2	Corruption Perception Index	What is the country's score on the Corruption Perception Index? (The Corruption Perception Index measures the perceived level of public sector corruption.)	Quantitative indicator using existing dataset	0–100 (100 = lowest perceived level of corruption)	Transparency International
6.3.3	Political stability	What is the country's score on the Political Stability Index? (The Political Stability Index "measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.")	Quantitative indicator using existing dataset	Standard deviations from mean (positive = above average)	World Bank, WGI

Appendix D

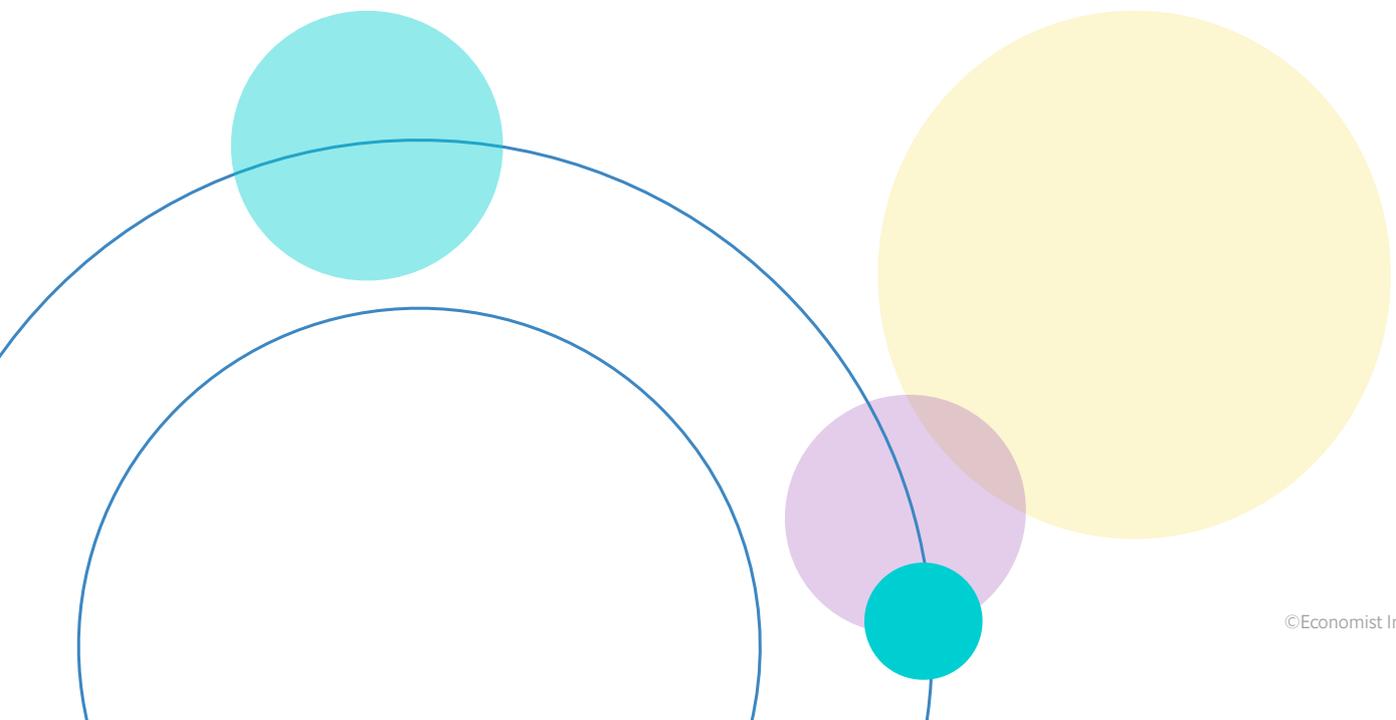
Case studies: selected countries over-performing relative to expectations

Some countries performed better than one expected based on their reported immunisation rates. The following three case studies provide more context with respect to country-specific performances, and draw attention to discrepancies between immunisation readiness and immunisation rates. Each case study includes a:

- a country profile illustrating the level of immunisation readiness
- population vaccination rates for:
 - covid-19¹⁸
 - the third dose of a diphtheria, tetanus and pertussis vaccine (DTP3)¹⁵
 - the final dose of a measles-containing vaccine (MCV2)¹⁵
- a rationale for the country's performance
- recommendations for improvements in immunisation readiness

It is our hope that highlighting areas in which countries do well (as well as those where improvements can be made) will enable policymakers and other stakeholders to focus their efforts on improving immunisation throughout their populations while creating an environment that is conducive to achieving immunisation goals.

