


Inequities in the deployment of COVID-19 vaccine in the WHO Eastern Mediterranean Region, 2020–2021

Q Hasan,¹ E Elfakki,¹ K Fahmy,¹ Osama Mere,¹ A Ghoniem,¹ H Langar,² N Musa,¹ Rania Attia ³, M M Othman,¹ Dahlia Samhoury,² Irtaza Chaudhri,² Abdinasir Abubakar,² Rana Hajjeh,² Y J Hutin³

To cite: Hasan Q, Elfakki E, Fahmy K, *et al*. Inequities in the deployment of COVID-19 vaccine in the WHO Eastern Mediterranean Region, 2020–2021. *BMJ Global Health* 2022;**7**:e008139. doi:10.1136/bmjgh-2021-008139

Handling editor Seye Abimbola

Received 6 January 2022

Accepted 30 May 2022

ABSTRACT

The WHO Eastern Mediterranean Region (EMR) is characterised by a large range in routine immunisation coverage. We reviewed progress in access, deployment efforts, and use of COVID-19 vaccines in the EMR to identify bottlenecks and propose recommendations. We compiled and analysed data reported to WHO regarding the number of vaccines provided emergency use authorisation (EUA) in each country, the number of vaccine doses allocated and delivered by COVAX, the number of vaccine doses received bilaterally, the date of initiation of vaccination, vaccine usage rate and overall vaccination coverage. In June–July and October–November 2021, we conducted two rounds of a regional survey to assess vaccine acceptance and calculated the weighted proportion of individuals who would get vaccinated once a vaccine is available and recommended. We stratified the analysis according to four groups based on their participation status in COVAX, from the highest to lowest income, that is, (1) fully self-financing high-income countries (group 1), (2) fully self-financing upper middle-income countries (group 2), (3) Advance Market Commitment (AMC) countries not eligible to receive Gavi support (group 3) and (4) AMC countries eligible for Gavi support (group 4). As of 31 December 2021, the median number of vaccines provided with EUA was 6 for group 1, 11 for group 2, 8 for group 3 and 9 for group 4. On the same date, COVAX had delivered 179 793 310 doses to EMR countries. Vaccination started on 10 December 2020 in group 1, on 13 December 2020 in group 2, on 30 December 2020 in group 3 and on 20 January 2021 in group 4. The regional acceptance survey (first round) pointed to higher vaccine acceptance in group 1 (96%), than in others, including group 2 (73.9%), group 3 (78.8%) and group 4 (79.3%), with identical patterns in the second round (98%, 78%, 84% and 76%), respectively. Usage of vaccine allocated by COVAX to participating countries was 89% in group 1, 75% in group 2, 78% in group 3 and 42% in group 4. The full dose and partial dose coverage decreased with the income groups of countries, from 70% and 6% in group 1, to 43% and 8% in group 2, to 33% and 11% in group 3, and 20% and 8% in group 4. All 22 EMR countries introduced COVID-19 vaccines by 21 April 2021, but with major inequities in coverage. Additional efforts are needed to address the determinants of unequal vaccine coverage at all stages of the result chain to improve vaccine equity.

SUMMARY BOX

- ⇒ A large amount of regulatory work successfully led to access to a number of new vaccines over a short period of time.
- ⇒ In 2021, especially till the 3rd quarter, vaccine supply was the key reason for low coverage. Vaccine acceptance was not a major challenge.
- ⇒ Beside vaccine availability, developing a strong vaccination service delivery system within the overall health system is key to ensure equity

INTRODUCTION

The large-scale use of vaccine represents an important tool to end the acute phase of the COVID-19 pandemic.¹ In April 2020, Gavi, the Vaccine Alliance, the Coalition for Epidemic Preparedness Innovation and the WHO launched COVAX; the vaccine pillar of the Access to COVID-19 Tools. The initial goal of COVAX was to reduce mortality and protect the health system by vaccinating 20% of the population in each country by end of 2021. On 21 July 2021, the WHO Director General defined more ambitious goals, and pledged to reach 10% general population coverage by the end of September 2021, 40% coverage by the end of 2021 and 70% coverage by June 2022.² Under the principle of Universal Health Coverage (UHC), equity is a major consideration in this goal, as no one will be safe until everyone is safe. As of 31 December 2021, WHO had enlisted eight vaccine products (ChAdOx1-S (recombinant) AstraZeneca, Janssen Ad26.COVS.2.S, Moderna mRNA-1273, Pfizer-BioNTech BNT162b2, Sinopharm BIBP, Sinovac-CoronaVac, Bharat BBV152 Covaxin, Novavax/SII NVX-CoV2373) for emergency use listing (EUL) after evaluating available safety and efficacy data.^{3 4} National regulatory authorities can use these data to issue emergency use authorisation (EUA) that allows these vaccines to be used in their



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹DCD/IVP, WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt

²WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt

³DCD, WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt

Correspondence to

Dr Q Hasan; hasanq@who.int

countries. By 31 December 2021, COVAX had successfully shipped over 941.51 million doses of seven different vaccines to its 144 participants. Countries (mostly high income and upper middle income) also secured additional doses through bilateral purchase agreements. Countries with strong health system were more effective at delivering COVID-19 vaccines. Countries with weaker health system struggled to consume the few doses they received.⁵ An efficient supply chain and service delivery system is needed to ensure all vaccines are effectively delivered to the priority population according to SAGE (Strategic Advisory Group of Experts) recommendations.⁶ The WHO 'Immunization Agenda 2030' (Global Strategy to Leave No One Behind, IA2030) envisions new vaccine delivery system integrated to primary healthcare to reach people throughout their life course for UHC.⁷

