

TECHNICAL BRIEF

ETHIOPIAN PHARMACEUTICALS SUPPLY AGENCY NETWORK ANALYSIS

Optimizing commodity delivery to remote health facilities and the communities they serve

BACKGROUND

The Ethiopian Pharmaceutical Supply Agency (EPSA) is responsible for supply chain management of public health commodities in Ethiopia. The agency has 19 branch warehouses that serve more than 3,800 health facilities that in turn serve 105 million people in nine regional states and two administrative states. EPSA is responsible for commodity distribution across 1.1 million km square (425,000 square miles). Some communities are difficult to reach due to their remoteness or lack of roads or other necessary access to deliver health commodities. (See Figure 1.) Understanding the levels and gaps of coverage in EPSA's branch network is essential for EPSA and the Ministry of Health (MoH) to improve access to essential health commodities for the people of Ethiopia.

EPSA has acknowledged complaints from regional health bureaus that some health facilities are not covered by EPSA branches, therefore leaving them without the public health commodities needed to serve the needs of people in hard-to-reach communities. To address these gaps in coverage, the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project and EPSA conducted a network optimization analysis to understand the level of coverage gaps – including where gaps are concentrated – and determine the optimal number of branches to provide the needed coverage. This analysis informed strategic decision making in supply chain network design and allocation of resources to meet the desired level of coverage.

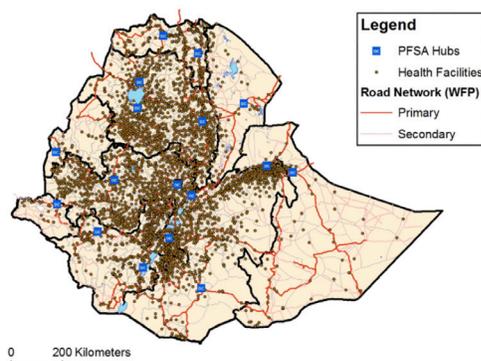


Figure 1: Although many health facilities are in high-density areas of Ethiopia, some are quite remote and far from good roads.

OBJECTIVE

Data-driven network optimization analysis compares existing networks with various scenarios to determine the most effective supply chain design. Network optimization can provide many benefits, including cost savings and increased efficiency and coverage. Ethiopia's network optimization analysis aimed to determine the coverage level of health commodity delivery provided by EPSA's existing branch network, determine if and where gaps in coverage exist, and consider potential redesign of the network – including the addition of more branches – for maximum coverage to health facilities.

METHODOLOGY

The network optimization analysis included three steps:

1. Collection of necessary data, including site locations, road network and coverage parameters (assumptions made to determine the coverage status of health facilities).
2. A workshop to gain consensus on key assumptions and to define benchmarks.
3. Optimization analysis and delivery of findings and recommendations to key stakeholders.

Step 1: Data collection

The three key data used in the analysis were the MOH's global positioning system (GPS) data of most health facilities, GPS data tracking of EPSA delivery vehicles, and travel times and distances using Google Maps' application programming interface (API). (See Figure 2.) The tracking of GPS data of EPSA vehicles revealed an average travel speed of 41 kilometers per hour. This data was then used to adjust the travel speeds provided through Google Map's API.

These three data sources helped generate an origin and destination matrix between all health facilities and EPSA branches.

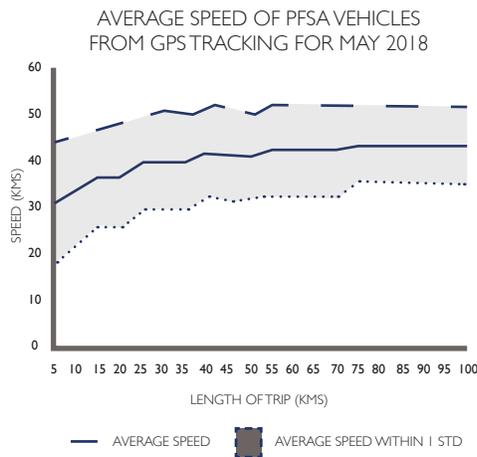


Figure 2: Average speed of EPSA vehicles from GPS tracking for May 2018

A mathematical optimization model – with adjustable key parameters used to test the robustness of the analysis – used an origin and destination matrix with benchmarks to determine EPSA’s coverage of health facilities, categorized by the ease of which they are reached by EPSA delivery vehicles. Level of coverage was defined as the percentage of facilities that were defined as “easy to reach” or “reachable” based on benchmarks to be established.

