



SUMMARY REPORT

Improved Supply Chains for Neglected Tropical Disease Drugs
(JSI SC-NTD)

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Organization of the report

4

Executive summary

10

Methodology

12

What are the drivers of NTD supply chain design?

15

What are the common characteristics of NTD supply chains?

22

What are the challenges for NTD supply chains?

38

What can segmentation, benchmarking, and supply-chain strengthening for other programs tell us about NTD supply chains?

42

First- and last-mile supply chain agreements and future assessment mechanisms

46

What are the four key strategies for improving NTD supply chains?

58

Additional documents, tools, and references

Purpose

Improve supply chains for neglected tropical disease (NTD) drugs to help meet the London Declaration 2020 goal to “Sustain, expand and extend programmes that ensure the necessary supply of drugs and other interventions to help eradicate... and control” specific NTDs.

(London Declaration, 2012).

Focus

Identify key challenges to achieving full supply of NTD drugs in communities at the time of mass drug administrations (MDAs); recommend strategies to mitigate these challenges; and align last-mile strategies with the goals and progress of the upstream first-mile partners involved in NTD drug supply.

Acronym List :

| | |
|--------|--|
| BMGF | Bill & Melinda Gates Foundation |
| CMS | Central medical stores |
| CMS/T | Central medical stores/Trust |
| CDD | Community drug distributor |
| DHMT | District health medical team |
| DNTDC | District NTD Coordinators |
| EVM | Effective Vaccine Management |
| EPI | Expanded Program on Immunization |
| FIFO | First in first out |
| FLHW | Frontline health worker |
| JSI | John Snow, Inc. |
| JAP | Joint Application Process |
| LMIS | Logistics management information system |
| LF | Lymphatic filariasis |
| MDA | Mass drug administration |
| MSD | Medical Stores Department |
| MOH | Ministry of Health |
| M&E | Monitoring & evaluation |
| NTD | Neglected Tropical Disease |
| NTDCP | Neglected Tropical Disease Control Program |
| NGO | Non-governmental organization |
| NTDSCF | NTD Supply Chain Forum |
| OR | Operations research |
| POS | Pediatric oral suspension |
| PBI | Performance-based incentive |
| PCT | Preventive chemotherapy |
| RTAC | Regional technical assistance center |
| STH | Soil-transmitted helminth |
| SOP | Standard operating procedure |
| SC | Supply chain |
| SC-NTD | Supply Chains for NTD Drugs Project (JSI) |
| USAID | United States Agency for International Development |
| WHO | World Health Organization |



Executive Summary

Few public health initiatives have developed with more attention to the “first mile” of the supply chain than integrated NTD control. However, the “last mile” of that supply chain (drug distribution within country programs) remains relatively neglected as donors and partners have focused on expanding the supply available to country programs.

Improving last-mile supply chains for NTD drugs

There are two main schools of thought on in-country supply chains for NTD drugs:

First, that last-mile supply chains for NTD drugs are adequate and the responsibility of Ministries of Health (MOH), and that external initiatives to bolster supply chain effectiveness risk undermining the success of current arrangements and ownership by national programs

The alternative view is that in-country supply chains for NTD drugs are constrained by fragmentation, resulting in multiple and often ad hoc supply chains that do not utilize well-defined standard operating procedures (SOPs) resulting in duplication and a risk of performance failure.

Our research indicates that while flexible supply chain solutions used by NTD control programs have, in many cases, been notably effective in ensuring full supply at the community level during campaigns, these ad hoc supply chains require strengthening to ensure that coverage targets can be met each year. This research reinforces previously identified findings regarding challenges in human and physical capacities, motivation, supply chain design, and health system funding that compromise drug availability.

These constraints are magnified because NTD supply chain requirements are nuanced and do not always match well with existing public health supply chain capabilities and processes designed for routine supply programs.

Primary challenges to NTD drug supply & management

A full supply of NTD drugs is critical to realizing control and elimination goals. Primary risks that threaten full supply and cost-effective management are as follows:

Limited capacity of MOH pharmacists regarding management and tracking of campaign drugs

Resource constraints limit volunteer motivation and performance

Temporary (ad hoc) supply chain solutions subject to change and disruption

Funding constraints limit implementation of supply chain strengthening efforts

Use of multiple (duplicative) supply chains for only 4-6 NTD drugs

Limited access to supply chain expertise inhibits effective planning and execution

Lack of clear and operational “open container” policies increases wastage

Incomplete and inaccurate drug supply data

Strategy:

An eight-point call to action for improving NTD drug last-mile supply chains

JSI's Improved Supply Chains for Neglected Tropical Disease Drugs (SC-NTD) project has developed following strategy to address these challenges:

Strengthen Capacity:

1 Build human capacity in supply chain management at the community level

Create concise, community-level training and reference materials for frontline health workers (FLHWs) and community drug distributors (CDDs) that include key supply chain messages, and incorporate them into the national NTD control programs training system.

2 Strengthen planning and management of NTD drugs for district health management teams

Develop guidelines and reference materials for district NTD program coordinators, pharmacists, and health management teams on NTD drug management and on planning and budgeting for the delivery of drugs for mass drug administrations (MDAs) and the collection of unused drugs following MDAs.

3 Strengthen NTD program district-to-central-level accountability

Develop tools and guidelines to help NTD programs develop plans and budgets for direct post-MDA meetings between central and district NTD coordinators and central to district-level assessment of district performance. Visibility into district level performance is critical for MDA success.

4 Develop regional providers of supply chain capacity

Develop regional (e.g., West Africa, East Africa) campaign supply chain expertise resource centers to help national and district NTD coordinators assess needs and develop plans and budgets for better coordinated, more reliable, and more sustainable supply chains. Regional experts should support NTD programs to identify, cost, and plan for private and/or NGO alternatives to MOH supply chains when government systems are not a reliable or cost-effective option for ensuring drug availability.

5 Strengthen coordination of NTD drug shipments and MDAs

Develop tools and advocacy materials to help NTD programs better coordinate international shipments of drugs and implementation of MDAs to reduce the number of parallel supply chains.

An eight-point call to action

Identify New Approaches:

6 Improve performance motivation at the community and health facility levels

Conduct operations research (OR) to determine cost-effective strategies for improving reporting and return of unused NTD drugs. Strategies to be tested include: 1) “second-tier stipend” for CDDs returning their registers, completed reports, and unused drugs on time; and 2) performance-based incentives (PBI) (e.g., cellular air time credits or “mobile banking” transfers) to reward reporting and return of unused drugs.

7 Improve data visibility and utility

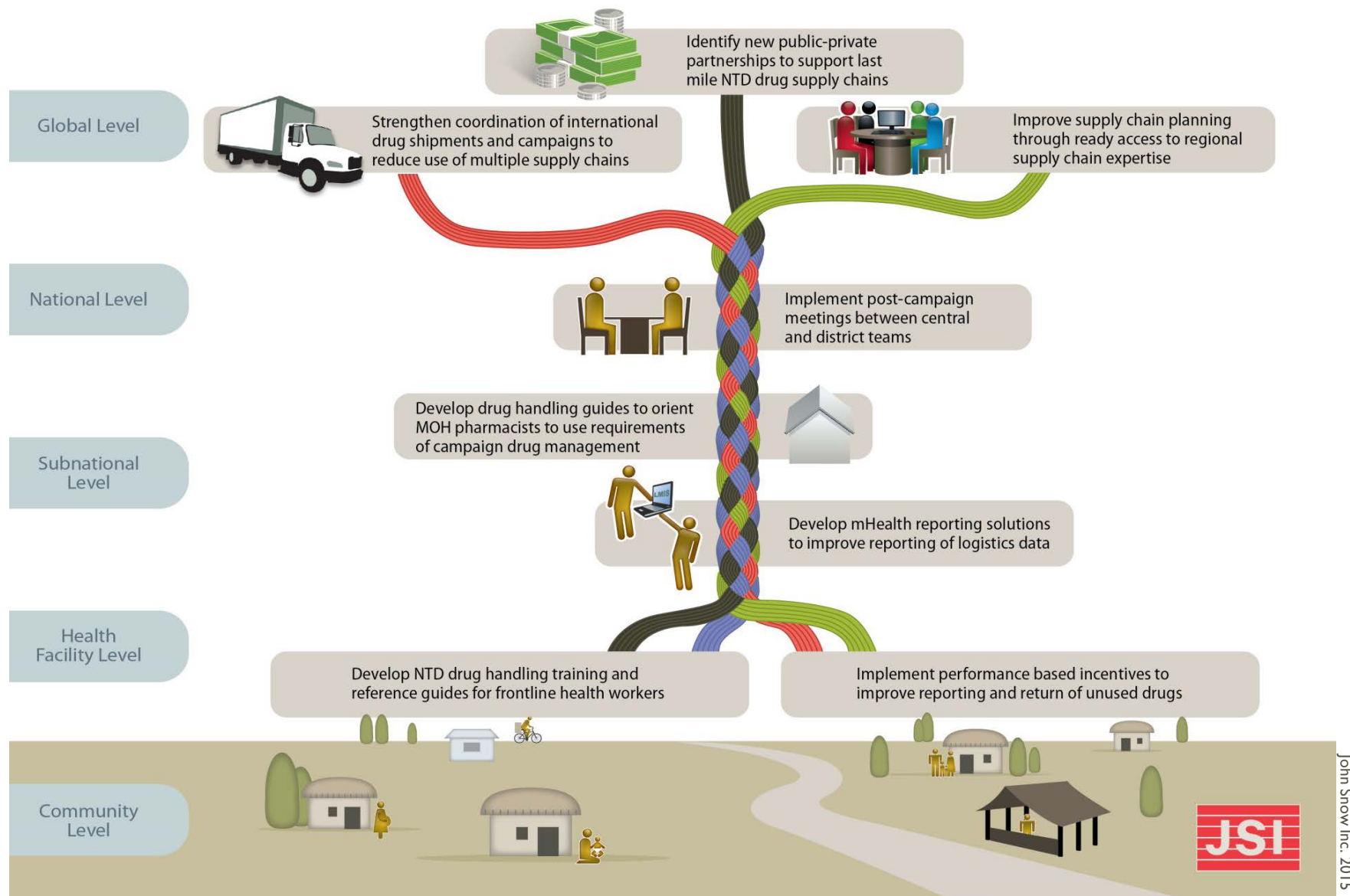
Conduct OR on the most robust and cost-effective mobile health (mHealth) solutions to improve drug distribution reporting. Areas for study include: 1) technology platform (e.g., type of phones and messaging); 2) level in the system to target (e.g., CDD versus health facility); and 3) level of data (e.g., the full report versus LMIS data or drug balances only).

