# Last-Mile Distribution Interventions

## CHAI's Experience and Learnings (2019-2022)

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# Contents

# 1. Introduction

For a national immunization program to be effective, it is essential to ensure the continuous and uninterrupted availability of vaccines up to the point of vaccination. Countries (especially LMICs) continue to face vaccine stock-outs at national, district, and health facility levels, affecting immunization services.

Distribution systems in the lower tiers of the supply chain and at the last mile are often ineffective or nonexistent. As a result, they cannot ensure vaccine delivery to health facilities on time, in full, and in the right state for use. For example, before CHAI's intervention, only 38 percent of deliveries in Kenya and 15 percent in Uganda were completed on time and in full. Ineffective vaccine delivery is one of the core drivers of health facility stockouts.

This document aims to provide insight into three key inadequacies that affect the last mile - procedural, structural, and transportation (Section 2) - and why they persist. These insights are further elaborated on through three case studies highlighting CHAI's work on last-mile distribution in Kenya (3.1), Lao PDR (3.2), and Uganda (3.3.3). Finally, the document highlights key learnings (Section 4) that can be used by those implementing (EPI supply chain specialists, logistics partners) or supporting the implementation (core and expanded implementing partners) of similar interventions.

# 2. Problems affecting delivery of vaccines at the last mile

## 2.1 Inadequacies in the supply chain

Many countries lack a well-organized or optimized vaccine distribution process, resulting in several inadequacies in the supply chain. There are three major categories of inadequacies - procedural, structural, and transport-related;

### 2.1.1 Procedural inefficiencies

There is minimal coordination across the supply chain to navigate undefined responsibilities and complicated processes. The delivery mechanisms are not clearly defined at higher levels of the supply chain, and downward distribution is usually not utilized. As a consequence, healthcare workers (HCWs) are responsible for maintaining adequate stock levels and ensuring vaccine delivery. They are under-equipped to collect vaccines and therefore have to resort to ad hoc methods. Vaccine collection presents several challenges to healthcare workers:

- **Lack of defined ordering and collection times causing low order timeliness:** HCWs do not have set timelines on when to place orders and collect vaccines. Collection trips occur at the last moment on an ad-hoc basis leaving the supplying store with minimal time to arrange the required stock. Vaccine orders aren't placed on time and HCWs often return empty-handed after collection trips.
- **Low stock visibility due to poor communication causing low order fulfillment:** Since there isn't an effective order tracking system, supplying stores do not have a clear indication of how much stock they need to store. There is minimal data visibility and data use with no mechanisms to keep track of stock across health facilities. This results in low order-fulfillment rates when vaccine collection does take place. As order requests aren't honored, there is a low incentive for store managers to monitor and manage stock.
- **Overburdened healthcare workers causing poor service delivery:** Facilities often lack transport to collect vaccines leaving HCWs to use personal vehicles and bear the cost of vaccine collection. Additionally, HCWs are primarily trained in service delivery and lack the training to collect vaccines effectively. They often delay the collection exercise to combine trips to supplying stores with other objectives, thereby increasing stockout duration. The multiple job roles can become a heavy burden for healthcare workers causing stockouts, and ultimately, poor service delivery.

### 2.1.2 Inadequate transport infrastructure

Low understanding of transport requirements along with low funding results in poor allocation of transport across the supply chain. Lack of transport ultimately causes longer stockouts and higher out-of-pocket expenditures for HCWs. This inadequacy can be caused by multiple factors:

- **Inefficient use of scarce vaccine-allocated transport:** Vaccine programs are often plagued with low supply chain funding causing the limited allocation of vehicles for vaccine transportation. Even when transport is allocated to the program, it is allocated disproportionately across supply chain tiers. Vehicles are generally allocated at higher levels of the supply chain where they are used at a lower frequency (Bi-Monthly/Quarterly), as opposed to facilities that are burdened with more frequent (Monthly) collection trips.
- **Low levels of integration across health programs:** Despite clear opportunities, there is hesitation in integrating vaccine supply chains with those of other programs. This is often due to multiple factors including low communication between health programs and the massive procedural change required in integration. Low integration causes multiple duplicate supply chains to exist at the same time making inefficient use of scarce vehicles. As seen in

Laos, estimating the cost benefits of integration can also be tough. Integration tends to replace 'hidden costs' which are ignored in typical cost analyses. These hidden costs are difficult to calculate as they are a part of inefficiencies that already exist in distribution models - for example, the out-of-pocket expenditure made by healthcare workers during vaccine collection is rarely accounted for in LMD cost analyses. This makes the integration appear to be more expensive and difficult to advocate despite the improvement in supply chain indicators.

- **Low use of 3rd party logistics:** Low implementation of outsourcing mechanics in delivery is primarily due to how costly it can prove to be. Outsourcing has been shown to reduce delivery times in more advanced supply chains, but it can often involve a significant increase in delivery costs causing LMI countries to prefer insourced distribution models. For example, a study on outsourcing in Uganda proved the model to be much more expensive than the existing insourced system causing the government to move forward with an insourced model for LMD interventions. However, similar to integration, such cost analyses can often ignore the hidden costs involved in insourced models. Since outsourcing models account for these costs, they can appear to be much more expensive than their insourced counterparts.

### 2.1.3 Structural inefficiencies

Vaccine supply chains in every country require a complex network of distribution points that take vaccines from a central port to the last mile. The number and location of these distribution points are often inadequate leading to higher lead times, especially for remote health facilities with higher ZD populations. These complications can occur in multiple forms:

- **An insufficient number of supply chain tiers leading to higher delivery times:** Supply chains can often have an inadequate number of tiers creating large distances and delivery times between tiers. This creates a greater burden on distribution points with higher delivery loads. For example, in Uganda, the existing supply chain before CHAI's intervention consisted of only 3 tiers (Central, Regional, and District stores) causing a high burden on districts with higher populations serving a disproportionately high number of facilities.
- **Too many supply chain tiers leading to complex delivery processes:** On the other hand, supply chains can also have too many tiers making the delivery process more complicated. For example, in Ethiopia, the supply chain consists of 5 tiers (Central, Regional, Districts, Facilities, and Health Posts) which involve too many stakeholders making delivery complicated and costly with duplication of resources.
- **Unoptimized location of distribution points leading to disproportionate delivery distances:** Even with the right number of tiers, distribution points are often located arbitrarily keeping governance structures in mind rather than optimizing delivery distances. For example, in Uganda, several health facilities on borders were closer to district vaccine stores (DVS) of a neighboring district than the DVS in their own district, but couldn't benefit from this due to rigid processes

## 2.2 Why inadequacies continue to persist

The primary reasons why these inadequacies continue to persist across supply chains is low data visibility and data use. All of the aforementioned challenges are exacerbated due to unorganized systems that don't generate enough data to bring supply chain challenges to the forefront. This results in a negative self-enforcing cycle where supply chain challenges continue to plague immunization without ever being countered. This cycle is further explained in the below figure.


- Unorganized supply chains produce little data, with low stock monitoring and order tracking. Especially at the health facility level, key indicators like stockouts are not tracked and communicated to higher levels in time. eLMIS use remains low and data remains decentralized in facility registers. This restricts easy review and analysis of data resulting in minimal data use at higher levels
- Limited data visibility, review, and use hinder EPI's ability to respond to and prioritize distribution challenges in an evidence-based manner. Even where data review meetings exist, discussions remain limited to service delivery and general coverage rates - as supply chain KPIs are deprioritized in already packed integrated DRMs. As a result, most supply chain challenges remain unidentified or undiagnosed. The difficulty in estimating the cost benefits of optimized supply chains also makes LMD interventions seem too expensive for the benefit they provide.
- With a surface-level understanding of supply chain challenges, they remain unprioritized in larger immunization strategies. This low prioritization of supply chain challenges leads to inadequate allocation of resources. Stores and facilities operating at the last mile often lack the right amount of personnel trained to manage vaccine delivery. The personnel that do exist often do not have the right tools for adequate management such as dedicated transport, money for fuel, and per-diems. They are left with no reliable mechanism to replenish the stock in a timely manner
- Low prioritization results in low funding for the supply chain creating a negative self-enforcing cycle where stock levels are not monitored proactively, orders aren't made routinely, and no delivery of stock occurs, rather collection takes place when convenient alongside other travel with HCWs often using personal vehicles, without awareness that stock is available at higher tiers.

CHAI's interventions over the last years have tried to implement pilots that break the self-enforcing cycle by bringing supply chain challenges to the forefront and testing scalable and sustainable solutions that tackle root causes. The following sections detail our work in three countries along with key learnings that can inform future LMD interventions.

# 3. CHAI's Intervention - Case studies and results

Over the last few years, CHAI has been working in multiple countries to implement LMD interventions that improve the aforementioned problems in a sustainable way. CHAI's approach to these interventions has been to implement customized pilots across a broad range of environments to counter all three categories of problems:

- **Solving procedural inefficiencies (3.1)**: In Kenya, CHAI has implemented pilots in 3 counties looking to redesign the distribution process by introducing downward delivery with optimized frequency to eliminate ad-hoc vaccine collection.
- **Solving transport inadequacies (3.2)**: In Laos, CHAI has worked with 2 provinces to integrate vaccine supply chains with other commodities to bring organized processes as well as cost efficiencies. Both of these interventions were backed by rigorous data tracking to ensure the implementation of necessary corrective actions, as well as to create a culture of data use across all tiers of the supply chain.
- **Solving structural inefficiencies (3.3)**: In Uganda, CHAI's initial strategy exploring outsourcing vaccine delivery proved infeasible for the government. However, the challenges highlighted during the pilot encouraged the government to explore alternative solutions. This led to the creation of a system redesign strategy to introduce a new supply chain tier and reduce last-mile distances through insourced downward distribution.

