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Data Sharing via SMS Strengthens Uganda's Health System

A Case Study of mTRAC, Uganda
Prepared by SDSN TRéNDS

The health system in Uganda is highly decentralized and geographically dispersed, with thousands of health facilities spread across 112 districts. Low capacity for information sharing between distant health facilities and the centralized health ministry resulted in low stocks of life-saving medication for malaria, slow or inadequate responses to disease outbreaks, and misappropriated funds, among other issues. The Ugandan government, with the support of UNICEF, began leapfrogging this outmoded system in 2011 by introducing an SMS-based health reporting program called mTRAC. This program has supported significant improvements in Uganda's health system, including halving of response time to disease outbreaks and reducing medication stockouts, the latter of which resulted in fewer malaria-related deaths. mTRAC has cost-effectively enhanced the quality and exchange of health data and strengthened the capacity of practitioners to use this data to improve health outcomes. The recurrent costs of the program are being taken on by the Government of Uganda and its success is being replicated in other low-income countries, testifying to the value of investing in quality data and efficient data sharing enabled by mobile technology.



Context

Lack of access to quality healthcare in Uganda is an endemic challenge. Maternal and infant mortality rates are some of the worst in the world, at 343 per 100,000 live births and 38 per 1,000 live births respectively (WHO et al. 2015; UNICEF et al. 2017). Malaria kills some 70,000 people in Uganda annually, accounting for 20 percent of all deaths in the country (DFID 2014). The WHO-recommended treatment for malaria is artemisinin-based combination therapy (ACT) (WHO 2018), but Uganda has struggled with ACT stockouts, meaning that health facilities would regularly run out of medicine supplies (DFID 2014).

The mTRAC program required an initial three-year investment of approximately US\$4.5 million, with costs going towards capacity development, technology, and staff training. The UK Department for International Development (DFID) was the primary donor (DFID 2014).

These problems were historically compounded by the lack of a comprehensive health management information system. Health facilities have to provide district health offices with weekly surveillance forms, which report on disease incidents, treatments and other health issues (Muhereza and Mukasa 2018). Under the previous, paper-based system, surveillance forms had to be physically delivered over distances as far as 100 kilometers (Nabunya 2013). Given the great expense and poor infrastructure, facilities would routinely fail to provide weekly health reports in a timely manner.

With support from DFID, WHO, and UNICEF, Uganda's Ministry of Health (MoH) implemented an innovative package of interventions to overcome these obstacles and build on unprecedented rates of growth in telecommunications infrastructure and high rates of mobile phone penetration in Nigeria (DFID 2014). The package, mTRAC, aimed to use mobile phones that already existed in health facilities and communities to track health service quality, drug access, and disease patterns, with a particular focus on malaria (DFID 2014).



Description of Data Solution

The mTRAC program—short for “mobile tracking”—is a phone-based information sharing system that enables timely transfer of health data among beneficiaries, health professionals, and the Ugandan MoH (Yoweri 2018). It is based on RapidSMS, an open-source platform from the UNICEF Innovation Unit (Huang, Blaschke, and Lucas 2017). The application was specifically designed to integrate with the national health system, with the format of SMS reports matching the structure of existing health surveillance forms. Although initial priority was given to malaria, mTRAC collects data on 17 different diseases, as well as public health emergencies (DFID 2014). It also monitors 64 key medicines, including HIV treatments, drugs for tuberculosis patients, and vitamins for children (Muhereza and Mukasa 2018).

“We don't have to spend money on fuel to drive to national medical stores just to inquire about drugs. We simply SMS and this triggers an immediate response that culminates in delivery of medicines to the health facility.”

