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DEPLOYING DIGITAL TOOLS FOR MALARIA PREVENTION: ZAMBIA'S JOURNEY TOWARDS ITN CAMPAIGN DIGITALIZATION

amp | The Alliance for Malaria Prevention
Expanding the ownership and use of mosquito nets

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BACKGROUND

Malaria remains a major cause of morbidity and mortality in Zambia. In 2021, the country reported 7,050,968 cases and 1,499 total deaths from malaria[1]. By 2023, cases had risen 37 per cent and deaths to 1,602[2], a rise of 19 per cent. The 2022—2026 National Malaria Elimination Strategic Plan[3] (NMESP) builds on progress made and lessons learned in implementing the 2017—2021 NMESP. The main goals are to reduce malaria infection, disease and death in Zambia by 2026; increase the proportion of the population living in malaria free health facility catchment areas; and maintain malaria-free status and prevent reintroduction and importation of malaria into areas where the disease has been eliminated.

In line with the NMESP, the Ministry of Health, through the Zambia National Malaria Elimination Centre (NMEC), implements various malaria vector control interventions with support from partners including the Against Malaria Foundation (AMF), Akros, Churches Health Association of Zambia (CHAZ), The Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), Malaria Control and Elimination Partnership in Africa (MACEPA), PATH, the US President's Malaria Initiative (PMI) and World Vision. The key vector control interventions implemented in the country include indoor residual spraying (IRS), distribution of insecticide-treated nets (ITNs) through campaign and continuous channels, and larval source management.

One objective of the NMESP is to provide universal access to vector control to at least 86 per cent of the population through an integrated approach. The implementation of integrated vector control requires extensive planning processes to deliver IRS every year and ITNs every three years to protect communities.

Before 2020, the NMEC faced several challenges in targeting areas eligible for IRS and ITNs, particularly at the lower administrative levels. Population data were often inaccurate and did not provide spatial context at a granular level. Implementing the mosaic approach of 50 per cent IRS and 50 per cent ITN distribution in districts was difficult to operationalize due to a lack of accurate, location-specific data on population sizes for ITNs and residential structures for IRS.

This document gives a description of the process of digitalization, how it developed over the course of two campaigns (2020 and 2023), how decisions were made, the major challenges faced, lessons learned, and the positive outcomes, all of which may inform staff of other malaria programmes and partner organizations considering a transition to digitalization.

1. Zambia National Malaria Elimination Strategic Plan, 2022-2026
2. https://www.aa.com.tr/en/africa/malaria-cases-in-zambia-up-37-in-2023/3198570#:~:text=Sylvia%20Masebo%20said%20the%20country,per%20day%20from%20the%20disease
3. Zambia National Malaria Elimination Strategic Plan, 2022-2026

THE 2020 CAMPAIGN

Campaign components

PLATFORM

The NMEC partnered with Akros[4] to implement geospatial mapping during the microplanning of the IRS and ITN campaigns using the Reveal platform[5]. The decision to use Reveal was influenced by its open-source availability and its user-friendly system, designed in a format similar to paper-based forms. Additionally, the tool's offline functionality was a crucial factor, considering the intermittent cellular and internet coverage in remote areas. Similarly, DHIS2[6] was used to aggregate data at the district level.

MICROPLANNING

To address the issue of inaccurate population and non-location-specific data, the NMEC integrated geospatial mapping using GRID3[7] into the microplanning process, which aimed to achieve the following objectives:

1. Apply the GRID3 products to create planning maps
2. Develop and implement a planning template to complement the maps
3. Use the microplanning map data within Reveal in 14 districts to guide IRS delivery

Traditionally, the microplanning for these campaigns depended on hand-drawn maps to designate areas for intervention, but the use of GRID3 and Reveal enabled the identification of settlements and sub-catchment areas for ITN and IRS distribution.

Geospatial mapping was introduced in all 116 districts, a light touch mobile data collection approach in 14 medium-priority districts and a more granular intensive digital approach in nine high priority districts. The NMEC used field-verified household-level data obtained through the Reveal platform. The data were obtained from the following sources: population and "building footprints" at settlement level were obtained from GRID3; residential structure counts were obtained using an Akros model generated from field-verified Reveal data and satellite-derived data; health facility catchments were manually developed. The NMEC used the GRID3 data to create planning maps and developed a planning template to complement the maps. Detailed maps with structure counts and population were printed and sent to all 116 districts across the 10 provinces to assist with microplanning. During microplanning, district teams updated the maps and demarcated where they would implement IRS versus ITN interventions ensuring no settlements were missed. Thus, in support of the development of operational budgets, the final output from the microplanning phase identified which areas were to receive ITN or IRS. Additionally, it was also used to determine number of prepositioning sites in each district and number of workers required for household registration and distribution.

