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Pro-equity immunization and health systems strengthening strategies in select Gavi-supported countries ☆

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ABSTRACT

Background: Achieving universal immunization coverage and reaching every child with life-saving vaccines will require the implementation of pro-equity immunization strategies, especially in poorer countries. Gavi-supported countries continue to implement and report strategies that aim to address implementation challenges and improve equity. This paper summarizes the first mapping of these strategies from country reports.

Methods: Thirteen Gavi-supported countries were purposively selected with emphasis on Gavi's priority countries. Following a scoping of different documents submitted to Gavi by countries, 47 Gavi Joint Appraisals (JAs) for the period 2016–2019 from the 13 selected countries were included in the mapping. We used a consolidated framework synthesized from 16 different equity and health systems frameworks, which incorporated UNICEF's coverage and equity assessment approach – an adaptation of the Tanahashi model. Using search terms, the mapping was conducted using a combination of manual search and the MAXQDA qualitative analysis tool. Pro-equity strategies meeting the inclusion criteria were identified and compiled in an Excel database, and then populated on a tableau visualization dashboard.

Results: In total, 258 pro-equity strategies were implemented by the 13 sampled Gavi-supported countries between 2016 and 2019. The framework determinants of social norms, utilization, and management and coordination accounted for more than three-quarters of all pro-equity strategies implemented in these countries. The median number of strategies reported per country was 17. Afghanistan, Nigeria, and Uganda reported the highest number of strategies that we considered as pro-equity.

Conclusion: Findings from this mapping can be useful in addressing equity gaps, reaching partially immunized, and 'zero-dose' vaccinated children, and valuable resource for countries planning to implement pro-equity strategies, especially as immunization stakeholders reimagine immunization delivery in light of COVID-19, and as Gavi finalizes its fifth organizational strategy. Future efforts should seek to identify

Abbreviations: AEFI, Adverse Events Following Immunization; BMGF, Bill & Melinda Gates Foundation; CAR, Central African Republic; CEA, Coverage and Equity Assessment; CHW, Community Health Worker; COVID-19, SRAS-2 Corona Virus Disease; CRVS, Civil Registration and Vital Statistics; CSO, Civil Society Organization; DHIS2, District Health Information System 2; DRC, Democratic Republic of Congo; eCHIS, electronic Community Health Information System; EPI, Expanded Programme on Immunization; Gavi, Gavi, the Vaccine Alliance; GIS, Geographic Information System; GPF, Grant Performance Framework; HeRAMS, Health Resources Availability Monitoring System; HSS, Health System Strengthening; ICN, Immunization Communication Network; IPC, InterPersonal Communication; IR, Implementation Research; IRDS, Implementation Research and Delivery Science; JA, Joint Appraisal; LMIS, Logistic Management Information System; LQAS, Lots Quality Assurance Sampling; MAXQDA, a Qualitative Data Analysis Software; NGO, Non-Governmental Organization; ODK, Open Data Kit; OIRIS, Optimized Integrated Routine Immunization Sessions; PBF, Performance Based Funding; PHC, Primary Health Care; PPP, Public Private Partnership; RED, Reaching Every District; RISS, Routine Immunization System Strengthening; RSO, Regional Surveillance Officer; SDG, Sustainable Development Goals; SMS, Short Message Service; SWAp, Sector Wide Approach; TCA, Targeted Country Assistance; ToR, Terms of Reference; UHC, Universal Health Coverage; UNICEF, United Nations Children's Fund; VAN, Visibility Analytics Network; VHT, Village Health Team; WAVA, Women Advocates for Vaccine Access; WHO, World Health Organization.

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pro-equity strategies being implemented across additional countries, and to assess the extent to which these strategies have improved immunization coverage and equity.

1. Introduction

Reaching every child with life-saving vaccines can only be achieved with the adoption or implementation of context-specific equity strategies for immunization and health system strengthening. Health equity requires that everyone progressively realizes his or her right to accessing quality healthcare without any undue disadvantage arising from individual or personal attributes such as demography, social, economic, or geographic strata [1]. Immunization equity will allow all children and individuals to access and utilize the immunization services they need unhindered. While vaccines are very cost-effective, with a return on investment (ROI) up to 44 times the invested amount, disparities in access to and utilization of the services have remained pervasive across regions, countries, and communities [2,3]. Millions of children are missing essential vaccines across the developed and developing countries globally due to factors such as poverty, ethnicity, gender, remoteness, and conflicts [3–6].

Gavi, the Vaccine Alliance, is an international public–private partnership primarily focused on immunization. Established in the year 2000 Gavi aimed to provide low-income countries with access to high-impact lifesaving vaccines which until that time was only accessible to wealthier countries. [7]. By its design, Gavi is primarily an equity-focused organization helping to get vaccines to over 70 poorer countries. Gavi's mandate is to vaccinate more than 760 million children in the world's poorest countries, preventing more than 13 million deaths [7].

By the end of 2019, an estimated 20 million children had not received three doses of DPT containing vaccines, of which 14 million had not received even the first dose of DPT, with 60% of these children living in 10 countries, of which many are Gavi eligible [8]. Despite the progress being made in reaching more children with vaccines thereby improving the breadth of coverage and reducing missed opportunities – the number of unreached children has remained refractory to all our intervention keeping the proportion of the world's children who receive recommended vaccines the same over the past few years [8]. The 2030 global immunization agenda, prioritizes identifying communities and reaching children who have received no vaccines at all, referred to as 'zero-dose' children as part of its coverage and equity strategic goal [9]. Equity improvements are crucial to sustainably increase global immunization coverage, including using effective tools and context-adapted approaches to map and identify missed populations and reach the unreached and marginalized populations [10]. More concerning are the initial reports from countries indicating disruption of immunization services due to the COVID-19 pandemic [11], which could potentially deny more children protection from vaccine-preventable diseases.

