

# Starting at the Last Mile

## Rethinking Medical Supply Chains in Low-Income Countries

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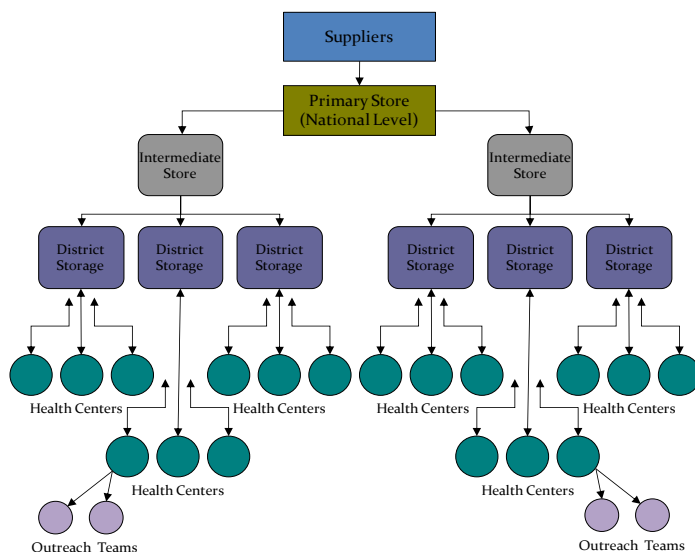
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## Executive Summary

Existing medical commodities distribution systems in most low-income countries have insufficient capacity to meet current demand; the anticipated future increases in medical supply throughput will only magnify the problem. With over a decade of experience working to improve the performance of health systems at the lowest levels of medical supply chains in low-income countries, VillageReach has developed, applied and refined three key interventions that have produced significant supply chain improvements: (i) streamlining logistics; (ii) implementing digital logistics management information systems (LMIS) all the way to the service delivery level; and (iii) leveraging the private sector to build shared infrastructure that benefits the health system.

## Overview of the Current Distribution Model

The diagram depicts a simplified picture of the typical distribution system for medical supplies currently used in low-income countries.<sup>1</sup> These systems distribute medical commodities from one source to many locations. Efforts to strengthen medical supply distribution systems typically start at the top where the commodities are grouped together in bulk at one or a limited number of locations; few personnel are involved. Even though each distribution system is a single, unified system, it is obvious the system will become weaker as it becomes more distributed. Moving down the supply chain, inventory is broken into smaller and smaller quantities, spread across more locations and managed by a greater number of personnel. The number of distinct transactions goes up as does the complexity of managing the inventory.



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### Limited Information

Each level of the supply chain is dependent on the level above for its supplies, but each level is also dependent on the level below it for information. Each level must determine how and when to divide and distribute the inventory it holds to the level below, based on information from below. Consumption and demand information originates from health centers and outreach teams at the final segment or “last mile” of the distribution system. In effect, *the last mile of distribution is the first mile of information*. In low-income countries, the lack of infrastructure at the last mile level severely limits the quality and availability of information regarding the medical supplies needed at each health center and for each outreach team.

Absent accurate information regarding the supplies actually needed at the service delivery level, the distribution system can only be a supply-driven, with pre-positioned bulk supplies placed at various levels and locations based on anticipated vs. actual demand. This approach requires increased and costly infrastructure and forecasted inventory plus appropriate buffer stocks at each

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<sup>1</sup> The diagram is highly simplified as there is not just one distribution system flowing through the various levels shown. Due to the multitude of vertical healthcare intervention programs there is usually a chaotic patchwork of distribution systems, each with its own operational logistics.

location. Forecasts based on incomplete and inaccurate information can lead to both insufficient and excessive supply at all levels of the supply chain.

