Finding Efficiencies in Zambia’s Immunisation Supply Chain

A Priority on Prevention

Vaccines are at the core of Zambia’s efforts to prevent childhood death and illness and move towards prevention rather than treatment of disease. The country’s Expanded Programme on Immunisations (EPI) has an ambitious vision, with plans to meet the following national objectives:

- To reach 90% fully immunised coverage and 80% coverage of all antigens in all districts by 2021
- To achieve 100% government funding for vaccines used in routine immunisation programme by 2021
- To have 80% of the Primary Health Centres (PHC) meet at least 80% in at least 6 out of the 8 Effective Vaccine Management Assessment (EVMA) criteria by 2021
- To improve data quality and utilization

Efficient, regular delivery of vaccines to support more than 2,000 health facilities is required to achieve Zambia’s vision. This document summarises the current state of the country’s immunisation supply chain and how additional value and efficiency can be achieved. It specifically examines overall costs, health worker time, and resources spent to collect vaccines, as well as the state of the cold chain. Finally, it provides a summary of near-term opportunities to successfully strengthen Zambia’s supply chain – ultimately measured by the ability to deliver more vaccines to more children at a lower cost.

“Vaccines are only effective when they reach every child in all communities, not when they are still in an upstream cold room, however effective the cold chain.”

— Dr. Francis Dien Mwansa, National EPI Manager, Zambia Ministry of Health
Zambia’s Supply Chain Bottleneck

The capacity to accurately forecast and deliver vaccines and other essential medicines to health facilities remains a major constraint to achieving better health outcomes in Zambia.¹ Stock-outs at health facilities occur, but their frequency is unknown or unreported, resulting in distribution inefficiencies, improper stock management and reporting, insufficient cold chain, and other challenges. Although the country has achieved gains in immunisation coverage in recent years, supply chain bottlenecks pose a risk to ensuring equitable coverage of immunisations for all children. Data quality challenges also persist, with reported coverage rates above 100 percent in nearly 25 percent of districts,² hindering the country’s ability to accurately forecast and allocate resources. Many health facilities are reporting administered vaccines that are well above the total amount of stock they received and the forecasted target populations for their catchment areas.

Health facilities are the last stop in the supply chain and the most important to reaching children. They are also the most burdened with regard to resource constraints, both human and financial. Zambia has a growing population, new health facilities and districts, and an expanding EPI portfolio with increased budgetary requirements. An efficient and high-performing supply chain will help protect the country’s investment in vaccines for all children.

An Approach to Continuous Improvement

WHO, UNICEF and Gavi, the Vaccine Alliance, recommend intensifying efforts to improve immunisation supply chains to respond to challenges like those Zambia is facing.³ Discussions about supply chain improvements began in Zambia in 2015, as the country’s EPI Technical Working Group reviewed experiences from other countries to increase the performance and efficiency of supply chains through activities such as:

- ✔ Removing a layer from the distribution system;⁴
- ✔ Optimising the use of cold chain equipment;
- ✔ Improving transportation routes; and
- ✔ Involving dedicated logisticians for delivery and data management.

Inspired by what they saw from these countries, the Ministry of Health and partners initiated a process to develop a plan for how the immunisation supply chain should run, and how all the components fit together and interact.⁵

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1. Zambia’s Health Sector Supply Chain Strategy & Implementation Plan
2. 2016 HMIS data, provided March 2017
4. A review of 57 Gavi countries found that having too many levels complicates coordination, increases the number of sites to manage, reduces economies of scale, and introduces redundancies.
In Zambia, EPI stakeholders wanted to consider how the current system may be impacted by:

- An increase in vaccine delivery frequency;
- Optimising transport via different routes, including multi-stop routes rather than just point-to-point delivery; and
- Changes to distribution administrative levels.