For more information about any specific country policies and practices, or immunisation rates for the routine vaccines below, please see the interactive Data Dashboard.



Colombia

Figure D1. Immunisation Readiness in Colombia

Colombia's overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

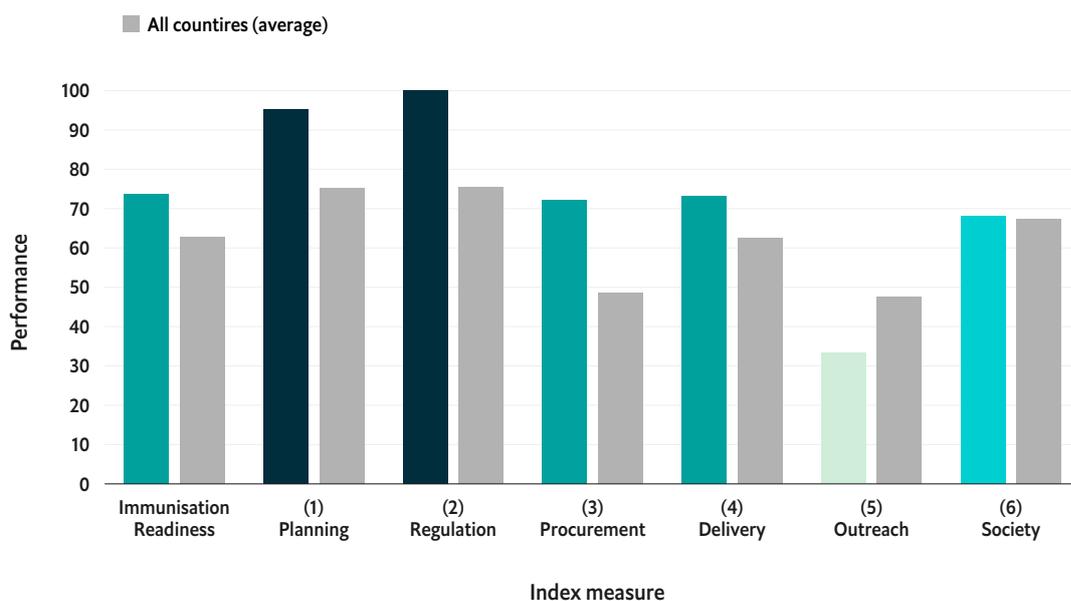


Table D1. Vaccination rates for vaccines against covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in Colombia, as included in the Data Dashboard

Type of vaccine	Vaccinated population
Covid-19 ¹⁸	71.4%
DTP3 ¹⁵	86.0%
MCV2 ¹⁵	86.0%

Rationale for performance

Despite reported vaccination rates that were below immunisation targets, Colombia performed well in the Planning and Regulation domains, which are essential for a robust immunisation programme. Colombia's Extended Programme on Immunisation has well-developed policy and regulatory structures, alongside several agencies and institutions that support efforts related to vaccination and vaccine-preventable diseases.⁴⁵ The agencies include Columbia's National Institute of Health, the National Food and Drug Surveillance Institute and the Agency for Integrated Management of Immuno-preventable Diseases. Most importantly, this interconnected web of institutions is properly backed by legislation, ensuring legal support for their respective activities.⁴⁶ Despite the opportunities for improvement described below, Colombia performed above the average observed across the thirty Index countries.

Building better Immunisation Readiness in Colombia

Colombia has much lower performance in the Outreach and Society domains than in the Planning and Regulation domains, with the potential for improvement in the Procurement and Delivery domains. The lower performance in Outreach relates to its public education programme, which lacks consistency and structure, and there are socioeconomic and demographic factors that may act as barriers to its immunisation efforts, including low performance on the Corruption Perception Index and Political Stability Index (in the Society domain). Similarly, research suggests that barriers to routine vaccination include factors relating to parents (e.g. a lack of time), adverse events concerns, and religious and cultural beliefs, and such a combination of factors may contribute to the below-target vaccination rates.