The WHO Eastern Mediterranean Region (EMR) had an overall population of 745 million people in 2021.⁸ In terms of the gross national income and the development of health system, the region is characterised by substantial inequity and is affected by conflict, dispute and war.⁹ Nine countries are in humanitarian emergency situation, accounting for 43% of those who need humanitarian assistance worldwide.¹⁰ In 2020, WHO and UNICEF estimated that coverage for the third dose of the diphtheria, pertussis and tetanus-containing vaccine was 81%, ranging from 42% in Somalia to 99% in Iran, Morocco, Oman and oPt. All 22 countries participate in the COVAX facility. Eleven high and upper-middle income are self-financing. These self-financing countries are further divided into six high-income and five upper middle-income countries. In addition, 11 lower middle-income and low-income Advance Market Commitment (AMC) countries benefit from Official Development Assistance to fund the vaccine. These AMC countries are further divided into seven Gavi-eligible countries and four non-Gavi-eligible countries. Regional strategies to reach high vaccine coverage must take this diversity into account so that no one is left behind.

In early 2021, one of the first goals of WHO was to introduce the COVID-19 vaccine in each country of the world during the first hundred days of the year.¹¹ This effort, reported in an earlier document, was largely achieved, even though richer countries were able to start vaccination earlier and reach higher coverage faster than others.¹¹ As more vaccine became available through COVAX and bilateral donations, WHO needs to report on the subsequent phase of vaccine deployment efforts aiming to protect most at-risk and vulnerable population groups. Following initial introduction, countries aimed at achieving higher vaccination coverage to minimise the health and economic impact of the pandemic. The emergence of the Delta variant strain of SARS-CoV-2 underlined the need to vaccinate the largest number of people prioritising higher risk groups, for example, the elderly and people with chronic diseases, as soon as possible as the vaccine is effective against severe disease, hospitalisation and deaths.¹² The objective of this report

is to describe 2021 COVID-19 vaccine deployment efforts in terms of types of vaccines available, vaccine delivery systems, vaccine coverage and acceptance to identify challenges and bottlenecks and propose recommendations for improving vaccine coverage with universal vaccine equity as the major criterion of success.

DATA SOURCES AND ANALYSIS

Data sources

Vaccines authorised, allocated, delivered and used

We abstracted reports from Ministries of Health and National Regulatory Authorities on the issuance of EUAs. For COVAX-specific vaccine allocation, we monitored the various allocation rounds and dose-sharing announcements from the facility. We monitored vaccine doses received through reports from WHO country office (WCO) focal points and the Strategic Coordination Office online tracker maintained by COVAX. We monitored vaccine consumption and progress in vaccination through WCO focal points' periodical reports and official websites of Ministries of Health. We compiled all data along with other global data repositories (eg, 'Our World in Data', Bloomberg) using the WHO online dashboard. We used national population figures of EMR countries according to World Population Prospects 2019 of the United Nations Department of Economics and Social Affairs to calculate the vaccination indicators.⁸ All the data were collected, validated and entered daily in the WHO regional COVID-19 vaccination database, from where it was extracted later (table 1).

Vaccine acceptance

To assess vaccine acceptance and factors influencing vaccine uptake, we collaborated with UNICEF and conducted two rounds of a COVID-19 knowledge, attitudes, and behaviours regional survey in June–July 2021 (first round) and in October–November 2021 (second round). We estimated the frequency of parameters likely to influence COVID-19 vaccine uptake. A third-party contractor collected data on perceptions, acceptance and behaviours for COVID-19 vaccine through mobile-based interviews on a population sample targeting those 18 years of age and above identified through random digital dialling of mobile phone numbers in all EMR countries. We selected a non-probability quota sample of 500–1000 persons proportionate to the population size per country. We defined vaccine acceptance as the status of those who had been vaccinated or intended to receive the vaccine when available based on a series of questions on vaccination status and intention to receive the vaccine.

Data analysis

We plotted the proportion of countries issuing EUA for a specific vaccine using the countries that had been allocated that vaccine as the denominator. We calculated the proportion of doses received out of the doses allocated. We also calculated doses received, allocated and expected from COVAX, according to the proportion of

Table 1 Data sources that were used for this report

Source of information	Link	Date of extraction
COVAX portal	https://cpp.unicef.org/dashboard/1	29 December 2021
Bahrain MoH	https://healthalert.gov.bh/en/	27 December 2021
Djibouti MoH official Facebook account	https://web.facebook.com/minister.sante.dj/	17 December 2021
Iraq MoH dashboard	https://app.powerbi.com/view?r=eyJrIjojODY4ZTU2YzAtNzlyZi00YjMzLTg5MzktZmY3ZTM5ZTI4ZDcyliwidCI6ImY2MTBjMGI3LWJkMjQtNGlzOS04MTBILTnkYzI4MGFmYjU5MCIsImMiOjh9&pageName=ReportSection	27 December 2021
Jordan MoH dashboard	https://corona.moh.gov.jo/ar	27 December 2021
Kuwait MoH dashboard	Ministry of Health-Kuwait Home (moh.gov.kw)	28 December 2021
Lebanon MoH official Twitter account	https://twitter.com/mophleb	22 December 2021
Libya National Center of Disease Control official Facebook account	https://www.facebook.com/NCDC.LY/	27 December 2021
Morocco MoH dashboard	http://www.covidmaroc.ma/Pages/AccueilAR.aspx	27 December 2021
Pakistan MoH dashboard	https://covid.gov.pk/	28 December 2021
Palestine	https://www.corona.ps/ https://www.facebook.com/mohps/	20 December 2021
Qatar MoH dashboard	https://covid19.moph.gov.qa/AR/Pages/Vaccination-Program-Data.aspx	28 December 2021
Saudi Arabia MoH dashboard	https://covid19.moh.gov.sa/	28 December 2021
Tunisia MoH official Facebook account	https://www.facebook.com/santetunisie.rns.tn/?ref=br_rs	19 December 2021
UAE MoH dashboard	https://covid19.ncema.gov.ae/	28 December 2021
OurWorldin Data	Coronavirus (COVID-19) Vaccinations-Our World in Data	28 December 2021
Bloomberg	More Than 10.2 Billion Shots Given: Covid-19 Vaccine Tracker (bloomberg.com)	28 December 2021
Vaccination WHO internal database	https://www.activityinfo.org/app#form/csv9sywkm20xp7ge/table/cjdm313km89wqt719	29 December 2021
United Nations Department of economics and Social affairs Population Dynamics	World population prospects-population division-United Nations	29 December 2021