4. https://akros.com/
5. https://revealprecision.com/2020/07/
6. https://dhis2.org/
7. GRID3 works with countries in sub-Saharan Africa to generate, validate, and use core spatial datasets on population, settlements, subnational boundaries, and crucial infrastructure. See: https://grid3.org/

The use of geospatial information through the Reveal platform led to several positive outcomes for both the campaign process and its results. Microplanning teams gained access to accurate data on populations and residential structures, facilitating evidence-based and more straightforward intervention allocation. Approximately 96 per cent of visited structures were in predetermined areas, indicating that field teams successfully reached the correct sites due to the microplanning data provided by the Reveal mobile client application. Access to maps allowed field teams to locate structures accurately, reducing the occurrence of incorrectly coding structures as refusals, which, in turn, improved the accuracy of campaign implementation data. The adoption of geospatial information for microplanning also increased intervention coverage. Accurate population data supported decision-making through data dashboards, enhancing the accuracy of coverage data by precisely mapping targeted structures or households, as well as identifying areas that had not been reached.

HOUSEHOLD REGISTRATION (HHR)

Paper-based data collection tools were used without any digitalization of the HHR process.

ITN DISTRIBUTION

An initial step was taken towards digitalization of the ITN distribution data. Aggregate data sent to district health offices were entered into the DHIS2 platform. However, this process encountered delays, primarily because only one member of staff conducted the data entry for each district, resulting in slow data processing at the district level.

LOGISTICS

Not digitalized.
Paper-based tools were used.

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Challenges

The major challenge in 2020 was the absence of clear health facility catchment area boundaries to guide demarcations and set accurate targets at the health facility level. As a result, the maps were primarily used as district-level resource allocation validation tools, limiting their effectiveness in precise targeting and intervention.

Lessons learned

The following areas for improvement were identified:

- Integrate maps earlier in the planning process to guide initial allocation during macroplanning. Use historical data and adjust allocation plans during microplanning based on district-specific justifications.
- Use multiple datasets to estimate district and health facility catchment area populations accurately. Achieving the correct population denominator is crucial to planning.
- Assess the accuracy of all population datasets. In some districts, discrepancies between population numbers and traditional head counts or Central Statistics Office (CSO) data posed harmonization challenges.
- Create health facility catchment area boundary data and integrate it into microplanning maps for accurate demarcations and target setting. Utilize district information officers to input microplanning targets into DHIS2 by leveraging their platform familiarity.
- Ensure offline functionality to enable data collection where internet access is unreliable.
- Seek interoperability between Reveal and DHIS2 for future campaigns to enhance data integration and management.
- While physical maps are an improvement, digital maps could offer more precise capabilities for microplanning.

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2023 CAMPAIGN

In October 2023, the NMEC launched the largest-ever ITN mass campaign in Zambia, reaching 21 million individuals and distributing over 11.5 million nets to over three million registered households. Leveraging its earlier experience with digital tools for microplanning, the programme expanded the digitalization in the 2023 campaign to include household registration, distribution, logistics and monitoring and supervision.

PLATFORM

DHIS2 was selected as the digital platform primarily due to its user familiarity and out-of-the-box configurability. The DHIS2 Tracker app was designed to be accessible in both online and offline modes, ensuring consistent usability. One significant feature was the system's ability to automatically assign unique household identities (IDs). The system also integrated geographic information system (GIS) capabilities to capture global positioning system (GPS) coordinates during household registration.

MICROPLANNING

The geospatial maps implemented in 2020 were no longer used for the 2023 campaign planning due to a lack of funding to support this activity. Additionally, the primary purpose of using geospatial maps was to clearly delineate which areas were to receive either ITNs or IRS. Since the 2023 campaign distributed nets to every part of the country, it was decided not to continue the exercise.

HOUSEHOLD REGISTRATION

Building on the experience from the district level aggregation of distribution data during the 2020 campaign, the NMEC decided to digitalize the household registration and ITN distribution for the 2023 mass campaign. To facilitate this transition, the NMCP procured 10,500 smartphones and tablets, along with accessories, and printed paper registers for backup. The NMEC converted paper ITN registers into electronic formats using DHIS2 Tracker.

The shift to digitalization was not only a requirement for securing AMF funding for six provinces but also aimed to resolve numerous issues inherent in the use of paper registers during previous campaigns. These issues included the manual assignment of unique household IDs, missing data, poor handling of documents, illegible handwriting and errors in calculating the necessary ITNs for health facility catchment areas.

