Commentary

Lessons learned from the Global Polio Eradication Initiative: A roadmap for the international COVID-19 vaccination campaign

William B.Belshe[1]*, Jared M. Alswang[2]*, Alexander M. Uplift-Brown[1], Luso Chilenga[3], John Chipolombwe[4], Vincent Y. Seaman[5]

1. David Geffen School of Medicine at UCLA (Los Angeles, CA)
2. Harvard Medical School (Boston, MA)
3. Chitipa District Health Office (Chitipa, Malawi)
4. Mzuzu Central Hospital (Mzuzu, Malawi)
5. Bill & Melinda Gates Foundation (Seattle, WA)

Corresponding Authors: William B. Belshe; E-mail: wbelshe@mednet.ucla.edu

***William B. Belshe and Jared M. Alswang are co-first authors for this paper**

Abstract

The COVID-19 vaccine is lauded by many as one of the greatest accomplishments in modern medicine, with the potential to definitively contain the deadliest pandemic of the last century. With the vaccine rollout now underway in the developing world, a robust, methodical, and swift global distribution effort is required to ensure that it will be done in an equitable manner. Taking into account the vast geographic, socioeconomic, cultural, and political diversity of countries around the world, global vaccination efforts have historically required multifaceted, time consuming, and labor-intensive approaches to be effective. However, with over 33 years of experience from the Global Polio Eradication Initiative – an international health initiative aimed at eradicating poliomyelitis – the COVID-19 vaccination campaign does not have to be approached blindly. Using lessons learned from the Global Polio Eradication Initiative, this paper aims to identify the supply- and demand-side barriers to the success of the international COVID-19 vaccination effort, and ways each can be overcome. Most notably, health systems shortcomings, political and cultural messaging, and civil unrest and violent conflict serve as daunting obstacles to the success of the COVID-19 vaccination campaign. The Global Polio Eradication Initiative has been able to overcome many of these same obstacles with innovative strategies such as context-specific microplanning, robust health surveillance systems, and community-centered education and advocacy programs. Ultimately, while the Global Polio Eradication Initiative is still fighting the battle of polio eradication, it has provided a roadmap for the COVID-19 vaccination campaign to be executed in a more swift and equitable manner.

Introduction

The first COVID-19 case was reported in December 2019, marking the start of what has become the deadliest pandemic in the last century. While the public health, economic, and sociocultural consequences of COVID-19 were unprecedented, so too was the speed at which the COVID-19 vaccine was developed. However, as doses of the COVID-19 vaccine flood high-income countries (HICs), the epicenter of the vulnerability shifts to low- and middle-income countries (LMICs) – where the infrastructure needed to treat and control the spread of the virus remains under-developed. Recent data shows that less than 3% of individuals in low-income countries (LICs) have received a dose of the COVID-19 vaccine, compared to more than 60% in HICs[1]. Ultimately, while the COVID-19 vaccine is rightfully lauded by many as one of the greatest accomplishments in modern medicine, it will be added to the ever-growing list of global health inequities if the global distribution effort is not robust, methodical, and swift.

The global health community is no stranger to disparities of resource allocation and subsequent health outcomes. Consider wild poliovirus (WPV): the continent of Africa was certified WPV-free in August of 2020 after a 32-year vaccination effort spearheaded by the Global Polio Eradication Initiative (GPEI), a public-private partnership involving the world's most preeminent health organizations and philanthropies[2]. In contrast, WPV was eradicated from the United States in 1979 – almost 10 years before the GPEI even began[3]. While the GPEI has succeeded in reducing the annual incidence of WPV by 99.9%, WPV remains endemic in Pakistan and Afghanistan – propped up by a complex interplay of political, societal, and cultural forces[2,4]. Now, as COVID-19 continues to accelerate and mutate, it is vital that we draw upon the lessons learned over 33 years of the GPEI, in order to equitably organize and execute another international vaccination effort. In this paper, we aim to identify the predominant barriers to the success of the COVID-19 vaccination campaign, and ways each can be overcome.

