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Availability of Malaria Products at the Last Mile: Analysis of Facility and Community Level Data

SC4CCM 2013

A Health Surveillance Assistant (HSA) in Malawi sorts his medicine box, containing the commodities that he uses to manage common illnesses at the community level.

Community-level consumption accounts for up to 50% of pediatric ACT consumption[1].

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Community health workers (CHWs) are a major entry point to the health system for detection and treatment of malaria. As a first point of contact and common source of artemisinin-based combination therapy (ACTs) and other health commodities, there is a need to include consumption at the community level for an accurate picture of health service delivery.

Health facilities usually serve as the primary source of resupply for CHWs, and CHWs often send reports on services and commodities back to the health facility. In addition, health facility staff provide supportive supervision for CHWs.

Resupply systems supporting CHWs can vary from the very informal to structured systems. Even within the same country, the type of resupply system can vary across locations, or from one commodity group to another. Irregular supply protocols and a lack of records or consistent feedback can make it difficult for individual facilities, and the entire health system, to account for community-level consumption.

Systems that supply CHWs through health facilities can account for community-level consumption in their summary reports and order quantities. However, a reliable supply chain and robust monitoring system are necessary to understand how services are accessed by beneficiaries at the community level, and the logistics system requirements to adequately support these services.

Malawi presents an opportunity to learn more about community-level consumption, and the relationship between consumption at the health facility level and the community level. The logistics management information system (LMIS) gathers supply chain data across the facility and community levels for the entire country. This exercise hopes to gain a better understanding of consumption patterns across these levels to better ensure availability at the last mile.

[1] Result of analyzing consumption data between the facility level (through Supply Chain Manager) and community level (cStock)

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This document aims to describe relationships between supply chain data on malaria commodities at the community and facility level, specifically looking at stockout data and consumption data. Current limitations of the data and areas for improvement are also explored.

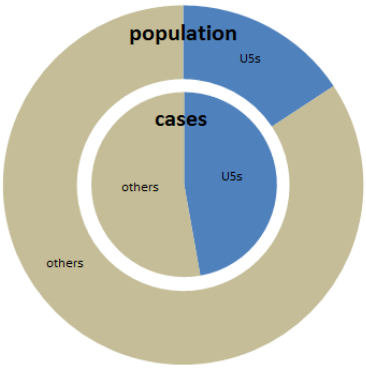
Malaria in Malawi

Malaria is endemic in Malawi, placing the entire population of 15.9 million at risk. It is the leading cause of childhood mortality, accounting for 15% of all deaths among children under the age of 5 (U5s).

Between 2007 and 2013, there were over 31.9 million recorded cases of malaria and over 37,360 deaths in Malawi[1]. In 2013, malaria affected more than 3.59 million Malawians[2], resulting in 5,500 deaths. Almost half of these cases occurred in U5s.

U5s comprises less than 20% of Malawi's population but they accounted for 47% of the cases as shown in figure 1. Because of their particular vulnerability to malaria, children under the age of five are a primary target population for malaria interventions.

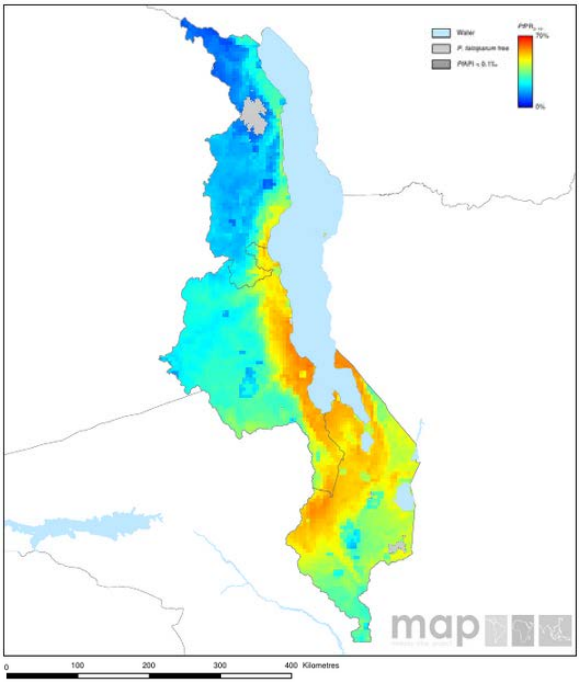
Figure 1. Demographic Breakdown of Population and Malaria Cases



Epidemiological Profile[4]

- First-line treatment: artemether-lumefantrine
- Rainy season: January - April
- Population living in high transmission areas: 100% (*distribution of P.f. parasite edemicity across Malawi is shown in figure 2*)[5]
- Population of U5s at risk: 2,854,000 (19% of the pop)[6]
- Incidence: 59,340/100,000
- Cases per year: 3,587,000 (HMIS data)
- Cases among U5s: 1,693,500

Figure 2. The Spatial Distribution of Plasmodium Falciparum Malaria Endemicity Map in 2010 in Malawi [3]



1 World Health Organization data repository, Malawi, 2013
2 Based on data provided by the MoH from the HMIS.
3 http://www.map.ox.ac.uk/browse-resources/endemicity/Pf_mean/MWI/
4 All case and incidence data based on 2013 HMIS data provided by the MoH
5 <1 case/1000 people
6 Malawi 2010 Census

The Malaria Supply Chain in Malawi

In Malawi, the USAID | DELIVER PROJECT (the project) works closely with the Ministry of Health to strengthen supply chain management of malaria commodities and improve product availability. The project manages a parallel supply chain (PSC) and strengthens and supports the LMIS. Malaria commodities procured by PMI and the Global Fund are distributed through the PSC, which was designed to mitigate some weaknesses detected in the existing distribution system run through the Central Medical Stores Trust (CMST). Working with two Third Party Logistics providers, the project provides oversight for the PSC which has resulted in greater accountability for commodities.

