Vaccine 40 (2022) 5089–5094

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

# COVID-19 vaccine express strategy in Malawi: An effort to reach the un-reach

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ARTICLE INFO

*Article history:*
Received 7 July 2022
Accepted 12 July 2022
Available online 18 July 2022

*Keywords:*
Covid-19
Vaccine express
LMIC countries
Malawi

ABSTRACT

*Objectives:* To establish the impact of "Covid-19 Vaccination express" (CVE) on vaccine uptake in Malawi.
*Design:* Retrospective cross-sectional study to compare the daily vaccine administration rate in CVE and routine covid vaccination (RCV). RCV data was collected from March 2021 to October 2021. The data regarding CVE was collected from 5 November 2021 to 31 December 2021. Data was collected regarding (1) the total number and type of vaccine doses administered and (2) Demographic details like age, gender, occupation, presence of comorbidities, the first dose, or the second dose of the people who received a vaccine.
*Results:* From March-December 2021, a total of 1,866,623 COVID-19 vaccine doses were administered, out of which 1,290,145 doses were administered at a mean daily vaccination rate of 1854 (95 % CI: 1292–2415) doses as a part of RCV, and 576,478 doses were administered at a mean daily vaccination rate of 3312 (95 % CI: 2377–4248) doses as a part of CVE.

Comparing the mean daily doses (Astra Zeneca, AZ doses 1 & 2) administered in the CVE and RCV showed that the mean daily doses of AZ vaccine administered were significantly higher in the CVE ($p < 0.05$).
*Conclusion:* CVE successfully increased the uptake of the Covid-19 vaccine.


## 1. Background

Malawi is a low-income country with a population of 20,799,375 in 2021 [1]. The coronavirus disease-19 (COVID-19) vaccine was introduced on 11 March 2021 by the President of the Republic of Malawi. Till 25th October 2021, the government had received 2,425,790 doses of the Covid-19 vaccine, of which 640,350 were manufactured by Johnson and Johnson (J&J) and the rest by AstraZeneca (AZ). Out of the total Covid-19 vaccine doses, 2,273,790 were obtained from the COVAX facility (COVID-19 Vaccine Global access), 102,000 from the African Union, and 50,000 from the Indian government.

The first phase of vaccination targeted population groups at high risk of mortality from COVID-19, such as frontline health workers, social workers, individuals with comorbidities, and the elderly above 60 years of age. From May 2021 onwards, people aged 18–59 years, pregnant women, and marginalized people like prisoners and refugees were also offered the COVID-19 vaccine.

Overall, the uptake of the vaccines had been slow, with the consumption of 1,290,145 doses over eight months from March to October 2021, with a mean daily vaccination rate of around 1854 (95 %CI: 1292–2415). To improve the vaccine roll-out and uptake,

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https://doi.org/10.1016/j.vaccine.2022.07.014
0264-410X/

the Ministry of Health (MOH), in partnership with The United Nations Children's Fund (UNICEF) and stakeholders, conducted a preliminary survey to identify the reasons behind low vaccine uptake. The critical reasons specified were hard-to-reach areas, misinformation, fear of side effects, vaccine hesitancy, supply chain challenges, and a limited number of vaccines at the service point in remote places. Hence, a project, "Covid-19 Vaccination Express (CVE)", was implemented to achieve target 3.8 of the sustainable development goal [2]. This project aimed to increase vaccine uptake in the population. We designed this study to assess the impact of CVE on vaccine uptake. Our primary objective was to compare the daily vaccine administration rate in CVE and RCV.

## 2. Material and methods

We retrospectively analyzed the data obtained from the Ministry of Health, the Republic of Malawi. An approval from the National Health Sciences Research Committee, Malawi, was taken to conduct this study (IEC-397/08). RCV data was collected from March 2021 to October 2021. The data regarding CVE was collected from 5 November 2021 to 31 December 2021. Data was collected regarding (1) the total number and type of vaccine doses administered and (2) Demographic details like age, gender, occupation, presence of comorbidities, the first dose, or the second dose of the people who received a vaccine.

