

Annex 2 – Benchmarking Analysis

Benchmarking Study for Supply Chains for Neglected Tropical Diseases

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List of Acronyms

CMS	Central Medical Store
CMS/T	Central Medical Stores Trust
EPI	Expanded Programme on Immunization
EVM	Effective Vaccine Management
JSI	John Snow, Inc.
MDAs	Mass Drug Administrations
MOH	Ministry of Health
NEPI	National Expanded Programme on Immunization
NTD	Neglected Tropical Disease
NTDCP	Neglected Tropical Disease Control Program
NTDD	Neglected Tropical Disease Drug
SC	Supply Chain
SOP	Standard Operating Procedures
STH	Soil-Transmitted Helminth
WHO	World Health Organization

Executive Summary

Purpose

Performance benchmarking is a commercial sector supply chain-strengthening technique that has recently started to be applied to public health efforts in developing countries. Organizations and programs use performance benchmarking to evaluate financial and/or functional performance levels against well-performing peer groups, identify areas of underperformance, define aspirational performance goals, and identify specific strategies for improvement.

The purpose of this analysis is to investigate whether performance benchmarking is an effective strategy for understanding and strengthening Neglected Tropical Disease (NTD) supply chains.

Methodology

Few public health supply chain performance datasets from Africa are available for benchmarking, and even fewer performance data exist for NTD-specific supply chains. The World Health Organization's Expanded Programme on Immunization (EPI) Effective Vaccine Management (EVM) database is the most comprehensive public health supply chain database available for African countries, and EPI programs have a large campaign distribution component.⁴ Based on these criteria, the EVM was deemed more appropriate than others for NTD supply chain benchmarking. While an ideal benchmark includes a representative sample of data points, this research found a lack of relevant supply chain performance data in Africa. The peer group used for benchmarking consists of 20 supply chains.

Planning, distribution, and managing and monitoring inventory indicators were chosen for this analysis. Planning indicators include the existence of standard operating procedures (SOPs), training materials, and use of evidence-based forecasting methods. Distribution indicators include delivery planning and execution, storage capacity, and transport capacity. Managing and monitoring inventory indicators include stock sufficiency, records maintenance and inventory accuracy.

Fieldwork to compare NTD supply chains to the benchmark was conducted in Malawi, Tanzania and Ghana in mid-2014. Data were collected at central, intermediate and health facility levels using the NTD Supply Chain Assessment Tool developed by JSI for this project.

Initial Analysis

The first part of the analysis focuses on the benchmark itself. Researchers found that just over half of benchmark supply chains have SOPs in place, while fewer than 50% of the supply chains reported that training materials are completely clear and correct. The use of forecast methods was strongest at the

⁴ Results from the USAID | DELIVER PROJECT's Logistics Indicators Assessment Tool (LIAT) in various countries in Africa were also considered (USAID | DELIVER PROJECT 2008). While the LIAT reports on indicators similar to those in the EVM, differences in survey design limit the ability to align data sets and results from the two assessments, hence data from the LIAT were not included in this study.

central level, with over 50% using multiple evidence-based forecast methods. Distribution indicators were more varied; delivery planning is carried out by approximately half of the central level supply chains, and only slightly more than a quarter deliver according to the plan. Warehouse capacity for benchmarked supply chains is adequate for 65% of central level supply chains and fewer intermediate and health facility-level supply chains, while transport capacity is weaker, with fewer than half of central level supply chains reporting adequate capacity. Indicators for managing and monitoring inventory and data also varied. Stock level sufficiency and keeping stock records current are strongest at the central and intermediate levels of the supply chain, while inventory accuracy shows the poorest results of all indicators.

The second part of the analysis compares NTD supply chain performance from field assessments in Malawi, Tanzania and Ghana to the benchmark. While all three countries have SOPs in place, training materials are of fair quality. All countries' use of evidence-based forecast methods aligns with bottom quartile supply chains in the benchmark. Distribution indicators are strong at the central level, with somewhat reduced performance at the lower levels. Warehouse and transport capacity appear strong in all countries when compared with the benchmark, while indicators for managing and monitoring inventory and data vary. Sufficient stock quantities are reported the majority of the time, while record-keeping is often nonexistent, especially at the intermediate and health facility levels. (For summary table of indicators and data, please refer to Appendix 1.)

Additional Analysis

Preliminary analyses produced confounding results, whereby known weaknesses looked like strengths. For example, while it appears that warehouse capacity is sufficient for all NTD supply chains assessed, we know from observations during field work that NTD programs rarely have dedicated warehouses and instead typically share space with other programs. As such, the issue isn't whether a warehouse is big enough to store NTD drugs, but whether there is space available in warehouses when NTD drugs need to be stored or whether NTD drugs will overwhelm a storage facility already filled with other health commodities. Because of known confounding issues, researchers conducted additional analysis to highlight methodological and programmatic constraints inherent in benchmarking NTD supply chains against existing data sets. These constraints are described indicator-by-indicator below.

- *Standard Operating Procedures for logistics exist* While NTD supply chains make use of existing supply chain capacities, there were no Neglected Tropical Disease Drug (NTDD) or campaign product-specific SOPs in use. Hence, while the benchmark analysis of NTD supply chains indicates that SOPs are in place, these SOPs are written for non-NTD, non-campaign commodities, and NTDDs are managed without relevant SOPs.
- *Warehouse is adequate to receive goods* While adequate warehouse space is a revealing indicator for EPI programs with dedicated storage facilities, it is of limited usefulness for NTD programs, which rarely have dedicated warehouses and typically share Ministry of Health (MOH) warehouse space with other programs. Spatial capacities of MOH warehouses will always exceed the requirements for Neglected Tropical Disease Control Program (NTDCP) drugs. However, MOH warehouses are

required to house hundreds of commodities not related to NTD programs, so while the overall storage capacity exceeds NTD needs, the issue is whether there is space available when NTD drugs arrive, or whether NTDDs will overwhelm a storage facility already filled with other health commodities. Many MOH facilities, particularly at the district level, experience acute shortages of space when they receive the annual shipment of NTD drugs.