Leverage New Resources:

8 Develop new public-private partnerships to support last-mile NTD supply chains

The current partnership with donating pharmaceutical corporations and the leadership of the NTD CEO Forum, one of the largest and most successful partnerships in international public health, has resulted in the donation of billions of preventive chemotherapy drug treatments for the control and elimination of NTDs. A complementary effort and partnership would improve the management of the drugs once they arrive in countries. BMGF could engage the major telecoms companies—which are among the most successful and fastest growing businesses in Africa—to support the last mile of NTD drug supply chains. With their partnership, NTDCP staff and volunteers could get free or subsidized cell phone minutes, which would improve capacity, reporting, and motivation for NTD MDAs.

— Key strategies for strengthening NTD supply chains —



Methodology

“These challenges for NTD (last-mile) supply chains so far are anecdotal. Little has been done to independently and systematically document the most critical and most frequent supply chain failures.”

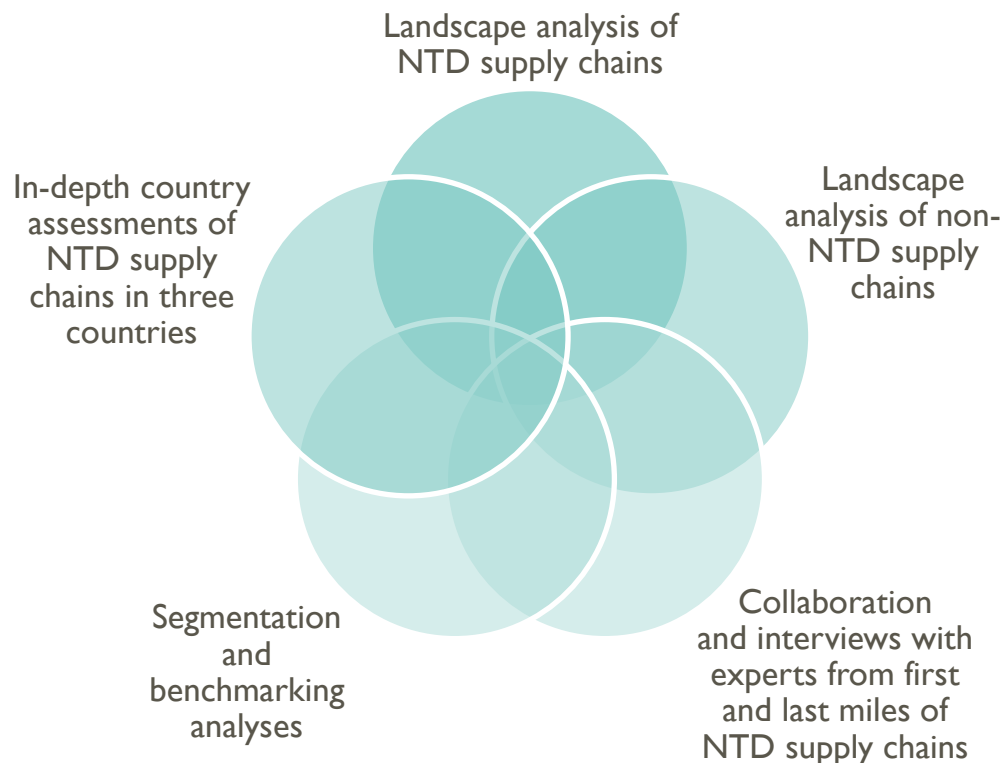
- Bill & Melinda Gates Foundation

Methodology

Our findings and recommendations derive from the interrelated activities and outputs presented on the right. This document synthesizes information from a literature review that includes research reported in peer-reviewed journals, implementation experience included in partner reports, donor-commissioned reports, and other grey literature, as well as information collected from key informants based on their experience with NTD control programs (NTDCPs) and last-mile supply chains.

Further, we conducted segmentation and benchmarking analyses and an in-depth landscape review of last-mile supply chains to augment key findings and recommendations.

Finally, in-depth NTD last-mile supply chain assessments were conducted in three focal countries: **Ghana, Malawi, and Tanzania.**



What are the drivers of NTD supply chain design?

“The regular distribution of single-dose chemotherapy drugs to an entire at-risk population is founded on the idea that successive, adequate coverage of MDAs will reduce the prevalence of infection that can lead in some cases to elimination. This means that achieving and maintaining adequate drug coverage during MDAs, is paramount to the success of NTD control and elimination programs.”

(Worrell and Mathieu 2012)

Determinants of last-mile supply chain design

Supply chain structures are shaped by many factors, including the determinants noted below:

NTD drugs in the “last step” of the last mile are distributed by unpaid CDDs.

NTD campaign supply chains must be highly effective only for the number of years it takes to achieve elimination or control goals of MDA. When the goals are achieved, campaign supply chains end.

Districts are responsible for receiving and distributing NTD drugs at the time of cascade training. This inhibits “direct to health facility distribution” by central medical stores (CMS).

FLHWs and volunteers must learn all aspects of MDA implementation in annual trainings of one day or less. There is little time to emphasize drug management.

The NTDCPs have the responsibility for and ownership of in-country processes for managing NTD drug donations. There has been relatively little external investment in last mile supply chains.

A single report integrates service (client) and logistics (commodities) data. Service (i.e. coverage) data drive NTD M&E. LMIS data are a lesser priority.

Country context impacts NTD supply chain design

There are many country-specific factors that impact the complexity and success of last-mile NTD supply chains. The logistical complexity of ensuring drug supply for the Democratic Republic of the Congo, for example, is on a different scale than for a smaller country with more and higher quality roads and telecommunications. Some of the most salient considerations which result in the wide variety of NTDCP country supply chains include:

- Population and country size
- Geographic pattern of NTD endemicity and prevalence
- Degree of campaign and disease integration
- Level and type of implementing partner support
- NTDCP maturity
- Capacity and quality of MOH supply chain
- Whether NTDCP is required to pay handling fees for usage of MOH/CMS supply chain