Some studies have looked at different aspects of Gavi's support to countries [12–16]; however, to date, country-specific strategies designed to reach underserved children and populations (what we refer to as 'pro-equity strategies') have not been reported. This paper summarizes the first mapping to synthesize evidence on pro-equity strategies being implemented across Gavi-supported countries, which could be a useful tool for stakeholders and in Gavi 5.0 towards addressing equity gaps by purposefully and systematically targeting zero-dose children and the communities they live in

2. Methodology

We reviewed relevant country reports submitted to Gavi between 2016 and 2019 to examine relevant pro-equity immunization activities implemented through the Health Systems Strengthening (HSS) strategies at national or subnational levels.

2.1. Data sources

The 58 currently Gavi-eligible countries [17] countries are split into three tiers of support and prioritization. Thirteen countries were selected purposively from across Tier 1, Tier 2, and Tier 3 countries (Table 1). All currently active nine Gavi Tier-1 countries were included in this study. Three countries from Tier-2 and one country from Tier-3 were purposefully selected, using convenient non-probability methods, to reflect geographic spread. As such, data collected may not be representative of all Gavi tier-2 and tier-3 countries.

2.2. Source document selection

To identify the most appropriate documents for the mapping, an initial scoping review of the following Gavi-related documents and reports were conducted: Joint Appraisals (JAs) or Joint Appraisal Updates, Grant Performance Framework (GPF) Reports, Country HSS Grants Evaluation Reports, Gavi HSS Proposals Submitted by Countries, Annual HSS and Vaccines Renewal Request and Gavi Targeted Country Assistance (TCA). Besides, consultations were made with UNICEF and Gavi staff regarding the content of the various reports.

Joint appraisals are annual in-country multi-stakeholder reports on the status of implementation, progress, and performance of Gavi support to the country, including its contribution to improving immunization outcomes [18]. The JA replaced the previous Gavi Annual Progress Reports and is conducted by a joint appraisals team which is multi-stakeholder, including the government and its partners. It reflects work done in the period of the reporting year and usually captures a comprehensive summary of all Gavi-supported activities, including HSS in the country over the specified reporting period. These reports were identified as having more comprehensive annual updated information on the specific strategies implemented by countries as compared to all other documents reviewed. Therefore, we reviewed country JAs for the years 2016, 2017, 2018, and 2019 for all 13 selected countries.

We retrieved all JAs from the Gavi website except the 2019 JA documents which we obtained from the Gavi Secretariat directly. In total, we reviewed 47 JA documents for the mapping; 35 from the Gavi website and 17 directly from the Gavi secretariat (see Fig. 1).

2.3. Search strategy

The search for and mapping of pro-equity strategies was guided by a consolidated equity framework developed from an ongoing[1]

[1] A review and analysis of frameworks related to immunization, equity, and health systems were conducted to understand the domains and constructs considered to be important in understanding health inequities. TERMS OF REFERENCE (TORs) Health systems strengthening, immunization, and equity consultant 16 August 2019.

Table 1
Gavi-supported countries included in this mapping of Pro-equity immunization strategies.

Gavi Tier-1 Countries	Gavi Tier-2 Countries	Gavi Tier-3 Countries
Afghanistan, Chad, Democratic Republic of the Congo (DRC), Ethiopia, India, Kenya, Nigeria, Pakistan, Uganda.	Myanmar, Madagascar, Central African Republic (CAR).	Kyrgyzstan.

UNICEF review of health systems-oriented strategies to improve immunization equity outcomes in immunization, synthesized from 16 different frameworks relevant to immunization, equity, and health systems [19–34]. The consolidated framework is shown in Table 2 also incorporated UNICEF's Coverage and Equity Assessment approach – an adaptation of the Tanahashi and modified Tanahashi models [35,36], and the four key priority areas of the equity reference group (ERG) on immunization [37,38]. Following several iterations, refined search words, terms, and synonyms relevant to each of these domains, subdomains, and priority areas were generated and used for the manual and software-assisted search in the Gavi JAs (See Annex 1). The term "pro-poor" was included in the initial search of a sample of the joint appraisals with zero yield. In addition to search words specific to each approach, we conducted an additional search for innovations using related search terms to retrieve all relevant strategies being tested or piloted in these countries. Two authors (ID and AHS) searched through the JA documents using the identified key search terms. The search was done both manually