Our primary objective was to compare the daily vaccine administration rate in CVE and RCV. The impact of CVE on COVID-19 vaccination rate in different categories of the population like health care workers, social workers, those with comorbidities, individuals between 18 and 59 years of age, elderly more than 60 years of age, refugees, and prisoners were also assessed.

The following activities were implemented as a part of CVE from 5 November 2021 to 31 December 2021.

1. One tableau Mobile Van per district involving a multi-pronged strategy with the vaccine, logistics, and human resources (Fig. 1)
2. COVID-19 Mobile Vaccination Clinic in remote places to reach hard-to-reach populations
3. Additional Fixed Vaccination sites/ Drive-in through Vaccination sites with extended vaccine access points in shops, markets, bus stands, etc.
4. Community awareness/sensitization and engagement through Community Radio and the involvement of Local/ religious leaders
5. Vaccination of Non-Resident Malawian (NRM) returning during the Christmas period at the international border

Sufficient vaccines and logistics were ensured to session sites from the nearest cold chain points to avoid missed opportunities. The vaccinator and support staff then provided the registration and vaccination of eligible beneficiaries. The vaccination team deployed with the vaccine express properly managed recording, reporting, and treating AEFI (adverse events following immunization). The team collected all immunization bio-wastes and disposed of them as per the guidelines.

## 3. Statistical analysis

Collected data were compiled and analyzed using Microsoft Excel 2010 (Microsoft Corporation, Redmond, Washington, USA). Descriptive statistics (mean ± standard deviation with 95 % confidence interval (CI)) was calculated for quantitative data related to the first and second doses of AZ vaccine and J&J vaccine doses with different categories like Health workers, Social Workers, Comorbid, 18–59 years, more than 60 years, Refugees & Prisoners. The Shapiro-Wilk and Kolmogorov-Smirnov tests were the first normality tests. Depending upon the results from normality tests, a non-parametric test (Mann-Whitney *U* test) or parametric test (Student's *t*-test) was done to compare the CVE and RCV. The p-value $< 0.05$ was taken as the statistical significance for all analyses.

## 4. Results

From March-December 2021, a total of 1,866,623 COVID-19 vaccine doses were administered, out of which 1,290,145 doses were administered over eight months (11 March-31 October) at a mean daily vaccination rate of 1854 doses (95 %CI: 1292–2415) as a part of RCV and 576,478 doses were administered over two months (5 November- 31 December) with a mean daily vaccination rate of 3312 doses (95 %CI: 2377–4248) as a part of CVE. Comparing the brand-wise percentage of vaccine doses showed that the AZ brand vaccine (doses 1 and 2) was higher in CVE. In contrast, the portion of the J&J brand vaccine was higher in the RCV (Fig. 2).

The mean daily doses of AZ vaccine and J&J vaccines administered during the RCV and CVE are shown in Table 1.

Comparing the mean daily doses (AZ dose 1 & 2) administered in the CVE and RCV showed that the mean daily doses administered were higher in CVE than RCV (Table 1). Normality tests conducted by Shapiro-Wilk ($p = 0.05$) and Kolmogorov-Smirnov ($p = 0.05$) were significant for both AZ doses and the J&J vaccine, concluding that data did not follow a normal distribution (Table 1). A Mann-Whitney *U* test was used to establish a statistical difference after the normality test, which showed a significant difference