— Cathy Mugisha, Medical Records Officer at Mukono Health Center (UNICEF 2014)

The mTRAC program consists of three data collection techniques: an SMS-based health facility tracking mechanism; an anonymous hotline that allows members of the general public to submit complaints by SMS to the government about local health facilities; and U-Report, an SMS service for registered stakeholders to share feedback on developmental issues (DFID 2014; UNICEF 2018). The program has also enlisted the support of Village Health Teams (VHTs), groups of volunteers that serve as links between communities and health facilities (The Republic of Uganda Ministry of Health 2018). In addition to collecting health data, mTRAC facilitates two-way communication between district offices or other central units and local health workers (Berman 2012; Huang, Blaschke, and Lucas 2017). The exchange of information is managed by the District Health Information System



(DHIS) (Muhereza and Mukasa 2018), an open-source platform that has been deployed in 60 countries (“DHIS2 (District Health Information System 2)” 2018). DHIS data warehouse collects between 10,000 and 16,000 SMS messages every week (Muhereza and Mukasa 2018).

Implementation

The mTRAC program was launched in 2009 by the nonprofit Foundation for Innovative New Diagnostics in two of Uganda's 112 districts (Huang, Blaschke, and Lucas 2017). UNICEF approached the Foundation in 2011 and proposed scaling the program to the entire country in a single year. Implementation was not as rapid as first suggested; by March 2012, mTRAC was extended to approximately 1,000 facilities in 28 districts, and by March 2013, it reached every public health facility in all 112 districts. Statisticians and health officers were trained on form completion, SMS reporting, and data analysis (Blaschke 2013). By June 2015, mTRAC had also reached most nonprofit and non-government health facilities (Huang, Blaschke, and Lucas 2017). As of 2018, 52,946 health facility workers had been trained on mTRAC, representing 5,684 health facilities across Uganda (Muhereza and Mukasa 2018).

As of 2018, 52,946 health workers at 5,684 health centers across the country were using mTRAC (Muhereza and Mukasa 2018).

The Ugandan MoH has taken on additional responsibility, with ongoing support from UNICEF (Muhereza and Mukasa 2018). Among other tasks, the government trains health facility workers on procedures for reporting data. The system produces a dashboard that helps districts monitor the reporting status of facilities and provide guidance to local health workers (Muhereza and Mukasa 2018). The MoH also publishes weekly reports that include maps of recent health data and descriptions of trends across the country (National Malaria Control Program, WHO Uganda Country Office, and Uganda Malaria



Surveillance Project 2018). Weekly data outputs include counts of deaths resulting from identifiable conditions, maternal mortality, and infant mortality, as well as testing and treatment rates for the National Malaria Control Program (Muhereza and Mukasa 2018).

Funding

Initial funding came from DFID, which was particularly eager to see the program used to tackle malaria (DFID 2014). Over its three years of involvement, DFID invested £3,005,919 (US\$4,582,194) towards mTRAC development and implementation. Costs included technical equipment, personnel training, and mobile phone bills. Additionally, £556,682 (US\$848,601) was used to purchase 10 million doses of ACT. £65,908 (US\$100,470) was spent on monitoring and evaluation. Following the close of DFID funding for the project in 2014, the Government of Uganda has provided financial support for mTRAC and now covers approximately 70 percent of project costs, with UNICEF and the WHO responsible for the remaining 30 percent (Muhereza and Mukasa 2018). Based on figures provided in 2018 (Muhereza and Mukasa 2018), the annual budget for mTRAC is estimated to be between \$800,000 to \$850,000. Ongoing negotiations are ensuring that the government will be able to assume complete financial responsibility in the future.

The Government of Uganda now covers 70 percent of the estimated \$800,000 to \$850,000 in annual costs, with the remainder covered by UNICEF and the WHO (Muhereza and Mukasa 2018).

Impact

DFID evaluated the efficacy of the mTRAC program after each of its first three years of operations and identified a number of positive impacts. DFID's first-year evaluation found that mTRAC was improving transparency and accountability of health services, enabling more informed responses to drug shortages and medical



issues, and improving overall communications in the health system. The second-year evaluation concluded that the program was on track to achieve results without overspending (Department for International Development 2013). DFID's 2014 Project Completion report scored the mTRAC intervention with an "A" grade and determined that several expectations had been exceeded (DFID 2014). Successes included the use of mTRAC for emergency response, improved reporting, and efficient health center drug stocking. It has also served as inspiration for health programs in other countries.

“My proudest moments have been seeing community health workers [...] get excited about learning a new function for their personal phones: positively impacting the health of their families and neighbors.”