### Limited Resources/Infrastructure

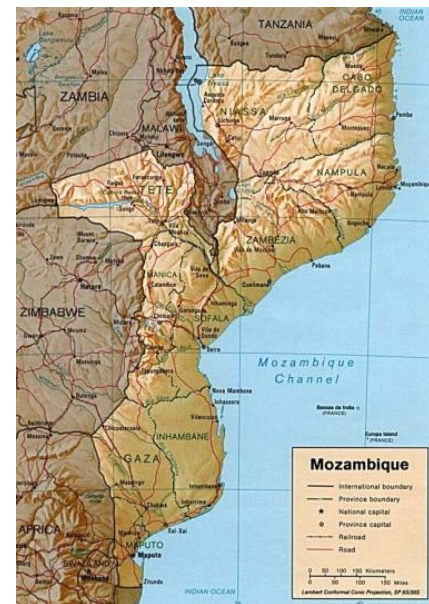
In low-income countries' health distribution systems, the quality of infrastructure (electricity, roads, warehouse facilities, and communications and computer networks) and human resource capacity available to support the system are significantly less at the lower levels of the supply chain. This situation is especially true for distribution systems operating in rural areas. Every country has a policy defining how its medical supply chain should operate. Given the lack of available resources, however, large gaps normally exist between how the supply chain is designed to work on paper and how it operates in reality. The gap between policy and reality is usually largest at the lower end of the supply chain. There, the supply chain usually dissipates into an *ad hoc* approach that operates quite differently from the stated government policy for how it should work.

### The Innovation Pile-Up

Over the last few decades there has been significant focus on the discovery, development and financing of new medical products. Given the successes these efforts are generating, it is now time to address the inadequacies of the health systems into which these and future (and expensive) products must enter. Existing distribution systems in many countries struggle to meet current needs and cannot support the anticipated future increases in medical supply throughput. Absent improvements, we are facing an "innovation pile-up"<sup>2</sup> that will render the billions of dollars that have been and will be devoted to discovery, development and procurement a profoundly diminished investment. Fortunately, there are a number of new approaches that can significantly improve in-country supply chain performance.

### Mozambique Experience

In 2001, VillageReach and its Mozambique-based partner, *Fundação para o Desenvolvimento da Comunidade* (FDC), conducted a year-long study that reviewed public health systems in Mozambique and other African countries, nations in Europe and the United States. Based on the study, VillageReach and FDC found a focus on transport, logistics, stock management, and strengthening the cold chain would solve problems of getting vaccines to the people of northern Mozambique. In close collaboration with the Mozambique Ministry of Health (*Ministério da Saúde* or MISAU), VillageReach and FDC selected Cabo Delgado province for a demonstration project because the infrastructure problems at its rural clinics were particularly acute. At the time, Cabo Delgado had the lowest vaccination rates and lowest per capita income of any province in Mozambique. The project had three key components:



Redesigned Logistics System. The *ad hoc* collection-based approach, where frontline health workers must collect vaccines and related supplies from their district office and perform various administrative tasks, was replaced by a dedicated, centralized distribution system (Dedicated Logistics System or DLS) with a small number of specialized workers visiting the

<sup>2</sup> *Can We Ensure Health is in the Reach of Everyone?*, Christopher J. Elias, *The Lancet*, Volume 368, December 2006.

health centers monthly to deliver vaccines and supplies, repair equipment, collect data using a management information system, and provide supportive supervision.

**Information System.** The DLS was supported by the development and deployment of a digital LMIS covering the supply chain all the way to the service delivery level. The information system enabled those responsible for the DLS to monitor and analyze the logistic system's performance to ensure the appropriate types and quantities of vaccines, medicines and equipment supplied to rural health facilities were available where and when needed. The information system was designed to track key performance indicators on a routine basis to enable critical decision-making by health administrators and frontline health workers.

