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Evaluation of the Zimbabwe Assisted Pull System

Endline Report

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Abstract
This report provides results from the endline measurement for the evaluation of the Zimbabwe Assisted Pull System (ZAPS). The ZAPS, which was piloted in Manicaland province, consolidates management of four existing health commodity distribution systems for the primary healthcare facility level: Delivery Team Topping Up (DTTU); Zimbabwe Informed Push/Primary Health Care Package (ZIP/PHCP); Zimbabwe ARV Distribution System (ZADS); and Essential Medicines Pull System (EMPS). For the hospital level, the ZAPS consolidates the DTTU ZIP/PHCP, while the ZADS and EMPS continue operating as separate systems. The evaluation compared the performance and costs of the ZAPS with these existing distribution systems. The ZAPS pilot maintained supply chain performance and did so at a lower overall cost and more efficiently compared to the four existing supply chain systems. With other factors, such as per-province start-up costs, the comparative sustainability of the ZAPS model, and how ZAPS is financed relative to the existing supply chain model, decisionmakers can use the results of the evaluation to make an informed decision on how to move forward with implementing ZAPS elsewhere in Zimbabwe.

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Acronyms

ADC	area distribution coordinator
AMC	average monthly consumption
ART	antiretroviral therapy
ARV	antiretroviral
DFID	U.K. Department for International Development
DPM	district pharmacy manager
DPS	Directorate of Pharmacy Services
DTTU	Delivery Team Topping Up
EID	early infant diagnosis
EMPS	Essential Medicines Pull System
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
JSI	John Snow, Inc.
LMIS	logistics management information system
MOHCC	Ministry of Health and Child Care
mRDT	malaria rapid diagnostic test
PHC	primary healthcare
PHCP	Primary Health Care Package
PMD	Provincial Medical Directorate
PMTCT	prevention of mother-to-child transmission
POC	point of care
POD	proof of delivery
PPM	provincial pharmacy manager
RHZE	rifampicin150mg/isoniazid 75mg/pyrazinamide 400 mg/ethambutol 275mg
RTK	rapid test kits
SCMS	Supply Chain Management System
SOH	stock on hand
TB	tuberculosis
UNDP	United Nations Development Programme

UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
ZAPS	Zimbabwe Assisted Pull System
ZADS	Zimbabwe ARV Distribution System
ZIP/PHCP	Zimbabwe Informed Push/Primary Health Care Package
ZISHAC	Zimbabwe Information System for HIV and AIDS Commodities
ZNFPC	Zimbabwe National Family Planning Council

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The authors are grateful to the many people who made this study possible. Hundreds of workers from the Ministry of Health and Child Care of Zimbabwe—at the central-, province-, district-, and health facility–level—gave generously of their time and expertise to guide and inform the authors. Likewise, we are deeply indebted to the many NatPharm and Zimbabwe National Family Planning Council staff in Harare and Manicaland who helped us at key points. We also thank the staff of USAID in Washington, D.C., and in Zimbabwe, who supported this effort in many ways; and other development partners we interviewed and who provided us with valuable information. Participants in workshops in June 2014 and June 2015 provided helpful and timely feedback on preliminary baseline and endline findings.

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Executive Summary

Background

This report provides results from the evaluation of the Zimbabwe Assisted Pull System (ZAPS), which was piloted in Manicaland province. It included the consolidated management of four existing health commodity distribution systems for the primary healthcare facility level: Delivery Team Topping Up (DTTU), Zimbabwe Informed Push/Primary Health Care Package (ZIP/PHCP), Zimbabwe ARV Distribution System (ZADS), and Essential Medicines Pull System (EMPS). At the hospital level, the ZAPS consolidates the DTTU and the malaria and tuberculosis portions of the ZIP/PHCP; while the ZADS and EMPS continue to operate as separate systems. The evaluation compared the performance, costs, and efficiency of the ZAPS with these existing distribution systems. Results from this evaluation are intended to inform the decision on whether to expand the ZAPS model from Manicaland to the rest of Zimbabwe.

The evaluation asks the following questions:

1. Can the ZAPS yield the same or higher levels of supply chain performance compared to the existing supply chain systems when the performance includes both product availability and number/percentage of facilities served?
2. Can the ZAPS provide the same or higher quality reporting of logistics data compared to the existing supply chain systems? Can the system ensure the same level of data visibility as the existing systems?
3. Can the ZAPS improve product management—for example, stocked according to plan, stockout rates at the facility level?
4. Can the ZAPS minimize losses from product expiry—same low rates of expiry or lower?
5. How will the cost to operate the ZAPS compare with operating the existing supply chain systems?
1. Will the ZAPS be more efficient—cost-effective—than the existing supply current systems?

The research hypothesis is that the ZAPS will provide better product availability, data availability, and reduced losses from expiry; and will do so more cost effectively than systems replaced by the ZAPS.

Methods

The study design was quasi-experimental for some elements and non-experimental for others. Specifically, for supply chain performance indicators already routinely collected through the existing information systems, the study combined non-equivalent control and time series approaches. The general evaluation strategy was to focus on the baseline performance and cost indicators for the DTTU, ZIP/PHCP, ZADS, and EMPS for Manicaland province from January 2013–April 2014 and compare those with the performance of the ZAPS in Manicaland province during the one-year pilot:

April 1, 2014–March 31, 2015. The evaluation drew on data from the health facility–, district-, and provincial-levels in Manicaland; and from central-level actors, such as NatPharm, Zimbabwe National Family Planning Council, and various development partners. The comparison measured four groups of indicators that include information availability and quality, customer response, commodity availability/inventory management, and cost and cost effectiveness. Data collection on the first three categories of indicators drew mainly on existing electronic databases, including AutoDRV/Top Up, ZISHAC, and Navision. Baseline performance on the EMPS was not available. Cost data on the four existing systems and the ZAPS came from financial records, interviews, and surveys.

Results

ZAPS Implementation

After overcoming initial challenges, ZAPS processes worked, for the most part, as designed. The first ZAPS run took six months to complete—three months longer than planned—reflecting an initial period during which the various actors adjusted to their new roles. After managers of the pilot addressed the many start-up challenges, ZAPS operations settled into a steady rhythm. By round 4 of the ZAPS, the average number of ordering days per ordering unit had fallen to 9.4, slightly less than the target of 10 days. Nonetheless, opportunities to improve ZAPS processes and increase efficiencies remain. During the four runs, ZAPS fell short of its target of reaching three facilities per day during the ordering round. Similarly, ZAPS also fell short of its goal of covering five facilities per day during the delivery round.

Adding to the complication of trying a new approach, the ZAPS began at a time when the health system was putting significant additional demands on the public health supply chain in Manicaland. Compared to the baseline year, ZAPS served a larger number of facilities; and managed a higher number, volume, and value of products. Moreover, the ZAPS pilot coincided with a nationwide rapid push by the Ministry of Health and Child Care (MOHCC) to decentralize antiretroviral therapy (ART) services. This meant that, in Manicaland, as elsewhere in the country, several smaller and more remote facilities began providing ART for the first time. The number of facilities that the ZAPS served per run increased by 50, on average, between the baseline and the pilot periods—from 210 to 260—mainly because of a large increase in the number of Manicaland health centers dispensing ARTs to clients. In addition, the overall number of products that the ZAPS managed was 138, compared to 114 at baseline. ZAPS in Manicaland also managed about 20 percent more product by volume and by value than the baseline systems.

Supply Chain Performance

In general, ZAPS performed about the same as the previous systems. For information availability and quality, at baseline the DTTU and ZIP showed levels of reporting coverage of almost 100 percent; this was to be expected because both systems were visited by the order/delivery teams that simultaneously produce the required reports. Reporting levels for the ZADS were similarly high at baseline. ZAPS experienced reporting coverage rates of between 99 and 100 percent. For the evaluation, *on-time* data collection occurs within 90 days from the last ordering visit. At baseline, the average number of days between ordering rounds was 98 days for the DTTU and 118 days for the ZIP. During the ZAPS, the average time between ordering rounds gradually decreased from 108 to 101 to 98.

As an indicator of customer responsiveness, the evaluation calculated on-time delivery as the number of days between deliveries, averaged across the health facilities in Manicaland. For the baseline DTTU and ZIP systems, deliveries occurred at the same time as orders; therefore, the on-time delivery indicator is the same as the previously discussed on-time data collection indicator. With 90 days between deliveries considered on-time, the ZAPS average was 98 days between delivery rounds 1 and 2, 104 days between delivery rounds 2 and 3, and 95 days between rounds 3 and 4.

The evaluation also compared commodity availability and inventory management indicators. Overall, stock availability rates for tracer products during ZAPS averaged 89 percent compared to 87 percent at baseline. These averages, however, mask some significant differences in comparative performance when examining specific tracer products or groups of products. For example, stock availability rates of the two contraceptives—oral pills and male condoms—decreased from about 99 percent at baseline under the DTTU to 95 percent during ZAPS. Meanwhile, stock availability rates for the malaria, tuberculosis (TB), and essential medicines, ZIP/PHCP tracer products increased during ZAPS compared to the baseline. For the ZADS products, there was no clear pattern. For two of the three tracer products, stock availability rates decreased during the ZAPS compared to the baseline; for the third product, rates remained roughly the same.

To help gauge the extent to which the observed stock availability levels in Manicaland were the result of the ZAPS, or because of other factors influencing supply chain performance, we compared the experience in Manicaland with how the supply chain was performing elsewhere in Zimbabwe. For the most part, the trends we saw in Manicaland mirrored what was happening in the rest of the country. For example, the slight overall improvement in product availability under the ZAPS pilot in Manicaland tracked closely with the increase seen in other provinces. However, for some individual products, the Manicaland performance diverged from the rest of the country. For example, the supply chain elsewhere in Zimbabwe maintained almost 100 percent availability of the control pill and condom at the same time the rates dipped in Manicaland during the ZAPS.

The comparison of stockout duration showed mixed results. For those facilities that stocked out of the DTTU tracer products, the average number of days stocked out was higher under ZAPS compared to the baseline. For ZIP products, the average stockout duration was roughly the same—excluding the first round of the ZAPS. For essential medicines products, stockout duration was higher during the first rounds of the ZAPS compared to the baseline. By the fourth round of the ZAPS, however, average stockout duration was at a level approximately the same as at baseline. Information was not available on ZADS product stockout duration.

The stock status or *stocked according to plan* indicator measured the percentage of facilities that manage products within the correct range of months of inventory. Stock status was similar during ZAPS versus the baseline. All tracer products—both at baseline and during the ZAPS—showed significant overstocking.

The expiry rate is the percentage of expired products, calculated by dividing the total quantity of product that expired during the specified period by the quantity of the opening balance of the product at the beginning of the period. We combined the DTTU, ZIP, and ZADS baseline rates to produce an overall baseline average for expiries of 0.74 percent. During ZAPS, the expiry rate fell to 0.42 percent.

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Supply Chain Costs and Throughput

The total annual cost to operate the ZAPS was about $220,000 less than what it cost to operate the previous systems, $1.51 versus $1.73 million. Most of the ZAPS savings were realized at the health facility level. Health workers spent less time managing products under the ZAPS compared to the time they spent managing products under the four separate systems at baseline. Furthermore, under the ZAPS, health facility workers almost completely eliminated the time and out-of-pocket transport expense associated with picking up commodities under regular ordering. Meanwhile, central, provincial, and district costs remained roughly the same under ZAPS compared to the baseline. Although operating at a lower total cost, ZAPS handled a higher volume of commodities compared to the baseline systems, 1,955 cubic meters (m^3) versus 1,803 m^3. Similarly, the value of commodities that the ZAPS handled was higher compared to the baseline, $12.3 million compared to $10.4 million.

Cost-Effectiveness

The ZAPS was more cost-effective than the previous systems. Because ZAPS cost less and handled more volume and value of commodities at the same level of performance, it was a more cost-effective or efficient system compared to the baseline systems. Cost per cubic meter of commodity handled was $960 at baseline versus $770 during ZAPS. Efficiency as measured by supply chain cost as a percentage of product value was 17 percent at baseline versus just 12 percent during ZAPS. Using a performance-adjusted measure of throughput, cost per cubic meter was $1,107 at baseline versus $869 under the ZAPS. Cost per throughput value was 19 percent at baseline versus 14 percent under the ZAPS. Results of the sensitivity analysis showed that, even when taking into account some of the uncertainty underlying our cost-effectiveness calculations, the ZAPS retained its efficiency advantage over the baseline systems.

Discussion and Conclusions

The results of the evaluation of the ZAPS provide clear guidance for decisionmakers. The ZAPS pilot maintained supply chain performance and did so at a lower overall cost and more efficiently, compared to the four existing supply chain systems. With other factors—such as per-province start-up costs—the comparative sustainability of the ZAPS model and how the ZAPS is financed relative to the existing supply chain model, decisionmakers can use the results of the evaluation to make an informed decision on how to move forward with implementing the ZAPS elsewhere in Zimbabwe. Although the ZAPS performed well overall compared to the baseline, there was some variability across product. Drops in product availability for contraceptives, condoms, and antiretrovirals—however small—should be viewed with concern. Program managers should investigate what might be causing these problems and appropriately address underlying any causes.

Introduction

The Zimbabwe Ministry of Health and Child Care (MOHCC) piloted the consolidated management for four existing health commodity distribution systems into a single Zimbabwe Assisted Pull System (ZAPS) for the primary healthcare facility–level. The pilot ran for one year—beginning in April 2014—in Manicaland province, one of 10 provinces in Zimbabwe. This report summarizes the results of the evaluation that compared the performance and costs of the ZAPS with the existing distribution systems. Preliminary results were presented at a workshop in Harare on June 25, 2015.

Study Rationale

At the time the pilot was conceived in late 2012, four different systems distributed most health commodities in the public sector; each of the four had a unique structure, including the associated costs and level of performance. Stakeholders were interested in merging these systems as a way to shift primary responsibility for supply chain funding and management from international donors and technical assistance agencies to Zimbabwe's government. Government officials believed that a single, unified system would be simpler to manage, cost less, and would produce similar or higher levels of performance compared to the existing separately managed systems. Discussions among the various supply chain stakeholders resulted in an agreement in February 2013 to work toward integrating the management of most health commodities into a single *assisted pull* system, which was formally designed in October 2013. Stakeholders agreed to pilot the ZAPS in one of Zimbabwe's 10 provinces, and then roll it out nationwide, if the pilot proved successful. Stakeholders defined success if the ZAPS generated the same or better level of supply chain performance at a lower cost when compared to the existing distribution systems.

Several parties in Zimbabwe are interested in evaluating the pilot, including the Directorate of Pharmacy Services (DPS) of the MOHCC, NatPharm (the public-sector central medical stores), the Zimbabwe National Family Planning Council (ZNFPC), and the various international partners; including the U.S. Agency for International Development (USAID) and other U.S. government organizations, U.K. Department for International Development (DFID), United Nations Children's Fund (UNICEF), and Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM). The USAID | DELIVER PROJECT (the project) and the Supply Chain Management System (SCMS) have been fully involved in designing and providing technical assistance to the current supply systems and they led the effort to support the MOHCC to design, implement, and test ZAPS.

The ZAPS evaluation forms part of a larger global research agenda that the project supports. Beyond Zimbabwe, the results will benefit the design of public health supply chains in other developing countries. Moreover, the research methods, in particular the application of economic evaluation techniques, will contribute to global best practice.

Existing Supply Chains and the Development of the ZAPS

As noted, at the time the ZAPS pilot was conceived, four public health supply systems were distributing most of the products in Zimbabwe.[1]

- The Delivery Team Topping Up (DTTU) system has a *rolling warehouse* approach using an informed push to about 2,000 service delivery points nationwide. The DTTU distributes condoms, contraceptives, human immunodeficiency virus (HIV), syphilis rapid test kits (RTKs), antiretroviral (ARV) medicines for the prevention of mother-to-child transmission (PMTCT) of HIV, early infant diagnosis (EID) bundles, and cluster of differentiation 4 (CD4) point-of-care (POC) commodities.
- Like the DTTU, the ZIP/PCHP system uses the rolling warehouse approach to reach about 1,600 service delivery points with malaria products; tuberculosis (TB) medicines; and a Primary Health Care Package (PHCP), which contains 26 other essential medicines and medical supplies. The system also collects logistics data for an additional 16 items that are not in the package.
- The Zimbabwe ARV Distribution System (ZADS), a *pull* system, distributed ARVs for antiretroviral therapy (ART) and fluconazole to approximately 700 sites by the end of 2013, later scaled up to 852 sites by March 31, 2015.
- The Essential Medicines Pull System (EMPS), a traditional ordering/requisition system, is used by all health facilities for all other essential medicines and medical products not distributed by another system.

Although the DTTU and ZIP/PCHP have historically performed well, donors and other decisionmakers consider them to be costly to operate. Both systems rely on team leaders who collect data on laptops, determine resupply quantities, and resupply while at the facility. The involvement of the team leaders contributes to a higher level of data integrity, but resupplying from the rolling warehouses is time consuming. Moreover, both systems are at their limits in terms of the number of products they can manage, and increasing volumes of products will require more delivery runs to serve the same number of facilities. Finally, both systems rely on the same vehicles, so any delay in one delivery run affects the other. Local human resources manage the systems, and they currently rely heavily on donor funding.

The ZADS has also performed well using the traditional pull model, but timely reporting from health facilities requires considerable effort from the central level. Central-level resources are also required to ensure data quality and order integrity; all orders must be reviewed before being approved. As with the DTTU and ZIP/PHCP, local human resources currently manage the system; but, again, this system is heavily donor reliant.

In contrast to the other three systems, the EMPS has historically suffered from low reporting rates, irregular ordering, and interruptions in product supply. In addition, there are no regularly scheduled distribution runs for the products. These problems have made it difficult to do regular resupply and to forecast long-term needs.

The existing systems essentially were managed separately, using different transport, warehousing, and management information systems; while drawing on different funding streams. In this context,

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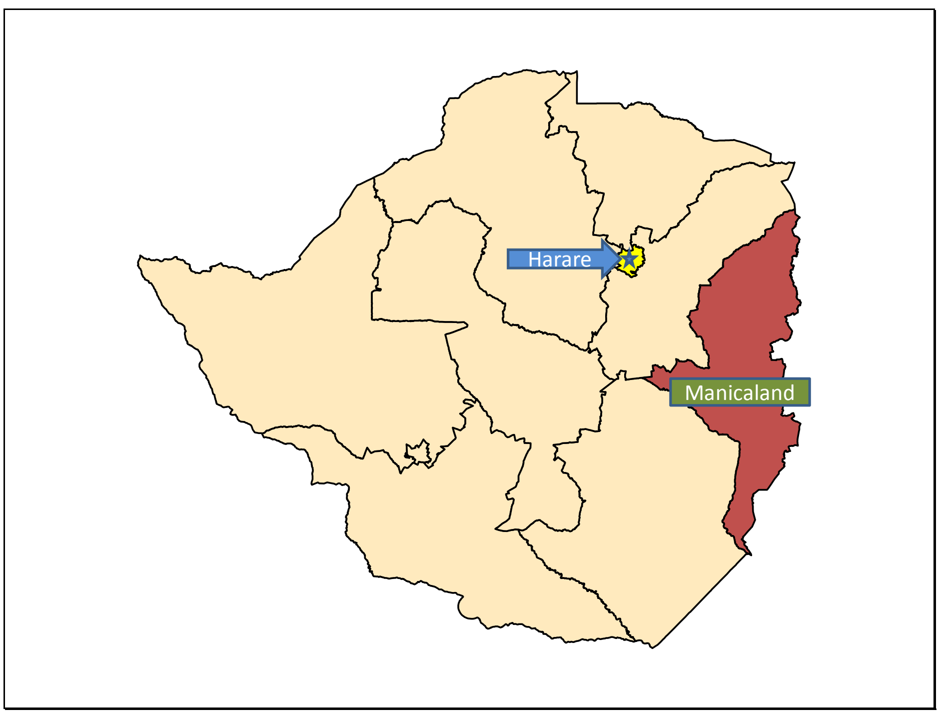
[1] Two other relatively small supply chains deliver laboratory commodities—ZiLaCoDS to 111 sites—and Voluntary Medical Male Circumcision products—VMMC, to 65 sites.

the MOHCC DPS was interested in managing all the health commodities under a single unified system that the ministry could cost effectively manage. In November 2012, the DPS convened a meeting of more than 50 local staff from all levels of the supply chain and central-level partners to review the current situation and explore options for moving forward. The results of that meeting included general agreement on the principle of moving forward with the integration of health commodity management and the formation of a smaller technical working group to recommend how to achieve the integration.

In February 2013, the technical working group met and agreed on the general outlines of what evolved into the ZAPS. The ZAPS builds on the technology and lessons learned from the DTTU and ZIP/PHCP, but it removes the limits on the number of products the supply chain can manage.

Subsequent to the working group meetings, the MOHCC identified Manicaland province as the desired site for the ZAPS pilot (see Figure 1). Manicaland province, whose capital is Mutare, has about 14 percent of the country's population; it has more health facilities than any other province in Zimbabwe. Its size and geographic diversity present the full range of challenges that the ZAPS implementation might face, thus making it a suitable proving ground for extending the model to other provinces. A NatPharm branch is located in the provincial capital.

Figure 1. Map of Zimbabwe Showing Manicaland and Harare



A system design workshop, held in Manicaland in October 2013, developed the ZAPS procedures (Chiyaka and Printz 2013), summarized below:

- The ZAPS operates quarterly.

- The ZAPS combines ZIP/PHCP, DTTU, ZADS, and EMPS products for the primary healthcare facility level (see Table 1). Hospitals will continue to receive other products through the existing systems.
- The pilot divides Manicaland into 11 resupply areas, each roughly corresponding to a district or subdistrict of about 30 health facilities.
- An ordering team, comprising a driver and a district pharmacist, travels to all facilities in their resupply area to assist health facility staff collect essential logistics data and use an automated system (AutoOrder) to place orders.
- Hospitals place EMPS orders at the same time.
- The ordering team transmits orders for both systems to the NatPharm Mutare branch.
- Staff at the NatPharm Mutare warehouse pick and pack the order.
- NatPharm Mutare then delivers pre-parceled orders to health facilities.

Table 1. Products Managed by the ZAPS, by Health Facility Type and Current System

Product	System Where Products Are Currently Managed	System that Manages Products under ZAPS	
		Primary Care Health Facilities (including rural hospitals)	District/Mission/ Provincial and Central Hospitals
Condoms	DTTU	ZAPS	ZAPS
Contraceptives	DTTU	ZAPS	ZAPS
HIV RTKs	DTTU	ZAPS	ZAPS
Syphilis RTKs	DTTU	ZAPS	ZAPS
ARVs for PMTCT	DTTU	ZAPS	ZAPS
EID reagents	DTTU	ZAPS	ZAPS
POC reagents	DTTU	ZAPS	ZAPS
Malaria products	ZIP/PHCP	ZAPS	ZAPS
TB medicines	ZIP/PHCP	ZAPS	ZAPS
Essential medicines and medical supplies in the primary healthcare list	ZIP/PHCP	ZAPS	EMPS
Selected nutrition products	ZIP/PHCP	ZAPS	ZAPS
Selected PHC essential medicines and medical products	EMPS	ZAPS	EMPS
ARVs for ART	ZADS	ZAPS	ZADS
Fluconazole	ZADS	ZAPS	ZADS

Table 2 summarizes how the ZAPS compares with the four main current systems. In summary, the ZAPS changes the methods of order fulfillment, data collection, and delivery for the products migrating to the ZAPS. Meanwhile, it is assumed that procurement approaches and quantities will not change during the pilot.

Table 2. Characteristics of the Distribution Systems in Place in Zimbabwe Compared with the ZAPS

Characteristic	Distribution System				
	DTTU	**ZADS**	**ZIP/PHCP**	**EMPS**	**ZAPS**
Year established	**2003**	**2007**	**2009**	**1998**	**Piloted 2014–15**
Products managed	Condoms, contraceptives, HIV & syphilis RTKs, PMTCT ARVs, EID, and POC reagents	ARVs & fluconazole	Malaria, TB, selected set of essential medicines, and medical supplies	All essential medicines and medical supplies (not managed by another system)	Combination of the four existing systems for primary healthcare level
Number of health facilities served (nationwide) at baseline	Approx. 1,600	≈1000 (scaling up)	Approx. 1,600	Approx. 1,600	267 (Manicaland only)
Type of LMIS	AutoDRV/Top Up (automated system)	Manual (facility level) ZISHAC (automated system at central level)	AutoDRV/ Top Up (automated system)	Manual (facility level) Computerized (central level)	AutoOrder/ Top Up (automated system)
Method of resupply	Forced order; push; data collection, resupply calculations, and delivery on the spot by the DTTU team	Bimonthly; standard; pull; delivery by NatPharm after submitting requisitions by the facilities and approval by DPS	Forced order; push; data collection, resupply calculations and delivery on the spot delivery by ZIP team	Monthly; standard; pull; delivery by NatPharm	Forced order; pull; data collection and resupply calculations by order team; order fulfillment and delivery by NatPharm
Reporting cycle	Quarterly	Bimonthly	Quarterly	Monthly	Quarterly

Research Questions and Hypothesis

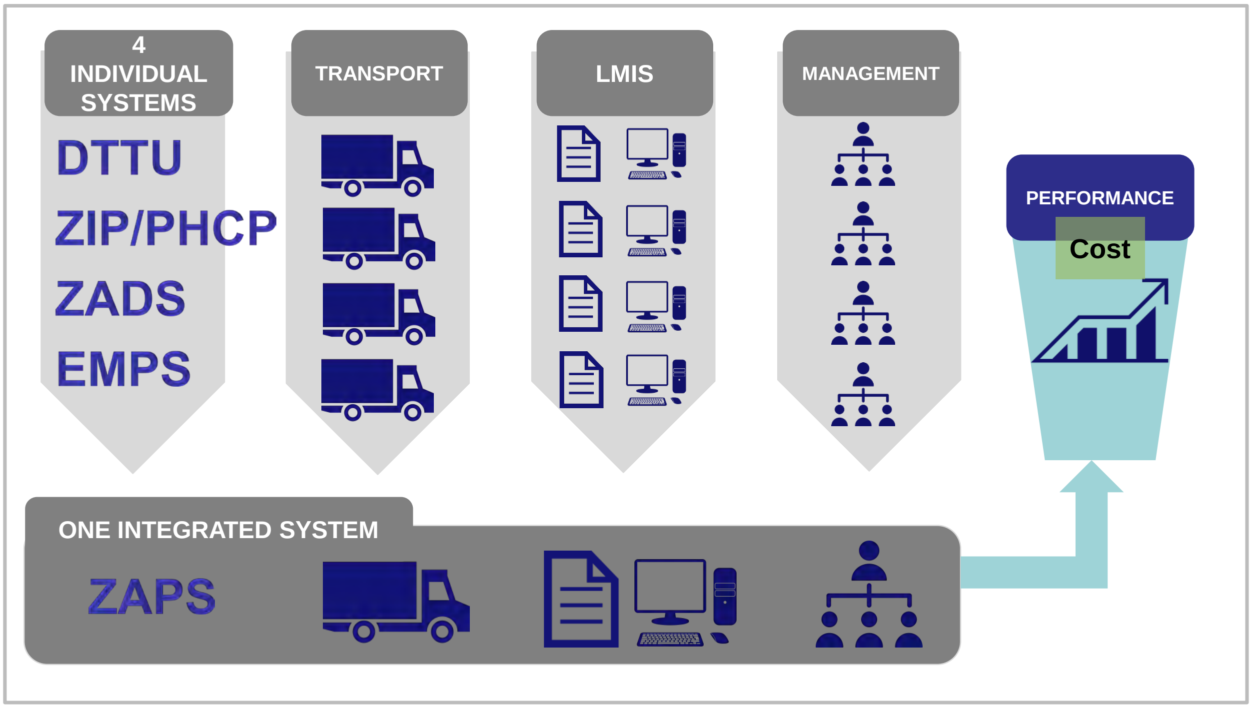
The objective of this study is to determine whether the ZAPS can achieve the same or a higher level of performance while being more efficient than the four separate systems.

The evaluation aims to help answer the following questions:

1. Can the ZAPS yield the same or higher levels of supply chain performance compared with the existing supply chain systems when performance includes both product availability and number/percentage of facilities served?
2. Can the ZAPS provide the same or higher quality reporting of logistics data compared with the existing supply chain systems? Can the system ensure the same level of data visibility as the existing systems?
3. Can the ZAPS improve product management—for example, stocked according to plan, stockout rates at the facility level?
4. Can the ZAPS minimize losses from product expiry—same low rates of expiry or lower?
5. What will the cost be to operate the ZAPS compared to operating the existing supply chain systems?
2. Will the ZAPS be more efficient—cost effective—than the existing supply current systems?

The research hypothesis is that the ZAPS will provide better product availability, data availability, and reduced losses from expiry; and will do so more cost effectively than the systems that the ZAPS replace (see Figure 2).

Figure 2. Study Hypothesis of How the ZAPS Will Reduce Redundancy and Cost While Maintaining and Improving Performance



Methods

Study Design

The design for this study is quasi-experimental for some elements and non-experimental for others. Specifically, for supply chain performance indicators already routinely collected through the existing information systems, the study combined non-equivalent control and time series approaches. The general evaluation strategy was to focus on the baseline performance and cost indicators for the DTTU, ZIP/PHCP, and ZADS for Manicaland province for 2013 and the first quarter of 2014; and compare those to the performance of the ZAPS in Manicaland province during the one-year pilot: April 1, 2014–March 31, 2014.