To guide decision making and ensure an evidence-based approach, data was collected across all ten provinces in Zambia, documenting current supply chain practices, inputs and costs. This data was used to provide a picture of how the current system operates and generate insights into potential ways to improve availability and data quality, as well as to reduce costs.

A Window into Current Supply Chain Costs

Zambia’s current distribution system is based on four levels. In general, the national level delivers to 10 provinces, 103 districts collect vaccines from the provinces, and more than 2,000 health facilities collect vaccines from districts every month, with variances of weekly to once per quarter. See Figure 1.

Zambia’s total annual supply chain cost is estimated at ZMW37.4M [USD 3.9M]. As shown in Figure 2, costs are in four categories:

1) **Cold chain** (equipment, maintenance and depreciation),

2) **Vaccine pick-up/delivery** (including fuel, public transport, depreciation, human resources time, lunch and per diems),

3) **Administrative human resources** (including time spent on vaccine stock taking, cold chain maintenance, vaccine reporting, cold temperature monitoring), and

4) **Inventory holding**, which estimates the risk of spoilage.
Nearly three-quarters of the costs were found at the health facility level, and there was considerable variation in costs between provinces. See Figure 3.

More urban provinces like Copperbelt and Lusaka have relatively low costs as they maximise efficiency given larger populations (and thus more vaccines), and generally shorter distances. Rural, less densely populated provinces such as Western, North Western and Muchinga have substantially higher costs with a factor of four variations between the lowest (Copperbelt) and highest (Western). See Figure 4.

The Problem of Health Workers on the Road

Most health facilities in Zambia (91 percent) travel to district stores to pick up vaccines. The frequency with which health staff pick up vaccines ranged by province with some health facility staff going weekly in Copperbelt, and others waiting two and a half months between pick-ups in parts of Western Province. In addition to the money required for per diems and transport, this resulted in a considerable time investment by health workers away from the health facility. In total, it was found that health facility staff spend more than 100,000 hours per year away from other health care activities to pick up vaccines.

Health facility staff spend **100,000+ hours annually picking up vaccines from the next level of the supply chain.**
While the average distance travelled to the district was 54 kilometres, there was great variability in these distances. Poor road conditions were common in remote areas and demonstrated challenges many health facilities face in getting vaccines. A range of transportation options were used. In addition to vehicles, boats and public transport, there were several health facilities picking up vaccines by oxcart. See Figure 5.

On average, health facility staff travelled at least four hours, but many travelled up to seven hours to pick up vaccines. Another way to quantify this: if staff were relieved of their duty to pick up vaccines, it would be like adding at least 50 full-time staff to Zambia's health facilities.

**Cold Chain Impact on Immunisation**

Keeping heat-sensitive vaccines at the right temperature is an important part of a functioning supply chain. In areas with limited power, this can be a challenge. Following the 2011 Effective Vaccine Management Assessment, Zambia developed a cold chain expansion strategy to address the existing gaps. Hundreds of new refrigerators were added throughout the vaccine supply chain – a concerted effort led by Government and EPI partners. Today, provinces and districts are running primarily electric refrigerators or cold rooms and most health facilities have functional refrigerators with sufficient capacity to handle vaccines.

At the time of data collection, however, 10 percent of all health facilities had no working cold chain and more than 130 health facilities, seven percent, did not have a refrigerator; with new health facilities being built, this number is growing. See Figure 6. Almost 80 health facilities had their only refrigerator not functioning. Despite recent investments, 11 percent of nearly 2,000 vaccine refrigerators in Zambia are still kerosene or gas, causing unnecessary expense and a weak spot in the supply chain. On the day of vaccination for health facilities with no cold chain, some 200 health workers must leave their posts to pick up or drop off vaccines to conduct immunisation sessions. Some of these trips are as long as 80 kilometres, significantly limiting time for immunisations and negatively impacting service delivery.