- *Transport is adequate to deliver goods* Similar to the adequacy of storage space, the transport capacity indicator is of limited usefulness in understanding the adequacy of transport for distributing NTDDs. While EPI programs have dedicated transport with defined capacities, NTD programs rarely do. This indicator measures the capacity of whichever vehicle is borrowed, hired or “piggybacked-on”, but it does not measure the availability of those vehicles when required by the NTDCP nor does it measure whether the vehicles are required to transport other, non-NTD commodities during the same trip.
- *Quantity of goods is sufficient* Inventory records are rare at the lower levels of NTDCPs. Without inventory records for NTDDs at the community, health facility and even district levels, answers to whether stock levels are sufficient were based on verbal responses in the field assessments. This may have led to response bias, as those tasked with ensuring full supply for MDAs may be reluctant to report stock outs. Conversely, higher-level facilities that do keep stock records for the NTDDs demonstrated a zero balance, but this is the norm for most of the year in an annual campaign program rather than an indication of under-supply.
- *Records are kept up to date and inventory is accurate* Because of the comparative lack of inventory records being used for NTDDs at a majority of facilities below central level, the ability to assess whether inventory records are kept up to date and are accurate is compromised.

Conclusion

Many NTD supply chain challenges are similar to those facing other public health supply chains, including poor infrastructure, limited financial, human and material resources, and limited availability of logistics and consumption data. However, NTD supply chains have additional challenges that other health commodity supply chains do not have, including a lack of vertical financial and human resources, a lack of dedicated warehouse and transportation assets and a lack of dedicated cold chain distribution capacities. As such, NTD supply chains are often forced to rely on the resources of other supply chains, which makes performance dependent on the primary program’s supply chain performance. In addition, while most supply chains have well-defined processes in place, and are managed and distributed as routine-delivery drugs in addition to mass-distribution campaign activities, NTD drug management and distribution are typically completed on a yearly basis and only in campaign style. All of these issues confound analysis of the performance of NTD supply chains when compared to benchmark EPI supply chains.

Despite using the EPI EVM, deemed most appropriate to benchmark against because of its large number of country-specific data and its partial use of campaign delivery, there were relatively few supply chain performance measurement data sets and indicators identified as appropriate to use for NTD. These data and indicator limitations, as well as the specific methodological and programmatic constraints associated with using non-NTD data for NTD benchmark purposes, described in depth above, are significant constraints to effective benchmarking. As such, we do not recommend investing additional resources in NTD benchmarking until more appropriate benchmark data sets for NTD supply chains can be developed and are available.

Introduction

Performance benchmarking is a commercial sector supply chain-strengthening technique that has recently started to be applied to public health efforts in developing countries. Organizations and programs use performance benchmarking to evaluate financial and/or functional performance levels against well-performing peer groups, identify areas of underperformance, define aspirational performance goals, and identify specific strategies for improvement.

The purpose of this analysis is to investigate whether performance benchmarking is an effective strategy for understanding and strengthening Neglected Tropical Disease (NTD) supply chains.

The specific objectives of this report are to:

- discuss the state of NTD-specific supply chain performance benchmarking;
- identify a selected set of supply chain performance indicators from the most comprehensive supply chain performance data set available to serve as the benchmark;
- analyze the performance of the benchmark;
- compare NTD supply chain performance data from field assessments to the benchmark developed; and
- consider the utility and limitations of this approach.

Methodology

To create the benchmark against which field assessments of NTD supply chains would be compared, researchers conducted a desk review of performance assessments for NTD and relevant non-NTD supply chains in Africa. Among non-NTD supply chains, those of particular interest were supply chains with campaign-style distribution efforts such as vaccines, and those with strong seasonal demand such as malaria, which can drive large seasonal commodity shipment volumes and impact the supply chain in ways similar to mass distribution efforts.

Few public health supply chain performance datasets from Africa are available for benchmarking, and even fewer performance data exist for NTD-specific supply chains. The World Health Organization's Expanded Programme on Immunization (EPI) Effective Vaccine Management (EVM) database is the most comprehensive public health supply chain database available for African countries, and EPI programs have a large campaign distribution component. Based on these criteria, the EVM was deemed more appropriate than others⁵ for NTD supply chain benchmarking. While an ideal benchmark includes a representative sample of data points, this research found a lack of relevant supply chain performance data in Africa. The peer group used for benchmarking consists of 20 supply chains.

⁵ Results from the USAID | DELIVER PROJECT's Logistics Indicators Assessment Tool (LIAT) in various countries in Africa were also considered (USAID | DELIVER PROJECT 2008). While the LIAT reports on indicators similar to those in the EVM, differences in survey design limit the ability to align data sets and results from the two assessments, hence data from the LIAT were not included in this study.

