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Immunization Supply Chain Interventions to Enable Coverage and Equity in Urban Poor, Remote Rural and Conflict Settings


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2. Acronyms and abbreviations

ARVs	antiretroviral drugs
CCE	cold chain equipment
CCEOP	Cold Chain Equipment Optimization Platform (Gavi)
cMYP	comprehensive multi-year plan
CTC	controlled temperature chain
DOTS	direct observation of treatment, short course
DTP3	diphtheria-tetanus-pertussis-containing vaccine
EPI	Expanded Programme on Immunization
ERG	Equity Reference Group for Immunization
Gavi	Global Alliance for Vaccines and Immunization
GIS	geographic information system
GSM	Global System for Mobile Communications
HepB-BD	hepatitis B-vaccine birth dose
HPV	human papillomavirus
IOM	International Organization for Migration
iSC	immunization supply chain
LMIS	logistics management information system
ODP	operational deployment plan
NGO	non-governmental organization
PQS	Performance, Quality and Safety (World Health Organization)
SDD	solar direct-drive
TB	tuberculosis
TT-CV	tetanus toxoid-containing vaccine
UAV	unmanned aerial vehicle (drone)
VVM	vaccine vial monitor
WHO	World Health Organization

3. Purpose of this document

This document summarizes the challenges faced by the immunization supply chain (iSC) in reaching the communities with the most zero-dose children, namely urban poor, remote rural and conflict-affected communities. It also provides guidance on the iSC strategies and interventions that may be used to address them. It ultimately aims to enhance coverage and equity in the three most underserved community types. 'Remote rural' refers to settings that are physically distant from cities and characterized by low population densities and small settlements.[1] 'Urban poor' refers to settings "characterized by high population density, high mobility and unevenly distributed wealth and services".[2] 'Conflict' settings are involved in an active or long-standing conflict that limits the choice of iSC strategies, and are becoming increasingly prevalent, with the highest concentrations of zero-dose children.[3] These three settings share common challenges, for which cross-cutting strategies have been identified.

1 Levine, Orin, et al., 'Tackling inequities in immunization outcomes in remote rural contexts: summary', Discussion Paper 8, Equity Reference Group for Immunization, December 2018.

2 Nandy, Robin, et al., 'Tackling inequities in immunization outcomes in urban contexts: summary', Discussion Paper 7, Equity Reference Group for Immunization, December 2018.

3 Okwo-Bele, Jean-Marie, et al., 'Tackling inequities in immunization outcomes in conflict contexts: summary', Discussion Paper 6, Equity Reference Group for Immunization, December 2018.

4. Executive summary

According to World Health Organization-United Nations Children's Fund (WHO-UNICEF) annual estimates of immunization coverage released in July 2020, approximately 20 million children worldwide – more than 1 in 10 – missed out on life-saving vaccines such as measles, diphtheria and tetanus in 2019.

These under-immunized children live in the most underserved communities: urban slums, remote rural areas and conflict-affected areas. Here, they are not registered with health clinics and are inaccessible to health workers. Furthermore, parents of children born into these marginalized communities often do not know the benefits of vaccination.[4]

The immunization supply chain (iSC) is a key component of the health system for reaching these zero-dose children, enabling delivery of services to underserved communities, ensuring vaccine availability and potency, and maximizing efficiency where possible.

This document looks at Equity Reference Group for Immunization (ERG)-identified challenges in remote rural, urban poor and conflict areas, and identifies the most effective immunization programme operational strategies to overcome these challenges, with the aim of helping countries reach these children through the necessary adaptations in iSC interventions.

Each of these operational strategies and adaptations are discussed in terms of iSC implications, challenges and opportunities.

A brief description is also included of the implications of measuring immunization programme performance in terms of zero-dose children (for the new Immunization Agenda 2030 and Global Alliance for Vaccines and Immunization (Gavi) 5.0 strategy).

The document has been divided into cross-cutting strategies and interventions specific to each of the three settings so that in a training context, staff need only use the section that applies to their setting plus the cross-cutting section.

4 Gavi, 'Health System and Immunisation Strengthening', https://www.gavi.org/programmes-impact/types-support/health-system-and-immunisation-strengthening, accessed 12 October 2020.

A toolkit has also been included to aid collection of relevant data and support decision-making.

Cross-cutting strategies can be summarized as follows:

- Adjusting forecasts to accommodate variations in target populations and ensure vaccine availability
- Stratified budgeting based on disaggregated data for each setting
- Leveraging the controlled temperature chain (CTC)
- Utilizing alternative vaccine presentations
- Increasing vaccine storage capacity and solarization
- Optimizing cold/cool/warm life
- Considering weight (mass) of cold boxes and planning appropriate human resources
- Integrating iSC into microplans and strengthening the system.

Additionally, interventions specific to each of the three settings include:

a. Remote rural

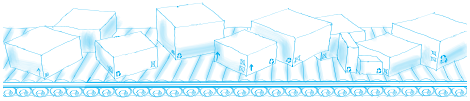
- Coordination with other programme interventions
- Community-based involvement
- Use of long-range passive containers and temporary storage sites to aid cross-border and mobile teams
- Adequate storage capacity to accommodate buffer stock

b. Urban poor

- Partnerships with the private sector
- Adaptation of health facility operations to local contexts
- Increase in distribution points in system design

c. Conflict-affected

- Partnerships with military agencies
- Use of shockproof passive containers
- Use of temporary storage sites and long-range passive containers for ‘hit-and-run’ teams.



5. Introduction

Since the Expanded Programme on Immunization (EPI) was established in 1974, coverage has been used as the indicator of success or progress. Since 2000, immunization coverage in Gavi-supported countries has increased from 59 per cent to 80 per cent,[5] but progress has stalled over the last decade. Meanwhile, the population has increased significantly. As such, while the number of children reached each year is increasing, health systems in the poorest countries are still failing to give almost one in five children a full course of basic vaccines.[6]

"Most unvaccinated children live in the poorest countries and are disproportionately in fragile or conflict-affected states. Almost half are in just 16 countries – Afghanistan, the Central African Republic, Chad, Democratic Republic of the Congo (DRC), Ethiopia, Haiti, Iraq, Mali, Niger, Nigeria, Pakistan, Somalia, South Sudan, Sudan, Syria and Yemen."

– UNICEF/WHO Press Release, 15 July 2019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In 2017, the Equity Reference Group for Immunization (ERG) was convened by UNICEF and the Bill & Melinda Gates Foundation to generate innovative ideas that would accelerate progress on equity in immunization. The ERG is made up of "global health experts who work with WHO, Gavi, the World Bank, the Bill & Melinda Gates Foundation, and UNICEF; academics in critical fields such as metrics, gender, and health systems development, and senior leaders from several countries, ensuring that diverse perspectives are shared to identify the best way forward."[7] The ERG has identified four priorities:

1. **urban poor areas**
2. **remote rural areas**
3. **children affected by conflict**
4. **gender-related inequities and barriers to immunization.**[8]

Under the new Immunization Agenda 2030 (IA 2030) currently being developed and the next Gavi 5.0 strategy,[9] 'zero-dose' children are being considered as a new priority indicator and target.