MoH, Ministry of Health; UAE, United Arab Emirates.

the population to be covered by the end of 2021, and expressed it as a percentage. We plotted the proportion of COVAX-supplied doses consumed against those received. We drew a map of the EMR countries to represent geographical differences in the proportion of acceptance for the vaccine in the population. For each country, we then estimated the proportion of the population vaccinated against COVID-19, either partially (received one dose out of two-dose regimen vaccines) or fully (received either one dose of one-dose regimen vaccines or two doses of two-dose regimen vaccines). We stratified the analysis in four groups according to their participation type in COVAX and World Bank classification by income level, from the highest income to the lowest income, including (1) fully self-financing high-income countries (group 1), (2) fully self-financing upper middle-income countries (group 2), (3) AMC countries not Gavi-eligible (group 3), (4) AMC Gavi-eligible countries (group 4).

Patient and public involvement

We used secondary data and reports from countries, including data collected from our online tracker sites and others as specified in the Data sources section. Aside from the acceptance survey, we did not involve any patients, whether by design, recruitment or conduct in this report.

FINDINGS OF THE ANALYSIS OF THE DATASETS

Emergency use authorisations

As of 31 December 2021, COVAX had allocated six vaccines to EMR countries. All countries issued EUA, including 2 countries were allocated Sinovac-CoronaVac vaccine, 14 countries were allocated Pfizer-BioNTech BNT162b2 vaccine, and countries were allocated Moderna mRNA-1273 (N=4), Sinopharm BIBP (N=6), Janssen (N=10), and ChAdOx1-S AstraZeneca vaccines (N=20, figure 1).

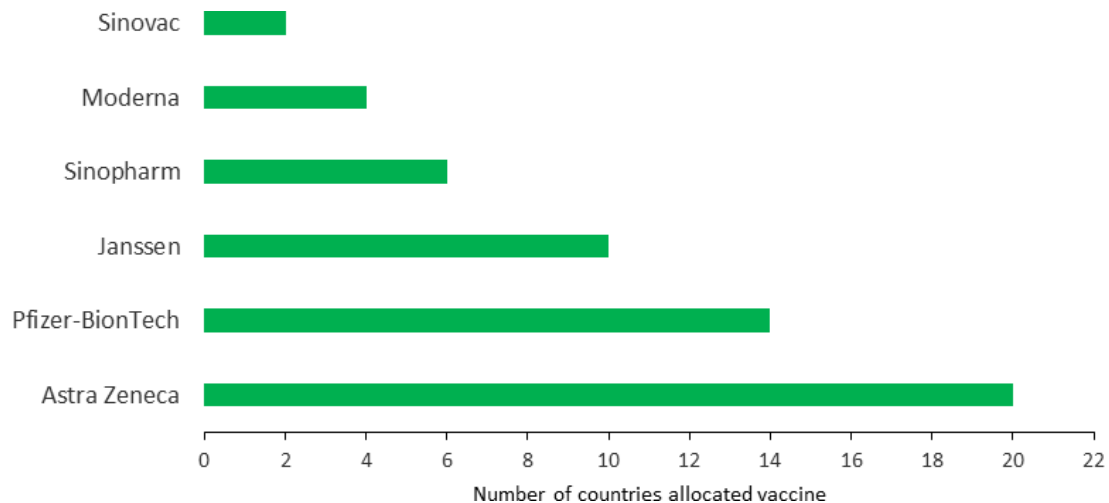


Figure 1 Emergency use authorisation status of vaccines in countries that were allocated specific products, WHO Eastern Mediterranean Region, 31 December 2021.

Allocation and deliveries

Following initial shortages of vaccine in COVAX facilities in the first half of 2021, COVAX allocation started to increase from the third quarter of 2021. Vaccination started in December 2020 in group 1, group 2 and group 3, and in January 2021 in group 4. As of 31 December 2021, COVAX allocated 314 million doses of which 180 million doses shipped to countries in the EMR. Of the total doses allocated to EMR countries, COVAX allocated 62.4% to group 4, 26.4% to group 3, 10.6% to group 2 and less than 0.6% to group 1 countries. Group 4 countries received the highest proportion of the total doses delivered by COVAX (54%), followed by group 3 (31%), group 2 (14%) and group 1 (1%) (figure 2).