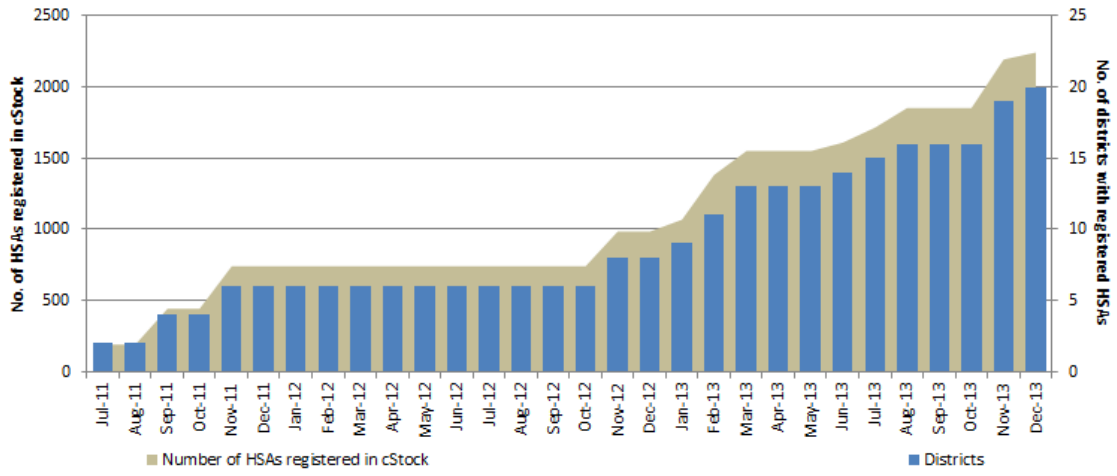
Electronic capture of supply chain data began in 2004 with the introduction of Supply Chain Manager (SCMgr) Software, an Access-based application. Since then, the project has been involved in supporting subsequent iterations of the software.

In 2008, Malawi rolled out a new strategy for integrated community case management (iCCM) of childhood illness to improve treatment by Health Surveillance Assistants (HSAs). HSAs are located throughout the country in hard to reach areas. In the initial roll-out for HSAs, health facilities did not collect regular data on community-level cases, consumption, and current stock levels. Without this information, facility-level requests for stock were not able to accurately reflect the total consumption in their catchment area.

Noting poor availability of medicines and weak linkages between community health workers and health facilities, the Gates Foundation funded Supply Chain for Management of Community Case Management (SC4CCM) Project to identify, demonstrate, and institutionalize community-based supply chain management practices that improve the availability and use of selected essential health products in Ethiopia, Malawi, and Rwanda. SC4CCM activities in Malawi focus on improving availability of products that HSAs need to treat the basic treatable conditions that present at the community level.

A large part of the project is the monitoring and feedback system designed to address data visibility between resupply points and HSAs. In coordination with Dimagi, the selected private sector vendor who developed the technology, the project has an online system (cStock) that is designed to capture basic information on each HSA's stock status with the SMS submission of just two data points per managed commodity: stock on hand (SOH) and quantities received. cStock began gathering community-level stock data in 2011. In Malawi, cStock was initially piloted in 6 districts and has since scaled to 23 of Malawi's 28 districts, as shown in Figure 3. Commodities monitored as part of this system cut across 3 main categories: family planning, HIV, and community case management of childhood illness. Nineteen medicines are managed by HSAs in Malawi. For malaria, products include AL 1x6 and AL 2x6, used to treat malaria in pediatric patients.

Figure 3. Number of HSAs in Malawi



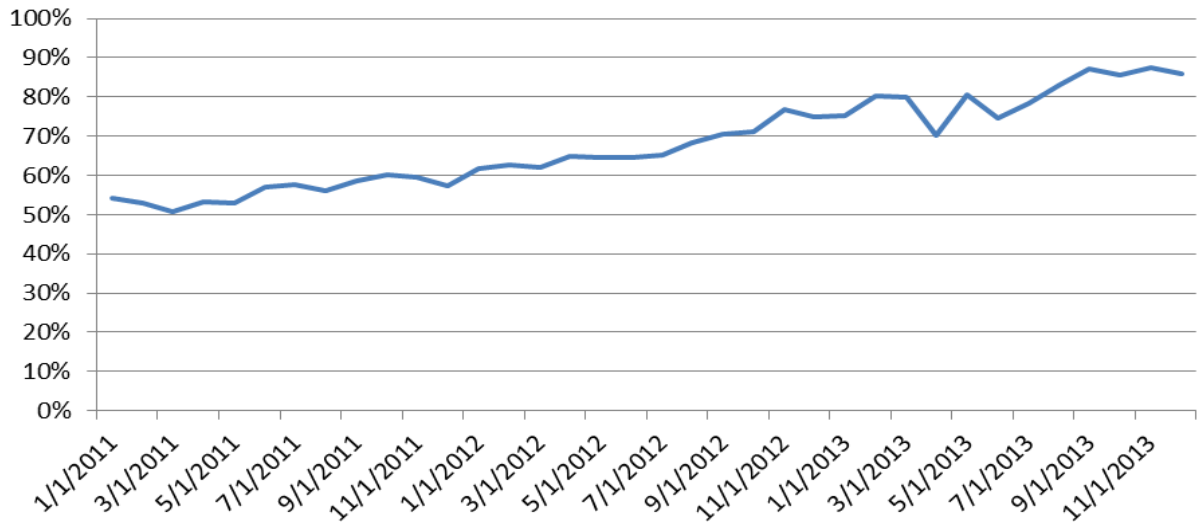
Data and Analysis

This exercise utilizes data on facility- and community- level supply chain data sourced from SCMgr and cStock, respectively.