France

Figure D2. Immunisation Readiness in France

France’s overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

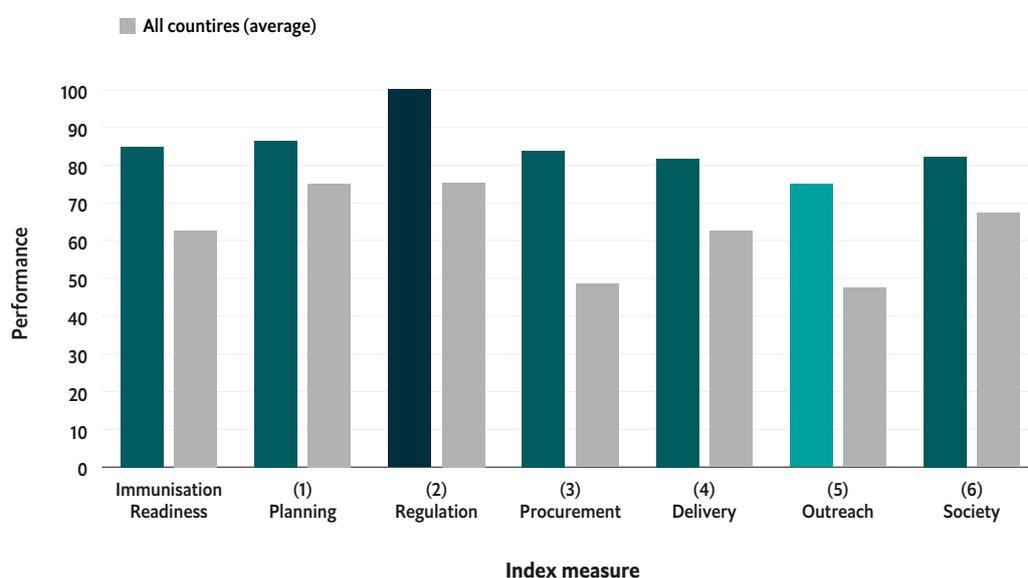


Table D2. Vaccination rates for covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in France, as included in the Data Dashboard

Type of vaccine	Vaccinated population
Covid-19 ¹⁸	78.4%
DTP3 ¹⁵	96.0%
MCV2 ¹⁵	86.0%

Rationale for performance

France had above-average performance in all domains, with its best performance in the Regulation domain. It has a robust immunisation programme covering nearly all analysed aspects within the Immunisation Readiness Index, including a dedicated budget, target rates for vaccination, and a significant focus on preventing diseases amenable to vaccination.⁴⁷ There is also a strong emergency mechanism that allows it to attain immunisation goals in public health emergencies,⁴⁸ consistent with reports from late 2021 detailing the success of the French Health Pass. It did little to decrease hesitancy for covid-19 vaccines,⁴⁹ but it successfully increased vaccine uptake, with the share of individuals receiving both doses of the initial regimen increasing from 49% in July 2021 to 89% in mid-December 2021.⁵⁰ This demonstrates France’s ability to harness the potential of vaccines in public health emergencies.

Building better Immunisation Readiness in France

In 2022, research began to show the shortcomings of the Health Pass programme, including a failure to address inequities related to vaccination as reported in the media.⁵¹ The delivery system in France also lacked distribution efficiency. There was no system for reaching marginalised populations and it does not appear that over 80% of the country’s districts have been reached. The country scores well in Regulation and the Finance area of Procurement, but there are opportunities to improve in the Planning and Delivery domains and the operationalisation and implementation of vaccination policy.