The proportion of doses received among those allocated was 54% in group 4, 56% in group 3, 72% in group 2 and 79% in group 1 countries (figure 3). When expressed in terms of the proportion of the population that could be covered by the vaccine received by COVAX, group 1, 2, 3 and 4 countries were allocated vaccine for 3%, 14%, 33% and 25% of their population, respectively, and received vaccine for 2%, 9%, 6% and 9% of their population, respectively.

Consumption

Group 1 had the highest consumption of doses received from COVAX (89%), followed by group 3 (78%) and group 2 (75%); while group 4 consumed only 42% of doses received from COVAX. Group 1 countries consumed a high number of doses secured bilaterally as well (figure 4).

Overall, group 1 countries delivered highest number of doses per 100 population (139/100), followed by group 2 (69/100), group 3 (56/100) and group 4 (30/100). Overall, 70 doses delivered per 100 population in the EMR (figure 5) until 31 December 2021.

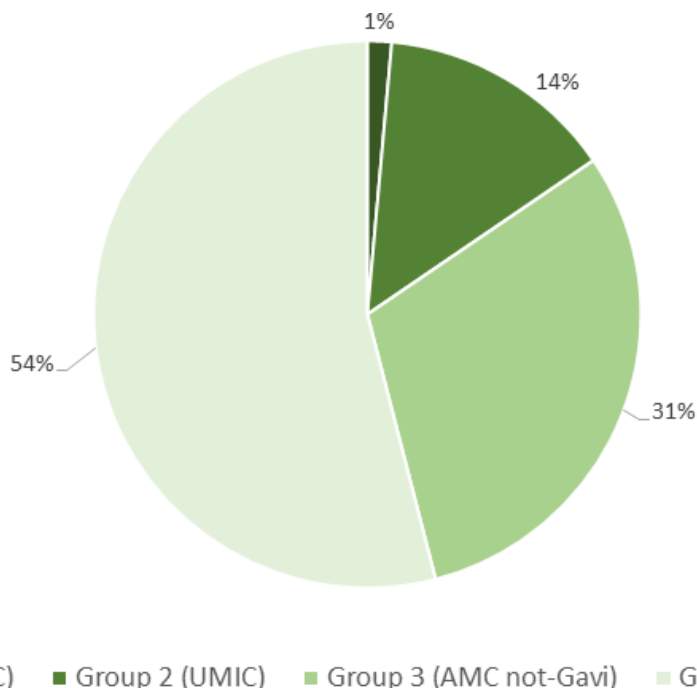


Figure 2 Proportion of doses delivered to different groups of countries from COVAX, WHO Eastern Mediterranean Region, 31 December 2021. AMC, Advance Market Commitment; HIC, high-income country; UMIC, upper middle-income country.

Acceptance

According to the first-round survey, the median proportion of the vaccine acceptance was 84.9% in the region, ranging from 48.5% in Djibouti to above 94% in all group 1 countries. The average and ranges of acceptance were 73.9% (range: 67.2%–87.6%) in group 2 countries, 78.84% (range: 74.2%–88.1%) in group 3 countries, 79.3% (range: 48.5%–87.5%) in group 4 countries. In the second round, the average of vaccine acceptance was higher in group 1, 98% (range: 92%–100%); group

2, 78% (range: 68%–91%); and group 3, 84% (range: 80%–89%) than in group 4, 76% (range: 63%–95%) (figure 6).

Coverage

On 31 December 2021, overall, in the region, 30% of the population was fully vaccinated while another 8% was partially vaccinated. However, COVID-19 vaccination coverage varied across countries. The proportion of fully/partially vaccinated people was the highest in

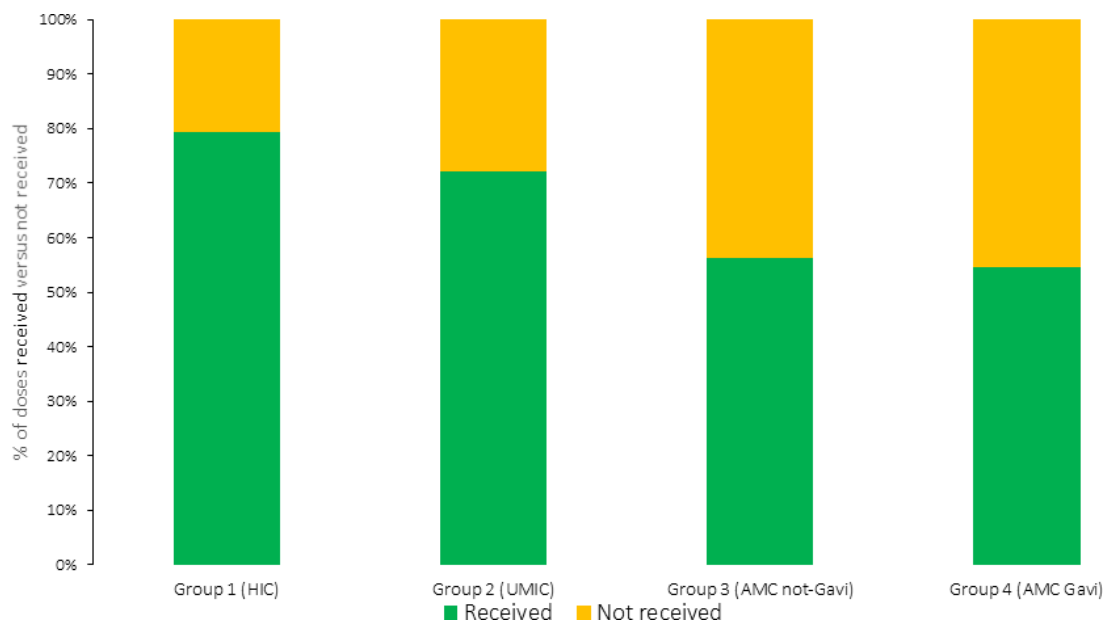


Figure 3 Proportion of doses received among allocated from COVAX in different country groups, WHO Eastern Mediterranean Region, 31 December 2021. AMC, Advance Market Commitment; HIC, high-income country; UMIC, upper middle-income country.