**Social Business.** To support the cold chain, a consistent and reliable supply of energy was required. Given the absence of reliable energy sources in northern Mozambique, VillageReach and FDC established VidaGás Limitada, a for-profit Mozambique company (VidaGás), to import and distribute propane to health centers and hospitals, as well as to private customers, throughout northern Mozambique.<sup>3</sup>

VillageReach released the results of an independent impact evaluation for Cabo Delgado province in November 2008.<sup>4</sup> In June 2009, VillageReach released the results of a complementary study comparing the costs of the DLS in Cabo Delgado province with the system used in the control province of Niassa, typical of government practices used throughout the country.<sup>5</sup> The following table summarizes the key findings:

<b>Higher Coverage Rates</b>	<b>DPT-Hep B3 vaccine coverage rates increased from 68.9% to 95.4% for children age 24-35 months. All other vaccines had similar increases resulting in an average coverage rate of 92.8%.</b>
<b>Reduced Stock Outs</b>	<b>The reported monthly incidence of stock-outs in rural health centers decreased from 80% to 1%.</b>
<b>Higher Capacity Cold Chain</b>	<b>Up-time of the cold chain increased from approximately 40% before the project to 96% over a year after the conclusion of the project.</b>
<b>Greater Capacity Health System</b>	<b>An average of 95% of health centers were visited each month by DLS staff with an average interval of 31 days in between visits despite extremely difficult road conditions and harsh, rainy seasons.</b>
<b>More Patients Served</b>	<b>Over 90% of all children surveyed in the evaluation had visited a health center in the previous month despite 47% of the population living over two hours away, 85% having to walk to get there, and the most common reason for vaccination failure being "place of immunization too far."</b>
<b>Greater Cost Effectiveness</b>	<b>The DLS was 17% more cost-effective, at \$5.03 per child fully vaccinated with DPT-Hep B3 compared to \$6.07 per child vaccinated in Niassa, where VillageReach was not engaged. It was also 21% less expensive per vaccine dose delivered: \$1.18 per dose delivered vs. \$1.50 per dose delivered for the control province.</b>

<sup>3</sup> Two third-party studies regarding VidaGás were prepared contemporaneously with the demonstration project. See, United States Agency for International Development (USAID), *LPG Market Assessment Study* (prepared by Nexant Inc., for USAID), June 2005; and Courtenay Sprague, *VidaGás: Powering Health Clinics and Households in Mozambique with Liquefied Petroleum Gas*, 2007.

<sup>4</sup> See, <http://villagereach.org/vrsite/wp-content/uploads/2010/02/Evaluation-ExecSum-and-Report-081202.pdf>.

<sup>5</sup> See <http://villagereach.org/vrsite/wp-content/uploads/2010/10/091009-VillageReach-Cost-Study-Report.pdf>.

Based on the results achieved in Cabo Delgado and a second province, Nampula, in November 2009, the Minister of Health authorized each of Mozambique's provinces to explore implementation of the DLS. VillageReach is currently assisting the provincial health authorities in Niassa, Gaza, Maputo and Cabo Delgado provinces as they implement and operate the DLS in their respective provinces. That assistance includes logistical support, provision of an Internet/mobile-enabled LMIS, operation of a small fleet of heavy duty trucks to supplement government trucks for deliveries, and limited financial support to smooth gaps in government funding. FDC is supporting the provincial health authorities in Zambezia, and had previously supported Nampula province. VidaGás has expanded to become the largest propane distributor in northern Mozambique and is currently distributing propane to fuel the vaccine cold chain in Cabo Delgado, Nampula and Zambezia provinces.

## Rethinking In-Country Supply Chains

There are three key principles that can be extracted from the demonstration project and applied across the entire in-country medical commodities supply chain.

### Streamlining Logistics

Medical supply distribution systems in low-resource countries are weak, in part, because of the lack of focus on strengthening the final segment of the supply chain. On paper, most in-country supply chains envision the provincial or zonal depot delivering supplies to the district which then delivers to each of their health facilities. Trucks and money for fuel, per diems and other operating expenses are severely limited at those levels, either due to a lack of absolute resources or management capacity. As a result, the distribution system generally functions as an *ad hoc* collection-based approach. Getting to the district to pick up supplies is just another task falling on the shoulders of overburdened health workers with whatever transport they can find.