This section covers case studies of the interventions in Laos, Kenya, and Uganda that generated significant impact and generated learnings that can guide interventions in the future.

## 3.1 Piloting organized downward distribution in Kenya to counter procedural inefficiencies

### 3.1.1 Problem Statement

In Kenya, vaccines are distributed on a quarterly basis from the National Vaccine Store to Regional Vaccine Stores (RVS), and then to Sub-County Vaccines Stores (SCVS). On a monthly basis, most immunizing health facilities (IHFs) collect vaccines from the SCVS. Unfortunately, IHFs are inadequately equipped to carry out the monthly vaccine collection exercise.

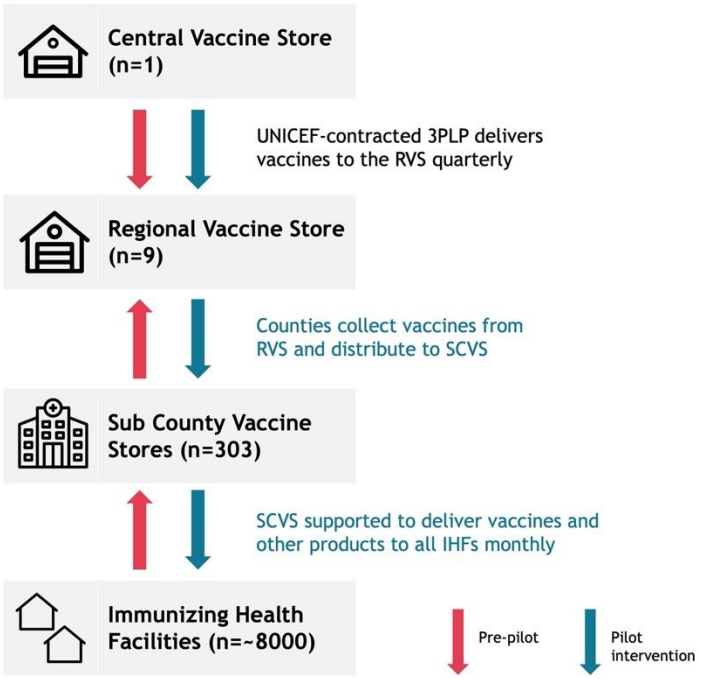
This is primarily driven by low availability of vaccine-dedicated transport at facilities. Healthcare workers generally use their personal vehicles, often two-wheelers, to carry out collection. Further, even when vehicles are available, Inadequate cold chain equipment and temperature monitoring devices make it difficult to maintain and monitor vaccine temperature while in transit leading to stockouts.

At baseline across three surveyed counties, 77 percent of IHFs reported at least one antigen stocked out and 17 percent of IHFs had at least three antigens stocked out. 41 percent of stockouts lasted more than 28 days signaling prolonged structural challenges, and 65 percent of IHFs had at least one antigen stocked above the maximum level.

### 3.1.2 CHAI's approach

From August 2019 to July 2022, Clinton Health Access Initiative in partnership with county leadership piloted an in-sourced vaccine Last Mile Distribution (LMD) system. The pilots were implemented in three counties - Kwale, Kisii, and Uasin Gishu, and covered 430 health facilities supporting 1.3 million people. ~190 of these facilities were studied across three time periods (baseline, midline, endline) to track progress with one county conducting a post-pilot study. The pilot encompassed three primary interventions to increase stock availability and immunization coverage.

First, the existing pull system was strengthened through IHFs placing regular orders to SCVs. Quarterly, counties would collect stock from the Regional Vaccine Store (RVS) and distribute it to the sub-county level. Monthly, the Sub-County Vaccine Stores (SCVS) would distribute to Immunizing Health Facilities (IHFs). The transition placed personnel and vehicle requirements on the better-resourced senior level enabling healthcare workers to focus on service delivery. The pilot formalized distribution timelines and reduced ad hoc practices creating a more flexible supply to improve vaccine access and availability.




Second, the pilot adjusted the culture surrounding distribution. Distributions were no longer simply moving stock but encompassed a supervisory support capacity. Each distribution included a cross-functional leadership team of logisticians, M&E, cold chain, and pharmaceutical teams. The culture around distribution graduated from simply a logistical function to an opportunity for data sharing, information passing, and inspection of operations. Senior leaders then used this increased awareness of operations to advocate and inform decision-making.

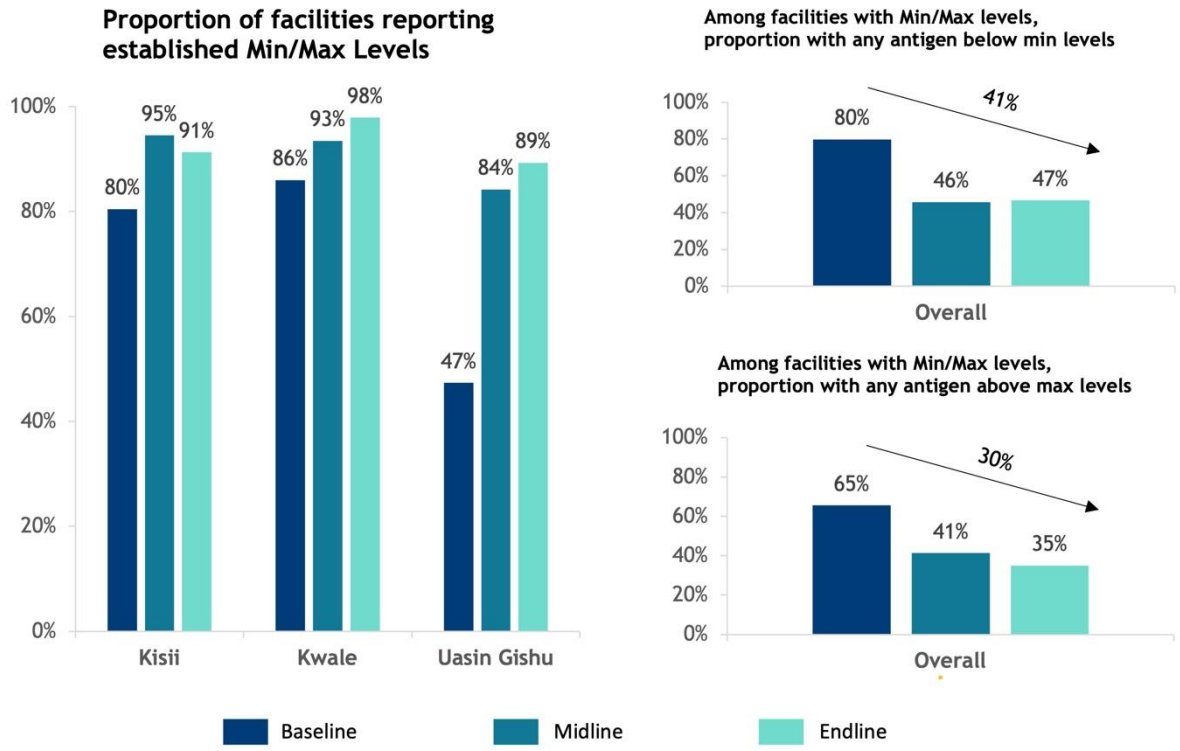
Third, the pilot incorporated integrated quarterly immunization performance review meetings in totality with a focus on the supply chain – stock status, cold chain, and service delivery and addressed immunization-related challenges. This ensured KPI measurements were taken into consideration, involving senior leadership in decision-making.

### 3.1.3 Results

At the end of the pilot, all three counties showed positive results:

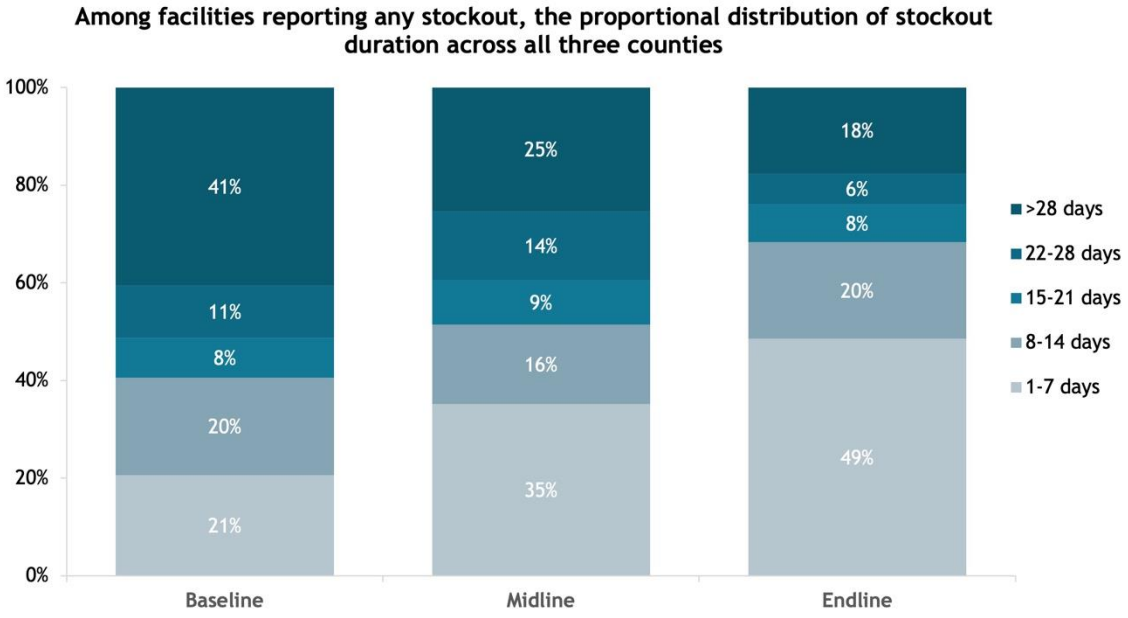
- **Appropriate stock levels**: Stocking practices improved across the board. On average by the end of the study, there was a 41 percent decrease in the proportion of IHFs with any antigens stocked below the minimum level along with a 46 percent decrease in overstocking
- **Stockout Frequency**: On average, there was a 50 percent reduction in the proportion of IHFs reporting stockouts of any antigen across the three counties. IHFs experiencing stockouts of three or more antigens reduced from 17 percent at baseline to seven percent endline. The impact was significant in Uasin Gishu where the proportion of IHFs reporting any stockouts had an 85 percent reduction
- **Stockout Averages**: The average number of antigens stocked out (out of the nine total antigens studied) across the counties decreased from 1.5 at baseline to 0.7 at the endline. Kwale and Uasin Gishu had a major reduction – 2.4 to 1.2 in Kwale and 1.4 to 0.1 in Uasin Gishu
- **Stockout duration**: Among IHFs still experiencing stockouts, stockout duration reduced dramatically. On average across the three counties, by the study conclusion, there was a 57 percent reduction in stock-outs over 28 days and a 58 percent increase in stock-outs under seven days