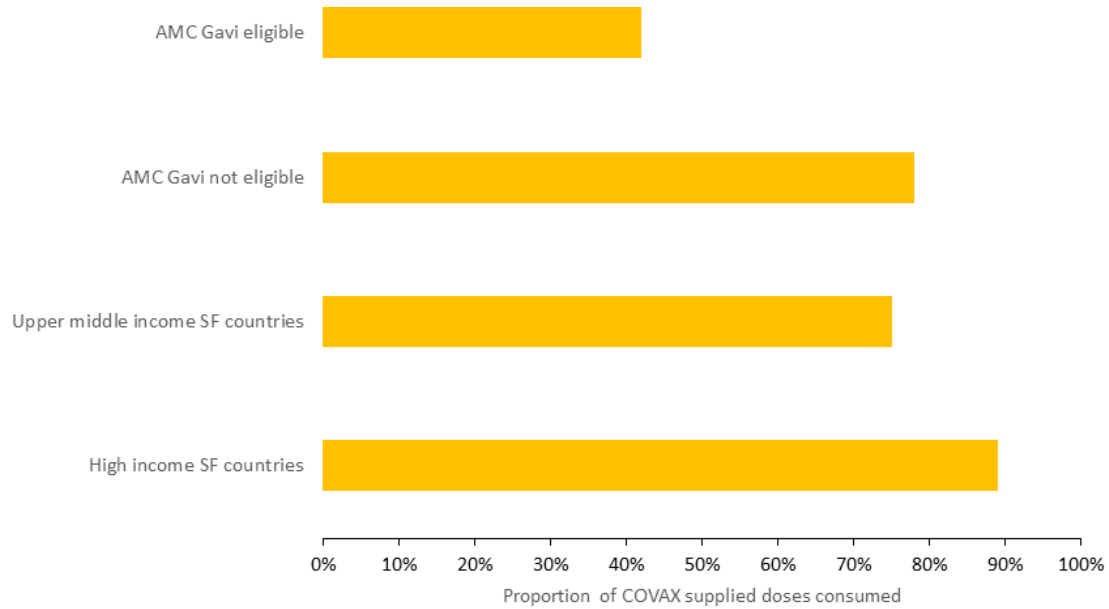


Figure 4 Proportion of received COVAX doses consumed, by groups of countries, WHO Eastern Mediterranean Region, 31 December 2021. AMC, Advance Market Commitment; SF, self-financing.

the high-income countries of group 1 (ranging from 91%/9% in United Arab Emirates to 55%/4% in Oman), intermediate in the middle-income countries of group 2 (ranging from 60%/10% in Iran to 14%/7% in Iraq) and group 3 (ranging from 62%/4% in Morocco to 20%/12% in Egypt) and lowest in the countries eligible for Gavi support from group 4 (ranging from 30%/12% in Pakistan to 1%/1% in Yemen) (figure 7). Vaccination coverage was lower in countries in humanitarian emergency situation in comparison with other countries in the same income group. For example, coverage in Iraq and Libya did not exceed 15%, whereas other upper middle-income countries vaccinated around 30% or more of their population. Countries did not report disaggregated coverage data among different priority target groups, for example, age, gender, migrants, refugees and other vulnerable groups.

Interpretations of the findings

After the successful introduction of COVID-19 vaccines in all EMR countries in the first 100 days of 2021, we addressed challenges to increase coverage in the subsequent phase. Support to regulatory approval led to in-country EUAs. COVAX delivered 179 793 310 doses to EMR countries. The regional acceptance surveys pointed to higher vaccine acceptance in higher income countries than in others. At the end of 2021, 30% of the population was fully vaccinated while another 8% was partially vaccinated. Analysis of the data through these steps of the result chain allowed to identify, understand and address the obstacles to reach higher coverage in the future.

New vaccine introductions have labour-intensive implications in terms of regulatory approval. Under routine circumstances, national immunisation programmes need