Indonesia

Figure D3. Immunisation Readiness in Indonesia

Indonesia’s overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

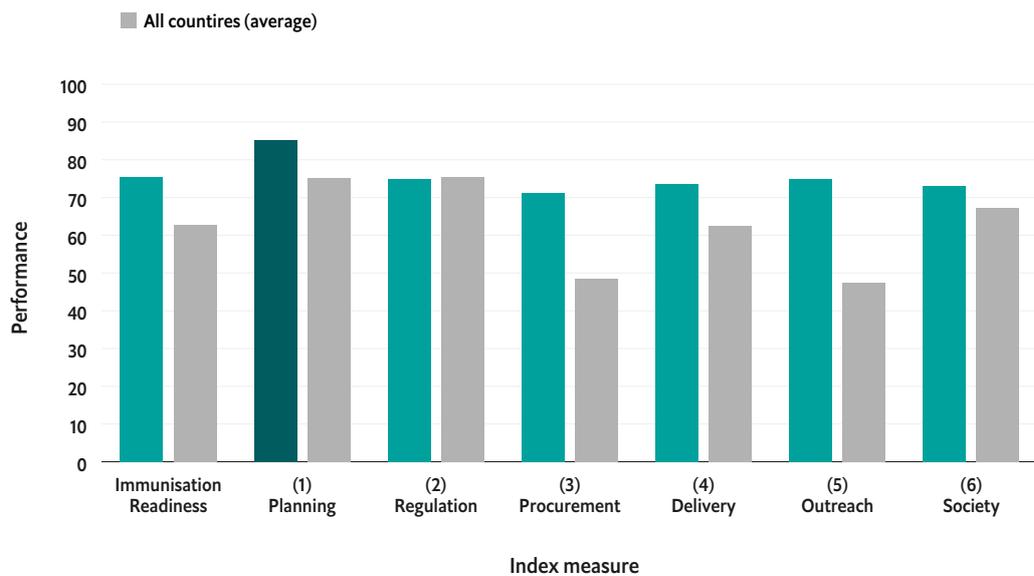


Table D3. Vaccination rates for covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in Indonesia, as included in the Data Dashboard

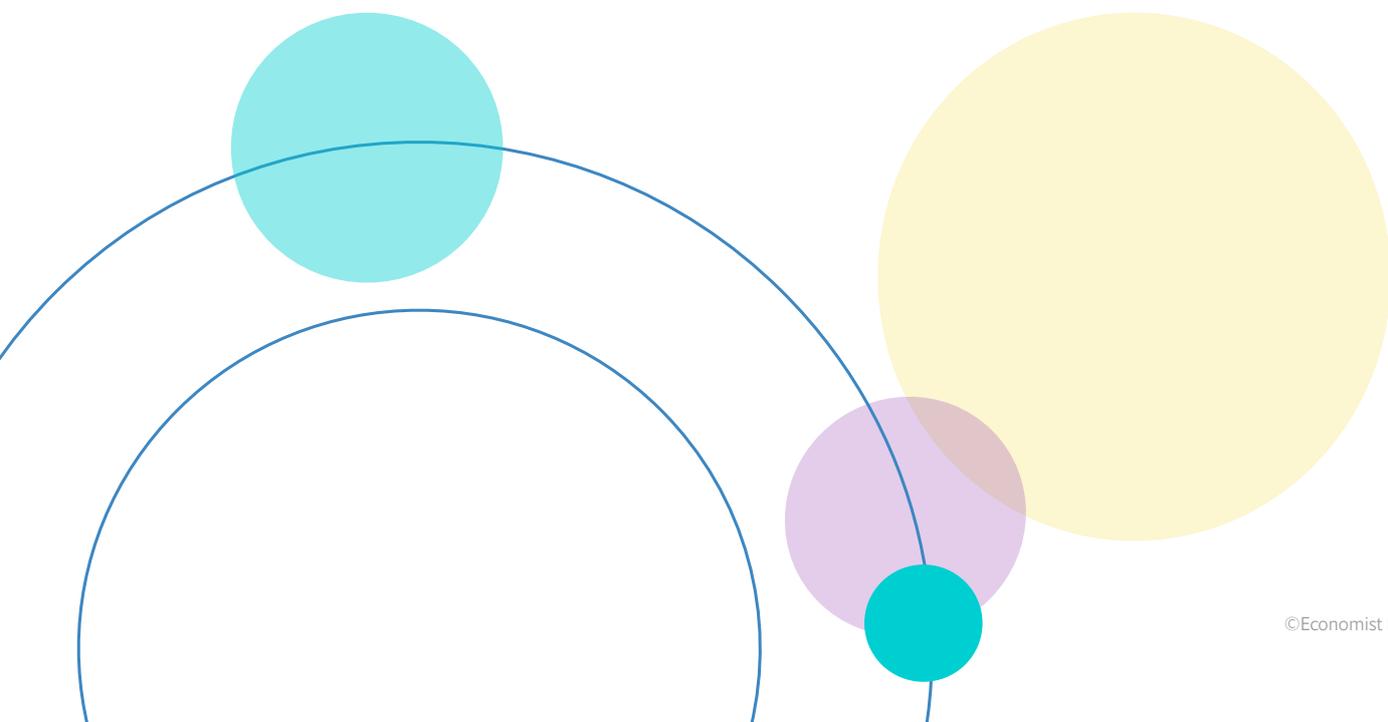
Type of vaccine	Vaccinated population
Covid-19 ¹⁸	62.7%
DTP3 ¹⁵	67.0%
MCV2 ¹⁵	50.0%