*Figure 1.1 Appropriate Stock Levels*




*Note: Kenya level data represents combined average for all 3 counties*

*Figure 1.2: Stockout Durations*




*Note: Kenya level data represents combined average for all 3 counties*

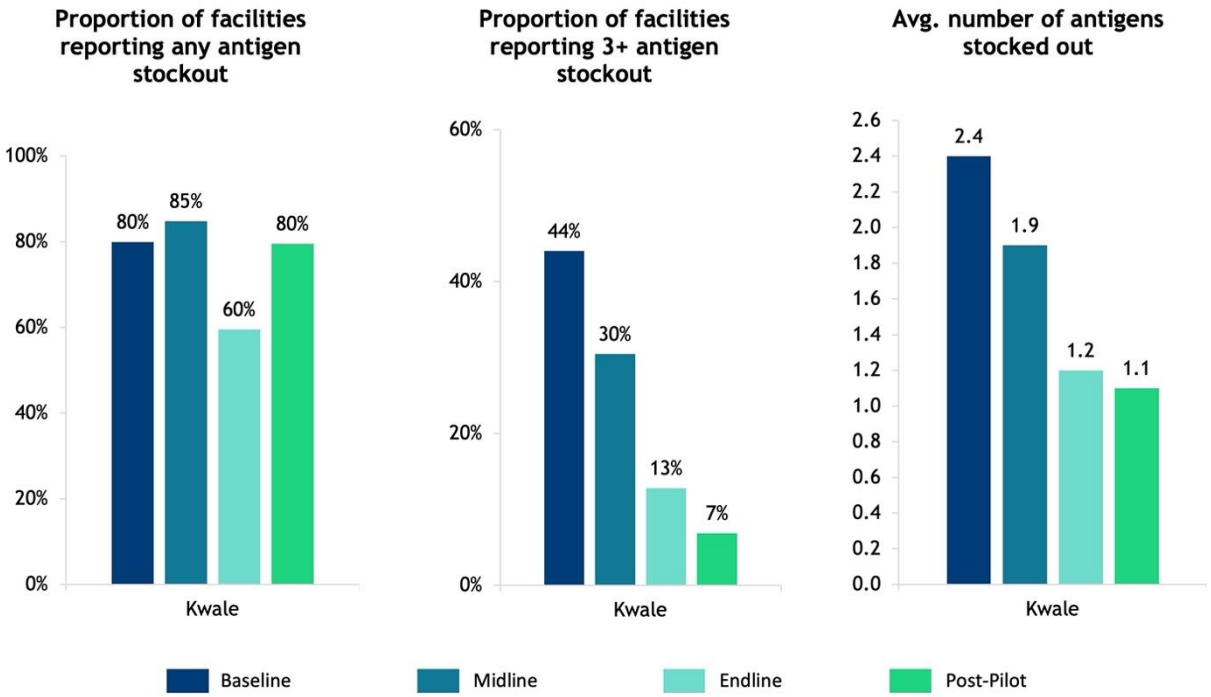
## 3.1.4 Sustainability

Promoting sustainability was a primary focus of the pilot. This was done by utilizing existing funds to finance the additional cost of supportive supervision. The quarterly cost of supportive supervision during the LMD program was higher compared to baseline operation by ~US$1,800 (~US$5,400/quarter vs. ~US$7,200/quarter). However, supervision during the LMD program was carried out monthly compared to a baseline quarterly approach. This allowed for greater monitoring of stockout performance allowing counties to take corrective measures where necessary.

All counties were encouraged to incorporate the LMD system in their annual working plan. This allowed for LMD to be a consistent part of the agenda for county leadership and ensured that the program always had sufficient funding. All three counties incorporated LMD in their Annual work plan (AWP) driven by the positive results seen during the pilot. Kwale was the earliest to transition out of external support and lead LMD on their own starting May 2021 and incorporated the system in the County Investment Development Plan (CIDP) which allows them to find resources for implementation directly from the treasury. A recent study conducted in the county provided evidence that results have sustained:

- **Stockout Frequency**: The proportion of IHFs experiencing stockouts of three or more antigens improved further from ~13 percent at the endline to ~7 percent post-pilot, resulting in a total reduction of 85 percent throughout the study (44 percent baseline to 7 percent post-pilot)
- **Stockout averages**: A year from the end of the pilot, the average number of antigens stocked out maintained the level achieved at the endline (1.2 endline and 1.1 post-pilot) resulting in a total decline of more than 100 percent throughout the study (2.4 baseline to 1.1 post-pilot)
- **Integration**: For the first time in the county, cadres across programs were involved in vaccine distribution during the LMD program. The proportion of IHFs integrating programs further increased by 36 percent, from 32 percent at the endline to 50 percent post-pilot

*Figure 1.3: Post-pilot data from Kwale County*



## 3.2 Piloting integrated distribution in Laos to counter inadequate transport resources

### 3.2.1 Problem Statement

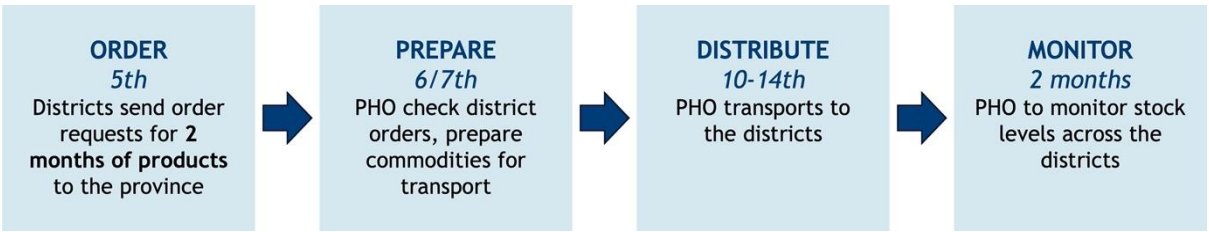
As in other low- and middle-income countries, the distribution of health products across Lao PDR is inefficient, with siloed program distribution, irregular scheduling, and reliance on ad-hoc collection from lower levels. This not only stretches limited subnational resources, but leads to lower stock availability, high expiry rates, and ultimately reduces access to essential services.

Since 2014, strengthened and integrated end-to-end logistics systems have been a key pillar of the Ministry of Health's strategic plan, with the Food and Drug Unit (FDU) taking ownership of warehouse functions and distribution for all health programs. EPI data review meetings (DRMs) in two key provincial warehouses, Champasak (CPS) and Oudomxay (ODX) have frequently cited distribution as a major contributing factor to low stock adequacy and cited inadequate funding for distribution as a contributing factor.

### 3.2.2 CHAI's approach

CHAI engaged with both CPS and ODX provincial warehouses in 2020, to support the inclusion of vaccines into integrated distribution to their district warehouses. As the Ministry of Health already had an integration strategy, the aim was to support implementation, evaluate the impact, and identify areas for improvement before wider rollout in the other 16 provinces within Lao PDR. To support this work, CHAI officers, based in both provinces, were working directly with the provincial EPI and FDU teams

Integrated distribution aims to provide commodities from all programs once every quarter to each of the districts in CPS and ODX provinces. The districts were given a deadline for when to place orders via mSupply (LMIS), and the provinces then had three days to process and pack before distributing the following week. CHAI would financially support the first three cycles, cost-share the fourth cycle with the provincial government, and the provincial government would then support each subsequent round with its budget.




The anticipated outcome was that integrated distribution would (i) reduce stockouts and low stock levels, (ii) reduce the workload of the provincial staff who would no longer be fulfilling ad-hoc requests from the districts throughout the month, (iii) reduce the workload of the district staff across multiple programs who currently come to the province themselves to collect stock, and (iv) reduce the overall costs of distribution of medical commodities from province to districts.

### 3.2.3 Results

Data was recorded in mSupply (eLMIS being used in Laos), but as the system contains over 4,000 items, one product each from the Malaria, Vaccines, Nutrition, Essential Medicines, TB, and SRH programs was selected as 'tracer commodities' (n=6) whose stock status (stockout /low /adequate /overstock) was monitored throughout the implementation period. The average number of collections/distributions of medical commodities made between the province and districts were recorded through the transactions on mSupply. For analytical purposes, the distribution cycle was tracked in the months when the provincial invoices were generated.