5 WHO/UNICEF Estimates of National Immunization Coverage, 'Global Immunization Performance 2000–2018', 2018.

6 Gavi, 'Health System and Immunisation Strengthening', https://www.gavi.org/programmes-impact/types-support/health-system-and-immunisation-strengthening, accessed 12 October 2020.

7 The Equity Reference Group for Immunization, https://sites.google.com/view/erg4immunisation/home, accessed 12 October 2020.

8 Ibid.

9 Gavi, 'Strategy Phase 5 (2021-2025): The Equity Goal', https://www.gavi.org/our-alliance/strategy/phase-5-2021-2025//equity-goal, accessed 12 October 2020.

6. The importance of the immunization supply chain (iSC) in enabling coverage and equity

It is widely acknowledged that under-vaccination has several causes. In 2012, Favin et al.[10] found that some of the main reasons were related to immunization services (access, quality of care and convenience) and parental knowledge and attitudes (this partly relates to quality of care and impacts on demand). This considered, supply chain interventions can significantly improve coverage. In 2017, Kahn, Kristensen and Rao[11] observed how the CTC could facilitate delivery of vaccines closer to target populations, and Prosser et al.[12] achieved an increase in diphtheria-tetanus-pertussis-containing vaccine (DTP3) coverage from 68.9 per cent to 92.8 per cent in Mozambique by redesigning the supply chain. Vouking et al.[13] shared similar findings on studying the relationship between outsourcing logistics, system design and vaccine availability. LaFond et al.[14] also found that sustained availability of basic supplies and equipment is a critical enabler of vaccination coverage.

A number of iSC levers can be utilized to implement operational immunization strategies in microplans and are summarized as follows:

- **Forecasts – increase buffer stocks and adjust forecasts to accommodate variations in target populations across the three settings**
- **Establish stratified budgets for each setting to ensure that there is sufficient funding to meet their unique requirements**
- **CTC – use licenced vaccines outside of the cold chain**
- **Alternative vaccine presentations – utilize smaller dose-per-vial presentations to encourage health workers to open vials and prevent missed opportunities where target populations are small**
- **Cold chain capacity – optimize vaccine carrier and cold box carrier capacity for transportation and session sizes**
- **Cold life/range of passive devices – improve the range of passive devices to reach target populations**
- **Optimize supply chain design to prioritize coverage and equity over the usual efficiency indicators**
- **Integrate health commodities into the supply chain system to ensure delivery of comprehensive health services.**

10 Favin, Michael, et al., 'Why children are not vaccinated: a review of the grey literature', *International Health*, vol. 4, no. 4, 1 December 2012, pp. 229–238.

11 Kahn, Anna-Lea, Kristensen, Debra and Rao, Raja, 'Extending supply chains and improving immunization coverage and equity through controlled temperature chain use of vaccines', *Vaccine*, vol. 35, no. 17, 19 April 2017, pp. 2214–2216.

12 Prosser, Wendy, et al., 'System redesign of the immunization supply chain: Experiences from Benin and Mozambique', *Vaccine*, vol. 35, no. 17, 19 April 2017, pp. 2162–2166.

13 Vouking, Marius Zambou, et al., 'Interventions to increase the distribution of vaccines in Sub-Saharan Africa: a scoping review', *Pan African Medical Journal*, vol. 32, no. 14, 9 January 2019.

14 LaFond, Anne, et al., 'Drivers of routine immunization coverage improvement in Africa: findings from district-level case studies', *Health Policy Plan*, vol. 30, no. 3, April 2015, pp. 298–308.

7. Common challenges and immunization supply chain (iSC) strategies to enable coverage and equity across urban poor, remote rural and conflict settings

Although this document has defined a set of iSC strategies to address the challenges identified in urban poor, remote rural and conflict settings separately, the three settings also share common challenges. The strategies set out in this guide are based on three main objectives:

- **To improve vaccine availability – are enough doses of all vaccines available to the vaccinator when and where required?**
- **To ensure vaccine quality – have all vaccines and diluents been stored and transported in line with the relevant cold chain requirements?**
- **To improve efficiency of the iSC – are the vaccines presented to the vaccinator at the most efficient or lowest cost per dose possible under these challenging conditions?**

a. Challenges

1. Target populations across the three settings have a high level of uncertainty, making planning for immunization sessions more complex, and accurate forecasting of vaccine needs challenging.[15]
2. There are limited available disaggregated district budget data at the national level,[16] and limited capacity to develop fractional comprehensive multi-year plans (cMYPs) per setting and then integrate them into the national cMYP.
3. Temperature control during transportation and outreach is subject to excursion. In many countries, temperatures are not routinely monitored during transportation, despite evidence gathered in temperature monitoring studies showing that this can affect vaccine potency.[17]
4. Recent evidence suggests that the WHO multi-dose vial policy is poorly applied. Health workers are reluctant to open a preservative-free vaccine vial unless the session size is large enough to warrant it, but while this practice reduces wastage rates, it unfortunately results in missed opportunities for vaccination.[18]

15 Shen, Angela K, Fields, Rebecca and McQuestion, Mike, 'The future of routine immunization in the developing world: challenges and opportunities', *Global health, science and practice,* vol. 2, no. 4, 2 December 2014, pp. 381–394.

16 United Nations Children's Fund, 2018/19 Child Immunization Budget Brief, April 2019.

17 Hanson, Celina M, et al., 'Is freezing in the vaccine cold chain an ongoing issue? A literature review', *Vaccine*, vol. 35, no. 17, 19 April 2017, pp. 2127–2133.

18 Dose Per Container Partnership, 'DPCP Snapshot: Immunization Tools to Help the Dose per Container Decision', 2017, https://www.jsi.com/resource/immunization-tools-to-help-the-dose-per-container-decision/, accessed 12 October 2020.

b. Cross-cutting strategies

i. Adjusting forecasts to accommodate target population variations and ensure vaccine availability

Target populations across the three settings tend to have a high level of uncertainty. This is not only due to population growth, but also unexpected or unknown population movement and migration within these settings. Variability in supply intervals and immunization of unvaccinated children who have not been included in the programme's history are additional barriers to an accurate forecast. As such, forecasts for these three settings need to be adjusted to pre-empt greater variation in target populations: while a routine immunization forecast may include a buffer of up to 25 per cent, a much larger buffer is required in these challenging settings to accommodate uncertain target populations and delayed replenishment due to seasonal access or conflict disruption. The major iSC challenge here will be the trade-off between missed opportunities and wastage rates (especially unopened vials). The cost of avoiding missed opportunities in these settings is proportionally higher than in normal settings due to higher storage, distribution and access costs. Although policy interventions have sought to address these missed opportunities, EPI programmes continue to face challenges.