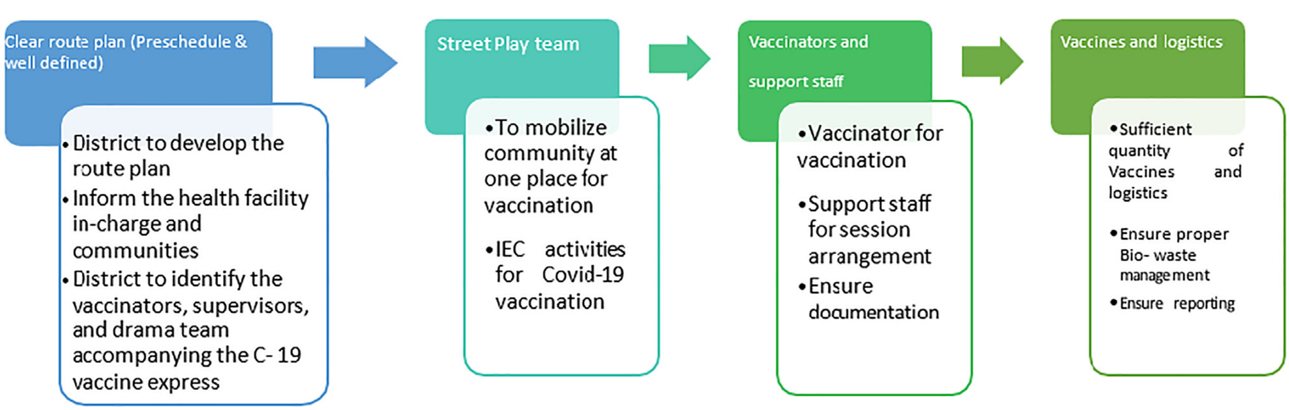


**Fig. 1.** Methodology of vaccine express.

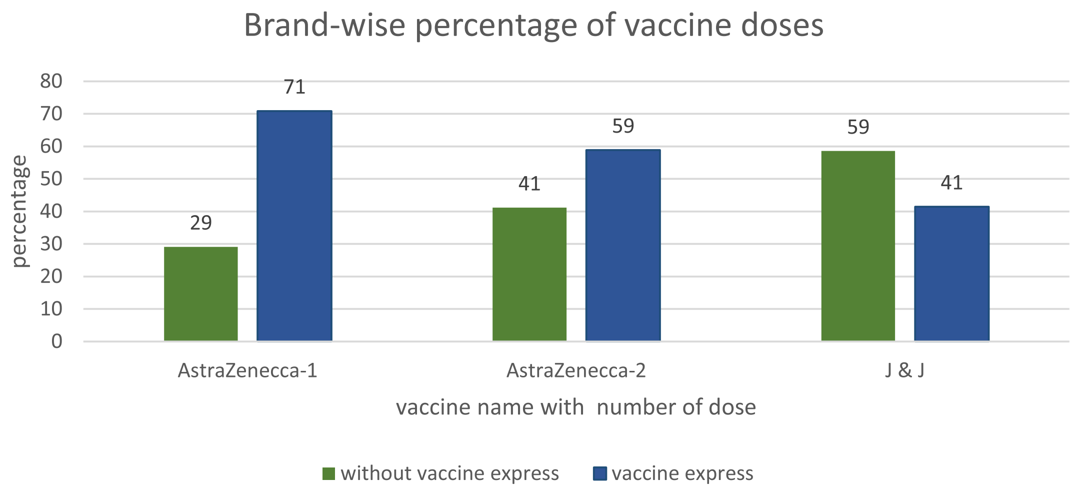


**Fig. 2.** Brand-wise percentage of vaccine doses administration administered by routine vaccination and vaccine express program.

**Table 1**
Comparison of mean daily doses (AZ, J&J vaccine) administered by RCV and CVE.

| Category | MEAN ± SD "RCV" | 95 % confidence interval | MEAN ± SD "CVE" | 95 % confidence interval | Shapiro Wilks test | P-value | Mann-Whitney U | P-value |
|---|---|---|---|---|---|---|---|---|
| **AstraZeneca Dose 1** | 2944.28 ± 3778 | 1507–4381 | 7170.36 ± 5461 | 5092–9247 | 0.835 | 0.001 | 183 | 0.005 (S) |
| **AstraZeneca Dose 2** | 1267.03 ± 1852 | 562–1971 | 1812.71 ± 1833 | 1115–2510 | 0.725 | 0.001 | 335 | 0.18 (NS) |
| **Johnson and Johnson** | 1350.07 ± 1322 | 846–1853 | 955.53 ± 1570 | 358–1552 | 0.733 | 0.001 | 239 | 0.005 (S) |

S: significant, NS: non-significant.