As part of the pilot Integrated Distribution project, five cycles of integrated distribution have taken place in ODX and four in CPS. The following charts demonstrate the impact of integrated distribution on both frequency of distribution and stockouts. Whilst data fluctuates month to month, the overall trend shows a reduction in the number of distribution days. It was noted that the monthly frequency of collections/distributions between province and districts reduced from 5 to 4 in Oudomxay province (Figure 2.1) and from 4 to 3 in Champasak province (Figure 2.2) during the integrated distribution pilot project.

*Figure 2.1: Frequency of self-collections/distributions by/to the districts in Oudomxay province*

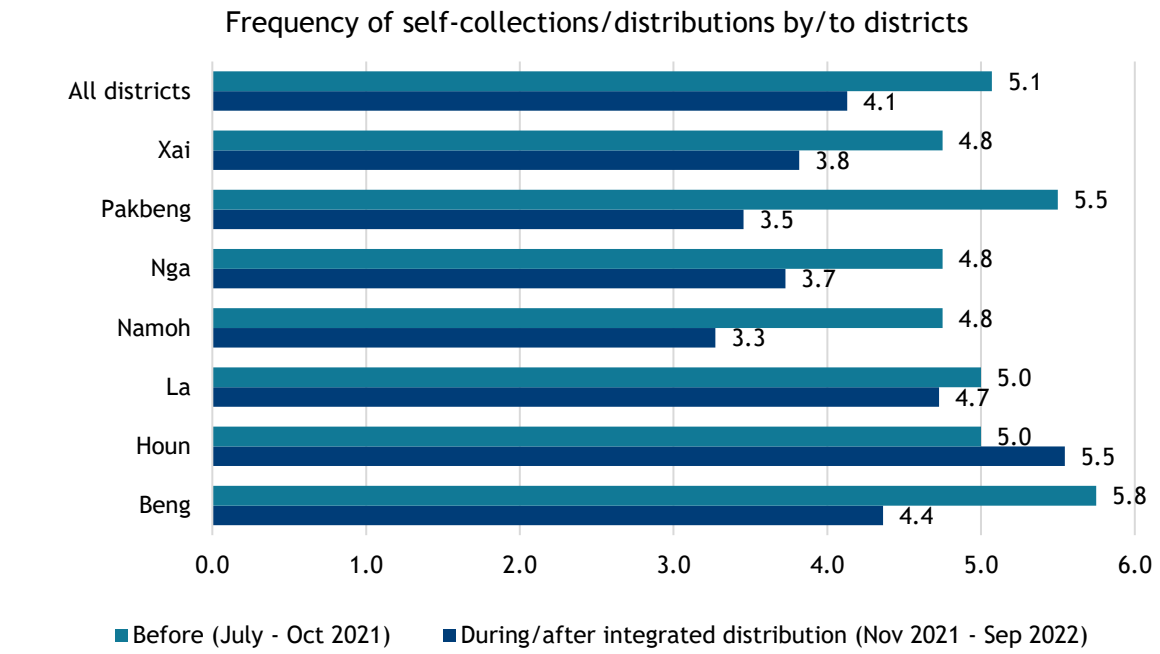
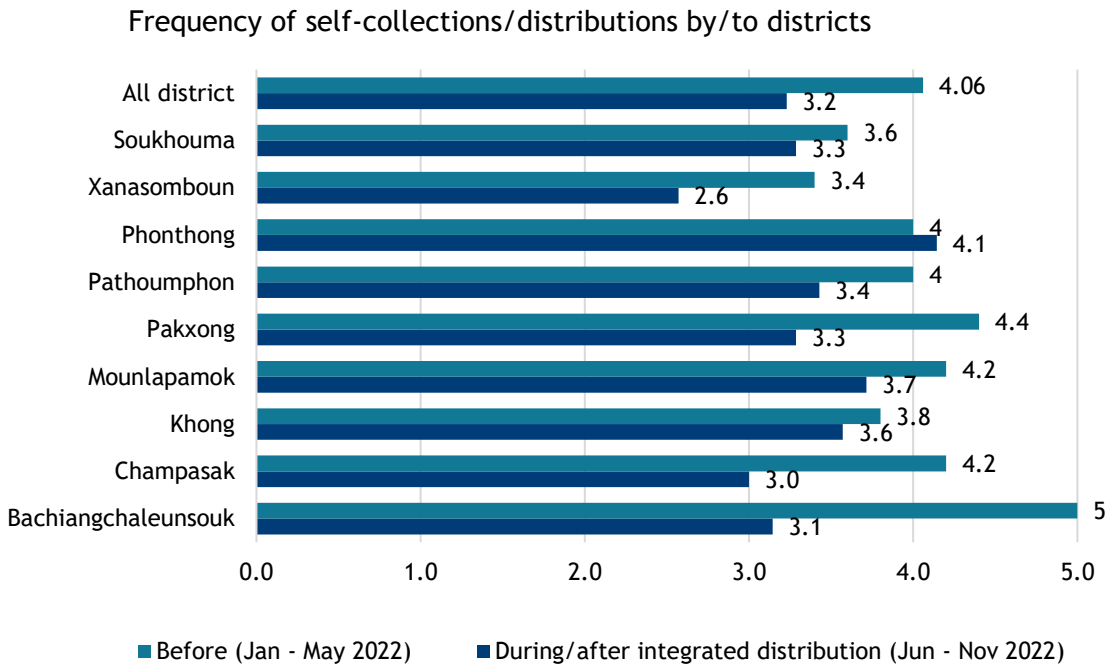



*Figure 2.2: Frequency of self-collections/distributions by/to districts in Champasak province*

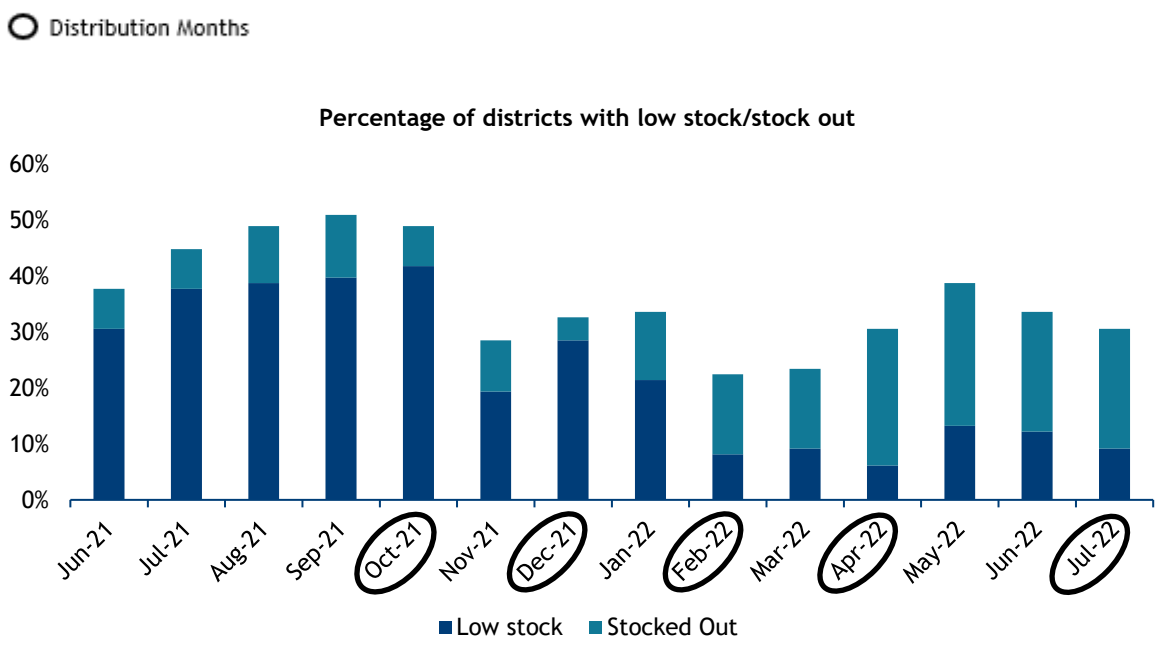


Reduced frequency of collections/distributions allowed for reduced time and costs of distribution including time for packing and unpacking, labor cost for loading and unloading, transport costs/fuel costs, etc. The reduction in the number of trips made between province and districts implies reduced estimated transportation costs (petrol, DSA). Based on the average number of trips made per month between province and district, there was an estimated cost saving of $512 and $445 per month in Oudomxay and Champasak province respectively[1]. If the integrated distribution model is expanded to all 18 provinces, it is expected to save around $75,000 per year in the country. In addition to cost saving, the reduced frequency of distribution and collections allowed the provincial health staff to track the distribution and delivery timelines.

One eLMIS (mSupply) allowed for stock visibility across the provinces and districts, and a unified method of ordering stock was available. As the integrated distribution was implemented, an increase in the use of mSupply (eLMIS) at district level was noted for ordering commodities. All districts gradually shifted from ordering through WhatsApp or call, to ordering through mSupply, allowing timely receipt of orders, quicker processing, and timely deliveries. There was improved accuracy and reduced order mistakes seen as the orders were placed through mSupply.