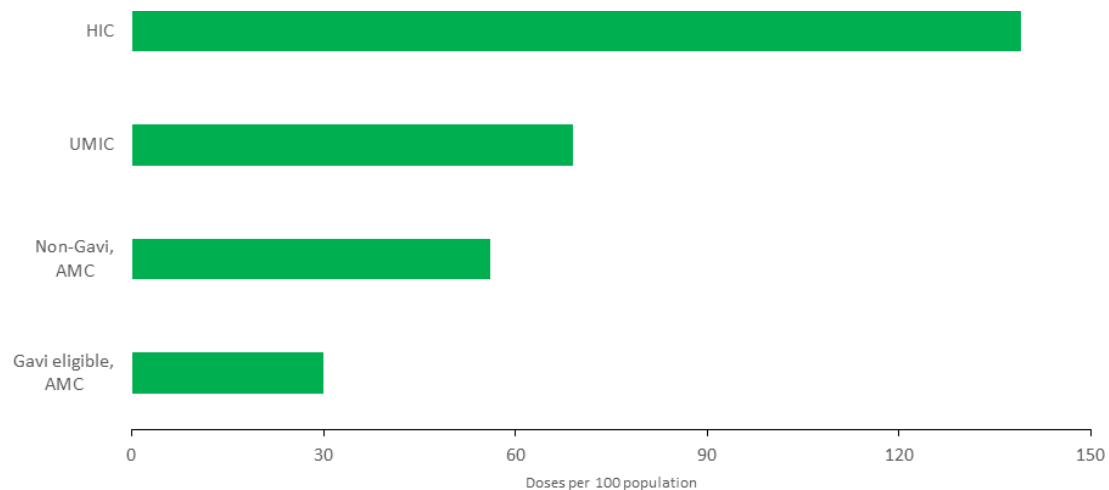


Figure 5 Ratio of doses administered per 100 population by group of countries, WHO Eastern Mediterranean Region, 31 December 2021. AMC, Advance Market Commitment; HIC, high-income country; UMIC, upper middle-income country.

First Round



Second Round

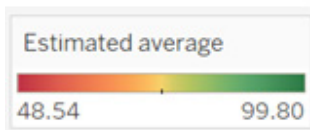


Figure 6 Eastern Mediterranean Region countries COVID-19 vaccine acceptance, expressed as percentage, WHO Eastern Mediterranean Region, June–July (first round) and October–November (second round), 2021.

to introduce one vaccine at a time, with ample amount of time to issue market authorisation. In the case of COVID-19 vaccine, this process had to take place on a larger scale, for more vaccines, and at an accelerated pace. In that high-pressure process, no corners were cut. WHO's leading contribution consisted in the issuance of EULs while national regulatory authorities followed with national EUAs. To some extent, the COVAX initiative facilitated the process by consolidating the offer around a smaller number of products. However, bilateral donations led to additional procedures that occasionally had a high transaction cost. Countries, supporting bodies and agencies may want to centralise donation through COVAX to simplify regulatory work.

During the first half of 2021, global shortage was the key bottleneck to COVID-19 vaccine deployment. AstraZeneca represented the highest proportion of COVID-19 vaccines received globally. As of December

2021, it accounted for 23.6% of COVID-19 vaccines globally and 24% of all vaccines used in the EMR (WHO/UNICEF unpublished data). Therefore, any disruption in its production or exportation led to a marked global shortage. After the wave of the Delta variant,¹² India stopped export of the Covishield-AstraZeneca coronavirus vaccine manufactured in the country. Some manufacturers failed to scale up their production and thus meeting their commitment to COVAX, which adversely affected COVID-19 vaccine supply. This shortage specifically affected supply to Gavi-eligible countries as they mostly relied on COVAX for vaccine supply. In this subsequent phase of the deployment, between June and December 2021, supply situation gradually improved, particularly to AMC countries. The quantities of vaccine made available further increased in the last quarter of 2021, which meant that the following challenge was to deliver the vaccine effectively.

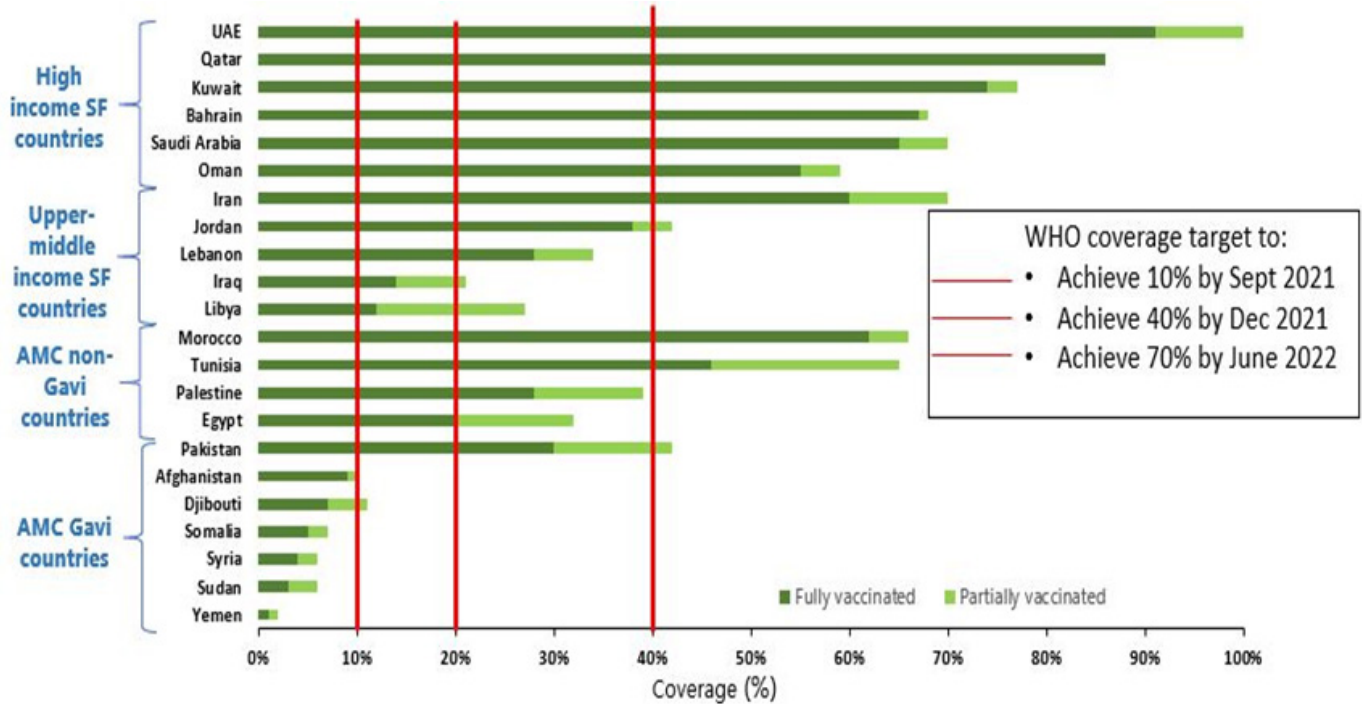


Figure 7 COVID-19 full and partial vaccination coverage, expressed as percentages, WHO Eastern Mediterranean Region, 31 December 2021. AMC, Advance Market Commitment; SF, self-financing.