Planning indicators chosen include the existence of standard operating procedures (SOP), training materials, and use of evidence-based forecasting methods. Distribution indicators include delivery planning and execution, storage capacity, and transport capacity. Managing and monitoring inventory indicators include stock sufficiency, records maintenance and inventory accuracy. Some of these indicators were only analyzed at the central level due to absence of data at other levels, while others were analyzed at central, district and health facility levels. Several additional indicators were considered for inclusion but in the end were omitted from analysis. These included on-time delivery,⁶ condition of shipments upon arrival,⁷ product loss rate,⁸ product expiry rate⁹, and reporting rate.¹⁰

Fieldwork to compare NTD supply chains to the benchmark was conducted in Malawi, Tanzania and Ghana in mid-2014. Data were collected at central, intermediate and health facility levels using the NTD Supply Chain Assessment Tool which was developed for this project. Quartile analysis for Malawi and Tanzania, discussed in detail in Appendix 1, was completed before fieldwork was conducted in Ghana. As such, the formal quartile analysis was not conducted for Ghana although the data were collected, reviewed, are consistent with findings from other countries and have been included in the report.

Data Limitations

- **Few sources to draw comparable data.** Few data sources are available that report on performance of public health supply chains in Africa, and even fewer that report on this particular set of indicators. No data were found that directly report on performance of NTD supply chains. Malaria supply chains in Africa were reviewed, given their strong seasonal demand, but no relevant and comparable data found. Hence, to create this benchmark, data were drawn primarily from performance reports on supply chains in Africa that carry out vaccine distribution, which often incorporates annual mass distribution or campaign-style distribution activities.
- **Small sample size of benchmarked supply chains.** A small number of comparable supply chains comprise the sample evaluated and are neither statistically significant nor geographically

⁶ On-time delivery rates from suppliers may be available through the USAID | DELIVER Project, but they are not indicative of in-country distribution performance. International performance benchmarks for on-time delivery from suppliers are also available. Delivery according to schedule is available in the EVM data and is included in this study.

⁷ EVM data do not measure the condition of shipments on arrival as a separate indicator; rather, they are combined with the measure of shipments arriving with complete documentation. A measure of the condition of shipments upon arrival from suppliers may be available through the USAID | DELIVER Project, but this is not indicative of in-country distribution performance.

⁸ EVM data do not provide data on loss due to theft or leakage. LIAT and other data sources reviewed also did not provide loss rate due to theft or leakage.

⁹ EVM data measure whether or not a facility has expired product on hand and if product is “expired” due to temperature exposure. They do not measure expiry value or rate due to other causes such as exceeding the shelf life of the product. LIAT and other data sources reviewed did not provide expiry value or rate.

¹⁰ EVM data do not include reporting rates. LIAT reporting rates are based on number of facilities surveyed, but this may or may not be statistically significant or representative of the nationwide rate for the country surveyed.

representative. Results describe the relative performance of the limited number of comparable supply chains where data were available.

- **No performance data for individual facilities below the central level.** Data available for this set of indicators were only available as aggregated results for each country at each level of the supply chain rather than at the individual facility level. The benchmark was created based on aggregated scores or average results.
- **Less consistent performance data for lower levels of the supply chain.** Central level data were available for all benchmark indicators, but data became less consistent for facilities below the central level. Intermediate level data were available for most benchmark indicators, while health facility level data were available for only two indicators.

Benchmark Performance Findings

This first part of the analysis focuses on the benchmark itself. It provides an overview of the indicators used to assess performance by benchmark supply chains and discusses performance across all measured indicators.

Planning Indicators

Standard Operating Procedures for logistics exist

This indicator measures whether supply chain policies and guidelines that support standardized processes are in place and are used as reference material for workers who are responsible for supply chain activities. Three aspects of this indicator were measured: a Standard Operating Procedures (SOP) manual exists, the facility surveyed has a copy of the manual, and clear and correct logistics training materials exist. Data for this indicator were available only for the central level of supply chains. Fifty-three percent of supply chains comprising the benchmark have SOP manuals in place and had a copy available at the facility, while fewer than 50% of the supply chains report that training materials are completely clear and correct. It should be noted that this indicator did not assess whether or not the SOPs for logistics are actually followed.

Data-based forecast method is used

This indicator measures how many supply chains are using evidence-based methods to develop forecasts, including whether a standard method is used; whether a target population is used; whether coverage data is used; and whether drug wastage rate data is used. At the central level, over 50% of supply chains report using all four methods while at the intermediate level this figure was somewhat lower. Data for the health facility level were not available for this indicator.

Distribution Indicators

Deliveries are scheduled in advance and done according to plan

This indicator measures how many facilities send a distribution plan or notification to the receiving party, as well as how many deliveries are made according to that plan. At the central level, 53 percent of facilities send a distribution plan or notification to the recipient; however, only 29 percent of deliveries are made according to schedule. At intermediate levels, performance varies widely, with between 0 and

100 percent of supply chains sending distribution plans prior to delivery and delivering according to the schedule. Even among the highest performing quartile of intermediate level supply chains, performance ranges from 45-100 percent for sending distribution plan notification and from 41-100 percent for delivering according to schedule at the intermediate level. Data for the health facility level were not available for this indicator.

Warehouse is adequate to receive goods

This indicator measures whether or not the capacity of the warehouse is adequate to store the maximum volume of commodities to be stored. At the central level, 65 percent of facilities report adequate storage capacity, while at the intermediate level, the top two quartiles of supply chains report between 71 and 100 percent of adequate storage capacity, indicating relatively good storage capacity for these supply chains. The top two quartiles of health facility level supply chains report between 90 and 100 percent of adequate storage capacity.

Transport is adequate to deliver goods

This indicator measures whether or not transport capacity is adequate for the maximum volume of commodities to be transported between levels. Only 43 percent of central level facilities report that transport capacity is adequate for the maximum volume of commodities. Data for this indicator were only available for the central level.