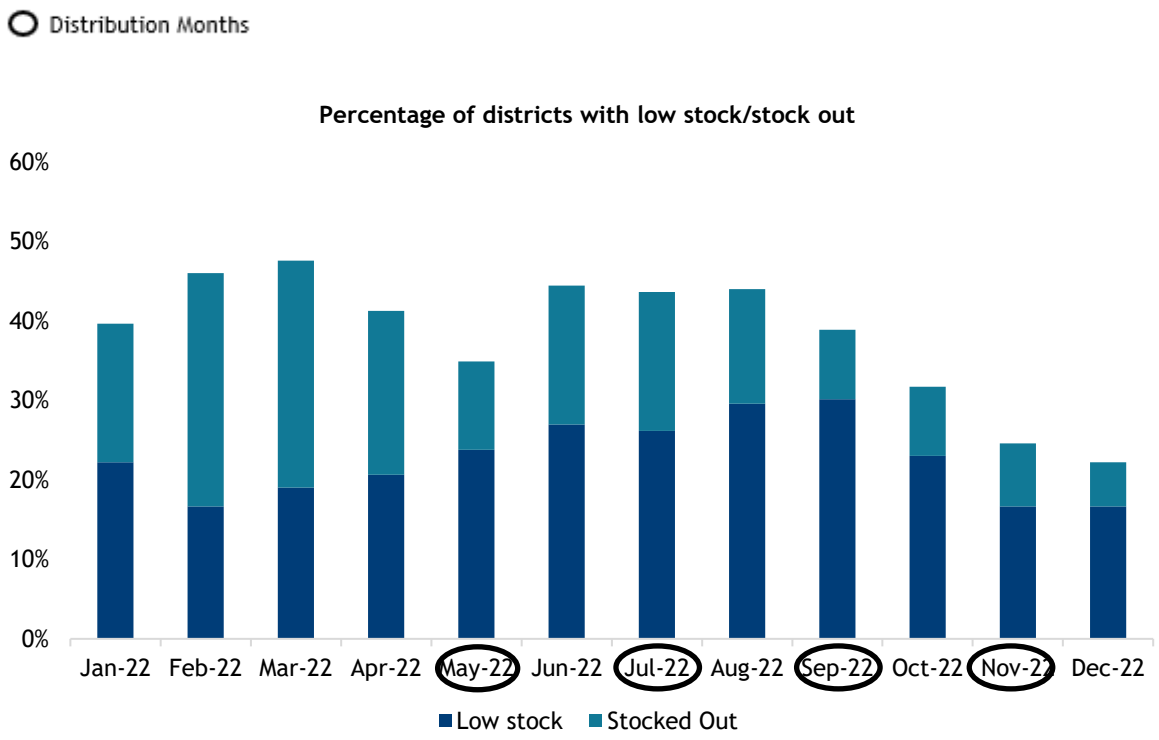
Additionally, a key variable assessed during the project was the number of stock-outs and low-in-stock events in the province. In the Figures 2.3 and 2.4 below, the bars reflect the stock out/low stock rate across districts in each month.

*Figure 2.3: District low stockout rate and distribution transactions at ODX Provincial warehouse*




[1] Exchange Rate 1 USD=15033 Lao kip (UN Treasury dated 1 July 2022) URL: https;//treasury.un.org

*Figure 2.4: District low stockout rate and distribution transactions at CPS Provincial warehouse*




In both provinces, however, upper-level stock outs remained a key contributor to under-delivery (incomplete or partial delivery) and stock-outs, especially for vaccines, at district level. For example, the stock-out of OPV and Td vaccine at the provincial vaccine store in Oudomxay and Champasak resulted in a stock-out at all districts for variable period of time.

## 3.2.4 Sustainability

The long-term sustainability of integrated distribution continues to be discussed at the central level and with key stakeholders. Some of the key strengths in successful implementation of the pilot project is the strong national and sub-national commitment of the government for an integrated supply chain. The identification of dedicated and trained personnel at both provinces was pertinent to the sustainability and success of the project. Positive progress has been made in Oudomxay province, where the provincial officer has supported budget advocacy efforts for integrated distribution. The province has cost-shared one cycle and has fully supported one subsequent cycle. However, further cycles were discontinued due to financial constraints. Implementation in Champasak province did not start until May 2022, and had four cycles of integrated distribution were completed by November 2022.

CHAI continues to advocate for expansion of this initiative to other provinces and support planning in both these focal geographies and as well as provide eLMIS integration support and monitoring. Additionally, CHAI supported the MoH in advocacy on the integrated distribution practices to all provinces, development partners and other stakeholders through the RMNCAH annual review meeting, held in December 2023, to emphasize the importance of sub-national leadership and replicating the good practice of an integrated supply chain and integrated distribution across the country.

## 3.3 Strategizing System Redesign in Uganda to counter structural and procedural inefficiencies

### 3.3.1 Problem Statement

Over the past six years, from 2014 to 2020, Uganda has made strides in improving the efficiency and effectiveness of its vaccine supply chain, particularly at the national vaccine store level. Despite the improvements seen at the national level, many challenges continue to be seen at the sub-national level i.e. from district to health facility.

However, stockouts at the last mile (health-facility level) continue to be a problem. This is evidenced by CHAI's baseline study in Uganda in 2018 across ~150 health facilities in three districts. At the time of assessment, all facilities reported stockouts lasting ~18 days on average. This is primarily driven by inefficiencies in the current distribution model.

The current model of distribution operates monthly from the Central Vaccine Store (CVS) to District Vaccine Stores (DVS), which then distributes at the health facility level.

According to the *2016 Landscape Analysis and Advocacy Recommendation Report*, only ~15 percent of health facilities receive direct delivery of immunization supplies from the DVS store while the remaining health facilities self-pick their supplies. This self-pick arrangement at irregular intervals results in frequent interruptions in service delivery at lower health facilities.

Several bottlenecks affect the reliable distribution of vaccines and immunization supplies from the district to the health facility level and these include:

- Unreliable access to transportation means for supervision and vaccine distribution,
- hard-to-reach areas,
- district management shortfalls that impact timely access to funds for vaccines and supplies distribution,
- poor vaccine handling during delivery and storage leading to wastage;
- limited visibility of facility-level vaccine stock

To solve this issue, in 2018, with funding from Gavi, CHAI, National Medical Stores (NMS), and MOH-UNEPI piloted an outsourced last mile delivery of vaccines model for 18 months in three districts. The goal of the pilot was to test the feasibility and effectiveness of distributing vaccines to lower health facilities by outsourcing to a third-party logistics provider (3PL) private company, UPS/FIT.

The pilot was successful in solving many issues at the last mile. District delivery of vaccines to health facilities increased from four percent (6/150 HFs) at baseline to 97 percent (145/150 HFs) at the endline. The proportion of health facilities with their orders honored in full at the endline was reported to be at 73 percent (110/150).

Despite the many benefits observed with the outsourced model, the direct and indirect costs of implementing such a model were significant, making it difficult for the government to sustainably take over and scale this approach to LMD, post-pilot.

The total cost of the pilot was valued at ~US$814,000 with direct distribution costs contributing 28 percent of the total and indirect costs accounting for the remainder. The latter was attributed to contract management fees on warehousing and fleet management and supplementary activities such as supportive supervision. Labor costs accounted for the largest driver of direct distribution costs at 52 percent followed by capital costs at 32 percent.

The high costs dissuaded the government from scaling up the pilot but instigated discussions on implementing an insourced optimized LMD system. The primary challenge for an insourced model to succeed was high distances at the last mile, supplemented by inefficient route plans causing long

lead times, especially for facilities in remote corners of districts holding high numbers of zero-dose populations.

### 3.3.2 CHAI's Approach

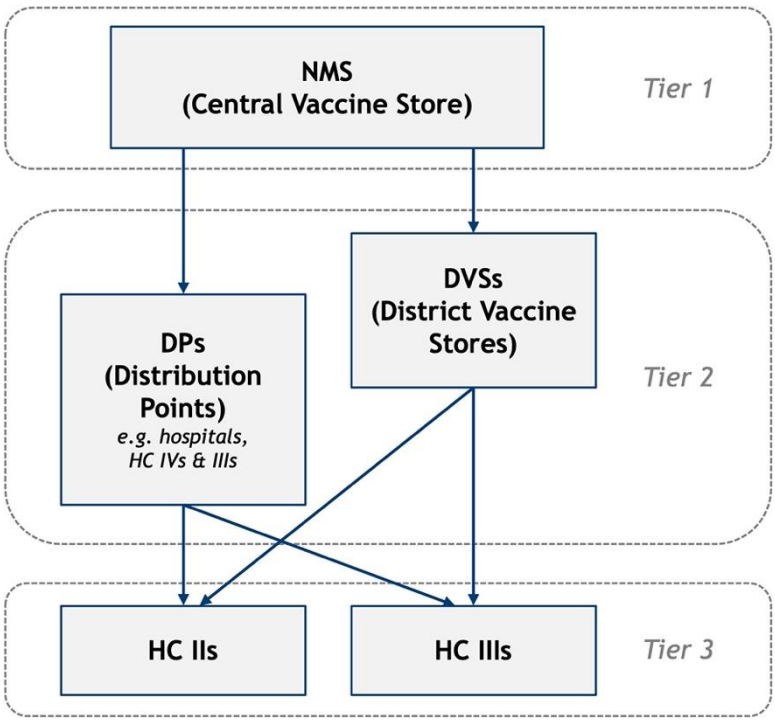
The outsourcing pilot supported by CHAI allowed the government to have a deeper look into the problems affecting LMD in Uganda. In turn, NMS and MoH tasked CHAI with creating a comprehensive strategy that solves all aforementioned challenges using an insourced delivery system.

