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The Absorption-Capacity Challenge

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Executive Summary

It is in every country's interest to vaccinate the world as quickly as possible. Failure to do so risks new variants emerging that could evade vaccines and undo all the hard work that has been done to date, as well as lead to deaths, overwhelmed health systems and untold economic damage.

While much of the developed world has aligned on this objective, the question of *how* has primarily focused on vaccine supply. This is a key part of the equation, and it is right that the world commits to a bold, ambitious target of vaccinating as many people as possible in 2021. Modelling from our previous paper Vaccinating the World in 2021 found that we can strategically vaccinate the world in 2021 by using the available supply to inoculate the 3.2 billion people that make up priority populations (such as health-care workers, clinically vulnerable people and those in densely populated urban areas) in order to help minimise mortality, maintain essential services and reduce viral transmission.

Supply is, however, not the only component of this unprecedented challenge. We must do all we can to ensure that when doses are received by countries, they can actually be administered. We call this absorptive capacity, and countries in the developing world must begin building and scaling it now.

Already we have seen countries around the world disposing of expired doses, and many more struggle to vaccinate amid rising hesitancy. In May, Malawi destroyed almost 20,000 doses of the AstraZeneca vaccine. In June, South Sudan destroyed 59,000 doses and handed back 72,000 of the 132,000 doses it received through COVAX. The Democratic Republic of the Congo was unable to use most of the 1.7 million AstraZeneca doses it received under COVAX and was forced to redistribute them. All three countries were unable to administer their supply by the expiry date. This will become more acute as supply increases. Indeed, to fully account for incoming vaccine supply from COVAX and other bodies to the countries most in need of vaccines, our modelling shows that a global increase in their absorptive capacity from 170 million doses to 410 million doses per month will be needed by the end of 2021. This is the absorption-capacity challenge – and it requires a plan.

Of course, the context of each country is different. Factors including a country's existing health-care capability combined with budgetary and political constraints create a unique set of circumstances that will shape requirements. This should not preclude the creation of a central framework and an internationally coordinated approach to building capacity.

In this paper we offer a framework that is adaptable to specific contexts, drawing on examples from the developed and developing world, along with lessons from historic vaccination programmes. Starting with an assessment of the strategic needs for a country, this framework will ensure that capacity is focused in the right places to facilitate targeting vaccines at those most vulnerable to Covid-19 infection or those most likely to transmit the virus. At the same time, sustainability should be part of this endeavour: we should build absorptive capacity that readies us for future pandemics, as well as tackling this one.

We recommend that countries introduce measures for what we call the four S's framework: setting and supply chains; staffing and equipment; systemisation and data; and strategic communications and community engagement – as the key pillars to guide a successful vaccine rollout. Figure 1 below sets out this framework.

Any investment in strengthening absorption capacity has the dual impact of benefiting the populations of individual countries *and* protecting previous investments in aid and development abroad. Therefore, donor countries should ensure that sufficient concessional financing is available through grants and other special drawdown mechanisms, and they should lead an effort to track this funding to avoid duplications or gaps.

Figure 1

KEY HEALTH-SYSTEMS COMPONENTS NEEDED TO DELIVER VACCINES

The IMF estimates that at least $6 billion is needed for delivery costs to achieve 60 per cent vaccine-coverage rates – a relatively low price compared to the total amount spent on overseas development aid each year, which exceeds $150 billion. As these figures help to highlight, vaccine delivery is an investment to ensure that spend on other development programmes is effective and to minimise how much the pandemic derails other development efforts.

We have previously argued that there is a need for strategic allocation of vaccines to health-care workers, vulnerable populations and people in densely populated urban areas. We similarly believe that a strategic prioritisation of investments to support absorption capacity is required to maximise return on investment, avoid duplications and minimise financing gaps to the extent possible.

Recommendations:

We recommend that the G20 – as the premier global body accounting for the majority of the world's economy and with representation from the Global North and Global South – set up a task force with the Access to COVID-19 Tools Accelerator (ACT-A) with the following mandate:

- Quantify and centralise country-level financing requirements for the rollout of vaccines
- Determine which strategic investments in absorption capacity have the greatest impact in terms of number of people vaccinated
- Set and commit to a realistic financing target to deploy those strategic investments, including through repurposing of existing funds
- Channel funds through key multilaterals (e.g. Gavi for supply chain and logistics, Global Fund for community engagement)
- Track investments to specific country needs in a centralised and coordinated manner in order to maximise return on investment, avoid duplications and minimise financing gaps to the extent possible
- Prioritise vaccinations of health-care workers, vulnerable populations and people in densely populated urban areas to maximise lives saved and minimise viral transmission

In parallel, in-country efforts to strengthen absorption capacity require leadership by national and local governments of each country, supported by local partners to provide technical assistance and implementation.

Vaccines: The Solution Requires More Than Supply

International efforts to vaccinate the world need to extend beyond the procurement and commitment of doses. Efforts must also be directed at helping countries around the world build their distribution and absorption capacity for vaccines as well as ensuring demand and uptake. Doing so in a sustainable manner will not only accelerate the end of this pandemic but will also leave the global population safer in the face of future outbreaks.

The World Health Organisation (WHO), as the COVAX lead for allocation, proposes that protecting individuals and health systems and minimising the impact on economies should be the driving force behind the allocation of Covid-19 health products across different countries. However, the allocation process does little to take into account the role of absorption capacity.

Currently COVAX plans to allocate doses in two phases:[1]

1. In the first phase of allocation, doses will be made available to participating countries simultaneously until approximately 20 per cent of the population of every country is covered.
2. Once countries have been allocated enough doses for 20 per cent of the population, the pace at which countries would receive additional doses of vaccine in phase two would be determined by an assessment of their risk at any given time, if substantial supply limitations remain. Additional considerations are made based on an evaluation of threat and impact of Covid-19 on a country as well as the vulnerability of a country, based on health systems and population factors.

For phase two, the risk analysis will identify countries with the highest risk, and they will receive vaccines at a faster pace than those considered at lower risk. Special consideration will be given to countries that may suddenly face major outbreaks or national disasters throughout the allocation process.[2]

This approach has at least two potential limitations.

First, prioritising only vulnerable populations and not populations most likely to spread the virus may slow our ability to end the pandemic overall. Some research suggests that the best way to protect vulnerable populations at scale is to

vaccinate individuals most likely to spread the virus, at least while supplies are limited. While a balanced approach to protecting the vulnerable is important, vaccine allocation should take into consideration the risk of widespread localised transmission of the virus, such as in densely populated urban areas.

Second, allocating vaccines to areas already in the throes of an outbreak is too late. Vaccines are much better at preventing an outbreak than breaking ongoing transmission. By the time a region gets to widespread community transmission, non-pharmaceutical interventions (NPIs), such as lockdowns and banning of large gatherings, are also required to rapidly interrupt transmission.

While supply is an essential first step, absorptive capacity ensures that those secured doses make it from the shelves into peoples' arms as quickly as possible and before doses expire. When absorption capacity is not taken into consideration, vital doses are more likely to go to waste.