**Table 2**
Category-wise comparison of the mean daily doses of Astra Zeneca vaccine during RCV and CVE.

| Category | MEAN ± SD "RCV" | 95 % confidence interval | MEAN ± SD "CVE" | 95 % confidence interval | Normality test/ Shapiro Wilks test | P-value | Mann-Whitney U | P-value |
|---|---|---|---|---|---|---|---|---|
| **Health workers** | 201.21 ± 238. | (110–291) | 13.90 ± 14.184 | (8–19) | 0.522 | 0.0001 | 15 | 0.0001 (S) |
| **Social Workers** | 690.90 ± 1464. | (133–1247) | 384.98 ± 677 | (127–642) | 0.442 | 0.0001 | 324 | 0.13 (NS) |
| **Comorbid** | 201.41 ± 279 | (94–307) | 143.31 ± 111 | (101–185) | 0.670 | 0.0001 | 405 | 0.81 (NS) |
| **18–59 years** | 1526.69 ± 1864 | (817–2235) | 5904.14 ± 4580 | (4161–7646) | 0.815 | 0.0001 | 134 | 0.001 (S) |
| **>60 years** | 317.76 ± 368 | (177–457) | 695.45 ± 489 | (509–881) | 0.876 | 0.0001 | 203 | 0.001 (S) |
| **Refugees** | 2.93 ± 9.8 | (−0.83–6.69) | 10.12 ± 38.55 | (−4.5–24) | 0.242 | 0.0001 | 409 | 0.83 (NS) |
| **Prisoners** | 3.45 ± 6.8 | (0.83–6.07) | 19.05 ± 57.701 | (−2.90–41) | 0.251 | 0.0001 | 346.5 | 0.20 (NS) |

S: significant; NS: non-significant.

($P < 0.05$) between the number of doses administered for the AZ vaccine first dose and J&J vaccine during CVE and RCV, whereas for the AZ second dose mean difference although high, was not statistically significant (Table 1).

The category-wise comparison of the mean daily doses of AZ vaccine administered as a first dose during RCV and CVE is tabulated in Table 2.

Normality tests conducted by Shapiro-Wilk ($p = 0.00$ for both) and Kolmogorov-Smirnov ($p = 0.05$ for both) were significant for all categories like health workers, social workers, comorbid, 18–59 years, more than 60 years, refugees, and prisoners, concluding that the data did not follow the normal distribution (Table 2). A Mann-Whitney *U* test showed significantly higher mean daily doses administered to people between 18 and 59 years and the elderly over 60 years ($P < 0.05$). In contrast, although high for refugees and prisoners, the mean difference is not statistically significant during CVE compared to RCV (Table 2).

Statistical analysis for category-wise comparison of second doses of AZ from CVE and RCV is shown in Table 3.

Normality tests conducted by Shapiro-Wilk ($P = 0.05$) and Kolmogorov-Smirnov ($P = 0.05$) were significant for all categories like health workers, social workers, comorbid, 18–59 years, more than 60 years, refugees and prisoners, concluding that data did not follow a normal distribution (Table 3). A Mann-Whitney *U* test showed a significantly higher mean number of second doses of AZ vaccine administered for 18–59 years people ($p = 0.01$) whereas,

**Table 3**
Category-wise comparison of the mean daily doses of AZ Vaccine administered as a second dose during RCV and CVE.