Managing and Monitoring Indicators

Quantity of goods is sufficient

This indicator measures two aspects of stock sufficiency—whether stock was available on hand during the review period and whether or not the facility is able to service or fill orders for lower level facilities. Over half of central and intermediate level supply chains report necessary stock levels at greater than 50 percent, while at the health facility level, the corresponding figure is 45 percent. Note that results for the health facility level reflect stock availability only, i.e., no stock outs, as health facilities do not serve lower level facilities.

Records are kept up to date

This indicator measures whether or not stock transactions are recorded and stock balances updated within one working day of the transaction. At the central level, 76 percent of facilities report that records are kept up to date.

Inventory is accurate

This indicator measures whether or not results of a physical inventory count are within 1 percent of inventory recorded on stock records, based on counting a sample commodity. Data for this indicator were only available at the central level, and only 11% of central level facilities report accurate inventory when compared with records.¹¹

¹¹ It should be noted that the sample size for measuring inventory accuracy for the supply chains in the benchmark is thought to be one commodity per facility; however, the sample size cannot be verified. It is also important to

Summary of Benchmark Performance Findings

For the supply chains that comprise the benchmark, 53% have SOPs in place, while fewer than 50% of the supply chains report that training materials were completely clear and correct. The use of forecast methods is strongest at the central level, with over 50% using four evidence-based forecast methods. Distribution indicators are more varied, with delivery planning carried out by approximately half of the central level supply chains, and only slightly more than a quarter delivering according to the plan. Warehouse capacity for benchmarked supply chains is adequate for 65% of central level supply chains and fewer intermediate and health facility-level supply chains, while transport capacity is weaker, with fewer than half of central level supply chains reporting adequate capacity. Indicators for managing and monitoring inventory and data also vary. Stock level sufficiency and keeping stock records current are strongest at the central and intermediate levels of the supply chain, while inventory accuracy shows the poorest results of all indicators. A summary table of indicators and data are found in Appendix 1.

NTD Supply Chain Performance Findings from the Field Assessments

This second part of the analysis compares NTD supply chain performance from field assessments to the benchmark and discusses performance across all measured indicators. A more detailed quartile analysis of field assessments in Malawi and Tanzania are found in Appendices 2 and 3.

Planning Indicators

Standard Operating Procedures for logistics exist

All three countries have SOPs in place, but the quality of all training materials is fair.

Data-based forecast method is used

In all three countries, use of evidence-based forecast methods aligns with the lowest performing group of benchmarked supply chains at central and intermediate levels.

Distribution Indicators

Deliveries are scheduled in advance and done according to plan

In Malawi, all levels of the NTD supply chain report that a majority of facilities sent distribution plans and delivered against them, making Malawi a top performer when compared to the benchmark. Tanzania's central level of the NTD supply chain also reports scheduling deliveries in advance and delivering against the schedule; however, lower levels report less frequent use of scheduling and mixed results regarding adherence to the schedule. In Ghana, the central level performs well; no data were collected at the intermediate and health facility levels.

Warehouse is adequate to receive goods

In all three countries, warehouse capacity is at least 110% of the maximum volume to be stored.

note that this indicator only measures whether the inventory was accurate on the day of the assessment, not over a longer period of time.

Transport is adequate to deliver goods

In all three countries, transport capacity is at least 110% of the maximum volume to be transported.

Managing and Monitoring Indicators*Quantity of goods is sufficient (no stock outs)*

In all three countries, NTD drug stock levels at the central level are reported as sufficient to service all orders. Stock sufficiency levels are lower at the intermediate and health facility levels in Malawi and Tanzania; no data were collected at the intermediate and health facility levels in Ghana.

Records are kept up to date

In Malawi and Ghana, record keeping is conducted at the central level, but lower levels do not use stock records.

In Tanzania, no record keeping results were reported at the central level while at the intermediate level, record keeping is fair. Surprisingly, the health facility level reports the best relative performance of all three levels in Tanzania, aligning with the 2nd highest performing group of the benchmark.

Inventory is accurate

Malawi's inventory accuracy at the central level ranks with a small percentage of benchmark supply chains reporting good results, while Tanzania and Ghana report poor results for inventory accuracy at the central level. No other inventory accuracy data were collected.

Summary of Findings from the Field

Supply chain performance findings from the field assessments vary widely. While all countries have SOPs in place, training materials are of fair quality. All countries' use of evidence-based forecast methods align with bottom quartile supply chains in the benchmark. Distribution indicators in all countries are strong at the central level, with reduced performance at the lower levels. Warehouse and transport capacity are strong in all countries, while indicators for managing and monitoring inventory and data vary. In all three countries, NTD drug stock levels at the central level are reported as sufficient, while stock sufficiency levels are lower at the intermediate and health facility levels in Malawi and Tanzania. Record-keeping is often nonexistent, especially at the intermediate and health facility levels. More information about the field assessments can be found in Appendices 2 and 3.

Analysis of Confounding Methodological and Programmatic Issues

While some of the findings reported above appear promising, the reader should review these results with caution, as these analyses produced confounding results, whereby known weaknesses looked like strengths. Because of this, researchers conducted additional analysis to highlight methodological and programmatic constraints inherent in benchmarking NTD supply chains against existing data sets. These methodological and programming issues are discussed below.

NTD supply chains are most often integrated into the greater MOH commodity distribution system. While SOPs for logistics may exist in some facilities that manage Neglected Tropical Disease Drugs

(NTDDs), the SOPs are often for routine-delivery drugs rather than for mass distributed or campaign drugs such as NTDs, which may not be handled in the same way and likely require a different set of SOPs. In countries where fieldwork was conducted, NTDDs are handled at the central level by MOH pharmacists trained in, and using, SOPs for handling drugs, but there are no NTDD, or even campaign product-specific SOPs in use, and the MOH pharmacists do not use many of the standard procedures (e.g. pallets and stock cards) for the NTD drugs that they use for routine distribution commodities. Hence, while NTDCPs and National Expanded Programmes on Immunization (NEPIs) may both score “yes” on this indicator, only NEPI programs have and use SOPs that are appropriate for their commodities.