WHAT ABSORPTION CHALLENGES ARE COUNTRIES FACING?

Countries around the world are facing serious and complex challenges in their attempts to absorb and administer vaccines.

COLD-CHAIN LOGISTICS AND STORAGE-MANAGEMENT CHALLENGES

Although all countries have their own logistical challenges, less-developed countries in the Global South will need more support to successfully distribute the vaccines. Intercontinental shipments are affected by constrained air-cargo capacity, with an overall reduction of 20 to 25 per cent expected in the first and second quarters of 2021. However, charter flights could solve this if adequate funding is made available.

Logistics capabilities vary among countries in the Global South, but cold-chain logistics are generally weaker in low- and middle-income countries (LMICs) than they are in mature economies. Particularly challenging are operations in relation to airport handling, warehousing, dry-ice facilities (to handle vaccines with deep frozen temperature requirements) and getting vaccines out to rural areas.

QUALITY-ASSURANCE CHALLENGES

There is a higher risk of deviation and counterfeiting in Global South countries, which require security solutions for serial numbers and tracking – and potentially blockchain technology. The distribution of high volumes of ancillary vaccine supplies – such as syringes, needles and personal protective equipment (PPE) kits – which exceed the volume of vaccine vials in number and tonnage will also require effective coordination and collaboration to ensure timely delivery across the transport ecosystem to these locations.

ACCESS

Vulnerable populations – especially in developing countries – could face added hurdles, including difficulty in reaching administrative sites, getting time off from work and arranging childcare to receive doses. Gaps in consumer education can also lead to higher levels of vulnerability to misinformation, fraud and vaccine hesitancy. Historical wariness of interacting with authorities can also be a barrier to trust.

INCREASED LABOUR REQUIREMENTS

Complex protocols for handling and preparing Covid-19 vaccines, as well as the added precautionary observation period after patients are injected, have the potential to strain labour capacities or divert workers from other critical roles. Our estimates suggest that at a streamlined vaccination site, one administrator could vaccinate seven to ten patients per hour with the help of two support staff. This rate is significantly slower and three-and-a-half times more labour intensive than that of the annual flu vaccination. According to the US Centres for Disease Control and Prevention (CDC), if retail pharmacies alone were tasked with public administration of the Covid-19 vaccine, 15 to 20 per cent of their qualified workforce would need to be allocated to this full-time task.

WASTAGE AT POINTS OF CARE

Errors in storing, preparing or scheduling administration of doses at points of care will have significant consequences. For example, failure to ensure that recipients attend their appointments will not only prevent individual immunity but could also lead to product wastage, since all vaccine doses in multidose vials must be administered within a short window of time after the vial has been opened. Proper on-site storage conditions are also of critical importance. The current mRNA vaccines – including Pfizer and Moderna – pose an additional challenge for on-site storage because of the low temperature requirement.

IT CHALLENGES

IT systems, including vaccine-tracking systems (such as the CDC's VTrckS) and immunisation information systems (IIS), will be essential for allocating, distributing, recording and monitoring the deployment of vaccines. In the United States, more than 50 uniquely designed IIS (for each state and territory) must interact with VTrckS. Ensuring that these can operate at unprecedented scale and are configured for a two-dose vaccine schedule has become a major software-development, data-hosting and operational challenge.

Additionally, it will remain vital that these systems protect patient privacy and are secure against cyberthreats, given the potential for hackers and criminals to cause damage. Cyberattacks have already occurred against Covid-19 vaccine developers and regulators.

INFORMAL ECONOMIES

Substantial portions of developing economies are informal, including many workers with high-exposure risk (for example, street vendors) or those employed by small- and medium-size enterprises. These workers can be much more challenging to reach than those who work for larger, more formal employers.

RURAL COMMUNITIES

Many developing countries have substantial rural populations. Rural populations can be much harder to reach (both logistically – for instance due to limited infrastructure or transportation difficulties – and because of weak underlying health-care systems) and present serious efficiency obstacles for a mass-vaccination programme. These obstacles include limited ability to host a single vaccination site that can reach a substantial population, vaccine utilisation problems for multidose vials that need to be fully used in a short period of time, and follow-up challenges for those requiring a second dose.

TRANSIENT POPULATIONS AND HUMANITARIAN SITUATIONS

Developing countries tend to face greater numbers of transient and hard-to-identify populations in humanitarian contexts, such as refugees, migrants or mobile workers. These groups may be challenging to identify and access outside of formal settings (for example, in refugee camps).

HOW MANY DOSES ARE GOING TO WASTE?

While many African nations are grappling with insufficient supplies of Covid-19 vaccines, others are destroying thousands of unused doses.

Kenya is just one of the countries that has used up more than 90 per cent of its stock of AstraZeneca vaccine doses, supplied by COVAX. The East African nation is just weeks away from joining its sub-Saharan neighbours Botswana, Eswatini, Ghana, Rwanda, Togo and Senegal on the list of African countries that have exhausted their COVAX donations. South Sudan, on the other hand, has announced plans to discard about 59,000 of a total 191,000 doses of the AstraZeneca vaccine it received in donations. The vaccines set to be disposed of are expired doses that were donated by telecommunications company MTN.

Health officials in South Sudan said the doses, which were supplied by the African Union's Covid-19 Africa Vaccine Acquisition Task Team (AVATT), arrived in the country just two weeks before they were due to expire, so they were not administered. In late March, South Sudan also took delivery of 132,000 doses of the AstraZeneca vaccine from COVAX. So far the country has managed to vaccinate just over 5,000 people against coronavirus. (The 59,000 doses that the country plans to discard are from the AVATT shipment, as donated by MTN, according to the WHO.) Similarly, 1 million AstraZeneca doses acquired through COVAX have been returned by the Democratic Republic of the Congo (DRC), following concerns that they may not be administered before their expiry date.

According to Our World in Data figures, 58 million vaccine doses have been administered in Africa (only 3 per cent of the population) out of a total of more than 170 million doses received. While this is in part due to lack of periodic reporting of vaccination status, low capacity to administer vaccines as well as vaccine hesitancy could also be playing a significant part.

Recommendation:

COVAX, with support and guidance from the G20 task force, should consider vaccine absorptive capacity when allocating doses in order to minimise the number of doses that go to waste. Countries able to put in place a framework for absorption capacity should be prioritised and those that are unable should be provided with the necessary support to achieve this.