| Category | MEAN ± SD "RCV" | 95 % confidence interval | MEAN ± SD "CVE" | 95 % confidence interval | Normality test/ Shapiro Wilks test | P-value | Mann-Whitney U | P-value |
|---|---|---|---|---|---|---|---|---|
| **Health workers** | 116 ± 145 | (61–171) | 22 ± 5.3 | (11–33) | 0.50 | 0.001 | 101 | 0.001 (S) |
| **Social Workers** | 406 ± 865 | (77–736) | 206 ± 82 | (54–357) | 0.34 | 0.001 | 271 | 0.002 (S) |
| **Comorbid** | 75 ± 97 | (38–112) | 74 ± 20 | (41–107) | 0.58 | 0.001 | 397 | 0.72 (NS) |
| **18–59 years** | 519 ± 90 | (271–767) | 1261 ± 1308 | (762–1761) | 0.63 | 0.001 | 262 | 0.01 (S) |
| **>60 years** | 138.14 ± 155 | (79–197) | 241 ± 1677 | (150–333) | 0.72 | 0.001 | 321 | 0.21 (NS) |
| **Refugees** | 2.72 ± 10.7 | (−1.35–6.80) | 2.74 ± 16 | (−1.45–6.93) | 0.25 | 0.001 | 400 | 0.66 (NS) |
| **Prisoners** | 7.34 ± 8.4 | (4.13–10.56) | 3.5 ± 43 | (0.04–6.96) | 0.37 | 0.001 | 280 | 0.01 (S) |

S: significant; NS: non-significant.

**Table 4**
Category-wise comparison of the mean daily doses of Johnson and Johnson's vaccine administered during the RCV and CVE.

| Category | MEAN ± SD "RCV" | 95 % confidence interval | MEAN ± SD "CVE" | 95 % confidence interval | Shapiro Wilks test | P-value | Mann-Whitney U | P-value |
|---|---|---|---|---|---|---|---|---|
| **Health workers** | 20 ± 21.48 | (12–29) | 3.09 ± 5.3 | (1.07–5.10) | 0.632 | 0.0001 | 66.5 | 0.001 (S) |
| **Social Workers** | 250 ± 451.3 | (78–422) | 45.10 ± 82 | (13–76) | 0.409 | 0.0001 | 120 | 0.001 (S) |
| **Comorbid** | 46 ± 41.48 | (31–62) | 13.88 ± 20 | (6–21) | 0.745 | 0.0001 | 135.5 | 0.001 (S) |
| **18–59 years** | 889 ± 813.8 | (579–1198) | 777.86 ± 1308 | (279–1275) | 0.734 | 0.0001 | 262 | 0.001 (S) |
| **> 60 years** | 137 ± 103.8 | (98–177) | 97.90 ± 167 | (34–161) | 0.785 | 0.0001 | 220 | 0.002 (S) |
| **Refugees** | 0.86 ± 2.7 | (−0.17,1.90) | 3.78 ± 16 | (−2.48–10) | 0.196 | 0.0001 | 419 | 0.9 (NS) |
| **Prisoners** | 4 ± 7.3 | (1.41–7.00) | 13.93 ± 43 | (−2.54–30) | 0.315 | 0.0001 | 293 | 0.01 (S) |

S: significant; NS: non-significant.

although high for >60 years people but not statistically significant during the CVE compared to RCV (Table 3). The mean number of second vaccine doses among those with comorbid illness and refugees was almost identical in both the programs.

Statistical analysis of category-wise comparison of J&J's doses by CVE and RCV is shown in Table 4.

Normality tests conducted by Shapiro-Wilk ($p = 0.05$) and Kolmogorov-Smirnov ($p = 0.05$) were significant for all categories like health workers, social workers, comorbid, 18–59 years, more than 60 years, refugees, and prisoners concluding that data did not follow a normal distribution. A Mann-Whitney *U* test showed no statistically significant difference in the refugees' category, although higher in CVE than RCV. The same test for the rest of the categories like healthcare workers, social workers, comorbid,18–59 years people, more than 60 years, and prisoners showed a significantly higher number of J&J vaccine doses in RCV in comparison to CVE results ($P < 0.05$) because the main focus of the vaccine express program was the AZ vaccine.