Facility-level LMIS (Source: SCMgr)

The facility-level LMIS gathers data on several hundred products such as contraceptives, ACTs, tuberculosis, HIV tests, laboratory supplies, and other essential commodities across the entire country. At each facility, data from the previous month's consumption and stock on hand are compiled and submitted to the District Health Office (DHO) each month. At the district level, SCMgr utilizes data from these reports to calculate the quantities to be ordered for each SDP. After submitting a request to the Regional Medical Stores (RMS), the order is reviewed, verified, and approved before the products are released and included in a subsequent monthly resupply request. The project installed and continues to provide support for the use of SCMgr software at the central and district levels. Significant investments (in training, supervision, collection and delivery of paper forms, as well as internet and airtime access) have been made in improving data reporting and quality, and as a result, reporting rates have substantially improved over time, as shown in Figure 4, from around 50% in 2011 to almost 90% in 2013 (see figure 4).

Figure 4. Percent of Facilities Submitting Monthly LMIS Reports through Supply Chain Manager



There is 100% visibility into stock levels of malaria commodities through the PSC that the project implements. This accountability extends to the data on monthly supplies to each health facility, down to the specific batch numbers delivered to individual facilities. At the same time, there are some concerns about the quality of submitted LMIS data. Data submission and quality issues are associated with a myriad of issues that range from IT constraints (e.g. internet connectivity, and computer literacy), low participation of non-government facilities, technical issues (e.g. absence of quality checks), and a lack of human resources at the health facility level where data are originally generated.

LMIS data used for this exercise include facility stock on hand and consumption for AL 1x6 and AL 2x6. The data was checked for duplicate records, errors recorded as such in the database, and other discrepancies. Much like the types and levels of cStock data detailed below, LMIS data for these indicators were analyzed in various combinations both as a sum or overall average of the project and by month over

several years, as well as a national aggregate and broken down by district. Most of the data presented below will show a national aggregate of facility-level data over time (by month).

Community-level LMIS (Source: cStock)

cStock is an SMS and web-based, open-source LMIS for reporting logistics data, calculating resupply, and monitoring all community-level health products. HSAs use their own mobile phones to transmit two data items - monthly stock level data and receipts - to a toll-free short code, with no additional hardware costs or financial incentives. cStock automatically calculates re-supply quantities based on reported data, and triggers re-orders to supervisors at health centers, facilitating accuracy and reducing transport time and costs. With regular reporting of only two data items, cStock is able to generate reports on more than 10 supply chain indicators that program managers and partners can use for performance monitoring and supervision.

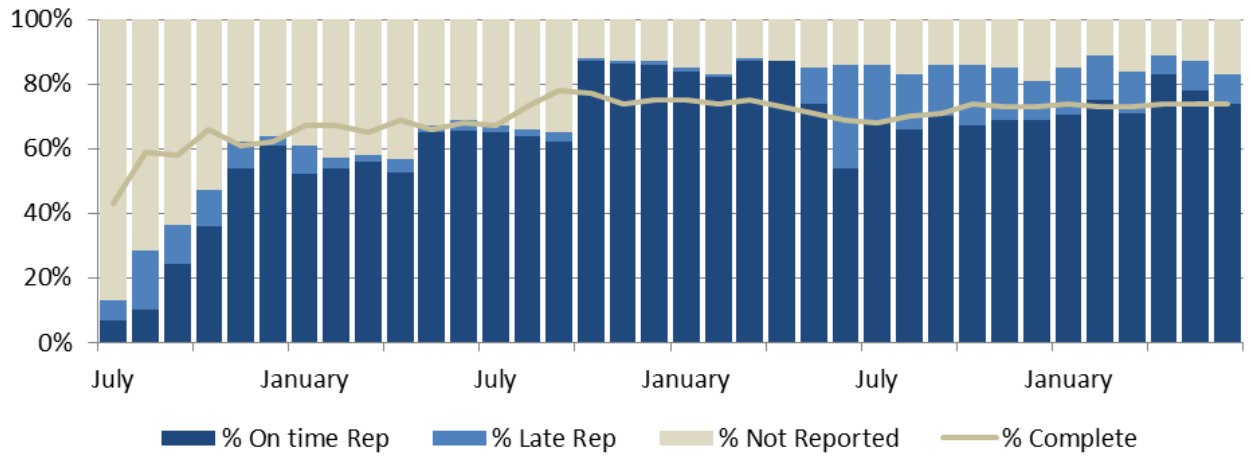
cStock, calculates several versions of consumption based on HSA inputs for stock on hand and receipts:

1. Total actual consumption – calculated by the system by summing the total number of consumed tablets for each HSA for each AL presentation. . For each individual HSA this is calculated using this formula:
   Previous SOH + Receipts this period – Current SOH = Consumption
2. Total consumption (adjusted for stockouts) – the total consumption expected if the HSAs had the specific product in stock throughout the period under review by extrapolating consumption from periods when the product was in stock.
3. Total consumption (adjusted for stockouts and data coverage) – The total consumption expected if all HSAs had the selected product in stock throughout the period under review and if data were available for all days in the period under review. When extrapolating for data coverage, consumption is based on HSAs who submitted data.
4. Average monthly consumption (AMC) – Provides an average for the quantity of tablets dispensed by each HSA each month. It is obtained by dividing the total consumption (adjusted for stockouts and data coverage) by the total number of respondent HSAs.