Where there are high levels of target population movement or migration, data external to Ministries of Health can be very helpful when forecasting to include unvaccinated children. Useful sources of information include the Office of the United Nations High Commissioner for Refugees (UNHCR), the International Organization for Migration (IOM), the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), and government departments such as urban planning and rural development. The UNICEF and WHO Regional Offices may also provide more local context.

ii. Stratified budgeting based on disaggregated data for each setting

In the short term, budget item costs across these underserved communities will be higher than overall fixed-post routine immunization costs. However, it is important to note that reaching these populations is highly cost-effective, as demonstrated by Lee et al. in their modelling scenarios.[19] In both centralized and devolved fiscal management structures, it is absolutely essential that disaggregated data are available to optimize fiscal allocations.

As such, the main challenge for iSC is the disaggregation of data by district for these three settings. Information required for stratified budgeting from the iSC perspective includes:

- Target populations
- Immunization programme operational strategies
- Vaccines required for each operational strategy
- Storage site availability
- Cold chain equipment (CCE) available for safe storage of vaccines and other immunization supplies, including their storage capacity (including energy supply)
- CCE available for transport and outreach activities
- CCE available for freezing of water-packs for use during outreach sessions (opened vials of unpreserved liquid vaccine and reconstituted vials of lyophilized vaccine[20])
- Availability of maintenance for CCE
- Delivery routes and access constraints

19 Lee, Bruce Y., et al., 'Economic value of vaccinating geographically hard-to-reach populations with measles vaccine: A modeling application in Kenya', *Vaccine*, vol. 37, no. 17, 17 April 2019, pp. 2377–2386.

20 Garnett, Andrew, WHO Vaccine Management Handbook, Module VMH-E7-02.1: *How to use passive containers and coolant-packs for vaccine transport and outreach operations*, Geneva, World Health Organization, 2015.

- Availability of adequate transport vehicles and fuel.

When these disaggregated data are available and needs have been determined, the most appropriate method of budgeting for these three settings is to develop a fractional cMYP Plan[21] and a fractional cMYP Costing[22] (using WHO-UNICEF Tools) for each of them, specifically:

- cMYP and Costing for Remote Rural Settings
- cMYP and Costing for Urban Poor Settings
- cMYP and Costing for Conflict Settings.

These three subsets of fractional cMYP can then be integrated into the national cMYP, allowing for individual management and annual monitoring and evaluation of each setting. This will enable the necessary adjustments to be made to accommodate the high level of uncertainty, especially in terms of target populations and stock management, and differential approaches to be implemented in a variety of programme delivery aspects, such as vial size presentations, buffer stock, supply intervals, and delivery mechanisms, including vehicles. It will be critical to explore expansion partnerships, such as implementation by third-party contractors and/or non-governmental organizations (NGOs) in these three settings, to enable coverage and equity.

To accomplish this fractional planning and budgeting format, countries should first establish their own iSC maturity level using the UNICEF Maturity Model. This format will be a major challenge if the country is at a low maturity level, but it is feasible in many settings.

It should also be noted that remote rural, urban poor and conflict settings may require different iSC maturity levels; the Immunization Programme should allocate planning and budgeting resources accordingly.

iii. Leveraging the controlled temperature chain (CTC)

WHO defines CTC as "an innovative approach to vaccine management allowing vaccines to be kept at temperatures outside of the traditional cold chain of +2°C to +8°C for a limited period of time under monitored and controlled conditions, as appropriate to the stability of the antigen. A CTC typically involves a single excursion of the vaccine into ambient temperatures not exceeding +40°C and for duration of a specific number of days, just prior to administration."[23]

21 World Health Organization, 'WHO-UNICEF guidelines for developing a comprehensive multi-year plan (cMYP)', https://www.who.int/immunization/programmes_systems/financing/tools/cmyp/en/, accessed 12 October 2020.

22 Ibid.

23 World Health Organization, 'Controlled temperature chain (CTC)', https://www.who.int/immunization/programmes_systems/supply_chain/ctc/en/, accessed 12 October 2020.

This CTC does not include all vaccines and all operational strategies. WHO states that for a vaccine to be labelled for and used in a CTC, it must meet the following criteria:

"The vaccine should be used in a campaign or special strategy setting. CTC is not currently recommended for immunization through routine fixed-post service delivery." "The vaccine must be able to tolerate ambient temperatures of at least +40°C for a minimum of three days and should be accompanied by:

A. a vaccine vial monitor (VVM) on each vial, and
B. a peak threshold indicator in each vaccine carrier."

"The vaccine must be licenced for use in a CTC by the relevant regulatory authorities, with a label that specifies the conditions."[24]

It is therefore important to consider CTC in operational strategies relevant to the three settings, such as:

- Cross-border teams
- Mobile teams
- Outreach services
- Vaccination campaigns in response to specific needs, preventive or outbreak response
- Vaccination following or prior to planned or unplanned mass migration
- Quick 'hit-and-run' operations in areas of insecurity.

The CTC Working Group states the following benefits of CTC:

- "Simplifying the logistical requirements and costs for vaccine distribution and extending outreach capabilities by allowing transport and short-term storage of vaccines without ice or refrigeration during the days immediately preceding administration;
- Decreasing the risk of freeze damage for freeze-sensitive vaccines, especially during outreach in vaccine carriers, when they are most at risk of being placed too close to ice packs;
- Enabling immunization coverage and equity by facilitating the distribution of vaccines used in campaigns or special strategies to reach underserved populations, for example:
    - meningitis A vaccine campaigns;
    - HPV vaccine administration in schools;
    - HepB-BD administration in homes or communities;
    - TT-CV administration in homes or communities;
    - mobile outbreak response with oral cholera vaccine in resource-poor settings;
    - facilitated access to under-immunized or unimmunized urban children, particularly in slum areas, for multiple CTC-compatible vaccines;
- Improving working conditions for vaccinators by reducing the weight of vaccine carriers, obviating the need to renew ice packs during long journeys and potentially avoiding the need to travel to return vaccines into the cold chain after outreach;
- Optimizing use of staff time by redirecting staff to routine immunization activities that ordinarily would need to be dedicated to conditioning ice packs for campaigns."[25]

Only a limited number of vaccines are currently approved for CTC (and are manufacturer-specific) but several other vaccines are in the process of applying for approval. Countries that would benefit from this should engage with their procurement agent to give the correct cues to industry.

24 Ibid.

25 World Health Organization, 'Controlled temperature chain: Strategic Roadmap for Priority Vaccines 2017-2020', https://www.who.int/immunization/documents/WHO_IVB_17.20/en/, accessed 12 October 2020.

iv. Utilizing alternative vaccine presentations

In many countries, one of the reasons cited for failure to vaccinate has been the reluctance of health-care providers to open a 10-dose vial in situations where immunization sessions are attended by fewer than six to eight infants .