The Absorption-Capacity Challenge

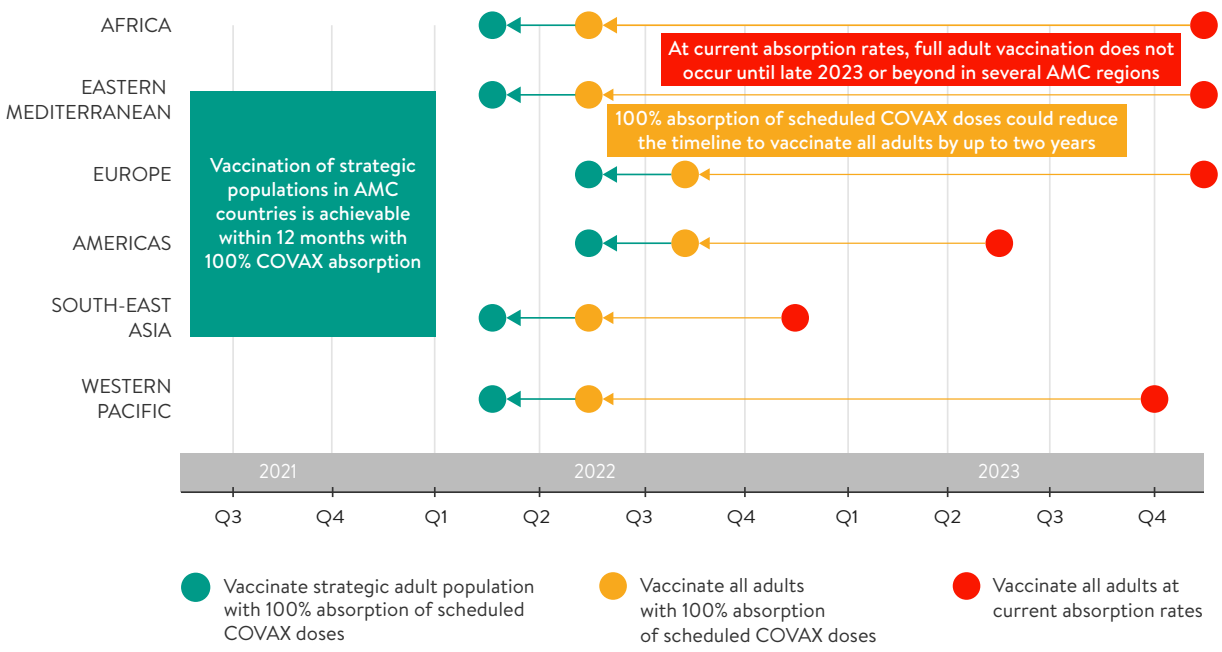
Vaccine supply is expected to increase in the third and fourth quarters of 2021, with COVAX securing new manufacturer deals and the additional G7 committed donations. COVAX has forecast that approximately 1.9 billion doses will be available for supply by the end of 2021, of which roughly 1.5 billion are due to be sent to the designated members of the Gavi COVAX Advance Market Commitment (COVAX AMC) programme – the principal WHO-backed initiative to share vaccines with low- and middle-income countries.

Our modelling shows that:

- Achieving 100 per cent absorption capacity of COVAX vaccines would allow for all key populations (health-care workers, those who are clinically vulnerable and urban populations) in COVAX AMC countries to be vaccinated within 12 months. This is more than a two-year reduction in vaccination timelines compared to current vaccination rates for many AMC countries.
- On average, COVAX AMC countries will need to be able to double their current vaccination rates in order to accommodate the increased supply.

Figure 2

ENSURING FULL ABSORPTION CAPACITY AND STRATEGICALLY ALLOCATING DOSES COULD REDUCE VACCINATION TIMELINES BY UP TO TWO YEARS IN AMC COUNTRIES



Source: GHSC modelling based on data from the United Nations, World Bank, COVAX, Our World in Data and https://www.bmj.com/content/371/bmj.m4704.

Note on our modelling: Vaccination timelines for each COVAX region are based on the latest July COVAX global supply forecasts and historical vaccination data from Our World in Data (OWID). Vaccination coverage for the first half of 2021 is drawn from historical OWID totals, and current absorption rates are calculated from OWID as total doses delivered by AMC countries in each COVAX region during June 2021, projected forward at a constant daily rate for the baseline scenarios. For the 100 per cent COVAX absorption scenarios, we assume that each COVAX region receives its full projected monthly supply on the first day of the month and then delivers vaccines at a constant daily rate until the month's end. We further assume that AMC countries receive all non-allocated COVAX donations as well as their explicitly allocated dose share, while Self-Financing Participant (SFP) nations – the other major COVAX country group that partially funds AMC vaccine donations – receive SFP-designated COVAX doses only.

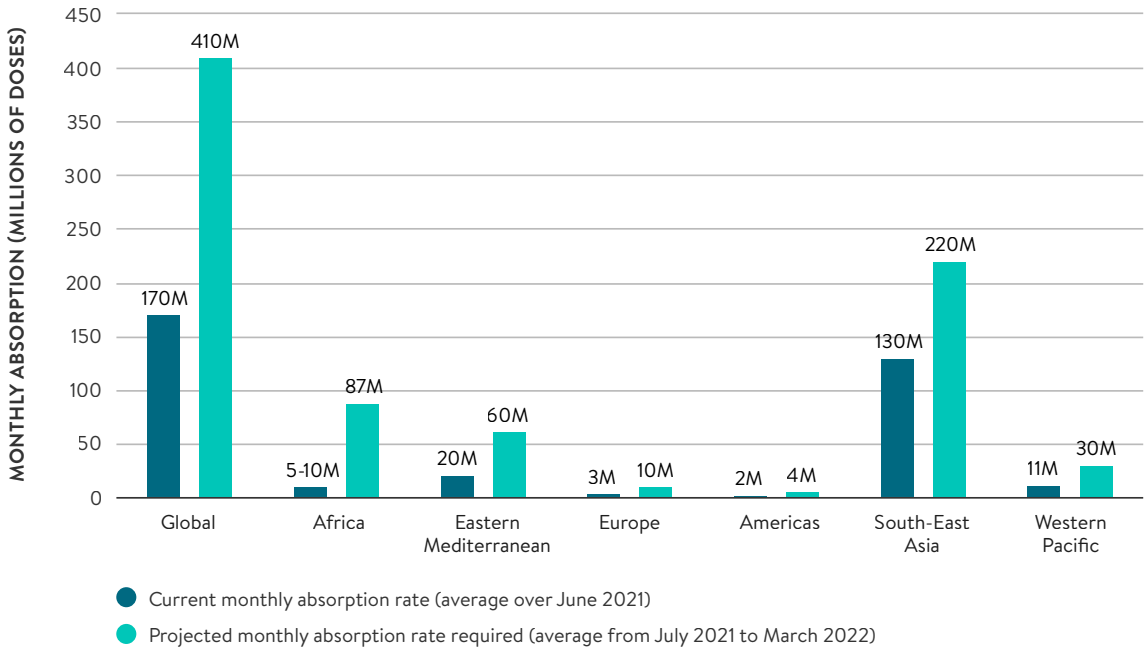
Timelines presented assume two-dose vaccination: we model second doses as being delivered 28 days after the first dose for all vaccines except Johnson & Johnson (J&J). We assume that the one-dose J&J vaccine becomes available to AMC nations after June and that each COVAX region receives a constant proportion of J&J each month based on the overall breakdown of vaccines by manufacturer listed in the COVAX forecast (c. 10 per cent J&J). We also factor a baseline level of non-COVAX vaccine supply into our model: this is calculated as the residual vaccinations recorded in each COVAX region in OWID during June after subtracting known June COVAX supply. We hold this level of non-COVAX vaccine supply constant going forward for each region in order to illustrate the anticipated absorption challenge for AMC nations relative to current total supply levels. We note that this is likely a conservative assumption, as further bilateral supply deals outside of COVAX may raise absorption demands for AMC countries significantly beyond this model's projections. Most non-COVAX supply in June was in the South-East Asia region.