Rationale for performance

Indonesia performed above average for all domains except the Regulation domain, which was slightly below the all-country average. Its best performance was in the Planning domain, because its National Immunisation Plan satisfies most of indicators studied.⁵² The Ministry of Health coordination mechanisms with other public programmes and sectors, with a well-developed level of community empowerment that involves religious and community leaders in supporting vaccination, as assessed in its Joint External Evaluation.⁵³

Building better Immunisation Readiness in Indonesia

During the last decade, Indonesia has been committed to building immunisation readiness, including the establishment of the National Immunisation Technical Advisory Group (NITAG) and immunisation performance reviews.⁵³ However, there was a time lag between the establishment of groups and programmes focused on the immunisation infrastructure and the increased rates of immunisation of the population. Vaccination coverage rates increase each year, but remain below the WHO immunisation targets,⁵³ due to inequality in access due to socioeconomic and demographic factors. Its lowest performance was in the Society domain, which covers socioeconomic factors.



Appendix E

Case studies: selected countries under-performing relative to expectations

Some countries did not perform as well as expected based on their reported immunisation rates. The following three case studies provide more context related to country-specific performance, and draw attention to discrepancies between immunisation readiness and immunisation rates. Each case study includes:

- a country profile illustrating the level of immunisation readiness
- population vaccination rates for:
 - covid-19¹⁸
 - the third dose of a diphtheria, tetanus and pertussis vaccine (DTP3)¹⁵
 - the final dose of a measles-containing vaccine (MCV2)¹⁵
- a rationale for the country's performance
- recommendations for improvements in immunisation readiness

It is our hope that highlighting areas in which countries do well (as well as those where improvements can be made) will enable policymakers and other stakeholders to focus their efforts on improving immunisation throughout their populations while creating an environment that is conducive to achieving immunisation goals.

For more information about any specific country policies and practices, or immunisation rates for the routine vaccines below, please see the interactive Data Dashboard.

Japan

Figure E1. Immunisation Readiness in Japan

Japan’s overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

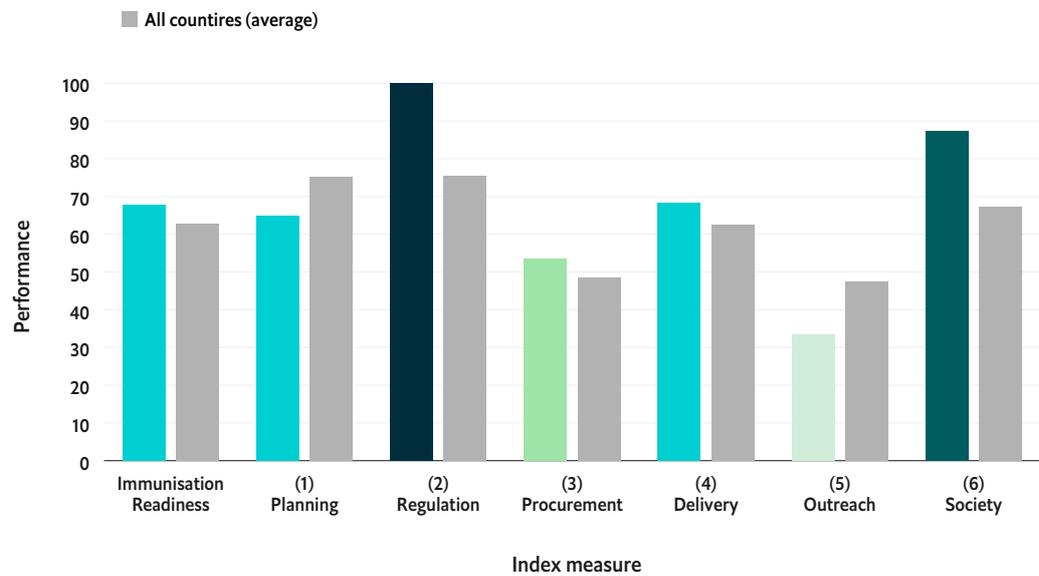


Table E1. Vaccination rates for covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in Japan, as included in the Data Dashboard