Similarly, training materials are available at MOH facilities for routine distribution health commodities, but these training materials are not generally relevant for campaign commodities, and the NTD logistics training materials found during field assessments are of fair quality at best.

In terms of data-based forecast methods, routine distribution supply chains including those used in the benchmark typically use several forecasting methods, comparing usage data-based forecasts to those based on population size and/or service statistics. Generally speaking NTD supply chain decision makers do not use multiple forecast methods and in all countries visited, forecasts rely first and foremost on population data.

Comparing the storage and transport capacity of NTD supply chains to the warehousing and transportation benchmark is also problematic. While the measurement of warehouse and transport capacity appear very strong in all three field assessment countries, conclusions drawn are misleading. Typically, NTDD supply chains share storage and transport with other health commodities rather than having their own dedicated storage and transport assets, due to the yearly or twice-yearly arrival and distribution of NTD drugs. As such, assessment of NTDD capacity requires estimating the storage or transport space needed for NTD drugs *as well as all other commodities* that use that resource; simply comparing the maximum volume of NTD drugs shipped to a given district against the total capacity of a district hospital store does not provide insight into whether there is space for the drugs when they arrive. In reality, NTD drugs often overwhelm storage and transport capacity, resulting in NTD drugs being stored in offices, corridors, and sunlit areas. In a similar way, while the benchmark transport indicator can measure the capacity of vehicles borrowed, hired or “piggybacked-on”, it cannot measure whether those vehicles are actually available when required or whether NTDDs are given lower priority than other health commodities in terms of transport.

There are also confounding factors with regard to managing and monitoring inventory indicators. Field assessment data indicate that inventory records are often missing. Without such records for NTDDs, establishing whether or not there were adequate stock levels was based on verbal responses, which may lead to response bias, as those tasked with ensuring full supply for MDAs may have been reluctant to report stock outs. Malawi, which reported keeping stock records at the central level, demonstrated a zero balance, but this is the norm for most of the year in an annual campaign program, and is not indicative of stock-out or under-supply. (Adequacy of stock availability for campaign programs has a temporal factor which routine supply distribution programs do not have.) In terms of inventory record-keeping and accuracy, interpretation of performance is compromised by the comparative lack of inventory records being used for NTDDs at a majority of facilities below central level.

Recommendations for NTD Supply Chains

- Develop and implement SOPs and keep copies on hand at facilities as reference for logistics staff. While procedures for NTDDs could be included in SOPs for other health products, they should contain specific instructions for handling and distributing NTDDs and other products destined for campaigns.
- Use three or more evidence-based methods when developing forecasts.
- Develop and share distribution plans with all partners in advance for all campaigns or MDA activities
- Strive to deliver goods according to the plan at a greater rate of execution than supply chains in the benchmark.
- Fill all orders at all levels of the supply chain. This is particularly critical given that distribution campaigns take place infrequently, requiring timely arrival of requested quantities.
- Improve record-keeping of NTDDs (receipt issuance, inventory levels) despite the

Conclusions

Many NTD supply chain challenges are similar to those facing other public health supply chains, including poor infrastructure, limited financial, human and material resources, and limited availability of logistics and consumption data. However, NTD supply chains have additional challenges that other health commodity supply chains do not have, including a lack of dedicated (vertical) financial and human resources, a lack of dedicated warehouse and transportation assets and a lack of dedicated cold chain distribution capacities. As such, NTD supply chains are often forced to rely on the resources of other supply chains, which makes performance dependent on the primary program's supply chain performance. In addition, while most supply chains have well-defined processes in place, and are managed and distributed as routine-delivery drugs in addition to mass-distribution campaign activities, NTD drug management and distribution are typically completed on a yearly basis and only in campaign style. All of these issues confound analysis of the performance of NTD supply chains when compared to benchmark EPI supply chains.

Despite using the EPI EVM, deemed most appropriate to benchmark against because of its large number of country-specific data and its partial use of campaign delivery, there were relatively few supply chain performance measurement data sets and indicators identified as appropriate to use for NTD. These data and indicator limitations, as well as the specific methodological and programmatic constraints associated with using non-NTD data for NTD benchmark purposes, described in depth above, are significant barriers to effective benchmarking. As such, we do not recommend investing additional resources in NTD benchmarking until more appropriate benchmark data sets for NTD supply chains can be developed and are available.

Appendix 1: NTD Supply Chain Benchmark Indicators – Results by Quartile

Defining “top” performance among supply chains is a subjective activity; therefore, the performance data for supply chains comprising the benchmark is organized and analyzed into quartiles. For each level, facilities are aggregated¹², sorted by rank (best to worst) within each indicator, and grouped into quartiles—four groups of data containing an equal number of data points for each supply chain level. Examining each indicator individually, the first quartile contains the top 25 percent of data points by rank, representing the top performing supply chains for that indicator; the fourth quartile contains the bottom 25 percent of data points, representing supply chains with the poorest performance for that indicator. The data point noted in each quartile is the highest performance result for the supply chains captured in each quartile. Because performance for each indicator is assessed individually, the top quartile will not necessarily contain the same supply chains across all indicators.

In the data set selected for this study, each data point represents performance for one entire supply chain level in one country. At the central level, one data point reflects performance of each central facility where data were collected. At lower supply chain levels, one data point reflects the aggregated performance of all facilities in the named level for one country’s supply chain. Disaggregated data that reflects the performance of individual facilities below the central level were not available.