To estimate the strategic population to prioritise for vaccination in each COVAX region – key workers, the elderly and clinically vulnerable, and urban residents – we use UN 2020 age-stratified population data to calculate the number of adults by country, and then apply elderly and vulnerable and key worker estimates from a 2020 academic analysis by Yu et. al published in the British Medical Journal. We then use national urbanisation ratios taken from the World Bank to estimate residual adult urban populations in each country. Timeline estimates assume 100 per cent vaccination coverage in both the strategic and total population scenarios. Booster doses are not modelled. Forecasts are based on 88 of the 92 countries that are part of the AMC: complete data was not available for Tuvalu, Palestinian territory in the West Bank and Gaza, Kosovo and North Korea.

In order to achieve this accelerated timeline, on average, COVAX AMC countries will need to at least double their absorption capacity. This scale-up is needed across the different regions; in some regions, such as Africa, where vaccine supply has historically remained extremely low, an increase in delivery from 5 to 10 million to almost 90 million doses administered per month will be required. Prioritising the absorption capacity in these regions will be essential to achieving global-vaccination goals.

Figure 3

COVAX AMC COUNTRIES WILL NEED TO MORE THAN DOUBLE THEIR ABSORPTION CAPACITY

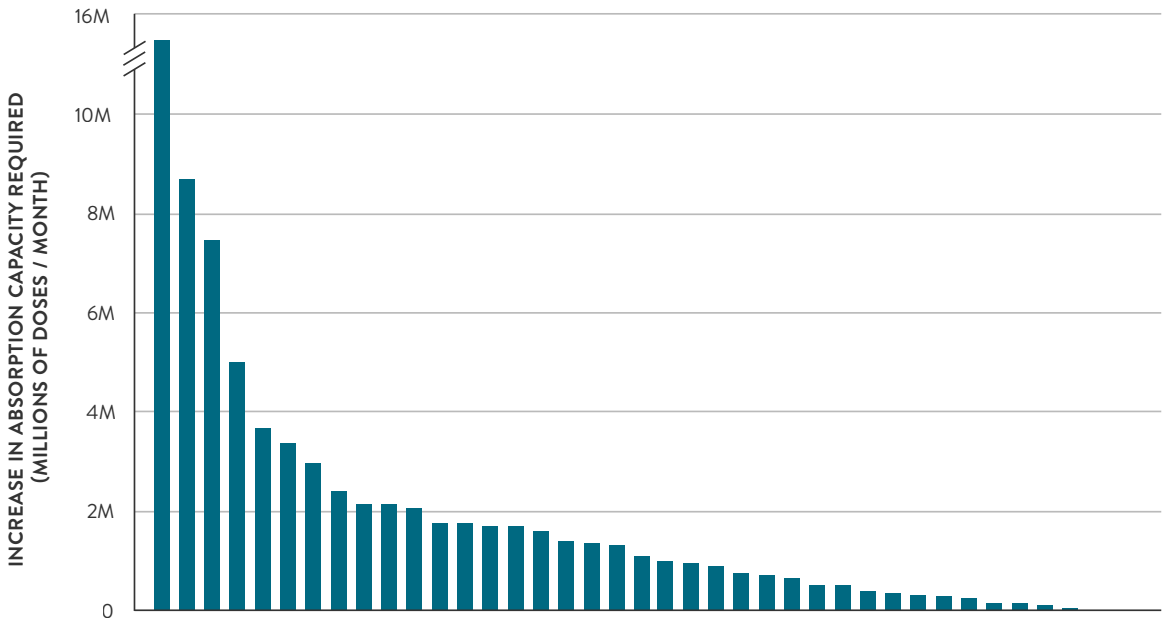


Source: GHSC modelling based on data from the United Nations, World Bank, COVAX, Our World in Data and https://www.bmj.com/content/371/bmj.m4704.

Note on our modelling: The projections above show the shortfall between total vaccine absorption in June 2021 as recorded in Our World in Data for each COVAX AMC region, and the average projected regional supply rate from July 2021 to March 2022 as outlined in Figure 2. In other words, this Figure shows current vaccination rates by COVAX region and the level that each COVAX region may need to reach in order to stay current with projected COVAX supply over the coming year. A range estimate is provided for the current vaccination absorption rate in COVAX Africa. This is because the June vaccination rate recorded in OWID for Africa AMC countries of 5m differs substantially from COVAX's estimated Africa AMC June delivery of roughly 10m. OWID and COVAX figures are broadly consistent for the other COVAX regions.

Figure 4

SCALING UP ABSORPTION RATES WILL VARY BETWEEN AFRICAN COUNTRIES, MAKING IT CRITICAL FOR STRATEGIC ALLOCATION OF INVESTMENTS



Source: GHSC modelling based on data from the United Nations, World Bank, COVAX, Our World in Data and https://www.bmj.com/content/371/bmj.m4704.

Note on our modelling: The projections above are based on the difference between the total vaccinations delivered by each Africa AMC country on their 30 best days of vaccination absorption, and the COVAX average projected monthly regional supply rate from July 2021 to March 2022, as outlined in the Figure 2 note. This Figure illustrates the absorption challenge facing many African countries even relative to their highest levels of vaccine absorption to date. All 40 Africa AMC participants are listed anonymously. Projected Africa AMC supply is split between Africa AMC countries each month proportionately by population, as per COVAX guidelines.

Our modelling clearly shows a need for structured vaccine rollout strategies to avoid wasting doses. This forms the basis of the absorption-capacity challenge we face. Countries must be equipped to effectively use the vaccines that are distributed to them. In order to achieve this, three things are required: an absorption framework, leadership and financing.

The Absorption Framework: The Four Pillars

While there is no silver bullet that will eradicate Covid-19, widespread vaccination is the best way to ensure the end of this pandemic comes as soon as possible. The ultimate objective must be to vaccinate the entire adult population as quickly as possible in order to reduce deaths and hospitalisations and to inhibit transmission of the virus.

We have developed a four-part framework that we call the four S's, which sets out four key tenets that are integral to a successful vaccination rollout programme once supply has reached a country. The framework was initially informed by the UK's vaccination programme that began at the end of 2020, but also draws on best practice from around the world. The four S's are as follows:

1. Setting and supply chains
2. Staffing and equipment
3. Systemisation and data
4. Strategic communications and community engagement

These four tenets all rest on having the right strategy in place. In the context of limited global supply, three key objectives are seen as critical for optimising vaccine allocations:

1. Reduce deaths and hospitalisations by vaccinating the elderly and individuals with underlying conditions that put them at risk of severe disease.
2. Maintain essential services and support the reopening of economies by vaccinating health-care workers, police, military and staff working in energy, food and transportation sectors.
3. Minimise viral transmission and the likelihood of viral mutation by prioritising densely populated urban areas.