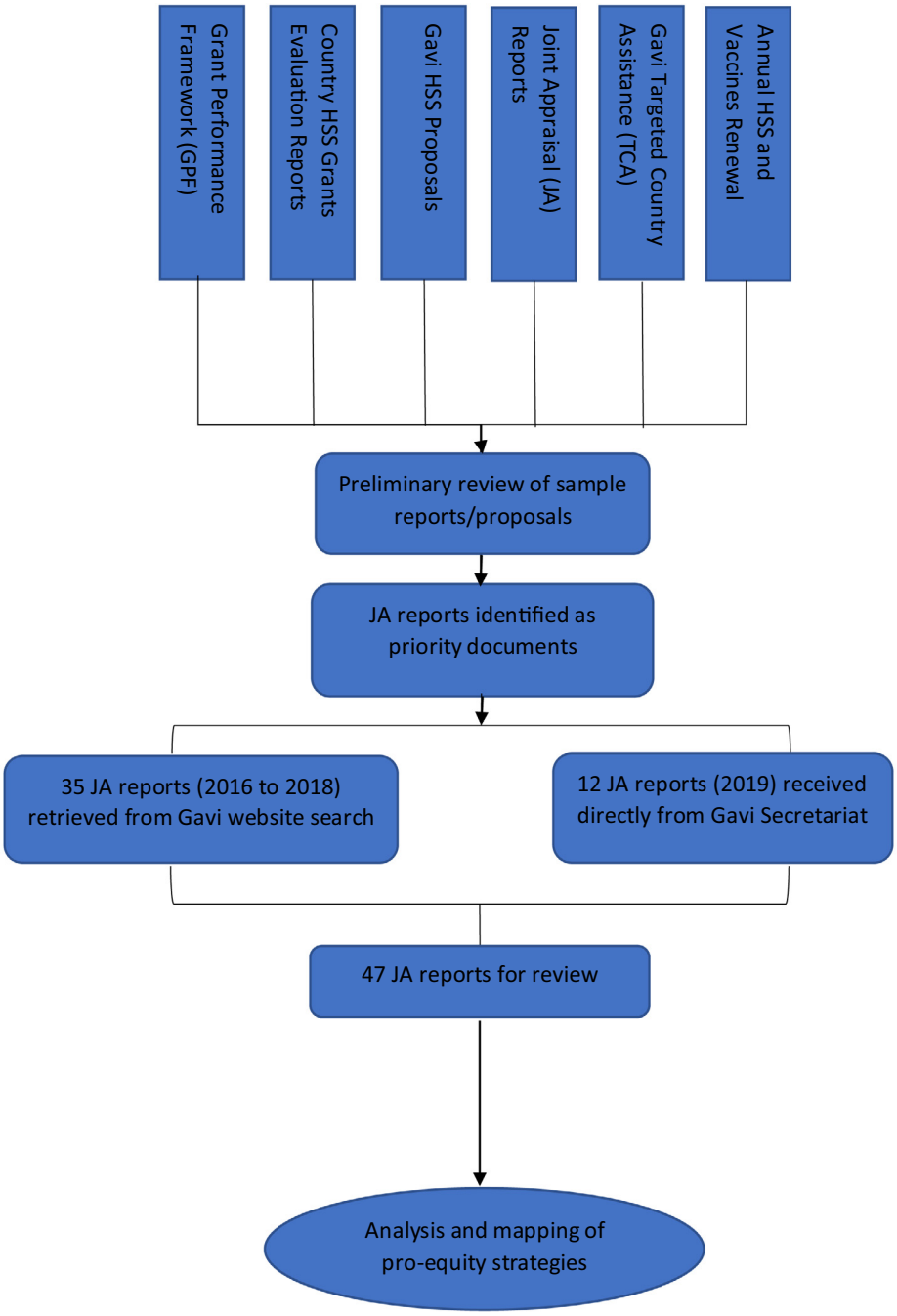

Fig. 1. Schematic Diagram Showing Mapping of Pro-equity Strategies Steps.

Table 2
Summary of Equity Framework and Domains used in the Mapping of Strategies.

CEA tool determinants of effective coverage	Equity Domain	Tanahashi level	ERG Priority Areas
o Legislation & Policy o Budget & Expenditures o Management & Coordination o Social norms o Commodities o Human resources o Environment o Utilization	o Social context, influence, circumstances o Recipient Factors o Rights o Healthcare system and policy context o Environment o Local-level context o Organizational level context o Intervention factors o Provider Factors o Clinical encounter	o Availability o Accessibility o Acceptability, contact, and effective coverage	o Urban poor o Remote/Rural o Conflict o Gender-related

and using a qualitative data analysis tool MAXQDA[2]. The use of the qualitative data analysis tool was necessitated due to the large amount of text data in individual JA reports. Using the qualitative data analysis tool, multiple JA reports were searched concurrently using the search terms through an extended lexical search. In both manual and software searches, paragraphs, where the search terms were identified, were scrutinized for pro-equity strategies meeting our inclusion criteria. Pro-equity strategies retrieved from the JAs from the use of these search words or terms were tabulated in an excel-based dashboard under headings of these domains and priority areas.

2.4. Inclusion and exclusion criteria

The following criteria were used to identify relevant HSS strategies:

- Strategies implemented at the country level covering one of the four priorities of the Equity Reference Group (ERG) on Immunization including urban poor communities, remote rural communities, conflict-affected communities, and gender (or any combination of these)
- Strategies belonging to one or more of the following determinants of effective coverage: legislation and policy, budget and expenditures, management and coordination, social norms, commodities, human resources, environment, utilization, and quality of care
- Innovative strategies or pilot interventions implemented in these countries to reach the unreached or hard-to-reach communities and strengthen health systems
- Routine or traditional strategies implemented differently – with innovation or through enhanced/new approaches.

Strategies that are implemented routinely as part of the expanded program of immunization (EPI) or in a traditional way such as trainings for health workers, routine microplanning, etc., were not included.

2.5. Data extraction and analysis

Two individuals (ID and AHS) extracted data both manually and using qualitative data analysis software – MAXQDA, between February and May 2020. AS and AsmS provided continued inputs into data extraction, analysis, and reporting. We analyzed extracted data by equity domains, approaches, and ERG priority areas initially identified by DC. We retrieved data from specific country JA reports based on relevance to the listed approaches and coverage equity domains. We then transferred data to an Excel database and summarized individual strategies by the following headings: (a) Coverage and Equity Assessment (CEA) determinants of effective coverage; (b) approach description; (c) ERG priority/-target population; and (d) gender lens. Retrieved strategies were consolidated into an excel database using the headings from the framework in Table 2. A color-coded frequency table was developed and used to summarize the data organized by country, with depth of color intensity depicting the frequency of retrieved pro-equity strategies (see Table 3). Descriptive statistics for illustrative purposes were conducted using Microsoft Excel (Microsoft Corp., USA). A comparative analysis of findings between countries and domains was done. Data was presented as either a table or a chart. A publicly available tableau dashboard was also developed to disseminate findings (See Annex 2).

3. Findings

Overall, 258 identified pro-equity strategies were reported to have been implemented by the 13 countries in their 2016 to 2019 JA reports (Fig. 2). Pro-equity strategies related to social norms, utilization, and management and coordination accounted for more than 75% (n = 168) of all pro-equity strategies reported.

Table 3 shows the types of strategies implemented by the country. Uganda and Afghanistan reported implementing 14 and 11 social norms related to equity strategies, respectively, while Nigeria reported 10 management and coordination strategies. Afghanistan most frequently reported pro-equity strategies relating to utilization, followed by Kenya, Pakistan, and Uganda. Determinants of effective coverage domains with the least pro-equity strategies reported include the environment which had only three strategies reported, followed by budget and expenditure with seven strategies, and human resources with nine strategies. The three countries of Afghanistan, Nigeria, and Uganda have up to 34, 35, and 38 pro-equity strategies implemented and reported, the highest reported among the sampled countries. Kyrgyzstan, which is the only Gavi tier-3 country among the sample, had the least number of implemented pro-equity strategies (11), with Madagascar, a Gavi tier-2 country, reporting the second least number of implemented pro-equity strategies of 15.