Some indicator results are reported as Yes/No results, and hence results were categorized into top and bottom performers only. At the central level, four indicators are measured in quartiles and seven as binary responses (Yes/No); all data from lower levels of the supply chain are measured in quartiles.

Indicator	SC Level	Benchmark Results				Malawi Results	Tanzania Results	Ghana Results
		4 th / No	3 rd	2 nd	1 st / Yes			
1. SOPs for logistics exist								
1.1 Is there a Standard Operating Procedures (SOP) manual? [Y/N]	Central	47%	--	--	53%	Y	Y	Y
1.2 If there is an SOP manual, does the facility have a copy of it? [Y/N]	Central	47%	--	--	53%	Y	Y	Y
1.3 Are logistics training materials clear and correct? [Scale 0-100]	Central	0-50%	75%	100%	100%	63%	50%	50%
2. Data-based forecast method is used								
2.1 Is a data-based forecast method used? (<i>Measures the percentage of four evidence-based forecasting methods in use at each facility surveyed.</i>) [Scale 0-100]	Central	0-75%	100%	100%	100%	50%	50%	25%
	Inter-mediate	0-50%	65%	93%	100%	50%	50%	25%
	Health Facility	--	--	--	--	--	--	25%
3. Delivery is according to plan								
3.1 During the period under review, did the issuing store send a distribution plan or notification to each receiving store identifying dates for the delivery? [Y/N]	Central	47%	--	--	53%	Y	Y	Y
	Inter-mediate	0-10%	29%	44%	100%	100%	38%	--
	Health Facility	--	--	--	--	75%	58%	--

¹² Note that the central level typically represents *one facility*, therefore no facilities are aggregated at the central level.

3.2 If a distribution plan was in place, were the actual number of deliveries within +/-20% of plan?	Central	71%	--	--	29%	Y	Y	Y
	Inter-mediate	0-2%	20%	40%	100%	63%	67%	--
	Health Facility	--	--	--	--	89%	100%	--
4. Warehouse capacity is adequate								
4.1 Is warehouse capacity at least 110% of the maximum volume to be stored?	Central	35%	--	--	65%	Y	Y	Y
	Inter-mediate	0-24%	70%	87%	100%	100%	100%	100%
	Health Facility	0-57%	89%	98%	100%	100%	100%	100%
5. Transport capacity is adequate								
5.1 Is transport storage capacity at least 110% of the maximum volume to be transported?	Central	57%	--	--	43%	Y	Y	Y
6. Stock levels are sufficient (no stock outs)								
6.1 During the review period, were stock levels sufficient to supply all lower levels?	Central	0%	50%	50%	100%	100%	100%	100%
	Inter-mediate	0-28%	52%	69%	100%	88%	75%	--
	Health Facility	0-29%	44%	56%	76%	92%	75%	--
7. Stock records are kept current								
7.1 Are all stock transactions (arrivals and issues) recorded and stock balances updated within one working day of the transaction?	Central	24%	--	--	76%	Y	--	Y
	Inter-mediate	0-59%	78%	90%	100%	NA	50%	NA
	Health Facility	8-43%	65%	87%	100%	NA	67%	NA
8. Inventory is accurate								
8.1 Was physical inventory count found to be +/- 1% of inventory on stock records? [Y/N]	Central	0-89%	--	--	11%	Y	N	N
	Inter-mediate	--	--	--	--	--	--	--
	Health Facility	--	--	--	--	--	--	--

Appendix 2: Field Results—Malawi

To compare Malawi's supply chain for NTD drugs to the benchmark, data from three different MDA campaigns were collected in April 2014 using the NTD Supply Chain Assessment Tool developed by JSI. Data were collected at two central level facilities: the Central Medical Stores Trust (CMS/T) and Allied Freight. The first was the MOH facility and used for one community-based distribution and trachoma drugs. The second was private and belonged to the company paid for by project donors to complete customs clearance. Data were also collected at eight intermediate level facilities and 13 health facilities.

The first MDA campaign is a community-based campaign that targets onchocerciasis, lymphatic filariasis and soli transmitted helminthes (STHs) by distributing ivermectin and albendazole to eligible populations. The second targets schistosomiasis and STH by distributing praziquantel and albendazole to all eligible school-aged children. The third program targets trachoma, distributes Zithromax in endemic districts and is executed vertically by trachoma program.

Planning Indicators

Standard Operating Procedures for logistics exist

Both central level facilities report having SOPs in place, and having a copy of it. The MOH CMS/T facility reports moderately clear and correct training materials, placing the supply chain in the 3rd quartile relative to the benchmark.

Indicator 1: SOPs for logistics exist	SC Level	Benchmark Results				Malawi Results
		4 th / No	3 rd	2 nd	1 st / Yes	
1.1 Is there a Standard Operating Procedures (SOP) manual? [Y/N]	Central	47%	--	--	53%	Y
1.2 If there is an SOP manual, does the facility have a copy of it? [Y/N]	Central	47%	--	--	53%	Y
1.3 Are logistics training materials clear and correct? [Scale 0-100]	Central	0-50%	75%	100%	100%	63%

Data-based forecast method is used

The second indicator measures the use of four evidence-based methods in developing forecasts—whether a standard method is used; whether a target population is used; whether coverage data is used; and whether drug wastage rate data is used.

Malawi's central and intermediate levels report using two of the four types of data, placing it in the lowest quartile of benchmarked supply chains.