## 5. Discussion

CVE was introduced to ensure the reach of vaccines, health workers, and IEC (information, education, and communication) activities to all parts of the country, including the remotest of the rural locations where community settlements are high. It brought multiple stakeholders to one platform, including the community and religious leaders. We found that CVE was highly successful in increasing vaccine uptake in Malawi. The mean daily vaccination rate increased from 1854 (95 %CI: 1292–2415) doses as a part of RCV to 3312 (95 %CI: 2377–4248) doses as a part of CVE.

Category-wise analysis revealed that the mean daily doses of vaccine administered to health care workers, social workers, and those with comorbidities were higher during RCV than in CVE. This may be because the first phase of vaccination targeted frontline workers, social workers, individuals with comorbidities, and the elderly above 60 years. In the elderly population, mean daily doses of vaccine were higher in CVE than in RCV; few studies have shown vaccine hesitancy is higher in the elderly [3]. The strategies used in CVE, like mobile vaccination vans, helped increase uptake in the elderly.

The uptake of the AZ vaccine was more than that of the J&J vaccine because the expiry date of the AZ vaccine was earlier than the J&J vaccine. Thus, CVE successfully increased the vaccine utilization and rationalized the expedited uptake of AZ vaccine doses that were near expiry compared to J&J doses.

The success of CVE can be attributed to the fact that it made the covid-19 vaccine both accessible and acceptable. Thus, it played an essential role in reducing vaccine hesitancy and increasing vaccine uptake.

Vaccine hesitancy is one of the crucial factors that could nullify all the hard work of enhancing vaccination [4,5]. World Health Organization (WHO) has labeled vaccine hesitancy as one of the top ten threats to global health [6]. It is the leading cause of low coverage of COVID-19 vaccination in many countries (like Malawi) and is prevalent in low-income and high-income countries [6,7]. A systematic review from the USA showed vaccine acceptance rates ranging from 12 to 91.4 %, which is lowest in Black/African Americans (most of Malawi population were also black), pregnant and breastfeeding women [6]. Low vaccine acceptance among women, especially pregnant and breastfeeding, may be due to a lack of firm and consistent guidance in national policy regarding COVID-19 vaccination [8]. A Nigerian study found that unreliability of clinical trials, safety, and high cost are the main reasons for vaccine hesitancy [9]. A study from Bangladesh also emphasized the importance of affordability [10]. Similarly, in Malawi, affordability is the main issue for vaccine hesitancy as 50.7 percent of the population live below the poverty line, and 25 percent live in extreme poverty. In Ethiopia, concern for vaccine safety was the top reason for vaccine hesitancy [11]. However, in African countries (like Malawi), the fragmented healthcare system was the main reason hindering the acceptance of the COVID-19 vaccine [12]. Slum-dwellers, residents of semi-urban and rural areas, daily wager, divorced, widowed, prisoners, and drug addicts are more vaccine-hesitant as belonging to a partly excluded social group negatively affected the COVID19 vaccination [7,12,13,14] (approaching this group at their place might have built a sense of inclusiveness resulting in increased vaccination uptake in CVE). The high hesitancy is due to mistrust in the government, lack of confidence in the vaccine's efficacy and the integrity of the providers, anti-vaccine campaigns on social media, religious beliefs, and socioeconomic status [13] (Communication strategy adopted by CVE had overcome these issues of vaccine hesitancy).

LMICs with poor infrastructures, including inadequate roads, lead to an enormous difficult-to-reach population [15,16,17]. Ensuring access for every individual requires investment in infrastructure and domestic distribution [18]. Many LMICs face substantial hardship in the last-mile delivery of vaccines, especially to people living in more remote, rural, low-density areas. Data from Sierra Leone showed that a trip to a vaccination center for a person residing in a rural community is $6 and 1.5 h, which is a deterrent to vaccine acceptance, especially where more than 56 % of its population is living hand-to-mouth with an income of less than $1.25 per day [19].