Table 4 presents examples of pro-equity strategies by determinant of effective coverage and by thematic area. Pro-equity strategies were identified for all thematic areas except: (a) digital financial services/mobile money to pay health facility staff; and (b) setting up overnight stay points to reach compromised areas. A concise narration of findings with a focus on the top three determinants of effective coverage having the highest number of reported pro-equity strategies is below.

1. Social norms

The identified pro-equity strategies under social norms are summarized under the following six approaches:

[2] MAXQDA Analytics Pro: https://www.maxqda.com/products/maxqda-analytics-pro

Table 3
Frequency of pro-equity strategies by type as reported in Joint Appraisal reports, 2016–2019.

CEA determinant of effective coverage	Afghanistan	CAR	Chad	DRC	Ethiopia	India	Kenya	Kyrgyzstan	Madagascar	Myanmar	Nigeria	Pakistan	Uganda	Total
Legislation & Policy	0	1	2	3	1	0	1	0	0	3	4	1	1	**17**
Budget & Expenditures	0	0	0	0	0	1	1	1	2	0	1	0	1	**7**
Management & Coordination	6	2	1	4	6	4	2	2	4	5	10	9	7	**62**
Social norms	11	3	5	1	5	7	9	4	3	3	8	4	14	**77**
Commodities	3	4	3	4	1	3	1	2	2	2	2	1	1	**29**
Human resources	1	3	0	2	0	1	0	0	0	0	1	0	1	**9**
Environment	0	0	0	1	0	0	0	0	0	0	2	0	0	**3**
Utilization	9	4	5	1	2	5	8	2	2	3	5	8	8	**62**
Quality of care/Research	4	0	0	0	1	0	0	0	0	0	2	0	5	**12**
Total	**34**	**17**	**16**	**16**	**16**	**21**	**22**	**11**	**15**	**16**	**35**	**23**	**38**	

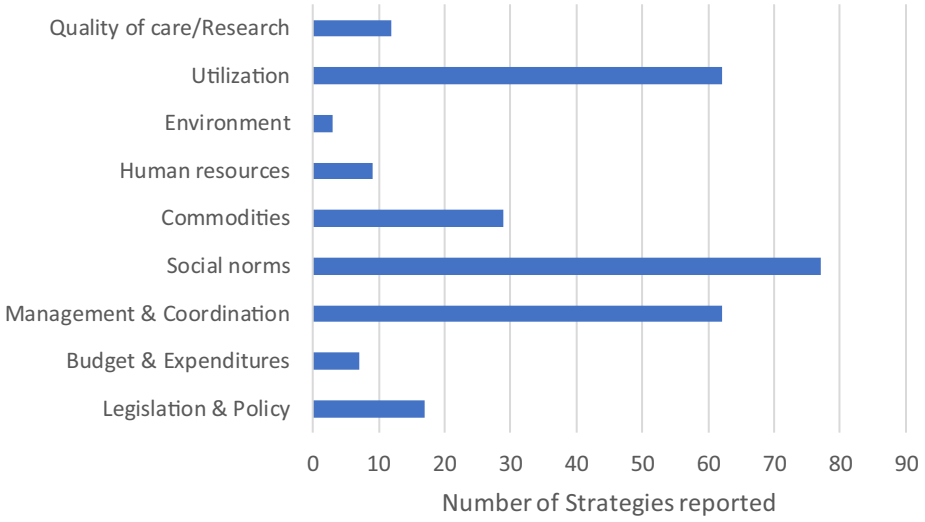

Fig. 2. Pro-equity strategies reported to have been implemented by sampled Gavi-supported countries.

(a) **Identify normative positions and match the messenger to the recipient** employed multiple strategies to ensure all target groups receive messages from the appropriate advocates. Afghanistan reported using community-based outreach vaccinators to increase immunization service delivery in urban settings and the use of religious leaders, Ulema, to promote immunization. India, Kenya, and Kyrgyzstan also employed the use of religious leaders to boost demand for immunization services and increase coverage, while Chad utilized village chiefs and community registers to promote immunization. The Accredited Social Health Activists (or ASHA) program in India serves as an interface between the community and public health system through which ASHAs receive performance-based incentives for promoting routine immunization in the community. Kenya developed a hard-to-reach audience strategy, while Madagascar conducted operational research in 8 major cities to know the reason for non-vaccination. Nigeria explored the use of non-monetary rewards systems for religious and traditional leaders as recognition for good performance and has incorporated a community cluster survey into the monthly routine immunization supportive supervision (RISS) exercise reported monthly on an ODK platform, while Pakistan established and is using slum health committees.

(b) **Peer/women-support groups in communities** enabled the sharing of information, healthy behavior promotion, and establishing trust. This addresses the remote rural, urban, gender, and conflict priority work areas of the ERG. Very few examples were observed in this area across the sampled Gavi countries, with one example from India in its implementation of Interpersonal communication (IPC) sessions referred to as Mother Meeting to boost immunization coverage, in addition to a vaccine hesitancy pilot in selected geographies.

Table 4
Example pro-equity strategies reported by countries in their 2016–2019 Joint Appraisal reports.