Indicator 2: Data-based forecast method is used	SC Level	Benchmark Results				Malawi Results
		4 th / No	3 rd	2 nd	1 st / Yes	
2.1 Is a data-based forecast method used? (Measures the percentage of four evidence-based forecasting methods in use at each facility surveyed.) [Scale 0-100]	Central	0-75%	100%	100%	100%	50%
	Intermediate	0-50%	65%	93%	100%	50%
	Health Facility	--	--	--	--	--

Distribution

Deliveries are scheduled in advance and done according to plan

Malawi reports relatively strong performance for planning and executing deliveries. The central level reports sending a distribution plan in advance, while all facilities at the intermediate level and 75% of facilities at the health facility level report sending a distribution plan in advance. The central level

reports completing deliveries according to the plan, while 63 percent of intermediate facilities and 89 percent of health facilities deliver according to the plan.

Indicator 3: Delivery is according to plan	SC Level	Benchmark Results				Malawi Results
		4 th /No	3 rd	2 nd	1 st /Yes	
3.1 During the period under review, did the issuing store send a distribution plan or notification to each receiving store identifying dates for the delivery? [Y/N]	Central	47%	--	--	53%	Y
	Intermediate	0-10%	29%	44%	100%	100%
	Health Facility	--	--	--	--	75%
3.2 If a distribution plan was in place, were the actual number of deliveries within +/-20% of plan?	Central	71%	--	--	29%	Y
	Intermediate	0-2%	20%	40%	100%	63%
	Health Facility	--	--	--	--	89%

Warehouse is adequate to receive goods

This indicator measures whether or not the capacity of the warehouse is adequate to store the maximum volume of commodities to be stored. At all levels, warehouse capacity was adequate.

Indicator 4: Warehouse capacity is adequate	SC Level	Benchmark Results				Malawi Results
		4 th /No	3 rd	2 nd	1 st /Yes	
4.1 Is warehouse capacity at least 110% of the maximum volume to be stored?	Central	35%	--	--	65%	Y
	Intermediate	0-24%	70%	87%	100%	100%
	Health Facility	0-57%	89%	98%	100%	100%

Transport is adequate to deliver goods

This indicator measures whether or not transport capacity is adequate for the maximum volume of commodities to be transported between levels. At the central level, transport was adequate.

Indicator 5: Transport capacity is adequate	SC Level	Benchmark Results				Malawi Results
		4 th / No	3 rd	2 nd	1 st /Yes	
5.1 Is transport storage capacity at least 110% of the maximum volume to be transported?	Central	57%	--	--	43%	Y

Managing and Monitoring

Quantity of goods is sufficient (no stock outs)

This indicator measures two aspects of stock sufficiency combined—whether stock was available on hand during the review period and whether or not the facility was able to fill all orders for lower level facilities. As the health facility does not serve any lower levels, it is measured on stock availability only. An item is considered as stocked out if an order is not able to be filled when placed. All NTD drugs supplied by the facility are considered in this measure.

In Malawi, stocks of four drugs were assessed. The central level supply chain reports sufficient stocks and the ability to fill all orders. The intermediate and health facility level performance is also strong. The intermediate level reports stock sufficiency at 88 percent, placing it in the 1st quartile with top performing supply chains, as do health facilities, reporting 92 percent stock sufficiency.

Indicator 6: Stock levels are sufficient (no stock outs)	SC Level	Benchmark Results				Malawi Results
		4 th /No	3 rd	2 nd	1 st /Yes	
6.1 During the review period, were stock levels sufficient to supply	Central	0%	50%	50%	100%	100%

all lower levels?	Intermediate	0-28%	52%	69%	100%	88%
	Health Facility	0-29%	44%	56%	76%	92%

Records are kept up to date

This indicator measures whether stock transactions are recorded and stock balances are updated within one working day of the transaction. At the Malawi central level, stock transactions were recorded and balances were updated in a time manner. This indicator was not measured below the central level because of minimal use of stock cards.

Indicator 7: Stock records are kept current	SC Level	Benchmark Results				Malawi Results
		4 th /No	3 rd	2 nd	1 st /Yes	
7.1 Are all stock transactions (arrivals and issues) recorded and stock balances updated within one working day of the transaction?	Central	24%	--	--	76%	Y
	Intermediate	0-59%	78%	90%	100%	NA
	Health Facility	8-43%	65%	87%	100%	NA

Inventory is accurate

This indicator measures whether results of a physical inventory count are within one percent of inventory recorded on stock records, based on counting a sample commodity. The sample size for the benchmark supply chains is thought to be one commodity per facility; however, the sample size cannot be verified. Data for the NTD supply chains include all NTD drugs managed by the program. Benchmark data were only available for the central level.

Few benchmark supply chains were found to have inventory accurate within one percent and Malawi's central level ranks among those few strong-performing supply chains, reporting inventory accuracy for the four drugs assessed. No intermediate and health facilities reported accurate inventory for the four drugs.

Indicator 8: Inventory is accurate	SC Level	Benchmark Results				Malawi Results
		4 th /No	3 rd	2 nd	1 st /Yes	
8.1 Was physical inventory count found to be +/- 1% of inventory on stock records? [Y/N]	Central	0-89%	--	--	11%	Y
	Intermediate	--	--	--	--	--
	Health Facility	--	--	--	--	--

Appendix 3: Field Results—Tanzania

To compare Tanzania's supply chain for NTD drugs to the benchmark, data from three different MDA campaigns were collected in May 2014 using the Supply Chain Assessment Tool.¹³ Data were collected at the central level Medical Stores Department, three zonal facilities (grouped below with intermediate facilities), eight intermediate level facilities and 15 health facilities.