Achieving these objectives requires targeted prioritisation of sub-populations, as well as a coordinated strategy for delivering vaccines at scale. To this end, we have also developed a proposed tiering system and strategy, based on the four S's framework. This system – to be applied in a country's specific context depending on COVAX supply – could look like this:

- Tier 1: To immediately protect health systems and reduce mortality, countries should consider prioritising the initial COVAX allocation, sufficient to cover 3 per cent of the population, to frontline health- and community-care workers[3] as well as to densely populated urban areas.[4]

- Tier 2: As additional supply becomes available to cover up to 20 per cent of the population, people over 65 years of age and people under 65 who have underlying high-risk comorbidities should be next to receive the vaccine.[5]

- Tier 3: Further priority groups as defined by the country. This may include essential workers (such as bus drivers), frontline business operators (such as restaurant servers) and international travellers (such as those crossing land or air borders).

- Tier 4: Further priority groups as defined by the country. The risk profiles will need to be re-evaluated periodically as more epidemiological data about the virus becomes known and assessed against any changes to country context.

Furthermore, we advocate an approach that distributes vaccines based on level of risk due to population density, which would focus the above distribution on urban residents across all socioeconomic levels. Prioritising vaccination in densely populated urban areas will accelerate a reduction in the spread of the virus.

SETTING AND SUPPLY CHAINS: MAKING ALL POSSIBLE VACCINATION SETTINGS AVAILABLE

A key element of maximising vaccine absorption involves using the largest number of venues in the right areas to reach as many people as possible, as well as ensuring that the infrastructure to transport vaccines to each of these settings is in place.

In addition to traditional health-system infrastructure (clinics, hospital hubs and pharmacies), additional settings such as pop-ups at markets (both big and small) should be brought online to the extent possible given cold-chain requirements. Mobile units should be used to serve harder-to-reach communities and individuals, such as those who live outside urban areas or where the geographic distribution of vaccine sites is not possible.

The selection of vaccination sites also needs to account for supply-chain necessities, from the port of entry through to the delivery of vaccines to sites. At the port of entry, it is important to ensure that customs-clearance arrangements have been made and that transportation or storage arrangements are in place in order to prevent any delay or potential wastage of doses. An increase in storage-capacity requirements is to be expected. Ensuring an up-to-date cold-chain inventory is key to evaluate capacity to receive vaccines. In addition, different vaccines have different storage requirements, and some need to be stored at freezing temperatures. For example, the Moderna vaccine must be stored at -20° Celsius, and the Pfizer vaccine needs to be stored at -70° Celsius. These ultra-low temperatures require additional investments in ultra-cold storage boxes, which typically cost between $10,000 and $20,000 each.[6]

According to a report by Sustainable Energy for All, even with AstraZeneca and Janssen's Johnson & Johnson vaccines, which can be stored at normal refrigerator temperatures of between 2° and 8° Celsius, the scale of the cold-chain challenge needed to reach herd immunity is "immense."[7] Cold-chain infrastructure and storage are key considerations in order to reduce vaccine waste.

Israel is a useful example of an effective vaccine rollout, especially in regard to setting and supply-chain management. It has so far fully vaccinated 64 per cent of its population since the beginning of the vaccination campaign in December 2020 and has had one of the most successful vaccine rollouts globally. While the success is attributed to various factors – such as geographic suitability, experience in mass-vaccination drives, and effectiveness of technology and data management – efficient setting and supply-chain management also played a significant role.

When it comes to distribution techniques, countries would benefit from receiving approval from vaccine manufacturers to repackage and transport smaller quantities to remote areas and communities without compromising the quality of the vaccines. This modified strategy can ensure that distribution of vaccines first reaches populations at the highest risk of death from Covid-19 with minimal waste of vaccine doses.

Israel also provides valuable lessons for repurposing venues to become vaccination sites. Early in the vaccination rollout, health-maintenance organisations (HMOs), which are responsible for administering the vaccines in Israel, set up vaccination centres in stadiums, parking lots, school playgrounds and other venues in coordination with the private sector to facilitate mass vaccination. Israel then began to transition away from its early efforts to deliver vaccines at large venues and clinics to mobile vaccination sites, aiming to make it easier for those facing logistical challenges to get vaccinated. Health officials say they are hoping to reach those who aren't actively seeking out the vaccine but who aren't opposed to being immunised if the vaccines are easily accessible.

Recommendations:

1. **Strategically allocate resources to a combination of existing health-care sites and novel sites for mass-vaccine administration to the extent possible given cold-chain requirements**
2. **Ensure that customs-clearance arrangements have been made and that transportation or storage arrangements are in place in order to prevent any delay or potential wastage of doses**
3. **Develop additional cold-chain infrastructure as necessary**

STAFFING AND EQUIPMENT: PUTTING IN PLACE THE REQUISITE INFRASTRUCTURE

When vaccine volume grows, so will the need for personnel to administer vaccines. Supplementing the existing workforce is a critical step for successful absorption for two key reasons: first, to ensure target populations are reached as and when planned, and second, to ensure routine vaccination and health-care services are not compromised during the Covid-19 vaccine campaign. Recruiting and training the largest number of people possible to safely administer vaccines will allow vaccination to take place at scale and very quickly. Further, research has shown that task-shifting medical care, especially primary care, in developing countries can reduce costs without sacrificing health outcomes.[8]

Staff recruitment extends beyond the people who will be physically administering jabs into arms; it also includes people to set up and ensure the vaccination sites are running efficiently, register and assist with patients, input data, manage equipment and conduct community outreach.

Some experts estimate that for every vaccinator physically administering doses, an average of five support staff are needed in order to prevent backlogs, though that figure will depend on vaccination strategy and demand.[9] Backlogs should be prevented wherever possible in order to maintain physical-distancing rules and avoid disincentivising people from waiting in line for their vaccine.

A few examples of the categories of people that governments could draw upon to join the rollout programme include:

- Health-care professionals (including pharmacy staff)
- Retired medical professionals
- Medical students and qualified first aiders
- Community health workers
- Administrators and data managers
- The armed forces

In March, as vaccine supply grew in the United States and the country prepared to open vaccination eligibility to all adults, the federal government announced new steps to increase the number of qualified administrators.[10] The new act expanded authorisation rights to prescribe, dispense and administer vaccines to groups including paramedics, midwives, veterinarians, dentists, students in the health-care profession, and health-care providers whose certification had expired within the past five years. A significant outreach effort was undertaken by the Department of Health to recruit staff, including the establishment of an online portal for volunteers to sign up directly. Sufficient staffing enabled the US to administer as many as 4.6 million doses in one day in mid-April.[11]

Every country should have a target number of staff to recruit. Calculating the target number requires disaggregated demographic data on the number of eligible individuals per priority group in each district.