From the district levels and above, managers have access to a web-based dashboard (cstock.jsi.com) to monitor performance. cStock was designed to mimic the paper reporting & resupply system but does not replace the paper reporting system that collects data on additional indicators.

By streamlining and reducing the reporting burden on HSAs, SC4CCM has been able to increase reporting rates over the life of the project and consistently maintain them, as shown in figure 5.

Figure 5. HSA Reporting Rate



Methods

LMIS data was exported from SCMgr and included:

1. managed commodities (across all treatment areas, listed by name and product ID),
2. location data (Region, District, facility name, individual facility IDs)
3. logistics data (starting and closing balances, units dispensed, and any errors)

Because HSAs only manage pediatric presentations of AL, when exporting the SCMgr data on facility-level supply chain indicators from Access, data was only retrieved for AL 1x6 and AL 2x6. After these were exported into excel, duplicate and error entries were removed.

SC4CCM data from cStock was exported from the web-based database[7] in several forms: 1) national-level summary data across the whole project; 2) national-level data disaggregated by month across the span of the project's activities; 3) district-level data summarized across the project period; 4) district-level data exported by month and analyzed across the span of the project's activities.

cStock output and indicators used for this exercise include:

- Total consumption: actual and adjusted for stockouts
- Average monthly consumption
- Order fill rates (OFR): calculated as the percentage of the quantity requested that was received by the HSA. The average OFR for each product indicates if on average HSAs were over (>100%) or under supplied (<100%) for each product.
- Stock status

The main outcomes and relationships of interest are consumption and stockouts across service delivery levels. Because of the geographic variations expected across districts and facilities for both of these indicator categories, disaggregated data was used initially. However, the data shown here is primarily based on national-level aggregate due to the presence of artifacts or errors that are more apparent when disaggregated.

National-level aggregates for cStock include an increasing number of districts as the program is rolled out. As such, when comparing to facility-level data (such as that used to determine consumption across levels), the facility-level data pertains only to districts implementing SC4CCM activities and submitting cStock data at that time.

When examining data broken down by district (some of which contain just a few reporting facilities), a single error or artifact can completely alter or misrepresent patterns of consumption and stock status at the district level. Unfortunately, this does greatly reduce the possibility of drawing conclusions about potential relationships or associations between the two systems at the district level based on these data sources alone.

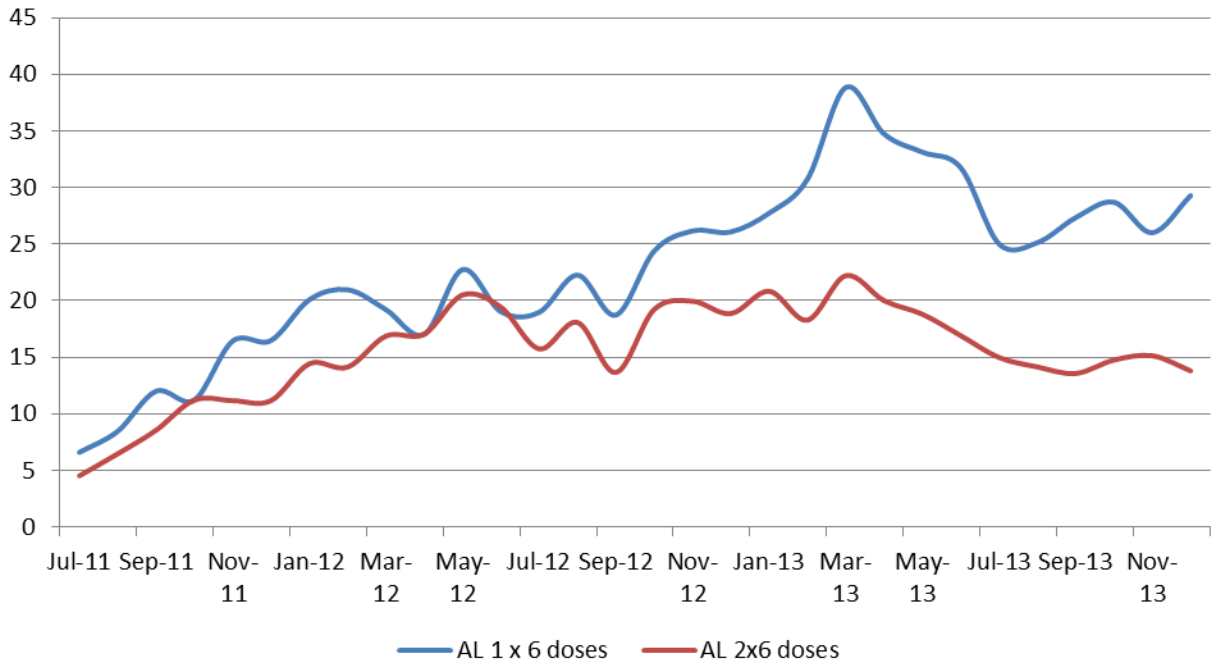
[7] www.cstock.jsi.com

Findings

Consumption

The AMC in cStock is a monthly average of the quantity of product dispensed by each HSA, calculated over a 60 day period. HSAs track consumption based on the number of tablets dispensed, so the cStock output was divided by either 6 or 12 for AL 1x6 and AL 2x6, respectively, to illustrate AMC in treatments or doses. Since SC4CCM began implementing activities in Malawi, there has been an increase in the overall consumption, as well as the AMC, shown in figure 6.

