

# The first multi-sectoral, user-driven data pipeline to adaptively manage HIV prevention programs in Malawi

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## Background

In Malawi, HIV prevention data have been historically captured at community, facility, and national level. Yet these data are often fragmented, managed by different custodians, and are difficult to analyze and interpret. District, city, and health facility managers have limited visibility and tools for investigating HIV data, both within the formal health system and in the community. Despite the importance of social determinants on HIV risk, data are typically summary statistics without additional context that could shed light on important trends, such as mobility, access preferences, service quality, social networks, and shifting micro-epidemics. This results in underused information and missed opportunities for more targeted and effective prevention activities. We addressed this gap by developing a 'data pipeline' with most recent-time, web-based, automated analyses and visualizations for decision makers in Blantyre, Malawi.

## Description

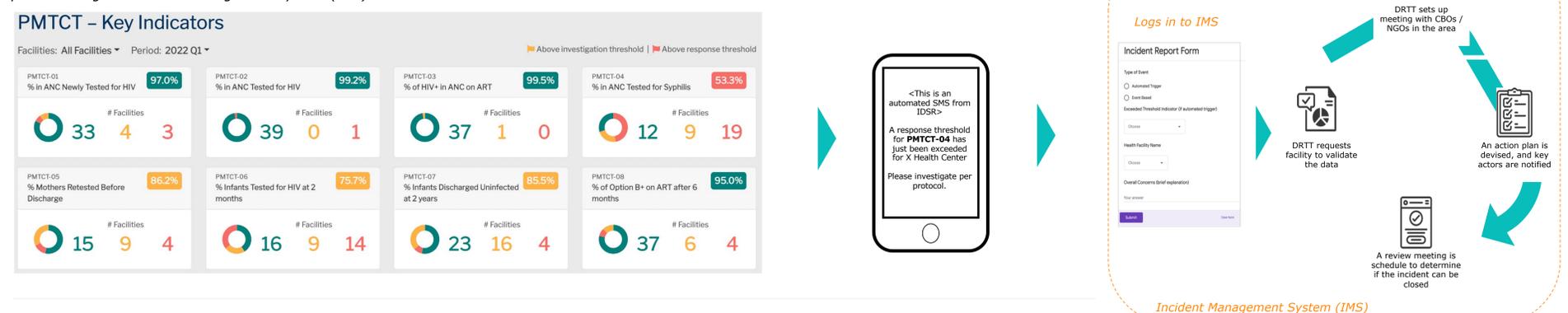
The data pipeline is a set of coherent data system components, defined protocols for processing and exchange, analytics, and user-defined data products. Importantly, this approach doesn't rely on a single piece of software, instead it leverages existing country data sources and application programming interfaces (APIs), and standardizes information against common country metadata (e.g. facility, terminology, and product registries). Incorporated data are routine and non-routine, program and research derived, and multi-sectoral (Figure 1). The result is an efficient back-end data architecture that pools, relates, and layers data for HIV stakeholders like never before. In addition, we developed a front-end user application – the Prevention Adaptive Learning and Management System (PALMS) – allowing users to specify and customize views, fully access all relevant HIV data without tier restriction, and receive pre-coded alerts when new data exceeds specified thresholds (Figure 2). This pipeline is currently being used to monitor quality improvement plans, validate data anomalies across multiple sources, investigate deviations from clinical protocols, and support the move toward event-based surveillance (EBS) for HIV response in Blantyre. EBS identifies triggers from the datasets or community that indicate an investigation, and potentially a tailored response, is needed to mitigate risk. As a companion technology, we are currently configuring an incident management system (IMS) to automate notifications from the data pipeline and track response plans to resolution (Figure 3).

All tools are developed in open-source programming languages and fully integrated within the Malawi health data framework. Currently, management of the pipeline is being institutionalized, with Ministry of Health (MOH) technicians responsible for maintenance and ongoing development system features.

## Lessons Learned

PALMS was rapidly adopted by decision-makers and is routinely used to monitor site performance, detect anomalies or poor quality data, and identify concerning statistics that warrant investigation and management intervention. Compared with other local data systems, users access the system frequently and report high satisfaction with functionality, while also continuing to request features that directly support their routine information needs. Having feature requests prioritized by local Blantyre coordination teams has helped to facilitate strong ownership of the platform. System notifications are the most popular feature and have helped focus attention on facilities and programs that need the most support. The biggest barriers to PALMS development were not technological, but rather involved navigating the complex data stewardship landscape. We attribute the unusually high user satisfaction and engagement to the development process, which focused on end-user articulated needs, rather than reporting requirements.