Barriers to success for the COVID-19 vaccination campaign

Both supply-side and demand-side barriers contribute to profound disparities in the COVID-19 global vaccination campaign. On the supply-side, there is a growing shortage of vaccines allocated and delivered to LMICs, as evidenced by vaccine supply falling 25% short of what was required to meet the WHO's goal of vaccinating 10% of Africans by September 2021[5]. Of the 945 million doses promised by HICs, only 13% have been delivered to LICs[1]. This is in stark contrast to countries like the United States and the United

https://dx.doi.org/10.4314/mmj.v34i4.12

Kingdom, who have secured enough doses to vaccinate and provide boosters to all eligible populations. LMICs, on the other hand, remain reliant on COVAX, a struggling public-private partnership that have thus far administered only 4% of the total vaccines worldwide.6 Due to the supply constraints experienced by COVAX, only 39 of 89 eligible LMICs received doses during the October 2021 allocation round with uniquely vulnerable countries like Sudan, Somalia, and Yemen left off of the list[1].

Doses of the COVID-19 vaccine that do reach LMICs still have a difficult road to administration. Because it is an intramuscular shot, the COVID-19 vaccine requires access to clean syringes and must be administered by trained medical professions – often in settings where the health workforce is already stretched thin by the pandemic. UNICEF projects that, even with an unlimited access to vaccine doses, the world would still require an additional 2.2 billion auto-disabling syringes to meet the UN General Assembly vaccination goals[7]. Additionally, the Pfizer-BioNTech and Moderna vaccines only last 5 and 30 days at 4-8°C, respectively[8-10]. A relative lack of storage infrastructure and reliable power sources stands to complicate the cold-chain requirements of the COVID-19 vaccine and contribute to expiration and waste. Furthermore, these barriers are even more pronounced in countries like Afghanistan, Syria, Yemen, and Haiti where conflict, unrest, and natural disasters have further stressed health and civil infrastructure[11-13].

In addition to infrastructural shortcomings, demand-side barriers have also significantly impacted vaccine uptake globally. Reasons for vaccine refusal vary by country but are most often related to concerns about safety and side effects, or a general distrust of the vaccine[14,15]. While vaccine hesitancy has increased around the world in recent years, it appears to be more pronounced with the COVID-19 vaccine[16]. The African CDC's report on COVID-19 vaccine perception showed that while 78% of respondents believe vaccines in general are safe, only 68% share that opinion about the COVID-19 vaccine[15]. While there exists a long and shameful history of unethical colonial medicine throughout Africa that contributes to mistrust, the ubiquity of social media has also been increasingly highlighted as a source of misinformation surrounding the COVID-19 vaccine[15,17]. In fact, social media has been identified as the primary source of misinformation in nearly 60% of cases, disproportionately affecting persons aged 18-24 years old, a demographic that is already less likely to accept the vaccine in many countries[15]. This is compounded by a growing distrust in the both government and scientists among LMICs, contributing to decreased vaccine acceptance in these populations[18-20].

Even positive health behaviors have the potential to interfere with vaccination efforts, as social distancing guidelines may deter vaccination clinic attendance and act as a barrier to door-to-door vaccination efforts. Given the psychosocial complexity of demand-side barriers, effective solutions require nuanced, context-specific approaches.

Barriers to success for the GPEI

Health Systems

While the COVID-19 and poliovirus vaccination campaigns share many of the same barriers, their supply-side barriers are not completely analogous. The OPV has many logistical advantages relative to the COVID-19 vaccine. Notably, because United States eradicated WPV years before the GPEI began, there was not an arms race for vaccine access[6]. Additionally, because the poliovirus vaccine is orally administered, it does not require the same degree of medical training and safe administration is not contingent on access to clean syringes.

While the GPEI benefited from easier vaccine procurement and administration, working within limiting infrastructural frameworks created many programmatic challenges. For example, even though the OPV lasts months longer than the COVID-19 vaccine, episodic cold-chain system failure still occurs due inconsistent electricity sources in rural areas. In the case of rural north India, this would lead to seasonal spikes in WPV cases[21]. Despite bearing a disproportionate burden of diseases, rural and remote areas often lack quality health services and infrastructure due to their geographical isolation, high rates of poverty, and fragmented supply chains. In Nigeria, the last African country to successfully eradicate polio, over a third of the cases in 2014 came from hard-to-reach settlements[22]. Countries like Angola and Chad presented similar challenges with topographically isolated and nomadic populations[23,24].

Even with acute flaccid paralysis (AFP) surveillance meeting global standards in the mid-2000s, sub-national inefficiencies led to delays in both outbreak response and programmatic planning in areas like central Africa, Nigeria, and Pakistan[25]. In Nigeria specifically, lack of quality assurance, documentation, and even accurate geographical mapping contributed to children in certain settlements being chronically missed[26]. Without a clear epidemiological picture – which requires accurate data on both polioviruses cases and community vaccination rates – it is difficult to design highly effective interventions.