Figure 6. Average Monthly Consumption of AL by HSAs



To explore the level of service provision at the facility and community levels, we compared consumption of both pediatric AL formulations. Figures 7 and 8 show the total number of treatments actually dispensed each month in columns. These columns are broken down into community-level consumption (the blue portion) and facility-level consumption (the brown portion). The number of treatments dispensed each month varies greatly, at each level, and as a whole (across both levels). The percentage of consumption through HSAs compared to facilities is shown in the blue line.

Because HSAs are supplied through facilities, consumption data in SCMgr includes the number of items that were given to HSAs, as well as the number that were dispensed to users at the facility level.

Peak consumption of both AL formulations aligns with the rainy season (January – April); this trend is more pronounced at the facility level as shown in figures 7 and 8.

Community-level consumption (and health seeking behavior) accounts for a greater portion of cases in the dry season and up to 50% of overall pediatric case treatment.

Figure 7. Consumption of A/L 1 x 6 at the Facility and Community Levels

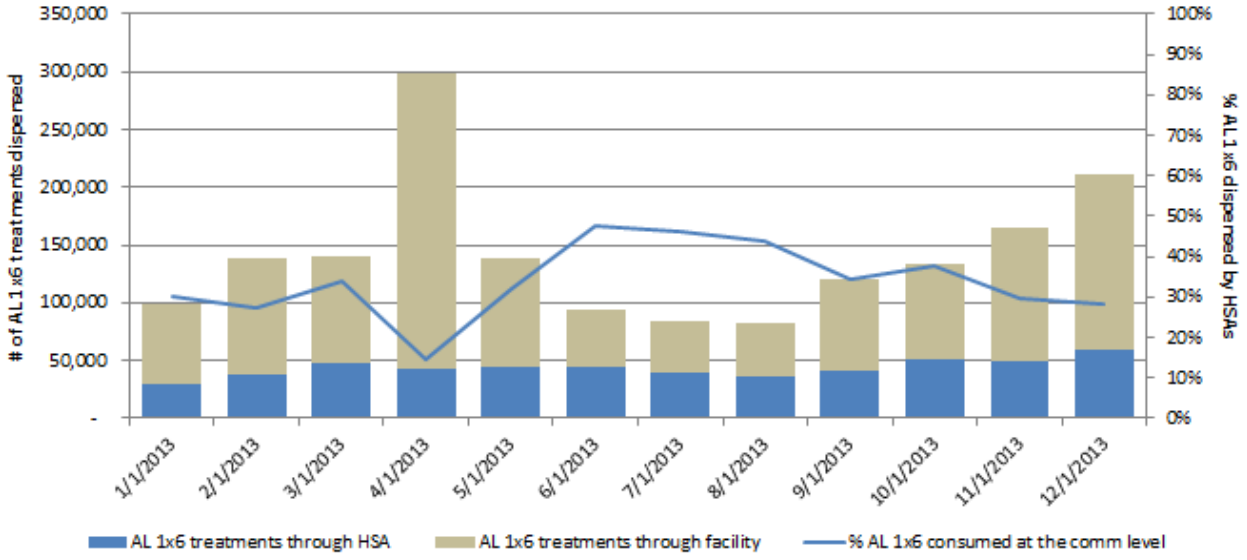
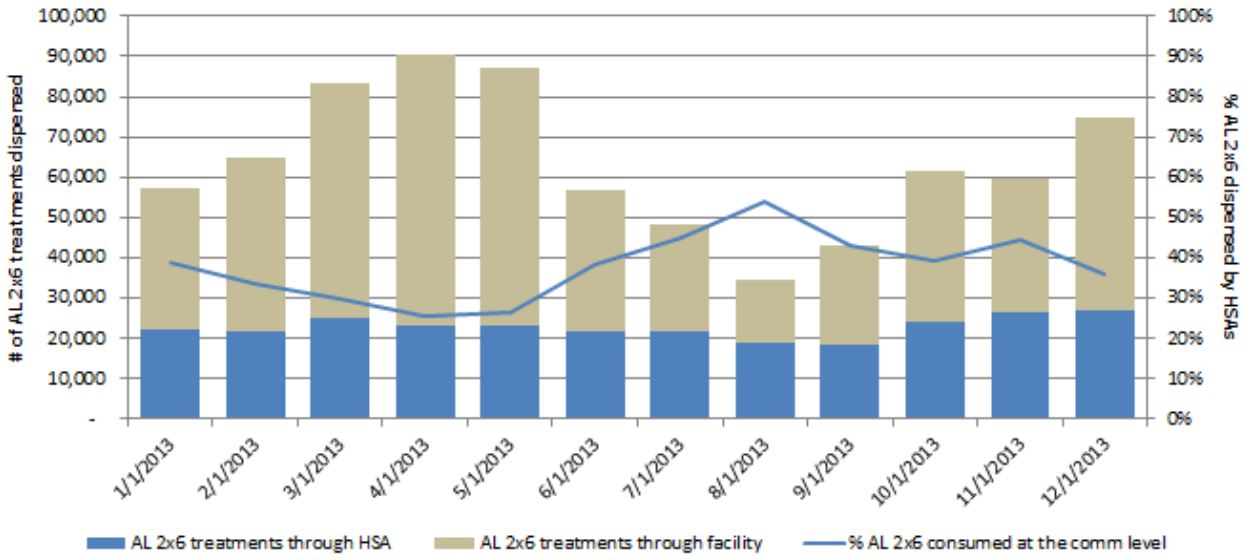