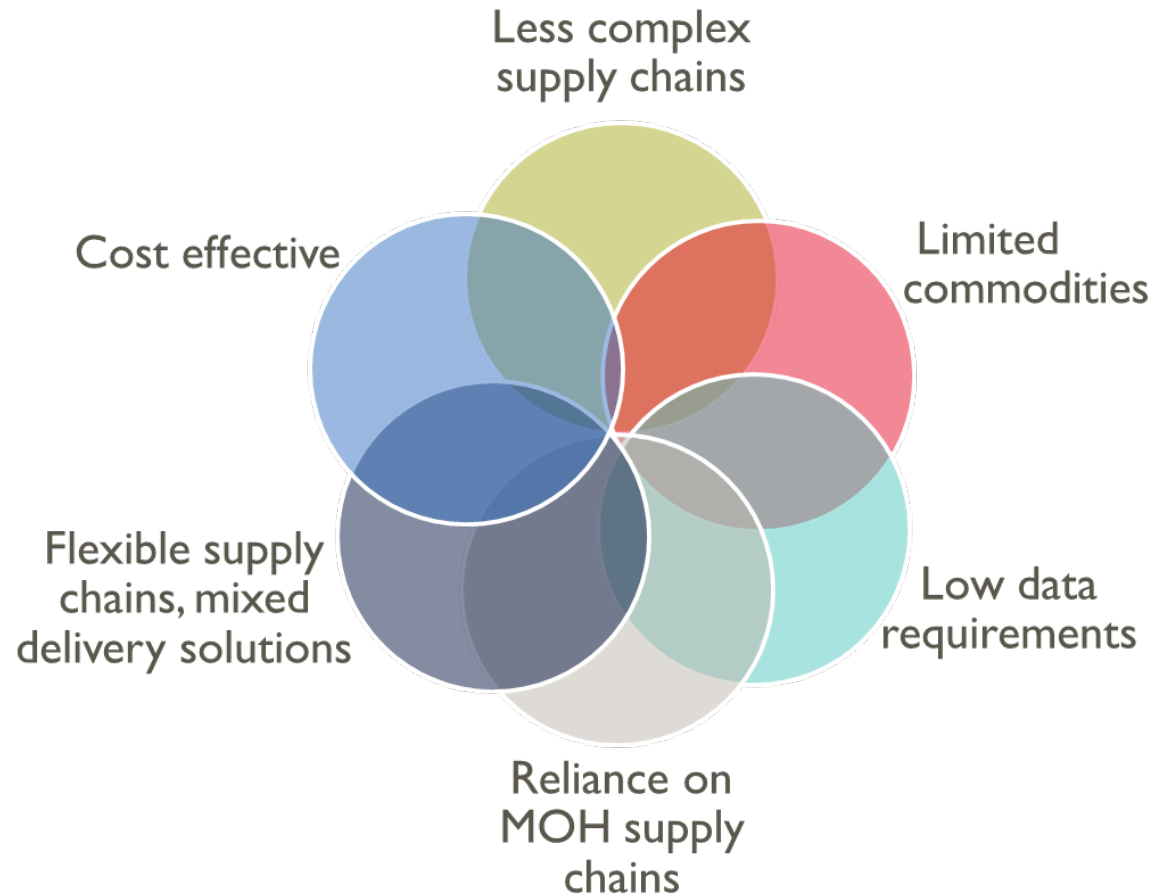


What are the common characteristics of NTD supply chains?

There is no singular last-mile approach for in-country NTD supply chains because every program context is different. Yet there are commonalities in how these supply chains function and the challenges they face.

Common characteristics of NTD supply chains

NTD supply chains across countries share common themes and characteristics. The following elements are essential to understanding NTD last mile supply chains:



NTDCP supply chains are less complex

Compared to the distribution of essential medicines, NTD programs operate less complex supply chains.

MOH essential drugs supply chains distribute hundreds of essential medicines and commodities monthly, while NTD programs roll out four to six PCT drugs in annual campaigns. Quantification of essential medicines relies on monthly consumption data, NTD drug quantifications depend on population data updated by the MOH and requiring less program effort.

These three facets of NTD supply chains lower the resource and management requirements for ensuring drug supply:

| Characteristic | NTD Drugs Supply Chain | Essential Drugs Supply Chain |
|-----------------------|----------------------------------|---|
| Number of commodities | Less than ten | Hundreds |
| Frequency of delivery | Once per year | Once per month |
| Data requirements | Population data updated annually | Consumption and client data updated monthly |

Flexible supply chains and mixed delivery systems

Globally, NTD control programs fall along a spectrum of integration with existing MOH/CMS supply chain distribution systems. NTDCPs utilize MOH/CMS capacities where they can, and alternatives to those capacity where they must.

In Malawi (2014), the NTDCP negotiated with the MOH/CMS to store the drugs at the central level without incurring the 6% handling fee charged by CMS. The NTDCP also negotiated an agreement with the Expanded Program on Vaccination (EPI) program to transport NTD drugs to zones and districts for which the NTDCP pays only fuel and per diems

(SC-NTD Project 2014).

In Mali (2011), the NTDCP bypassed the public-sector Peoples Pharmacy of Mali and utilized a dedicated warehouse funded by USAID and commercial transporters for distribution to districts

(Strengthening Pharmaceutical Systems Project 2011).

These flexible supply chain solutions may be negotiated on a year-by-year basis. The fluidity of the arrangements is driven by the capacities, constraints, opportunities, and personal relationships on the ground during the MDA planning phase. With the support of implementing partners, for many programs these ad-hoc arrangements have been notably successful in ensuring availability of drugs at the time of the campaigns. For example, Malawi's community-based MDA coverage was well above 80% in 2013, despite the program's lack of CMS control and minimal access to its capacities.

NTD supply chains are cost-effective



Ghana Health Service delivery vehicle

Photo Source: JSl, July 17, 2013. Tema, Ghana.

NTD supply chains are highly cost-effective for the programs and implementing partners that support them.

Where possible, NTD programs rely on the physical and managerial capacities of MOH supply chains at both central and district levels. MOH transport and storage capacities have typically benefitted from external (donor) support for public health programs, but less direct financial support from the NTD community.

The “last steps” in NTD drug supply chains are taken by the volunteer CDDs who carry the drugs from the health facilities to the communities. The volunteers receive small stipends for their participation in the campaigns and there are no additional costs for their role in transporting drugs to the communities or storage fees once they arrive.

NTDCPs rarely fund dedicated supply chain managers.

The Malawi NTDCP 2013 supply chain budget for managing nearly \$60,000,000 worth of ivermectin and albendazole for the community-based MDA was less than \$100,000.

Limited LMIS data requirements

NTDCPs rely on a minimal set of drug supply indicators that are collected and reported with service delivery data. There is no stand-alone logistics management information system (LMIS) to collect and monitor commodities data.

Country programs vary on the exact formats used, but in general employ registers and/or tally sheets for recording LMIS data at the community level and report the aggregated data on standard summary reports that flow from the communities to the intermediate levels and ultimately to the national level. A feature of NTDCP reporting is that the national level receives data all the way down to the community level, allowing for visibility into and decision making regarding performance at every level.

LMIS data drive few drug management decisions.

Examples of recording and reporting in the field:

Left: Ghana Summary Report

Right: Malawi Tally Sheet

NEGLECTED TROPICAL DISEASES CONTROL
MDA/ CDTI REPORTING FORM

REGION... CENTRAL DISTRICT* ABURA ASEBU KWAMANKESE
TRAINING DATES (PERIOD): 24th June 2014

| NO | Name of sub-district | Population by Gender | | Total population | Treatment by Gender | | Total Number treated | Total pop. Coverage | Albendazole | | |
|----|----------------------|----------------------|-------|------------------|---------------------|-------|----------------------|---------------------|-------------|-------|---------|
| | | M | F | | M | F | | | Received | Used | Balance |
| 1 | ABAKRAMPA | 5912 | 6380 | 12292 | 4988 | 5974 | 10962 | 89.2 | 13200 | 11192 | 2008 |
| 2 | ABURA DUNKWA | 12490 | 15952 | 28442 | 10242 | 13055 | 23297 | 81.9 | 28800 | 23384 | 5416 |
| 3 | ASUANSI | 5324 | 5613 | 10937 | 4630 | 4988 | 9618 | 87.9 | 12200 | 9885 | 2315 |
| 4 | MOREE | 11687 | 14362 | 26049 | 9878 | 12199 | 22077 | 84.8 | 24400 | 22077 | 2323 |
| 6 | TOTAL(DISTRICT) | 35413 | 42307 | 77720 | 29738 | 36216 | 65954 | 84.9 | 78600 | 66538 | 12239 |

| | |
|--|-----|
| Total no. of communities (c) | 133 |
| Total no. of communities treated (t) | 133 |
| Geographic coverage (t/c x 100) | 100 |

| | | | | | |
|---------------------------------|-----|---------|-----|----------|-----|
| No. of health workers trained : | 30 | Males : | 8 | Females: | 22 |
| No. of CDDs trained : | 226 | Males : | 126 | Females: | 100 |

NB: In calculating No. of health workers trained for the region, add the nos. trained at the regional level to those trained in the districts

DISTRICT TARGET=105925
POPULATION TREATED= 65954
POPULATION COVERAGE=62.2%

MINISTRY OF HEALTH MALAWI

Tally sheet for recording preventive chemotherapy treatments at drug distribution points

Drugs distributed (tick): ☐ Praziquantel ☐ Albendazole/Mebendazole ☒ Ivermectin ☐ DEC ☐ Azithromycin

Zone: Southern District: Chitipa Health unit: Chitipa Village: T.C. Chitipa

| GENDER | Number of persons treated | | | | | | | | | | | |
|--------------------------------|---------------------------|-------|------------|-------|-------------|-------|------------|-------|-------|-------|-------|-------|
| | Male | | | | Female | | | | | | | |
| | 0-4 years | | 5-14 years | | 0-4 years | | 5-14 years | | | | | |
| AGE-GROUP | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 0-4 years | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 |
| 5-14 years | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 |
| ≥15 years | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 | 00000 |
| TOTAL treated, by age-group | 16 | 21 | 29 | 8 | 7 | 34 | | | | | | |
| TOTAL treated, by gender | 63 | | | | 115 | | | | | | | |
| TOTAL TREATED: Males + Females | 178 | | | | | | | | | | | |
| Drugs | Received | | | | Distributed | | | | Lost | | | |
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NTD quantifications involve minimal LMIS data requirements

Unlike routine delivery public health programs that issue supplies to lower levels based on monthly consumption patterns, NTDCPs rely minimally on logistics data. The key decision regarding what quantity of each drug to issue to lower levels is driven by population data. The quantification calculations are less (LMIS) data dependent as demonstrated below.

$$\text{Total population} \times 80\% \times 1.1 \text{ Tablets} - \text{Balance} = \text{Quantity of Albendazole required}$$

As drug balance data is often incomplete and inaccurate NTDCP coordinators are often required to estimate drug balances.