This is due to fear of a high wastage rate, which is often used as a job performance indicator, and fear of stock-out for future sessions. For instance, in a 2011 CDC-led study of vaccine wastage-related knowledge and practices in Nigeria,[26] health-care providers said that they only opened measles vials when six or more children were present and only on certain days of the week. While this practice aims to reduce vaccine wastage, it results in missed opportunities for vaccination.

In contrast to these observed practices of waiting for more children or turning away children eligible for measles vaccinations, WHO policy[27] states that a vaccine vial should be opened at any time, even if only one eligible child presents for vaccinations, irrespective of the number of doses in the vaccine vial. This policy exists to increase coverage; nevertheless, health workers often feel obliged to weigh up the immediate concern of vaccinating a single child against the potential of having measles vaccines stock out if available stocks are used up faster than anticipated (because vaccine usage forecasts assume lower wastage rates). Based on forecasts published by countries procuring measles/measles-rubella vaccines through UNICEF, the national wastage rate for 2017 ranged from 10 per cent to 60 per cent for measles/measles-rubella vaccines administered via routine immunization.[28]

When planning iSC support for a particular operational strategy, the volume of required vaccines will determine the net vaccine capacity required for CCE, cold boxes and vaccine carriers.

Smaller vial presentations may require greater storage capacity, as well as being heavier and more costly. The decision to make the change is never easy, and many factors must be considered. A study in Zambia[29] found that "Health workers' fear of wasting vaccines may contribute to Zambia's inability to reach the 95 per cent coverage target for the two meningococcal vaccine doses mandated in Zambia. Health workers need an approach for balancing the trade-offs between increasing timely coverage and minimizing wastage. Examining the impact of a lower dose-per-container presentation may strengthen meningococcal vaccine delivery". They go on to identify the trade-offs:

- coverage rates (including timeliness)
- wastage rates
- safety
- costs per dose and child vaccinated
- the supply chain
- health worker behaviour (including willingness to open a multi-dose vial no matter how many children present).

26 Wallace, Aaron S., et al., 'Vaccine wastage in Nigeria: An assessment of wastage rates and related vaccinator knowledge, attitudes and practices', *Vaccine*, vol. 35, no. 48, 4 December 2017, pp. 6751–6758.

27 World Health Organization, *Immunization in Practice: A practical guide for health staff*, 2015 update, World Health Organization, Geneva, 2015.

28 Internal UNICEF data.

29 Dose Per Container Partnership, 'DPCP Snapshot: The Effects of Dose Per Container Change in Zambia', 2019, https://www.jsi.com/resource/the-effects-of-dose-per-container-change-in-zambia, accessed 21 October 2020.

These findings are encouraging and may be significant for remote rural, urban poor and conflict settings. However, another major factor to consider is the complexity of managing different vial sizes for the same vaccine – that is, routine immunization using different vial sizes to the vials used in alternative settings. This demands a well-functioning logistics management information system (LMIS), accurate data and good stock management to prevent the wrong vial sizes from being delivered to the wrong immunization site. These are also needed to prevent confusion in stock records, which most countries will have experienced when campaign stock (with different vial sizes) is integrated with routine stock without accurate recording of doses and vial sizes. This is a potentially significant disadvantage of the use of different vial sizes for the same vaccine.

v. Increasing vaccine storage capacity and solarization

The Performance, Quality and Safety (PQS) guidance on the use of cold boxes and vaccine carriers is of special relevance to the three settings and is repeated here as an aide-memoire for when the iSC requirements are integrated with the microplans.

The choice between short-range and long-range cold boxes or vaccine carriers, in the context of travel time and the immunization operational strategy, is critical. The vaccine storage capacity of cold boxes and vaccine carriers is provided in the individual PQS product data sheets. The quantity and type of vaccine transported in each container depends on what the cold box or vaccine carrier is being used for. For example:

- **Large-scale routine distribution**: In most countries, distribution from a primary to subnational store, and between subnational stores, generally requires several cold boxes. It is good practice to separate oral polio and single-antigen lyophilized vaccines, which can safely be packed with frozen icepacks, from freeze-sensitive and multi-valent vaccines. Freeze-sensitive and multivalent vaccines should preferably be packed with cool water-packs to eliminate the risk of freezing during transport. Freeze indicators will also be needed where the ambient temperatures may drop below 0°C.
- **Small-scale routine distribution**: A single cold box is typically used to transport vaccines from a subnational store to a health facility. When all the vaccines are packed in a single cold box, cool water-packs should be used.
- **Routine outreach**: Vaccine carriers are packed with a mix of vaccines, and possibly supplements, appropriate to the local schedule.
- **Campaigns**: A limited range of vaccines and/or supplements are distributed between the primary and subnational stores and the same limited range will be taken on outreach.

Increased storage capacity and intentional system design for equity creates a resilient supply chain able to withstand systemic shocks, which are often seen in these contexts.

Furthermore, increasing the use of solar power will expand the reach of immunization services, ensuring that services are delivered to underserved communities.

vi. Optimizing cold/cool/warm life[30]

It is important to understand the impact that different types of cooling pack have on cold chain temperatures in cold boxes and vaccine carriers, especially in these three settings. The correct temperatures must be maintained for the total duration of the operational strategy of the programme until the moment remaining vaccines are returned to the storage point, to minimize wastage rates.

The PQS product data sheets categorize cold/cool/warm life into three types, measured in hours:

- cold life with frozen icepacks
- cool life with cool water-packs
- warm life with warm water-packs.

Because cold/cool/warm life is tested with the lid closed, estimated life requirements must be doubled to allow for cold box opening and transport delays. For example, if a proposed activity is estimated to require a 12-hour cold life, equipment with at least a 24-hour cold life should be purchased.

Doubling estimated cold/cool/warm life requirements has a profound effect on equipment choices in the three settings. See the PQS catalogue for cold box and vaccine carrier options.

vii. Considering weight (mass) of cold boxes and planning appropriate human resources

The three settings will make extensive use of cold boxes and will likely have minimum human resources available to handle them, especially in remote rural and conflict settings. Cold boxes are usually very heavy due to the number of cooling packs required (up to 44) to maintain cold chain temperatures throughout their use, including during transport and storage. Furthermore, their vaccine storage capacity is much smaller than their cooling pack capacity, meaning that a large cold box is required to transport or store a small volume of vaccines due to the space taken up by cooling packs.

30 Performance, Quality, Safety, WHO PQS Devices Catalogue, 2011, https://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/index.aspx, accessed 12 October 2020.

The PQS guidance on weight is as follows:

"A box's maximum fully loaded weight depends on how it will be transported: by vehicle, by pack animal, by bicycle or by hand. For health and safety reasons, one person should not be asked to lift a load greater than 25kg, and even this may be excessive. Larger cold boxes require two people to lift them."[31]

This is an important consideration for the three settings. The PQS catalogue should be consulted for available options; only two long-range cold boxes have a fully loaded mass of under 25kg:

- RCW 12 with a vaccine storage capacity of 7 litres and a cool life of only 26.4 hours (14 x 0.6 litre water-packs)
- AICB-156L with a vaccine storage capacity of 5.5 litres and a cool life of only 22.9 hours (15 X 0.6 litre water-packs).