— Health systems consultant Dr. Davis Musinguzi (Musinguzi 2012)

Emergency Response

UNICEF credits mTRAC with nearly halving the response time to disease outbreak. According to local UNICEF officials, tracking and responding to a disease outbreak previously took five to six days but can now take just two to three days with the support of mTRAC data (Muhereza and Mukasa 2018). With the system's near-real-time data, health professionals and institutions can implement quarantines and other protective measures more quickly. In particular, mTRAC aided the response to the 2012 Ebola outbreak in Kibaale District (Berman 2012). Likewise, during the 2012 Marburg outbreak, some 9,900 SMS messages sent to 825 health workers across five districts through mTRAC provided immediate exchange of outbreak details and response guidance. MoH epidemiologists also used the program's disease reporting functions to actively respond to cholera, measles, meningitis, and other diseases (DFID 2014). The MoH and district health teams were able to respond to a typhoid outbreak in 2015



within hours of its emergence through near-real-time reporting in mTRAC (The Republic of Uganda Ministry of Health 2018).

Reporting

Two related measures of success are the completeness and timeliness of weekly health facility reports (Muhereza and Mukasa 2018). Replacing paper-based health surveillance systems with mTRAC has enabled a number of districts to reach reporting levels never previously achieved. For example, Koboko District received mTRAC in March 2013 (Charason 2013); three weeks later, the district achieved a 93 percent reporting rate and, by the following week, all district health facilities were reporting. Moreover, the completion rate of surveillance forms has increased nationally, rising from 50 percent in January 2015 to 68 percent by December 2015 (Huang, Blaschke, and Lucas 2017). As of 2018, Uganda has reached a 78 percent completion rate (Muhereza and Mukasa 2018). Furthermore, 65 percent of facilities are submitting surveillance forms on time, although there has been difficulty surpassing this level (Muhereza and Mukasa 2018).

Malaria Treatment Stocks and Outcomes

Along with improving general health surveillance, mTRAC provided a platform for districts to share real-time reports on the availability of the malaria treatment ACT. None of the 112 districts were able to report ACT levels in June 2011 but by August 2013, there were 89 districts (79 percent) reporting ACT levels (DFID 2014). By March 2014, all 112 districts were reporting stock levels. As of 2018, districts are instead reporting ACT stock balances on a weekly basis, while reports on most other medicines are given on a monthly basis (Muhereza and Mukasa 2018).

A stated goal of DFID's support was to reduce the number of malaria-related deaths through swift identification and improved availability of treatments (DFID 2014), and this objective was supported by the production of data on ACT supplies. A key indicator was the proportion of health facilities reporting no stockouts of ACTs (DFID 2014). The project set a target of 50 percent, compared to a baseline of 21 percent.



Surpassing expectations, 84.6 percent of facilities reported no ACT stockouts by March 2014 (DFID 2014). All district officials interviewed by the project evaluators testified this success was due to the mTRAC program, because ACT could be distributed from facilities with an oversupply to facilities with a shortage. The testing rates of suspected malaria cases also increased from 82 percent to 95 percent between 2011 and 2016 (UNICEF, DFID, and WHO 2016). Previously, the malaria morbidity rate was at 40 percent but by 2016, it was being maintained at 17 percent (UNICEF, DFID, and WHO 2016).

However, the data also suggests that there is continued ACT wastage and that communication between districts could be improved (DFID 2014). The national medicine supply chain struggled to keep up with demands for reallocating ACT resources, and this service was temporarily halted (Huang, Blaschke, and Lucas 2017). Exchanges have renewed, but the government now requires that a select set of drugs receive national-level approval before being redistributed (Muhereza and Mukasa 2018). Concerns about navigating the new regulations has resulted in only 35 percent of districts internally redistributing drugs between health facilities (Muhereza and Mukasa 2018).

The anonymous hotline helped save \$400,000 in misappropriated funds in 2013 as a result of citizens reporting concerns about health facilities (DFID 2014).