Sample

The study drew on cost and performance data collected in the pilot province, Manicaland; and central-level actors, such as NatPharm, the ZNFPC, and the various development partners (see Table 3).

Table 3. Sample for the ZAPS Evaluation

Tool	Sample	
	Baseline	ZAPS
Interviews	NatPharm Harare & Mutare, ZNFPC, MOHCC/DPS, Logistics Unit, Crown Agents, GFATM/UNDP, UNICEF, JSI	NatPharm Harare & Mutare, ZNFPC, MOHCC/DPS, Logistics Unit, Crown Agents, GFATM/UNDP, UNICEF, JSI
Document review	Partner financial and programmatic documents	Partner financial and programmatic documents
Database draw	TopUp, ZISHAC, Navision	AutoDRV, ZISHAC, Navision
Activity-based survey—upstream supply chain actors (central, provincial, district)	Logistics Unit, ZNFPC, NatPharm, ADC, PPM, DPMs	Logistics Unit, ZNFPC, NatPharm, ADC, PPM, DPMs
Activity-based survey—facility supply chain actors	Health workers from 58 facilities in Manicaland	Health facility workers from 54 facilities in Manicaland

Data Indicators

The study measures two main groups of indicators. The first includes indicators for comparison between the ZAPS and the existing systems. The second group includes indicators to monitor the initial implementation of the ZAPS.

Comparison Indicators

Stakeholders identified four groups of indicators to compare the ZAPS with the existing systems (see Table 4). See the Monitoring and Evaluation Plan (Zimbabwe MOHCC, USAID | DELIVER PROJECT, and SCMS 2014) for definitions of each indicator.

Table 4. Comparison Indicators

Category	Indicator
• Information availability & quality	• Reporting coverage • On-time data collection
• Customer response	• Time and level of effort to complete a resupply cycle • On-time delivery
• Commodity availability/inventory management	• Stock availability/stockout rate • Stocked according to plan (at the time of data collection) • Stockout durations • Expiries
• Cost and cost effectiveness	• Total operating costs • Average cost effectiveness

Indicators for Monitoring the Initial Implementation of the ZAPS

Stakeholders also considered it important to gauge how well the ZAPS adhered to the various system design assumptions. For example, the design team set minimum and maximum health facility stock levels based on assumptions about the lead time between order and delivery. If the lead time was longer than expected, minimum-maximum stock levels would be too low to resupply facilities adequately. In addition to giving the ZAPS implementers critical knowledge on how the system processes were performing—enabling them to make mid-course adjustments—the monitoring indicators would provide information on whether the ZAPS interventions were implemented as planned. If ZAPS processes did not function as planned, this outcome might explain some of the measures of supply chain performance that we used to compare the ZAPS to the other systems.

Stakeholders identified the following monitoring indicators:

- lead time: data collection/ordering rounds
- lead time: time to database
- lead time: picking and packing at NatPharm branch, Mutare
- lead time: delivery from NatPharm branch to the receiving facility
- available human resource capacity at NatPharm Mutare branch

- order fill rate (quantity supplied versus quantity ordered)
- percentage of facilities that do a physical count
- percentage of facilities that completely and correctly fill the facility order worksheet before the order facilitator arrives.

Data Collection

Performance Data Collection

As Table 5 shows, automated systems are the primary source of performance data at the baseline and for the ZAPS. For the baseline, the study collected the available DTTU, ZIP/PHCP, and ZADS data from the AutoDRV/Top Up and ZISHAC databases, disaggregating by Manicaland province versus the rest of the country. Baseline performance on the EMPS was not available.

Table 5. Comparison Indicators and Source of Data at Baseline and during the ZAPS

Category	Indicator	Baseline Data Source	ZAPS Data Source
Information availability and quality	Reporting coverage	AutoDRV/Top Up ZADS consumption and requisition forms	AutoOrder
	On-time data collection	Original, actual data collection schedules	Original actual data collection schedules
Customer response	Time and level of effort to complete a resupply cycle	Travel expense reports, data collection/delivery team costing surveys	Travel expense reports, data collection/delivery team costing surveys
	On-time delivery	Original delivery schedule, PODs	Original delivery schedule, PODs
Commodity availability and inventory management	Stock availability/ stockout rate	AutoDRV	Site visits (physical inventories), as recorded in the AutoOrder
	Stocked according to plan	AutoDRV	Site visits (physical inventories), as recorded in the AutoOrder
	Stockout duration	AutoDRV Facility worksheet	AutoOrder Facility worksheet
	Losses due to expiry	• Physical count of expired (proxy: reported quantities that expired) • Total quantity of the product at the beginning of the reporting period (at the facility, within the district, within the province) • For value: value of the product	• Physical count of expired (proxy: reported quantities that expired) • Total quantity of the product at the beginning of the reporting period (at the facility, within the district, within the province) • For value: value of the product

For comparison, the analysis focused on a subset of products in full supply or *near* full supply. For this evaluation, a full-supply product is a product that never stocks out at any central-level warehouse in-country (ZNFPC and NatPharm) during the period being evaluated. Although the products managed under the DTTU and ZIP/PHCP have generally maintained full supply over the recent past, the same is not true for other products that the ZAPS is now incorporating—for example, some of the essential medicines. It is also possible that some products that traditionally have been in full supply could fall out of full supply during the pilot year, which would risk providing a false assessment of the ZAPS. Table 6 lists the full-supply products included in the baseline and endline measurement.

Table 6. Full-Supply Products Included in the Baseline and Endline Analysis

System	Product (condition or disease)
DTTU	• Control oral contraceptive (family planning) • Male condom (family planning and sexually transmitted infection and HIV prevention)
ZIP/PHCP	• Artemether/lumefantrine 120mg 1×6 blister (malaria) • Rapid diagnostic test (malaria) • RHZE 150/75/400/275mg tablet (tuberculosis) • *Amoxycilin 250mg caps (essential medicine) • *Paracetamol 500mg tabs (essential medicine) • *Doxycycline 100mg caps (essential medicine) • *Magn. sulphate injection 500mg/ml 10ml amp (essential medicine)
ZADS	• Lamivudine 150mg + zidovudine 300mg + nevirapine 200mg (HIV and AIDS antiretroviral drug) • Lamivudine 300mg + tenofovir 300mg (HIV and AIDS antiretroviral drug) • Zidovudine 60 + lamivudine 30 + nevirapine 50mg tab (HIV and AIDS antiretroviral drug)
*These tracer product were added during the endline analysis	

Cost Data Collection

Using the framework in Figure 3, the study collects relevant cost data at all supply chain tiers (health facility, district, province, and central) for a range of supply chain functions—logistics management information system (LMIS), storage, transport, and management—to estimate total supply chain costs.

Figure 3. Framework for Cost Collection and Analysis

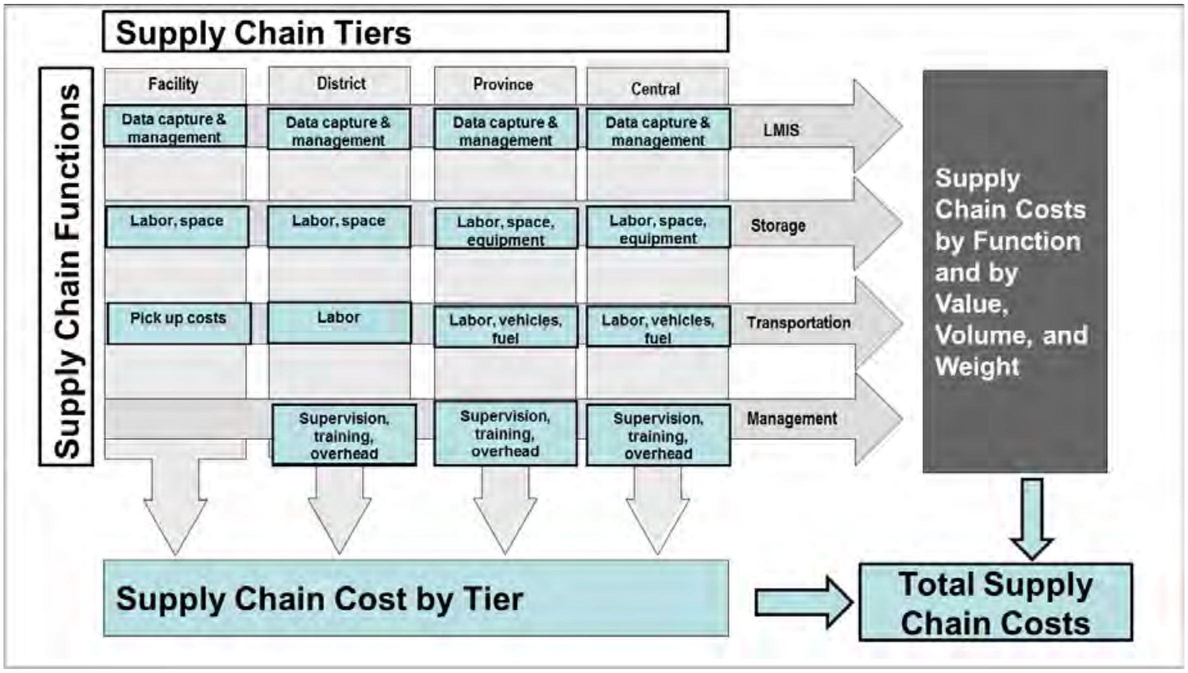


Table 7 describes the main sources of cost data. A line-item spending analysis provides much of the information on baseline spending, particularly for the three systems that are primarily donor-funded: DTTU, ZIP/PHCP, and ZADS. To facilitate the collection and analysis of the cost data, study teams interviewed officials at NatPharm Harare and Mutare, the ZNFPC, the MOHCC DPS, the DPS Logistics Unit, Crown Agents, the GFATM/United Nations Development Programme, UNICEF, and John Snow, Inc. (JSI). The team also interviewed provincial- and district-officials in Manicaland. These interviews of upstream supply chain actors also provided information on time and resource use, which were incorporated into the cost calculations. The team also surveyed health workers from 58 facilities in Manicaland to calculate labor associated with LMIS data capture and storekeeping, as well as transport and storage costs (see Appendix 1 for the survey tool).

Table 7. Tools for Collecting Cost Data

Tool	Source	Content	Sample Size	Procedure
Line-item spending analysis	Government and implementing partners supporting current systems	Direct and indirect costs and charged expenses for all cost categories	8	Interviews and review of financial documents
Activity-based survey—upstream supply chain actors (central, provincial, district)	Logistics Unit, ZNFPC, NatPharm, ADC, PPM, DPMs	Time use	8–central 2–province 4–district	In-depth interviews
Activity-based survey—facility supply chain actors	Health facility workers in Manicaland	Labor associated with LMIS data capture, storekeeping, transport costs, storage costs	58 facility workers at baseline; 54 facility workers at endline	Short survey applied at baseline during ZAPS training and at endline in April 2015

Throughput Data Collection

Information on commodity volume and value came primarily from special reports produced by NatPharm's Navision warehouse management system.

Data Analysis

Following data capture from routine information systems and distinct data collection efforts, the data was cleaned and analyzed in a spreadsheet format.

Potential Limitations Associated with the Study Methodology

A significant threat to internal validity—defined as the extent to which a causal relationship can be inferred from the study findings related to supply chain performance comparisons—is the extent to which commodities are available at central warehouses for delivery to facilities. For that reason, the study restricts performance comparisons related to stockouts and months of inventory to full-supply commodities—that is, products that never stock out at any central-level warehouse in-country during the evaluation period.

For the costing approach, non-controlled factors—such as inflation or other events that influence the cost of otherwise comparable resource inputs—can affect internal validity. However, this problem only affected a limited subset of resources. To address this potential problem, the study adjusted all inflation-affected prices and presented them in constant 2013 U.S. dollars.

Without a comparable baseline and endline for costs across other provinces in Zimbabwe, full external validity—the ability to generalize from the study findings to the rest of Zimbabwe—was not achievable for total cost and cost-effectiveness measures.

Timeline

Figure 4 shows how the evaluation fit into the timeline for the pilot. The ZAPS pilot operated for one year and three months, and included four order and delivery rounds. Cost data collection took place at baseline and after one year. Performance data collection took place at baseline and continued throughout the pilot. Routine implementation monitoring took place throughout the pilot.

Figure 4. Timeline for the ZAPS Pilot and Evaluation Activities

Activity	Calendar Year 2013	Calendar Year 2014				Calendar Year 2015		
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
ZAPS Pilot	ZAPS Design		Pilot in Manicaland					
Cost Data Collection		Baseline	Round 1		Round 2	Round 3	Round 4	
Performance Data Collection		Baseline	Round 1		Round 2	Round 3	Round 4	
Routine Monitoring			Implementation Monitoring					
Analysis			Baseline				End line	
Dissemination			Baseline					Final

Results

ZAPS Implementation

The extent to which the ZAPS adhered to its system design assumptions provides important context for interpreting the ZAPS performance on supply chain outcome indicators. This section examines various aspects of ZAPS implementation.

ZAPS Partners and Implementation Roles

As Table 8 shows, the ZAPS pilot included a number of key partners, each with an important technical or funding role.

Table 8. Key ZAPS Partners and Implementation Roles

Partner	Implementation Role
USAID | DELIVER PROJECT and SCMS	Technical support (system design and evaluation), training of staff, orientation meetings, software development and maintenance, monitoring vehicles for ordering, delivery trucks for transfer of stocks, additional work benches and trolleys, additional store hands for picking and packing, stationery, and monitoring
UNDP	Payment for rented extra storage space
UNICEF	DSAs for ordering teams
UNFPA	Training and funding for monitoring and evaluation meetings
Crown Agents	Monitoring staff (ADC)
NatPharm	DSA advances
ZNFPC	Monitoring of system
PMD	Guidance and monitoring of system
DPS	Guidance, resource mobilization, monitoring

ZAPS Implementation Challenges

Training was completed, on schedule, in March and April of 2014; but the initial operations of the ZAPS faced some challenges that affected its implementation in the early stages of the pilot. The result of these early challenges was that the first order and delivery round of the ZAPS took almost six months to complete, rather than the three months specified in the design. Subsequent rounds were completed in the planned three-month period (see Table 9).

Table 9. Timing of ZAPS Order and Delivery Rounds

	Calendar Year 2014			Calendar Year 2015	
	Q2	Q3	Q4	Q1	Q2
ZAPS order and delivery rounds	Round 1 (April–Aug 2014)		Round 2 (Sept–Nov 2014)	Round 3 (Dec–April 2015)	Round 4 (April–July 2015)

ZAPS Process Indicators

Table 10 shows the results of the ZAPS monitoring indicators analysis, beginning with round 2.[2] After managers of the pilot addressed the many start-up challenges, ZAPS operations settled into a steady rhythm. By round 4 of the ZAPS, the average number of ordering days, per ordering unit, had fallen to 9.4, slightly under the target of 10 days. Average lead time for picking and packing fell from 14 to 8.6 days and average lead time for delivery fell from 8 to 7.1 days, against a standard of 5 days per unit. Other opportunities to improve ZAPS processes and increase efficiencies remained. During the four runs, ZAPS fell short of its target of reaching three facilities per day during the ordering round. Similarly, ZAPS also fell short of its goal of covering five facilities per day during the delivery round.

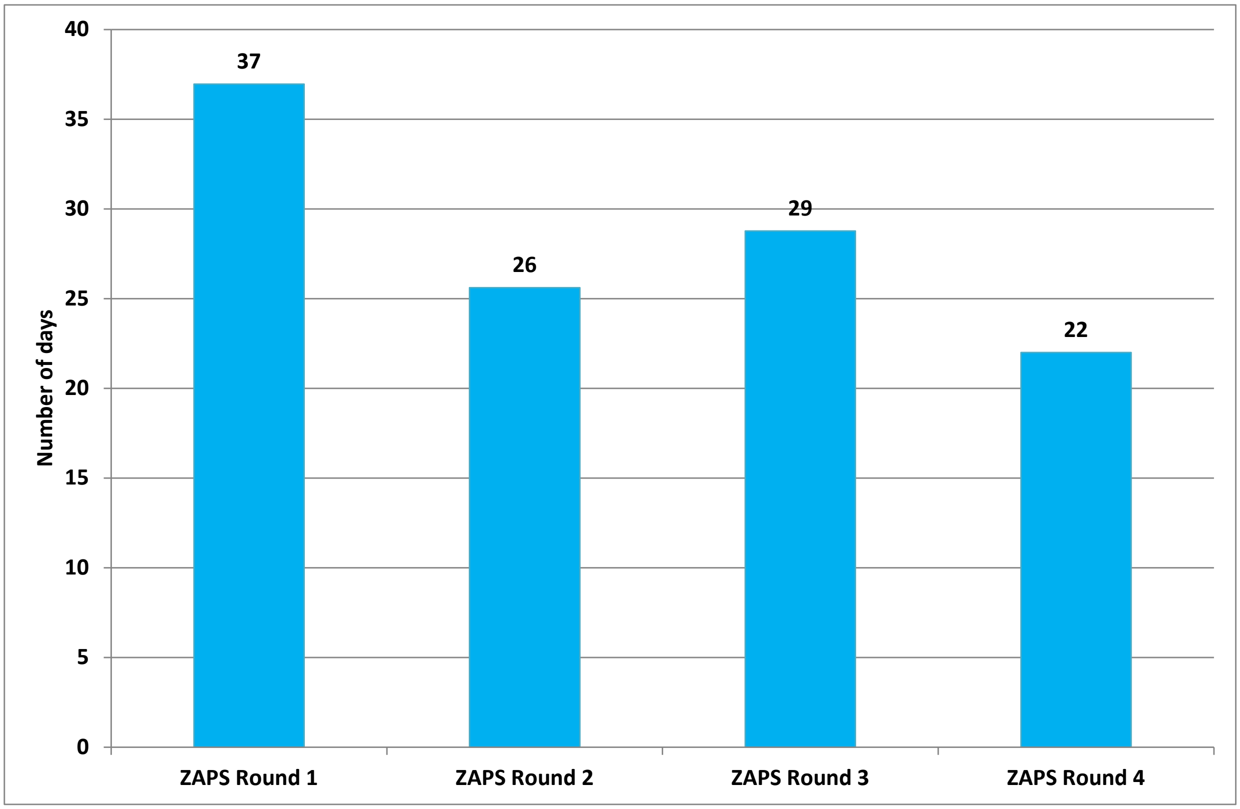
Table 10. Summary of ZAPS Process Monitoring

Indicator	Target (days)	Round 2	Round 3	Round 4
Average number of ordering days per ordering unit	10	11.2	10.7	9.4
Average number of facilities covered per day during ordering	3	2.7	2.96	2.5
Average lead time for pick and packing	5 days per ordering unit	14	11.4	8.6
Average lead time for delivery	5 days per ordering unit	8	7.7	7.1
Average number of facilities covered per day during a delivery	5	3.98	3.96	3.97

Another important measure of ZAPS processes was the average number of days between when a facility ordered and when it received the product—the standard set is 30 days. We calculated this by subtracting the order date from the delivery date, and then averaging over the facilities. As Figure 5 shows, the average number of days between ordering and delivery fell from 37 in round 1 to 26 in round 2, and then rose to 29 in round 3, before falling to 22 days in round 4.

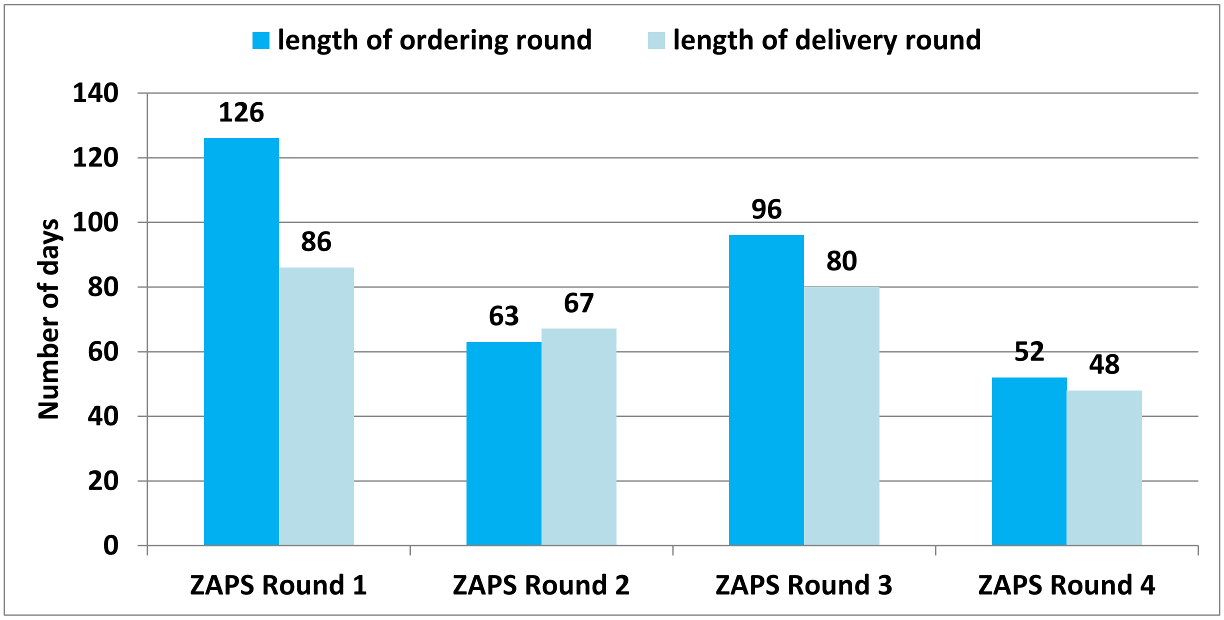
[2] Round 1 was not included because of the start-up challenges noted.

Figure 5. Average Number of Days between Order and Delivery, Round 1–3



Another way of measuring ZAPS implementation is the number of days it took for the order and delivery teams to complete each round. We calculated this by measuring the time between the first and last days of the round, against a standard of 90 days. As Figure 6 shows, the first ordering round took 126 days, reflecting the initial start-up challenges noted earlier. Ordering in round 1 took 86 days. In round 2, the length of both order and delivery fell significantly, to 63 days and 67 days respectively, before rising again in round 3. By round 4, the length of ordering and delivery rounds had fallen again, to 52 days and 48 days, respectively.

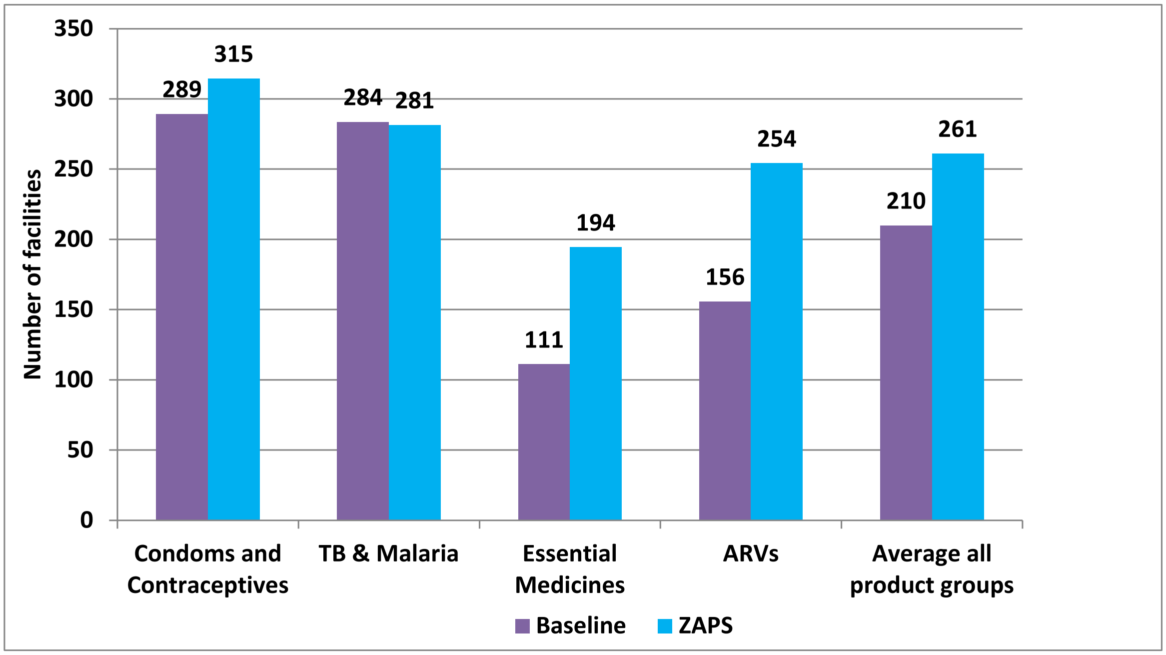
Figure 6. Number of Days for ZAPS Order and Delivery Round



Number of Facilities Receiving ZAPS Deliveries

It is also important to note that ZAPS was being piloted at the same time that the health system was putting significant additional demands on the public health supply chain in Manicaland. Compared to the baseline year, ZAPS served a higher number of facilities (see Figure 7). On average, ZAPS delivered to 261 facilities, per round, compared to 210 facilities served by the baseline systems. The average number of facilities that ZAPS served was higher for every product group, except for TB and malaria products, where it went down slightly from 284 to 281. The large increase in the number of facilities receiving ARVs reflects the rapid nationwide push by the MOHCC to decentralize ART services. This meant that in Manicaland, as elsewhere in the country, several smaller and more remote facilities began to provide ARTs for the first time.

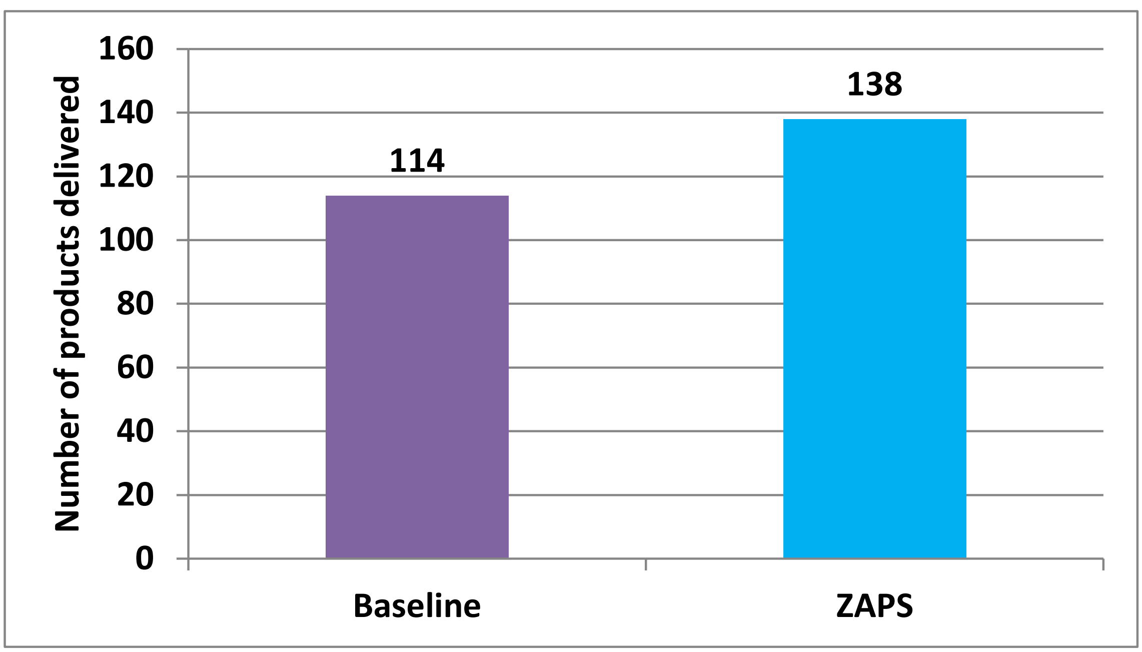
Figure 7. Comparison of Baseline versus Endline Number of Facilities Delivered to Commodity Group



Number of Products Delivered Under ZAPS

An increase in the overall number of products managed by ZAPS put additional pressure on the supply chain in Manicaland. As Figure 8 shows, the total number of products delivered under the ZAPS was 138 compared to 114 under the baseline systems.

Figure 8. Number of Products Delivered, Baseline versus ZAPS



ZAPS Performance

This section compares the baseline performance of the supply chain with its performance during the ZAPS pilot. Although our focus was on Manicaland, we also show how the supply chain was performing in the rest of the country during the same time.

Information Availability and Quality

The category of information availability and quality includes indicators on reporting coverage, as well as on-time data collection.

Reporting Coverage

For the ZAPS and the baseline DTTU and ZIP systems, reporting coverage is defined as the number of facilities receiving a quarterly order team visit divided by the total number of eligible facilities. Under the ZADS baseline, reporting coverage was the percentage of eligible facilities submitting a bimonthly report. As Table 11 shows, reporting coverage was high for the baseline systems, averaging between 93 and 100 percent. During the ZAPS, reporting coverage stayed at 99 or 100 percent for all four rounds.