Step 2: Consensus on assumptions and benchmarks

Eight key staff from EPSA and GHSC-PSM then held a workshop to establish benchmarks for use in the analysis. Participants agreed that the service coverage provided by EPSA applies to all public health facilities within 160 to 300 kilometers from a branch warehouse and reachable within 13 hours. The benchmark for maximum driving time was defined as 6.5 hours per day. The benchmarks were then used to assess the level of coverage being provided by the current network of 19 branches (see Figure 3), dividing health facilities into five categories:

1. **Easy to reach:** Less than 160km and less than 6.5 hours
2. **Reachable:** Between 160km and 300km and less than 6.5 hours
3. **Hard to reach:** Less than 160km and between 6.5 hours and 13 hours
4. **Very hard to reach:** Between 160km and 300km and between 6.5 hours and 13 hours
5. **No coverage:** Greater than 300km and greater than 13 hours

Facilities beyond 13 hours and/or beyond 300 kilometers were considered beyond what is defined as covered. EPSA’s objective is to minimize the number of sites where travel from a branch is beyond two days.

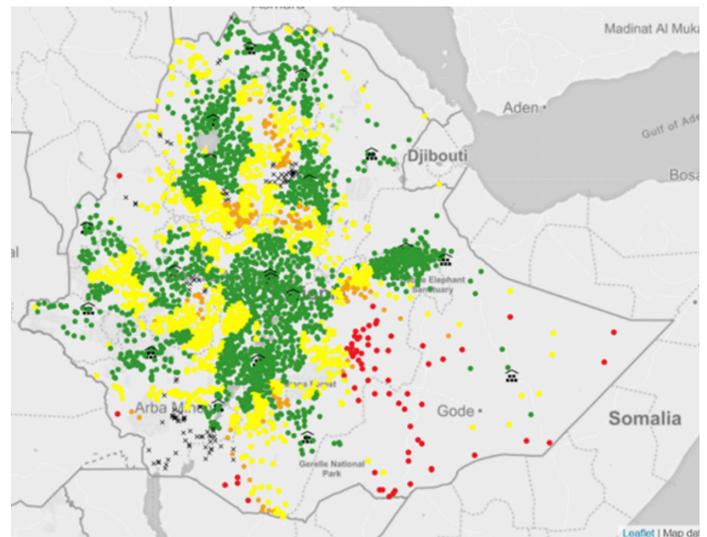


Figure 3: Level of coverage of EPSA to health facilities

- Easy to reach
- Reachable
- Hard to reach
- Very hard to reach
- No coverage
- X Insufficient road network data

Step 3: Analysis and key findings

Participants used three technology solutions – Excel spread sheets, Python (an open-source programming language) and CPLEX Optimizer (a high-performance mathematical program solver used to model business issues and support logical decisions) to explore different scenarios and interpret the results based on adjustable distance and time parameters. (See Annex A: Sample scenarios.)

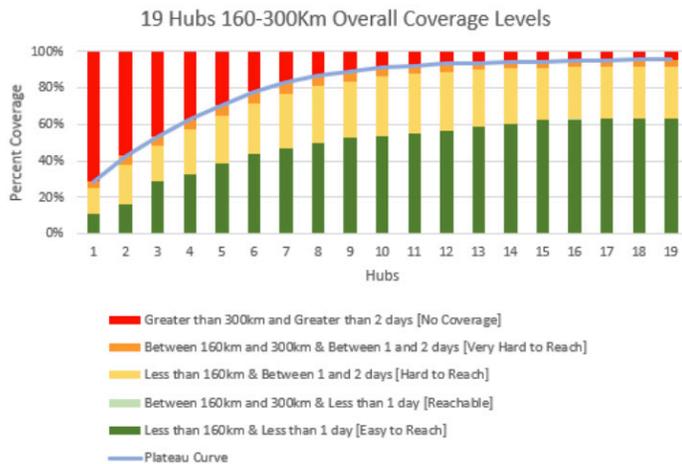
The analysis allowed for the generation of various coverage scenarios based on differences in the number of branch warehouses, distance and time. Specifically, the following changes could be made:

- **The number of branch warehouses:** From one to 19.
- **Minimum distance and time:** From 85 to 235km in 25km increments and 5 to 8 hours in half-hour increments.
- **Maximum distance and time:** From 225 to 375km in 25km increments and 12 to 15 hours in half-hour increments.