Note: The number of water-packs specified in the product data sheets for each cold box or vaccine carrier is essential to maintain the required cold chain temperatures and under NO circumstances should this number be reduced (e.g. to reduce weight). It is also crucial to ensure that the cold box is fully intact and not broken (e.g. missing hinge screws).[32]

It is essential when choosing the type of cold box that due consideration is given to its fully loaded weight in the context of the resources available to handle it during transport and storage.


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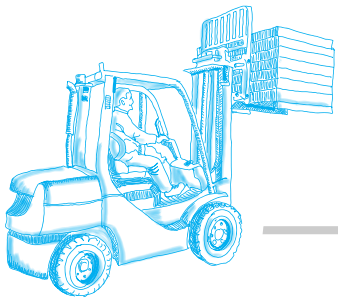
An investigation into high temperature excursions during a temperature monitoring study found that a broken hinge (82 per cent of cold boxes were broken) reduced cold life by 35 per cent. It was also found that the use of 25 conditioned icepacks instead of 39 frozen icepacks reduced cold life by 50 per cent.

31 Ibid.

32 Raubenheimer, Ticky, 'Cold box cold life analysis of broken boxes', 2012, unpublished.



viii. Integrating immunization supply chains (iSCs) into microplans and strengthening the system

The following activities are recommended in preparation for integrating iSCs into programme microplans:

1. A process for regularly updating (at least every six months) the CCE inventory for these three scenarios to identify and equip:
    a. Existing sites with no CCE for storage
    b. Existing sites with non-functioning CCE
    c. Existing sites with non-PQS CCE
    d. New sites that require CCE;

2. Strengthening the functioning and accuracy of the LMIS, especially stock levels, to ensure adequate stock availability in these three settings where accurate target populations may be unknown;
3. Mobile re-supply vehicles may be more efficient than maintaining fixed storage sites in certain contexts.

Health Worker Mekdes Eyasu, 23, prepares her vaccination box early morning at Gelan Health Center. © UNICEF Ethiopia/2020/Tadesse

8. Enabling coverage and equity in remote rural settings[33]

8.1 Challenges

As the ERG states, "Geographic inequities in vaccine coverage remain one of the unsolved challenges of immunization equity, with remote rural areas consistently hosting large numbers of under-immunized children. This lack of immunization creates vast inequities for the estimated 3.397 billion people who still live in rural environments."[34] The ERG identified five major challenges to equitable vaccination of populations in rural settings:

1. "The marginal cost of reaching remote rural populations is high relative to other environments [due to low population density].
2. Retention and motivation of staff is impeded by resource-limited environments in rural areas.
3. It is challenging to reach remote areas with potent vaccines at the right time due to the geographic remoteness.
4. Remote rural populations have limited sociopolitical power, which limits access to health institutions and health services.
5. Weak data and information use on remote rural populations limit the attention and effort focused on these areas."[35]

8.2 Operational and iSC strategies

- To address the high marginal costs of reaching remote rural populations, coordination with other programme interventions will increase efficiency and stimulate demand. Establishing basic health functions (Nutrition, Antenatal Care (ANC) and Water, Sanitation and Hygiene (WASH)), including essential long-term medication programmes, such as antiretroviral therapy for HIV and direct observation of treatment, short course (DOTS) for tuberculosis (TB), will ensure the presence of immunization services and reduce marginal costs. iSC could also leverage partnerships for vaccine storage and distribution, ensure availability of PQS-certified CCE with adequate storage capacity, and provide comprehensive vaccine and cold chain management training and basic CCE maintenance.

- Given that staff retention and motivation is a challenge in all programme areas in remote rural settings, community involvement is critical. If community members are responsible for vaccine storage, they should receive training in vaccine management and basic cold chain maintenance. Long-term passive storage devices may be appropriate and most efficient in this scenario. If storage in the community is not considered, community members could be involved in preparing water-packs, and packing cold boxes or vaccine carriers under supervision. They could also be involved in reporting CCE failures or energy interruptions and cleaning solar panels.

33 Levine, Orin, et al., 'Tackling inequities in immunization outcomes in remote rural contexts', Discussion Paper 8, Equity Reference Group for Immunization, December 2018.

34 Ibid.

35 Ibid.

- Cross-border teams and entry vaccination at border points or camps are another potential solution to gaps in human resources. This may require a temporary fixed site before the border for vaccine storage. Site assessment will be essential, especially for CCE energy requirements. Long-term passive storage devices may be appropriate for temporary storage at the border if a fixed site is not possible. Information on the antigens required and estimated target populations is important for choosing the appropriate CCE and containers and determining how much buffer stock is required.

- Mobile teams, outreach, periodic intensification of routine immunization (PIRI) and vaccination campaigns are strategies often used to address difficult geographic access and reach remote rural populations. It is important to ensure that teams have long-term passive vaccine storage devices (double the outreach time to ensure sufficient cold life for the safe return of unopened vials), and adequate storage capacity and vaccine stocks to manage fluctuations in session sizes. Mobile storage units will also aid vaccine availability and potency. Strengthening data collection to inform future outreach and mobile planning during these sessions is a priority. Unmanned aerial vehicles (UAVs such as drones) could be used for delivering vaccines and injection devices, and for population tracking to feed into the data-collection processes.

- Fixed sites for routine vaccination are a strategy still used to reach remote rural populations. As these settings are often resource-limited, iSC should focus mainly on the energy supply and use of solar direct-drive (SDD) equipment and solar technologies, and adequate storage capacity for buffer stock to accommodate both uncertain target populations (especially when underserved communities are first accessed) and the likelihood of longer – and sometimes unpredictable – supply intervals due to seasonal or other access limitations. Temperature monitoring and CCE maintenance in remote areas are a major challenge, and partnerships or third-party contractors are a viable option, where the market exists, to ensure optimal functionality of equipment. Fixed sites are crucial for mobile teams and outreach because they act as replenishment points for icepacks, cool water-packs or wet ice for vaccine carriers and cold boxes (note that domestic equipment can be used to prepare ice packs).

These areas are likely most easily understood by the iSC Manager, since most logistical challenges can be identified in the operational strategy planning phase. Once operational strategies have been identified in the microplans, these, along with the logistical challenges of the particular context, will determine the most appropriate iSC interventions to improve availability, quality and efficiency of the vaccines at the point of administration by the vaccinator.

Immunization supply chain interventions are summarized in Table 1 and categorized by contribution to availability, vaccine potency or efficiency.

