Predictive Modelling as a Tool for Improving Patient care

In a move to enhance HIV care in Uganda, the METS Program is leveraging advanced data analytics and visualization techniques to improve viral load suppression among patients on antiretroviral therapy (ART). This innovative approach aims to transform how healthcare providers monitor and support patient adherence to treatment.

The team analysed an extensive dataset of over 67,000 clients on ART across more than one million clinical visits. This comprehensive analysis led to the development of a predictive model that can identify patients at risk of interrupting their HIV treatment before it happens.

Musa Mwanje, a Software Developer at METS, noted that the goal is to move from reactive to proactive patient care by analysing patterns in treatment adherence, viral load suppression results, and other clinical factors, and using them to help healthcare providers intervene before the patients experience treatment interruptions.

The advantage of this approach is its integration with existing Electronic Medical Record (EMR) systems. The system allows for healthcare providers to receive real-time alerts and visual representations of patient adherence patterns, enabling them to make informed decisions quickly and efficiently. Treatment interruptions often lead to poor viral suppression and increased risk of HIV drug resistance.
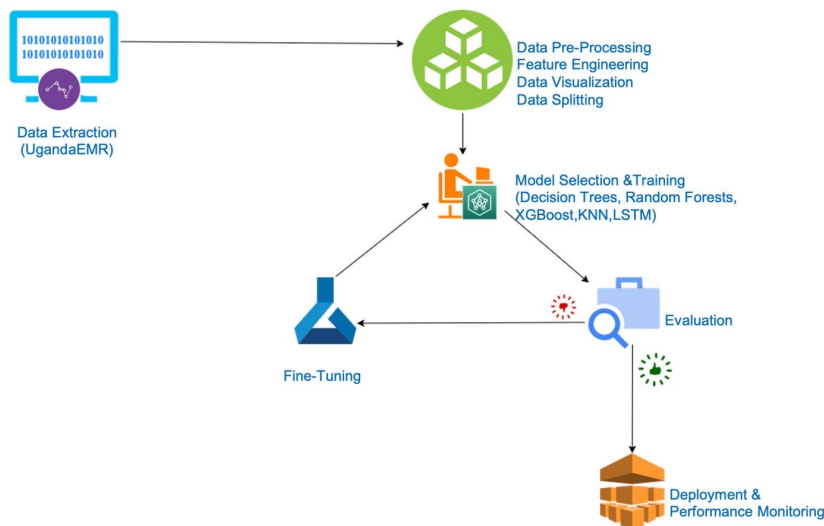
Looking ahead, the team plans to present this innovation to the Assistant Commissioner, Division of Health Information, Mr. Paul Mbaka who will advise on the next steps towards presenting to the MoH digital health governance committee for adoption, and thereafter fully integrate these predictive tools into the EMR systems, creating a more dynamic and proactive approach to HIV care. This initiative represents a major step forward in using technology to improve health outcomes for people living with HIV (PLHIV) in Uganda.

Viral load Suppression

➢ XGBoost was the best model with an AUC score of 0.99, 0.95 precision, 0.97 recall, and a specificity of 0.96.

➢ The most important VL status predictors were;
- VL suppression history
- Duration on Treatment
- # of VL tests
- TB status
- WHO stage
- Current Regimen Line
- Age
- Sex

Interruption in Treatment

➢ LSTM outperformed other models with an AUC score of 0.85, a precision of 0.98, 0.99 recall and a specificity of 0.96

➢ The predictive importance of variable;
- # of IIT ever
- # of IIT in the last 12 months
- Duration on Treatment
- Advanced HIV
- TB status
- WHO stage
- Current Regimen Line
- Age
- Sex

Data Extraction (UgandaEMR)

Data Pre-Processing
Feature Engineering
Data Visualization
Data Splitting

Model Selection &Training (Decision Trees, Random Forests, XGBoost,KNN,LSTM)

Fine-Tuning

Evaluation

Deployment & Performance Monitoring

Transforming EMR Implementation through a Community of Support t

Uganda's journey to digitize health records through electronic medical records (EMRs) has unveiled an innovative approach to overcoming technical challenges in resource-limited settings. Through the leadership of Ministry of Health (MOH) and the Monitoring and Evaluation Technical Support (METS) Program, a unique Community of Practice (COP) model has emerged, transforming how healthcare tfacilities adopt and maintain EMR systems.

> "
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> *"Traditional implementation methods often struggled with limited technical expertise among end-users," explains Naseef Mayanja from the METS Program. "We needed a solution that would empower our healthcare workers while providing more sustainable system operations.*
>
> "

The answer came in the form of collaborative platforms including a dedicated WhatsApp group and the UgandaEMR Talk forum. These digital spaces have become virtual classrooms where healthcare users share experiences, solve problems, and build confidence in managing the EMR systems. This peer-to-peer learning approach has dramatically reduced system downtime and strengthened user independence.

The impact has been remarkable, not only has the time required for problem resolution decreased significantly, but the MOH and METS teams have also been able to shift focus from routine troubleshooting to system enhancement, leading to the successful release of improved EMR versions.