Table 11. Comparison of Reporting Coverage Rates, ZAPS versus Baseline

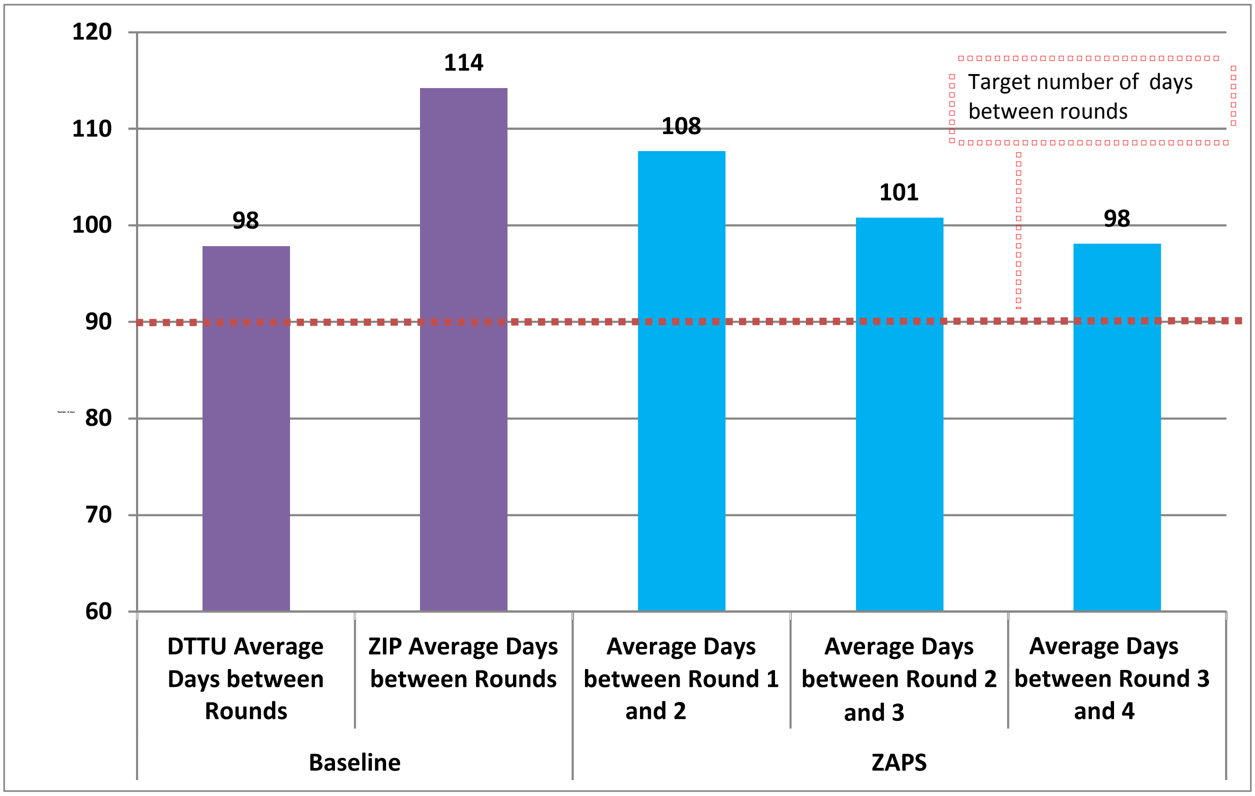
DTTU Baseline Average	ZIP Baseline Average	ZADS Baseline Average	ZAPS Round 1	ZAPS Round 2	ZAPS Round 3	ZAPS Round 4
98%	100%	93%	100%	99%	99%	100%

On-Time Data Collection

Timeliness of data collection is key to any supply chain system. One measure of timeliness is the average number of days since the last data collection. For the ZAPS, data collection occurs during the order team visit; for the DTTU and ZIP systems, data collection occurs during the visit of the order and delivery team. For the ZAPS, DTTU, and ZIP, 90 days is the standard interval between data collection. To calculate this indicator, we averaged the number of days since the last data collection across all facilities in Manicaland.

As Figure 9 shows, the number of days between data collection was 98 for DTTU and 114 for ZIP, somewhat above the target of 90 days. For the ZAPS, the average number of days between data collection rounds was 108 between rounds 1 and 2, but it steadily decreases. Between round 4 and round 3, the average number of days between data collection is 98 days, similar to the DTTU baseline average.

Figure 9. Average Number of Days between Data Collection, Baseline versus ZAPS



Customer Response

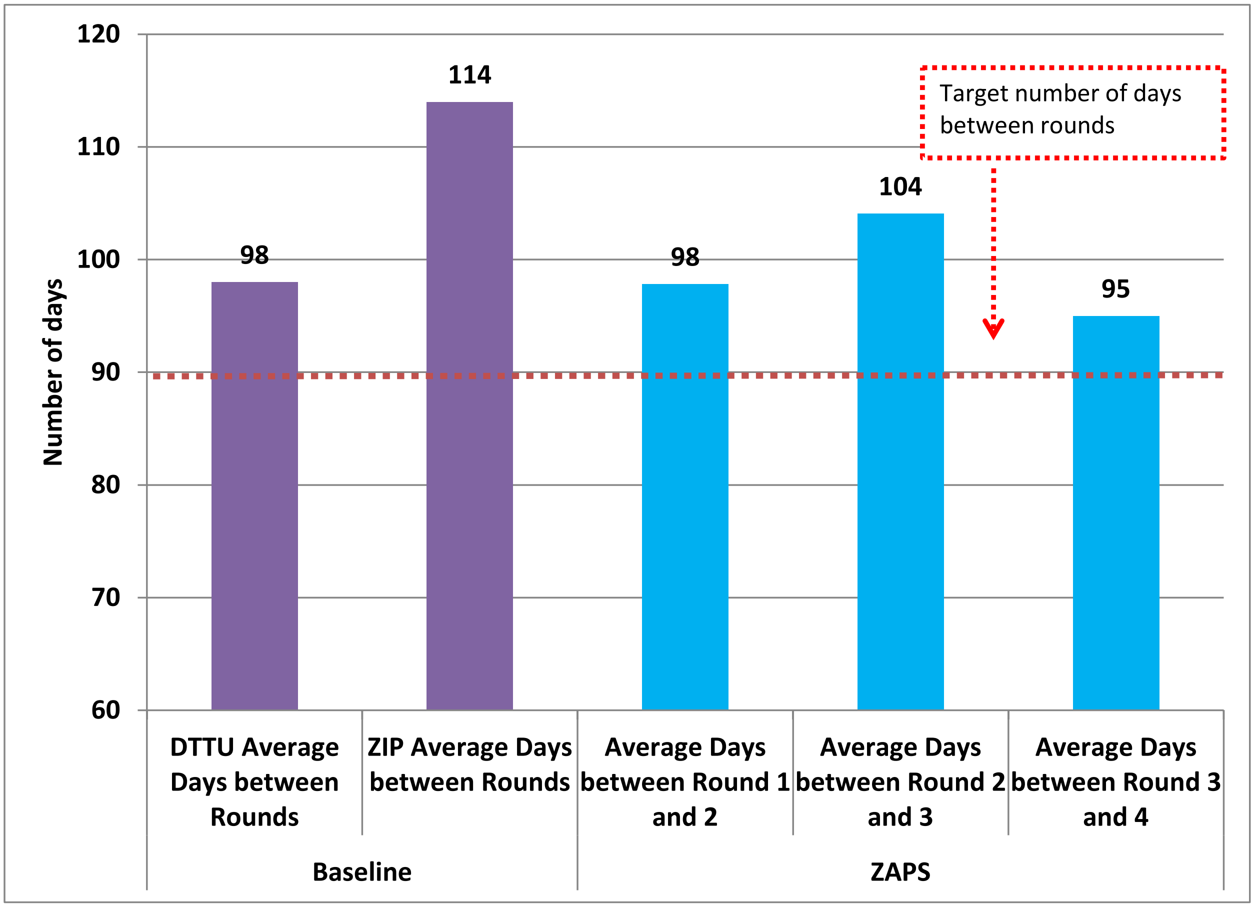
Customer response indicators assess the relationship between each supply chain system and its customers, principally the health facilities. These indicators include on-time delivery and time and level of effort to complete a resupply cycle. The cost study addresses the latter.

On-Time Delivery

To measure on-time delivery, we constructed an indicator similar to the one we used to measure on-time data collection—average number of days between deliveries. To calculate this indicator, we averaged the number of days between deliveries across all facilities in Manicaland. For both the DTTU and ZIP, data collection and delivery occurs on the same date. Thus, for those two systems, the on-time delivery indicator is equivalent to the measure of on-time data collection reported above. For the ZAPS, the standard interval between deliveries is 90 days. For the ZADS, we could not calculate on-time delivery measures from the existing data.

Figure 10 shows the average number of days between delivery rounds during the ZAPS compared to the averages for DTTU and ZIP at baseline. Neither at baseline nor during ZAPS did the systems achieve the target of delivering within 90 days. The ZAPS pilot did, however, average about the same number of days between deliveries as for DTTU, and it took less time than the ZIP system.

Figure 10. Average Number of Days between Delivery Rounds, Baseline versus ZAPS



Commodity Availability and Inventory Management

The category of commodity availability and inventory management includes four indicators: stock availability, stockout duration, stocked according to plan, and expiries.

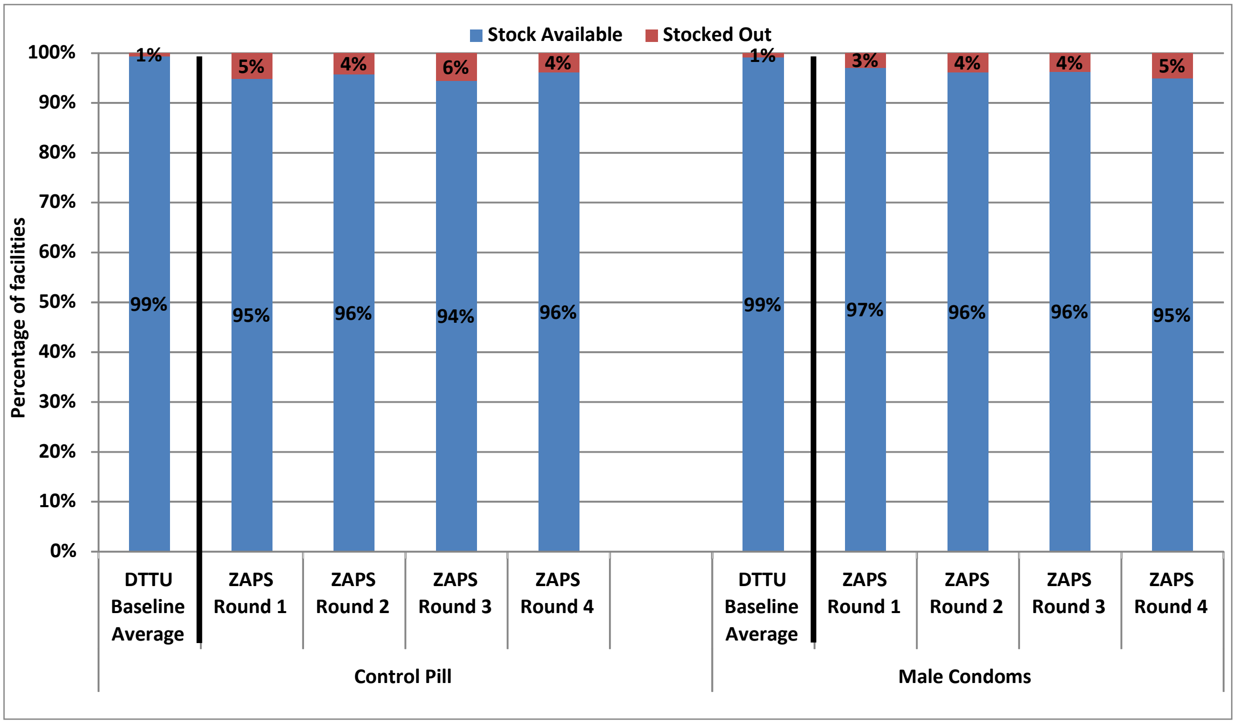
Stock Availability

Stock availability is a key indicator of supply chain performance and a focus of the evaluation. The definition of stock availability varies slightly, depending on the system. For the DTTU and ZIP, the stock availability indicator measures the percentage of eligible facilities with stock of full-supply products available on the day the order and delivery team visit the facility. For the ZADS, stock availability measures the percentage of eligible facilities with stock of full-supply products on the day the facility completes its report for the bimonthly period. For the ZAPS, the stock availability indicator measures the percentage of eligible facilities with stock of full-supply products available on the day the order visits the facility. Following, we compared the baseline average with the ZAPS round 1 through 4 data, by product.

Family planning products

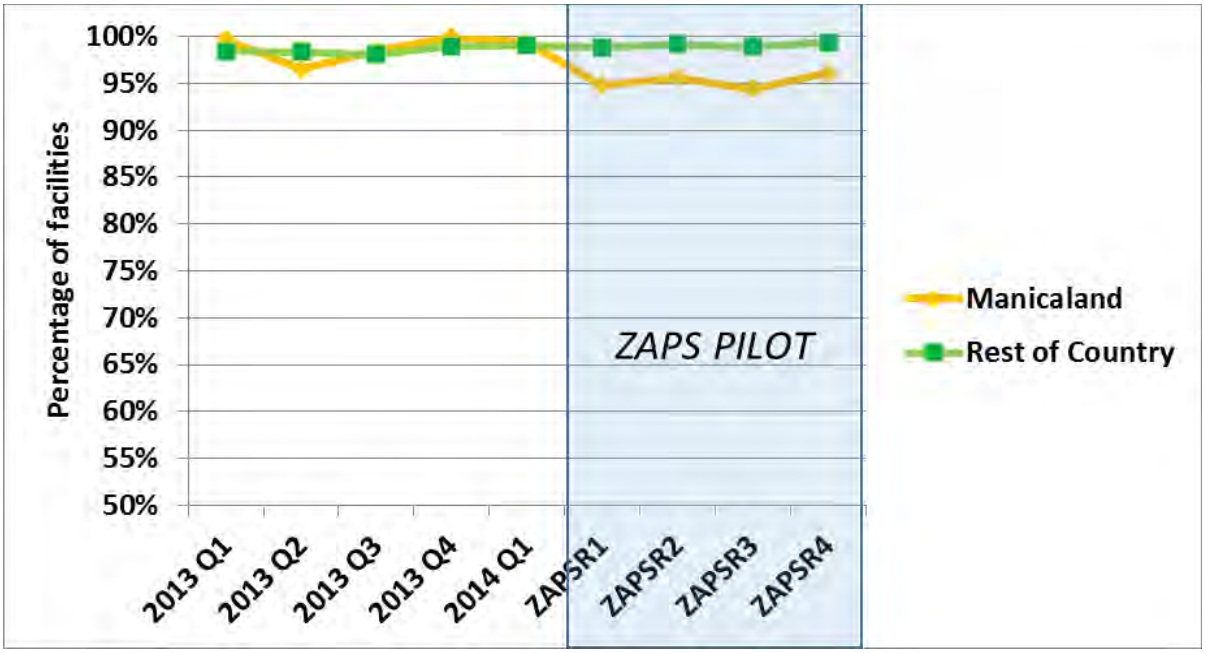
The DTTU manages both the control pill and male condom. As Figure 11 shows, the stock availability rate for both tracer products averaged 99 percent during the baseline period. Stock availability during the ZAPS pilot fell slightly for both products—between 94 and 97 percent.

Figure 11. Stock Availability of Control Pill and Condom, Baseline versus ZAPS



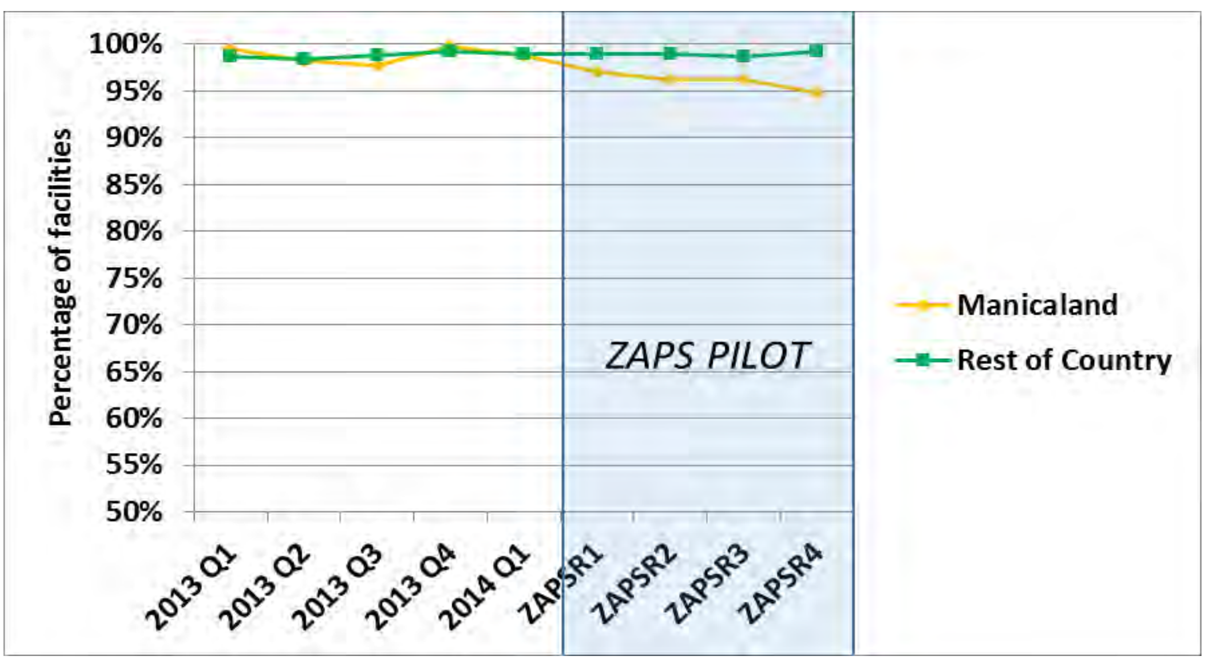
To what extent was the deterioration in availability for these two products a function of the ZAPS versus other factors in the supply chain context? We can partially answer that question by comparing the experience in Manicaland with how the supply chain was performing elsewhere in Zimbabwe. Figure 12 shows stock availability of the control pill for Manicaland and for the rest of Zimbabwe, beginning in the first quarter of 2013 and ending with round 4 of the ZAPS. As Figure 12 shows, in the five quarters prior to the ZAPS, the supply chain in both Manicaland and in the rest of the country maintained availability of nearly 100 percent for the control pill. During the ZAPS pilot, the supply chain in the rest of Zimbabwe continued to maintain rates of 99 to 100 percent stock availability. Meanwhile, we saw the stock availability rate in Manicaland dip to 95 percent during the ZAPS. These results suggest that it was the ZAPS, rather than other supply chain environmental factors, that caused the apparent drop in stock availability.

Figure 12. Stock Availability of Control Pill, Manicaland versus the Rest of the Country



When we made the same comparison for the male condom, a similar pattern emerged (see Figure 13).

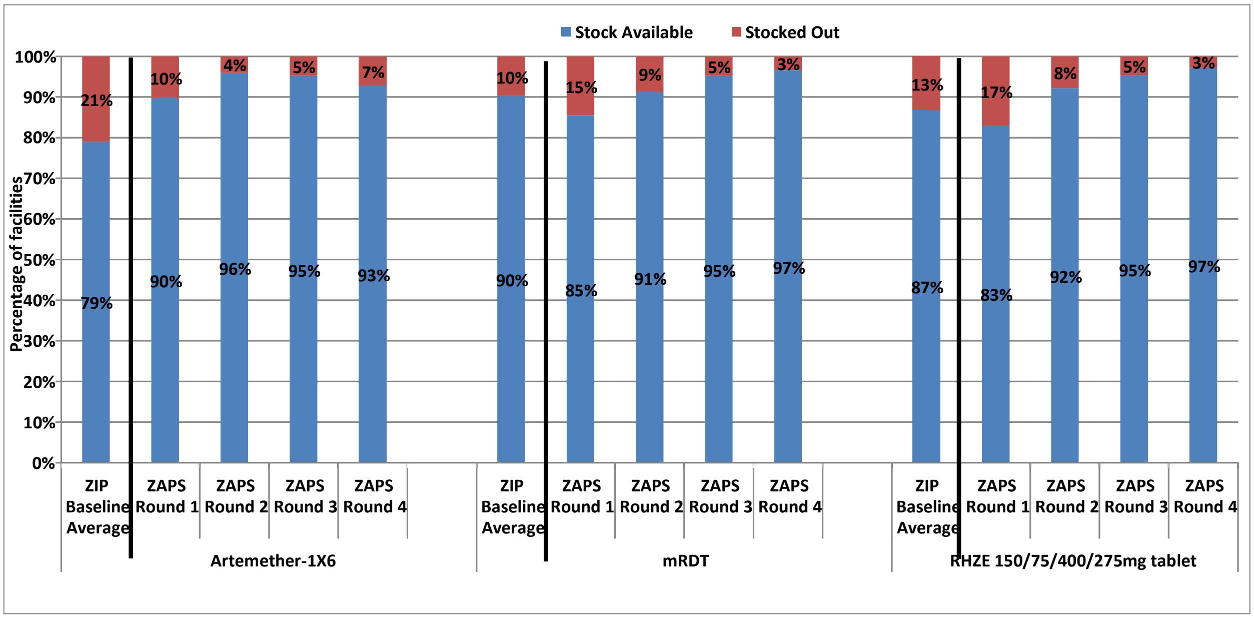
Figure 13. Stock Availability of Male Condom, Manicaland versus the Rest of the Country



Malaria and TB products

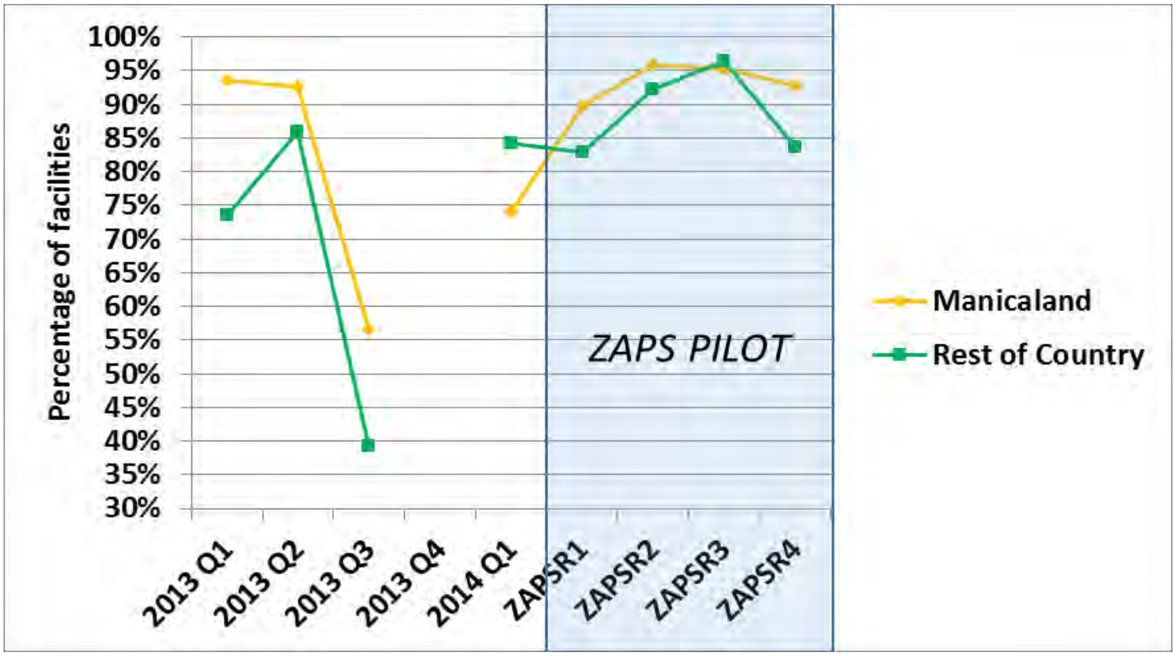
The three tracer products that ZIP has traditionally managed include two malaria products, artemether 1×6 and malaria rapid diagnostic test (mRDT); and a TB drug, rifampicin150mg/isoniazid 75mg/pyrazinamide 400mg/ethambutol 275mg (RHZE). As Figure 14 shows, the stock availability for all three tracer products under the ZIP baseline varied between 79 percent for artemether 1×6 to 90 percent for mRDT. With the advent of the ZAPS, stock availability rates for all three products increased. By round 4 of ZAPS, availability had increased to between 93 and 97 percent.

Figure 14. Stock Availability of Artemether 1x6, mRDT, and RHZE, Baseline versus ZAPS



Can we say that the ZAPS caused the improvement in stock availability? As Figure 15 shows, general trends in stock availability rates in Manicaland and in the rest of Zimbabwe track closely, both in the baseline period and during the ZAPS pilot. We can see, however, that Manicaland traditionally outperformed the rest of the country. This continued during the ZAPS period, in which for three of the four rounds Manicaland performed better. Thus, it appears that general national trends in supply chain performance played a larger role in the improvements we saw in Manicaland than the ZAPS.

Figure 15. Stock Availability of Artemether 1×6, Manicaland versus Rest of Country



Examining the data for mRDT (see Figure 16) and RHZE (see Figure 17) show similar trends.

Figure 16. Stock Availability of mRDT, Manicaland versus Rest of Country

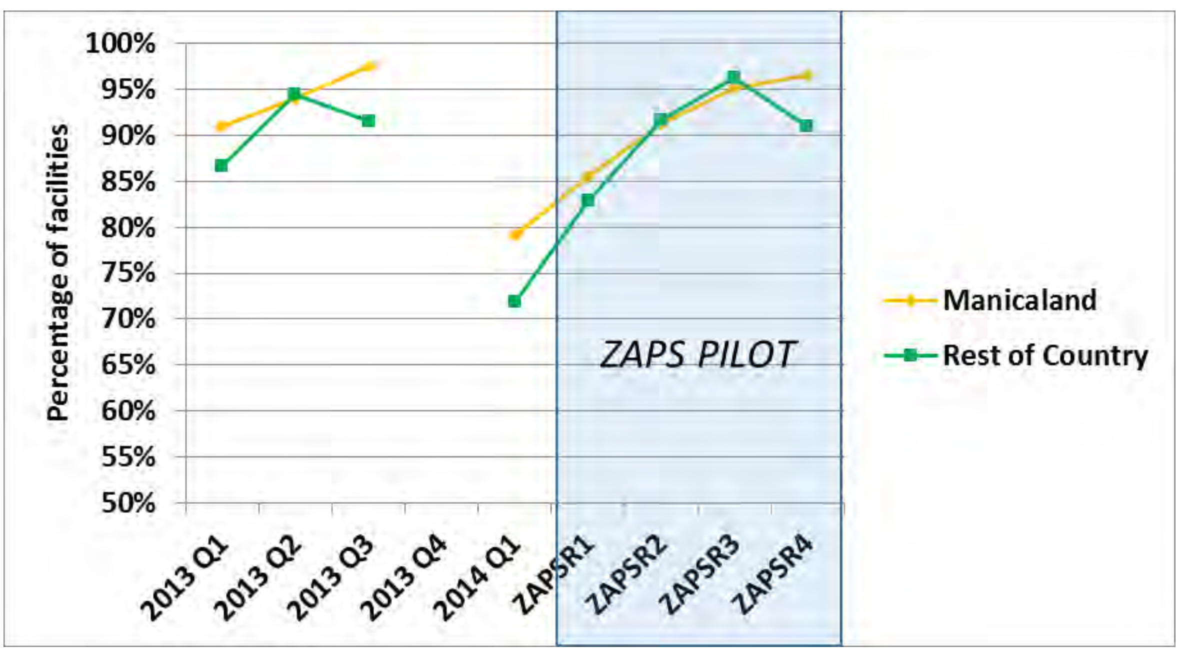
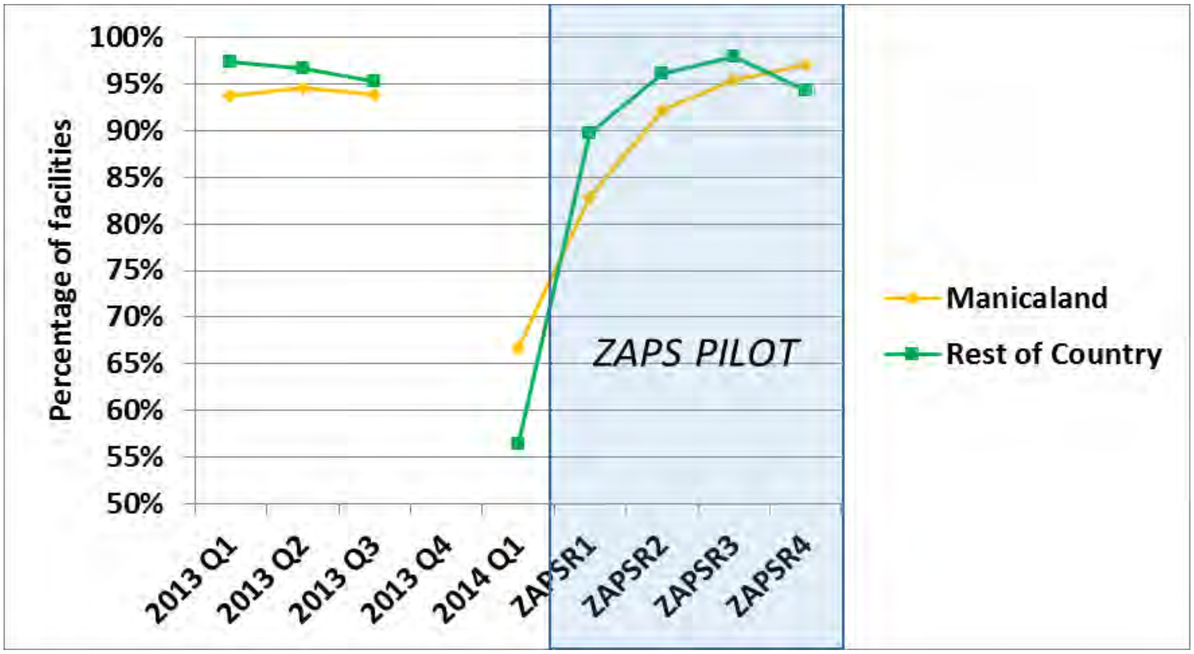


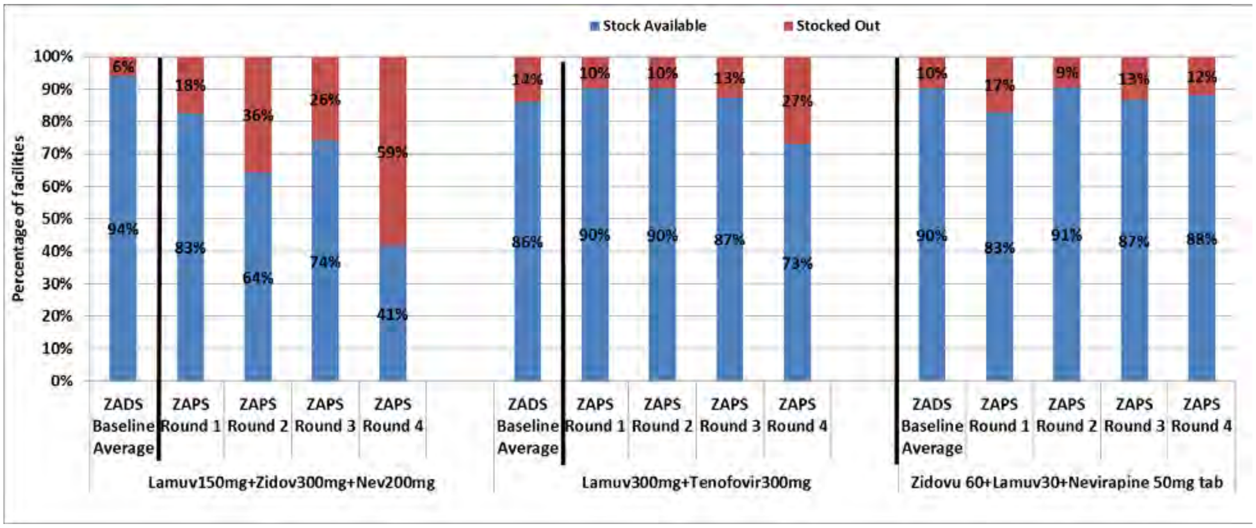
Figure 17. Stock Availability of RHZE, Manicaland versus the Rest of the Country



Antiretroviral drugs

The study examined stock availability for three antiretroviral drugs traditionally managed under the ZADS, lamivudine 150mg + zidovudine 300mg + nevirapine 200mg, lamivudine 300mg + tenofovir 300mg, and zidovudine 60 + lamivudine 30 + nevirapine 50. As Figure 18 shows, the ZADS during the baseline obtained levels of stock availability for the three tracer products that ranged from 6 to 14 percent. With the implementation of the ZAPS, stock availability evolved in different ways for each of the three products. Stock availability of lamivudine 150mg + zidovudine 300mg + nevirapine 200mg saw an immediate decrease in round 1 and continued to fall, reaching just 41 percent by round 4. For lamivudine 300mg + tenofovir 300mg, stock availability levels under the ZAPS remained about the same during round 1 through 3, then dropped sharply in round 4, to 73 percent. For zidovudine 60 + lamivudine 30 + nevirapine 50, stock availability dropped somewhat in round 1, but by round 2 had returned roughly to the baseline level of 90 percent.