To achieve its target of vaccinating 70 per cent of its population as quickly as possible, Morocco set up approximately 3,000 fixed vaccination centres and deployed 7,000 mobile units nationally. This required that the country of about 35 million mobilise more than 25,000 health professionals and vaccination teams to staff these sites, just over half of which were based in urban areas.[12] Morocco's campaign is considered among the most successful in LMICs, with 25.2 per cent of the population fully vaccinated as of 6 July.[13]

In contrast, Latvia, a much smaller country with a population of less than 2 million, planned to train a maximum of 500 administrators. Recognising it had a shortage of workers to administer vaccinations at its target pace, Latvia started recruiting and training additional personnel ahead of the launch of its mass-vaccination campaign.[14] Among those restaffed by the health ministry were medical personnel accustomed to administering the annual influenza vaccine and health workers who had recently returned to the sector. Latvia allocated €80 to finance each individual health-care worker's training.[15] The enlarged workforce is being trained to administer the new Covid-19 vaccines by medical university staff via virtual meetings and webinars.[16]

To the extent possible, training should be conducted ahead of the arrival of vaccine supply. This will provide proper time for workers to acquire new skills and ensure that the workforce is confident in the safety of the working environment and patient care. Covid-19 vaccine administration is a unique challenge to health-care providers, regardless of experience, for a number of reasons. These include: the volume of the vaccines that need to be distributed; traceability and tracking of each individual vial to ensure safety and security; the speed at which the vaccines must be given between in-country arrival and administration; and specific handling procedures, especially for vaccines that require extra-cold storage and a specific type of syringe, such as Pfizer.

To avoid spoilage, vaccinators must know the temperature requirements and shelf-life of every vaccine they are handling. To offset wastage, vaccinators must also know how to maximise the dosing per vial and use special syringes, when necessary. Well-trained staff will enable an effective and efficient administration process, avoiding vaccine waste and ensuring target goals are met.

In late February, Ghana became the first African country to receive a COVAX delivery and was able to administer approximately 50 per cent of that initial supply within the first ten days.[17] The training of staff and conducting of simulation exercises in advance of the rollout are two critical factors in the country's early success.[18]

Because the arrival date of Rwanda's first COVAX shipment in March was not confirmed until a few days before delivery, it was essential that health-care workers administering vaccines were recruited and trained in advance of the rollout. At least two vaccination teams were appointed at each hospital and health centre across the country more than a month before the immunisations commenced. Virtual and (where feasible) in-person, service-delivery training was rolled out in the month before the campaign. Hospital directors, doctors, nurses, data managers and surveillance officers were trained on service delivery and data management, with a training surge across the country in the days just before the rollout. Each vaccination site was given a checklist to ensure the requisite staffing, logistics, supplies and digital tools were in place the day before. This ensured that workers were on standby and ready the moment the vaccines arrived.

The target for any trained vaccinator should be to administer three injections per hour. We have estimated that each additional trained vaccinator would boost capacity by approximately 21 vaccinations per day[19] – meaning an additional 30,000 recruits with sufficient space would allow for 630,000 additional vaccinations per day – or 3.15 million per week.[20]

The teams of vaccinators also need equipment to safely get vaccines from vials into arms. At a minimum, this requires syringes, needles, saline, PPE and safe waste-disposal mechanisms. All staff – whether physically administering vaccines or managing the site – should have some form of PPE. Therefore, countries must also factor in their ability to procure a sufficient supply of equipment for their vaccination teams when calculating the scale and speed of their campaigns.

For example, Pfizer vials contain six, rather than the usual five, doses per vial. Countries that acquire Pfizer are counting on all six doses being used in order to meet their vaccination targets. However, extracting all six doses requires a special low dead-space syringe and needle. Though Pfizer has validated 35 syringe-needle combinations to extract the six doses, there are only a handful of manufacturers

globally that produce these special devices, and they are more expensive than standard units.[21] A global shortage of this equipment (and/or inadequate training on how to use them) will significantly impact vaccination rates.

Recommendations:

1. **Strategically allocate resources to ensure a sufficient number of workers to administer the vaccine given population size and strength of existing health system**
2. **Conduct training in advance of rollouts and supply surges**
3. **Ensure there is sufficient ancillary equipment, including syringes, saline and PPE, for all vaccinators**

SYSTEMISATION: EFFICIENCY THROUGH DATA

The need for large-scale Covid-19 vaccination-rollout programmes around the world has created an opportunity for LMICs to put in place long-term, specialised digital systems for monitoring vaccination status and collecting data for post-vaccination safety surveillance.[22] Additionally, building genomic-surveillance capacity, keeping track of seroprevalence to monitor risk and immunity levels, and collecting data on vaccine efficacy to ensure vaccines continue to work against variants are further aspects for building effective systems.

Data collection is essential to be able to call and recall patients for the multi-dose vaccines, keep track of who is being vaccinated with which vaccine, and potentially collate this information for some form of health pass.

Ensuring that data-capture and data-sharing systems allow for tracking of vaccine distribution is important, however including data on safety and side effects is also a key aspect of this principle. There are many different systems around the world set up to do this. One example is V-safe, a safety-monitoring system in the United States established by the CDC specifically for the Covid-19 vaccination programme. This is used alongside a wider monitoring system, the Vaccine Adverse Event Reporting System (VAERS).

V-safe participants voluntarily self-enrol to receive smartphone text messages providing hyperlinks to web surveys about their post-vaccination symptoms, whether they have any or not. Compiling this data and sharing it in a timely way can help reduce vaccine hesitancy for people who are worried about side effects.

The benefits of the V-safe approach were demonstrated by the recent decision to vaccinate pregnant women in the US and the UK, and the difference in time it took in these two countries. In the US, data showing an absence of reported side effects among pregnant women who received the vaccine meant that it was a straightforward, evidence-based decision to extend vaccine eligibility to expectant mothers. In the UK, this decision took three weeks longer, because no such system was in place.

Rwanda provides another example of best practice for using data to maximise vaccine absorptive capacity. Technology and the use of data has been at the heart of Rwanda's Covid-19 response from the start. The country has deployed data systems at every step of the vaccination process, from checking the allotment of vaccines to verifying cold storage using a geographic information system (GIS) tool to transferring vaccines to health facilities. Each administered dose was captured digitally, which is important for multiple reasons. Not only does it demonstrate exactly where vaccines are going, how quickly and to whom; it also creates reliable records of vaccinations for international travel and reopening of the economy.

Data was critical both for staying on top of the supply chain and for ensuring that all those who received first doses were identified and returned for their second doses. Public-health surveillance allowed community health workers to start outreach early and build trust with the population. Rwanda's community health workers collected data ahead of the vaccines arriving to identify those individuals with underlying conditions and non-communicable diseases, which aren't always readily apparent, so that community health workers could then use this list to get vulnerable people to vaccine sites and to make the best possible use of scarce resources.