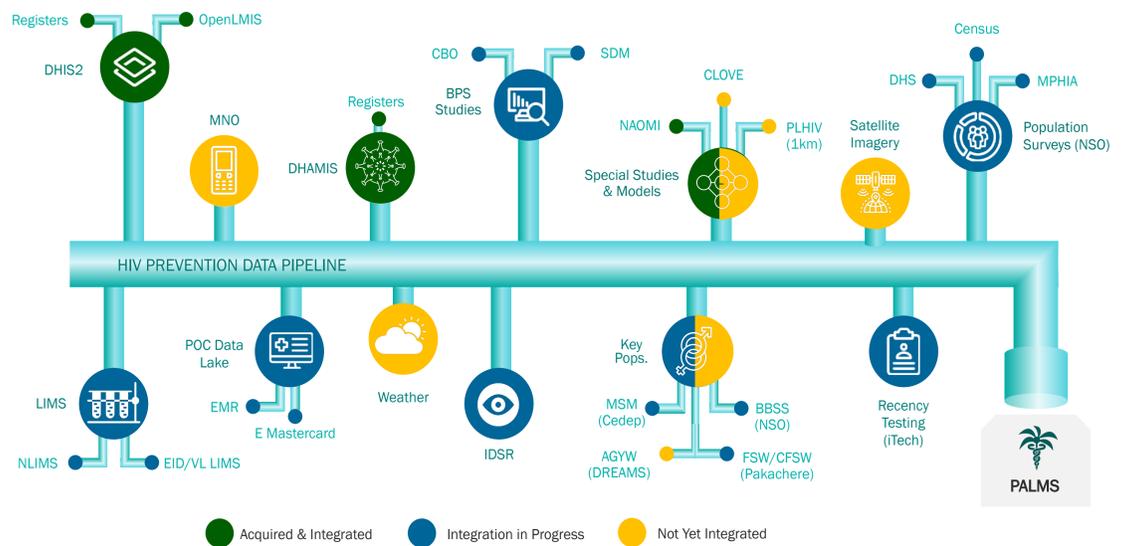
Figure 3. Example of key performance thresholds, user notifications, and the District Rapid Response Team (DRRT) process using the incident management system (IMS).



## Conclusions and Next Steps

The data pipeline will expand to include other geographies, interoperate with additional data sources, drive multi-platform notifications, and capacitate staff at all levels to effectively interpret key epidemiology and program data. We expect this approach to substantially shift how the HIV response is coordinated in Blantyre. With a unified set available data from all relevant sources, implementers, policy makers, and funders can more quickly engage in substantive planning. Application of the EBS approach will further leverage data to practically and routinely trigger collaborative action, that is customized to local context and routinely monitored. The data pipeline approach can be generalized to other settings. Such user-driven, sustainable, and scalable data systems are feasible and desperately needed for HIV programs throughout sub-Saharan Africa to empower locally-driven response.

Figure 1. Illustration of data pipeline sources and stages of integration.



PREVENTION ADAPTIVE LEARNING AND MANAGEMENT SYSTEM (PALMS)

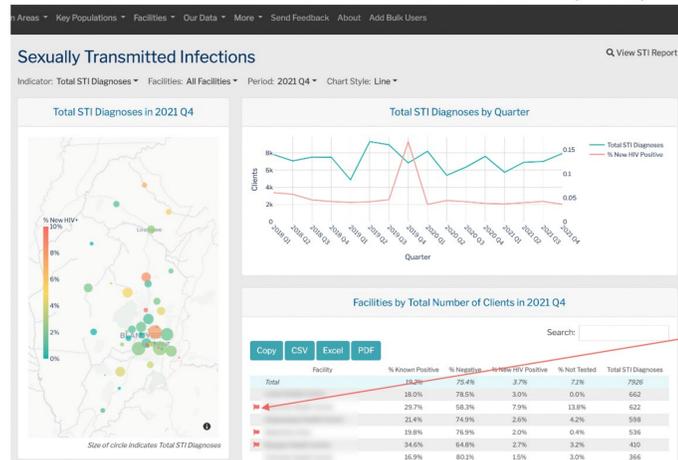


Figure 2. Example of data alerts triggered through automated analytics and displayed to end user.