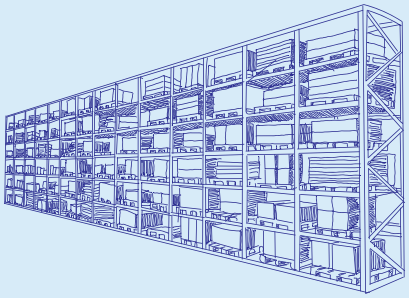


Table 1: Immunization supply chain (iSC) interventions to enable coverage and equity in remote rural settings

Interventions to improve availability	Interventions to improve vaccine potency	Interventions to improve efficiency
▸ Procurement of long-term passive storage devices ▸ Maintenance of CCE to maintain storage capacity ▸ Planning of distribution cycles and methods based on accessibility and seasonality ▸ Adjustment of storage capacity to accommodate higher stock levels including buffer stock ▸ Use of mobile units to move between immunization points for replenishment ▸ More distribution points to accommodate mobile populations ▸ Partnerships with other health interventions, or the agriculture or nutrition sector	▸ Procurement of freeze-free cold boxes and vaccine carriers ▸ Maintenance of CCE ▸ Basic maintenance of CCE, especially cleaning of solar panels ▸ Daily, weekly and monthly monitoring of temperatures and alarms ▸ Implementation of daily CCE functionality SMS-confirmation monitoring	▸ Use of smaller dose-per-vial presentations ▸ Involvement of community members to assist with tasks such as cleaning of solar panels ▸ Use of mobile units ▸ Use of UAVs (drones) ▸ Customization of information systems for data disaggregation ▸ Triangulation with non-supply chain data ▸ Regular update of CCE inventory ▸ Use of geographic information system (GIS) to increase CCE visibility ▸ Supply chain integration (with other health items) planning to support service delivery mechanisms

During the planning phase, it is essential to establish how long the vaccines will be in transit and the type of terrain involved (especially for remote outreach in mountainous areas) because this will determine the most appropriate type of cold box or vaccine carrier to use. It is also important to establish the mode of transport (pack animal, bicycle, motorbike, etc.) and how many health workers will be available to handle each cold box during transit because this will determine the maximum fully loaded weight – if only one health worker is available, choose a cold box with a fully loaded weight under 25kg. Finally, establish which antigens will be used for each chosen operational strategy (sometimes only a limited number may be chosen) and the estimated target population (this is likely to be inaccurate until a history is obtained, so adequate buffer stock must be included), since this will determine the storage capacity required for CCE, cold boxes and vaccine carriers. Depending on the accuracy of the target populations and expected session sizes and wastage, it may be appropriate to change dose-per-vial presentations to the smallest available dose-per-vial presentations, if possible. The additional cost of smaller presentation vials should be weighed against the benefits of reduction in wastage and missed opportunities.

9. Improving coverage and equity in urban poor settings[36]

9.1 Challenges

More than 300 million children live in slums; this is clearly a significant issue that needs addressing. The ERG identified seven key challenges to the equitable vaccination of populations in urban settings:

1. "A lack of accurate, disaggregated data creates difficulty in identifying and tracking populations.
2. Cultural differences and discrimination create social distance and disenfranchised communities and lead to a mistrust of the health system and influence health care-seeking behaviour.
3. Quality of services and a lack of information impact access to immunization services, especially for low-income, working caregivers.
4. A lack of political will to prioritize immunization services for disenfranchised communities.
5. Residents of informal settlements may fear encountering public authorities, and authorities may be less interested in investing in residents of informal settlements.
6. Multiple stakeholders and a lack of effective partnerships, particularly with private-sector providers, reduce the ability to improve immunization equity.
7. Insecurity and violent crime restrict access to public services, especially in slums."[37]

9.2 Operational and iSC strategies

- Integrating the iSC with the immunization programme operational strategies will be essential in this setting.
- Contract management expertise will be needed to set up practical third-party contracts that will ensure compliance with minimum standards and data-collection requirements. If private-sector pharmacies can be contracted, and the country has a pharmacy regulating authority, it will greatly enhance vaccine quality standards if this regulatory authority can publish and monitor adherence to minimum cold chain management standards in their professional Code of Practice. Before contracting private-sector providers, it is essential to study the WHO Guidance Note, 'Engagement of private/non-governmental health providers in immunization service delivery'.[38]
- A reliable energy supply will be critical for vaccine storage sites near these areas. Due to the high population density of these urban poor areas and difficult access to the area with big delivery vehicles, it may be appropriate to set up storage depots nearer to these areas so that immunization sites can be replenished more frequently with smaller quantities of vaccines and other immunization supplies such as syringes, needles and safety boxes.

36 Nandy, Robin, et al., 'Tackling inequities in immunization outcomes in urban contexts', Discussion Paper 7, Equity Reference Group for Immunization, December 2018.

37 Ibid.

38 World Health Organization, *Engagement of private/nongovernmental health providers in immunization service delivery*, https://www.who.int/immunization/documents/policies/WHO_IVB_17.15/en/, accessed 12 October 2020.

- Community involvement may partly address social distance between disenfranchised communities and governments. However, proper training and supervision will be required. Communities can also assist in ensuring that solar panels and cold chain equipment are protected.
- A number of factors must be considered during the planning phase for fixed sites providing routine vaccination: energy supply, solar equipment, CCE security, and adequate storage capacity for buffer stock to accommodate both uncertain target populations (which are constantly changing due to movement and influx) and the likelihood of longer – and sometimes uncertain – supply intervals due to seasonal or other access limitations.
- Mobile teams, outreach, PIRI and vaccination campaigns in response to specific needs address not only a lack of service delivery, but can also address a lack of health-seeking behaviour and other demand-related challenges, if service quality is sufficient.
- Partnerships with private for-profit health service providers may be useful for storage of vaccines and supplies, transport and delivery of vaccines and other supplies, and/or CCE maintenance. Use the WHO Guidance Note on engaging with private/non-governmental parties.[39]
- Adapting health facilities operations to the context (i.e. flexible opening hours) will provide opportunities for working caregivers to seek health services in urban settings. Transport, distribution, vaccine stocks and data collection should be adjusted accordingly.

Immunization supply chain interventions are summarized in Table 2 and categorized by contribution to availability, vaccine potency or efficiency.

Table 2: Immunization supply chain (iSC) interventions to enable coverage and equity in urban poor settings

Interventions to improve availability	Interventions to improve vaccine potency	Interventions to improve efficiency
▸ Greater CCE storage capacity and more frequent delivery ▸ Specific training on tools developed for urban slums ▸ Engagement of private-sector providers ▸ More distribution points to accommodate high-density populations	▸ Forecasting tools designed to cater for more frequent replenishment and greater flexibility ▸ Increased supervision	▸ A system design that includes the private sector and NGOs as a service delivery/supply chain point ▸ Allocation rules (who gets deliveries first) ▸ Smaller distance between distribution points ▸ Customized information systems for data disaggregation ▸ More efficient data collection, collation and use

39 Ibid.

10. Enabling coverage and equity in conflict settings[40]

10.1 Challenges

Approximately 40 per cent of the 20 million unimmunized children live in fragile or humanitarian settings, including countries affected by conflict. Within conflict areas, gender, education, disability, and ethnicity/caste may intersect to create compounded vulnerabilities. The following are critical challenges to immunization coverage and equity in these settings:

1. Damage or destruction of infrastructure and the supply chain
2. Difficulty retaining health workers
3. Delivery of services, since it is very likely that the storage of vaccines will be far removed from the target population (perhaps even in another country), and delivery of vaccines to specific immunization sites or teams will most probably be dependent upon clearances (which may involve lengthy processes) and will be granted at very short notice
4. Mistrust between authorities and communities
5. Uncertain target populations due to displacement and migration.