Civil Unrest and Violent Conflict

While associated in many ways with failures of health systems to deliver vaccines, civil unrest and violent conflict have served as significant external barriers to WPV eradication in countries like Afghanistan, Pakistan, and Nigeria. As of 2018, 100 of Afghanistan's 325 districts were inaccessible to humanitarian groups due to restrictions put in place by non-state armed groups. In Taliban-occupied regions, restrictions and civilians' mistrust of vaccinators have led to decreased house-to-house vaccination success[27]. Given its international importance, polio vaccination efforts are often targeted by insurgent groups as a means of putting pressure on governments they are fighting. In Pakistan, more than 100 polio vaccinators and members of their security convoys have been killed since 2012[28].

Nigeria encountered many of the same problems, as displacement of communities and threats of violence in Boko Haram-occupied Northeastern Nigeria interfered with both vaccine distribution and virus surveillance efforts[27]. Demographic Republic of Congo and Sierra Leone did not even implement polio eradication efforts until 2000 – 12 years after GPEI began – due to ongoing violent conflicts[25]. It remains to be seen whether the COVID-19 vaccination campaign will be subject to similar antagonism and delays, but the presence of insurgencies across the Middle East, West Africa, and the Sahel has and will likely continue to serve as a barrier to distribution.

Political and Cultural Messaging

A persistent and pervasive impediment to the success of GPEI is the variety of demand-side barriers created by

https://dx.doi.org/10.4314/mmj.v34i4.12

sociocultural customs and political messaging. For example, in Nigeria, political and religious leaders in the Northern states boycotted the OPV in 2003, on the basis that it was contaminated with antifertility-, HIV-, and cancer-causing agents. Stemming from a misalignment between the values of local, federal, and Western stakeholders, this erroneous messaging by respected local leaders sowed distrust in both the OPV and the intentions of the GPEI – contributing in part to Nigeria's difficulty eradicating WPV[29]. Distrust of the OPV is driven by similar fears and misinformation in Pakistan, where many believe the vaccine is intended to sterilize Muslim girls[30].

In certain cases, political and militant groups have been able to take advantage of the urgency of GPEI's mission to leverage political power. For example, Northern Nigeria's boycott of OPV in 2003 was also used as an attempt to wield religious and political power over the central government of Nigeria[31]. Difficulties untangling political motives from vaccination efforts have placed significant strain on the GPEI, and similar trends are already being seen in the COVID-19 vaccination campaign.

Overcoming barriers

As highlighted, there are many barriers to international vaccination campaigns. However, while barriers like misinformation and health systems failures can exist independent of one another, the solutions needed to overcome these barriers are necessarily multifactorial and intertwined.

The primary framework used by the GPEI to overcome supply-side barriers is microplanning – the process of identifying and mapping target populations, appraising resources requirements, training vaccinators and supervisors, and administering the vaccine with continual monitoring, feedback, and updates to the plan[32]. In countries like Nigeria, with 774 local government areas, each with unique governments and demographics, a one-size-fits-all approach does not work[33]. Microplanning has been effective by promoting context-specific initiatives that incorporate the perspectives of local, federal, traditional and religious stakeholders[26].

Microplanning is deliberate and iterative. Polio-affected countries and partner organizations aggregate data that is analyzed by the Independent Monitoring Board (IMB) – a group of nine public health or communications experts without any connection to GPEI – that produces reports to clearly communicate problems and solutions that help guide future microplans. Pakistan stands as living proof that this process is effective, as WPV incidence fell by 70% the year after IMB highlighted urgent concerns with the country's program. However, the IMB is unique to the GPEI and multinational independent monitoring and evaluation frameworks do not exist for COVID-19[34].

Equally as important to the success of the GPEI is the deployment of community-specific interventions through community-based education and advocacy programs. Consider Ethiopia, whose rural majority is sparsely distributed across a vast, isolated, and mountainous geographic region that is supported by weak health systems. To combat WPV, Ethiopia adopted a strategy under the CORE Group Polio Project (CGPP) that utilized community volunteers to disseminate health information and oversee disease surveillance[35]. With the support of local-global partnerships, this community-based program succeeded in elevating community knowledge of WPV, and ultimately increased vaccine uptake and coverage. Ethiopia declared itself free of endemic WPV in 2014[36].