Cost Savings

A formal evaluation of cost savings has not been performed. According to UNICEF officials, the project developed more “organically,” so the costs of the previous reporting system were not calculated (Muhereza and Mukasa 2018). Instead, resources have been concentrated towards creating a stable platform that integrates with the national statistical system. Yet the same officials point out that the value of mTRAC is underscored by the fact that the Ugandan government has



decided to take responsibility for continuing and funding the program (Muhereza and Mukasa 2018).

Program consultants say that, although this cannot be easily quantified, health facilities are saving on the expenses of transportation and staffing that were required to submit paper reports (Musinguzi 2012). The anonymous hotline has also helped realize other efficiencies. In 2014 alone, information provided by concerned citizens saved \$400,000 in misappropriated funds (DFID 2014), and the service has continued to help save resources (Muhereza and Mukasa 2018). Most notably, there has been an increase in health facility working hours, along with a 12 percent reduction in absenteeism, and the government has been better able to fight against illegal institutions offering health services (Muhereza and Mukasa 2018).

Additionally, mTRAC allows for rapid surveys of the medical system. For \$150, an effective survey can be conducted in 48 hours via SMS (DFID 2014). The MoH is able to receive responses from 95 percent of facilities within 24 hours, and the feedback informs the distribution of supplies (UNICEF, DFID, and WHO 2016). This approach was used to survey the availability of refrigerators and vaccines at health facilities, and vaccine stockouts were then significantly reduced (DFID 2014).

These outcomes have been supported by the U-Report campaign, which has engaged over 250,000 volunteers representing every community in the country (DFID 2014). U-Reporters have aided verification of anonymous complaints, are polled about local health and developmental issues, and have become resources for parliamentarians.

mTRAC, due to its success, has served as a template for other mobile-based health data reporting systems, including Liberia's mHero program (Blaschke and Alinaitwe 2015).



Replication

mTRAC has also served as a template for Liberia's mHero program (Blaschke and Alinaitwe 2015). IntraHealth International and UNICEF collaborated on mHero in response to Liberia's 2014 Ebola crisis, creating a platform that could provide training, surveys, and other communication via SMS (BenDor 2015). By August 2016, over 8,000 health workers were connected to the mHero system and Liberia formed a multi-year plan for its extension (Oaiya 2016).

Ongoing Challenges

Although mTRAC has improved disease response and the accountability of health facilities, the program has experienced challenges with achieving universal reporting and extracting the full value from available data:

- » All 112 districts are participating in mTRAC, but surveillance completion is not evenly distributed. Out of the 112 districts, 70 are above the suggested DHIS reporting rates and 35 districts are between 60 percent and 70 percent, but 17 more remote districts continue to experience difficulty (Muhereza and Mukasa 2018).
- » mTRAC is more convenient than prior reporting procedures, but data still needs to be collected from source documents. It is a supplement to—not a replacement of—the existing system, and reporting can still be time-consuming (DFID 2014). Also, there is sometimes network interference, and this can negatively impact SMS reporting (Yoweri 2018).
- » Facility reporting may have improved, but VHTs have experienced less success. Starting with no VHTs submitting timely reports, mTRAC helped 60 percent do so on time by March 2013. However, this number fell to 40 percent by August 2013 and 9 percent by March 2014 (DFID 2014).
- » The decrease in ACT stockouts exceeded expectations, but the use of mTRAC for redistributing doses has been described as suboptimal (DFID 2014). The exchange of ACT doses has not



been systematically recorded, so it is challenging to demonstrate exactly how data has informed decision-making.

- » Although the anonymous hotline has recovered value for the health system, additional improvements are needed. Sometimes, anonymous tips provide insufficient details for follow-up, but more cases also need to be properly analyzed by relevant authorities (Muhereza and Mukasa 2018).
- » Capacity development is a recognized priority. Ongoing MoH budget gaps have resulted in inadequate availability of data tools and limited resources to train facilities (Yoweri 2018). Additionally, the leadership bodies have been overwhelmed at times, and some participants have lost motivation, in part because of a failure to communicate the impact of community data (DFID 2014). Currently, the available support supervision is not robust enough to follow up with all issues raised in data reports, and additional capacity-building is required for the surveillance team in mTRAC (Muhereza and Mukasa 2018). In particular, there is a need for stronger data summaries, and the program wants to follow up with non-reporting facilities. Data verification at the district level is still weak, and the MoH needs to create greater uniformity with data collection.