In Mozambique, task shifting was used to consolidate distribution tasks in a small number of government workers called "field coordinators." They formed a functional team that performs various distribution and support activities for health centers and outreach teams as their full-time responsibilities. The field coordinators can operate out of the zonal or district level, depending on available infrastructure and geographic distances to the health centers. Because the physical transfer of inventory must occur, this approach systematizes that activity to establish a regular network to and from the service delivery level. Equipment servicing, data/information/knowledge, training and supportive supervision are then also carried on that network. A detailed cost study conducted by VillageReach confirmed this approach to produce significant cost savings over the typical *ad hoc* collection-based approach.<sup>6</sup>

### Routine Information for Transparency and Performance Optimization

Consistent with the adage "you manage what you measure," implementing an *appropriate* and a digital LMIS at the last mile level significantly improves performance of the medical supply chain. The improvement applies not only to stock-out reduction, cold chain performance and other supply measures, but also the quality of the information coming from the service delivery level. To be effective, the system must provide routine information regarding system performance to those operating the system at the lower levels as well as reporting information up the supply chain. In managing stock levels, field coordinators in Mozambique are able to partner with health workers who, because they are on the front line of healthcare delivery, are in the best position to understand and forecast medical supply needs at their location.

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<sup>6</sup> See <http://villagereach.org/vrsite/wp-content/uploads/2010/10/091009-VillageReach-Cost-Study-Report.pdf>.

For the Mozambique DLS, an Internet /mobile-enabled, open source LMIS application called vrMIS3 is used. Because 80% of the health centers do not have electricity and cell phone coverage is limited, the system moves information by taking advantage of the monthly circulation of the delivery trucks from the provincial level through each health center and back. Those delivering medical commodities also serve as data collectors. For environments such as Mozambique where communications infrastructure is extremely limited, *the truck is the network*.

There is growing interest from the global health community in developing dynamic information systems that can support new commodities. To encourage the collaboration needed to create capabilities such as vrMIS3 across the entire in-country supply chain, VillageReach, along with PATH and John Snow, Inc. launched OpenLMIS with funding from the Rockefeller Foundation and USAID.<sup>7</sup> OpenLMIS is a community that encourages common standards, collaborative software development, dialogue, alignment and partnerships with respect to the development and deployment of digital LMIS for use in in-country health supply chains in low-income countries.

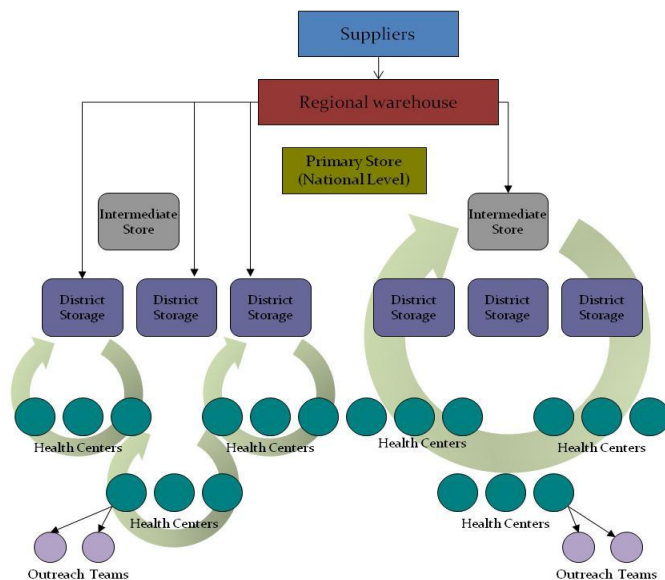
### Spreading the Cost of Building Missing Infrastructure

The health system faces key gaps in infrastructure which are particularly acute in rural areas, where the majority of populations in low-income countries reside. Building the necessary infrastructure exclusively for the public health system will be costly and difficult to sustain. Because many of the infrastructure components needed by the health system are also needed by other sectors, there is an opportunity for the public and private sectors to work together to meet those needs. Generic infrastructure services, such as transportation and energy supply, can be more effectively and efficiently provided to the public health system by the private sector as the cost of providing the infrastructure service can be spread across multiple sectors. These businesses fill gaps in the health system's wide range of needs as well as contribute to rural economic development. VidaGás is a successful example of this approach.