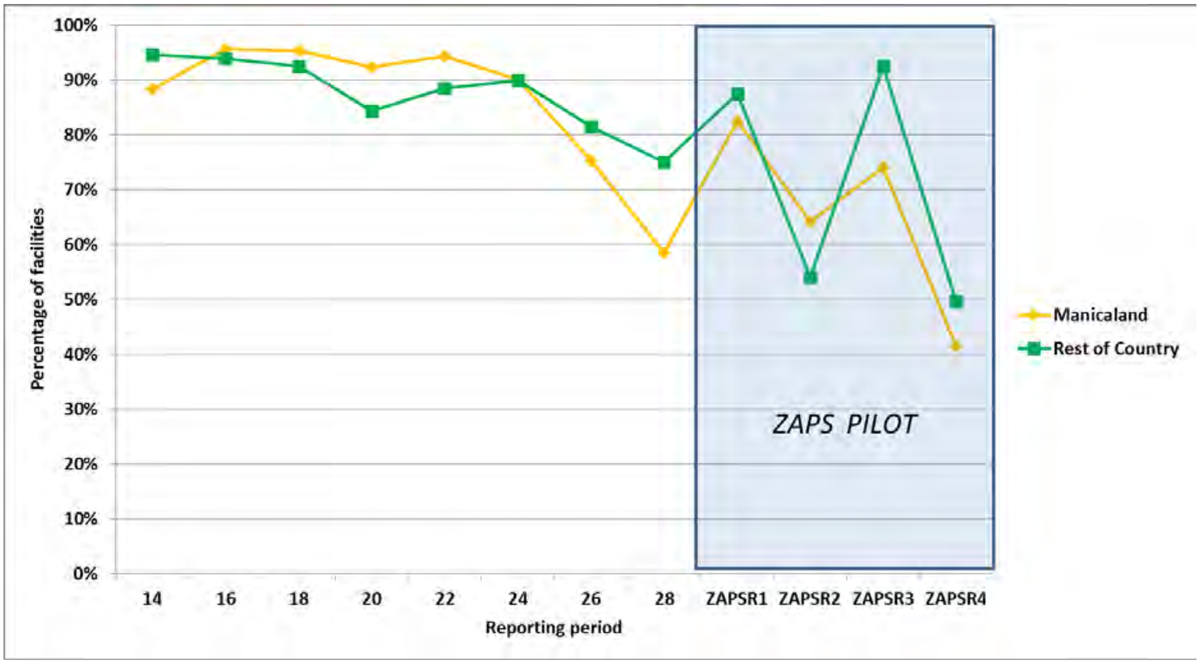
Figure 18. Stock Availability of Antiretroviral Drugs, Baseline versus ZAPS



One possible explanation for the lower stock availability during ZAPS is the noted increase in the quantity of short-dated ARVs, particularly for lamivudine 150mg + zidovudine 300mg + nevirapine 200mg. Another explanation for the sudden decrease in availability of lamivudine 300mg + tenofovir 300mg in round 4 is the planned phaseout of the drug that began in 2015. Another potential explanation for the lower performance of the supply chain for ARV drugs is the addition of several new primary healthcare facilities to the ARV program. Previously, staff at many of these new facilities had never seen clients on antiretroviral therapy and may have encountered problems in managing the supply of associated ARV products.

When we examined what was happening in the rest of Zimbabwe, we saw a similar pattern of stock availability for lamivudine 150mg + zidovudine 300mg + nevirapine 200mg (Figure 19). This finding supports the view that there were factors other than the implementation of the ZAPS that contributed to the deterioration of stock availability in Manicaland. Nonetheless, Manicaland had a poorer performance than the rest of the country in three of the four ZAPS rounds, thus raising the possibility that there were ZAPS-specific reasons for the drop in availability.

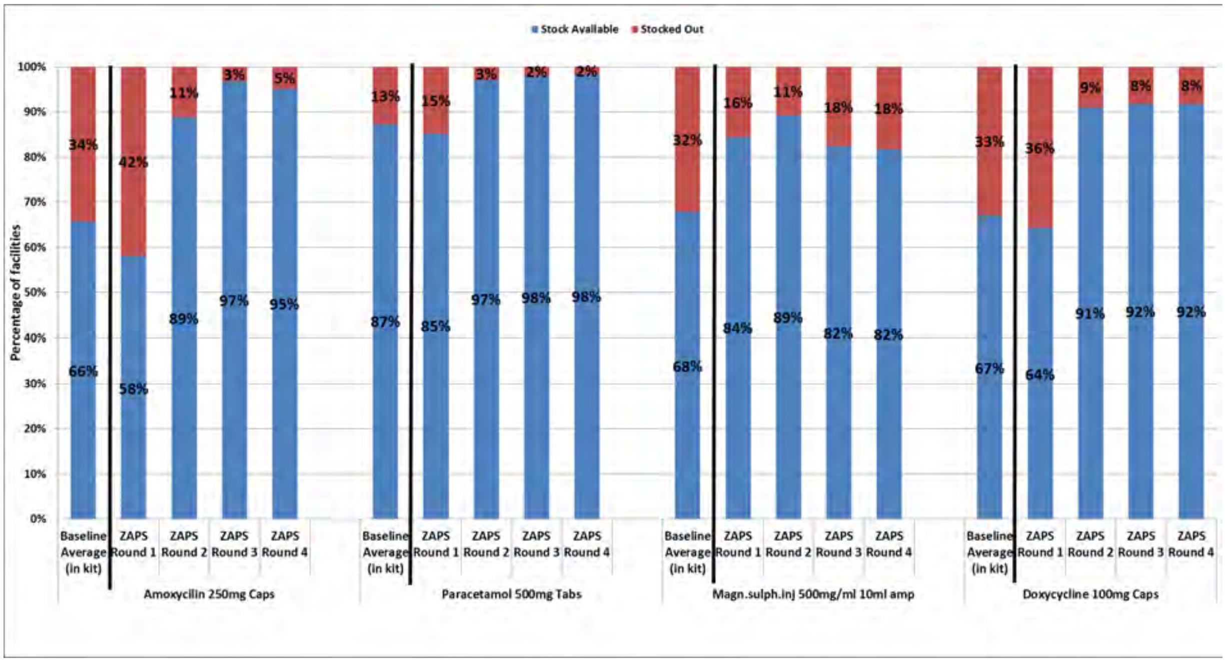
Figure 19. Stock Availability of Lamivudine 150mg + Zidov 300mg + Nevirapine 200mg, Manicaland versus Rest of Zimbabwe



Essential medicines

We also looked at the stock availability for four essential medicines that, at baseline, were part of the PHCP kit delivered under the ZIP/PHCP system, Amoxycillin, paracetamol, magnesium sulphate, and doxycycline. As Figure 20 shows, baseline levels were low for three of the four products, between 66 and 68 percent. Availability of paracetamol was somewhat higher at 87 percent. Under the ZAPS, there was a very substantial increase in stock availability for all four of the tracer essential medicines, now ordered individually. By round four, stock availability was between 91 and 98 percent.

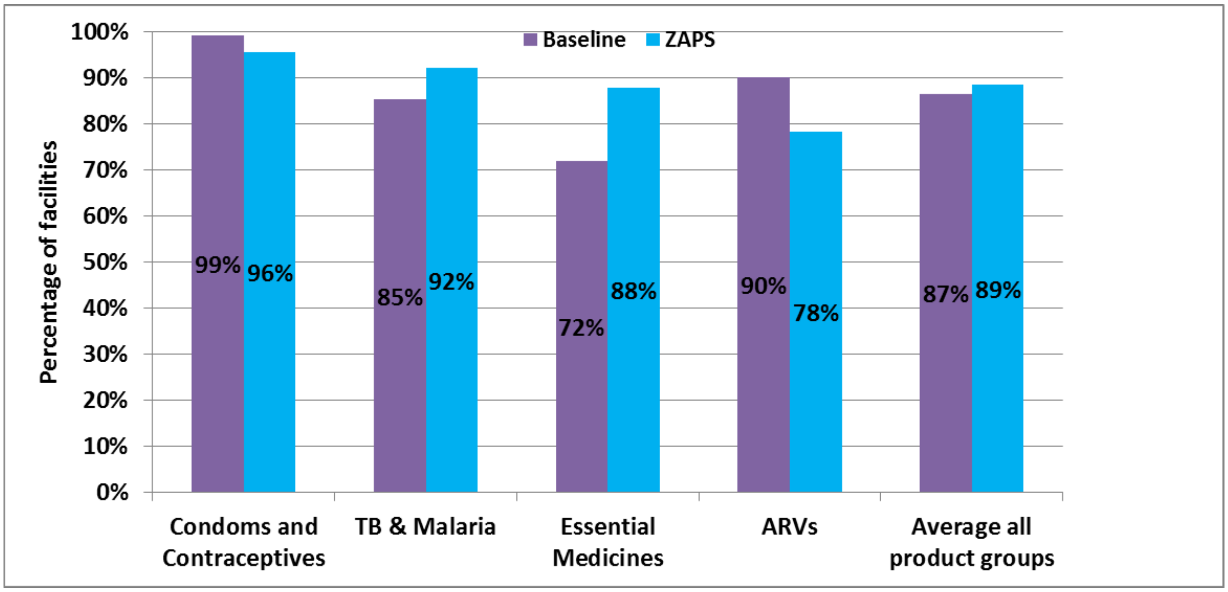
Figure 20. Stock Availability of Essential Medicines, Baseline versus ZAPS



Comparison of all products

Figure 21 compares stock availability rates by commodity groups and for all products combined. Here we compare average rates for the baseline and for the ZAPS. Average stock availability fell by 3 percent for condoms and contraceptives, rose by 7 percent for TB and malaria products, rose by 16 percent for essential medicines, and fell by 12 percent for ARVs. Combining all products, product availability rose 2 percent under the ZAPS—from 87 to 89 percent.

Figure 21. Summary of Stock Availability by Product Group, Baseline versus ZAPS



As we did for the individual products listed in figure 21, it is useful to place the Manicaland findings for all tracer products combined against the supply chain performance in the rest of Zimbabwe, during the same periods. What we found was that stock availability in the rest of the country rose 2 percentage points, from 89 to 91 percent, an increase almost identical to what we saw in Manicaland. This supports the idea that the slight increase in Manicaland was as much due to a general improvement in the supply chain environment in Zimbabwe as it was to the ZAPS.

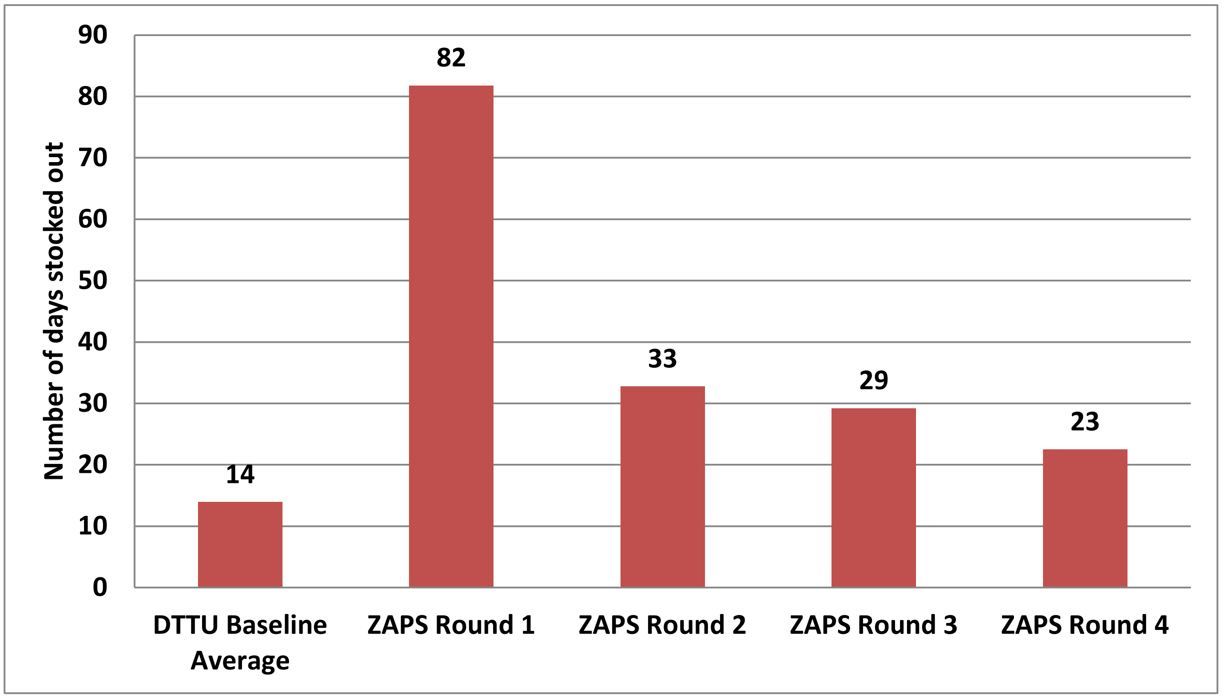
Stockout Duration

The stockout duration indicator measures the severity of those stockouts that do occur by calculating the average number of days stocked out. We can compare stockout duration for DTTU and ZIP products. Because stockout duration for ZADS products was not available for the baseline, we were not able to complete the comparison for the ARV products.

Family planning products

Figure 22 shows, of those facilities experiencing stockouts, the average number of days those stockouts lasted. DTTU products at baseline (control pill and condom) averaged a stockout duration of 14 days. This average increased dramatically during round 1 of ZAPS, probably reflecting the order and delivery delays that occurred while ZAPS experienced problems in its startup phase. Stockout duration then dropped substantially in round 2, and continued to fall to an average level of 23 days for round 4, still higher than the average at baseline.

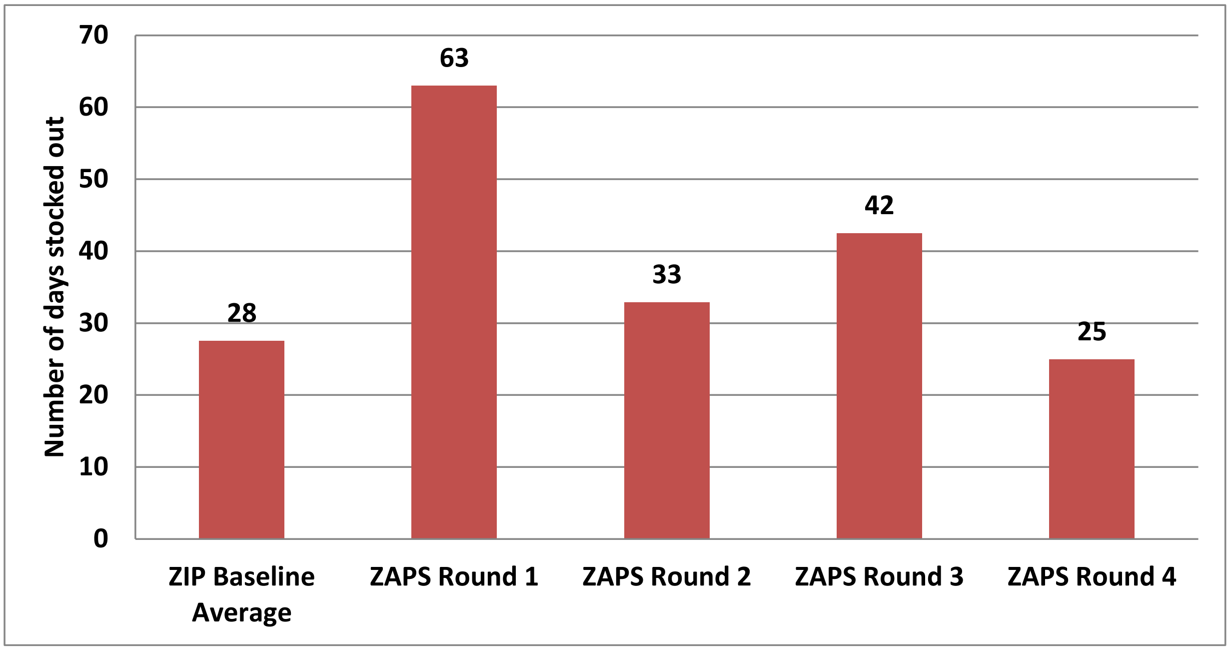
Figure 22. Average Duration of Stockout in Days for Condoms and Contraceptives, Baseline versus ZAPS



Malaria and TB products

Stockout duration for the TB and malaria products shows a similar pattern (Figure 23). Stockout duration in round 1 of the ZAPS was 63 days, much higher than the baseline average of 28 days. By round 4 of the ZAPS, however, the average duration was down to 25 days, lower than the baseline.

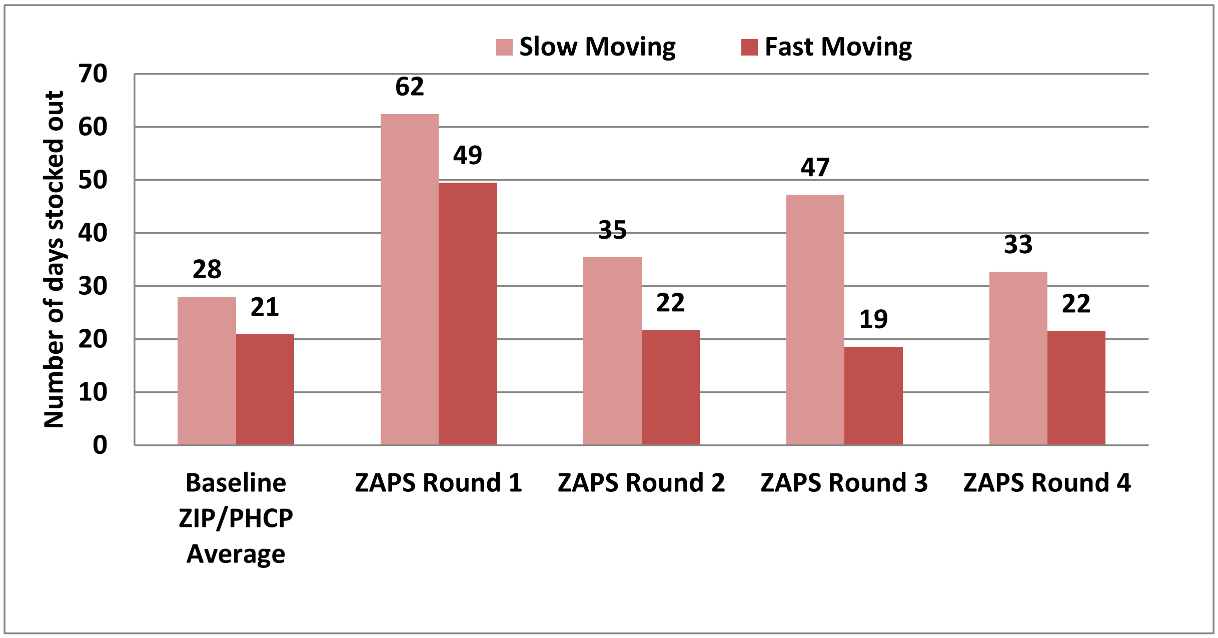
Figure 23. Average Duration of Stockout in Days for TB and Malaria Products, Baseline versus ZAPS



Essential medicines

Because we thought we might detect differences in stockout duration, we examined two types of essential medicines, slow- and fast-moving. Slow-moving included doxycycline 100mg caps and magnesium sulphate injection 500mg/ml 10ml amp; fast-moving included amoxicillin 250mg caps and paracetamol 500mg tabs. Overall, with the introduction of the ZAPS, stockout duration for the PHCP essential medicines products showed a pattern similar to what we saw for DTTU and ZIP products. Although the expectation was that we would see higher stockout duration for the fast-moving products and lower stockout duration for the slow-moving products; in fact, we found the opposite. Figure 24 shows that the baseline stockout duration was 28 days for slow-moving products and 21 days for fast-moving products. Like the other products groups, there was a sharp increase in stockout days in round 1 of ZAPS, followed by a generally downward trend. By round 4, the average stockout duration was 33 days, five days longer than at baseline. For fast-moving products, the average stockout duration under ZAPS was 22 days, only one day longer than at baseline.

Figure 24. Average Duration of Stockout in Days for Essential Medicines, Baseline versus ZAPS



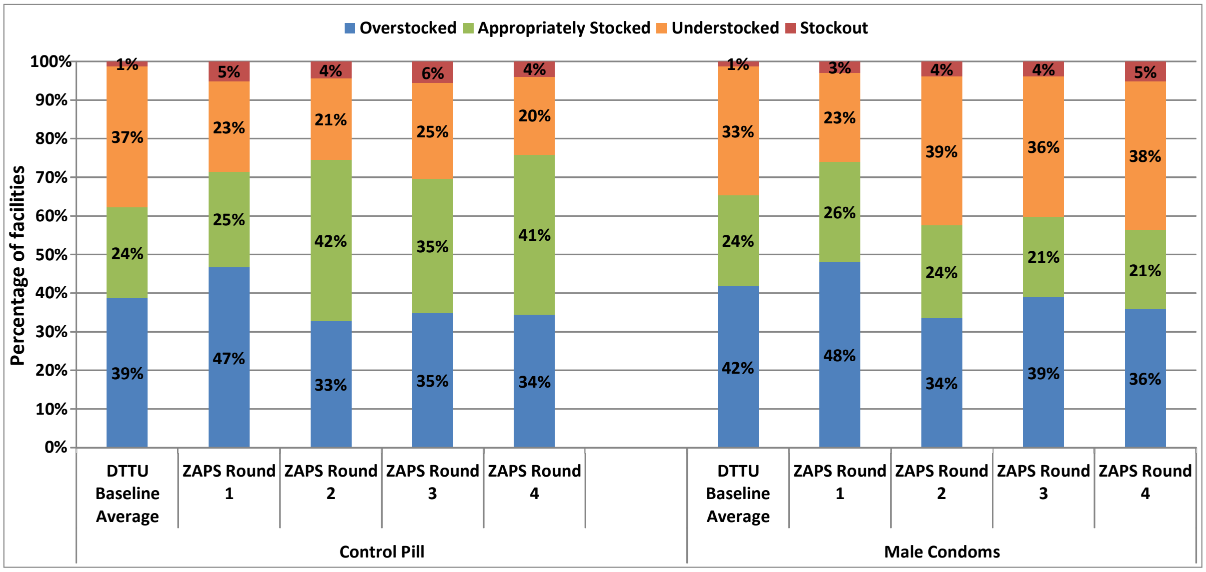
Stocked According to Plan

The *stocked according to plan* indicator measures the percentage of facilities that manage products within the correct range of months of inventory. For the DTTU, ZIP, and ZAPS, the order team measures stock on hand (SOH) at the time of their visit to the facility. If the SOH equals zero, the product is classified as stocked out. If the SOH is greater than zero but less than three months of average monthly consumption (AMC), the product is *understocked*. If the SOH is between three and six months of AMC, the product is *appropriately stocked*. If the SOH is more than six months of AMC, the product was *overstocked*. For the ZADS, the stock status definitions are the same for stockout and understocked, but slightly different for appropriately stocked and overstocked. If the SOH is between three and five months of AMC, the product is *appropriately stocked*. If the SOH is more than five months of AMC, the product is *overstocked*.

Family planning products

Figure 25 compares the baseline stock status to stock status during ZAPS for the control pill and condom (see Appendix 2 for values for the rest of Zimbabwe). For the control pill, the percentage of facilities appropriately stocked increased from 24 percent at baseline to 41 percent by round 4 of the ZAPS. Rates of under- and over-stocking fell. For the male condom, there was a slight decrease in the percentage of facilities appropriately stocked—from 24 percent to 21 percent by the ZAPS round 4. Meanwhile, understocking increased slightly while overstocking decreased slightly.

Figure 25. Stock Status for Condoms and Contraceptives, Baseline versus ZAPS

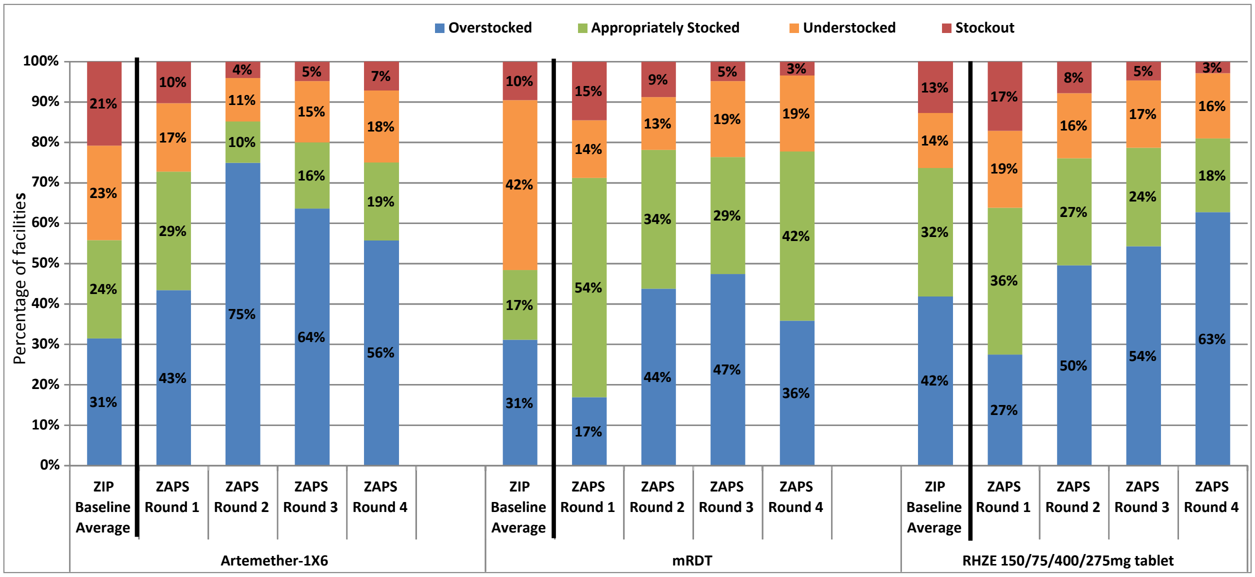


Malaria and TB products

Figure 26 compares the baseline stock status to stock status during ZAPS for artemether, mRDT, and RHZE. The percentage of facilities appropriately stocked with artemether fell from 24 percent at baseline to 19 percent by round 4 of the ZAPS. This corresponded to a large increase in the overstocking percentage, from 31 to 56 percent. For mRDT, by contrast, levels of appropriate stocking rose from 17 to 42 percent, while understocking decreased dramatically. Levels of mRDT overstocking remained about the same.[3] Stock status for RHZE showed a pattern similar to that of artemether, a substantial drop in appropriate stock levels and a corresponding rise in overstocking.