Determinants of Effective Coverage	Thematic area	Example pro-equity strategies
Legislation & Policy	Linkages to registration systems	Setting up the DHIS2 data encoding by health facility + MAGPI data import in CAR, and a roadmap for the operationalization of DHIS2 and population estimations with the help of satellite imagery in 3 districts (Benoyé, East N'Djamena and Yao) of Char republic.
Budget & Expenditures	Coordinated implementation plan	Nigeria reported having BMGF and Dangote Foundation supporting 6 states in the form of an MOU to address PHC and routine immunization. Kyrgyzstan reported using a Sector Wide Approach (SWAp) in health care where resources are pooled into the SWAp and managed.
Management & Coordination	EPI support groups	Madagascar involved the community in all immunization activities by strengthening communication both interpersonal and mass communication using community registers.
	Negotiate access to populations affected by conflict	In Afghanistan, the Public-Private Partnership (PPP) model was used as an innovation to provide basic reproductive and immunization services in the remote and insecure districts of six provinces in the country where both government and NGOs are not able to provide these services to affected populations.
	Improved communication chains amongst health providers	Immunization Communication Network in Afghanistan which helps with polio eradication, tracking of children who have missed their vaccines and community mobilization, while Pakistan sends targeted messages across 150 WhatsApp groups with thousands of memberships.
	Health Monitoring System	India is using an urban immunization dashboard developed based on HMIS data review, to improve quality and use of reported data as part of immunization strengthening in India's Universal Immunization Program, while in Nigeria DHIS2 and the RI Short Message Service (SMS) are used to track the conduct of daily fixed sessions as part of the OIRIS approach.
	Alternative approaches to immunization records	Ethiopia reported using electronic community health information systems (eCHIS) in immunization reporting and monitoring, while Uganda explored the use of electronic registers for immunization integrated with the HIV electronic medical records.
	Tracking population and movement through satellite imagery and mobile phone data	Myanmar reported geospatial information system QGIS-based micro plans developed/ updated with the community in major cities to include migratory, *peri*-urban and slum populations.
Social norms	Identify normative positions and match the messenger to the recipient	Chad republic conducted an advocacy and training of village chiefs on the use of community register for the promotion of immunization. India, Kenya and Kyrgyzstan employed the use of religious leaders to boost demand for immunization services and increase coverage.
	Peer/women-support groups in communities	Kenya has been working across sectors and religious bodies to address vaccine hesitancy, while Kyrgyzstan designed a comprehensive strategy to address vaccination.
	Leveraging social norms - using champions from the target population	Ethiopia created a network of informants and influencers, engaged with clan leaders and religious networks, mapped water points and livestock markets, and formed partnerships with animal health programs to improve access to immunization services.
	Proactive training of journalists, encouraging champions of health journalism	Kyrgyzstan developed a module for journalists' and conducted training for the journalists, while Uganda trained health workers and journalists on how best to respond to potential rumors about vaccines and vaccination.
	Widening the audience for IEC to strengthen and sustain social mobilization	Mapping of the urban populations that are underserved with immunization services and linking them to service points and development of an urban health communication guideline was done in Uganda.
	Gender transformative approaches	Kenya adopted a strategy for engaging and appealing to fathers to participate in immunization, while Uganda targeted men specifically through mobilization, health education, and participatory guidance thus empowering them to support their families in immunization uptake and demand generation.
Commodities	Solar direct-drive refrigerators, long-term passive cold boxes	Afghanistan implemented a Real-Time Vaccine Stock and Temperature Monitoring System (RTVSTMS), while India is using a GPS-enabled mobile application for the Cold Chain Points and the immunization session sites and real-time remote temperature monitoring of cold chain equipment.
Human resources	Digital financial services/mobile money to pay health facility staff	None reported.
	Increase recognition (non-financial incentive) of health workers	CAR has several implemented strategies to include PBF payment for health indicators to health facilities which allows them to implement strategies to reach their target population in more areas, improve the work environment, and motivate their staff to produce better results.
Environment	Security for safe access	Nigeria reported dialoguing with bandit groups to allow access for immunization services and adopted special strategies such as 'hit and run' and collaboration with the military authorities in security compromised areas to ensure access and utilization of immunization services.
	Setting up overnight stay points to reach access compromised areas	None reported.
Utilization	Adjust hours/timing of immunization services to better serve client/target population	The Government of Kenya implemented a policy extending opening hours of health facilities in Nairobi and procured mobile clinics to increase access to immunization service delivery.
	Tailor location of service delivery to meet the needs of caregivers	Pakistan implemented a transitory point immunization including locations like bus stations, airports, and regular transit areas between districts. The Optimized Integrated Routine Immunization Sessions (OIRIS) approach is an initiate rolled out in Nigeria for reaching remote communities.
	Peer-support groups for health providers.	Examples include the Immunization communication network - ICN in Afghanistan, the Regional Surveillance Officer (RSO) network established in Myanmar to focus on polio eradication.
	Reminder-recall systems - SMS reminders, phone calls.	Pakistan reported using ZM DIR which includes individual-level data to track each child in the community, web-based dashboard, unique QR code-based identification mechanism, interactive (2-way) SMS reminders, a decision support system to guide vaccinators for routine and catch-up immunizations.
Some additional pro-equity strategies	Others	Afghanistan conducted operational research on the implementation of the data quality, a pilot project on PEI support to strengthening routine immunization services, and micro-planning through RED strategy using CHWs.

(c) **Leveraging social norms - using champions from the target population** who are generally well-liked and influential, to shape perceptions peers have of vaccines. This addresses the remote rural, urban, gender, and conflict priority work areas of the ERG. Ethiopia created a network of informants and influencers and developed a community scorecard to help in tailoring services (time, location, care, etc.) to meet the needs of caregivers and help in the community-based monitoring of children eligible for vaccinations. Chad implemented a new Community Based Approach to Promote Immunization (CBAPI) in target districts. In Kenya, the Cabinet secretary and polio survivors were used as immunization champions which helped reduce vaccine hesitancy and advocate for immunization.

(d) **Proactive training of journalists, encouraging champions of health journalism** focused on the urban priority work area of the ERG. India, Kenya, and Kyrgyzstan engaged journalists to raise awareness on immunization which helped reduce vaccine hesitancy.

(e) **Widening the audience for Information Education and Communication (IEC) to strengthen and sustain social mobilization** focused on the remote rural, urban, gender, and conflict priority work areas of the ERG. Some of the strategies implemented across Gavi-supported countries include: a behavioral determinants survey to assess the determinants of immunization service utilization among Ethiopian Agrarian communities; a strategy for engaging and appealing to fathers to participate in immunization in Kenya; and an urban immunization strategy with linkages of services for improved community empowerment in Myanmar.

(f) **Gender transformative approaches** focused on the remote rural, urban, gender, and conflict priority work areas of the ERG. To overcome Ulema gender-related barriers to accessing immunization by women, Afghanistan developed specific training for female vaccinators to increase the number of female vaccinators as part of this cadre of health workers dominated by men, particularly for women to appropriately access tetanus toxoid vaccines. Kenya adopted a strategy engaging and appealing to fathers to participate in immunization, while Uganda targeted men specifically through mobilization, health education, and participatory guidance thus empowering them to support their families in immunization uptake and demand generation.