Between 2019 and 2020, CHAI created a comprehensive LMD strategy utilizing system redesign and downstream delivery to accomplish three objectives:

- **Ensure timely and cost-efficient last-mile delivery of vaccines**
  - Develop, map, and plan efficient route plans by incorporating a new layer in the supply chain termed 'distribution points
  - Train LMD staff on best distribution management practices
- **Improve vaccine handling during delivery and storage, to minimize wastage**
  - Conduct routine maintenance and repair of CCE and trucks across the supply chain
  - Train LMD staff on best EVM practices
- **Promote good data management practices and improved visibility at the last mile**
  - Train LMD staff on best data management practices
  - Develop and implement reporting tools for service delivery points

The primary pillar of this strategy was to reduce the distance health facilities have to move to pick vaccines by identifying, accrediting, and effectuating "distribution points" (DPs), which will be health facilities, public or private, and should be within 15 kilometers of the farthest health facility served by the distribution point. The DPs will not replace the district vaccine stores (DVS), but be on the same tier as the DVS and also hold a maximum of six weeks of stock (one month + two weeks of buffer).

*Figure 3.1: Updated distribution model in Uganda*

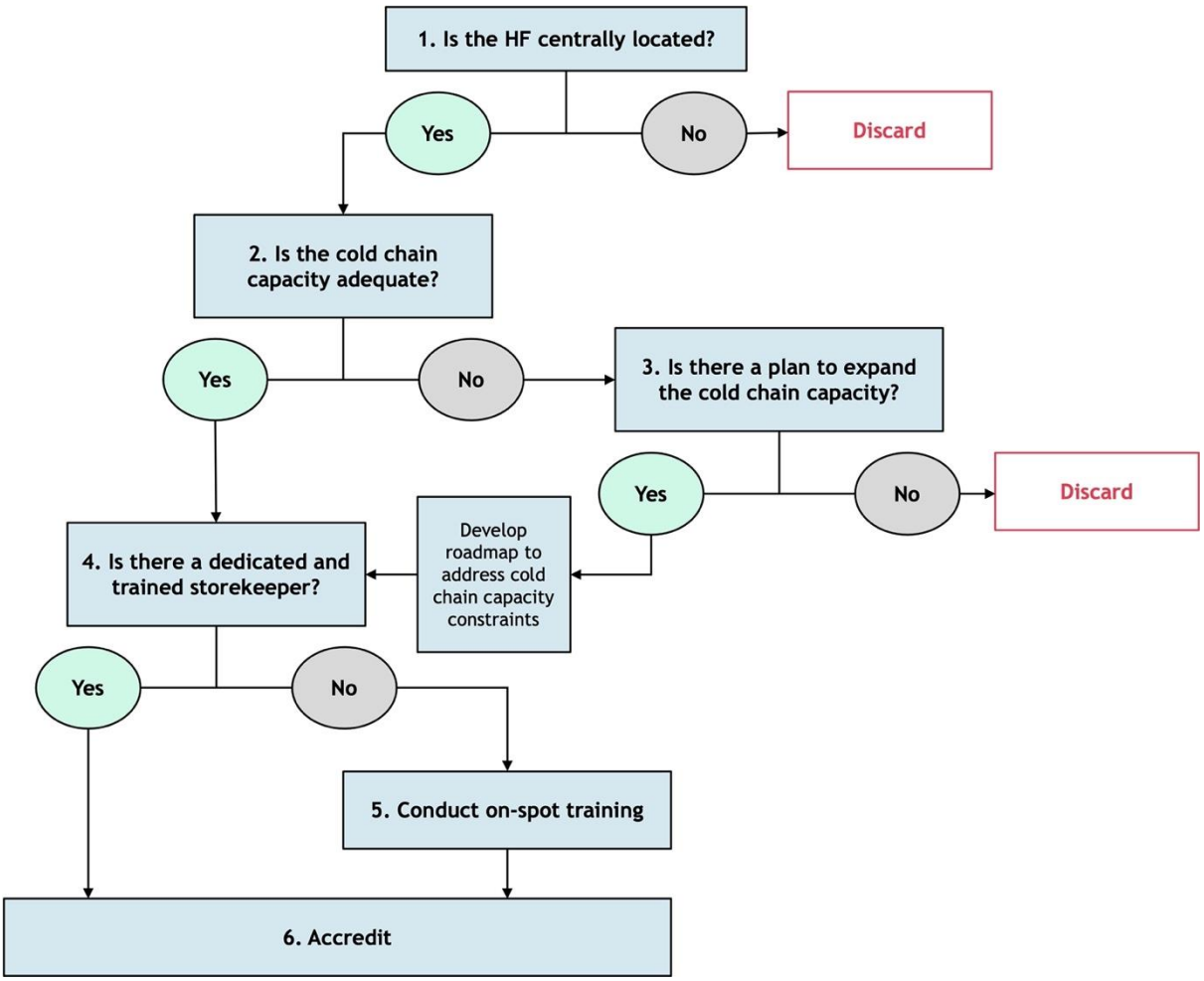



The implementation of this strategy will start with the selection of distribution points. The process of selection of distribution points aims to identify health facilities that are most accessible by health facilities in that health sub-district (HSD) for the collection of vaccines while ensuring cost

minimization for the National Medical Store as it delivers vaccines and other immunization supplies at a level below the district vaccine store. Selection criteria include:

- **Health-Sub District (HSD)**: Each distribution point will be located within a designated HSD
- **Centrality and Proximity from neighboring facilities**: Each distribution point will be near other neighboring facilities, within a 5 km or 10 km radius.
- **HF locations will be plotted using GPS coordinates** to determine the HF that are most central to the other health facilities within the HSD, with a target of reducing the distance from the DP to all HFs to under 10 km.
- **Population Density**: Each distribution point will be in a relatively high population density catchment area.
- **Rural vs Urban**: This strategy will prioritize increasing urban immunization coverage since they tend to be more densely populated than rural locations. Hence, additional DPs will be identified, selected, and set up to serve growing urban populations based on the centrality and proximity to high-volume catchment areas in urban settings.
- **Cold chain capacity**: Given that the DPs will store vaccines until the HFs collect them or the HSD picks the vaccines for delivery to HFs, there must be sufficient cold chain capacity, with remote temperature monitoring capabilities and a backup source of power.

*Figure 3.2: Selection of Distribution Points*




The strategy is expected to reduce the distance being traveled at the last mile from an average of 40 km to about 5 km.

### 3.3.3 Results

Though the strategy was drafted in 2020, the COVID-19 pandemic shifted the government's priorities and funds causing a delay in implementation. As the burden of the pandemic on funds has reduced, the government has decided to implement the strategy nationwide starting in 2023.

The strategy has been endorsed by Gavi, and work is ongoing to secure funding from various partners to procure the required vehicles that can support the new delivery model. CHAI will be a key player in the implementation, supporting the government with M&E during the roll-out and providing TA support where necessary.

### 3.3.4 Sustainability

As the strategy is still in the process of being implemented, conversations on sustainability are ongoing. CHAI is working closely with the NMS to ensure sustainability is a key focus during the implementation. This includes the use of existing resources where possible to equip distribution points with the required cold chain inventory, as well as ensuring budgets are marked for recurring training for new personnel.

# 4. Implementing LMD Interventions - Learnings from CHAI's experience

CHAI's work across all countries over the last few years has provided several learnings on how to start, manage, and sustain LMD interventions. Though each geography requires careful consideration of local contexts before designing solutions, these learnings can be considered the three key steps in implementing LMD interventions effectively:

## 4.1 Starting LMD interventions

LMD Interventions can be complex to design and implement - particularly in LMICs where lack of well-defined data channels can make it hard to diagnose root causes. Thus, it is essential to follow a structured approach to design an intervention that is effective in tackling the right challenges, and efficient in its use of scarce funds.

The following chart (Fig. 4.1) maps the process of diagnosing problems and creating solutions. The process can be broken down into four steps:

### Step 1: Assess the extent of supply chain problems

Implementation of any intervention at the last mile should begin with a diagnosis of the extent of the issues. Tracking key indicators is essential to not only diagnosing the extent of problems but also identifying root causes. The primary factor in diagnosing LMD problems is stockouts. This can be measured using a combination of indicators:

Percentage of facilities reporting stockouts - Though stockouts cannot be completely eliminated from any supply chain, a high percentage of facilities reporting stockouts of antigens independent of national-level stockouts can point to larger systemic issues that require solutions. Understanding stockouts better using additional indicators can provide more dimensions to the problem:

- **Stockout duration**: Measuring how long stockouts last can provide further details into how the supply chain is responding to stockouts. This can be measured using health facility registers which can provide details on when stock-outs occurred and when the next delivery occurred. In Kenya for example, the ideal range identified for stockout durations was between one to seven days.
- **Stock-outs by Antigens/Number of Antigens Stocked out:** Looking at stock-outs separated by antigens can provide further insight into whether LMD issues are specific to some antigens. This can vastly change the scope of the solution and also allow building linkage to national-level stockouts.

### Step 2: Conduct In-depth Review

Once the extent of supply chain problems has been gauged - an in-depth review is necessary to diagnose root causes. This should begin with creating a thorough understanding of the supply chain by diagnosing processes, structure, and transport. Ideally, a baseline assessment across the supply chain can not only help in identifying root causes but also create a wealth of data that can be tracked over time to assess improvement. However, with constraints on funding and time, thorough interviews with national and sub-national stakeholders can also provide a good understanding of the supply chain and its problems.