[3] During the intervention period, the number of malaria cases seen at the health facilities in the study area was lower than anticipated—probably due to a lower than normal incidence—and, therefore, contributed to an increased number of overstocked facilities.

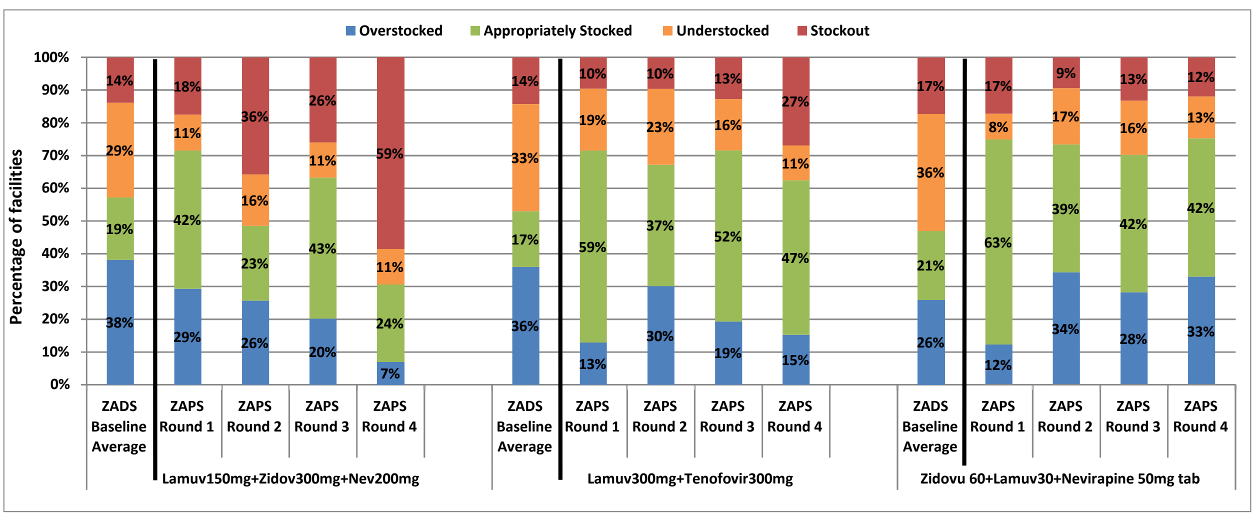
Figure 26. Stock Status for Malaria and TB Products, Baseline versus ZAPS



Antiretroviral drugs

Figure 27 compares the baseline stock status to stock status during ZAPS for three ARVs. For all three products, there was an increase in the percentage of facilities appropriately stocking the drugs. Meanwhile, levels of overstocking decreased substantially for two of the three drugs, while slightly increasing for the third. Levels of understocking also dropped across the board.

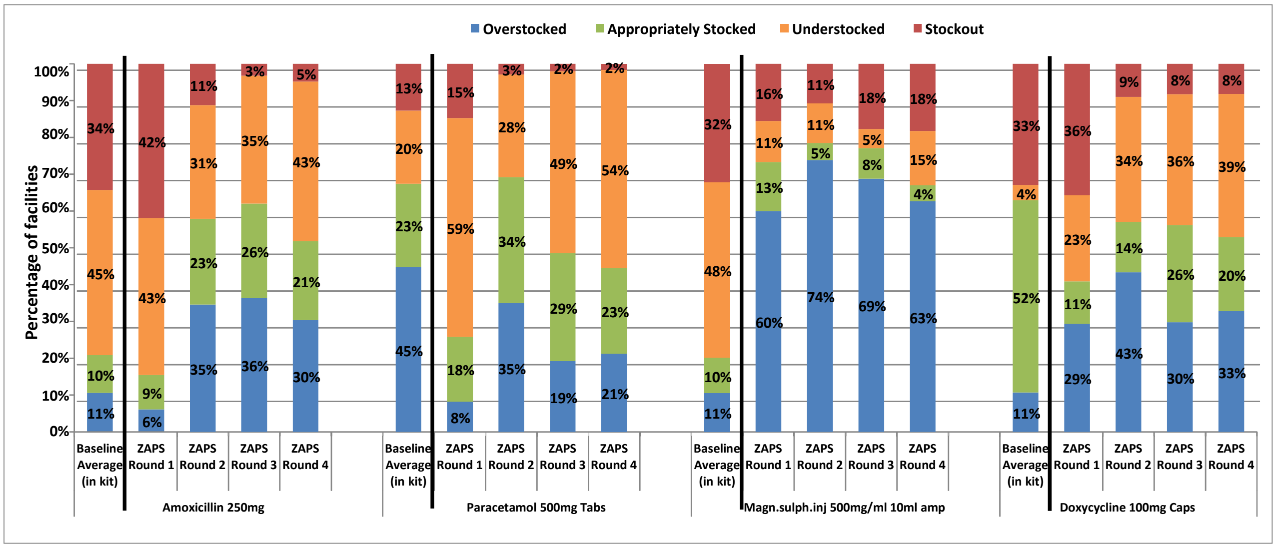
Figure 27. Stock Status for Antiretroviral Drugs, Baseline versus ZAPS



Essential medicines

Figure 28 compares the baseline stock status to stock status during the ZAPS for four essential medicines. For amoxycillin, the percentage of facilities with appropriate stock level increased between the baseline and round 4 of the ZAPS; for paracetamol, there was no change; and for doxycycline and magnesium sulphate, the appropriate stocking fell. Meanwhile, for three of the products, overstocking increased, while only paracetamol decreased.

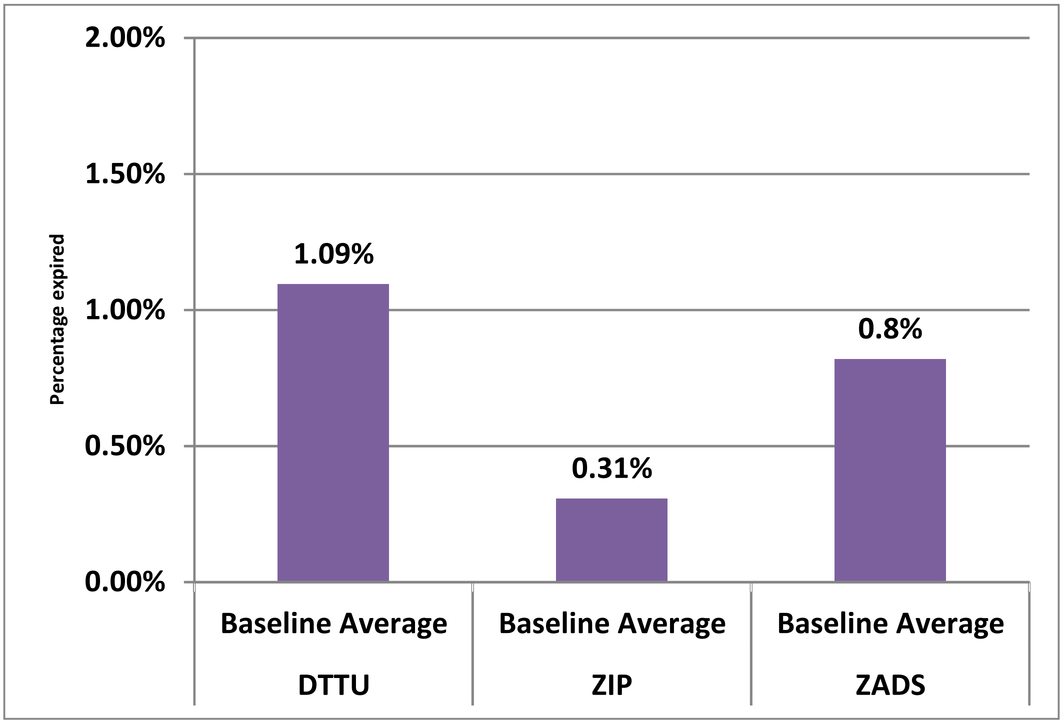
Figure 28. Stock Status for Essential Medicines, Baseline versus ZAPS



Expiries

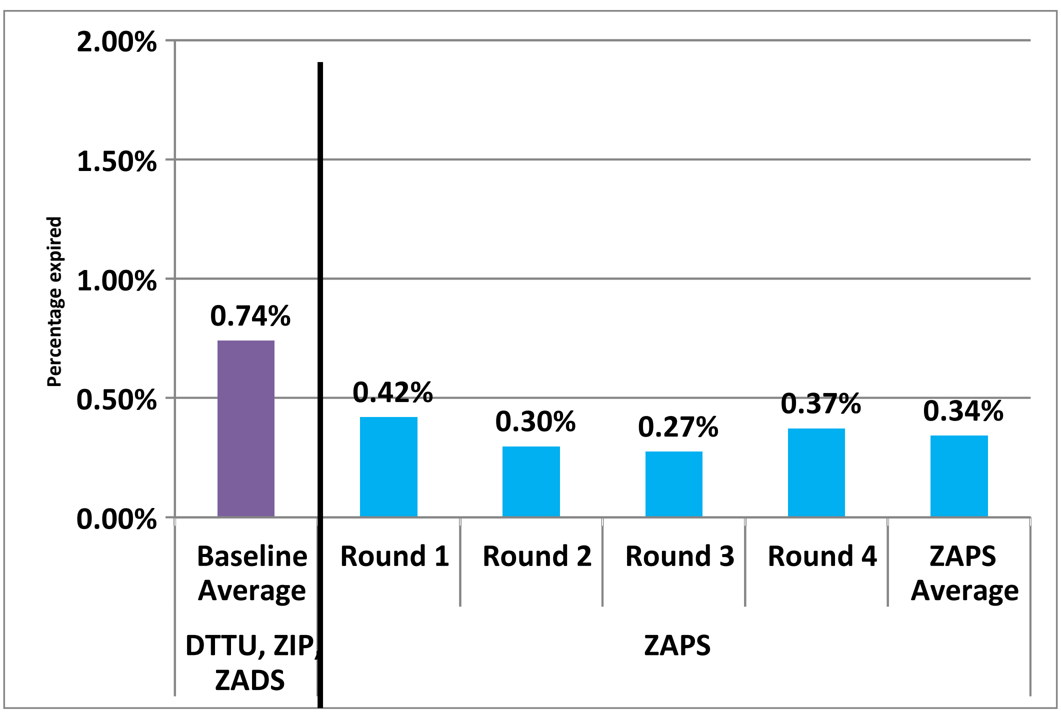
The expiry rate is the percentage of expired products, which is calculated by dividing the total quantity of product that expired, during the specified period, by the quantity of the opening balance of the product at the beginning of the period. Figure 29 shows the average expiry rate for the DTTU, ZIP, and ZADS for the baseline period. The expiry rates for all three systems were low; DTTU had the highest at 1.09 percent, followed by ZADS at 0.8 percent, and ZIP/PHCP at 0.31 percent.

Figure 29. Expiry Rate, Baseline DTTU, ZIP, and ZADS



We combined the DTTU, ZIP, and ZADS baseline rates to produce an overall baseline average for expiries of 0.74 percent. Figure 30 compares this baseline average to the ZAPS expiry rate. The rates for all four rounds were lower than the baseline rate of 0.42 percent or lower.

Figure 30. Expiry Rate, Baseline versus ZAPS



Cost

The designers of the ZAPS believed that merging four systems into one would offer significant cost savings for running the supply chain. Thus, an important part of the evaluation was to measure the cost of running the four separate supply chains in Manicaland in the year prior to implementing the ZAPS and to compare that to the cost of running the ZAPS for one year.

This section first presents information on commodity throughput—a measure of how much the system handles. Then, we present cost results, including a comparison of total cost, main function, (transport, warehousing, etc.), tier (central, province, district, and facility), and input (labor, fuel, etc.). All costs are presented in constant 2013 U.S. dollars.

Commodity Throughput

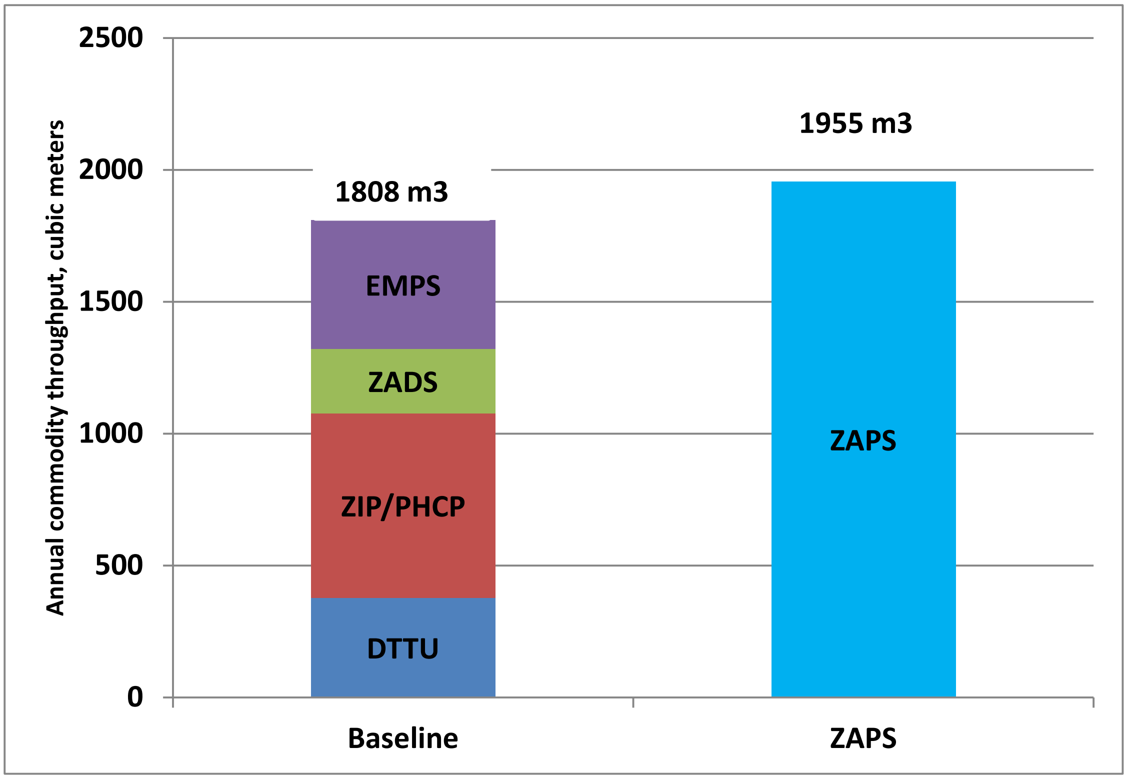
Commodity throughput—the amount of product in volume, value, or weight handled by the supply chain over the year—is an important measure of supply chain functioning. Any number of factors can affect throughput levels:

- number of facilities ordering
- demand generated by the facilities' clients
- availability of commodities for distribution
- seasonal factors
- fluctuations in incidence of diseases
- proper functioning of the procurement system
- increase or decrease in the number of facilities
- growth in population.

Understandably, throughput is a major determinant of costs, because most supply chain costs vary according to the level of throughput.

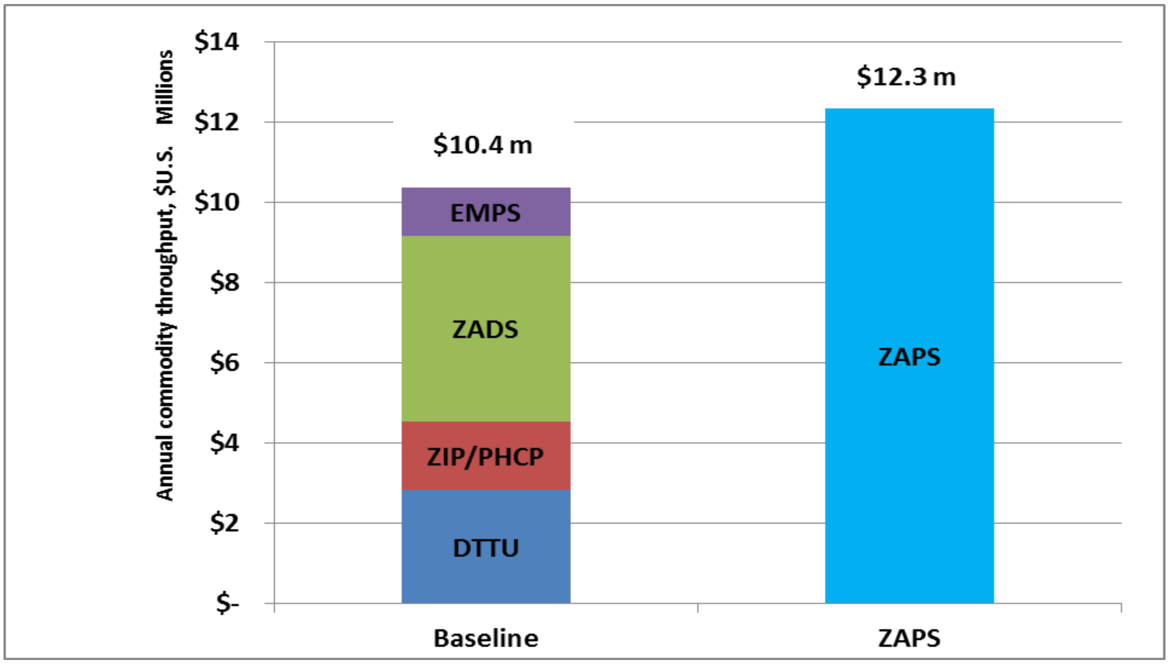
We found that the ZAPS handled a higher volume of commodities compared to the baseline systems: 1,955 cubic meters (m^3) versus 1,808 m^3 (see Figure 31).

Figure 31. Comparison of Annual Commodity Throughput Volume in Manicaland



Similarly, ZAPS handled a higher level of throughput value compared to the baseline—$12.3 million—compared to $10.4 million (see Figure 32). Note that, at baseline, the ZADS products, which include high-value antiretroviral medicines, heavily influence throughput value.

Figure 32. Comparison of Annual Commodity Throughput Value in Manicaland

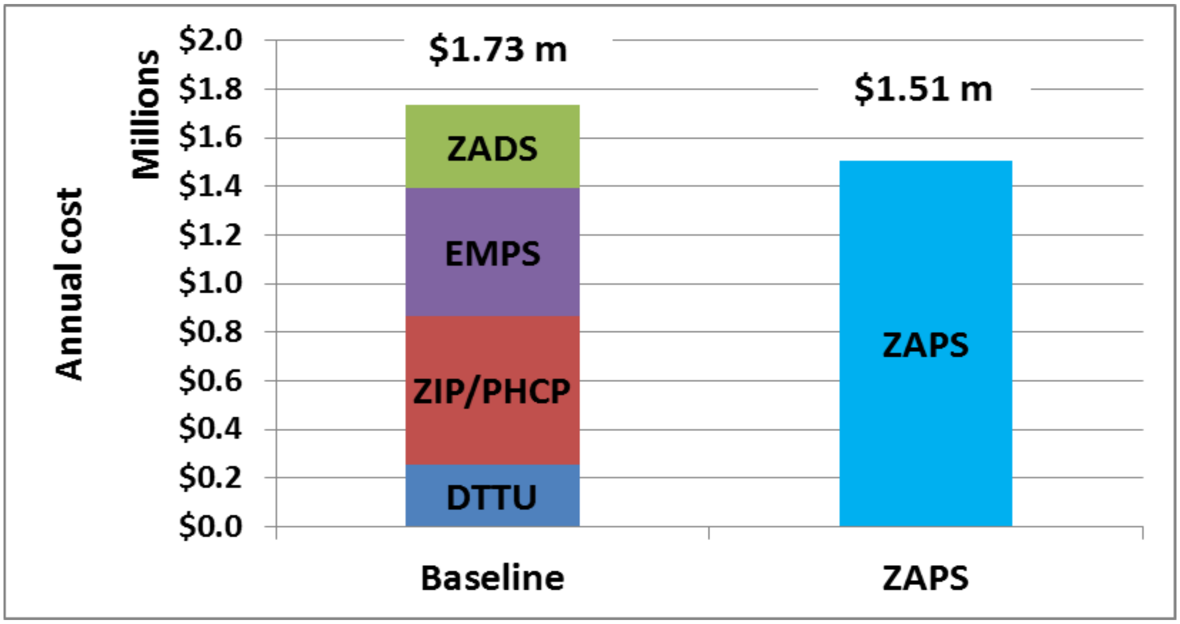


A range of factors likely influenced the 18 percent throughput increase. As noted above, ZAPS served 24 percent more facilities, on average, than during the baseline year. Improvements in the replenishment processes, especially for those commodities previously delivered under the EMPS, may have also contributed to the increase in throughput. Simple growth in the population may also have contributed to the increase in throughput. See Appendix 5 for details on throughput volumes and values.

Total Cost

Despite the significant increase in throughput seen during the ZAPS pilot, supply chain operational costs fell substantially—by about $220,000—from $1.73 million for the baseline systems to $1.51 million for the ZAPS (see Figure 33).

Figure 33. Comparison Total Supply Chain Costs at Baseline and During ZAPS



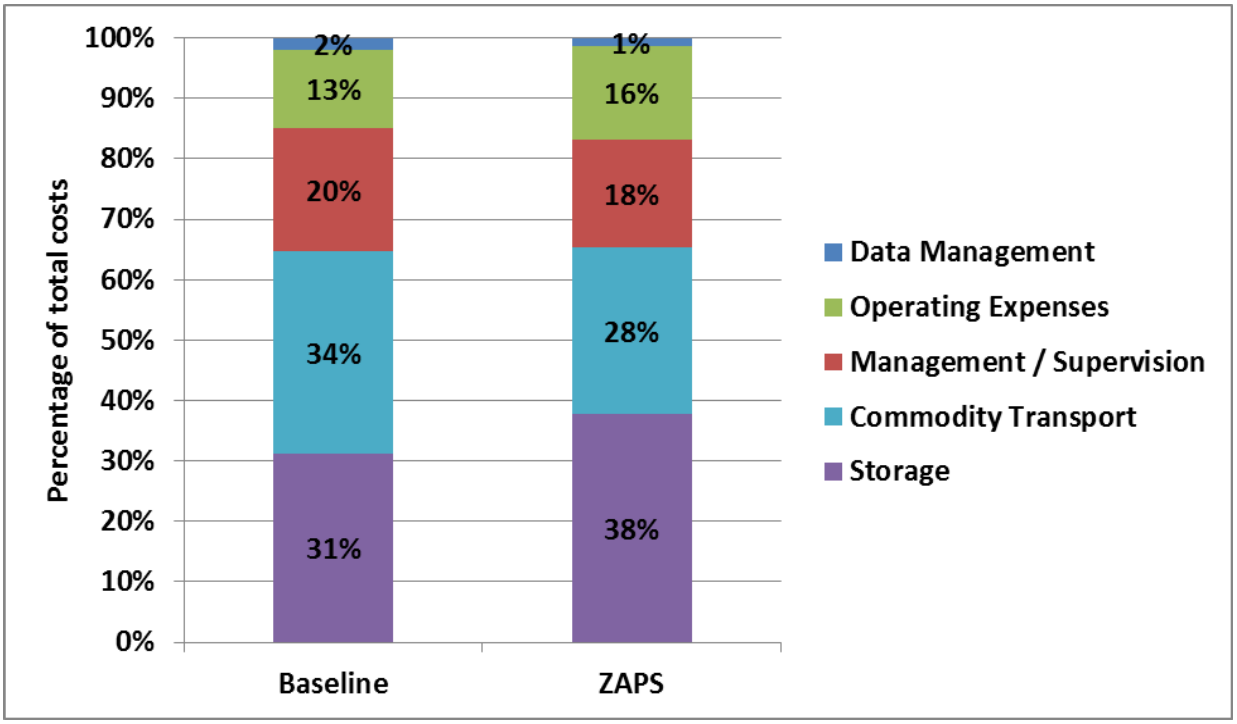
The following sections explore, in more detail, the composition of those costs and some of the underlying reasons for the decrease.[4]

Costs by Main Function

If we classify costs by five main supply chain functions, and examine what each function represents as a percentage of total costs (see Figure 34), we can see that the structure of costs is similar when comparing the existing systems to the ZAPS. Storage accounts for the largest share of costs: 31 percent for existing systems and 38 percent for ZAPS. The main elements of storage costs include space and the labor to manage commodities. The next biggest cost is commodity transport, which accounts for similar percentages at baseline (34 percent) and during the ZAPS (28 percent). Commodity transport encompasses the cost for drivers; per diem; vehicle depreciation; and vehicle running costs, such as fuel, service, and repair. Management and supervision, which includes costs of monitoring and training, accounted for 20 percent of the total at baseline and 18 percent during ZAPS. Operating expenses, which includes utilities, office costs, and other costs not directly attributable to one of the other main functions, were 13 percent of the total at baseline and 16 percent under the ZAPS. Finally, from the baseline to the ZAPS, the cost of data management—including data entry, software, Internet, and paper forms—fell from 2 percent to 1 percent of the total.

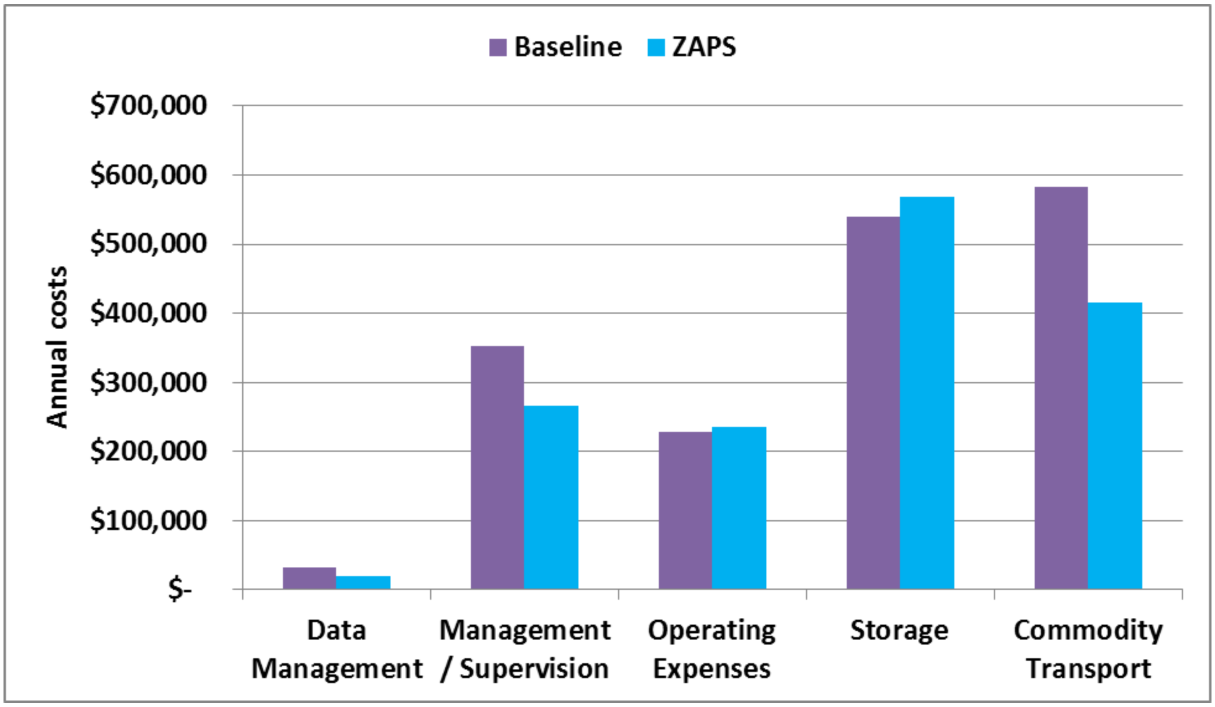
[4] For details on costs by system, main function, and item, see Appendix 3.

Figure 34. Supply Chain Costs as a Percentage of Total Costs by Main Function, Baseline versus ZAPS



We also compared absolute levels of cost by main function. Following the overall downward trend seen above, costs for the ZAPS compared to the baseline period fell for all main supply chain functions, with the exception of operating expenses and storage (see Figure 35).