Type of vaccine	Vaccinated population
Covid-19 ¹⁸	83.4%
DTP3 ¹⁵	96.0%
MCV2 ¹⁵	95.0%

Rationale for performance

Japan performed well in the Regulation and Society domains, indicating that its approach is conducive to supporting immunisation efforts and achieving immunisation goals. There is a contingency plan for public health emergencies, and there are evidence-based guidelines that state which groups should be vaccinated and when.⁵⁴ Furthermore, performance was above average in the Procurement and Delivery domains. The healthcare workforce is capable of vaccinating the population⁵⁵ and the country scores high on the Universal Health Coverage Index.⁵⁶

Building better Immunisation Readiness in Japan

While its immunisation rates exceed immunisation targets, Japan’s performance in the Planning domain indicates that more can be done to ensure that its policies are structured to promote the sustainability of immunisation success in the long term. The immunisation strategy does not include a dedicated budget, or target rates for vaccination, or a focus on equity. There are opportunities to improve the national immunisation strategy by updating it to include these important factors. Performance in the Outreach domain can also be enhanced by developing educational programmes that support the use of vaccination to combat vaccine-preventable diseases and promote knowledge and uptake across the population.

Senegal

Figure E2. Immunisation Readiness in Senegal

Senegal’s overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

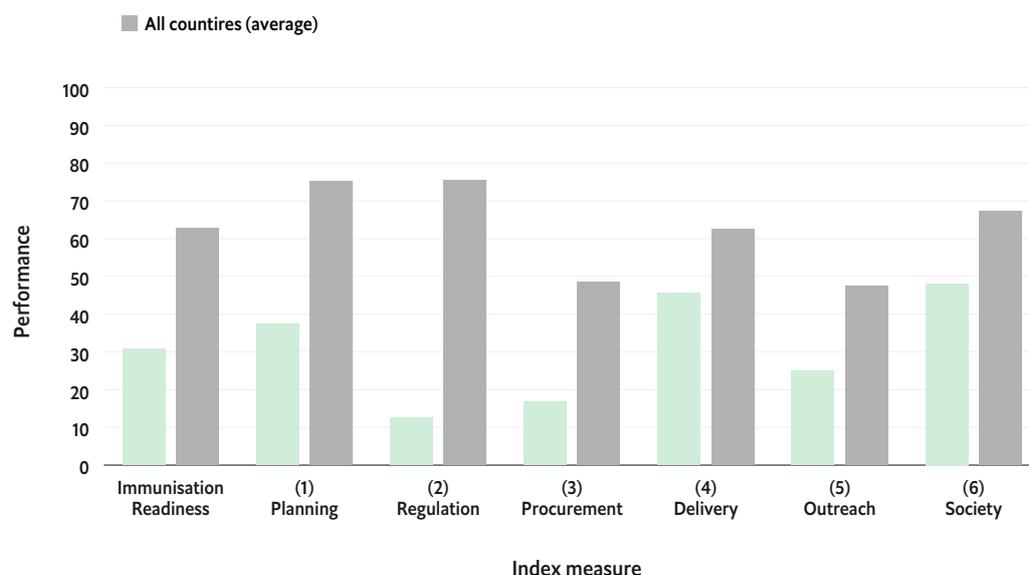


Table E2. Vaccination rates for covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in Senegal, as included in the Data Dashboard

Type of vaccine	Vaccinated population
Covid-19 ¹⁸	8.3%
DTP3 ¹⁵	85.0%
MCV2 ¹⁵	75.0%

Rationale for performance

Senegal has been regarded as a leader in developing immunisation programmes⁵⁷ due to its successes in vaccinating the public and reducing mortality rates among children under 5 years of age. However, these successes were not reflected within national policy; examination of its existing policies revealed below-average performance across all domains. Key pieces of national immunisation policies and strategies are missing, that are known to be essential for achieving equitable and sustainable immunisation programmes.⁵⁸ Despite having many opportunities for improvement, Senegal demonstrates an ability to provide population-wide vaccination that improves health outcomes and indicates its commitment to providing access to immunisations. This is reflected by its performance in the indicators measuring the use of community health workers to promote vaccination over the last few decades.⁵⁷

Building better Immunisation Readiness in Senegal

To improve readiness level, Senegal can codify its commitment within its policies, to formally endorse vaccinations within national policy and further support the infrastructure necessary to promote its immunisation efforts. Detailed national immunisation policies and strategies are helpful for promoting the improvement of immunisation programmes, and policies must be published in the public domain – not only for the benefit of the public but also for those who are able to provide support to the country or learn from its success.