What are the challenges for NTD supply chains?

NTD campaigns in many countries fail to achieve target coverage rates and in some instances annual campaigns are significantly delayed or even missed due to drug supply constraints. In almost all countries, drugs that are issued but not used are lost due to poor reporting and lack of reverse logistics and in many national programs the supply chain solutions in use are ad hoc and unstable.

Challenges to NTD supply chains

NTD supply chains need to function at a uniformly high level in every endemic district and for each year until disease control and/or elimination is achieved. Ensuring uniform high performance across all districts and years is the challenge for NTD last-mile supply chains.

NTDCP in-country supply chains observed in comparatively successful program country contexts (Ghana, Tanzania, and Malawi) demonstrate that challenges in capacities, design, policies and resources will need to be addressed if program goals for the control and elimination of NTDs are to be achieved.



NTD last-mile supply chain challenges

National-Level Challenges

Varied reporting and drug application requirements

Insufficient lead times for ordering drugs

Poorly coordinated shipments delay MDA campaigns

Customs clearance procedures and costs

MOH pharmacists lack understanding of campaign drug supply needs

Ad hoc supply chain solutions that are subject to disruption

Use of multiple supply chains increases costs and complexity

Lack of supply chain expertise inhibits effective planning

Sub-National-Level Challenges

Resource constraints limit volunteer motivation and performance

Poor LMIS reporting limits data visibility and use for quantification

Lack of reverse logistics leads to drug wastage

Recent solutions to national level challenges

Great strides have been made in addressing these challenges since 2012. Work led by the WHO and the major pharmaceutical donors has improved coordination, timeliness and availability of NTD drugs at the national level.

The key innovations underway to improve NTD drug availability in the last mile include:

Coordination of NTD reporting, application, and shipment scheduling: The global adoption of the WHO-led Joint Application Process (JAP) has led to standardized processes, tools, and timelines for reporting (Joint Reporting Form) on the use of NTD drugs in the past year, and the request for NTD drugs (Joint Request for Selected PC Medicines) for the coming year.

Increasing standardization of freight forwarders: Under the leadership of the NTD Supply Chain Forum (NTDSCF) more of the pharmaceutical donors are using a single freight forwarder and a “control tower” to centralize management and visibility in tracking orders and shipments, leading to improved timeliness and coordination of shipments.

“Door-to-door” delivery: The major pharmaceutical donors are increasingly using direct delivery to the MOH-designated central warehouses alleviating identified bottlenecks at customs clearance and delivery from port to the central warehouse.

Photo Source: J. Si. May, 15, 2013. Dar es Salaam, Tanzania.



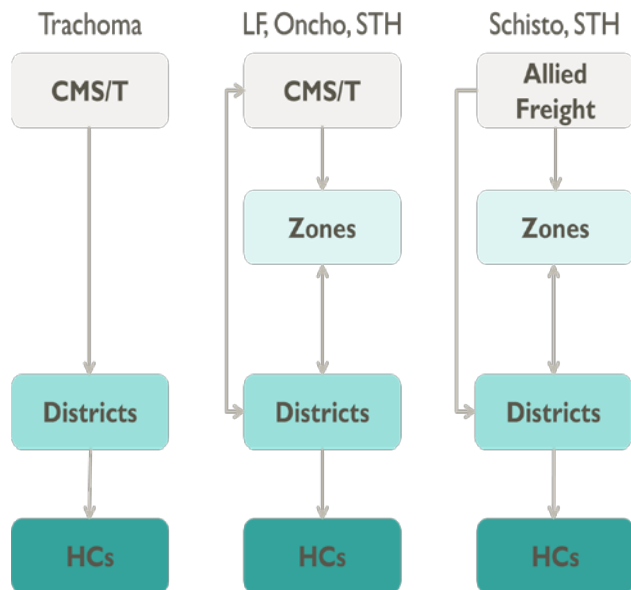
Tanzania Medical Stores Department central warehousing facility

Remaining challenges to last-mile supply chains



Photo Source: JSI, April 9, 2013. Mangochi, Malawi.

Reliance on multiple supply chains



Malawi NTD supply chains

As noted in the February 2012 WHO supply chain survey of selected NTD medicines, “**the challenge in analyzing the NTD supply chain is that it is comprised of multiple and distinct supply chains. The supply chains are largely based on the disease program and/or the individual medicines.**”

(WHO 2012).

Most often supply chain solutions are identified and implemented on a campaign-by-campaign basis resulting in:

One supply chain for school aged PCT drug campaigns,
a second for community-based campaigns,
and a third for distribution of Zithromax for trachoma campaigns.

The minimum number of NTD supply chains observed in the three study countries (Malawi, Tanzania, and Ghana) is three.

Managing the annual distribution of four to six drugs should be a relatively easy supply chain challenge. However, it is complicated by a general lack of coordination and co-implementation between the disease control programs.

Using multiple supply chains for so few drugs adds to the complexity and costs of NTD drug distribution for resource-constrained NTD control programs.

Drug wastage

Reports regarding last-mile supply chains for NTD drugs uniformly highlight the difficulties for NTDCPs in understanding where drugs remain in balance following campaigns, and ensuring that those drugs are returned to higher levels to be used in future campaigns.

Factors contributing to wastage:

Drug balances, unlike service data, can not be aggregated from the tally sheets and registers. Lightly trained and heavily burdened volunteers must conduct physical inventories, requiring counting of each pill left in their open bottles, to establish remaining balances. Staff charged with storing the drugs at higher levels need to add physical balances from their own facility to the reported balances from the level below them to accurately report balances. These two steps are rarely followed and the balance data is rarely accurate. Balances are routinely under-reported leading to lack of collection and reprogramming for future campaigns.

Where accurate information on balances is not a problem, the capacity for returning or retrieving the drugs usually is. Districts do not receive operating costs from the NTDCPs required to collect drugs from each health facility following the campaigns. Lower level staff are not compensated for travel costs to return unused drugs to the level above them.

Volunteers and FLHWs either did not know the “open container policy” for the NTD drugs, or did not know how to operationalize the policy. Anecdotal evidence is that once opened, few tablets were ever returned or re-programmed, but that the bottles were valued as pest- and water- proof storage containers for salt and sugar.



Photo Source: JSI, April 9, 2013, Blantyre, Malawi.

Expired goods store, Malawi

Motivation and performance



Photo Source: JSl. May 24, 2013. Tanga, Tanzania.

Community drug distributors, Tanzania

The last steps in the NTD supply chain are taken by volunteer CDDs and school health teachers. The programs rely on them to record each tablet swallowed, as well as the quantity they received, lost, and held in balance following the MDA. Further, these unsalaried workers are tasked with returning completed records and unused drugs to the health facilities following campaigns.

Supply chain activities are only a component of volunteers' responsibilities for the campaigns. Their main focus is the door-to-door distribution of the drugs and ensuring that all eligible members of each household are identified, and provided with the PCT drugs.

To carry out the work volunteers receive a day or less of training each year and a small stipend set by the program. These stipends are not adjusted annually to keep pace with inflation and in some instances (e.g., Ghana) stipends have lost much of their value in the face of rapid inflation. The declining value of stipends had the following consequences in the focal countries:

Performance of the volunteers declined as the ratio of first year CDDs to experienced CDDs increased.

In particular, second tier priorities like LMIS reporting and return of unused drugs suffered.

In Ghana and Tanzania sub-district reports reflected communities in which a campaign did not take place because the village had not been able to identify anyone willing to serve as the CDD.

Burden of reporting: LMIS data

Community level

Service and LMIS data are recorded for each person seen by the volunteers and school health teachers in campaign-specific registers. In the three study countries volunteers and teachers served and recorded data for, on average, 300 persons requiring approximately 25 pages of the register book. Register pages are meant to be summarized with a page total and all the page totals are to be aggregated for a campaign summary report to be submitted to the health facilities following MDA.

This level of data recording and aggregation is a burden on the lightly trained volunteers. They frequently do not complete the page totals or the summary reports following MDA. Moreover, they did not conduct physical inventories required to accurately report drugs remaining in balance.



Burden of reporting: LMIS data

Health facility level

FLHWs receiving non-aggregated registers and/or reports from CDDs are hard pressed to compile and submit timely, complete, and accurate summary reports following campaigns. FLHWs in health centers responsible for NTD campaigns in 50 villages often receive registers lacking page totals much less register totals or summary reports. To complete their own summary report, by hand they need to add values for up to twenty indicators across more than 1,200 register pages.