Figure 8. Consumption of A/L 2 x 6 at the Facility and Community Levels



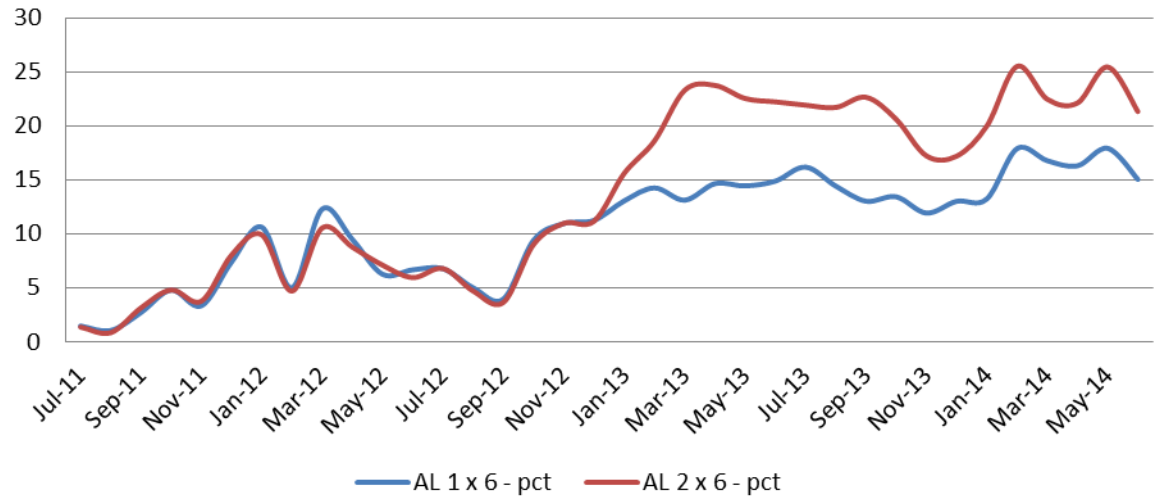
Stockouts

One SC4CCM goal in Malawi is to improve product availability at the HSA level by addressing transportation and data visibility challenges between HSAs and their resupply points. As detailed in the initial description of cStock, HSAs report their stock status at least once a month, providing information on their stock on hand and receipts. HSAs are also supposed to send an SMS if they have a stockout. The availability of stock with HSAs and thus, for treatment, is potentially limited by several factors including:

- Facility Stockouts – if a facility is out of stock, or is running low on stock, HSAs will not be notified that their requested stock is available for pick-up at the facility level
- Timing of HSA pick-up – after notification of available stock, if the HSA is unable to pick up available stock as soon as they are notified, this will lengthen any periods of stockouts

cStock tracks reported stockouts and the timing of their subsequent resupply to calculate the number of days that they experience a stockout for any managed commodity, as well as the number of HSAs stocked out of a particular commodity for each month. As cStock expanded to additional districts, HSAs began to report an increased number of stockouts, reflected both in the number of days that HSAs experience stockouts of a commodity each month[8] and the percent of HSAs reporting stockout of a commodity each month. Figure 9 shows the increasing percent of HSAs who experienced stockouts of pediatric formulations of AL each month.

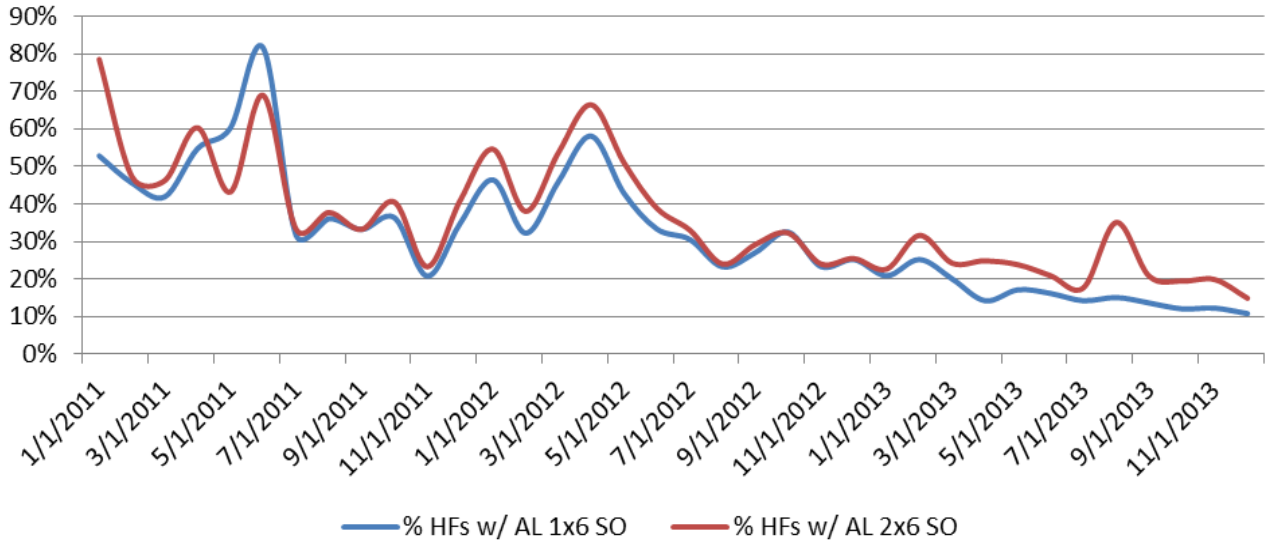
Figure 9. Percent of HSAs Experiencing Stockouts for AL 1x6 and AL 2x6



At the national level, the trend of increasing stockouts among HSAs is not reflective of stockouts at the facility-level. Overall facility-level stockouts during the dry season are low, and in general have decreased over time, as shown in Figure 10. In fact, the percent of HSAs stocked out increases significantly in 2013 as facility-level stockouts of pediatric AL decrease.