2. Management & Coordination

Five approaches were identified and used by Gavi-supported countries under this determinant, summarized by each approach below:

(a) **EPI support groups** focused on the urban priority work area of the ERG with implemented strategies such as Madagascar involving the community in all immunization activities by strengthening both interpersonal and mass communication. A combined microplanning and QGIS project in urban immunization commenced in Myanmar produced robust microplans as part of rolling out or implementing the urban immunization strategy. Nigeria developed immunization session plans to include outreach and mobile sessions for urban slums in line with the Reaching Every Ward (REW) micro-plan, which is an adaptation of the Reaching Every District (RED) strategy. Pakistan developed an equity-focused integrated urban immunization/health roadmap for Karachi, and Uganda is supporting outreach in slum areas and the establishment of village health team (VHT) systems in urban areas.

(b) **Multiple strategies for negotiating access to populations affected by conflict** with corridors of peace, safe havens, sanctuaries of peace, children as "zones of peace", working with non-traditional change agents. This focuses on the conflict area work priority of the ERG with Afghanistan, for instance, using a Public-Private Partnership (PPP) model to provide basic reproductive and immunization services in remote and insecure districts of six provinces in the country.

(c) **Improved communication chains among health providers and between providers and supervisors** focused on the conflict area work priority of the ERG. Some of the implemented strategies include: an Immunization Communication Network in Afghanistan which helps with tracking of children who have missed their vaccines; Pakistan sends targeted messages across 150 WhatsApp groups with thousands of memberships; and in Nigeria, an MOU to implement an "Immunization Service Delivery Accountability" approach, which aims to address data accuracy/quality and reduce pressure on the health care worker to falsely report on targets, was developed.

(d) **Health Monitoring System (e.g. HeRAMS), or similar,** focuses on conflict and urban priority work areas of the ERG with examples of reported pro-equity strategies including the use of urban immunization dashboard and use of web-based data tool for reporting AEFIs[3] in India, to improve the quality and use of reported data as part of immunization strengthening in India's Universal Immunization Program. The use of electronic community health information systems (eCHIS) in Ethiopia as an enhanced facility-level vaccine and supplies stock visibility monitoring and reporting, Vaccine Adverse Events Management Information System (VAEMIS) in Uganda, and integrating existing logistics management information systems (LMIS) with the Visibility Analytics Network (VAN) in Nigeria.

(e) **Alternative approaches to immunization records** focused on remote rural, urban, gender, and conflict priority work areas of the ERG. Nigeria tried the use of reminder bracelets to improve timeliness and completeness of childhood vaccinations, while Uganda explored the use of electronic registers for immunization integrated with the HIV electronic medical records.

(f) **Tracking population and movement through satellite imagery and mobile phone data** focuses on remote rural, urban, gender, and conflict priority work area of the ERG with some of the pro-equity strategies including the revision of micro plans through GIS and the use of tracking bags for defaulter tracking in Afghanistan, and GIS mapping of ward boundaries and immunization sessions in India. Kenya reported the use of GIS for equity programming in immunization, while Myanmar reported geospatial information system QGIS-based micro plans developed/updated with the community in major cities to include migratory, *peri*-urban, and slum populations. Pakistan reported the use of the GSM-based GIS module explored for integration into the ZM dashboard for real-time vaccinator tracking, E-VACCS 2.0 which individually tracks vaccinator attendance and greatly increased vaccination coverage.

3. Utilization

Strategies reported relate to adjusted hours for and timing of immunization services, tailoring delivery to meet client needs, peer support for health workers, and reminder call systems.

[3] AEFI as part of its Surveillance and Action for Events following Vaccination (SAFE-VAC)

(a) **Adjust hours/timing of immunization services to better serve client/target population** addressed the urban priority work area of the ERG with an example including the implementation of business-hour vaccination sessions introduced in Pakistan's urban centers. Uganda changed the timing for outreach in urban areas to weekends especially on Sundays to facilitate better access and coverage for immunization services. Kenya implemented a policy extending opening hours of health facilities in Nairobi and procured mobile clinics to increase access to immunization service delivery. Mobile teams organized by Civil Society Organizations (CSOs) for immunization sessions in Kyrgyzstan.

(b) **Tailor location of service delivery to meet the needs of caregivers** and ensure the acceptability of services for both mothers and fathers. This falls under the urban priority work area of the ERG. Pakistan implemented a transitory point immunization including locations like bus stations, airports, and regular transit areas between districts. In Afghanistan, high-risk mobile populations were vaccinated by permanent transit teams and 19 cross-border vaccination points plus geo-location monitoring. In Bangui, CAR, an immunization strategy for special populations (i.e. nomads, pygmies, IDPs/refugees, fishermen, mining sites, markets, etc.) was implemented. The Optimized Integrated Routine Immunization Sessions (OIRIS) approach was an initiative rolled out in Nigeria for reaching remote communities through periodic conduct of the Routine Immunization-Lot Quality Assurance Sampling (RI-LQAS).

(c) **Peer-support groups for health providers** addressed the remote rural priority work area of the ERG. Examples include the Immunization Communication Network (ICN) in Afghanistan, and the Regional Surveillance Officer (RSO) network established in Myanmar to focus on polio eradication, routine immunization, and new vaccine introduction. Women Advocates for Vaccine Access (WAVA) is a coalition of women-focused civil society organizations in Nigeria advocating for increased routine immunization and sustainable vaccine financing. The Vaccines & Immunization Research Network and its Scientific Advisory Group (SAG) for evidence building and guidance in India is another example. Kenya implemented the Health NGO networks, HENNET, which provided the needed peer support for immunization service delivery.