Figure 35. Comparison of Annual Supply Chain Costs by Main Function, Baseline versus ZAPS



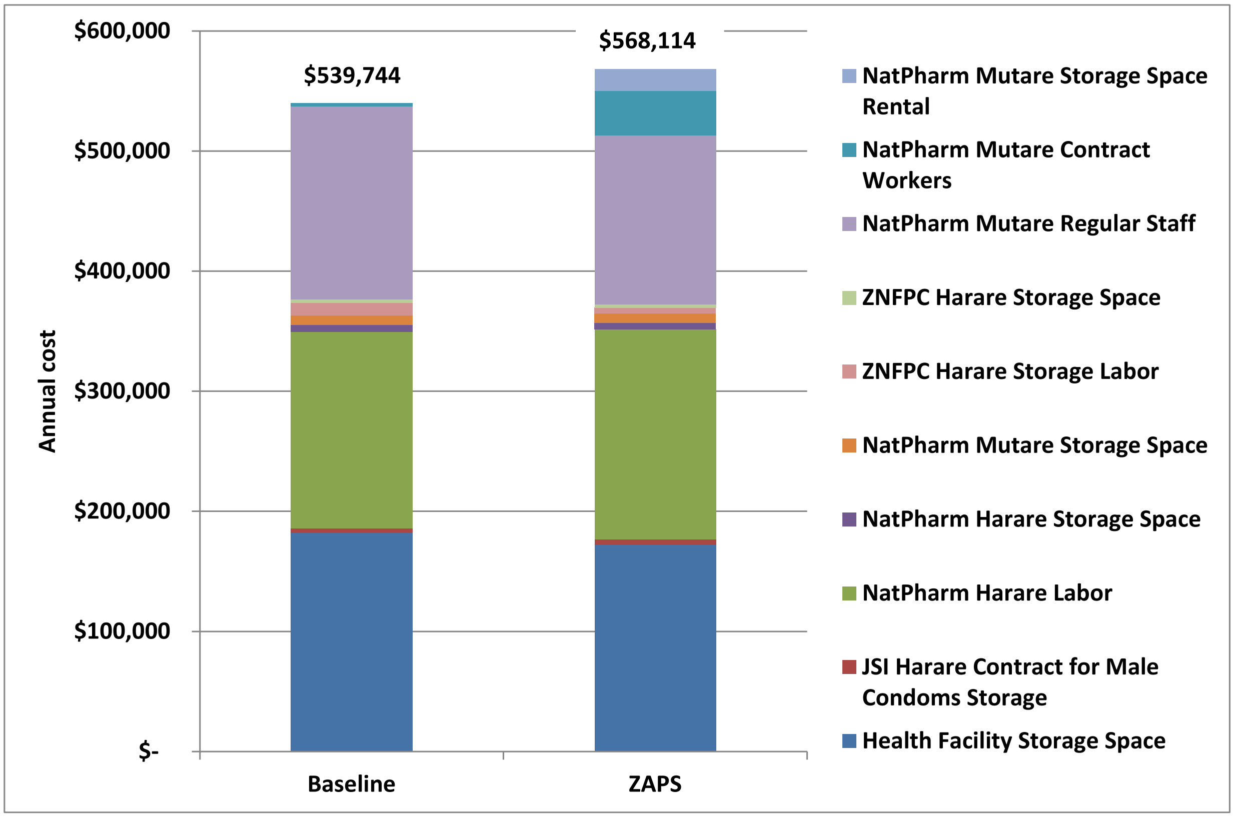
The drop in costs largely reflects the economies of scope generated when the four systems were merged into one. This is exactly what ZAPS system designers expected to occur. In the following sections, we further explore how costs behave for each of the main supply chain functional areas.

Storage

The storage category combines the cost of storage space and the labor to store commodities. Storage costs at the health facility level include the value of storage space. At the provincial level, storage costs include NatPharm Mutare space and labor. At the central level, storage costs include space and labor NatPharm Harare, ZNFPC, and JSI contracted space.

As Figure 36 shows, the structure and amount of storage costs are similar under both models, although slightly higher under the ZAPS. Because commodity volume is the main driver of storage costs, there was little expectation that the system's merger would have much, if any, influence on storage costs. ZAPS did, however, place significant additional demands on NatPharm's operations at the Mutare provincial warehouse. NatPharm had to employ eight more contract workers for picking and packing the facility orders—at a cost of about $36,000 a year. NatPharm's Mutare warehouse also lacked the capacity to store the additional commodities it handled under ZAPS; and therefore, had to rent extra storage space that cost $18,000 for the year.

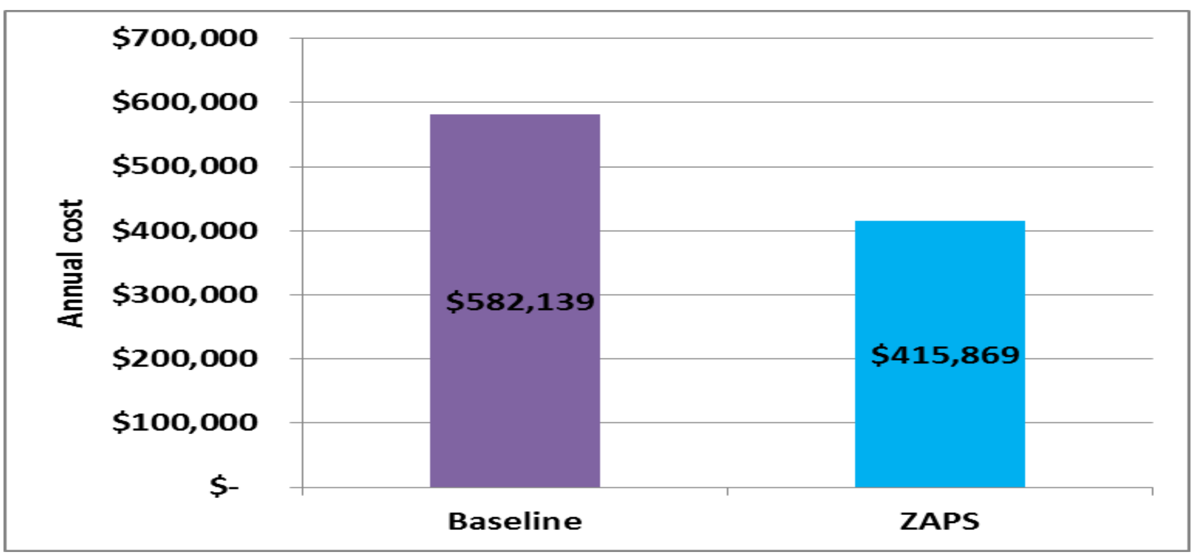
Figure 36. Comparison of Annual Storage Costs by Line Item, Baseline versus ZAPS



Commodity transport

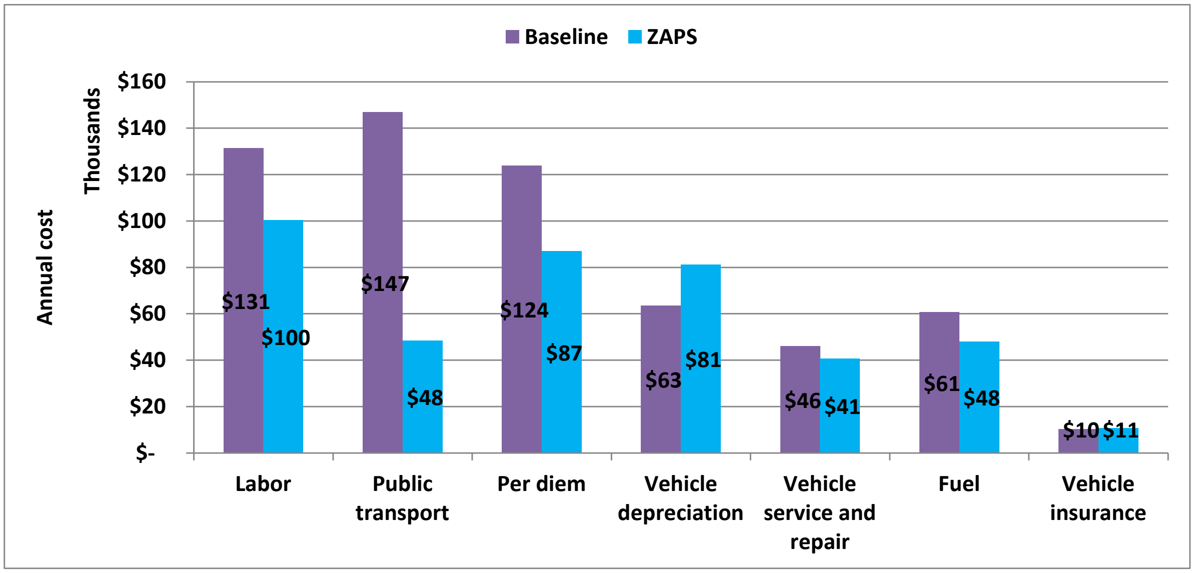
Annual transport costs fell after the merger of the four baseline systems into one—from $582,000 to $416,000 (see Figure 37).

Figure 37. Comparison of Annual Commodity Transport Costs, Baseline versus ZAPS



A more detailed comparison shows that the bulk of the transport savings under the ZAPS are concentrated in the labor and public transport line items, as well as in lower per diem costs (see Figure 38).

Figure 38. Comparison of Annual Commodity Transport Costs by Line Item, Baseline versus ZAPS



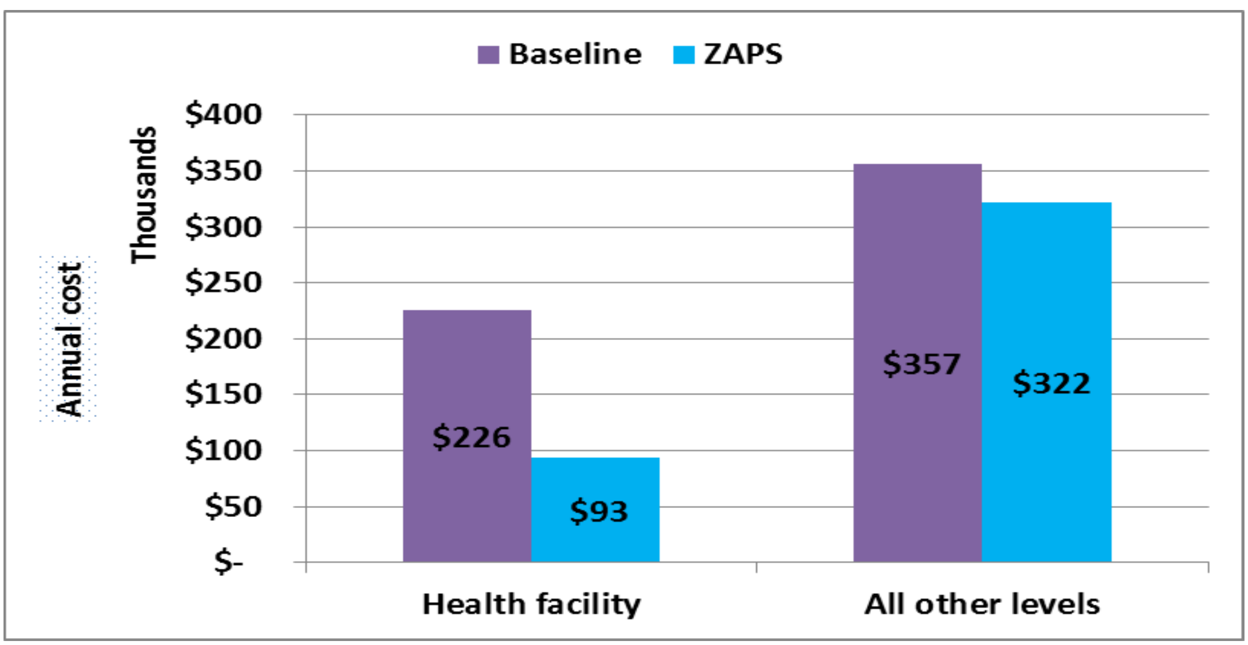
Another look at the labor and public transport costs (see Table 12) shows where the $30,000 savings occurred. Costs for ZAPS order and labor were slightly higher ($55,000) versus during the baseline ($52,500). The big savings under ZAPS, however, was the drop in cost for health worker labor for commodity pickup, which fell by $33,000 from $78,800 to $45,000. The other big reduction in costs was for what health workers had to pay for public transport to pick up commodities. These costs fell overall by almost $100,000. The public transport cost for the pick-up of regular order commodities also fell precipitously, from $77,000 at baseline to just $3,700 during the ZAPS.

Table 12. Commodity Transport Labor and Public Transport Costs, Baseline versus ZAPS

Line item	Baseline	ZAPS
Total commodity transport labor	$131,375	$100,147
Baseline order and delivery labor	$52,575	
Baseline truck drivers labor	$36,336	
Baseline truck dispatch assistants labor	$16,238	
ZAPS order and delivery labor		$55,070
ZAPS delivery truck drivers		$21,472
ZAPS ordering vehicle drivers		$33,598
Health worker labor for commodity pick up	$78,801	$45,077
Health worker emergency order labor to pick up commodities	$48,675	$43,648
Health worker regular order labor to pick up commodities	$30,126	$1,429
Total public transport cost for commodity pickup	$146,783	$48,374
Health worker emergency order public transport to pick up commodities	$69,618	$44,670
Health worker regular order public transport to pick up commodities	$77,165	$3,704

Examining the transport costs by tier provides additional insight. When comparing baseline transportation costs versus ZAPS transport costs, we can see that most of the ZAPS savings were at the facility level, where annual costs fell from $226,000 to $93,000 (see Figure 39).

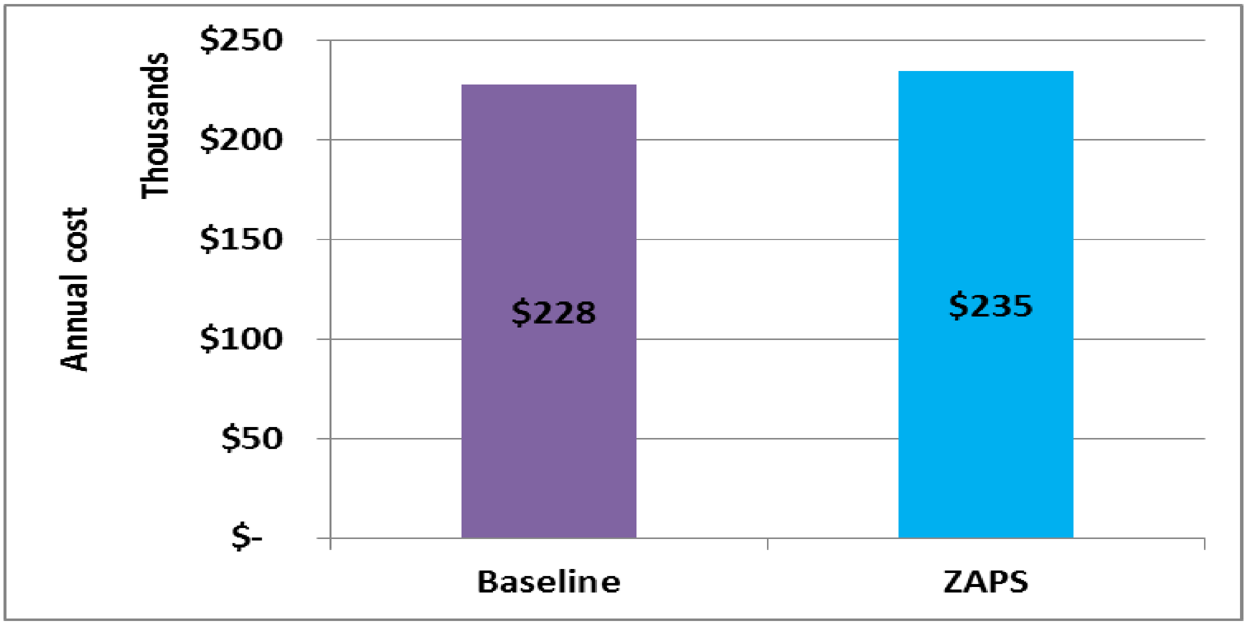
Figure 39. Comparison of Transport Costs, Facility Level versus all Other Levels



Operating expenses

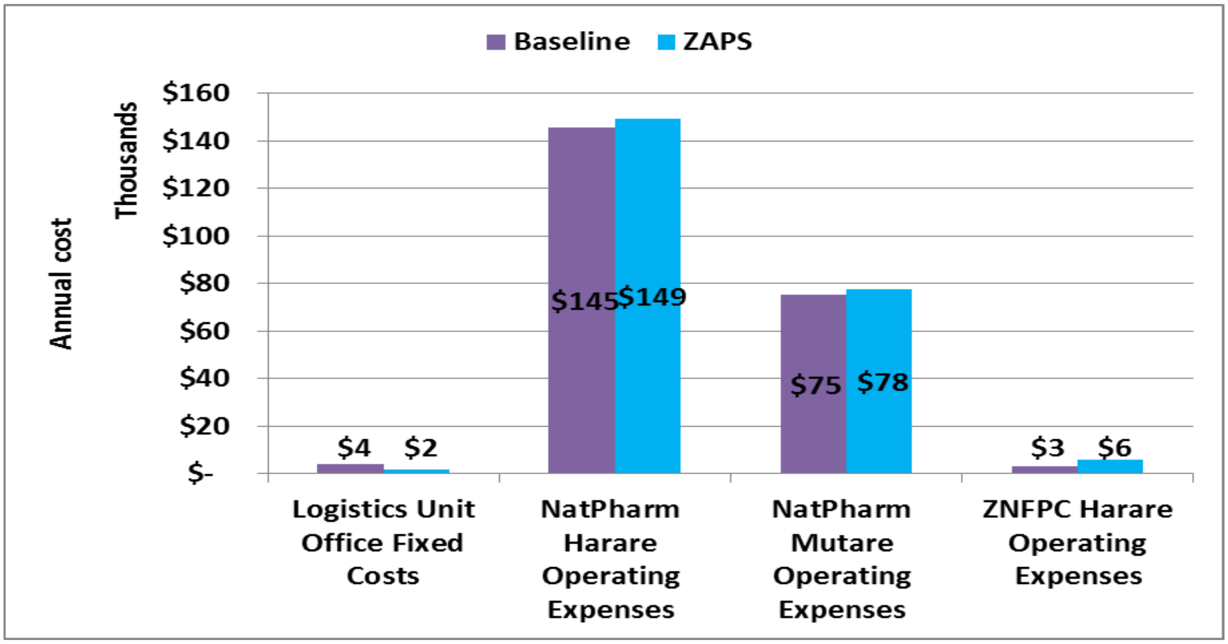
Operating expenses, which include office and overhead expenses not directly charged to the other main supply chain functions, rose slightly from $228,000 at baseline to $235,000 in the ZAPS (see Figure 40).

Figure 40. Comparison of Annual Operating Costs, Baseline versus ZAPS



As Figure 41 shows, there was very little variation between the baseline and the ZAPS for the major components of operating costs, which included logistics unit operating costs, NatPharm Harare and NatPharm Mutare operating expenses, and ZNFPC Harare operating expenses.

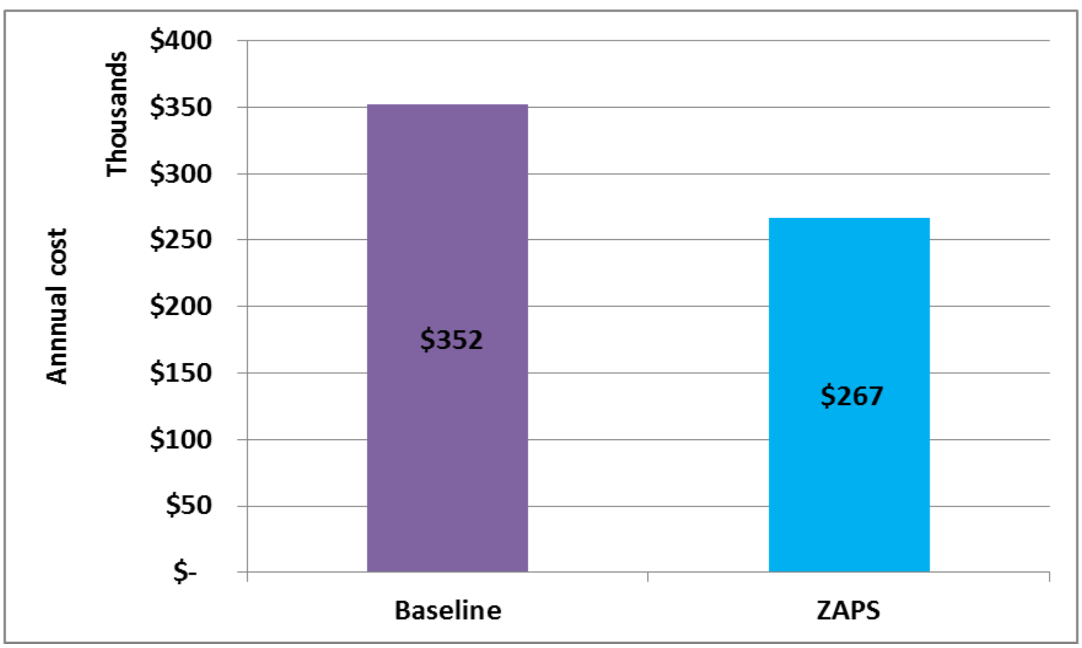
Figure 41. Comparison of Annual Operating Costs by Line Item, Baseline versus ZAPS



Management and Supervision

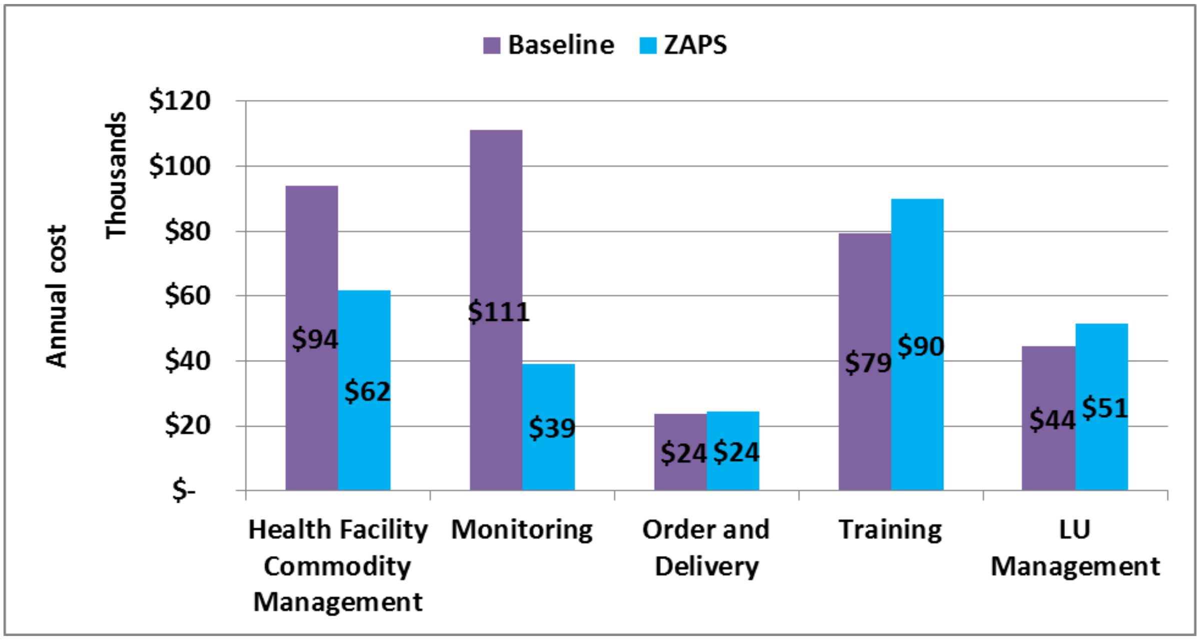
Overall, management and supervision costs fell from $352,000 at baseline to $267,000 under the ZAPS (see Figure 42).

Figure 42. Comparison of Annual Management and Supervision Costs, Baseline versus ZAPS



As Figure 43 shows, most of these savings were from a decrease in health facility commodity management costs—from $94,000 to $62,000. As noted, health facility workers under the ZAPS work with just one supply system instead of the previous four; the lower cost reflects their time savings. Monitoring costs also fell from $111,000 at baseline to $39,000 under the ZAPS. These savings came almost entirely from eliminating separate monitoring vehicles. Instead of using a separate vehicle, provincial supervisory staff under the ZAPS ride along on the ZAPS order and delivery vehicle to do their monitoring.

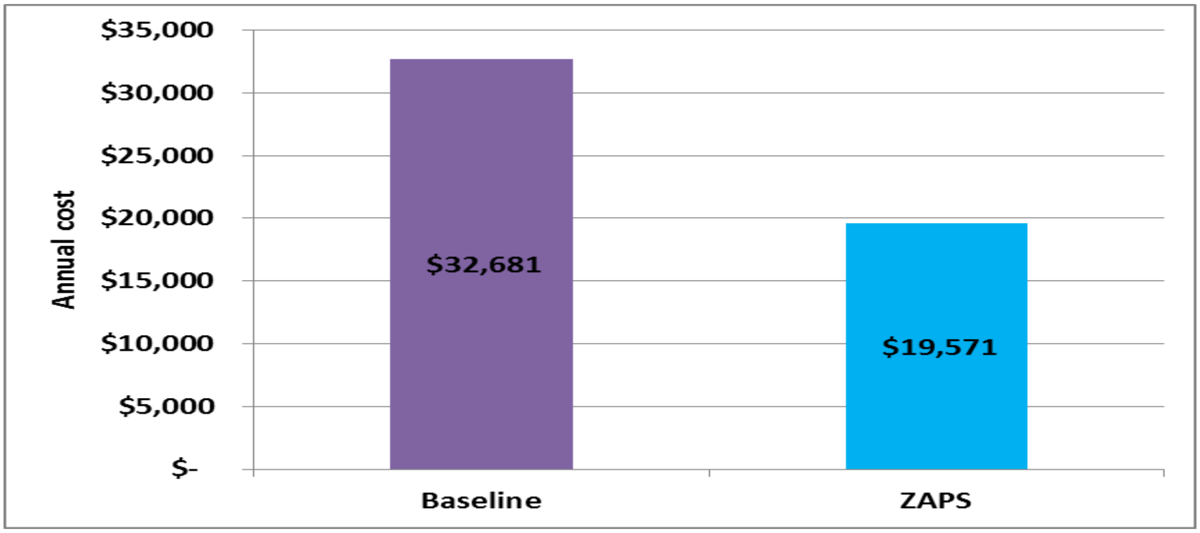
Figure 43. Comparison of Annual Management and Supervision Costs by Line Item, Baseline versus ZAPS



Data management

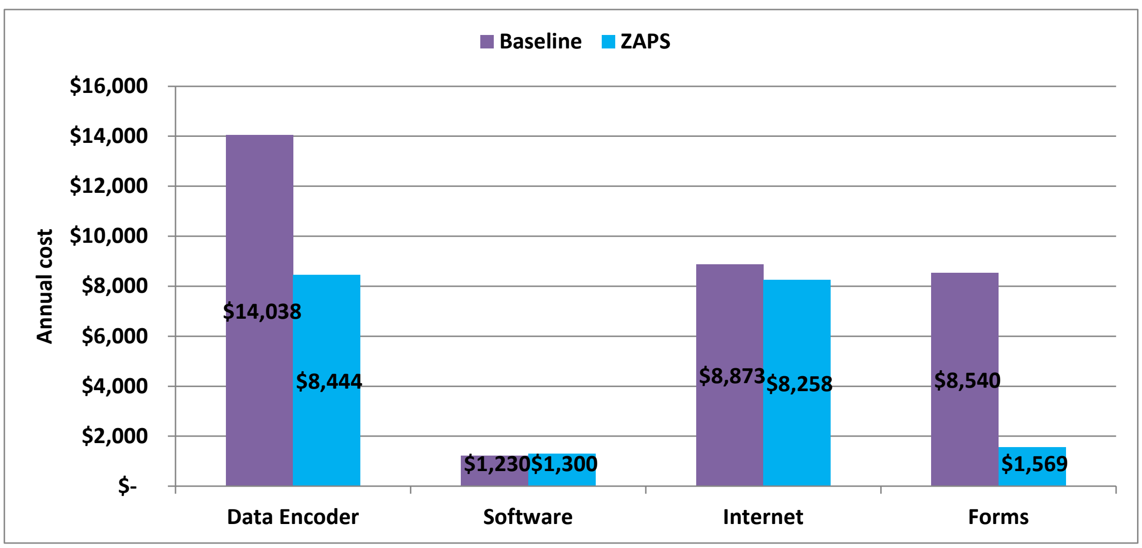
The final—and smallest—main cost function is data management. Cost for data management fell from $32,000 at baseline to $20,000 under the ZAPS (see Figure 44).

Figure 44. Comparison of Annual Management and Supervision Costs, Baseline versus ZAPS



As Figure 45 shows, ZAPS generated savings in data encoder costs and in the cost of paper forms, reflecting the merging of four separate data management systems into one. Software and Internet costs remain essentially fixed; and, therefore, do not vary between the baseline and the ZAPS.