Ranges in the scenarios helped to test different parameters (distance and travel times) to understand the robustness of the analysis in implementing different benchmarks and numbers of branches. The scenarios were presented through an excel-based user interface. The tool showed the level of coverage provided with different benchmarks and provided a map of coverage to help users identify gaps.

KEY FINDING

EPSA's and the Ethiopian government's aim of ensuring equal access to medications and other health commodities can be achieved with fewer than the existing 19 distribution branches.



The analysis revealed that **the existing network of 19 branch warehouses is significantly more than is needed** to provide enough coverage to most health facilities. In fact, coverage reaches 93 percent of health facilities with only 12 branch warehouses. Adding the last seven existing branches – for a total of 19 – increases the level of coverage by only two percent, for 95 percent coverage.

In this context, 'cannibalization' describes overlap in coverage by branch warehouses that can serve the same nearby health facilities. When adding a new branch in scenario modelling, a new branch will cover both new facilities that were not previously covered but also cannibalize sites that are reachable by another nearby branch. In a scenario that includes more **than nine branches, the amount of cannibalization is greater than the number of new sites covered** by new branches.

Workshop participants ran additional scenarios to adjust benchmarks and verify the robustness of the analysis. When the distance parameters were reduced to 85-225 kilometers and travel time parameters were reachable within 11.5 hours, the level of coverage dropped to 80 percent for 12 branches and 85 percent for 19 branches. Most importantly, this indicates that after 12 branches the level of coverage flattens as the number of branches increases. In other words, with the current distribution of health facilities, branches and road networks, an increase in the number of branches after 12 provides only marginal increases in coverage and higher increases in cannibalization of existing coverage by other branches.

Therefore, the current analysis indicates that, under the agreed benchmarks, EPSA coverage of health facilities is stable at 12 branches, with coverage at 93 percent, and that the level of coverage is insensitive to changes once the number of branches increases above 12.

Lastly, the analysis also showed that there are 'no coverage' areas around the Bale Zone – in the Oromia Region southeast of Addis Ababa – and the western edge of the Somali Region, both of which have a concentration of sites. A new branch in the Bale Zone would shift 40 sites from 'no coverage' status to 'reachable,' presenting a one percent increase in overall coverage. Regardless, all sites categorized as 'no coverage' can be reached by extending the kilometers and hours covered by existing branches. Because these sites typically have small numbers of patients, less frequent distributions – such as every four months rather than the current standard of two – can provide reliable supply of health commodities.

CONCLUSION

The network optimization provided strong evidence to maintain or even reduce the current number of EPSA branches. As Ethiopia continues to improve its road infrastructure, the travel time between branches and health facilities will decrease. This will, in turn, increase the number of sites falling within the coverage area of each branch warehouse and provide access to health facilities currently categorized as 'no coverage.' EPSA's current supply network of 19 branches, based on the current benchmark, has an acceptable 95 percent coverage. Adding more branches will not significantly increase the overall coverage of health facilities and has very limited value to improving coverage levels. In fact, to the contrary, the analysis suggests that an over-investment in distribution network assets happened in recent years due to decisions based on inadequate analysis and not reflecting supply chain best practice. Coverage rates only decreases by two percent to an acceptable 93 percent if seven branches were eliminated.

RECOMMENDATIONS

Based on the results of the analysis, the following recommendation were put forward to the Director General of the EPSA:

- EPSA should not invest in additional distribution centers and may consider decreasing the current number of branches.
- To expand coverage to 100 percent of health facilities, EPSA should consider better use of its transportation resources and partnering with relevant authorities to improve road infrastructure.

ACTION TAKEN

EPSA recognized the recommendations and used it as an input for its Pharmaceutical Transformation Strategic Plan (PSTP) for 2018 to 2020. The strategic plan recognized that there is an over-investment in distribution network assets and released a directive to reduce the number of branches to 10.

Annex A: Sample scenarios