AMC countries of group 3 and group 4 face major health system challenges in terms of vaccine delivery systems. As of December 2021, group 4 countries that were late in vaccine roll-out were catching up with larger volumes and improved vaccine usage. However, given the proposed target population, the current system for administering vaccines will need more support. These countries need to involve additional service delivery sites (hospitals, medical centres, primary healthcare, pharmacies and mega vaccination centres) and partners to scale up vaccination to a wider population faster. More health-care workers need to be trained as skilled vaccinators to deploy additional vaccination teams due to increasing workloads. This can be achieved through revised National Deployment and Vaccination Plans that include a costing for the required resources using the WHO COVID-19 Vaccine Introduction and deployment Costing tool.¹³ We also need to find ways to address short vaccine shelf lives as countries with weak health systems cannot cope with the short shelf life of donated vaccines. However, the vaccine delivery system only takes care of the supply side. The people also need to trust on benefits of vaccine and express demand to reach high coverage.

The vaccine acceptance survey suggested that the countries that deliver more vaccine have a higher level of acceptance than countries that were delayed in scaling up. In group 1 countries, high coverage and level of acceptance were associated with successful vaccination efforts. Earlier in 2021, when vaccines against COVID-19 were still seen as providing an unclear benefit, there were differences in global opinions with rumours, hesitancy and occasional high refusal among specific

groups. However, continued use of these vaccines, along with the documented low frequency of side effects, the transparency of communication and the public health benefits of vaccination, have improved the situation as these elements tend to increase acceptance. In a 2021 study, acceptance for COVID-19 vaccine was higher in lower middle-income countries than in the USA and Russia.¹⁴ Effective risk communication and community engagement interventions including efforts to generate vaccine demand, transparent communication, and effective management of related infodemics and serious side effects can affect knowledge, attitudes, and ultimately behaviours of communities toward vaccination. WHO must effectively communicate about the occurrence of serious illness, hospitalisation and fatality among population of higher risk infected with SARS-CoV-2 variants, particularly the new variants like Delta and Omicron.¹⁵ This, along with improved, client-friendly vaccine delivery systems, should continue to increase acceptance of the vaccine in the region and worldwide.

The introduction and scaling up of COVID-19 vaccine have challenged all aspects of vaccine delivery system to unprecedented levels. Coverage of COVID-19 vaccination improved substantially in the region since our last published update.¹¹ However, at the end of 2021, it remained heterogeneous and characterised by inequities in vaccine coverage among EMR countries that ranged from 1% to close to 100% across the region. Comparison of the range in the COVID-19 vaccine coverage with the range in routine immunisation suggests that COVID-19 vaccine introduction exaggerated pre-existing inequities in the region. These challenges can only be overcome

through efforts along with all the elements of the result chain, including addressing regulatory approval, making vaccine available to countries, improving or developing life course vaccine delivery systems as per Immunization Agenda 2030, and maintaining high demand of vaccine. The road map to increasing COVID-19 vaccine coverage will require a comprehensive approach that should also consider the need to restore routine immunisation coverage affected by the pandemic. This high coverage needs to be reached following the SAGE prioritisation framework. Those at higher risk of severe disease and death must be vaccinated first to optimise the impact of vaccination. We also have a duty to leave no one aside and to include eligible individuals in the most vulnerable groups, such as migrants, refugees and persons affected by conflicts.

Limitations

This update on vaccine deployment suffers from a number of limitations. First, the evolution of the supply of vaccine remains difficult to anticipate and will depend on the goodwill of high-income countries to increase vaccine equity. Second, acceptance for vaccination remains volatile and subject to antivax propaganda, recognition of different products in other countries, possible crises, especially following incidents of adverse events following immunisation. Structural barriers to vaccine uptake are not very clear, particularly in countries where the high vaccine acceptance is not consistent with the vaccine coverage. Third, immunisation programmes are still unclear on the way to combine COVID-19 and routine immunisation efforts to achieve both goals with an optimised approach. Fourth, we lack data on coverage for migrants, refugees and persons affected by conflicts. Finally, we still have limited data on vaccine effectiveness and impact assessment from low/middle-income countries.