The first MDA campaign is a community-based campaign that targets onchocerciasis, lymphatic filariasis and soli transmitted helminthes (STHs) by distributing ivermectin and albendazole to eligible populations. The second targets schistosomiasis and STH by distributing praziquantel and albendazole to all eligible school-aged children. The third program targets trachoma, distributes Zithromax in endemic districts and is executed vertically by trachoma program.

Planning Indicators

Standard Operating Procedures for logistics exist

The central level facilities report having SOPs in place and having copies of it at the facility. The only training materials are powerpoint presentations used during the annual cascade training.

Indicator 1: SOPs for logistics exist	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
SOPs for logistics exist						
1.1 Is there a Standard Operating Procedures (SOP) manual? [Y/N]	Central	47%	--	--	53%	Y
1.2 If there is an SOP manual, does the facility have a copy of it? [Y/N]	Central	47%	--	--	53%	Y
1.3 Are logistics training materials clear and correct? [Scale 0-100]	Central	0-50%	75%	100%	100%	50%

Data-based forecast method is used

The second indicator measures the use of four evidence-based methods in developing forecasts—whether a standard method is used, if a target population is used, if coverage data is used, if drug balance data is used and if drug wastage data is used.

Tanzania's central and intermediate level supply chains report use of two of four evidence-based methods, placing them in the bottom quartile of performance.

Indicator 2: Data-based forecast method is used	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
2.1 Is a data-based forecast method used? (Measures the percentage of four evidence-based forecasting methods in use at each facility surveyed.) [Scale 0-100]	Central	0-75%	100%	100%	100%	50%
	Intermediate	0-50%	65%	93%	100%	50%
	Health Facility	--	--	--	--	--

Distribution

Deliveries are scheduled in advance and done according to plan

Tanzania's central level supply chain reports sending a distribution plan in advance and completing shipments according to the plan. At the intermediate level, 38 percent of facilities report sending distribution plans while 67 percent report completing shipments as planned. Health facility level supply chains report better performance than the intermediate level, with 58 percent sending distribution plans and 100 percent of those facilities delivering as planned.

Indicator 3: Delivery is according to plan	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
3.1 During the period under review, did the issuing store send a distribution plan or notification to each receiving store identifying dates for the delivery? [Y/N]	Central	47%	--	--	53%	Y
	Intermediate	0-10%	29%	44%	100%	38%
	Health Facility	--	--	--	--	58%
3.2 If a distribution plan was in place, were the actual number of deliveries within +/-20% of plan?	Central	71%	--	--	29%	Y
	Intermediate	0-2%	20%	40%	100%	67%
	Health Facility	--	--	--	--	100%

Warehouse is adequate to receive goods

This indicator measures whether or not the capacity of the warehouse is adequate to store the maximum volume of commodities to be stored. At all levels, warehouse capacity was adequate.

Indicator 4: Warehouse capacity is adequate	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
4.1 Is warehouse capacity at least 110% of the maximum volume to be stored?	Central	35%	--	--	65%	Y
	Intermediate	0-24%	70%	87%	100%	100%
	Health Facility	0-57%	89%	98%	100%	100%

Transport is adequate to deliver goods

This indicator measures whether or not transport capacity is adequate for the maximum volume of commodities to be transported between levels. At the central level, transport was adequate.

Indicator 5: Transport capacity is adequate	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
5.1 Is transport storage capacity at least 110% of the maximum volume to be transported?	Central	57%	--	--	43%	Y

Managing and Monitoring

Quantity of goods is sufficient (no stock outs)

This indicator measures two aspects of stock sufficiency combined—whether stock was available on hand during the review period and whether or not the facility was able to fill all orders for lower level facilities. As the health facility does not serve any lower levels, it is measured on stock availability only. An item is considered as stocked out if an order is not able to be filled when placed. All NTD drugs supplied by the facility are considered in this measure.

At all levels, Tanzania places in the top quartile when compared to benchmark supply chains.

Indicator 6: Stock levels are sufficient (no stock outs)	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
6.1 During the review period, were stock levels sufficient to supply all lower levels?	Central	0%	50%	50%	100%	100%
	Intermediate	0-28%	52%	69%	100%	75%
	Health Facility	0-29%	44%	56%	76%	75%

Records are kept up to date

This indicator measures whether stock transactions are recorded and stock balances are updated within one working day of the transaction. Results for this indicator were not available for the central level in Tanzania. At the intermediate level, half of facilities reported keeping records current by updating them within one working day of a transaction, while at the health facility level, 67 percent of facilities at this level reporting keeping records current.

Indicator 7: Stock records are kept current	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
7.1 Are all stock transactions (arrivals and issues) recorded and stock balances updated within one working day of the transaction?	Central	24%	--	--	76%	--
	Intermediate	0-59%	78%	90%	100%	50%
	Health Facility	8-43%	65%	87%	100%	67%

Inventory is accurate

This indicator measures whether results of a physical inventory count are within one percent of inventory recorded on stock records, based on counting a sample commodity. The sample size for the benchmark supply chains is thought to be one commodity per facility; however, the sample size cannot be verified. Data for the NTD supply chains include all NTD drugs managed by the program. Benchmark data were only available for the central level.

Tanzania's central level supply chain performance aligns with the vast majority of the benchmark supply chains in that physical inventory is *not* accurate when compared to records for the commodities assessed.

Indicator 8: Inventory is accurate	SC Level	Benchmark Results				Tanzania Results
		4 th /No	3 rd	2 nd	1 st /Yes	
8.1 Was physical inventory count found to be +/- 1% of inventory on stock records? [Y/N]	Central	0-89%	--	--	11%	N
	Intermediate	--	--	--	--	--
	Health Facility	--	--	--	--	--

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