LMIS reporting suffers most as it does not draw the same level of scrutiny as the coverage data which drives NTDCPs. The LMIS data, including balance on hand data, were observed to be inaccurate. The consequences of the burden of reporting on FLHWS include the following:

Inaccurate LMIS data – particularly receipts, losses and balances – from the CDDs

Lack of inventory records and physical inventories for NTD drugs at the health facility store room

Failure to include drug balances in their own stores with the balances reported from the CDDs

Photo Source: JSI, July 28, 2013, Ghana.

| NEGLECTED TROPICAL DISEASES CONTROL PROGRAMME | | | | | | | | | | | | | | |
|---|-------------------|--------------------------------|-----|------------------|---------------------|-----|----------------------|---------------------|------------|------|---------|------------|------|---------|
| MDA/CDTI REPORTING FORMAT | | | | | | | | | | | | | | |
| REG CENTRAL | | DISTRICT ABURAASEBU KWAMANKESE | | | | | | | | | | | | |
| TRAINING DATES (PERIOD)..... | | 26th June 2014 | | | | | | | | | | | | |
| NO. | Name of community | Population by Gender | | Total population | Treatment by Gender | | Total Number treated | Total pop. Coverage | Albedazole | | | Ivermectin | | |
| | | M | F | | M | F | | | Received | Used | Balance | Received | Used | Balance |
| 1 | NEW SITE | 340 | 390 | 730 | 300 | 346 | 646 | 88.5 | 800 | 646 | 154 | 2500 | 2102 | 318 |
| 2 | TESTI | 270 | 250 | 520 | 250 | 250 | 500 | 96.2 | 600 | 500 | 100 | 2000 | 1860 | 140 |
| 3 | TSETSEKASUM | 53 | 57 | 110 | 51 | 44 | 95 | 86.4 | 200 | 95 | 105 | 500 | 302 | 198 |
| 4 | ABURAASEBU | 60 | 27 | 87 | 25 | 14 | 39 | 68.8 | 200 | 100 | 100 | 500 | 300 | 200 |

Sub-district summary report, Ghana

District level

[illegible]

District report, Tanzania

Summary reports are typically computerized at the district level. District NTD Coordinators (DNTDCs) are responsible for transferring the data from roughly 20 sub-district reports – each with up to 20 indicators – for approximately 50 villages – to a single excel spreadsheet summary report. This requires the DNTDC to accurately transfer over 10,000 data points to the spreadsheet report.

Cross checks of reported balances against physical counts of NTD drugs demonstrated that the LMIS data is inaccurate even when it is timely and complete. The district reports are the cornerstone of the programs' M&E and are used by NTDCPs to complete the national level (WHO) reporting and drug application requirements. Reasons for the inaccuracy of LMIS data include the following:

Inaccurate CDD data summarized in the health facility reports, not checked for accuracy

Lack of inventory records and physical inventories for NTD drugs at the district store

Failure to include drug balances in their own stores with the balances reported from the health facilities

The burden of reporting coupled with the primacy of coverage data and the lack of decision making based on LMIS data

Lack of SOPs and guidelines for NTD campaign drug requirements

NTD programs typically rely on MOH CMS and district capacity, to manage and distribute NTD drugs. However, the management of NTD drugs by MOH pharmacists is often compromised by their lack of understanding of campaign commodities' requirements.

FLHW and CDD drug management is similarly compromised by lack of SOPs and training materials.

Pharmacists oriented to monthly receipt and distribution of health commodities based on client usage data do not necessarily understand how to manage the NTD drugs that arrive annually in a single tranche.

In district and sub-district storage facilities, standard MOH logistics procedures are less frequently used for the campaign drugs. The NTD drugs arriving in a single tranche are seen as a burden to be managed by “pushing” the supplies to the next level as quickly as possible. MOH facilities, even at regional and zonal levels, often do not use pallets, stock cards, or requisition and issue vouchers for the NTD drugs.

The NTDCPs do not provide guidelines to MOH pharmacists in managing NTD drugs. At health facilities and in communities, workers are even more constrained by lack of training materials and guidelines regarding how to manage, store, distribute, report, and conduct reverse logistics for the NTD drugs.

The lack of SOPs and guidelines are reflected in the poor management and tracking of the drugs at most levels below CMS.

Lack of ready access to supply chain expertise

With so few drugs to distribute in annual campaigns, hiring dedicated supply chain managers for NTDCPs has not been a priority. National NTDCPs, with support from in-country partners, take the lead in identifying and implementing supply chain solutions to managing the distribution of the NTD supplies. The coordinators do not generally have the logistics management expertise to assess their needs and challenges and to weigh the benefits and risks of different supply chain options. While many of the ad hoc solutions being used by country programs have been successful in ensuring full supply of drugs at the time of the campaigns, others have not.

Consequences of this approach to supply chain design and management are as follows:

Costs: NTDCPs rely on multiple storage, transport, and management mechanisms rather than a single supply chain solution, thus increasing costs

Complexity: Multiple ad hoc supply chains, rather than more integrated and stable solutions, increase the complexity of management. Many of the agreements and arrangements for storage, transport, handling fees, and operating costs need to be “updated” or replaced annually.

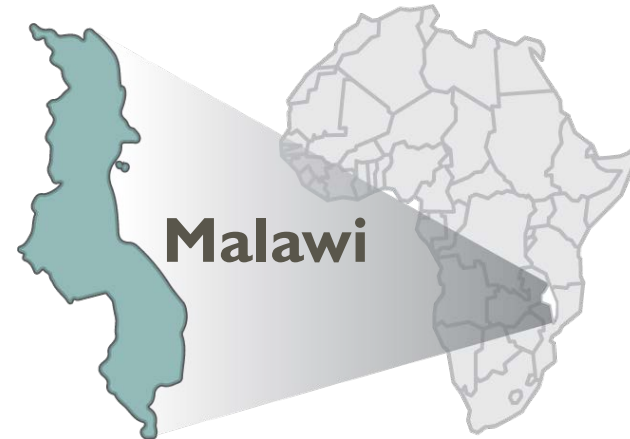
Multiple, ad hoc supply chain solutions present complexity and risk, particularly given the dearth of NTD logistics officers



Supply transport, Ghana

Photo Source: JSL July 22, 2013. Tamale, Ghana.

Supply chain challenges: Examples from three countries



Minimal use of inventory records for NTD drugs compromises visibility of drug supply data.

Heavy burden of reporting for FLHWs and minimal use of LMIS data for decision making results in low LMIS reporting rates.

Three distinct supply chains are used for only five NTD drugs, multiplying the cost and complexity of drug distribution.

The current “gentleman’s agreement” between the Central Medical Store (CMS/T) and the National NTD Coordinator allowing for storage without payment of the standard (6%) handling fee is subject to renegotiation and disruption on a year by year basis.

Like child health days and other MOH health campaigns, NTDCP relies on over-stretched district storage and transport capacities. Unlike the other campaign programs, NTDCP does not provide DHMTs funding for operating costs.

Supply chain challenges: Examples from three countries



Low motivation and high attrition of CDDs compromise performance and reporting at the community level.

The burden of reporting at the lowest levels compromises the completeness and accuracy of LMIS reporting.

Different disease emphases of the lead implementing partners in different regions has led to use of different data collection and reporting tools which challenges central level understanding of performance across regions.

The NTDCP relies on the Medical Stores Department (MSD) for storage and distribution to districts. MSD is a parastatal with the MOH as its only client and the MOH is in arrears of more than \$60 million as of May 2014. In-country supply chain experts predict that MSD will not be able to function for more than 12-18 months without an injection of capital.

Inaccurate quantification of drug needs by NTD managers at district and sub-district levels results in local supply imbalances.

Supply chain challenges: Examples from three countries




Difficulty attracting and retaining CDDs. Annual attrition of CDDs as high as 70% in urban districts visited compromises performance and coverage.

In districts visited in July 2014, the most recent MDA coverage was below 70%. Sub-district records highlighted communities with no distribution. These were explained as places where the community leadership was not able to identify volunteers to serve as CDDs.

Poor reporting of LMIS data, particularly drug balances, and poor quantification skills at the lower levels causes uneven distribution leading to stock-outs and lower coverage in some areas, with overstock and drug wastage in others.

The MOH/CMS responsible for management and distribution of NTD drugs was destroyed in a fire in January 2015.

Lack of SOPs, guidelines, or training materials for managing NTD drugs compromises management and availability of drugs.



What can segmentation, benchmarking, and supply chain strengthening for other programs tell us about NTD supply chains?

The challenge going forward is to ensure that country programs have access to the resources required to identify and mitigate risks to continued high performance in ensuring full supply of NTD drugs.

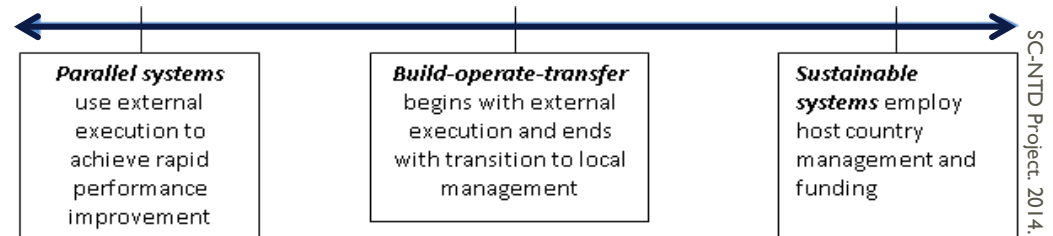
Lessons learned from non-NTD supply chains

Three decades of experience in improving public health supply chains for other disease-specific programs provides a substantial foundation regarding typical barriers to full supply and the best strategies for improving commodity availability. Lessons learned from the non-NTD experience can yield potential solutions to NTD supply chain constraints worldwide.