### Extending the Advantages of Last Mile Streamlining up the Supply Chain

As noted above, current medical supply distribution systems in low-income countries lack quality information regarding actual supply needs at the service delivery level. Commercial distribution systems currently used in high-income countries are premised upon this type of information. With accurate, ongoing information from the bottom of the supply chain, a distribution system can be more responsive to actual health system requirements with greater efficiency and less waste.

The diagram shows how a supply chain for low-income countries could be drastically improved by applying currently available supply chain techniques. In this diagram, the green circles represent a DLS-type system operating from either the district or zonal level in support of health centers and related outreach teams. With regular and accurate information regarding actual



<sup>7</sup> See <http://OpenLMIS.org/>.

medical supply needs at the health center level, there would be no need to pre-position bulk inventory at various levels of the supply chain to address anticipated but unknown need. There are a number of potential extensions of this approach. For example, a regional warehouse could be established in a free trade zone to receive all supplier shipments on behalf of a particular country. The country would remain in charge of its procurement, ordering and forecasting. On a routine basis, the regional warehouse could pre-pack inventory for each health center (and related outreach team) based on that center's actual need for inventory and load the pre-packs in containers to match how the deliveries will be divided once they arrive in country. Once the containers clear customs in country, a cross-docking operation is performed and the pre-packed inventory bundles are transported to provincial or district locations for pick-up by field coordinators and immediate delivery to health centers. Depending on the efficiency of the system, there might be multiple months of inventory deliveries on order and in process. Appropriate buffer stocks would be pre-positioned in country to address faults in the system and for emergency use. This approach would produce significant cost savings and facilitate the expansion of supply chain capacity.

### **Shared Public/Private Sector Transportation**

The resourcing, management and availability of transportation assets within public health systems in low-income countries is particularly problematic. The problem is especially acute at the lower levels of the distribution system where freight sizes are reduced and the number of delivery locations is the highest. For example, the public health system in Mozambique has approximately 1,500 health centers which are grouped under 144 districts within 10 provinces (excluding the capital city of Maputo which is technically also a province). The long haul trucking from the central medical store to each of the provincial warehouses is often problematic; the challenges mount for distribution from the provincial level to the service delivery level. Current MISAU policy expects the provinces to distribute to the districts which in turn distribute to the health centers. This approach requires each province and each district to possess, manage and maintain transportation assets. In Mozambique, the district may have one truck or a few motorcycles but very limited and sporadic funds for fuel and repairs. If the truck and/or motorcycle are available, they are also required for deliveries, ambulance services and many other operational tasks.

By streamlining the logistics as discussed above, the requirements for transportation assets for medical commodity distribution are reduced. MISAU is currently operating the single-tier DLS in four provinces covering 431 health centers and 53 districts. Each province is divided into three zones, each requiring a truck for two weeks per month to make deliveries to each health center within that zone. Currently there are approximately 10 trucks used for DLS deliveries, a significant reduction from the 57 trucks required for the standard two-tier distribution system.<sup>8</sup> Even with this reduction in requirements, the health system still struggles to provide sufficient transportation assets. To ensure vaccine deliveries are made on a regular basis, VillageReach is supplementing about half of the transport requirement with its own trucks.

Drawing on the VidaGás example of spreading the cost of building missing infrastructure across the public and private sector, a similar approach could be applied to enhance locally owned and operated private sector trucking companies so that they could serve the health system. Like international logistics companies which build networks of local transportation companies, it would be possible to establish an international organization (TransCo) to create (when necessary), qualify and build capacity in this type of network to support public health systems in low-income countries. TransCo would look to public health organizations such as WHO, UNICEF and GAVI

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<sup>8</sup> For a standard two-tier distribution system in these four provinces, at a minimum, 53 district-level trucks plus four provincial-level trucks are required.