CONCLUSION

Despite its limitations, this analysis of the deployment of COVID-19 vaccine in the EMR points to a number of conclusions. A large amount of regulatory work successfully led to enlisting a number of vaccine products for emergency use that opened the door for use of new vaccines over a short period of time. Following an initial shortage of vaccine, COVAX managed to supply more vaccines especially for the AMC countries during the last quarter of 2021. Vaccines made available were effectively used within the shelf life, and acceptance was not a major bottleneck. Overall, coverage remained heterogeneous. These conclusions point to a number of directions. We need to simplify and centralise all vaccine donations through COVAX, which will not only allow equitable distribution of available doses but will also help in consolidating and simplifying the required regulatory work. While we need to continue to mobilise additional doses of vaccine, we also need to develop sustainable vaccine

delivery systems within the overall health systems to administer the large quantities of vaccine coming through diversified platforms, while maintaining the vision of the Immunization Agenda 2030. Continued work on targeted and tailored risk communication and community engagement interventions, including supporting accessible and convenient vaccination services, will be needed to increase vaccine acceptance and uptake. Overall, COVID-19 vaccine deployment took inequities in access to vaccination to new extremes, underlining the need to find comprehensive solutions for vaccine delivery systems that will address both routine immunisation and pandemic response. We need to monitor and address inequities in vaccine coverage, whether they occur between countries or within the same country, according to sociodemographic status like age, gender, legal status such as refugee, migrant or vulnerable groups. Stronger impact monitoring with higher coverage will allow us to document our progress in terms of morbidity, mortality and societal recovery. The fight against vaccine injustice is needed not only on moral grounds, but also to make sure that the global community can look forward together to a sustainable recovery.

Twitter Osama Mere @Osama Mere and Rana Hajjeh @DrRanaHajjeh

Acknowledgements Manal Kamal Elzalabany prepared the acceptance map (figure 6).

Contributors QH is the primary and corresponding author of the manuscript who coordinated the deployment of COVID-19 vaccine in the region, along with monitoring and evaluation. He coordinated this work and the collection, analysis and interpretation of data, under the guidance of YJH and RH and in coordination with AA, the incident manager for the pandemic response. EE, KF, OM, AG, NM, HL, DS and IC contributed to the data collection, analysis and interpretation in their areas of work, including vaccination in emergencies, coverage monitoring, life course immunisation, laboratory support, logistics, regulatory authorities, acceptance and health systems, respectively. MMO consolidated and coordinated the data management and analysis. RA conducted a literature review, prepared drafts and collated input from coauthors. All authors contributed to conceptualising the work, drafting, reviewing and approving the different versions until the final one.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Map disclaimer The inclusion of any map (including the depiction of any boundaries therein), or of any geographic or locational reference, does not imply the expression of any opinion whatsoever on the part of BMJ concerning the legal status of any country, territory, jurisdiction or area or of its authorities. Any such expression remains solely that of the relevant source and is not endorsed by BMJ. Maps are provided without any warranty of any kind, either express or implied.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This analysis involves data reports from Ministries of Health and National Regulatory Authorities (NRAs) on the issuance of EUAs, EMRO online dashboard and reports from WHO focal points. The WHO EMRO Ethical Research Committee granted ethical clearance for the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID ID

Rania Attia <http://orcid.org/0000-0003-1441-6181>

REFERENCES

- 1 Wang J, Peng Y, Xu H, *et al*. The COVID-19 vaccine race: challenges and opportunities in vaccine formulation. *AAPS PharmSciTech* 2020;21:1–2.
- 2 WHO Director-General's opening remarks at the WTO - WHO high level dialogue: expanding covid-19 vaccine manufacture to promote equitable access. Available: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-wto-who-high-level-dialogue-expanding-covid-19-vaccine-manufacture-to-promote-equitable-access> [Accessed 10 May 2022].
- 3 World Health Organization. COVID-19 vaccines advice, 2021. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice> [Accessed 10 May 2022].
- 4 Burki T. Global COVID-19 vaccine inequity. *Lancet Infect Dis* 2021;21:922–3.
- 5 Torrelee E, Amon JJ. Equitable COVID-19 vaccine access. *Health Hum Rights* 2021;23:273.
- 6 WHO SAGE: Roadmap for prioritizing uses of COVID-19 vaccines in the context of limited supply. Available: <https://www.who.int/publications/i/item/who-sage-roadmap-for-prioritizing-uses-of-covid-19-vaccines-in-the-context-of-limited-supply>
- 7 WHO. Immunization agenda 2030. Available: <https://www.who.int/teams/immunization-vaccines-and-biologicals/strategies/ia2030?msclkid=4d3bfa4fd06811ecabb85c674d2f04c5>
- 8 Population Division - United Nations. World population prospects. Available: <https://population.un.org/wpp/> [Accessed 10 May 2022].
- 9 Bellizzi S, Lane C, Elhakim M, *et al*. Health consequences of drought in the WHO Eastern Mediterranean Region: hotspot areas and needed actions. *Environmental Health* 2020;19:1–9.
- 10 Al-Mandhari A, Kodama C, Abubakar A, *et al*. Solidarity in response to COVID-19 outbreak in the Eastern Mediterranean Region. *East Mediterr Health J* 2020;26:492–4.
- 11 Abubakar A, Al-Mandhari A, Brennan R, *et al*. Efforts to deploy COVID-19 vaccine in the WHO eastern Mediterranean region within the first 100 days of 2021. *East Mediterr Health J* 2021;27:433–7.
- 12 Lopez Bernal J, Andrews N, Gower C, *et al*. Effectiveness of Covid-19 vaccines against the B.1.617.2 (delta) variant. *N Engl J Med* 2021;385:585–94.
- 13 WHO. COVID-19 vaccine introduction and deployment costing tool (CVIC tool). Available: https://www.who.int/publications/i/item/who-2019-ncov-vaccine_deployment_tool-2021.1 [Accessed 10 May 2022].
- 14 Solís Arce JS, Warren SS, Meriggi NF, *et al*. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med* 2021;27:1385–94.
- 15 Kannan S, SSP A, Sheeza A. Omicron (B.1.1.529) - variant of concern - molecular profile and epidemiology: a mini review. *Eur Rev Med Pharmacol Sci* 2021;24:8019–22.