(d) **Reminder-recall systems, such as SMS reminders and phone calls,** focused on the remote rural, urban, gender, and conflict priority work areas. In Afghanistan, tracking bags made from cloth are used for defaulter tracing and catching up on dropouts or children who missed their immunization shots. Also, an android-based app *Zindagi Mehfooz* (ZM) which is used for tracking children and following them up to ensure they complete their vaccination series was used. Kenya has implemented the nomadic strategy in Turkana to track children for vaccination, and engaged teachers, school children, and community health volunteers in tracking children who have missed their immunization. Myanmar reported deploying technology to track missed children using for example electronic registries and reminders using DHIS-2 Tracker. Nigeria has piloted the use of SMS reminders to parents and caregivers, while Pakistan reported using ZM DIR which is a QR code-based identification system to track each child in the community. Uganda is using a tracking tool to track defaulters, with social media platforms (WhatsApp, Facebook, SMS) being used to transmit information to parents and caregivers.

4. Discussion

Achieving universal health coverage (UHC), including equitable access to safe, effective, quality, and affordable essential medicines and vaccines is a fundamental principle of the Sustainable Development Goal (SDG) 3 [3]. Much effort is being channeled towards improving immunization coverage. However, coverage trends over the past decade across various antigens point towards equity issues which if not intentionally and systematically addressed will not allow us to achieve universal immunization coverage [3,39]. Of even greater concern are the millions of zero-dose children who have received no single vaccination in their communities, signifying a potentially even broader deprivation for primary healthcare services thus providing a strong case for integrated service delivery. These pockets of zero-dose communities remain most vulnerable to outbreaks and hindrances to disease control and eradication efforts, as such is a priority of the 2030 global immunization agenda. While there are no one-size-fits-all solutions to address inequities in immunization, countries could benefit from policy interventions, service adaptations to meet specific community or program needs, and systems to analyze, disaggregate and maintain data [40]. The identified pro-equity strategies from this mapping could provide a synthesis of options and country examples to address equity challenges in different contexts.

The 13 countries in our review represent a significant proportion (i.e., approximately 50 percent) of all investments Gavi made to countries in 2019 [41]. However, these countries still have varying immunization coverage (DPT3) ranging between 41% in Chad to 94% in Kyrgyzstan, with wide-ranging equity concerns including variations in subnational immunization coverages [42]. Over time, Gavi's position and support for pro-equity work in immunization has been growing and evolving from a past focus on the introduction of new vaccines to now addressing intra- and inter-country variations in immunization access and utilization [43]. The findings from this mapping of a progressive increase in the number of pro-equity strategies implemented by Gavi-supported countries to about double between 2016 and 2019 could be a good pointer to this increasing focus by Gavi and other partners on equity. A paper co-authored by Chopra et al. and the ERG secretariat highlighted the critical importance of strategies to address inequity in immunization, including strategies to strengthen data and innovation, integration and optimizing vaccine delivery strategies, social behavior change, and use of CSOs, and gender empowerment among others [3]. This mapping suggests that countries continue to implement pro-equity strategies to reach every child with the recommended vaccinations. Evidence from our mapping showed about 75% of pro-equity strategies implemented by these 13 Gavi-supported countries are within the domains of social norms, utilization, or management and coordination.

The effect of social norms on immunization coverage has well been studied. These studies have shown the entrenched nature of social norms and how could derail vaccination and disease control efforts [44,45,46]. These social norms are seen to mostly impact the underserved communities as such having inequity implications. Some of our sampled countries in this study were shown to have implemented pro-equity immunization strategies addressing social norms, perhaps this could have been triggered by the massive underlying social norms challenges these countries face in equitably reaching everyone with vaccines.

India and Afghanistan for instance are two countries with most of their reported pro-equity strategies addressing social norms. By choosing to implement these types of pro-equity approaches, immunization stakeholders are aiming to address key drivers of inequity in childhood immunization, as reported by studies, to

include gender, rural dwelling, maternal literacy, lower household wealth, lower caste, not having faith in vaccination, and minority religion, at the individual, family, and community levels [5,47,48]. Gender transformative approaches, using community champions and key opinion leaders have also been reported by these countries. The data from these reports do not provide enough information to conclude on the level of impact and sustainability of these implemented strategies. These findings however emphasize that a key approach to bridging the equity gap and thereby increasing routine and even supplemental immunization coverage is adapting and implementing strategies to address social norms barriers.

Pro-equity strategies relating to management and coordination were the second most implemented strategies from our mapping. Some of these included the use of public–private partnerships, urban immunization dashboards, GIS-based micro plans, and electronic community health information systems (eCHIS), to mention a few. Some of the countries in this study reported implementing mostly management and coordination pro-equity strategies e.g. Nigeria and Pakistan. The choice of strategies in these countries could be attributed to the need to address large structural and organizational issues which are hindering efforts to effectively and equitably deliver routine immunization services [49,50]. The need to strengthen health and immunization management system capacity to broaden participation and to expand the reach of immunization services has been highlighted particularly in developing countries [51].

Another of the pro-equity strategies these countries reported implementing relates to improving the utilization of immunization services. Reported strategies included adjusting timing and tailoring delivery to ensure provision of immunization services at conducive timing and approach for the clients, use of reminder call systems such as SMS, and peer support for health workers. Persons of low socioeconomic status, from remote or hard-to-reach areas, and those affected by conflicts natural hazards, and disasters are more likely to miss their routine immunization shots or get them delayed. Often these groups are confronted by fundamental issues of survival as a priority. As such, adjusting the timing and mode of immunization service delivery to suit their schedules or deploying tools such as reminder systems could help greatly in improving immunization reach to these underserved groups.

Countries also reported several implemented pro-equity strategies related to legislation, commodities which included supply chain, and quality of care/research. Implementing pro-equity strategies must be situated in context and based on a fairly robust diagnostic at the national and sub-national levels. Countries such as Chad and the Central African Republic with coverage around 50% could benefit from approaches to rapidly increase coverage in tandem with pro-equity strategies for identified equity issues related to immunization. Reported national immunization coverage could be an indicator of overall improvement in coverage [42]. However, most importantly for pro-equity strategy implementation, it is useful to look beyond national coverage and focus on disaggregated sub-national data, which is more informative in ensuring equitable access and utilization of services. Table 5 contains a summary of the latest available national immunization coverage data for our study countries between 2016 and 2019. An illustration could be seen in Uganda which has not shown an increase in immunization coverage over the last four years and access barriers have been reported as a primary challenge to reaching every child with vaccines [52]. In this instance, subnational data at the districts where pro-equity strategies were implemented would have provided the best measure of success or otherwise of these strategies since national aggregates often mask subnational improvements in coverage or performance. Besides, the details of how and the extent to which the strategies were implemented will be crucial in understanding context-specific issues and understanding whether these strategies were considered successful or not.