[8] Defined as: [the average total number of days of stockout for all HSAs] ÷ [total # of HSAs reporting]

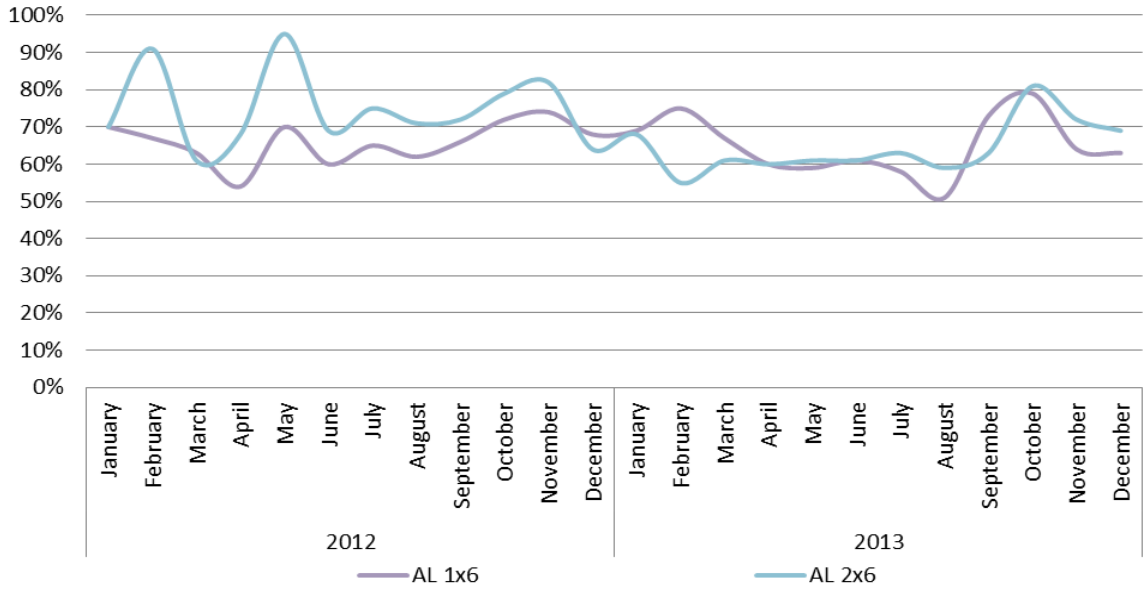
Figure 10. Percent of Facilities Stocked Out of AL 1x6 and AL 2x6



Order Fill Rates

Though the percent of facilities stocked out has decreased overall, this is not consistently reflected in HSA resupply. The OFR is calculated as the percentage of the quantity requested that was received by the HSA. When stock is available at the facility level, this does not necessarily correlate with a high OFR, as shown in figure 11. For most of 2012 and 2013, OFRs have ranged from around 50% to 90%, and averaging around 65%.

Figure 11. Order Fill Rate for AL 1x6 and AL 2x6



Comparing data at the district level does not show a direct relationship between facility-level stock and order fill rate. In some cases, high OFR is associated with low stockout rates. In other cases, low OFR is associated with low stockout rates. Using two examples of districts with zero facility stockouts in late 2013:

1. Likoma District – the OFR was between 90% and 100%
2. Ntchisi District – OFRs were between 60% and 70%

This inconsistent relationship between facility-level stockouts and OFR will be interesting to investigate further.

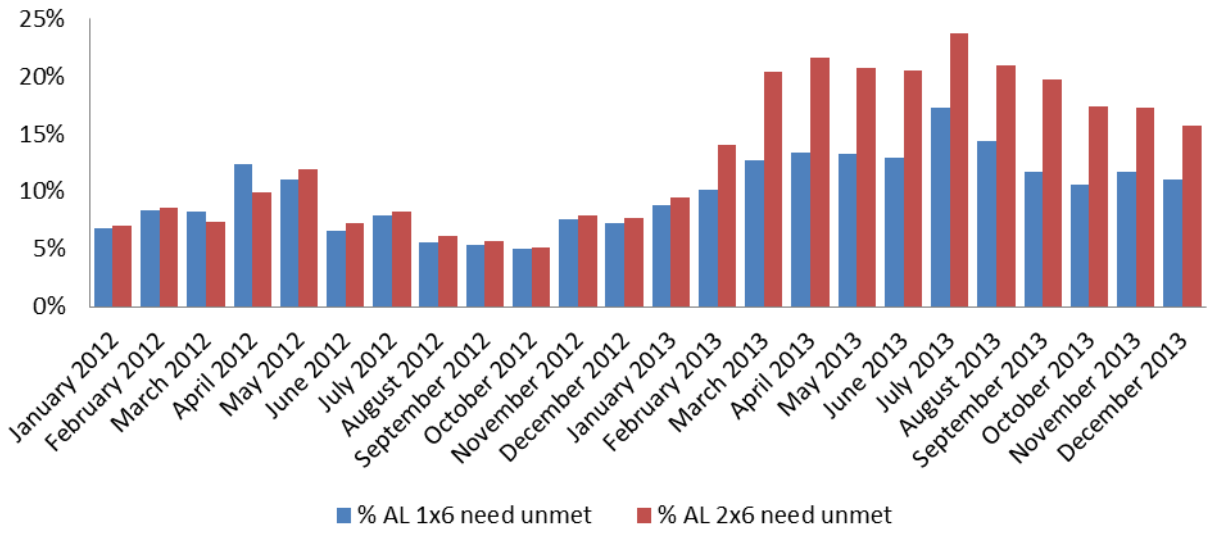
Estimating Unmet Need

When an HSA has zero stock, this can affect patient treatment by either delaying it, or resulting in no treatment altogether. Without conducting specific follow-up with these patients, it is not possible to know exactly how many patients do not follow up, but it is important to know how many patients comprise this group. To get an estimate for this potentially unmet need, it is possible to look at the difference between two of the consumption measures:

$$\frac{[(\text{total consumption adjusted for stockouts}) - (\text{total actual consumption})]}{[\text{total consumption adjusted for stockouts}]} \times 100$$