10.2 Operational and iSC strategies

Several operational immunization strategies can be used to manage these challenges; they may need to be used in combination to effectively increase coverage and equity. It is the responsibility of iSC to ensure that these strategies are properly enabled with equipment, stock and on-time deliveries. Strategies include (but are not limited to):[41]

- Cross-border teams and 'hit-and-run' teams may require a temporary fixed site at the border for vaccine storage. The scenario is similar for entry vaccination at border points or camps. Site assessment will be essential, especially for CCE energy and security requirements. Long-term passive storage devices may be appropriate for temporary storage at the border if a fixed site is not possible. Keeping these sites secure will be challenging.
- Under certain circumstances, NGOs and civil society organizations can partner with military medical services. Military agencies are experts in logistical functions and their equipment usually matches or sometimes even exceeds strict PQS specifications. Nevertheless, it is important to determine the operating specifications of their cold chain equipment before a decision is made about using it to store and transport vaccines.
- Where there is active conflict, shockproof passive storage devices made for helicopter drops are an option (these are not currently WHO pre-qualified). Vaccine delivery may also be integrated with other health commodities delivered in special convoy transport. Adequate precautions must be taken to ensure appropriate cold boxes and cold/cool life are available.

40 Okwo-Bele, Jean-Marie, et al., 'Tackling inequities in immunization outcomes in conflict contexts: summary', Discussion Paper 6, Equity Reference Group for Immunization, December 2018.

41 World Health Organization, Vaccination in humanitarian emergencies: Implementation Guide, https://www.who.int/immunization/documents/general/who_ivb_17.13/en/, accessed 12 October 2020.

- Fixed sites can still be a viable strategy, but are often vulnerable to insecurities. Data exchange via the Global System for Mobile Communications (GSM) may be restricted or absent, which makes remote temperature monitoring impossible and CCE functionality monitoring very challenging. Energy supply is also a major challenge in these areas and solar energy should be first choice if possible. However, the insecurity of the area may make it impossible to use solar power due to likely destruction or theft. All these challenges highlight the need for careful integration of iSC with the operational strategy and microplans of the immunization programme.

Immunization supply chain interventions are summarized in Table 3 and categorized by contribution to availability, vaccine potency or efficiency.

Table 3: Immunization supply chain (iSC) interventions to enable coverage and equity in conflict settings

Interventions to improve availability	Interventions to improve vaccine potency	Interventions to improve efficiency
▸ Long-term passive storage devices ▸ Larger CCE storage capacity and more frequent delivery ▸ Shockproof cold boxes for aeroplane/helicopter drops ▸ Engagement with community leaders ▸ Integration with other convoy supplies ▸ Engagement with NGOs/ private sector ▸ Engagement with military	▸ Design forecasting tools that include displaced populations ▸ Build resilient health system including solar fridges	▸ System design that includes the private sector and NGOs as a service delivery/supply chain point ▸ Decisions on allocation rules – who gets deliveries first ▸ Customization of information systems for data disaggregation ▸ Improved efficiency for collection, collation and use of data

11. Immunization supply chain (iSC) toolkit to enable coverage and equity in urban poor, remote rural and conflict settings

These three priority settings require focused attention so that the right choices can be made to reach the goal of increased coverage and equity, without interfering with countries' normal routine immunization strategies. Whether a fractional cMYP is compiled or not, it is essential that an outline of relevant information and strategic choices is recorded for future reference and to monitor progress. A toolkit is presented in Appendix 1, which summarizes guidance and can be used for recording purposes.

If alternative operational immunization strategies or iSC choices are made, please add them to the toolkit where appropriate. A separate toolkit should be completed for each of the three settings. This should be reviewed annually, and indicator results should be compared with previous years to establish progress made and identify areas for change or improvement.

Appendix 1: iSC toolkit to enable coverage and equity in remote rural, urban poor and conflict settings

Initial considerations for all three settings					
Name of country and managing unit:	Country……Managing unit……				
Period covered by this Framework: (align these dates with the cMYP cycle)	From: …… to: ……				
iSC maturity levels of managing unit (national/provincial/district):	**Leadership**	**Continuous improvement plan**	**Data for management**	**CCE**	**System design**
Level 1	☐	☐	☐	☐	☐
Level 2	☐	☐	☐	☐	☐
Level 3	☐	☐	☐	☐	☐
Level 4	☐	☐	☐	☐	☐
Level 5	☐	☐	☐	☐	☐
Setting:	☐ Remote Rural ☐ Urban Poor ☐ Conflict				

Geographical location and setting sites as applicable (Include the name and GPS coordinates of the sites and their supply points)	Findings
Weather patterns and temperatures (Preferably last 10 years: average minimum and maximum; single minimum and maximum)	
Access routes and distances/time (Condition of roads, river crossings, terrain; specific obstacles and challenges for travel; distance from nearest supply point and time required to travel from nearest supply point to each site)	
Solar suitability/electricity (A solar site evaluation is required for solar installations. For electricity, a minimum of 4–8 hours per 24 hours is required and voltage stabilizers are essential)	

GSM access (Is signal adequate and available 24 hours per day/what are the limitations?)	
Security (Is adequate security available to protect CCE and stock? What is it?)	
Available partners/NGOs/for-profit providers in area (List all available partners/NGOs/other providers that can be utilized for iSC)	

Waste disposal practices (What are the current practices, and can they be used for iSC/what should be provided for safe disposal?)	
CCE distribution in the area	**Findings**
Existing CCE (Each setting should have its own CCE inventory. If the country participates in the CCEOP, this should align with the ODP)	
Refrigerators, freezers (List each item, indicating whether it is PQS, old technology (non-PQS) or domestic)	

Cold boxes, vaccine carriers (List each item, indicating make, model, net vaccine capacity, number of water-packs required and whether it is damaged or not damaged)	
Syringes, needles, safety boxes (What is currently used and how is it procured, stored and delivered?)	
Swabs, other (What is currently used and how is it procured, stored and delivered?)	