Thus, in LMICs, the real issue is accessibility along with hesitancy. The same holds for Malawi, where 90 % of the population stays in hard-to-reach areas and has no public transport facilities. Therefore, mobile vaccination teams that deliver vaccines close to where people live have successfully increased vaccine uptake, as is evident in studies from Ghana, Liberia, India, Pakistan, and Sierra Leone [16,17]. These mobile teams involving nurses are backed by community mobilizers for sensitization and gathering people to administer the vaccine efficiently. These "outreach clinics" models have been successfully implemented to provide immunization services in hard-to-reach populations to eliminate measles in Gambia [20] (like one of the components of CVE).

Vaccination is a social contract whose success depends on the critical number of vaccinated individuals at the population level. 70 % of the world population should be vaccinated to achieve herd immunity [21]. So, we need more doses of COVID-19 to inoculate enough people for global vaccine immunity. Delayed vaccination in LMICs can lead to the development of new variants, as seen recently with the Delta and Omicron variants, which could spread globally and resist vaccines, thereby putting all efforts back to "square one" in the fight against the pandemic [22].

So, besides procuring a sufficient number of vaccines, policymakers should expand their capacity to administer them and achieve collective behavior change [14]. It includes strategic use of logistics with micro-planning to vaccinate individuals, disseminating the information on vaccine availability and eligibility, and an approach to reduce vaccine hesitancy [14]. Successful strategies to reduce vaccine hesitancy require a multi-purpose framework including increased awareness, community engagement, involvement of religious and community leaders, community mobilization, training and education of health care professionals, nonfinancial incentives, mass media campaigns, understanding concerns, building trust, managing rumors, and misinformation, and making the availability of vaccines at various convenient and accessible places such as churches, mosques, and markets [7,14,23] (CVE was a success in bringing all stakeholders together).

## 6. Conclusion

Malawi is one of the poorest countries in the world, with 50.7 percent of the population living below the poverty line and 25 percent living in extreme poverty. To get the covid-19 vaccine, most communities were supposed to travel to different locations.

With no public transport infrastructure in the country, it was tough for the general public to spend money from their pocket to reach the vaccination site to get a jab. To reach nearby health facilities in Malawi, most of the population is supposed to spend around 4000 to 6000 MWK (Malawi Kwacha). Accelerating vaccine roll-out in LMICs during pandemics requires equitable vaccine distribution and parallel, complementary investments for vaccine distribution to end the pandemic globally. Hence, CVE, conceptualized by UNICEF and the Ministry of Health-*EPI* to reach the un-reach population with Covid-19 vaccines, was essential in Malawi.

CVE ensured the availability and utilization of all Covid- 19 vaccination program components at one platform, particularly in Malawi's remote and inaccessible locations. CVE showed promising results regarding the Covid-19 vaccine acceptance by the communities in different settlements. It benefitted the vaccination program in two ways: it could reach the remotest population with potent vaccines and increase the vaccine uptake to save the wastage of vaccines in terms of expiry.

**Limitation of the study**

The impact of individual key activity of CVE was not analyzed.

**Ethics approval**

An approval from the National Health Sciences Research Committee was taken to conduct this study (IEC-397/08). The funding agency is not involved in data collection, analysis, and interpretation.

**Contributor statement**

GS, MNC, TD, and CM designed the study. KJ analyzed the data with help from LS, SS, PON, SM, TD, and AEB. KJ, SS, CM, MT, BL, and JF contributed to the interpretation of the results. SS, KJ, and LS drafted the original manuscript with editing and final approval from all authors. GS and KJ are responsible for the overall content.

## Funding

JF has received a grant from UNICEF to implement the Covid-19 vaccination express project (Grant No. SM219920).

## Data availability

Data will be made available on request.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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