Similarly, India's Social Mobilization Network (SMNet) employed a multifaceted approach – predominantly spearheaded by women within affected communities – to engage vested local-stakeholders, educate families house-to-house, and increase media awareness. At SMNet's inception in 2001, Muslim children were five times less likely to receive the first dose of the OPV and bore a disproportionate burden of the disease. However, the success of SMNet enabled India to overcome the many demand-side barriers to WPV eradication and record its last case of WPV in 2011[37]. The African CDC's report on COVID-19 vaccine perception showed that only 50% of African respondents felt adequately informed about the COVID-19 vaccine[15]. Accordingly, interventions that increase knowledge and build trust in the vaccine, like CGPP and SMNet, will be integral in the success of a robust international COVID-19 vaccination effort.

However, it is important to note that SMNet and the CORE Group were programs supported by non-governmental organizations (NGOs) such as UNICEF, USAID and the amalgam of organizations that make up and fund the GPEI. While the Access to COVID-19 Tools (ACT) Accelerator has leveraged the resources of organizations like the WHO, The Bill & Melinda Gates Foundation, GAVI and the World Bank to address supply-side issues of the COVID-19 pandemic – via expedited production and access to testing, treatments and vaccines – there remains a dearth of international efforts focused on demand-side barriers[38].

Until there exists a robust funding and organizational framework to support community-based, demand-side interventions, countries will need to turn elsewhere to increased vaccine acceptance. In Northern Nigeria, one mechanism to combat OPV skepticism was by implementing health camps that provided basic health services in conjunction with the OPV. Taking a more holistic approach to health promotion with these camps helped engage community leaders and members who initially resisted the GPEI[39]. Likewise, in Pakistan, temporary health camps that provided maternal and child health services alongside immunization interventions were highly efficacious in increasing the OPV coverage[40]. Leveraging health camps has the power to improve vaccine perception and uptake while also addressing many otherwise neglected healthcare needs within targeted communities.

With regards to circumnavigating ongoing civil unrest to vaccinate vulnerable populations, there is a less clear path forward. In Angola – previously home to the largest recorded WPV outbreak in Africa and significant post-conflict insecurity – partnership with the military vastly increased the ability of vaccinators to reach isolated and unstable populations. This strategy increased OPV uptake while also enabling the distribution of vitamin A supplementation and deworming drugs[23]. However, leveraging state militaries risks politicizing vaccination campaigns, something the GPEI tried to avoid, and is of limited efficacy in disputed territories run by non-state armed groups. For situations like these, COVAX has allocated 5% of its funding to a Humanitarian Buffer that provides vaccine doses to uniquely vulnerable populations where unavoidable gaps in coverage

https://dx.doi.org/10.4314/mmj.v34i4.12

exist. There are an estimated 167 million people at risk of being excluded from COVID-19 vaccination due to ongoing conflict and/or natural disasters and ensuring vaccine access for this populations will be an integral part of an equitable path forward[41].

Conclusion

While the COVID-19 vaccination campaign is already well underway in many HICs, it is clear that the international effort will continue to face challenges that require troubleshooting and strategy optimization. As doses of the COVID-19 vaccine become increasingly available throughout LMICs, the public health community must draw from past experiences, such as the lessons learned throughout GPEI, to preemptively address, rather than react to, well-known barriers to vaccine uptake.

Paramount to this process is emphasizing community-engagement and the involvement of local partners. Similar to the WPV eradication campaign, the diversity of individuals and communities affected by COVID-19 precludes the possibility of a one-size-fits-all approach and highlights the need for microplanning to actively tailor and adjust approaches based on the unique issues they face. Social and behavioral change communication programs like CGPP and SMNet are requisite to adapt a global initiative to local contexts and overcome the enduring barriers of mistrust and misinformation. Additionally, the success of Nigeria and Pakistan in leveraging health camps to increase OPV uptake highlights the need for the COVID-19 vaccination campaign to not be carried out in isolation, but instead be undertaken as part of a comprehensive health promotion approach. This holistic approach works not only towards COVID-19 herd immunity, but towards general health equity.

While the COVID-19 vaccination campaign is a tall undertaking, 33 years of lessons from the GPEI have brought to light many ways by which the international community can overcome the obstacles that stand in the way of health and health equity around the world.

References

1. Usher AD. Vaccine shortages prompt changes to COVAX strategy. Lancet. Oct 23 2021;398(10310):1474. doi:10.1016/S0140-6736(21)02309-6

2. Centers for Disease Control and Prevention. (2020, August 25). Africa Kicks Out Wild Polio. https://www.cdc.gov/polio/why-it-matters/africa-kicks-out-wild-polio.html

3. Center for Disease Control and Prevention. (2019, October 25). Polio elimination in the U.S. https://www.cdc.gov/polio/what-is-polio/polio-us.html.