Recommendation

Put in place specialised digital systems for monitoring vaccination status and collecting data for post-vaccination safety surveillance

STRATEGIC COMMUNICATIONS AND COMMUNITY ENGAGEMENT: THE RIGHT PLAN REQUIRES THE RIGHT PROCESSES

It is important to reduce vaccine hesitancy and increase vaccine confidence among global populations to ensure sufficient demand for vaccines when they are available.

In 2019, the WHO declared vaccine hesitancy as one of the ten threats to global health.[23] The components of vaccine hesitancy are complacency, confidence and convenience.[24] It is a complex and context-specific occurrence that reflects a broad range of challenges. Convenience may relate to a wider set of practical issues that are addressed in the first three S's of our framework – but in parallel to these, clear and consistent public messaging and community engagement around the vaccination process is required, and must be tailored to the local context and underpinned by easily accessible data on safety. Numerous countries have found that securing enough vaccine supply and having the right infrastructure in place is not enough. Misinformation and skewed risk perception are a threat to vaccine absorption.

Vaccine hesitancy is more likely with new vaccines and mass-vaccination campaigns[25] and so is particularly important in our current context. It is a global concern and not unique to developing countries.[26] Additionally, it is not confined within borders: decisions made locally can affect vaccine uptake in other areas. Coordinating a global data-sharing platform would support this effort and lead to better decision-making.

As was suggested in our preceding paper on Vaccinating the World, strategic communications and community engagement require:

- A centrally directed and coordinated national communications campaign
- Clearly explained and publicly accessible data on safety
- Consistent messaging on the need to vaccinate to avoid future waves of the virus and safely re-engage in economic activity
- Targeted community-engagement strategies, utilising channels and media that are tailored to the cultural contexts of specific communities

Studies have shown that increasing the reach of positive and accurate information and building resilience to the spread of misinformation are more effective strategies than directly challenging scepticism.[27] Ultimately trust needs to be established and this can only be done with a people-centred approach. A coordinated community-engagement approach should be implemented to gather and analyse data in order to act on community perceptions and feedback. This may be done through the use of surveys.

At the regional and local levels, tailored media and community-engagement strategies should be deployed. It is essential to address the contextual influences (community leaders such as religious and traditional political figures, health-care professionals, celebrities and social-media influencers will be pivotal), individual and group influences (knowledge, awareness, personal experiences), and vaccine-specific concerns (safety, schedule, cost and the logistics of when, where and how to get to a point-of-care site to be vaccinated).[28]

For example, a Partnership for Evidence-Based Response to COVID-19 (PERC) survey from March 2021 across a number of African countries noted that the single most important reason individuals were hesitant about vaccination was due to "not knowing enough to make a decision". Additionally, it highlighted the overall importance of community health-care workers, hospitals and national public-health institutions as trusted sources of information. But it also showed that – in Tunisia and Ethiopia, for example – religious institutions may play a role, and further, in the example of Tunisia, that the military is a highly favourable source of information.[29] This shows that tailoring the dissemination of information could lead to greater vaccine uptake.

The most effective mode of engagement will also vary by community: radio, newspaper, television and internet penetration differ among different demographics and geographies. Radio broadcasts may be especially effective in communicating with hard-to-reach populations. Messaging should be multilingual as needed.

An excellent example of the practical application of these principles was seen in Rwanda. Since the arrival of the first COVAX shipment on 3 March 2021, the government of Rwanda has kept the public informed of the progress of deployment. Daily updates from the Ministry of Health and government of Rwanda – in both English and Kinyarwanda – on Twitter, TV and radio have offered citizens a window into the rollout operations. A key element included in the updates is the identification of the priority groups getting vaccinated, accompanied by photos. Regular newspaper articles and nightly radio interviews also track updates. Trusted community leaders have also been used to help those invited for vaccination know where to go and to understand the benefits of vaccination on their collective community.

Recommendations:

1. **Create a centrally directed and coordinated national communications campaign that is clearly explained and uses publicly accessible data on safety**
2. **Ensure consistent messaging on the need to vaccinate to avoid future waves of the virus and safely re-engage in economic activity**
3. **Target specific populations with low take-up via community-engagement strategies, utilising channels and media that are tailored to the cultural contexts of specific communities**

Leading the Absorption-Capacity Challenge

Countries in the Global North, where national vaccine rollout and absorption has outpaced the Global South, have multiple interests in supporting absorption capacity of vaccines in developing countries, including economic, public health and humanitarian:

Economic: For every $1 invested in vaccines in less wealthy countries, wealthy countries will see $4.80 of economic benefit because economies can fully reopen sooner. Failing to make this investment could cost wealthy economies $4.5 trillion in economic losses.[30]

Public health: Vaccinating the world is the only way to reduce the likelihood of new variants emerging, which could lead to viral escape (i.e. when a new variant can infect a previously vaccinated individual).

Humanitarian: Covid-19 has led to nearly universal setbacks in the global development agenda. The Bill & Melinda Gates Foundation has argued that the pandemic has led to "a setback of 25 years in 25 weeks" for global development priorities.[31] The only way to get programmes such as routine immunisations, job-creation programmes and education back on track is to ensure that people can go about their daily lives safely.

Recommendations:

As the premier global body accounting for the majority of the world's economy and with representation from the Global North and Global South, we recommend that the G20 sets up a task force, in coordination with ACT-A, with the following mandate:

- Quantify and centralise country-level financing requirements for the rollout of vaccines
- Determine which strategic investments in absorption capacity have the greatest impact in terms of number of people vaccinated
- Set and commit to a realistic financing target to deploy those strategic investments, including through repurposing of existing funds
- Track investments to specific country needs in a centralised and coordinated manner in order to maximise return on investment, avoid duplications and minimise financing gaps to the extent possible
- Prioritise vaccinations of health-care workers, vulnerable populations and people in densely populated urban areas to maximise lives saved and minimise viral transmission

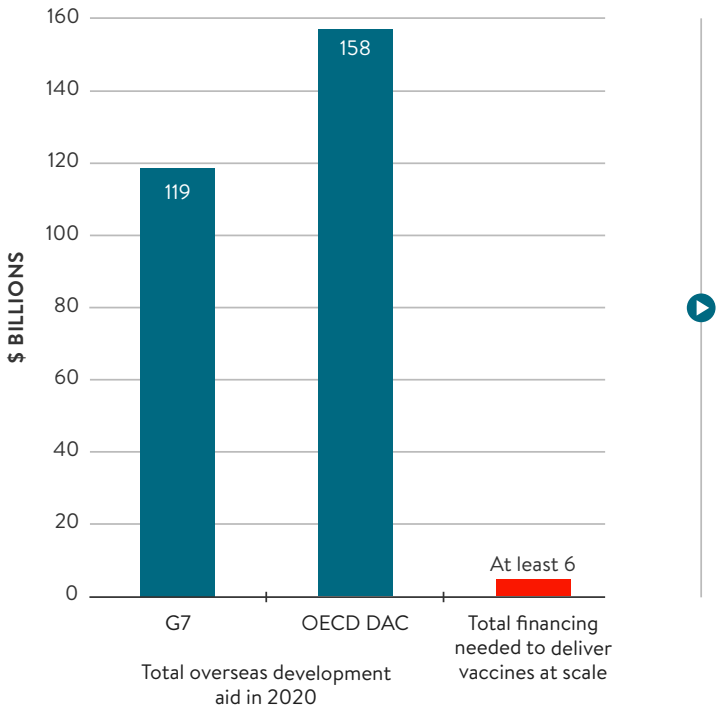
In parallel, in-country efforts to strengthen absorption capacity require leadership by national and local governments of each country, supported by local partners to provide technical assistance and implementation.