National NTDCPs have limited human and financial resources for drug distribution, and are not always able to rely on MOH supply chain capacity.

To address the annual distribution needs of PCT MDA campaigns MOHs and supporting partners may choose to either: 1) Strengthen public sector capacity, 2) Develop “mixed” (public and private) supply chains, or 3) Develop an external, parallel supply chain to deliver MDA drugs.

Our analysis concludes that, given the time-bound nature of the problem and the strong requirement for high performance, **parallel** or **build-operate-transfer** systems utilizing a mix of public and private capacities would make a good fit for NTD MDA supply chains in countries without robust MOH systems:



NTD supply chain design should emphasize the following attributes:

Capacity for rapid scale up

Capacity for ensuring full supply for campaigns

Cost effectiveness

Segmentation analysis

Segmentation analysis:

A commercial sector approach for determining the right mix of supply chain policies for delivery of a diverse set of products.

When applied to NTD last-mile supply chains, segmentation can help determine if it is feasible and appropriate to integrate all or part of the NTD supply chain with existing public health supply systems.

Using segmentation analysis, countries can identify other opportunities for supply chain integration, “piggy-backing”, or resource sharing, and weigh the costs and benefits of each to find a more holistic solution.

The greatest opportunities for NTD supply chains to integrate or piggy-back are with other health campaign supply programs.

In considering piggy-backing on these systems, however, it does not need to be an all-or-nothing endeavor. Opportunities for NTD programs to leverage existing capacity can occur at specific tiers and/or geographies only and can theoretically include full managerial integration or simple sharing of infrastructure. There are opportunities to integrate specific elements of NTD supply chains, and one key area for integration is distribution.

Segmentation is not a “one-and-done” proposition.

Within a specific country context, it is important to investigate other campaign distribution systems to understand the potential to support capacity gaps in the NTD supply chain.

Many NTD programs are already piggy-backing on elements of other public and private-sector supply chains.

In Malawi, the program relies on the central level warehousing from the MOH and private sector to store NTD drugs and “borrowed” EPI transport to distribute the drugs to the next level.

Benchmarking analysis

Performance benchmarking:

A commercial sector supply-chain strengthening technique that has recently been applied to public health efforts in developing countries.

Organizations 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.

To investigate whether performance benchmarking is an effective strategy for understanding and strengthening NTD supply chains, The Expanded Program on Immunization (EPI) Effective Vaccine Management (EVM) was selected for NTD supply chain benchmarking.

1st

The primary analysis focused on the benchmark (EPI) supply chains compared NTD supply chain performance to the benchmark. The three NTD country supply chains (Malawi, Tanzania, and Ghana) scored stronger than the EPI peer group for indicators such as having SOPs in place, training materials of quality, adequacy of warehouse and transport capacity, forecasting, and supply availability (no stock-outs).

2nd

The secondary analysis identified that programmatic and methodological issues provided a false picture of NTD supply chain performance. The most significant issues confounding result from EPI's reliance on dedicated (vertical) capacities while NTD supply chains require integrated approaches, as well as from the differences between routine and campaign delivery programs.

Conclusion: Until a supply chain performance database that allows for meaningful comparison to NTD supply chains is available, further investment in benchmarking is not recommended.



First- and last-mile supply chain agreements and future assessment mechanisms

Which NTD last-mile constraints are being addressed by first-mile supply chain initiatives? Can future NTD supply chain assessments be piggy-backed on existing supply chain assessment mechanisms?

NTD first-mile/ last-mile supply chain agreement

Coordination of international shipments

There is agreement between both “first-mile” and “last-mile” members of the Neglected Tropical Disease Supply Chain Forum (NTDSCF) that increased coordination of shipments of the different drugs from different donors is a key strategy to benefit in-country programs.

National NTDCPs struggle with coordination and co-implementation of NTD campaigns requiring three or more supply chains to deliver the five or six drugs being used in the different campaigns.

This requires resource constrained NTDCPs to absorb the costs for multiple storage, transport, and management mechanisms for the different campaigns.

The NTDSCF partners have made great strides in increasing coordination of drug shipments to country programs. With the exception of trachoma, the core NTD disease programs are using

the WHO Joint Application Process to report on past performance and to apply for drugs for the coming year based on past performance and coverage targets.

The donor partners are increasingly making use of a single freight forwarder using a single “control tower” for the coordination of shipments directly to the MOH central warehouse.

The **next step** should be working with NTDCPs to coordinate shipments to ensure delivery to country within a specified window (e.g., first quarter) to facilitate co-implementation of PCT MDA campaigns.



Commodity transfer point, Malawi

Photo Source: USAID/DELIVER. 2012. Usisya, Malawi

NTD first-mile/ last-mile supply chain issues for future consideration

In addition to enhanced coordination of international shipments, three key “handshake” issues that were highlighted by program managers or by members of the NTDSCF include the following:

Advanced application

Modification of the NTD drug application process to include a preliminary quantification for a second year to facilitate advanced demand and shipment planning.

Standardized reporting

Program Coordinators noted that different reporting requirements from their many donors and supporting partners required a large portion of their time. They would like to see a single standard accepted more broadly (e.g., the WHO Joint Reporting Form).

Standard/reduced number of tablets per container

NTDCP managers noted that bottles of 500 tablets or more increased the burden of reporting balances at the lowest levels, led to hygiene problems, and increased drug wastage overall. They noted bottles of 200 were more appropriate for community drug distribution.

NTD supply chain assessment

Are there opportunities for NTDCPs to piggy-back future supply chain assessments on existing supply chain assessment mechanisms for other health programs?

Some public health programs, such as the Expanded Program on Immunization (EPI), have well-resourced and long-established supply chain assessment mechanisms. These last-mile supply chain assessment tools and programs have funding “champions” in the global health community.

National NTDCPs do not have consistent access to the resources or champions required to support this aspect of MDA campaigns. NTDs are not included in the mandate of the global supply chain management support projects funded by USAID and last mile NTD supply chain support is currently without a global funding mechanism.

Preliminary discussions with existing public health, last-mile supply chain assessment programs indicate that piggy-backing NTD logistics measurement questions is unlikely for the immediate future **due to the following challenges:**

- Lack of a funding champion for this aspect of NTD MDAs
- NTDs not included in the mandate of current global public health supply chain support mechanisms
- Including a campaign supply chain requires timings and efforts that divert from the intended purpose of existing assessment exercises

Photo Source: JSI, May 20, 2013, Morogoro, Tanzania.



Supply chain assessment, Tanzania



What are the four key strategies for improving NTD supply chains?

Over the last two years NTD supply chains globally have seen substantial improvement – however, these improvements typically end at the central medical stores.

What is needed are strategies to improve what exists below this level, in the last mile.

First strategy

Capacity building: Guidelines and tools

Community level

We recommend that the Foundation and partners invest in developing a series of generic SOPs, training materials, and guidelines that can be adapted as needed to specific country contexts. The materials should build on the strengths of existing materials in terms of the number and depth of messages to include and how to present them for audiences such as CDDs.

Create concise, community-level, best-practice training and reference materials for FLHWs and CDDs to be incorporated into the cascade training system utilized across national NTDCPs.

The materials should include the key messages for drug supply chain management:

- Submitting accurate LMIS data
- Handling of drugs in bottles that have been opened
- Disposal of expired drugs
- The return of unused campaign drugs

These messages should be incorporated into the cascade training materials and into the reference booklets to be disseminated at the training. Supervisor checklists should be developed to reinforce these key procedures.

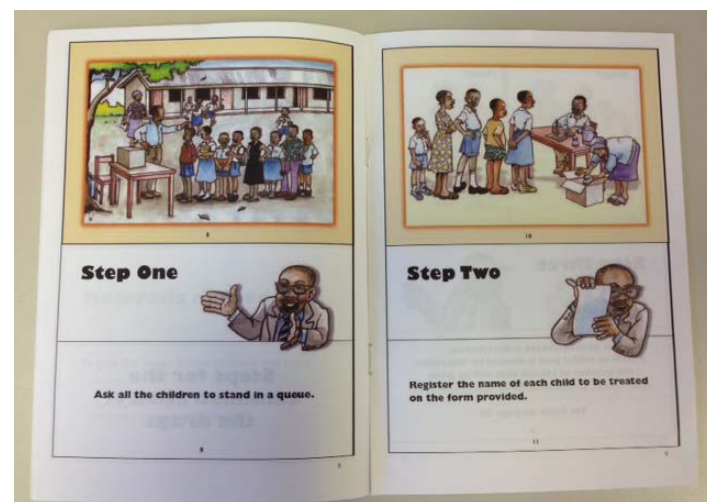


Photo Source: JSl. May 5, 2014; Malawi.