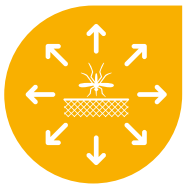
Data collection was implemented at the village level, with more than 79,000 villages loaded into the system to align with the administrative hierarchy, and involved approximately 19,000 data collectors. All metadata configuration, including account creation, was managed nationally to ensure a standardized approach across the campaign. To test the campaign and anticipate potential challenges, a pilot of the household registration exercise was conducted in six districts.

During the registration process, community-based volunteers (CBVs) were paired to conduct door-to-door household registration. Each team was given one smartphone and a printed register as a backup for data collection and was required to register at least 40 households per day over a period of 10 days. The CBVs collected household addresses, GPS coordinates (automatically generated), the household head's name, the number of persons and the number of sleeping spaces. The app then calcu-

lated the required ITNs per household and generated a unique identification code for each household. The parameters used to determine the quantity of nets per household included allocation of one net to two people and capping of a maximum of three nets per household in the Eastern province in the six districts (Petauke, Kasenengwa, Lusangazi, Mambwe Chadiza and Chipata) and four per household in two districts (Katete and Sinda). The reason for the capping in these districts included (i) low malaria risk based on epidemiological data; and (ii) district receiving IRS at high population coverage in the 2023 campaign. Eligible IRS districts were capped at three while the pre-elimination districts (Sinda and Katete) were capped at four. The registration process used National Registration Cards (NRC) or other forms of identity for verification for each household. The unique code generated by the mobile application was entered into the paper-based register at the end of the registration process. Each CBV was required to synchronize the data at the end of the day's work.

Digitalization improved efficiency of the campaign planning and implementation throughout the process. Firstly, it enabled monitoring and supervision of household and distribution data regardless of location. This real-time data collection allowed prompt feedback through WhatsApp groups to lower levels, flagging missing nets or over-distribution. The MoH and its partners enhanced monitoring, troubleshooting, and coordination efforts to address most issues onsite, which accelerated the campaign.

ITN DISTRIBUTION



During the ITN distribution, CBVs collected ITNs from health facilities based on allocations provided by the app and went door-to-door to distribute them to households. At each household, using smartphones or tablets, CBVs entered the NRC number, or the unique identification number recorded in the paper-based register during registration. If the number could not be found, the app allowed them to search for the household using other data, such as the name of the household head or phone number. After entering the ID, CBVs issued the number of ITNs specified by the app. Distribution was then marked as "complete" on both the mobile app and the backup register before synchronizing the data to the server.

LOGISTICS

In response to the challenges encountered during the mass ITN campaigns in 2017 and 2020—particularly issues with delivery delays, discrepancy resolution, and the legibility of Proof of Delivery (PoD) documents—a new initiative was launched in 2023 to enhance ITN visibility and delivery efficiency. This initiative aimed to provide faster and clearer information on deliveries, expedite the resolution of discrepancies, improve the PoD review process, and enhance traceability from distribution centres to last-mile locations by leveraging the Tracenet GS1[8] barcode system for better tracking. Real-time reporting was introduced to ensure the effective delivery of nets to their intended destinations.

The delivery tracking of the ITNs was implemented using electronic Proof of Delivery (ePoD) and barcode scanning. Bales of nets were scanned at the central warehouse during loading. Although it was initially planned for drivers to scan barcodes upon delivery this requirement was scaled back. Each driver used a third-party app—such as Telematics, Detrack, or Shipday—to provide these services, including offline functionality for areas with poor network coverage. Once the driver commenced delivery using the app, a tracking link was shared for

8. https://www.ghsupplychain.org/sites/default/files/2021-06/TraceNet%20Technical%20Brief_Final.pdf

real-time monitoring. Upon reaching each destination, the driver completed the ePoD on their phone, capturing names, signatures, GPS coordinates and photos, ensuring comprehensive and verifiable delivery records. Third-party logistics service providers played a key role in this approach by using electronic delivery platforms for real-time PoD transmission. Three service providers were selected based on their capabilities, and digital tools were integrated into the subcontracting process to enhance delivery efficiency.

This system was implemented in only six provinces where AMF procured nets. In the remaining four provinces, the DHIS2 platform was used to enter ITN deliveries at the district level.