Several decades ago, refrigerators powered by kerosene or gas were considered the best option for storing vaccines in places with limited electricity. However, these refrigerators are expensive to run, maintain and are often unreliable. In recent years, solar-powered refrigerators, and today Solar Direct-Drive (SDD) refrigerators, have become the
gold standard for places without electricity. Despite recent investments, 11 percent of nearly 2,000 vaccine refrigerators in Zambia are still kerosene or gas, causing unnecessary expense and a weak spot in the supply chain. See Figure 7.

Opportunities to Optimise

Members of the EPI Technical Working Group, along with Provincial and District EPI staff, recommended various scenarios to explore how best to optimise the current immunisation supply chain. The group recommended exploring:

- Changes to vaccine delivery frequency (1 month, 1.5 months, and 2 months);
- Optimising transport through multi-stop routes, eliminating point-to-point routes;
- Changes to the hierarchy of the supply chain (province to health facility, district to health facility, and regional hub to health facility); and
- Ignoring administrative boundaries.

Modelling results conclude that in several provinces, multi-stop routes with delivery from the province direct to health facilities is the most efficient, regardless of delivery frequency. The optimal scenario, shown in figure 8, illustrates how the district maintains responsibility for programme quality and provides buffer stock. In this case, health facility staff no longer must leave their posts to obtain vaccines, reducing travel time by 94 percent – 47 full-time equivalent (FTE) staff – and allowing them more time for patient care.

Figure 8: Comparison of Current and Optimal EPI Supply Chain Design

Health facility staff must leave their posts and collect vaccines from districts, resulting in health facility staff shortages and in some cases, closures.

Health facility staff do not leave their posts to obtain vaccines, reducing travel time by 94 percent and allowing them more time for patient care.
The table below compares multiple scenarios in terms of cost and the time health facility staff spend in vaccine logistics. A 2-month delivery cycle with direct delivery from the province to the health facility would offer the greatest cost savings (Scenario B) with a 16% reduction in cost per dose. However, while cost savings are an important consideration in determining how best to optimise the current immunisation supply chain, other factors also should be considered. These include state of data quality in a given geography, comparison of ease of implementation in one province versus another, available cold chain and vehicle capacity, etc. Zambia EPI must contextualize the different options available and decide what is feasible and most appropriate for implementation.

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Logistics cost per dose</th>
<th>HF staff time spent in vaccine logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Province to District to Health Facility</td>
<td>ZMW2.83</td>
<td>50+ FTE</td>
</tr>
<tr>
<td>Scenario A District to Health Facility (multi-stop)</td>
<td>ZMW2.62</td>
<td>50+ FTE</td>
</tr>
<tr>
<td>Scenario A + 25% buffer stock at Province</td>
<td>ZMW2.90</td>
<td>50+ FTE</td>
</tr>
<tr>
<td>Scenario B Province to Health Facility (multi-stop)</td>
<td>ZMW2.53</td>
<td>3+ FTE</td>
</tr>
<tr>
<td>Scenario B + 25% buffer stock at District</td>
<td>ZMW2.57</td>
<td>3+ FTE</td>
</tr>
<tr>
<td>Scenario C Regional hub to Health Facility (multi-stop)</td>
<td>ZMW2.85</td>
<td>3+ FTE</td>
</tr>
</tbody>
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An Investment in EPI Supply Chain is an Investment in Children

Getting potent vaccines to every child at the right place and at the right time has never been more important. Preventable deaths, finite resources and an expanding set of vaccines are motivation to rethink how to improve Zambia’s immunisation supply chain.

While costs are an important factor in considering change, they are not the only factor for determining how to best optimise the supply chain. Visibility of data, staff time and responsibilities, and alignment with national health priorities must all be considered. In the coming months,
stakeholders in Zambia will determine how best to improve performance and bring lifesaving benefits of vaccines to all. There may not be a one-size-fits-all approach for improvement, but one thing is for certain—Zambia is one step closer to ensuring that every child who is brought to a health facility will have lifesaving vaccines waiting for them.

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