Figure 45. Comparison of Annual Management and Supervision Costs by Line Item, Baseline versus ZAPS

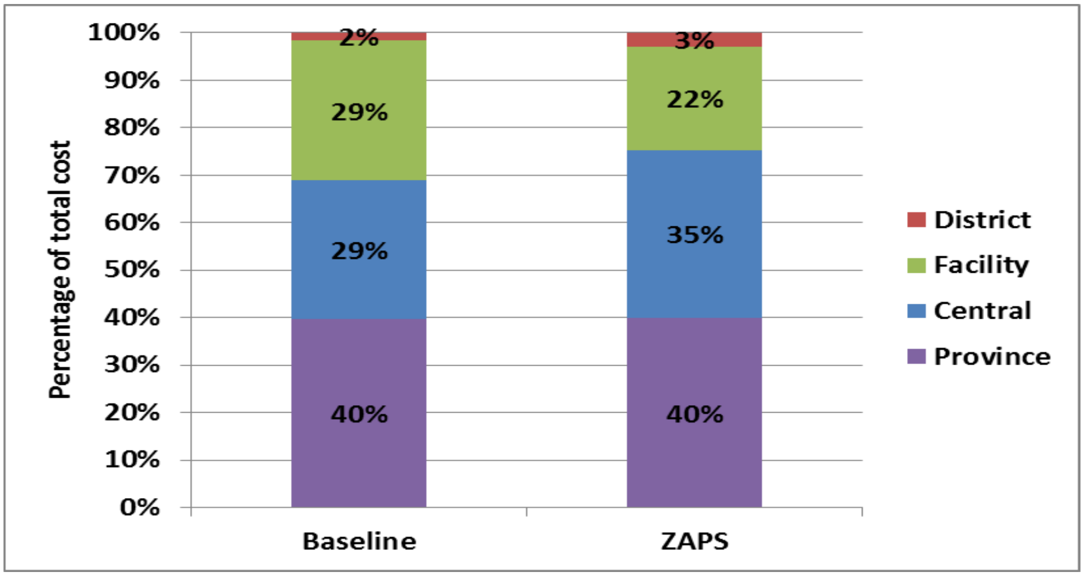


Costs by Tier

Looking at costs by tier or level indicates where the supply chain incurs costs. Our general approach to assigning costs by tier was to associate each line item with a specific actor in the supply chain that assumes that cost, and then identify what tier that actor occupies. It is clear from Figure 46 that the province level accounts for the largest percentage of costs—40 percent under both models. Central-level costs rise from 29 to 35 percent of the total under the ZAPS, while costs at the facility drop from

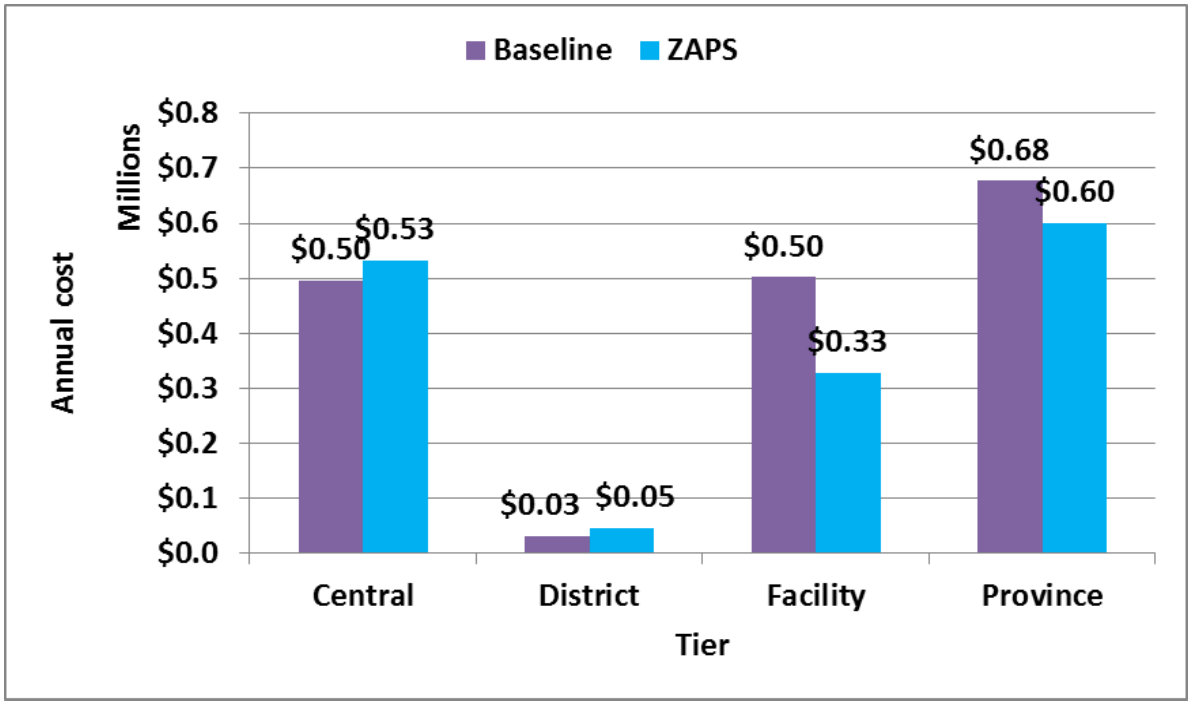
29 to 22 percent of the total under the ZAPS. District-level costs are insignificant under both models—2 percent for the separate systems compared to 3 percent for the ZAPS. These include the labor of district pharmacy staff and per diem associated with order and delivery activities. For details on the costs associated with each tier, see Appendix 3.

Figure 46. Annual Supply Chain Costs as a Percentage of Total Costs by Tier, Baseline versus ZAPS



We also compared the absolute levels of spending by tier. As Figure 47 shows, the overall $220,000 decrease in total costs comes mainly from decreasing costs at the facilities—from about $0.50 million to $0.33 million; and, at the provincial level, from $0.68 to $.60 million.

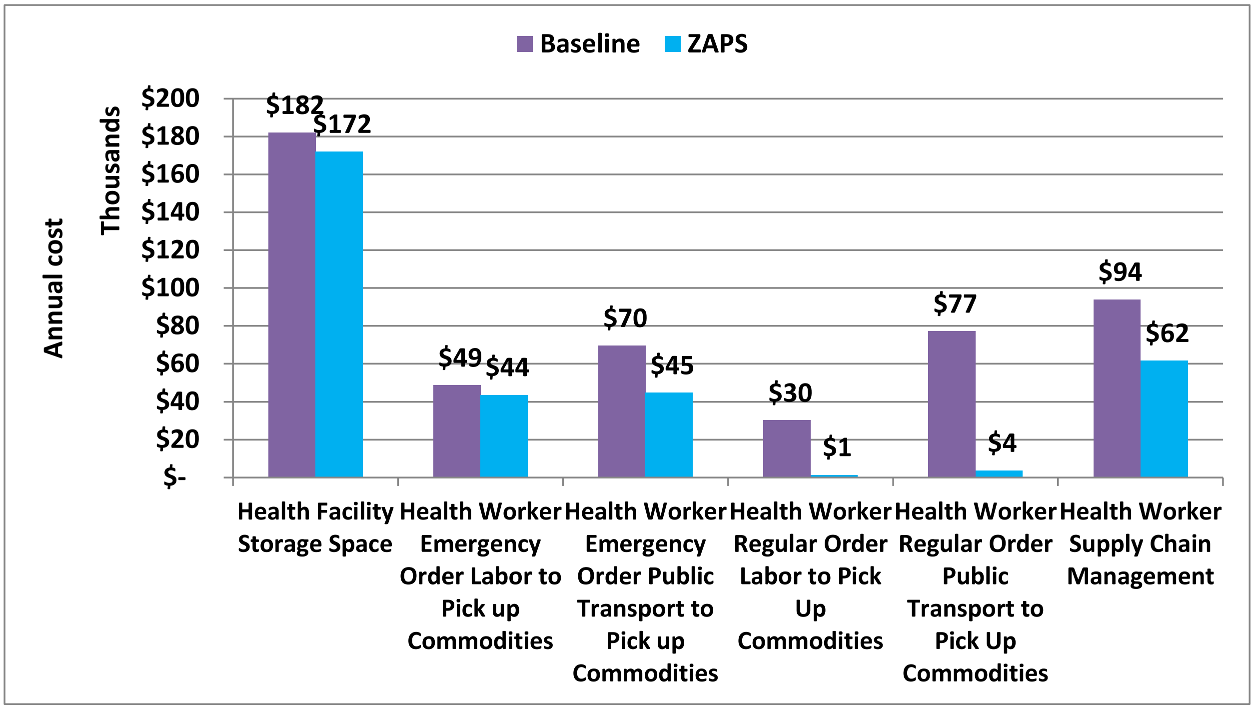
Figure 47. Comparison of Annual Supply Chain Costs by Tier, Baseline versus ZAPS



What is happening at the facility level to cause this decrease? Figure 48 compares each of the costs at the health facility. Storage space remains the largest cost, but it is essentially unchanged from the baseline. The labor of health facility workers to pick up emergency orders and associated out-of-pocket transport costs is slightly lower under ZAPS, perhaps representing a better-functioning system. The major savings under ZAPS are in the health worker labor and associated transport costs for pick up of regularly ordered commodities; which, from a total of $107,000 under the separate systems, fell to just $5,000 under ZAPS.

We can speculate that this steep drop is a direct result of the better functioning of the order and delivery system for the commodities that facilities previously ordered under the EMPS. Another area of savings at the health facility level is the labor of health workers to manage supply chain activities—falling from $94,000 to $62,000 under the ZAPS. This may be a direct result of merging four systems into one. In all, ZAPS saved about $116,000 annually in health worker labor at the facility level. For primary care nurses in Manicaland earning $2.93 per hour, this translates to freeing up almost 40,000 hours a year that they no longer need to manage commodities. That equals about 16 days, per facility, per year, that health workers can now redirect toward their main purpose—caring for the health needs of clients.

Figure 48. Comparison of Health Facility Costs, Baseline versus ZAPS



Costs by Input Type

Examining costs by type of input provides additional insight into the structure of costs under the two models. As Figure 49 shows, the ZAPS did not significantly change the cost structure. As for almost any public health supply chain, labor costs are the biggest single cost item in Zimbabwe—almost half the costs—45 percent in the baseline systems and 48 percent in the ZAPS.

Operating costs are next in importance, comprising 18 percent of costs at baseline and 16 percent of the total under the ZAPS. Most of these costs are associated with NatPharm's central headquarters in Harare, to which we allocated a portion of the costs of running Manicaland operations.

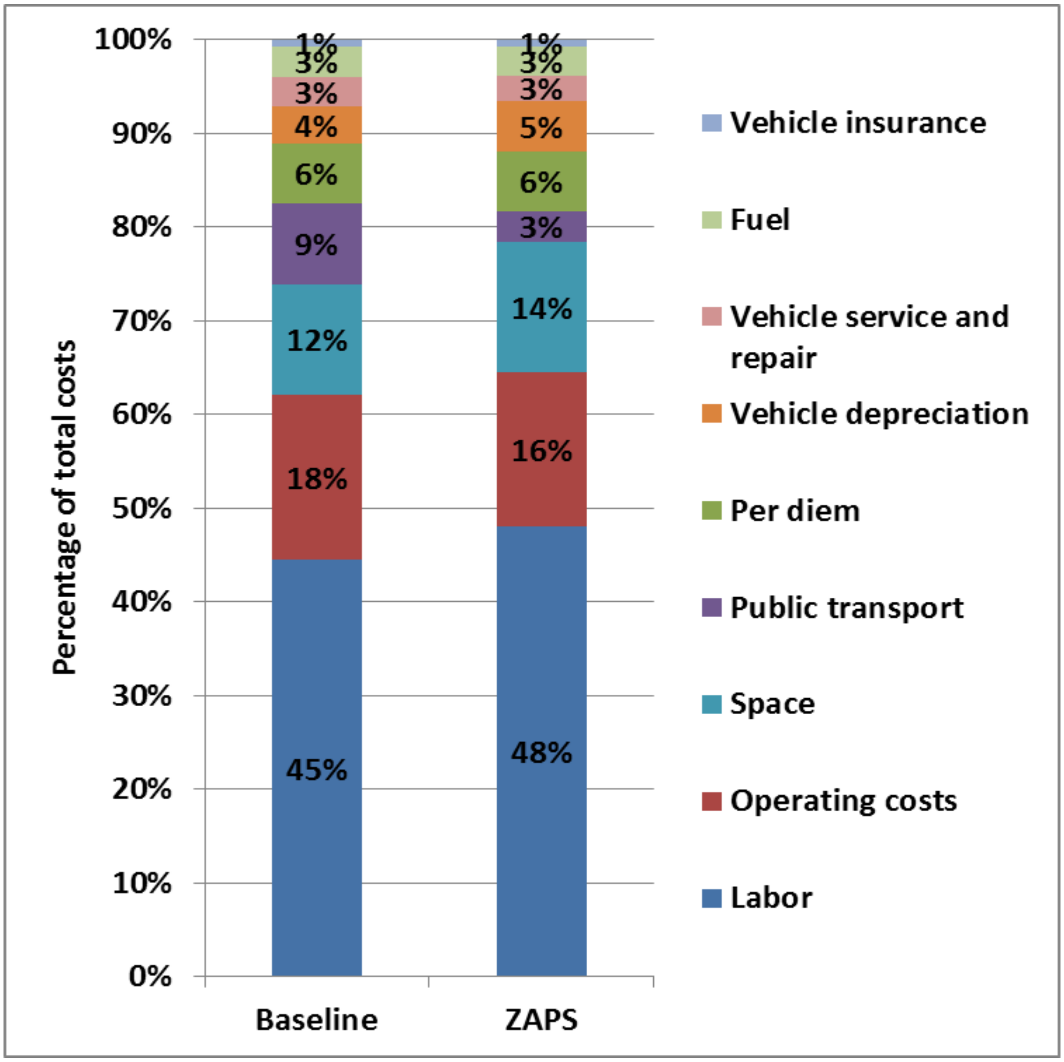
The second biggest contributor to operating costs is NatPharm Mutare branch operations, which services Manicaland directly.

The third biggest cost input is storage space, accounting for 12 percent of the baseline costs and 14 percent of the ZAPS costs. Most of the space costs—about 90 percent—are incurred at the health facilities in Manicaland. Each individual facility storeroom is relatively small—18 square meters on average—we set an imputed rental cost of only $2.00 per month, per square meter.

However, when multiplying by the roughly 300 health facilities in Manicaland, the total cost is quite high, about $182,000 for the baseline systems and about $172,000 under the ZAPS. The only input with a significance change when moving from the baseline systems to the ZAPS is for public transport costs, which fell from 9 percent to just 3 percent of total costs under the ZAPS.

As we noted in the discussion on health facility costs above, introducing the ZAPS appears to have greatly decreased the burden on health facilities to pay out-of-pocket for transporting regularly ordered health commodities.

Figure 49. Annual Supply Chain Costs as a Percentage of Total Costs by Input Type, Baseline versus ZAPS



Cost-Effectiveness Analysis

The previous sections reported on performance, throughput, and cost of the baseline systems when compared to the ZAPS. A cost-effectiveness analysis combines these measures to examine the relative efficiency of the two models for supply chain management.

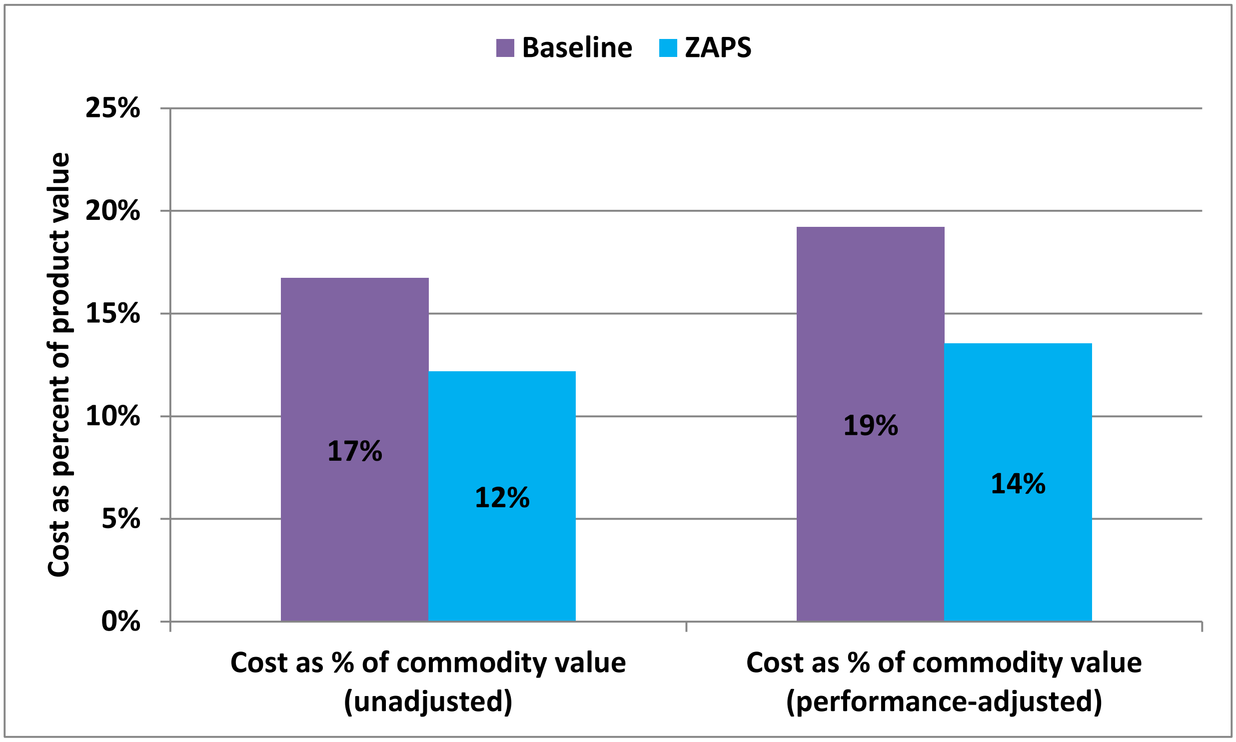
We measured both unadjusted and performance-adjusted cost effectiveness (see Table 13). Using the unadjusted measures, the ZAPS was more efficient than the baseline systems, with supply chain cost as a percentage of throughput value of 12 percent compared to 17 percent. Similarly, ZAPS had a lower supply chain cost per cubic meter of $770 versus $960. By these measures, ZAPS was both cheaper and more effective than the baseline systems.

Table 13. Cost-Effectiveness Comparison Measures

	Baseline	ZAPS
Supply Chain Cost Measures		
Supply chain cost	$1,734,961	$1,505,064
Throughput Measures		
Value of throughput ($)	$10,377,976	$12,346,469
Volume of throughput (m^3)	1808	1955
Supply Chain Performance Measures		
% point product availability	87	89
Cost-Effectiveness Measures (Unadjusted)		
Supply chain cost as % of $ value of throughput	17%	12%
Supply chain cost per cubic meter of throughput	$960	$770
Cost-Effectiveness Measures (Performance-adjusted)		
Supply chain cost per performance-adjusted throughput value	19%	14%
Supply chain cost per performance-adjusted throughput volume	$1,107	$869

We also calculated a measure of efficiency that considers the performance of the systems, in addition to the commodity throughput levels. This *performance-adjusted* cost-effectiveness ratio is calculated by multiplying the throughput level by the number of percentage points of product availability, divided by 100. With product availability of 89 percent during the ZAPS versus 87 percent during the baseline, this calculation raises the performance-adjusted cost per commodity value from 12 to 14 percent for ZAPS and from 17 to 19 percent for the baseline systems. Using this performance measure, ZAPS is still cheaper and more effective than the baseline systems. Figure 50 summarizes the comparison of cost effectiveness in terms of cost per commodity value, using the unadjusted and performance-adjusted measures.

Figure 50. Cost-Effectiveness Comparison, Baseline versus ZAPS



Sensitivity Analysis

The cost and cost-effectiveness analyses build on multiple assumptions. Because of limitations in the survey approach, or missing or incomplete data; some of the values we used for throughput, cost, and performance have significant associated uncertainty. Sensitivity analysis helps determine the extent to which changes in these assumptions might substantially alter the findings. To incorporate this uncertainty and to simulate the degree to which it might affect the main study outcomes, we used a Monte Carlo approach to carry out a sensitivity analysis. First, we listed the throughput, cost, and performance parameters that hold a significant degree of uncertainty (see Table 14).

Second, for each parameter, we assumed an underlying normal distribution of possible values. We defined our base case assumption as the mean of this distribution and assigned a standard deviation, minimum, and maximum based on either (1) a reasonable notion of the range of possible values that the parameter might take, or (2) on the 95 percent confidence interval for the sample parameter distribution.

Table 14. Throughput and Cost Parameters Used in the Sensitivity Analysis

			Range	
Parameter	**Mean (base)**	**Standard Deviation**	**Minimum**	**Maximum**
ZAPS hospitals still served by ZADS, as % of total ZADS Manicaland value during baseline period	43.3%	4%	33.3%	53%
Manicaland systems as % of NatPharm operations, baseline	13%	2%	10%	16%
Manicaland systems as % of NatPharm operations, ZAPS	11%	2%	8%	14%
% point product availability, baseline	87	33	86	88
% point product availability, ZAPS	89	32	88	90
SDP storage cost per cubic meter	$ 2.00	$ 0.50	$ 1.00	$ 4.00
NatPharm Harare central costs as % of total	60%	5%	50%	70%
			Range	
	Mean (base)	**Standard Deviation**	**Min Value As % of Base Value**	**Max Value As % of Base Value**
Health worker regular order public transport to pick up commodities	value reported	20%	-50%	50%
Health worker emergency order public transport to pick up commodities	value reported	20%	-50%	50%
Health worker emergency order labor to pick up commodities	value reported	20%	-50%	50%
Health worker emergency order public transport to pick up commodities	value reported	20%	-50%	50%
Health worker supply chain management	value reported	20%	-50%	50%
SDP storage space estimates	value reported	20%	-50%	50%
Volume of throughput	Value reported	4%	-10%	10%

Next, for the baseline and ZAPS values, we allowed each of these parameters, simultaneously, to vary randomly; each time calculating a total cost, total throughput, and associated cost and cost-effectiveness measures. We repeated this procedure 10,000 times and derived a mean, standard deviation; and 95 percent confidence intervals for cost and cost-effectiveness measures (see Table 15). The sensitivity analysis found overlap in the baseline and the ZAPS 95 percent confidence intervals for total cost, total volume, total value, and cost per cubic meter (unadjusted). For cost per product value (unadjusted), cost per cubic meter (performance-adjusted), and cost per product value (performance-adjusted), there was no overlap in the 95 percent confidence intervals. Thus, for the measures for which there is overlap in the confidence interval, we are somewhat less certain that there is a true difference in the value for the baseline and the value calculated for the ZAPS. For the efficiency measures for which no overlap exists, the sensitivity results bolster our initial findings of differences between the baseline and the ZAPS.

Table 15. Results of Monte Carlo Simulation for Various Cost, Throughput, and Cost-Effectiveness Measures

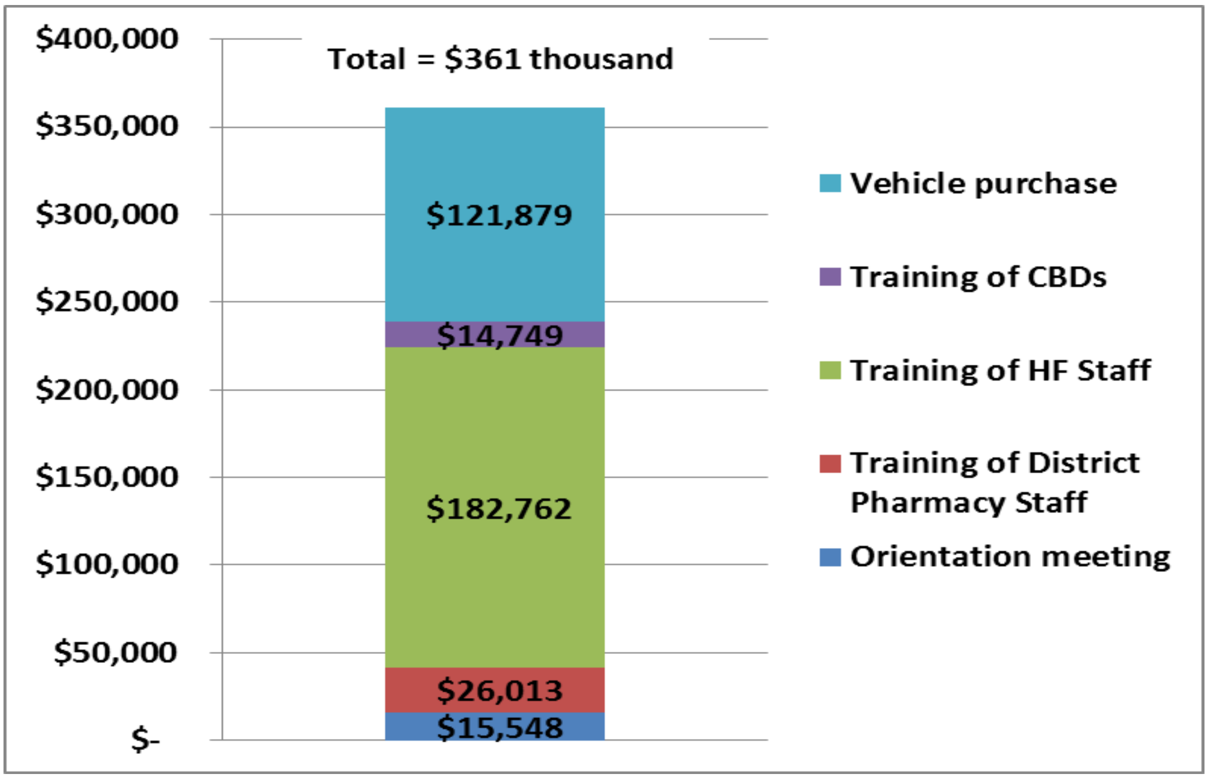
			95% Confidence Interval	
Cost, Throughput, and Cost-Effectiveness Measure	**Mean**	**Standard Deviation**	**Low**	**High**
Total cost *				
Baseline	$1,735,533	$ 81,250	$1,576,283	$ 1,894,782
ZAPS	$1,506,261	$77,539	$1,354,284	$ 1,658,238
Total commodity volume *				
Baseline	1,808	42	1,726	1,890
ZAPS	1,955	77	1,803	2,106
Total commodity value *				
Baseline	$10,398,120	$689,159	$9,047,369	$11,748,871
ZAPS	$12,344,110	$488,109	$11,387,417	$13,300,802
Cost per cubic meter, unadjusted *				
Baseline	$960	$49	$864	$1,057
ZAPS	$772	$50	$674	$870
Cost as a percentage of product value, unadjusted				
Baseline	16.8%	1.3%	14.2%	19.4%
ZAPS	12.2%	0.8%	10.7%	13.8%
Cost per cubic meter, performance-adjusted				
Baseline	$1,102	$58	$989	$1,215
ZAPS	$870	$57	$758	$982
Cost as a percentage of product value, performance-adjusted				
Baseline	19.2%	1.5%	16.2%	22.2%
ZAPS	13.7%	0.9%	12.0%	15.5%

* Indicates parameter for which there is overlap in the 95 percent confidence interval for the baseline and ZAPS measures.

Scaling up the ZAPS Nationwide

The cost analyses reported above include only the ongoing operations cost of the two models. Policymakers also have an interest in knowing what the start-up costs would be to roll out the ZAPS to the other nine provinces in Zimbabwe. By start-up, we mean all the activities that need to take place before the ZAPS can begin operating in a province. We estimated that each province would require $361,000 in start-up costs, as summarized in Figure 51. Note that we base this estimate on the profile of a *typical* province. Factors, such as the number of districts and health facilities, availability of vehicles, etc., will determine the actual costs.

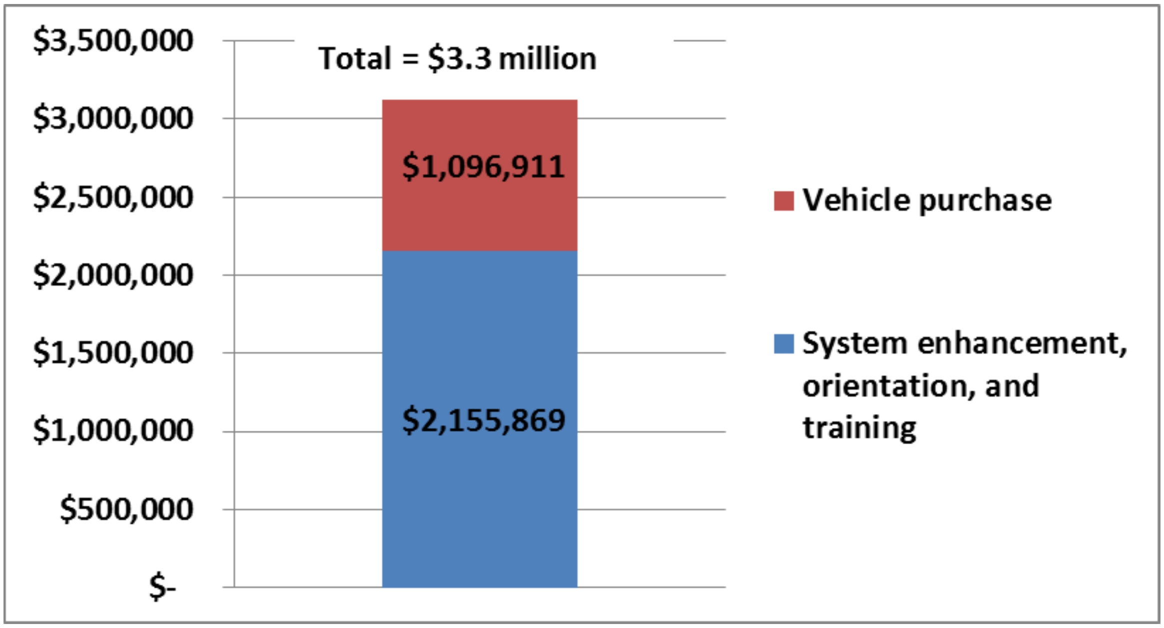
Figure 51. ZAPS Start-Up Cost per Province



Start-up costs for a province comprise a range of activities. For an initial orientation meeting to brief key provincial stakeholders on the ZAPS, three people from Harare traveled to each province to meet with provincial- and district-officials for a one-day meeting, for a total cost of $15,548. A three-day training of district pharmacy staff to orient them on system design, tools, and roles would follow. This would, again, require three people from Harare, two pharmacy staff per district, the provincial pharmacy manager, the area distribution coordinator, the NatPharm branch staff, and the ZNFPC provincial office. The estimated cost of this district pharmacy staff training is $26,013. A series of two-day health facility staff trainings would follow the district staff training, which involved two staff per health facility and was carried out by district- and provincial pharmacy–staff. This training is estimated to cost $182,762, per province. An additional $14,749 would be needed to train community-based distributors (CBDs) in ZAPS procedures. We also estimate that each province will need to purchase two land cruiser-type vehicles to be used for the ordering round of the ZAPS. The two vehicles would cost $121,879.