USA

Figure E3. Immunisation Readiness in the USA

USA's overall and domain performance in the Immunisation Readiness Index compared to the averages for all Index countries

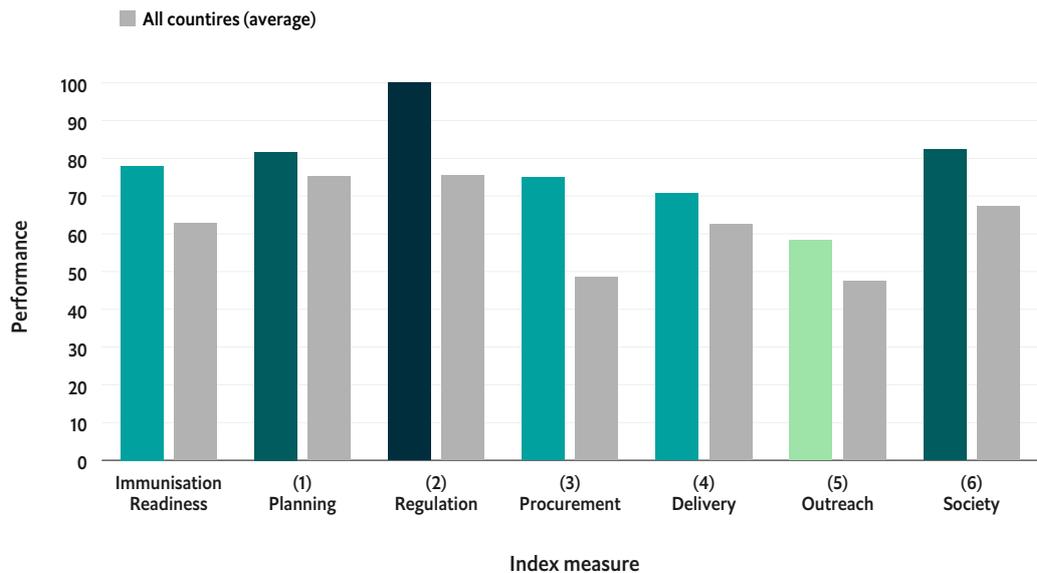


Table E3. Vaccination rates for covid-19, diphtheria, tetanus and pertussis (DTP3) and measles (MCV2) in the USA, as included in the Data Dashboard

Type of vaccine	Vaccinated population
Covid-19 ¹⁸	69.5%
DTP3 ¹⁵	93.0%
MCV2 ¹⁵	95.0%

Rationale for performance

While the USA consistently performed above the all-country average, its overall immunisation readiness score was lower than expected based on its ability to meet and exceed vaccination targets. It performed best in the Regulation domain, and has regulatory approval processes for new vaccines, including an emergency approval mechanism that can be used in public health emergencies.^{59,60} It also engages with a variety of stakeholders, including vaccine manufacturers.⁶¹ Furthermore, its performance is above average in the Procurement and Delivery domains, particularly with respect to vaccine financing.

Building better Immunisation Readiness in the USA

Under the US system, public health – including vaccination – is not a federal government responsibility; rather, individual state governments are responsible.^{62,63} Some state programmes satisfy the indicators in the Index, but the international guidance recommends that policies and programmes are best carried out with specific guidance, funding and support at a national level. There have been challenges for many decades because of the separation of roles and responsibilities between federal and state governments in the health arena.⁶³ Without an overarching federal government responsibility, the national government lacks an ability to manage programmes across state lines and consequently, cannot guarantee that access, education, and outreach are being carried out in a sustainable or equitable manner. This lack of a national approach to delivery infrastructure impacts the success of immunisation programmes and the ability to provide vaccinations to the entire population, which is reflected in performance relating to procurement, health system infrastructure, and the Outreach domain. Opportunities to improve outreach include the federal government providing more detailed guidelines and funding for states to use in creating their own individual outreach programmes.

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