The number of pro-equity strategies implemented does not seem to relate to the amount of Gavi funds each country received. However, there was some commonality between countries in the approaches used. For example, the use of community groups and networks to boost immunization coverage and increase uptake was a strategy implemented across several of these countries. For countries that have conflict-affected areas or regions such as Nigeria, Afghanistan, and Pakistan, specific conflict-related pro-equity strategies were implemented such as a safe corridor for ensuring vaccination of children and immunization strategies specific to reaching displaced communities.

Within the domains of human resources and environment, there were no reports by the 13 countries of these two strategies that had previously been identified, i.e. use of digital financial services/mobile money to pay health facility staff and setting up overnight stay points to reach compromised areas. There is increasing evidence that digital services can contribute to the UHC agenda [53]. Some other strategies within these domains were reported such as the use of non-financial incentives to reward vaccinators and encourage accurate reporting in Afghanistan, as well as performance-based funding for health indicators paid to health facilities in the Central African Republic (CAR). The CAR example was however noted to have negatively incentivized health workers to falsify their data to get the performance funds.

Table 5
Immunization Coverage WUENIC and Country Reported Data in Percentages[1].

Country name	Vaccine	WUENIC				Administrative Coverage			
		2019	2018	2017	2016	2019	2018	2017	2016
Afghanistan	DTP3	66	66	66	66	87	87	81	81
Central African Republic (the)	DTP3	47	47	47	47	61	74	53	54
Chad	DTP3	50	46	41	41	81	77	72	78
Democratic Republic of the Congo (the)	DTP3	57	57	57	57	95	94	94	92
Ethiopia	DTP3	69	68	69	66	96	95	96	96
India	DTP3	91	90	89	88	91	99	89	88
Kenya	DTP3	92	92	82	89	83	81	71	78
Kyrgyzstan	DTP3	95	94	92	96	95	94	92	96
Madagascar	DTP3	79	75	74	77	95	91	90	93
Myanmar	DTP3	90	91	89	90	90	91	89	90
Nigeria	DTP3	57	56	55	53	57	58	33	45
Pakistan	DTP3	75	75	75	75	75	72	75	75
Uganda	DTP3	93	93	94	93	73	79	94	93

[1] WHO vaccine-preventable diseases: monitoring system. 2020 global summary. https://apps.who.int/immunization_monitoring/globalsummary/ [updated July 15, 2020].

4.1. Limitations

This mapping was done on a sample of country reports – Joint Appraisals – submitted to Gavi by 13 countries and mapping relevant pro-equity strategies on immunization and HSS implemented and reported between 2016 and 2019, with purposive representation from the Gavi country tiers. Findings cannot be generalized for all Gavi countries. Furthermore, this mapping did not retrieve and review strategy implementation reports from the countries and we were not able to assess the effectiveness and sustainability of the reported strategies. This is an area for future analysis; besides, more research would be required to obtain subnational data and evidence on the outcomes associated with these strategies in improving equity. Expanding the mapping of pro-equity strategies to all Gavi-supported countries could be useful in guiding countries to context-specific approaches, and better tracking of effective resource utilization. Since the annual Joint Appraisals are now replaced by multi-stakeholder dialogues (MSD), the MSD should be used for the mapping of these strategies going forward.

5. Conclusion

Addressing equity gaps is crucial to achieving universal health coverage. Adopting specific pro-equity strategies will assist countries in reaching the millions of children who are either 'zero-dose' or partially immunized. Findings from this mapping show the range and types of pro-equity strategies implemented in different contexts and can be useful for countries facing similar challenges to consider. This will help in the drive to achieve much-needed progress towards universal vaccination, especially in low and middle-income countries. It is also encouraging to see countries going beyond traditional and more routine strategies to improve their reach of all children with vaccines. This mapping represents only pro-equity strategies implemented and reported by a sample of Gavi-supported countries and should not be taken to represent strategies implemented across all other Gavi-supported countries. However, it can serve as a start and should encourage more investment in mapping, identifying, and sharing lessons learned across Gavi-supported, and even other countries implementing pro-equity strategies to accelerate the agenda of universal childhood vaccination and broader primary healthcare (PHC). Using operational and implementation research, the benefits of these pro-equity strategies can be harnessed to the fullest.

Identifying, disseminating, and implementing relevant pro-equity strategies will be useful in reaching every child with recommended vaccines, and thereby achieving more with fewer resources. The benefits can even be greater with periodic evaluations of these strategies to ascertain the success and effectiveness of these interventions before use by policy and decision-makers. We can, therefore, reimagine immunization by synergizing across pro-equity strategies and further integrating immunization with PHC, as such a potential shift in focus towards investments that support pro-equity strategies and reach more children with life-saving vaccines and essential health interventions.

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7. Authors' contributions

All authors have made valuable contribution to this work and the development of the manuscript meeting the ICJME criteria for authorship. Ibrahim Dadari (ID) and Alyssa Sharkey (AS) conceived the methodology for the mapping based on equity frameworks consolidated by Danielle Charlet (DC). Ibrahim Dadari (ID) and Ariel Higgins-Steel (AHS) extracted data from the Joint Appraisal documents both manually and using qualitative data analysis software – MAXQDA. Alyssa Sharkey (AS) and ASM Shahabuddin (AsmS) provided continued inputs into data extraction, analysis, and reporting. Ibrahim Dadari (ID) drafted manuscript with inputs from all co-authors. Deborah Jackson (DJ) and Robin Nandy (RN) provided strategic inputs and editing in manuscript development and finalization. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

8. Disclaimer

The contents and opinions expressed herein are those of the authors interpreting findings from the study and in no way reflect the views of their affiliated organizations.

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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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2021.03.044.

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