Standard operating procedures (SOPs), Malawi

First strategy

Capacity building: Guidelines and tools

National, regional, and district levels

For **NTDCP coordinators**, create best-practice SOPs, guidelines, and training materials at the national, regional and district levels that clarify the supply chain system design and their responsibilities within that system.

Develop an improved “summary report” design for reporting balances and guidance for developing clear and operational open container policies.

Strengthen NTDCP capacity to coordinate delivery of NTD drug shipments into countries with the timing requirements for the campaigns. Develop a framework and guidance for national NTDCPs to determine which MDAs can be co-implemented to reduce cost of distribution of NTD drugs. Help NTDCPs align the timing of MDAs with international shipments of the NTD drugs.

For **MOH pharmacists**, develop SOPs and guidelines for MOH pharmacists in countries where the NTDCP drugs are integrated into the MOH supply chain. Currently, there is a lack of understanding and orientation to managing annual campaign supplies. The SOPs need to clarify use of pallets, FIFO and inventory records, open vial and disposal policies, and the procedure for receiving and reprogramming unused drugs.

For **district teams**, create guidelines, budget template, and checklist for holding post-MDA group meetings between the national leadership and the district NTD teams to review and compile summary reports, check the data, and identify where the data need further review and where the coverage is weak and requires “mop-up” support.

Second strategy

Provide NTDCPs with easy access to supply chain expertise

Develop regional (e.g., West Africa, East Africa) technical assistance centers (RTACs) to allow NTDCPs easy access to supply chain expertise. The resource centers could be located with NGOs, universities, or other local providers of supply chain expertise. Once identified and developed, the RTACs would be available to national coordinators to support the following activities:

Risk assessment:

RTAC experts will conduct rapid supply chain assessment to identify current and potential supply chain bottlenecks.

SOPs and guidelines:

RTAC supply chain experts will adapt the generic SOPs, training materials, and guidelines to the needs of the specific country program context.

Advocacy:

RTAC consultants will support national coordinators to make the case for partner support to address identified supply chain challenges.

Capacity building:

RTAC experts will develop capacities of NTDCP managers in supply chain through both formal and on-the-job training.

Implementation:

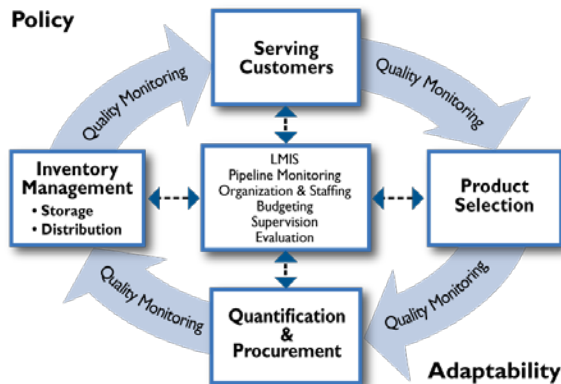
RTAC staff will support the coordinators to implement and monitor agreed-upon supply chain strengthening plans.

Forecasting and reporting:

RTAC consultants will support the annual national level reporting and drug application process.

Planning and budgeting:

RTAC experts will support national NTDCs through presenting costed options for supply chain strengthening. Consultants will support program managers to develop implementation plans and budgets, and to advocate with program partners for supply chain support.



The Logistics Cycle
USAID | DELIVER PROJECT. 1998.

Ten steps to implement regional technical assistance centers (RTACs)

- 1 Develop a consensus within the national NTDCPs and supporting partners regarding the need for and mission of the RTAC model
- 2 Identify sources of funding
- 3 Develop a framework for the types of support the RTACs will need to provide NTDCPs in supply chain management, and the means to transfer that technology and capacity
- 4 Develop criteria for selecting potential RTACs
- 5 Identify and short list potential providers of NTD supply chain support in regional hub
- 6 Interview and select providers based on capacity to provide the services and cost-effectiveness
- 7 Build the capacity of selected RTAC providers with the skills and materials required to support NTDCPs in supply chain management
- 8 Develop a short list of priority countries for rapid assessment and development of budgeted plans to strengthen last-mile supply chains
- 9 Conduct initial assessments and develop supply chain strengthening master plans
- 10 Respond to requests for supply chain support on an as needed and as funded basis

Third strategy

Improve data visibility and utility

The reporting of LMIS data (quantities received, used, lost, and in balance) from the community level is incomplete and inaccurate. Ensuring that lightly trained volunteers and health facility level staff fully implement accurate and complete LMIS reporting for the NTD drugs is a complex and costly intervention given the numbers of staff, teachers, and volunteers who would need to be trained and supported. The actual use of the data by NTD coordinators does not necessarily warrant this investment.

Recommendations:

- **Streamline LMIS reporting**
NTDCPs should streamline the LMIS data reported in the summary report to 1) **quantity used** (distributed to clients) and 2) **quantity in balance**. Current reporting on quantities received and lost is incomplete, inaccurate, and not used in decision making.
- **The focus going forward should be on accurate and timely reporting of drug balances following MDA**
These are essential for two purposes: 1) the return and reuse of NTD drugs for subsequent campaigns, and 2) quantification accuracy.
- **Implement and monitor the use of inventory records and physical inventories for NTD drugs**
Drug balances are under-reported because inventory records and physical inventory are rarely used and because the NTDCs do not add their own balances to those reported from the level below them
- **Modify the summary report design in order to capture complete drug balances**
Include a table at the foot of the report to capture the balance reported from the level below as well as the balance at the level reporting, as follows:

| | Ivermectin | Albendazole |
|-----------------------------------|------------|-------------|
| Balance from CDD registers | | |
| Balance in sub-district store | | |
| Total sub-district balance | | |

Third strategy

Use mHealth to improve data visibility and utility

mHealth reporting of LMIS data should be introduced to ease the burden of reporting and improve the timeliness, accuracy, and completeness of drug supply data. This will allow managers to make informed decisions such as the following:

Drug return: Where do drugs remain in balance that need to be returned to a higher level for storage until the next campaign?

Drug quantification: How many drugs are available for the next campaign and should be factored into the annual drug quantification to avoid over-supply and wastage?

When implemented correctly, mobile reporting tools can benefit NTD supply chains by:

- improving data visibility by providing disaggregated data
- improving data accuracy
- reducing the burden of reporting
- expediting the flow of information through the supply chain
- enabling decision makers to access data in real-time
- improving the effectiveness of campaigns by sending reminder messages

Fourth strategy

Use performance-based incentives (PBI) to improve reporting and return of unused drugs

PBI, also known as performance-based financing (PBF) and pay-for-performance (P4P), are cash or non-monetary benefits given for measurable actions or achievement of a clearly specified result or defined performance target. By linking payment to performance, PBI may be an effective tool to strengthen health outcomes. In the context of NTD supply chains, PBI can potentially help improve various aspects of MDAs, including recruitment and retention of volunteers, reporting of logistics data, and return of unused commodities.

We propose addressing challenges to motivation, performance, and volunteer retention that negatively impact reporting and the return of NTD drugs following campaigns through the following three PBI strategies:

PBI via bonus (second-tier) stipend

Volunteers returning complete reports and unused drugs will get a bonus (second-tier) stipend over and above the standard stipend. This would be handed to the hi-performing volunteers when they present their timely, completed paper summary reports and drugs to health facilities and in the same manner as they currently receive the basic stipend.