A comprehensive national rollout of ZAPS would require $3.3 million—$2.2 million for system enhancement, orientation, and training; and $1.1 million for vehicle purchase (see Figure 52).

Figure 52. Total Start-up Cost to Rollout the ZAPS to Nine Additional Provinces



Discussion

This report summarizes the evaluation of the ZAPS, a new approach to managing the public health supply chain; it was piloted in Manicaland province in 2014–2015. The evaluation compared the cost, performance, and efficiency of the ZAPS with the four main existing commodity distribution systems—DTTU, ZIP/PHCP, ZADS, and EMPS. Results from this evaluation were to inform the decision on whether to expand the ZAPS model to the rest of Zimbabwe.

In line with previous evidence and the general perception of supply chain stakeholders in Zimbabwe, the baseline measurement during the year before the pilot found the four existing systems to be, for the most part, well performing. During the year of the pilot in Manicaland, the ZAPS performed similarly well, after overcoming some initial implementation challenges common to any new approach. For information availability and quality, the ZAPS maintained the high levels of reporting coverage and on-time data collection seen during the baseline. The ZAPS also performed similarly to the baseline systems for on-time delivery—an indicator of customer responsiveness. On measures of commodity availability and inventory management, such as stockout rates, ZAPS performed about the same as the baseline systems; although the average duration of stockouts was somewhat higher under the ZAPS. Overstocking continues to be a concern under ZAPS, as it was at baseline. Product expiries, another indicator of inventory management, were lower under ZAPS compared to the baseline.

To help gauge the extent to which the observed performance levels in Manicaland were the result of the ZAPS, or because of other factors influencing supply chain performance, we compared the experience in Manicaland with how the supply chain was performing elsewhere in Zimbabwe. For the most part, the trends we saw in Manicaland mirrored what was happening in the rest of the country. For example, the slight overall improvement in product availability under the ZAPS pilot in Manicaland tracked closely with the increase seen in other provinces.

The cost and cost-effectiveness analyses found the ZAPS costs less and operates more efficiently than the four baseline systems combined. The total cost to operate the ZAPS was $220,000 less than the cost to operate the baseline systems, or about 13 percent less. At the same time, the ZAPS handled about 8 percent more commodity throughput (by volume) than the baseline systems. In the context of levels of throughput and performance, the ZAPS was about 20 percent more efficient compared to the baseline systems. Results of the sensitivity analysis showed that, even when considering some of the uncertainty underlying our cost-effectiveness calculations, the ZAPS retains its efficiency advantage over the baseline systems.

The overall conclusion from these evaluation results is that, compared to the four existing baseline systems, the ZAPS pilot maintained previous supply chain performance levels in Manicaland, at a lower cost and higher efficiency. These results largely validate the original views of the designers of the ZAPS. Nonetheless, it is important to recognize that the performance averages mask some differences across products and product groups. Because product availability fell—albeit slightly—for the male condom and control pill, further investigation is needed. A similar drop in availability of some of the ARV products is also a concern. Program managers should follow up closely using the various performance databases and site visits to determine what might be hampering further performance improvements.

Are the results in Manicaland replicable in other provinces of Zimbabwe? The answer appears to be yes, given the response of the various supply chain actors in Manicaland. In focus groups carried out in April 2015, health facility staff were very positive in their assessment of the ZAPS. This endorsement of the new system coincides with the findings showing, at the health facility level, the ZAPS generates significant savings in time and out-of-pocket transportation costs. Moreover, officials and staff at NatPharm's Mutare branch in Manicaland also reported a positive experience with the ZAPS, despite the significant additional demands that ZAPS put on the NatPharm branch storage, picking and packing, and delivery operations. In interviews, provincial MOHCC staff also expressed their support for the ZAPS approach. District staff expressed support that is more cautious for the ZAPS, perhaps because of the additional demands ZAPS places on the time of the district pharmacy staff.

The results of the evaluation of the ZAPS provide clear guidance for decisionmakers. Compared with the four existing supply chain systems, the ZAPS pilot maintained supply chain performance, did so at a lower overall cost, and did so more efficiently. With other factors, such as per-province start-up costs, the comparative sustainability of the ZAPS model, and how ZAPS is financed relative to the existing supply chain model, decisionmakers can use the results of the evaluation to make an informed decision on how to move forward with implementing the ZAPS elsewhere in Zimbabwe.

References

Chiyaka, Ignatio, and Naomi Printz. 2013. *Zimbabwe Assisted Pull System: Design of Ordering and Resupply Procedures*. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4.

Zimbabwe Ministry of Health and Child Care, USAID |DELIVER PROJECT, and Supply Chain Management System. (unpublished). *Zimbabwe Assisted Pull System (ZAPS) Pilot. Manicaland Province. Monitoring and Evaluation Plan.* Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.

Appendix 1

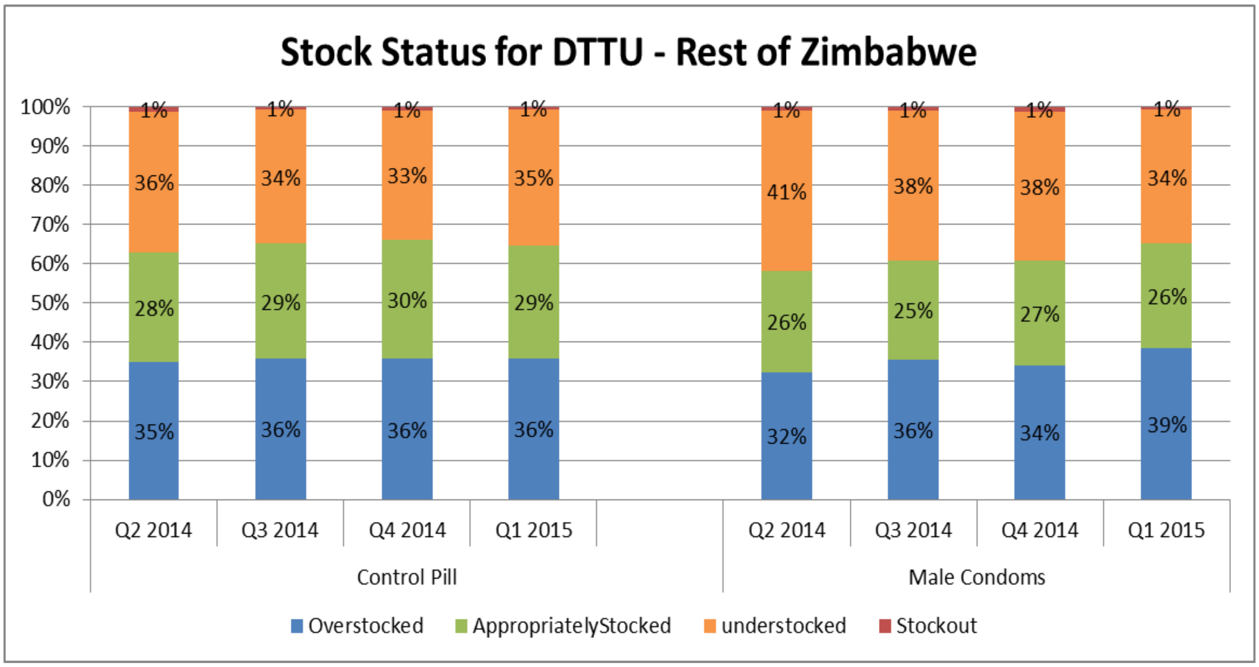
Endline Health Facility Survey on Supply Chain Effort

ZAPS Endline Survey on Health Facility Supply Chain Effort	
Please answer the following questions:	
General Information	
1)	What is your position and title?
2)	What is your civil service grade?
3)	How many total years of service do you have?
4)	What is the name of your facility? (optional)
5)	What District is your facility located in?
6)	Which of the following best describes your facility type? (check one) □ *Primary Care Health Clinic* □ *District Hospital* □ *Mission Hospital* □ *Provincial Hospital* □ *Cost Center*
7)	Besides yourself, how many other people work in your facility who perform supply chain activities?
ZAPS physical counts	
8)	How often do you do physical counts of ZAPS products?
9)	How many minutes does it take you on average to do a physical count for ZAPS products?
ZAPS ordering	
10)	How many minutes does you take you on average beforehand to prepare for the arrival of the District Pharmacist who assists you in ordering ZAPS products?
11)	Upon their arrival, how many minutes on average do you spend with the District Pharmacist who assists you in ordering ZAPS products?
ZAPS delivery	
12)	Each time the ZAPS delivery truck arrives, how many minutes do you spend supporting the delivery of ZAPS products?
ZAPS compared to the previous systems	
13)	Thinking back, would you say you spend more, less, or the same amount of time doing physical counts, ordering, and delivery of ZAPS products compared to the time you spent for DTTU, ZIP/PHCP, ZADS and Essential Medicines products?

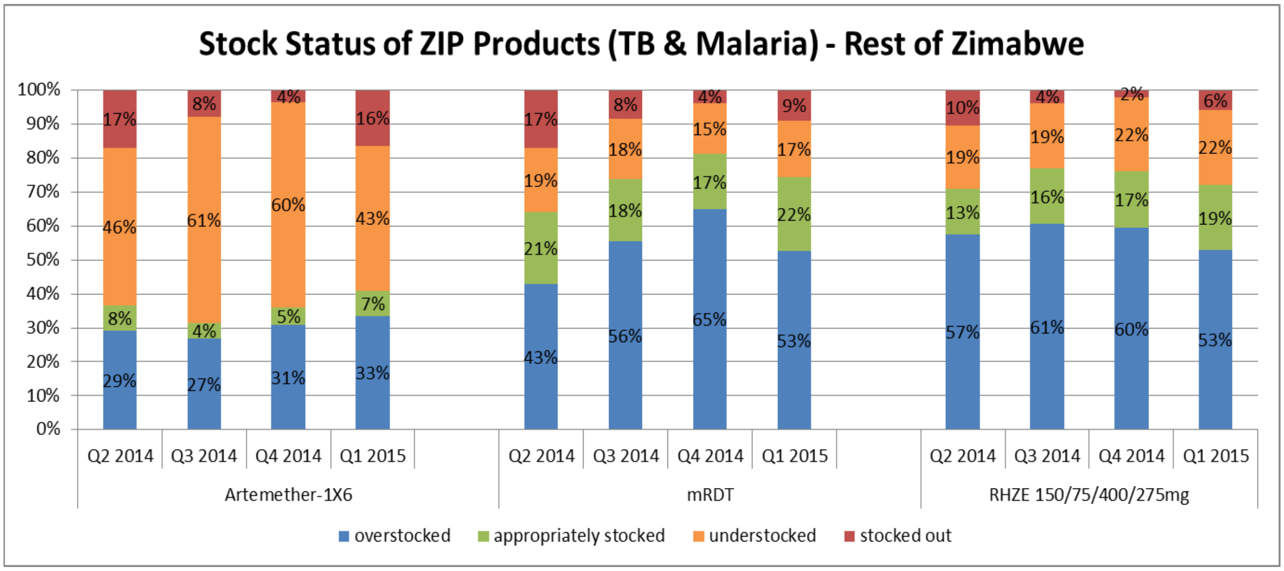
Emergency Orders	
14)	How many times a quarter do you have to make an emergency run and pick up medicine from another facility or district or from NatPharm?
15)	*If yes…* How much time and money do you spend travelling for a single round trip?
Pick up of ZAPS products	
16)	Do you ever have to pick up ZAPS products?
17)	*If yes…* How often do you have to travel to pick up the ZAPS products?
18)	How much time does it take you to travel for a single round trip?
19)	How much money do you spend traveling each time you pick up medicine?
All supply chain activities	
20)	What percentage of your time do you spend on all supply chain activities such as storekeeping/record keeping and dispensing commodities? (check one)
Storage	
21)	What is the approximate length in meters of the space where you store commodities?
22)	What is the approximate width in meters of the space where you store commodities?
23)	Of the current space where you store commodities, what percent full is it? *(ex. 50% full, 80% full, 100% full)*
Other	
24)	Major challenges with ZAPS?
25)	Average lead time
	Version: March 25, 2015

Appendix 2

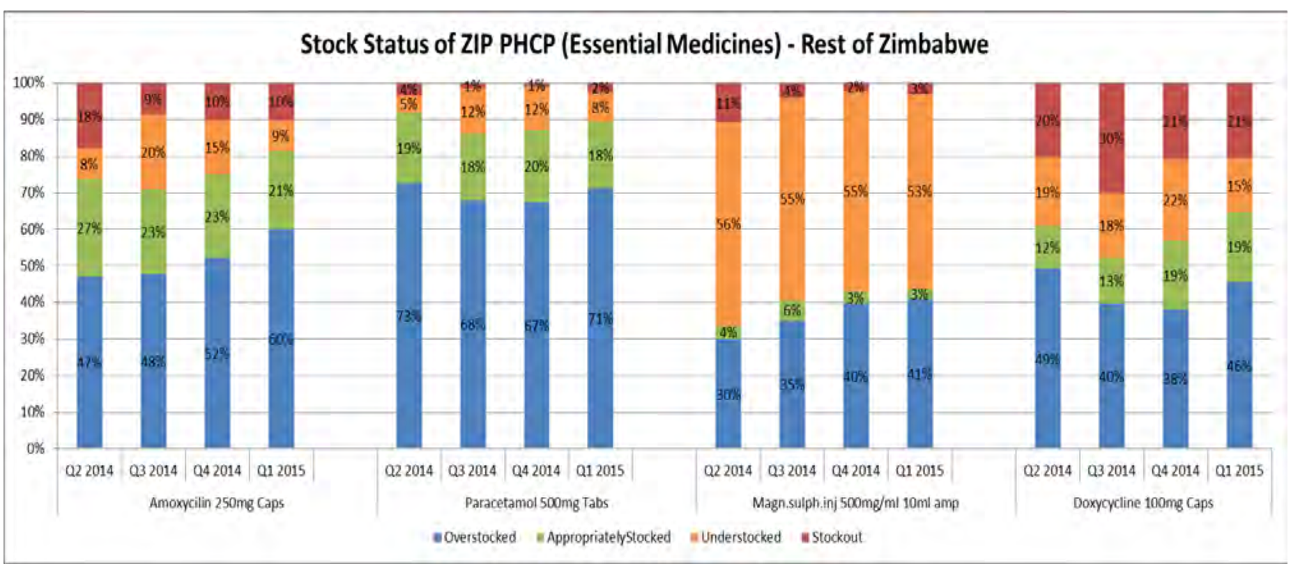
Stock Status for the Rest of the Country during the ZAPS Pilot



ZIP – TB & Malaria



ZIP/PHCP – Essential Medicines



Appendix 3

Detailed Costs by Tier, Main Function, and Line Item

Tier, Main Function and Line Item	Baseline	ZAPS
Central	$ 495,992	$ 532,168
Data Management	**$ 32,681**	$ 19,571
LMIS Paper Forms	$ 8,540	$ 1,569
LMIS Software (licenses, server, etc.)	$ 1,230	$ 1,300
Logistics Unit Data encoder 1	$ 2,000	$ -
Logistics Unit Data encoder 2	$ 1,464	$ -
Logistics Unit Data encoder 3	$ 1,296	$ -
Logistics Unit Data encoder 4	$ 981	$ -
Logistics Unit Internet	$ 8,873	$ 8,258
NatPharm LMIS Data Clerks	$ 8,296	$ 8,444
Server Costs for AutoOrder TOP UP	$ -	$ -
Management / Supervision	**$ 123,818**	$ 141,400
Logistics Unit Deputy Manager	$ 5,032	$ 6,451
Logistics Unit Logistics Officer	$ 9,720	$ 14,289
Logistics Unit Overall Management Labor	$ 23,508	$ 23,461
Logistics Unit PMTCT Logistics Coordinator	$ 6,129	$ 7,198
Training	$ 79,429	$ 90,000
Operating Expenses	**$ 152,755**	$ 157,261
Logistics Unit Office Fixed Costs	$ 3,979	$ 1,792
NatPharm Harare Operating Expenses	$ 145,473	$ 149,478
ZNFPC Harare Operating Expenses	$ 3,303	$ 5,991
Storage	**$ 186,737**	**$ 192,425**
JSI Harare Contract for Male Condoms Storage	$ 4,027	$ 4,431
NatPharm Harare Labor	$ 163,494	$ 175,042
NatPharm Harare Storage Space	$ 5,877	$ 5,573
ZNFPC Harare Storage Labor	$ 10,633	$ 4,652
ZNFPC Harare Storage Space	$ 2,706	$ 2,727
Commodity Transport		**$ 21,512**
ZAPS Truck Depreciation, JSI Harare-Mutare Delivery		$ 5,102
ZAPS Truck Driver Labor, JSI Harare-Mutare Delivery		$ 4,108

Tier, Main Function and Line Item	Baseline	ZAPS
ZAPS Truck Driver Per Diem JSI Harare-Mutare Delivery		$ 3,476
ZAPS Truck Fuel, JSI Harare-Mutare Delivery		$ 3,549
ZAPS Truck Insurance, JSI Harare-Mutare Delivery		$ 933
ZAPS Truck Service & Repair, JSI Harare-Mutare Delivery		$ 4,344
District	**$ 29,929**	**$ 45,497**
Management / Supervision	**$ 14,570**	**$ 24,334**
District Pharmacy Staff Labor	$ 14,570	$ 24,334
Commodity Transport	**$ 15,358**	**$ 21,163**
District Pharmacy Staff Per Diems	$ 15,358	$ 21,163
Facility	**$ 501,582**	**$ 327,148**
Management / Supervision	**$ 93,966**	**$ 61,665**
Health Worker Supply Chain Management	$ 93,966	$ 61,665
Storage	**$ 182,032**	**$ 172,032**
Health Facility Storage Space	$ 182,032	$ 172,032
Commodity Transport	**$ 225,584**	**$ 93,451**
Health Worker Emergency Order Labor to Pick up Commodities	$ 48,675	$ 43,648
Health Worker Emergency Order Public Transport to Pick up Commodities	$ 69,618	$ 44,670
Health Worker Regular Order Labor to Pick Up Commodities	$ 30,126	$ 1,429
Health Worker Regular Order Public Transport to Pick Up Commodities	$ 77,165	$ 3,704
Province	**$ 707,458**	**$ 600,250**
Management / Supervision	**$ 120,095**	**$ 39,223**
Area Distribution Coordinator Per Diems	$ 8,160	$ 2,993
Area Distribution Coordinator Labor	$ 19,578	$ 23,126
Monitoring Vehicle Drivers Labor	$ 8,521	$ -
Monitoring Vehicle Drivers per Diems	$ 9,199	$ -
Monitoring Vehicles Depreciation	$ 24,614	$ -
Provincial Pharmacy Manager Labor	$ 6,470	$ 7,104
Provincial Pharmacy Manager Per Diems	$ 5,465	$ 6,000
ZNFPC Team Leader Labor	$ 9,015	$ -
Monitoring Vehicle Fuel	$ 14,290	$ -
Monitoring Vehicle Insurance	$ 4,693	$ -
Monitoring Vehicle Service & Repair	$ 10,091	$ -
Operating Expenses	**$ 75,192**	**$ 77,628**
NatPharm Mutare Operating Expenses	$ 75,192	$ 77,628
Storage	**$ 170,975**	**$ 203,658**
NatPharm Mutare Contract Workers	$ 2,710	$ 36,754
NatPharm Mutare Storage Space	$ 7,607	$ 7,664
NatPharm Mutare Storage Space Rental	$ -	$ 18,135
NatPharm Mutare Regular Staff	$ 160,658	$ 141,105
Commodity Transport	**$ 341,197**	**$ 279,742**
ZAPS Delivery Truck Dispatch Assistants	$ -	$ -
ZAPS Delivery Truck Dispatch Assistants Per Diems	$ -	$ -

Tier, Main Function and Line Item	**Baseline**	**ZAPS**
ZAPS Delivery Truck Drivers	$ -	$ 21,472
ZAPS Delivery Truck Drivers per Diems	$ -	$ 44,362
ZAPS Delivery Truck Fuel	$ -	$ 13,314
ZAPS Delivery Truck Insurance	$ -	$ -
ZAPS Delivery Truck Maintenance & Repair	$ -	$ 17,466
ZAPS Delivery Trucks Depreciation	$ -	$ 22,193
ZNFPC Team Leader Per Diems	$ 19,260	$ -
ZAPS Ordering Vehicle Drivers	$ -	$ 33,598
ZAPS Ordering Vehicle Drivers per Diems	$ -	$ 21,322
ZAPS Ordering Vehicle Fuel	$ -	$ 31,194
ZAPS Ordering Vehicle Insurance	$ -	$ 9,771
ZAPS Ordering Vehicle Maintenance & Repair	$ -	$ 18,816
ZAPS Ordering Vehicles Depreciation	$ -	$ 46,233
Baseline Truck Dispatch Assistants Labor	$ 16,238	$ -
Baseline Truck Dispatch Assistants Per Diems	$ 21,174	$ -
Baseline Truck Drivers Labor	$ 36,336	$ -
Baseline Truck Drivers per Diems	$ 68,019	$ -
Baseline Truck Fuel	$ 60,552	$ -
Baseline Truck Insurance	$ 10,149	$ -
Baseline Truck Service & Repair	$ 46,013	$ -
Baseline Truck Depreciation	$ 63,455	$ -
Grand Total	**$ 1,734,961**	**$ 1,505,064**

Appendix 4

Detailed Costs by Input and Line Item

Main Input, Line Item	Baseline	ZAPS
Fuel	$ 74,842	$ 48,057
ZAPS Delivery Truck Fuel	$ -	$ 13,314
Monitoring Vehicle Fuel	$ 14,290	$ -
ZAPS Ordering Vehicle Fuel	$ -	$ 31,194
ZAPS Truck Fuel, JSI Harare-Mutare Delivery		$ 3,549
Baseline Truck Fuel	$ 60,552	$ -
Labor	$ 758,847	$ 723,772
Area Distribution Coordinator Labor	$ 19,578	$ 23,126
District Pharmacy Staff Labor	$ 14,570	$ 24,334
Health Worker Emergency Order Labor to Pick up Commodities	$ 48,675	$ 43,648
Health Worker Supply Chain Management	$ 93,966	$ 61,665
Logistics Unit Data encoder 1	$ 2,000	$ -
Logistics Unit Data encoder 2	$ 1,464	$ -
Logistics Unit Data encoder 3	$ 1,296	$ -
Logistics Unit Data encoder 4	$ 981	$ -
Logistics Unit Deputy Manager	$ 5,032	$ 6,451
Logistics Unit Logistics Officer	$ 9,720	$ 14,289
Logistics Unit Overall Management Labor	$ 23,508	$ 23,461
Logistics Unit PMTCT Logistics Coordinator	$ 6,129	$ 7,198
Monitoring Vehicle Drivers Labor	$ 8,521	$ -
NatPharm Harare Labor	$ 163,494	$ 175,042
NatPharm LMIS Data Clerks	$ 8,296	$ 8,444
NatPharm Mutare Contract Workers	$ 2,710	$ 36,754
Provincial Pharmacy Manager Labor	$ 6,470	$ 7,104
Training	$ 79,429	$ 90,000
ZAPS Delivery Truck Dispatch Assistants	$ -	$ -
ZAPS Delivery Truck Dispatch Assistants Per Diems	$ -	$ -
ZAPS Delivery Truck Drivers	$ -	$ 21,472

Main Input, Line Item	Baseline	ZAPS
ZNFPC Harare Storage Labor	$ 10,633	$ 4,652
ZNFPC Team Leader Labor	$ 9,015	$ -
Health Worker Regular Order Labor to Pick Up Commodities	$ 30,126	$ 1,429
ZAPS Ordering Vehicle Drivers	$ -	$ 33,598
Baseline Truck Dispatch Assistants Labor	$ 16,238	$ -
Baseline Truck Drivers Labor	$ 36,336	$ -
NatPharm Mutare Regular Staff	$ 160,658	$ 141,105
Operating costs	**$ 246,590**	**$ 246,016**
LMIS Paper Forms	$ 8,540	$ 1,569
LMIS Software (licenses, server, etc.)	$ 1,230	$ 1,300
Logistics Unit Internet	$ 8,873	$ 8,258
Logistics Unit Office Fixed Costs	$ 3,979	$ 1,792
NatPharm Harare Operating Expenses	$ 145,473	$ 149,478
NatPharm Mutare Operating Expenses	$ 75,192	$ 77,628
Server Costs for AutoOrder TOP UP	$ -	$ -
ZNFPC Harare Operating Expenses	$ 3,303	$ 5,991
Per diem	**$ 146,635**	**$ 95,840**
Area Distribution Coodinator Per Diems	$ 8,160	$ 2,993
District Pharmacy Staff Per Diems	$ 15,358	$ 21,163
Monitoring Vehicle Drivers per Diems	$ 9,199	$ -
Provincial Pharmacy Manager Per Diems	$ 5,465	$ 6,000
ZAPS Delivery Truck Drivers per Diems	$ -	$ 44,362
ZNFPC Team Leader Per Diems	$ 19,260	$ -
ZAPS Ordering Vehicle Drivers per Diems	$ -	$ 21,322
Baseline Truck Dispatch Assistants Per Diems	$ 21,174	$ -
Baseline Truck Drivers per Diems	$ 68,019	$ -
Public transport	**$ 146,783**	**$ 48,374**
Health Worker Emergency Order Public Transport to Pick up Commodities	$ 69,618	$ 44,670
Health Worker Regular Order Public Transport to Pick Up Commodities	$ 77,165	$ 3,704
Space	**$ 202,249**	**$ 210,561**
Health Facility Storage Space	$ 182,032	$ 172,032
JSI Harare Contract for Male Condoms Storage	$ 4,027	$ 4,431
NatPharm Harare Storage Space	$ 5,877	$ 5,573
NatPharm Mutare Storage Space	$ 7,607	$ 7,664
NatPharm Mutare Storage Space Rental	$ -	$ 18,135
ZNFPC Harare Storage Space	$ 2,706	$ 2,727

Main Input, Line Item	Baseline	ZAPS
Vehicle depreciation	**$ 88,068**	**$ 81,113**
Monitoring Vehicles Depreciation	$ 24,614	$ -
ZAPS Delivery Trucks Depreciation	$ -	$ 22,193
ZAPS Truck Depreciation, JSI Harare-Mutare Delivery		$ 5,102
ZAPS Ordering Vehicles Depreciation	$ -	$ 46,233
ZAPS Truck Driver Labor, JSI Harare-Mutare Delivery		$ 4,108
ZAPS Truck Driver Per Diem JSI Harare-Mutare Delivery		$ 3,476
Baseline Truck Depreciation	$ 63,455	$ -
Vehicle insurance	$ 14,843	$ 10,704
ZAPS Delivery Truck Insurance	$ -	$ -
Monitoring Vehicle Insurance	$ 4,693	$ -
ZAPS Ordering Vehicle Insurance	$ -	$ 9,771
ZAPS Truck Insurance, JSI Harare-Mutare Delivery		$ 933
Baseline Truck Insurance	$ 10,149	$ -
Vehicle service and repair	$ 56,104	$ 40,627
ZAPS Delivery Truck Maintenance & Repair	$ -	$ 17,466
Monitoring Vehicle Service & Repair	$ 10,091	$ -
ZAPS Ordering Vehicle Maintenance & Repair	$ -	$ 18,816
ZAPS Truck Service & Repair, JSI Harare-Mutare Delivery		$ 4,344
Baseline Truck Service & Repair	$ 46,013	$ -
Grand Total	**$ 1,734,961**	**$ 1,505,064**

Appendix 5

Details on Commodity Throughput, Baseline versus ZAPS

	Baseline					ZAPS
	DTTU	ZIP/PHCP	ZADS	EMPS	Total	
Commodity Volume (m^3)	377	700	244	487	1808	1955
Commodity Value ($)	$ 2,835,193	$ 1,701,261	$ 4,636,145	$ 1,205,377	$ 10,377,976	$ 12,346,469

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