The digitalization of the ITN delivery process improved visibility and provided the ability to track multiple distributions simultaneously. It enabled successful live tracking and the identification of drivers going off-route. PoDs were shared quickly and were easily legible, featuring extra information such as photos and GPS data. Deliveries became more accurate, allowing for changes and corrections to quantities, which reduced the need for reverse logistics. Also, the NMEC contracted companies that already had ePoD systems in place, eliminating the need to develop or train transporters. Early confirmation of deliveries allowed for the early disbursement of funds to vendors, preventing pauses in deliveries. There were no net losses in delivery, suggesting that high-touch tracking may have contributed with a deterrent effect.

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MONITORING AND SUPERVISION

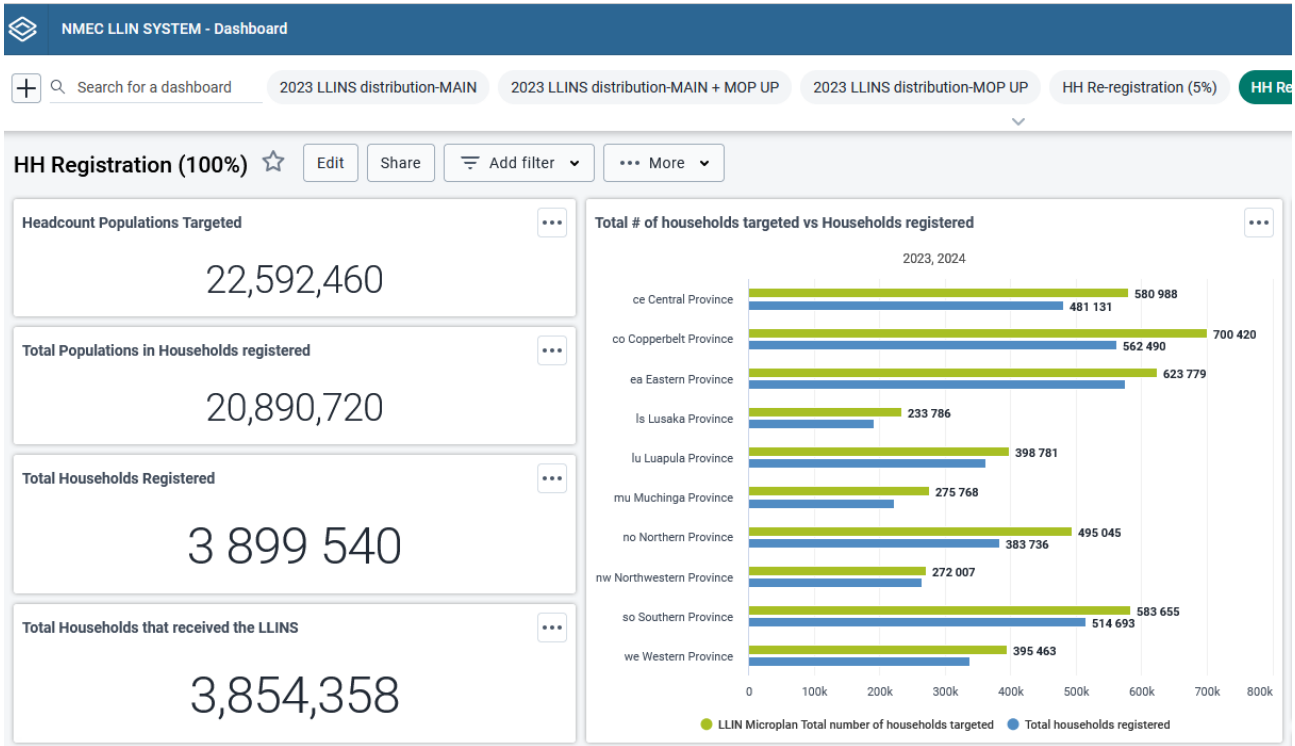
Digitalization enabled remote supervision by allowing central-level review of data and feedback to various campaign actors across all levels, something that was previously not possible with the manual data entry process.

DHIS2 dashboards were developed for progress monitoring at various levels. Data were visualized in charts and tables, enabling the tracking of progress, enhancing accountability, and informing management decisions to resolve bottlenecks. Data from the digitalized processes were triangulated with data from paper registers to ensure accurate monitoring and evaluation.

In addition to this, supervision checklists at all levels were digitalized using Kobo Collect. However, this was only effective at national level since most people at lower administrative levels did not use them due to lack of training of the digital checklist that was shared for monitoring and supervision.

Not only did the introduction of digital tools make it possible to support over 10,000 CBVs simultaneously at full operating capacity without compromising performance, but it also, through training and field experience, built capacity in digital tools and data capture at the provincial, district, health facility and community levels.