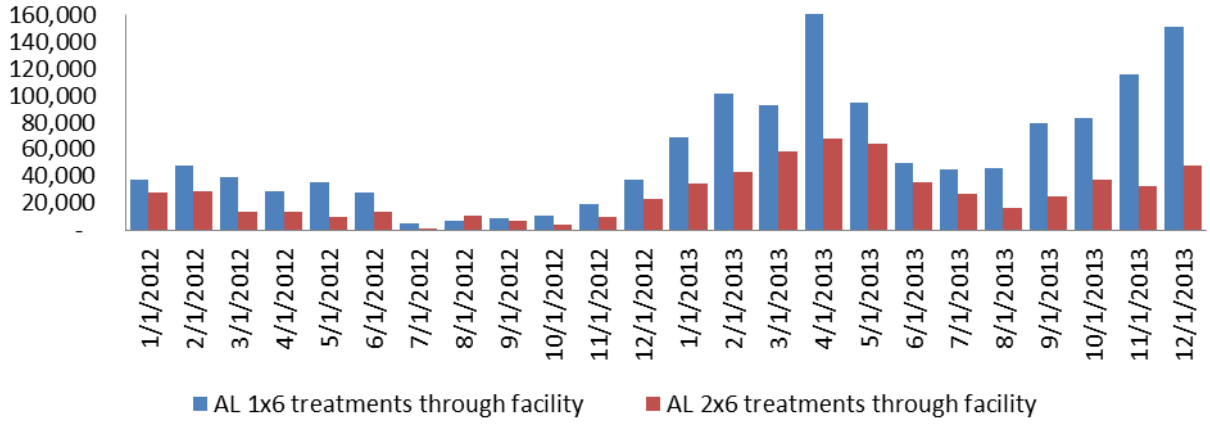
Total consumption adjusted for stockouts is based on the actual consumption, taking into consideration any days out of stock; in other words, what would have been consumed if the product had been consistently available. By comparing the actual consumption and adjusted consumption, an estimate can be made as to the number of cases that were likely missed. As shown in figure 12, this group could constitute up to 20% of the patients or cases treated by HSAs.

Figure 12. Percentage of Cases Treated by HSAs that Could Represent Unmet Need



Higher levels of potentially unmet need at the community level overlap with periods of increased percentages of facility-level consumption (seasonal variation of pediatric AL consumption shown in figure 13, showing how facility consumption varies seasonally). Without additional sources of data, it is not clear whether this is the result of HSA cases who subsequently seek treatment at facilities. With cStock accounting for as much as 20-25% of the reported consumption[9] of pediatric AL, it is important to clarify health seeking behavior after encountering an HSA-stockout. Understanding this response will help refine the overall needs and improve the accuracy of consumption for future resupply strategies.

Figure 13. Number of Pediatric AL Treatments Used at Facilities



Conclusions

It is clear that HSAs are an important source of treatment at the community-level in Malawi. Treatment of children with malaria through this cadre has increased not only because of the program's expansion to additional areas and HSAs (resulting in an overall increase in treatments dispensed), but also among each HSA as shown by the increasing AMC.

Having this visibility into community-level consumption data alongside a robust LMIS is invaluable and with further study will be able to tell us more about how to improve the program. The analysis presented here brings up more questions that would be helpful to answer:

- Order Fill Rate. Why are OFRs below optimum levels? Is it possible to increase the OFR? Does this stay consistently around 60 or 70% because facilities themselves are trying to avoid stockouts? Why does there not seem to be a relationship between OFR and facility level stockouts? Is there a strong relationship between OFR and HSA level stockouts? To answer these questions, selected facilities across districts could be chosen to determine how their stock levels affect OFR. A focus could specifically be made on those facilities with low stockout rates to investigate bottlenecks that occur when stock is available at the facility level

[9] Unadjusted total actual consumption

- HSA stockouts. What happens to cases when they seek treatment from an HSA who does not have products in stock? Do cases follow up by seeking treatment at facilities? Does this increase consumption at facilities? Or are we losing an opportunity to treat these cases and improve their prognosis? To answer these questions, an analysis could be done at several facilities (and their associated HSAs), where HSAs are asked to keep track of any cases they do not treat. Facility staff could also be asked to track whether the patients they are treating previously went to an HSA. Based on these two data points for individual facilities, it should give us an idea about potentially untreated cases and the effect that HSA stockouts may have.
- Data quality. Even after late reports come in, up to 20% of HSAs do not submit. Do unsubmitted reports from HSAs reflect consumption that is reported? HSAs that do not report could be followed up with, to see if their consumption is comparable to the rates of HSAs nationwide who submitted reports. Additionally, there are still some errors in consumption data at the community and facility levels. HSA submissions to cStock can result in greatly exaggerated consumption estimates for an entire district or even nationally. Inputting additional data quality checks could help flag outliers and highlight actions to be taken by supervisors.

By highlighting these issues and areas for improvement, comparison of these two sources allows us to gain a better understanding of the health seeking behavior in areas where community-level services are provided. The data shows the importance of reliable supply chains and supporting data sources down to the community level and highlights areas where there may be room for improvement or gaps in understanding.

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