4. Center for Disease Control and Prevention (2021, March 19). Our progress against polio. https://www.cdc.gov/polio/progress/index.htm.

5. Mwai, P. (2021, October 1). Covid-19 vaccinations: More than 50 nations have missed a target set by the WHO. BBC. https://www.bbc.com/news/56100076.

6. Usher AD. A beautiful idea: how COVAX has fallen short. Lancet. Jun 19 2021;397(10292):2322-2325. doi:10.1016/S0140-6736(21)01367-2

7. UNICEF (2021, October 27). Urgent action needed now to ensure sufficient COVID vaccine syringe supply to meet 2022 vaccination targets. https://www.unicef.org/press-releases/urgent-action-needed-now-ensure-sufficient-covid-vaccine-syringe-supply-meet-2022.

8. Sokhey J, Gupta CK, Sharma B, Singh H. Stability of oral polio vaccine at different temperatures. Vaccine. Feb 1988;6(1):12-3. doi:10.1016/0264-410x(88)90006-0

9. Center for Disease Control and Prevention. (2021, March 3). Pfizer-BioNTech COVID-19 vaccine storage and handling summary. https://www.cdc.gov/vaccines/covid-19/info-by-product/pfizer/downloads/storage-summary.pdf.

10. Center for Disease Control and Prevention. (2020, December 20). Moderna COVID-19 vaccine storage and handling summary. https://www.cdc.gov/vaccines/covid-19/info-by-product/moderna/downloads/storage-summary.pdf.

11. Powell, A. (2021, October 26). In a war zone, COVID isn't the only health problem. The Harvard Gazette. https://news.harvard.edu/gazette/story/2021/10/in-war-zone-covid-isnt-only-health-problem/.

12. Reuters (2021, August 17). WHO concerned about COVID-19 in Afghanistan as jabs slow. https://www.reuters.com/world/asia-pacific/who-concerned-about-covid-19-afghanistan-jabs-slow-2021-08-17/.

13. Drexler, M. (2021, August 29). The Troubled History Of Vaccines And Conflict Zones. NPR. https://www.npr.org/sections/goatsandsoda/2021/08/29/1031007332/the-troubled-history-of-vaccines-and-conflict-zones.

14. Solis Arce JS, Warren SS, Meriggi NF, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. Nat Med. Aug 2021;27(8):1385-1394. doi:10.1038/s41591-021-01454-y

15.Center for Disease Control and Prevention. (2021, March 10). COVID 19 Vaccine Perceptions: A 15 country study. https://africacdc.org/download/covid-19-vaccine-perceptions-a-15-country-study/.

16.Lane S, MacDonald NE, Marti M, Dumolard L. Vaccine hesitancy around the globe: Analysis of three years of WHO/UNICEF Joint Reporting Form data-2015-2017. Vaccine. Jun 18 2018;36(26):3861-3867. doi:10.1016/j.vaccine.2018.03.063

17. Lowes S, Montero, E. The Legacy of Colonial Medicine in Central Africa. American Economic Review. 2021;111(4):1284-1314.

18. Lazarus JV, Ratzan SC, Palayew A, et al. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med. Feb 2021;27(2):225-228. doi:10.1038/s41591-020-1124-9

19.Wellcome (2018). Wellcome global monitor 2018. https://wellcome.org/reports/wellcome-global-monitor/2018.

20.United Nations (2021, June). Trust in public institutions: Trends and implications for economic security. https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2021/08/PB_108.pdf.

21. Samant Y, Lanjewar H, Parker D, Block L, Tomar GS, Stein B. Evaluation of the cold-chain for oral polio vaccine in a rural district of India. Public Health Rep. Jan-Feb 2007;122(1):112-21. doi:10.1177/003335490712200116

22. Bawa S, Shuaib F, Saidu M, et al. Conduct of vaccination in hard-to-reach areas to address potential polio reservoir areas, 2014-2015. BMC Public Health. Dec 13 2018;18(Suppl 4):1312. doi:10.1186/s12889-018-6194-y

23. Fekadu L, Okeibunor J, Nsubuga P, Kipela JM, Mkanda P, Mihigo R. Reaching the unreached with polio vaccine and other child survival interventions through partnership with military in Angola. Vaccine. Oct 10 2016;34(43):5155-5158. doi:10.1016/j.vaccine.2016.05.069