PBI stipend through mobile money transfer

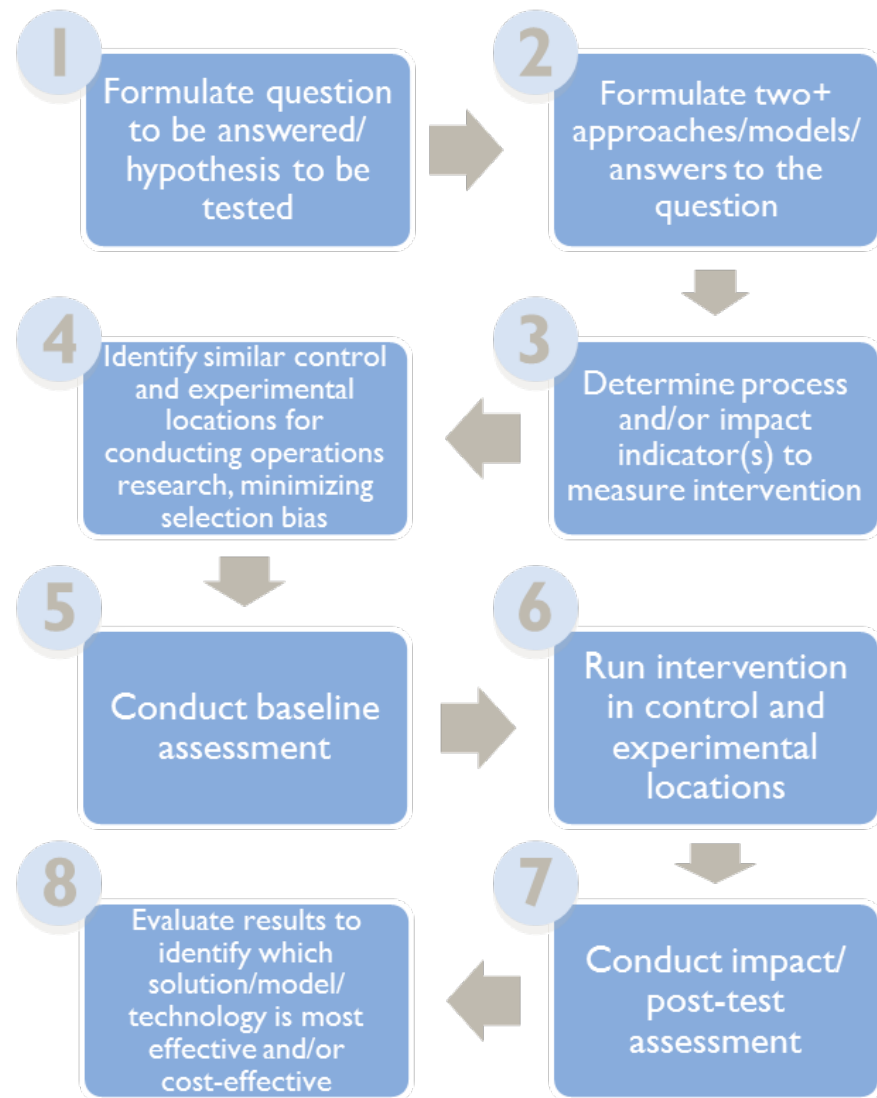
Sub-district staff who return timely, complete summary reports and unused drugs to the districts will receive mobile money transfers by cell phone. The compensation value would need to compensate for transport costs to/from the district, plus an incentive to motivate the staff to take these steps.

PBI stipend using cell phone minutes reward

Cell phone minutes could be used to reward CDDs in two scenarios: a) with mHealth reporting CDDs would get cell phone minutes for sending in their text message reports, and b) without mHealth reporting CDDs would get cell phone minutes for timely paper reporting and return of drugs.

Use an operations research model to test Strategies 3 and 4

Conducting OR provides the opportunity to test proposed mHealth and PBI solutions for optimization of country NTDCPs. The following eight step schematic reflects the model of OR used in health and development that will guide the implementation of OR for PBI:



Use an operations research model to test mHealth strategies

Since the mHealth solution can be implemented in a variety of ways, OR should be carried out before embarking on the development of an mHealth solution. The OR will address two main issues:

Data points captured

OR can address which option give the right balance between data visibility for decision makers and reporting burden for system users. This means identifying which data points to capture with mobile phones. Options to be tested include:

- remaining balance of product available only
- quantity received, quantity used, and balance
- quantity received, quantity used, balance, limited services indicators

Level of personnel using mobile phones to report

OR can help determine feasibility of whether mobile reporting can be implemented down to the lowest level of the supply chain, which for NTD programs is the CDD level, to address the reporting burden. Options to be tested include:

- mobile phone reporting at the CDD level
- mobile phone reporting at the sub-district level

OR can be conducted to compare the cost effectiveness, reporting rates, timeliness, and data quality for the two approaches.

Use an operations research model to test PBI strategies

Operations research will precede the implementation of PBI solutions for reporting to gauge technical effectiveness and the most cost-effective solution. A key question is what level of incentivization is substantial enough to trigger behavior change amongst the recipients but still within an acceptable level of risk for the NTDCP?

To address the challenges that relate to motivation, performance, and volunteer retention, impacting LMIS reporting and the return of NTD drugs, we propose three PBI strategies and related OR to achieve the optimal solutions. The combination of which cadre to incentivize, the delivery method of the incentive, and the action being rewarded, will be investigated to determine which one is most likely to motivate and incentivize workers.

Before implementing PBI solutions to improve reporting and return of unused drugs, OR will be conducted to address three main questions:

Which cadre of workers should be selected for PBI?

At which level of the supply chain should PBI be applied to achieve the most improvement for the least cost? Options to be tested include:

- Community drug distributors
- Front-line health workers

What type of incentive is most effective?

The delivery method chosen for each incentive can influence the effectiveness and cost effectiveness of the PBI solution. Options to be tested include—

- Cell phone minutes
- Mobile money transfers
- Second tier bonus stipend

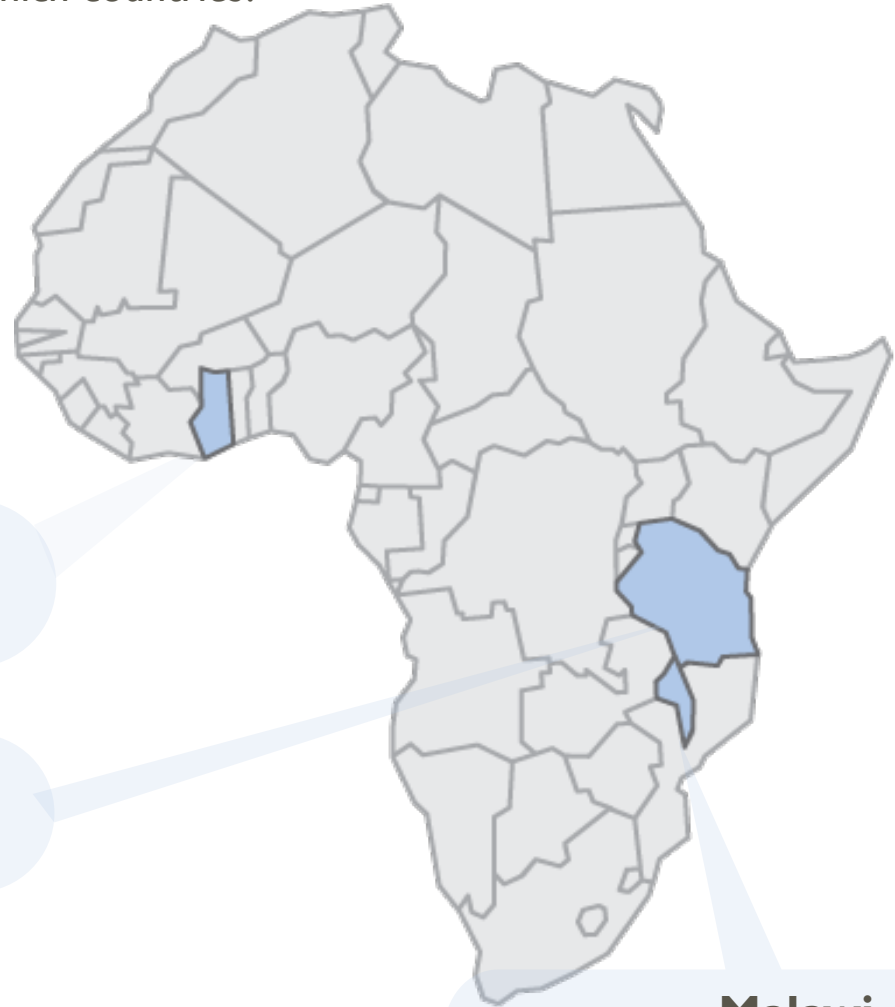
How much should be paid?

What level of incentive payment sums will suffice to increase performance regarding reporting and returning unused drugs, as well as retaining volunteers?

- Gauge various payment thresholds, such as \$3 vs. \$10 and 30 free cell phone minutes vs. 50 free cell phone minutes

Use an operations research model to test mHealth and PBI questions

Which questions should we test through OR and in which countries?



Ghana

mHealth: *Level of personnel?*

PBI: *Level of personnel? Payment amount?*

Tanzania

mHealth: *Level of personnel?*

PBI: *Level of personnel? Payment amount?*

Malawi

mHealth: *Data points captured?*

A photograph of three young children, two boys and one girl, standing behind a chain-link fence. They are all wearing checkered dresses. The child on the right is smiling and looking towards the other two. The child in the middle is looking down, and the child on the left is looking towards the middle child. The background is a wall made of horizontal wooden logs. The entire image has a teal overlay.

Additional documents, tools, and references

For further information, access these documents and tools at:

<http://internet-dev.jsi.com/resources/SCNTD>

NTD supply chain landscape analysis

What we know about global NTD drug supply chain efforts to date

Non-NTD supply chain landscape analysis

How non-NTD experience informs NTD last-mile supply chains

Country reports based on assessments in three countries

Findings from last-mile NTD supply chain assessments in Malawi, Ghana, and Tanzania

Supply chain assessment tools

Evaluation tools for assessing last-mile NTD supply chains at three levels: central, intermediate, and health facility

Development plan

Recommendations for NTD last-mile supply chain optimization globally and for three focus countries

Segmentation analysis*

Application of commercial sector approach to public health supply chains to analyze possible NTD drug piggy-backing on existing distribution systems

Benchmarking analysis*

Measurement of NTD drug supply chain performance against other comparable supply chains

*Can be found as annexes in *NTD Supply Chain Landscape Analysis*

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