Dashboard showing progress of the 2023 ITN distribution in Zambia



Challenges

- The campaign faced delays due to the need to procure and distribute devices that were not initially planned. The timeline was affected because the NMEC initially required 10,000 phones for the campaign, but only 6,300 were available at the start. The NMEC then acquired an additional 3,000 phones, and later another 200. The delayed arrival of these devices disrupted the planned schedule, necessitating prioritization to mitigate logistical challenges, especially with transporting nets during the rainy season in the north.

- The pilot of the 2023 campaign did not include the ITN distribution phase. As a result, several unforeseen challenges were encountered during the full-scale campaign that could have been avoided if this phase had been piloted. This oversight led to unpreparedness for distribution-related issues, causing new challenges to arise at a large scale.

- Inadequate technical skills at the district level hindered full support for facility and community levels, exacerbating technological difficulties and affecting the effectiveness of on-the-ground support structures. This led to innovations such as developing short videos to explain common complaints during implementation.

- The platform experienced major issues in synchronizing data during implementation, resulting in data loss and discrepancies during distribution. The complexity of DHIS2 workflows for CBVs slowed down data collection, which was further exacerbated by a new app version release implemented by DHIS2 in the middle of the campaign.

- Collecting numerous data elements at each household took considerable time. The requirements of AMF necessitated gathering extensive information, leading to data volumes exceeding 100GB, which resulted in backup challenges.

- Technical issues with the tablets, such as their inability to support a full day of work due to insufficiently charged batteries and inadequate solar power banks, caused delays in the registration exercise. In most areas, the 10-day registration period was extended.

- Low GPS accuracy posed challenges in accurately locating target households, affecting the correctness of household positions. This issue hindered the efficiency of the campaign's household targeting efforts.

- Transporters faced challenges with damaged barcode scanning and tracking individual bales, leading to distribution delays and hindering efficient monitoring in some districts.

- About 20 per cent of CBVs' data failed to upload to DHIS2, which forced management decisions to be made from printed registers.

- Significant extra costs, including procurement of devices, training, and technical support, were incurred due to digitalization, straining campaign budgets and resource allocation. Additionally, the 2023 campaign ran three months behind schedule, which can be partly attributed to digitalization.

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Lessons learned

- IT capacity of local staff in the districts should be built up, training them to troubleshoot and resolve IT issues without relying on central level staff.

- During microplanning, an assessment of which facilities are internet connected should be made and regular movements to these facilities planned and budgeted to streamline data synchronization.

- A comprehensive budget and realistic timeline should be developed that anticipates all costs, including all necessary accessories, transport of devices to the sites, and redeployment after the campaign. High-capacity power banks should be included to permit full work days in the field.

- The digitalization planning process should begin as early as a year before the campaign to ensure all components, such as training and device procurement, are ready in advance. This minimizes the risk of disruptions and delays to the campaign timeline.

- Sufficient time needs to be allocated for set-up and familiarization with new tools. Tools to meet the campaign's specific needs should be customized and continuously tested throughout the setup process to promptly identify and resolve issues.

- Pilots should be conducted in selected districts to address technical issues for the entire campaign process to anticipate potential challenges. The pilot will help test device functionality, battery capacity, data synchronization, digital forms, data servers' capacity to handle increased data and user volumes, etc.

- Data transmission bottlenecks should be minimized in rural areas. The longer data stays on devices, the more challenging it is to synchronize to the server. Plans should be made for reaching places that are not covered by the internet.
  For example:
  - Periodically collect devices from CBVs and synchronize data.
  - Log in all devices to the production server in advance on behalf of the CBVs during the district-level trainings, where internet connectivity is typically better.

- Strong training materials and job aids should be developed:
  - Develop a troubleshooting manual. In Zambia's case, following the pilot, a comprehensive troubleshooting manual was developed to address commonly faced challenges with clear screenshots of issues.
  - Create short explanatory videos. The actors at provincial, district and facility levels are trained on the digital tool but do not always retain the information precisely. Short explanatory videos covering specific areas of the data collection greatly help them remember what to do.
  - Create CBV-friendly user manuals and standard operating procedures (SoPs) on the data collection tools for sharing with CBVs.

- WhatsApp groups (or similar) should be created for wide sharing of best practices and addressing challenges as they arise.

Overall, digitalizing the 2023 mass campaign improved data accuracy and reduced the time of data collection, which, in turn, increased transparency and accountability. The lessons learned in both the 2020 and 2023 campaigns will be used to inform decision-making and further digitalization potential for future campaigns.

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AMP CONTACTS

To join the weekly AMP conference call each Wednesday at 10:00 AM Eastern time (16.00 PM CET) use the following Zoom meeting line:
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