24. Ndiaye SM, Ahmed MA, Denson M, et al. Polio outbreak among nomads in Chad: outbreak response and lessons learned. J Infect Dis. Nov 1 2014;210 Suppl 1:S74-84. doi:10.1093/infdis/jit564

25. Aylward B, Tangermann R. The global polio eradication initiative: lessons learned and prospects for success. Vaccine. Dec 30 2011;29 Suppl 4:D80-5. doi:10.1016/j.vaccine.2011.10.005

26. Barau I, Zubairu M, Mwanza MN, Seaman VY. Improving polio vaccination coverage in Nigeria through the use of geographic information system technology. J Infect Dis. Nov 1 2014;210 Suppl 1:S102-10. doi:10.1093/infdis/jiu010

27. Owoaje E, Rahimi AO, Kalbarczyk A, Akinyemi O, Peters MA, Alonge OO. Conflict, community, and collaboration: shared

implementation barriers and strategies in two polio endemic countries. BMC Public Health. Dec 18 2020;20(Suppl 4):1178. doi:10.1186/s12889-020-09235-x

28. Hashim, A. (2020, February 18). Pakistan policeman killed in attack targeting polio campaign. Al Jazeera. https://www.aljazeera.com/news/2020/2/18/pakistan-policeman-killed-in-attack-targeting-polio-campaign.

29. Jegede AS. What led to the Nigerian boycott of the polio vaccination campaign? PLoS Med. Mar 2007;4(3):e73. doi:10.1371/journal.pmed.0040073

30. Khan MU, Ahmad A, Aqeel T, et al. Knowledge, attitudes and perceptions towards polio immunization among residents of two highly affected regions of Pakistan. BMC Public Health. Nov 5 2015;15:1100. doi:10.1186/s12889-015-2471-1

31. Clements CJ, Greenough P, Shull D. How vaccine safety can become political--the example of polio in Nigeria. Curr Drug Saf. Jan 2006;1(1):117-9. doi:10.2174/157488606775252575

32.World Health Organization (n.d.). Best practices in microplanning for polio eradication. https://www.who.int/polio-transition/documents-resources/best-practices-microplanning.pdf?ua=1.

33. Gali E, Mkanda P, Banda R, et al. Revised Household-Based Microplanning in Polio Supplemental Immunization Activities in Kano State, Nigeria. 2013-2014. J Infect Dis. May 1 2016;213 Suppl 3:S73-8. doi:10.1093/infdis/jiv589

34. Rutter PD, Donaldson LJ. Oversight role of the Independent Monitoring Board of the Global Polio Eradication Initiative. J Infect Dis. Nov 1 2014;210 Suppl 1:S16-22. doi:10.1093/infdis/jiu181

35.Stamidis KV, Bologna L, Bisrat F, Tadesse T, Tessema F, Kang E. Trust, Communication, and Community Networks: How the CORE Group Polio Project Community Volunteers Led the Fight against Polio in Ethiopia's Most At-Risk Areas. Am J Trop Med Hyg. Oct 2019;101(4_Suppl):59-67. doi:10.4269/ajtmh.19-0038

36.Bisrat, F. (n.d.). Ethiopia. CORE Group. https://coregroup.org/cgpp-ethiopia/.

37.Deutsch N, Singh P, Singh V, Curtis R, Siddique AR. Legacy of Polio-Use of India's Social Mobilization Network for Strengthening of the Universal Immunization Program in India. J Infect Dis. Jul 1 2017;216(suppl_1):S260-S266. doi:10.1093/infdis/jix068

38. World Health Organization (n.d.). What is the ACT-Accelerator. https://www.who.int/initiatives/act-accelerator/about.

39. Birukila G, Babale SM, Epstein H, et al. Reducing resistance to polio immunisation with free health camps and Bluetooth messaging: An update from Kaduna, Northern, Nigeria. Glob Public Health. Jan 2017;12(1):19-30. doi:10.1080/17441692.2016.1152283

40. Habib MA, Soofi S, Cousens S, et al. Community engagement and integrated health and polio immunisation campaigns in conflict-affected areas of Pakistan: a cluster randomised controlled trial. Lancet Glob Health. Jun 2017;5(6):e593-e603. doi:10.1016/S2214-109X(17)30184-5

41. Jalal, T. (2021, March 30). The COVAX Humanitarian Buffer Explained. Gavi. https://www.gavi.org/vaccineswork/covax-humanitarian-buffer-explained.