UNICEF officials explained that plans have been made to update mTRAC (Muhereza and Mukasa 2018). The MoH created a Health Sector Development Plan for Uganda's health system for 2015/2016 through 2019/2020 with the stated objectives of improving staffing levels, infrastructure, and equipment (UNICEF, DFID, and WHO 2016). These issues extend beyond mTRAC but relate to core difficulties that the program has faced.

BOX 1: A District Perspective

The Gulu District in Northern Uganda piloted mTRAC in 2009 and has continued using the program to positive



effect. The district has a population of 301,286 across 248 villages and is served by 62 health facilities, including four hospitals. The local health system employs 1,560 but has 13 percent of staff positions unfilled. Regular health issues include cholera, flu, malaria, measles, meningitis, pneumonia, and respiratory tract infections.

Mr. Idiba Yoweri is the Gulu District health department biostatistician, and he is responsible for receiving weekly mTRAC reports and managing administrative data. Yoweri presents an analysis of the data to the district's Epidemic Preparedness Committee, which brings together district government leaders along with representatives from hospitals, health facilities, and prison services. The committee reviews trends in different diseases and determines what actions may be required to mitigate them.

Yoweri says that the Gulu District is better prepared in multiple ways with mTRAC, explaining that "[...] it's a good software which helps with service delivery, which helps with reporting, which helps with communicating." Before mTRAC, Yoweri says, the health reporting process in Gulu was very poor. Some health facilities would have to travel 70 kilometers to physically submit paperwork to the district office. 48 percent of facilities were submitting reports and just 30 percent were submitting on time. Now, 80 percent of facilities are submitting on time and the district regularly has 100 percent completion. The district also has three to four VHT workers per community, and the district plans to begin paying volunteers to improve their participation.

Gulu uses mTRAC data to monitor the use of medicines and request additional supplies for the district. Officials can also communicate more easily with individual facilities and organize the redistribution of medicine stocks. "You



don't need to waste resources when mTRAC is available," Yoweri explained.

If a disease outbreak is reported, nearby communities are quickly alerted and can now respond with precautionary measures. Data also informs the timing of targeted health education campaigns. For example, if the district observes an increase in malaria, radio messages can be broadcast to remind the public about ways to protect themselves. Furthermore, the district has integrated mTRAC with family planning and antenatal services. Yoweri was positive in his assessment of the program, saying, "mTRAC is efficient in terms of resource utilization. Therefore, it must be scaled up in other countries. [...] It works everywhere."

Source: (Yoweri 2018)

Testimonies

- » "My proudest moments have been seeing community health workers [...] get excited about learning a new function for their personal phones: positively impacting the health of their families and neighbors." Dr. Davis Musinguzi (Musinguzi 2012).
- » "I used to cry whenever it came to submitting weekly surveillance data to the District Health Office because I had no information records from which I could get the information. I wasn't collecting that information because I knew I couldn't be able to transport it to the district and neither did I have airtime to call the district every week." A nursing assistant at Rwantaaha HC II (Nabunya 2013).
- » "We don't have to spend money on fuel to drive to National Medical Stores just to inquire about drugs. We simply SMS and this triggers an immediate response that culminates in delivery of medicines to the health facility." Cathy Mugisha, a Medical Records Officer at Mukono Health Center (UNICEF 2014).



Conclusion

The mTRAC system was designed as a technical platform to improve the exchange of health administrative data in Uganda between local health facilities and the Ministry of Health. DFID provided initial funding with the hope of improving the availability of malaria treatments. The system has led to an increase in the complete and timely submission of health surveillance forms, and all districts in Uganda can now report on levels of malaria treatment supplies. mTRAC has since contributed to better emergency response times for endemics, improved distribution of resources, and more efficient health system operations. It has also been shown to be cost-effective, saving local health officials transportation costs and time when submitting detailed health information. The Ugandan government has demonstrated strong support for the initiative, assuming 70 percent of the program's annual operating costs. mTRAC has also inspired innovation in other sub-Saharan African countries, such as the mHero program in Liberia.

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