This community-driven model is now being considered as a template for EMR implementation in other resource-limited settings. As Uganda continues to scale-up EMR implementation nationwide, this story demonstrates how innovative thinking and community engagement can overcome seemingly impossible technical challenges in healthcare digitalization.

Uganda's Success Story in Finding Undiagnosed Cases

Uganda has made significant strides in its HIV testing services through an innovative quality improvement program launched in October 2022. The initiative, supported by PEPFAR, aims to identify and link more HIV-positive individuals to care, addressing the challenge of approximately 202,343 people living with HIV who remain undiagnosed.

The program, implemented across 700 key health facilities nationwide, focuses on enhancing HIV screening efficiency, testing services, and linkage to care. Through systematic improvements and regular monitoring, the initiative has achieved remarkable results in its first year of implementation.
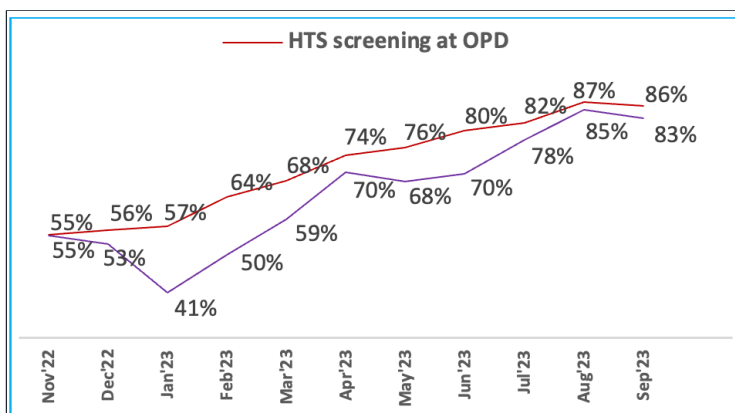
HTS screening at OPD and other entry points
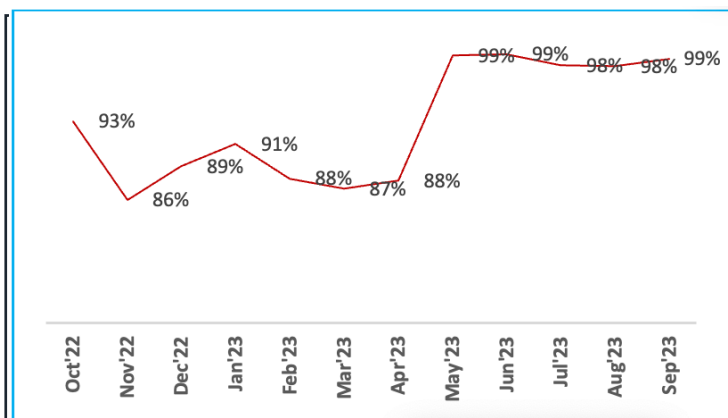
Linkage of identified HIV positive to care
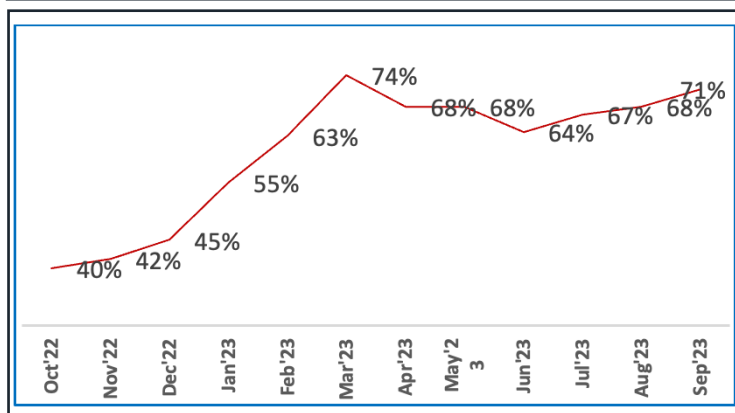
HIV testing for eligible clients

METS has supported the Ministry of Health to conduct quarterly coaching and mentorship visits, regional learning sessions, led Bi-weekly data review, harvest and stakeholders' meetings. Additional technical support has been provided to develop change packages.

By September 2023, some milestones had been attained

> · HIV screening in outpatient departments increased from 54% to 86%, while screening at other entry points rose from 49% to 83%.

> · The program's success is further demonstrated by an increase in HIV testing yield from 2.3% to 4.3%, approaching the national standard of 5%.

> · Linkage to care for newly identified HIV-positive individuals improved from 93% to 99%.

These improvements show how systematic quality enhancement can transform the country's HIV testing services. Identifying more undiagnosed cases and linking them to care, gives milage to the goal of ensuring that 95% of people living with HIV know their status.

A noteworthy outcome from this program shows that scale up of systematic quality improvement can transform HIV testing nationwide, bringing Uganda closer to meeting international HIV goals.

Key Achievements attained from October 2022 to September 2023

- *HIV screening in OPD: 54% to 86%*
- *Testing yield: 2.3% to 4.3%*
- *Linkage to care: 93% to 99%*

METS WATCH
Editorial Team

Nancy Karunganwa
Dr. Alice Namale
Naseef Mayanja
Musa Mwanje
Innocent Musoke
Ausse Kalega