## Step 3: Curate Interventions

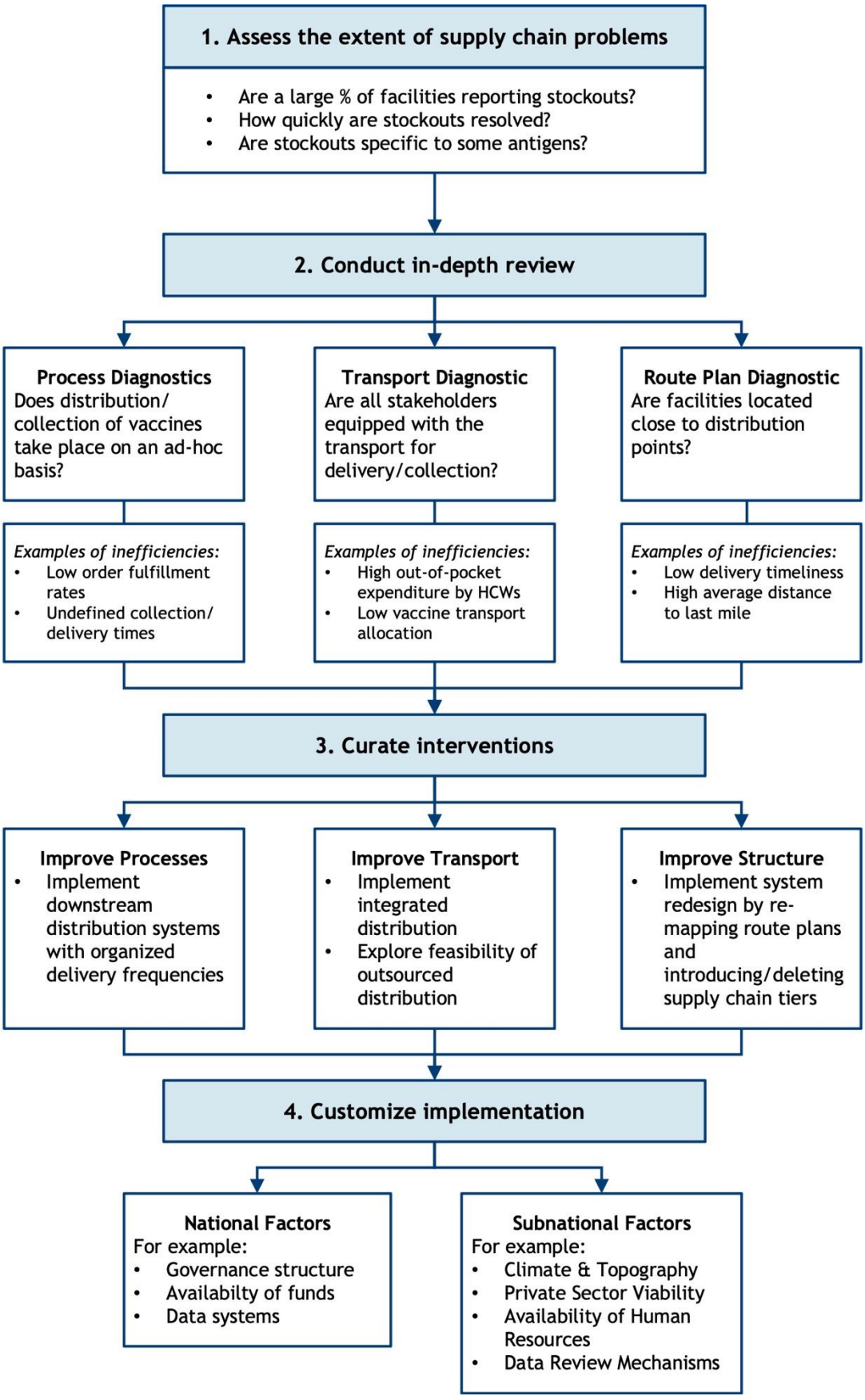
Once root causes have been identified, an updated supply chain strategy can be curated to address each barrier. It is important to note that supply chains usually don't face any of the highlighted problems in isolation. A combination of procedural, structural, and transport problems causes LMD inefficiencies. Therefore, ideal interventions should aim to make improvements on all ends. However, regions and challenges creating the most urgent barriers can be addressed first. Interventions can also take a phased approach - starting with pilots in a few regions and later expanding to the remaining regions. Data tracking during such pilots is important to track the feasibility and impact of the solutions.

## Step 4: Customize Implementation

Solutions should be tailored to address these root causes while considering national and sub-national factors. Some examples of such factors and their implications are listed below:

- **National Factors**
    - Governance Structure - A decentralized governance structure may require a bottom-up approach to change working closely with sub-national governments, while a centralized system may require the creation of strategies that accommodate a rapid national scale-up.
    - Availability of Funds - Low availability of funds may require starting with smaller-scale pilots which can serve as proofs-of-concept, and may require additional feasibility studies
    - Data Systems - Well-adopted data systems including ELMIS can allow for real-time tracking of data during pilots without the need of expansive surveys. On the other hand, low adoption of ELMIS requires constant assessments to ensure interventions are on track
- **Sub-national Factors**
    - Climate & Topography - At the sub-national level, differences in climate and topography will require customization – for example, certain hard-to-reach areas might require different distribution/collection models involving different modes of transport
    - Private Sector Viability - Regions with a strong private sector can allow governments greater ability to outsource segments of the supply chain and enhance efficiency in transport
    - Availability of Human Resources - Strong human resources in the region reduce the requirement for hiring private workforces as well as the need for orientations and training
    - Data Review Mechanisms - To ensure the best use of the data generated by LMD interventions, it is essential to embed its study into existing data review mechanisms. In the absence of existing mechanisms, new mechanisms need to be set up while ensuring low costs

*Figure 4.1 Roadmap for LMD Interventions*



## 4.2 Tracking LMD Interventions

### 4.2.1 Performance Management is crucial for LMD

Performance management forms the backbone of LMD interventions. Support from data-review meetings and effective LMIS systems is essential to track the progress of LMD and take corrective action where necessary.

Data Review Meetings can act as a key performance management tool during LMD interventions. DRMs create a circle of accountability, keeping interventions honest and providing a deeper understanding of LMD problems. This creates a positive reinforcement cycle which is necessary to break the negative cycles that plague the last mile. Initially, DRMs can be used as forums to further LMD solutions. Once solutions are implemented, they generate a wealth of data that can be reviewed in DRMs to exercise control on impact. On the other hand, when solutions are successful, DRMs act as a forum to display the benefits of LMD and thereby creating a positive reinforcement cycle.

Despite the benefits, the effectiveness of Data Review Meetings is hindered by low data visibility and use. For interventions to be successful, it is important to create a culture of data use by using each interaction in the supply chain as an opportunity for data and information sharing. By institutionalizing a culture of data use for routine decision-making at all levels, countries can proactively identify issues/ risks and take prompt action to correct or avoid stock-outs. Similarly, data visibility is a prerequisite to effective data use. Both of these factors can be improved together to create effective performance management systems, as explained below:

#### 4.2.1.1 Improving Data Visibility

Collating data to capture key performance indicators is crucial to track the progress of last-mile delivery interventions. Ideal performance management systems are able to track data at the last mile alongside implementation, however, visibility on key data points can be low, especially at the last mile. To ensure the right indicators are being monitored, the right use of regular assessments and existing eLMIS systems is important.

The easiest way to compile data during an intervention is to make use of already existing data pipelines in the eLMIS. Basic eLMIS systems usually record essential data related to the supply chain - including stock availability, stockouts, and order effectiveness. Tracking these indicators can not only provide a good start to monitoring implementation, but also provide data to form larger indicators (For example, using stock availability, and order/delivery times to measure stock-out durations). These systems do often lack an in-depth view of the last mile, omitting key indicators and data at the health facility level. Regular assessments can bridge this gap.

Regular assessments can take the form of baseline, midline, and endline surveys. Though these can be expensive to implement, they can be extremely impactful in providing in-depth insight into the effectiveness of interventions. Such assessments are especially crucial for the piloting stage - where they can provide the right data necessary for proof of concept. The table presented at the end of this section (Figure 5.2) provides a list of important indicators that can be tracked through both assessments and eLMIS.

#### 4.2.1.2 Improving Data Use

To track LMD interventions, it is essential to prioritize stock management data within DRMs. Data tracking and problem identification within immunization in most countries are limited to coverage rates, completely discounting supply chain indicators. Including these indicators in the conversation through data review meetings at all levels can provide a more holistic look at the supply chain. The key challenge here is the limited scope for deeper conversations on the supply chain during integrated data review meetings - where the inclusion of several health programs causes packed schedules with immunization discussions limited to coverage data to save time.

For integrated DRMs, it is important to push the inclusion of at least the indicators that are easy to calculate so that supply chain issues are at least briefly studied during the meetings. Figure 5.2 shows some key performance indicators and the complexity in their calculation. While some indicators are easy to calculate using existing data sources, other indicators require dedicated assessments for minute variables. Organizing SC-specific review meetings at lower levels, while involving inputs from healthcare workers can provide extra space for closer tracking of both data sets together. Outcomes from these meetings can then be fed into higher-level integrated DRMs to create clear action items.

Successful DRMs must involve the right personnel required to make decisions on SC performance, have the right technical capability to be able to use data productively, create accountability through action trackers, and must follow set frequencies without straining budgets.