Alliance (in the case of vaccine distribution) for distribution standards that the local affiliates must meet to be certified to transport medical commodities for the public health system. In the same way GAVI Alliance has had a catalytic effect on development, pricing and procurement of vaccines, TransCo would be designed to have a similar effect on in-country distribution systems. TransCo would be funded by multilateral/bilateral public funding and the international private sector which is also seeking to fill gaps in transportation in low-income countries. TransCo would help facilitate outsourcing arrangements between its affiliates and the public health system and, as necessary, could subsidize a portion of the cost for the public health system to supplement and smooth the flow of government funding needed to pay for the outsourcing arrangements. Governments would not be required to use TransCo affiliates, but given the reliability, cost effectiveness and ability to meet international standards for distribution of medical commodities, TransCo could make the outsourcing alternative very attractive. Over time, as the TransCo affiliates spread their customer base across other sectors needing transportation services (e.g., agriculture), the need for TransCo as a catalyst for change would be reduced.

## **Challenges to Systems Change**

### **Decentralization Policies**

A common policy in global development is to place responsibility at the lowest appropriate level of the system. For example, most low-income countries seek to build the necessary logistics capacity at the district level despite the challenges and cost of doing so. A centralized delivery system such as the DLS appears inconsistent with this policy. There are two responses. First, certain activities are best left centralized because the benefits of centralization outweigh the benefits of decentralization. In this case, the lowest *most appropriate* level does not necessarily mean the district level. Second, a DLS-type system can accommodate the benefits of decentralization. For example, one incentive for decentralization is districts should be responsible for activities at the health facility level because they are most familiar with the realities in their district. In the Mozambique DLS, this information is shared, discussed, and analyzed at the district and provincial level. As a result, knowledge of areas related to the program (stock management, cold chain, logistics, etc.) is known not only at the district level, but it also is passed up the chain to the provincial level.

### **Adherence to Traditional Multi-tier Distribution Structure**

The multi-tier distribution structure depicted on page 1 was designed decades ago when low-income country infrastructure and health system capacity were significantly weaker than they are today. The multi-tier approach has produced huge improvements in health outcomes such as increases in immunization coverage rates from less than 10% to over 75%. The system, however, still reflects the reality at the time it was designed. It fails to take advantage of improved infrastructure, increased health system capacity and, most important, new information communications technologies. The DLS is an example of “level jumping” where medical commodities bypass a particular tier of the previous distribution system. Despite the growing evidence of the advantages of streamlining logistics, there continues to be resistance to change.

### **Government Funding Reliability**

Any system that performs routine operations depends on a steady flow of funds that is regularly available. The internal flow of funds, even when budgeted, within many ministries of health is notoriously unreliable. The Mozambique DLS was stopped on numerous occasions due to lack of government funds for fuel and per diems for the field coordinators, until alternative solutions to ensure a steady flow of funds were put in place.

### **Changes to the Status Quo**

Any change in an existing system will affect the status quo to the benefit of some and the detriment of others. For example, the Mozambique DLS increases costs at the provincial level but decreases costs at the district level. Even though there is a net reduction in cost for the health system, it is often a challenge to affect change within rigid and compartmentalized government structures.

### **Outsourcing Concerns**

To gain the cost and reliability benefits of shared infrastructure, the public health system must be willing to outsource certain components to private sector providers. Many governments have deep concerns over any reliance on a private sector provider for a health system component that to date has been performed by the government. Their reluctance is partly due to a lack of viable private sector options and failure of previous outsourcing attempts. Outsourcing transport is an obvious example where substantial efficiency gains could be made, yet it has been difficult to do in practice. In addition, many governments lack the expertise to manage outsourcing arrangements. Building trust in the private sector and outsourcing management capability will be challenging at first, but will grow over time.

### **Conclusion**

By starting at the last mile and rethinking how the Mozambique vaccine distribution system could operate, VillageReach has proven an innovative approach that has produced significant performance improvements and cost efficiencies. Today, the revised system is being operated by MISAU in four Mozambique provinces serving almost a third of the country's health facilities. VillageReach is confident that the key principles behind this approach, when applied to other medical commodities and in other countries, can produce the improvements needed to deliver medical commodities, both existing and future, to those who need them most.