CCE functionality (Use the existing CCE list and update it monthly, preferably daily)	
Adequacy of capacity (increased buffer/ safety stock plus population increase) (When calculating capacity needs, include expected population/migrant growth and at least 30 per cent buffer stock. For settings where seasonal access is restricted, ensure that stock levels are adjusted for these prolonged supply intervals. Where different dose-per-container presentations are used, capacity needs must include this increase in volume per dose.)	
CCE maintenance support (How and by whom is the CCE currently being maintained and is it adequate? If inadequate, what needs to be put in place?)	

iSC support (Who provides iSC support for the setting and is it adequate? If inadequate, what needs to be put in place?)	
Historical records (In recently active conflict areas where historical data and records are not appropriate, establish with the immunization programme the quantities and methods to be used and when to review them (using data collected in this framework)	**Findings**
Stock movement and stock-outs (Check the last two years of delivery records for the area: have they been constant or erratic, and why? How many stock-outs have occurred in the last five years, for which items and why?)	

Wastage (Check the wastage rates for the setting for the last three years. This may be difficult and may require disaggregation of data from stock movements)	
CCE maintenance/replacement (How many CCE items have required maintenance over the last three years and how many were successfully repaired? How many CCE items have needed replacing over the last three years and how many were replaced within one year?)	
Delivery schedules and replenishment intervals (What were the delivery schedules for the area over the last two years? Were supply intervals constant or erratic?)	

Agreements to make with the immunization programme	Findings
Operational strategies applicable in each area (Agree with the immunization programme which operational strategies will be implemented for each area, and when, for the next year)	
Estimated target population for each strategy Agree with the immunization programme on what the estimated target population for each area should be for the next year and when it should be reviewed (together with stock movement), as well as annual population/ migration growth)	
Dose-per-vial presentations to be used for each antigen (Agree with the immunization programme on which vaccines should be procured and distributed in smaller dose-per-container presentations for the setting – especially where wastage rates have been or are expected to be high. This may also be preferable where estimated target populations are highly uncertain)	

Operational plan and budget (this should include the chosen operational strategies together with the chosen iSC interventions to enable coverage and equity)

Possible iSC interventions to increase coverage and equity for each alternative setting:

Remote rural

Operational immunization strategies (mark as appropriate):

- ☐ Community-based involvement
- ☐ Cross-border teams
- ☐ Entry vaccination at border points or camps
- ☐ Fixed sites for routine vaccination
- ☐ Mobile teams
- ☐ Outreach
- ☐ PIRI
- ☐ Vaccination campaigns in response to specific needs
- ☐ Re-establishment of basic health functions, including essential long-term medication programmes such as ARVs-HIV, DOTS-TB, etc.

Improve vaccine availability	Improve/assure vaccine quality	Improve efficiency
☐ Use long-term passive storage devices	☐ Use freeze-free cold boxes and vaccine carriers	☐ Increase utilization of smaller dose-per-vial presentations
☐ Maintain CCE to maintain capacity	☐ Maintain CCE (clean solar panels)	☐ Use CTC vaccines
☐ Plan distribution cycles and methods based on accessibility and seasonality	☐ Use SDD and ice-lined refrigerators	☐ Involve communities to assist with tasks such as cleaning of solar panels
☐ Adjust storage capacity to accommodate bigger stock levels, including buffer stock	☐ Ensure daily, weekly and monthly monitoring of temperatures and alarms	☐ Use mobile units
☐ Use mobile units to move between immunization points for replenishment	☐ Implement daily CCE functionality SMS-confirmation monitoring	☐ Use UAVs (drones)
☐ Increase number of distribution points to accommodate mobile populations		☐ Use timely and accurate data
☐ Seek partnerships with other health interventions, or agriculture or nutrition sector		☐ Customize information systems for data disaggregation
		☐ Triangulate with non-supply chain data
		☐ Regularly update CCE inventory
		☐ Improve efficiency of data collection, collation and use
		☐ Use GIS to increase CCE visibility
		☐ Integrate supply chain (with other health items) planning to support service delivery mechanisms

Urban Poor

Operational immunization strategies (mark as appropriate):

- ☐ Community-based involvement
- ☐ Cross-border teams
- ☐ Entry vaccination at border points or camps
- ☐ Fixed sites for routine vaccination
- ☐ Mobile teams
- ☐ Outreach
- ☐ PIRI
- ☐ Vaccination campaigns in response to specific needs
- ☐ Re-establishment of basic health functions, including essential long-term medication programmes such as ARVs-HIV. DOTS-TB, etc.
- ☐ Partnerships with private for-profit health service providers
- ☐ Adaptation of health facility operations to fit the context e.g. flexible opening hours

Improve vaccine availability	Improve/assure vaccine quality	Improve efficiency
☐ Increase CCE storage capacity and delivery frequency	☐ Use forecasting tools designed to increase replenishment and flexibility	☐ Design a system that includes the private sector and NGOs as a service delivery/supply chain point
☐ Use SDDs	☐ Increase supervision	☐ Increase utilization of smaller dose-per-vial presentations
☐ Use long-term passive storage devices	☐ Use freeze-free cold boxes and vaccine carriers	☐ Use CTC vaccines
☐ Use solar cold rooms		☐ Establish allocation rules (who gets deliveries first)
☐ Specific training on tools developed for urban slums		☐ Use targeted Effective Vaccine Management assessments (EVMAs)
☐ Engage private-sector providers		☐ Reduce distance between distribution points
☐ Increase the number of distribution points to accommodate high-density populations		☐ Customize information systems for data disaggregation
		☐ Improve efficiency of data collection, collation and use
		☐ Use GIS to increase CCE visibility

Conflict

Possible operational immunization strategies (mark as appropriate):

- ☐ Community-based involvement
- ☐ Cross-border teams
- ☐ Entry vaccination at border points or camps
- ☐ Fixed sites for routine vaccination
- ☐ Mobile teams
- ☐ Outreach
- ☐ PIRI
- ☐ Vaccination campaigns in response to specific needs
- ☐ Re-establishment of basic health functions, including essential long-term medication programmes such as ARVs-HIV. DOTS-TB, etc.
- ☐ Partnership with military medical services (in certain circumstances)
- ☐ Vaccination before moving populations out of newly accessed places
- ☐ Vaccinations at transit points
- ☐ Holding areas for observation before entry into camp
- ☐ Quick 'hit-and-run' operations

Improve vaccine availability	Improve/assure vaccine quality	Improve efficiency
☐ Use long-term passive storage devices	☐ Design forecasting tools that include displaced populations	☐ Design a system that builds resilience into the iSC
☐ Increase CCE storage capacity and delivery frequency	☐ Use freeze-free cold boxes and vaccine carriers	☐ Design a system that includes the private sector and NGOs as a service delivery/supply chain point
☐ Use SDDs		☐ Increase utilization of smaller dose-per-vial presentations
☐ Use shockproof cold boxes for aeroplane/helicopter drops		☐ Use CTC vaccines
☐ Engage with community leaders		☐ Respond to short-notice deliveries
☐ Integrate with other convoy supplies		☐ Integrate supply chain (with other health items) planning to support service delivery mechanisms
☐ Engage with NGOs/the private sector		
☐ Engage with the military		

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