*Figure 5.2: Some Key Performance Indicators*

| Category | Indicator | Calculation | Complexity in calculation |
|---|---|---|---|
| **Stock Management** | Months of Stock | Stock on Hand / Average or Forecasted Consumption | Easy |
| | Stock Adequacy | Percent of facilities reporting adequate stock (within Min/Max) | Easy |
| | Stockout Frequency | Percent of Facilities reporting stockouts | Easy |
| | Stockout Duration | Percent of facilities with stockout resolution under 7 days | Hard |
| | Number of Antigens OOS | Average number of antigens reported out of stock | Hard |
| **Process Efficiency** | Order Timeliness | percent of facilities placing orders on time | Moderate |
| | Delivery Timeliness | Percent of facilities receiving delivery on time | Moderate |
| | Order Fulfillment | Percent of facilities receiving orders in full | Moderate |
| | Min/Max Levels | Percent of facilities with Min/Max levels established | Moderate |
| **Integration** | Integration Level | Percent of facilities integrating distribution | Hard |
| **Transport** | Transport Model | Percent of facilities collecting vs. receiving delivery of vaccines | Hard |
| | Vehicle Availability | Percent of facilities with vaccine dedicated transport | Hard |
| **Cold Chain** | Cold Chain Excursions | Percent of facilities reporting cold chain excursions | Hard |
| | Number of Cold Chain Excursions | Average number of excursions being reported per facility | Hard |

## 4.3 Sustaining LMD interventions

### 4.3.1 Designing Sustainable Interventions

Sustainably financing LMD interventions is crucial to ensure the long-term success of interventions but can be a huge challenge in LMI countries. Streamlined financial processes and government buy-in are essential to kick off and sustain LMD systems. Financial availability is crucial throughout the implementation process - from having funds to implement changes, to creating a continuous stream of funds to support the updated processes:

**Setting up interventions for sustainability**:

- A collaborative approach is essential for effectively sourcing funds in the pursuit of sustainability. This strategy should encompass a well-defined pathway to secure funding, involving active engagement with crucial stakeholders such as the Government (specifically the Ministry of Health), donor agencies, implementing partners, as well as national and sub-national level stakeholders. While additional funding from third parties is beneficial for advancing interventions, it's equally crucial to optimize the utilization of existing financial and human resources to alleviate financial strain once external support diminishes. This optimization should extend beyond financial assets to encompass human resources. By leveraging a diverse array of skills and expertise across different cadres, the burden on immunization programs can be reduced, and responsibility can be more equitably shared among a broader group of stakeholders

**Planning for continued funding at the end of the intervention**:

- It is essential to secure sustained financing for LMD (Last Mile Delivery) programs beyond the pilot phase. Achieving this involves implementing robust resource mobilization platforms. This includes accurately identifying and updating key budget lines on LMD and integrating improved processes and structures consistently into existing and future budgeting platforms and work plans. It is also important to ensure alignment among all stakeholders regarding their respective roles in sustaining the program. To strengthen the case for sustained financial support for LMD interventions, integrating comprehensive costing studies into the initial interventions is highly advantageous. These studies offer valuable insights and evidence that underscore the necessity of continued financial backing for LMD initiatives. This empirical data enhances the credibility of the advocacy efforts, compelling stakeholders to recognize the importance of consistent funding for the success and impact of LMD programs

For both the above to be successful - large-scale sensitization of all stakeholders about the intervention is necessary. The following section describes how such sensitization can be curated

### 4.3.2 Advocating for LMD

Creating impactful sensitization materials for LMD is essential to not only securing buy-in at the national level but also ensuring a complete understanding of the strategy at the sub-national level. Therefore, an impactful sensitization document for LMD should strive to summarize the intervention clearly, while also communicating the impact and associated costs involved. Communication of LMD interventions must be different across the stages of interventions - from the pre-pilot stage to the scale-up stage, as shown in the below figure (Table 4.3.1):

*Table 4.3.1 - Difference in sensitization materials at different stages of advocacy*

| Key Questions for Sensitization | Advocating for LMD Pilots | Advocating for LMD Scale-up |
|---|---|---|
| **What is the intervention?** | Answer 3 Key Questions:<br>1. What is the current status and what is the problem at hand?<br>2. What does the intervention change?<br>3. Which stakeholders along the supply chain are impacted? | Answer 3 Key Questions<br>1. What are the feasible models and how were they customized to local context?<br>2. How did the stakeholders respond to the changes brought about by the intervention?<br>3. When, Where, and How will the scale-up take place? |
| **What is the cost?** | Collaborative work with Key Government and Donor/IP stakeholders to create budgets for the pilot based on estimated costs | Analyze the actual cost of the pilot and create estimations for the cost of scale-up and customize to already existing/ acceptable cost rates |
| **What is the impact?** | Create models for estimated impact, cost on defining what constitutes 'success' for the pilot | Analyze the actual impact of the pilots, while considering the local contexts of the piloting regions |

### 4.3.2.1 Advocating for LMD Pilots

**What is the intervention?**

Describing the intervention in a clear and concise manner requires answering three key questions:

- **What is the problem?**
  - It is crucial to begin with analyzing the current state and defining a problem statement. Supply chain problems tend to go unnoticed beyond stockout rates, so supporting the problem statement with tangible data from recognized indicators is essential for everyone to be on board with the need for an intervention. This data can usually be extracted from existing data sources including desk reviews and baseline assessments.
- **What does the Intervention change to counter the problem?**
  - This section should describe the change proposed under the intervention, using visual aids that map the existing process and the proposed changes to allow stakeholders to clearly assess the change. It is also important to focus on what makes the intervention innovative in the country's context - LMD interventions often draw on global learnings and bringing examples forward from other countries can help build confidence in what can seem like a complex change.
- **Which stakeholders along the supply chain are impacted?**
  - Finally, how the intervention impacts each stakeholder along the supply chain should be clearly stated, including how job roles and responsibilities might change. This helps build confidence among stakeholders that the intervention is actively considering its impact on all actors and is testing feasibility at all levels.

**What is the impact?**

This section should define the impact of the intervention on the target population, the health system, and the environment. In the pre-pilot stage, examples of similar interventions in other countries with similar contexts can be used to show impact. This can be supported with estimations of impact from a few focus regions that have the highest degree of LMD challenges. Defining impact in terms of supply chain indicators such as stock outs can be useful, but supporting this with the impact on service delivery, immunization, and zero-dose populations at large can make the section more convincing. Data from existing E-LMIS can be used alongside assessments to estimate the impact.

**What is the cost?**

Estimating the actual cost of LMD interventions can be a challenge. As discussed in previous sections, LMD interventions often replace unseen costs, making them appear to be expensive, when in fact they are only formalizing costs that stakeholders along the supply chain were previously bearing without being accounted for in national or sub-national budgets. Therefore, cost estimates for such interventions should compare to the real costs of existing models, accounting for wastage, spoilage, delays, inefficiencies, and out-of-pocket expenditures taking place along the supply chain.

Although cost breakdowns can focus on a wide range of buckets, certain key components are important to account for. These include:

- Cost of additional infrastructure (e.g.: Transport and cold Chain)
- Cost of training stakeholders
- Recurring variable costs (e.g.: Maintenance and fuel).

Based on cost estimates, budgets should be created specifically for the pilots. Financing opportunities should then be identified In coordination with ministries.

### 4.3.2.2 Advocating for LMD scale-up

In a post-pilot stage, depending on governance structures in the country, LMD may be practiced in a fragmented manner. As such, the priority order of key questions changes, focusing first on the impact of the pilot, then on the scale-up potential of the intervention itself, and finally on the estimated cost of such scale-up.

**What was the impact?**

The key question to answer post-pilot is its direct and indirect impacts on the supply chain. Direct impact reflects the reduction/improvement in the primary indicator that the indicator targeted such as stockouts of vaccine wastage rates. Indirect impact reflects the subsequent effects on service delivery, such as an increase in coverage rates or a decrease in drop-out rates. It is crucial to take a data-based approach while presenting the impact of the pilots while incorporating the context of geographies where the pilot was implemented

**What was the intervention?**

When reflecting on the intervention post-pilot, it is important to answer three key questions:

- **How were the pilots customized to local contexts?**
    a. It is essential to dive deeper into how interventions were customized to local contexts as it speaks directly to how the data from the pilot relates to the remaining geographies. Further, the representative nature of pilot geographies can then also help inform how scale-up needs to be customized to regions across the country. For example, in Kenya, customization of the intervention was necessary for coastal regions that involved multiple modes of transport to reach the islands at the last mile - these learnings were then carried forward to inform scale-up to other coastal regions in Kenya
- **How did the stakeholders respond to the changes brought about by the intervention?**
    a. Understanding aspects of change management is crucial to inform the extent of training and sensitization required during scale-up. Further, it is also important to evaluate responses from stakeholders regarding its effects to incorporate them into the scale-up strategy.
- **When, Where, and How will the scale-up take place?**
    a. After understanding all of the questions above, the next step is to strategize the scale-up - whether it is feasible, how much time it will take, which regions will adopt the interventions, and what customizations need to be made to the pilot when implementing in the next regions

**What is the cost?**

At the end of the pilot, the true cost of the intervention needs to be evaluated. The costing analysis here not only represents the cost of the intervention and a potential scale-up but also the intervention's ability to sustainably pay for itself by replacing hidden costs. Therefore, the costing analysis should contain the cost of the changes implemented in contrast to the costs that existed before the pilot was implemented.

# 5. Conclusion

CHAI's engagement in last-mile delivery not only highlights the criticality and effectiveness of efficient vaccine distribution but also offers invaluable insights to guide future efforts in implementing similar interventions in different nations. Despite the perceived complexity and financial demands associated with LMD interventions, compelling evidence indicates viable and scalable pathways for sustainable implementation. These approaches have the potential to directly mitigate stockouts and indirectly enhance overall service delivery, showcasing the feasible and impactful nature of last-mile delivery initiatives.