Financing the Absorption-Capacity Challenge

The IMF estimates that a total of at least $6 billion is needed for delivery costs to achieve 60 per cent vaccine-coverage rates. This figure is relatively low compared to the total amount spent on overseas development aid each year, which exceeds $150 billion, and is small compared to the potential benefits of a faster end to the pandemic, estimated at around $9 trillion.[32]

Figure 5

FINANCING TARGETS FOR VACCINE DISTRIBUTION ARE A RELATIVELY SMALL INVESTMENT NEEDED TO SECURE THE IMPACT OF OTHER DEVELOPMENT SPENDING



The G20 and ACT-A should work together to establish a task force to meet this need. The task force should:

- **Quantify absorption-capacity financing needs** at country level
- **Set and commit to a realistic target** to deploy these investments
- **Channel funds** through key multilaterals (e.g. Gavi for supply chain and logistics, Global Fund for community engagement)
- **Track collective investments** to avoid duplication and minimise gaps
- **Strategically prioritise vaccinations** of health-care workers and vulnerable and urban populations to minimise deaths and viral spread

From this perspective, any investment by countries in strengthening absorption capacity has the dual impact of benefiting their own populations and protecting their previous investments in aid and development abroad. Therefore, donor countries should ensure that sufficient concessional financing is available through grants and other special drawdown mechanisms, and they should lead an effort to track this funding to avoid duplications or gaps.

We have previously argued that there is a need for strategic allocation of vaccines to health-care workers, vulnerable populations and people in densely populated urban areas. We similarly believe that a strategic prioritisation of investments to support absorption capacity is required to maximise return on investment, avoid duplications, and minimise financing gaps to the extent possible.

Global investments in vaccine rollout and leading policy statements that shape the global vaccine dialogue are largely overlooking the critical issue of how patients receive vaccines and who administers them. Of the 58 public statements from governments and global leaders on the global vaccination campaign – including the Africa CDC, the WHO, the Pan American Health Organisation, the CDC, the G7 and key donor governments – fewer than 20 per cent referred to the costs of vaccine delivery[33]. These are critical gaps in the current global debate.

Fully realising the social and economic benefits of halting Covid-19 requires investing in a fast and fair global rollout of Covid-19 vaccines. The WHO estimates that the financial costs for service delivery (i.e. not including the cost of the actual vaccine) – including at the country, regional and global level – amount to $3.70 per person vaccinated with two doses. According to WHO data, technical assistance and global and regional costs amount to 15 per cent of total costs. In-country outreach and fixed-site delivery comprise 57 per cent of total costs, and in-country upfront costs comprise 28 per cent of the total.[34] Based on these figures, the IMF estimates total cost for service delivery to be about at least $6 billion.[35]

So far, COVAX has received commitments from donor countries of about $1 billion for vaccine delivery and costs. At least $15 billion has been made available from multilateral development banks like the World Bank and the Asian Development Bank,[36] some of which will go towards absorption capacity. There are other commitments that could help fill the funding gap if the donors direct them towards reinforcing system rollout and supporting frontline health workers. The IMF is considering a Special Drawing Right allocation of $650 billion for economic recovery, which once approved, would add substantial financial resources to all countries.[37] Gavi has committed $150 million to support country vaccine-delivery plans and health systems, and the International Finance Corporation's $4 billion Global Health Platform is supporting private

companies to deliver vaccines to developing countries. This includes investments in vaccine manufacturers to foster expanded production of Covid-19 vaccines in LMICs, with production reserved for emerging markets, the ability to invest in production to address potential bottlenecks and support for mapping Covid-19 vaccine-manufacturing capacity.[38]

If directed swiftly and appropriately, these resources could help fill the funding gap to guarantee fast and fair vaccine delivery. It is critical that these pledges be delivered rapidly. Success requires not commitments, but upfront financing made available immediately. Given the enormous social and economic cost of the pandemic, these grants are likely the highest-return investments that advanced economies, multilateral agencies and philanthropic individuals can make.

Conclusion and Recommendations

As we have set out previously, ensuring that the right level of vaccine supply is available globally is critical. No single country is safe until every country is safe. Until the world is fully vaccinated, the risk of new variants that are more easily transmissible and resistant to vaccines is real. All the work countries have put in so far on vaccinating their individual populations could be totally set back if a far more severe variant of Covid-19 emerges. For those countries pushing forward with their vaccination programmes, supporting global vaccine supply is not just a selfless act to help the rest of the world, it is a selfish one.

The right quantity of vaccines is, however, only half the solution. Without clear, robust and sustainable capabilities within countries to absorb and administer vaccines, the supply will be wasted. A plan for how countries prepare to receive and successfully administer as many jabs as possible has therefore been the missing element in the discussion on how we vaccinate the world as soon as possible. This paper corrects that omission. It has set out, in detail and across key areas, the steps required to fully absorb the supply of the vaccine needed to vaccinate the world.

Individual countries can take important steps to prepare absorption capacity, but global leadership is also needed. Key recommendations for how the world should move forward on this critical aspect of our struggle against Covid-19 are included below.

RECOMMENDATIONS:

While the IMF has provided a top-down estimate of at least $6 billion needed for financing absorption capacity and delivery of vaccines, we are not aware of any publicly available, holistic estimate of all absorption-capacity financing requirements at the country level.

Therefore, we recommend that the G20 – as the premier global body accounting for the majority of the world's economy and with representation from the Global North and Global South – sets up a task force with the Access to COVID-19 Tools Accelerator (ACT-A) with the following mandate:

- Quantify and centralise country-level financing requirements for rollout of vaccines
- Determine which strategic investments in absorption capacity have the greatest impact in terms of number of people vaccinated
- Set and commit to a realistic financing target to deploy those strategic investments, including through repurposing of existing funds
- Channel funds through key multilaterals (e.g. Gavi for supply chain and logistics, Global Fund for community engagement)
- Track investments to specific country needs in a centralised and coordinated manner in order to maximise return on investment, avoid duplications and minimise financing gaps to the extent possible
- Prioritise vaccinations of health-care workers, vulnerable populations and people in densely populated urban areas to maximise lives saved and minimise viral transmission

This task force should build on the existing tracking infrastructure and capabilities set up by ACT-A.[39] It would complement these capabilities by bringing much-needed global political leadership from donor countries to meet this urgent challenge.

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