# KENYA'S ADOPTION OF AN ELECTRONIC TUBERCULOSIS SURVEILLANCE SYSTEM

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As countries struggle to improve on tuberculosis (TB) surveillance, challenges are increasingly being seen in real-time surveillance and reporting on MDR- and XDR-TB. Paper-based recording and reporting in Kenya was replaced with an electronic TB surveillance system in 2012. Variables in the paper-based system are entered into a tablet using specially developed software and synched with the national database using a cloud-based storage system to create a real-time electronic reporting system. The system has several merits, including ease in computing cohort analysis, reduced time of reporting, no loss of data documents and minimizing errors in calculations.

As countries struggle to improve on case detection and reporting on diseases, greater challenges are being seen in the quality and timeliness of reports submitted. Increasingly, countries are expected to report seamlessly on any form of drug-resistant TB, especially as resistance to antimicrobials is taking a global security dimension. Since independence in 1963, Kenya has traditionally used a paper-based reporting system. This data is used for monitoring patients' progress while in care, surveillance and utilization of resources for outcome and impact. Patient-level data entered at the health facility and microscopy units is the commonest mode of data collection. Data is routinely recorded by healthcare workers at the facility units while performing daily healthcare activities using standard reporting forms, transcribed to summary forms which are sent to basic management units (BMUs), where they are aggregated and sent to the national level. However, the reporting structure is seldom used to facilitate usage of information generated from the data in making informed decisions. In 2013, Kenya's TB programme was reporting from 4,325 peripheral health facilities, 270 basic management units and 12 regions *(1)*. Proper, complete and comprehensive recording and reporting of data is critical in the care of patients with TB and overall control of the disease. The global TB community has set ambitious targets towards ending the global TB epidemic by 2035 *(2)*. Accurate and timely monitoring of progress towards achievement of these targets globally, regionally and locally is only possible through a robust system free from the conventional challenges of a paper-based system.

TB control in Kenya is managed through an elaborate structure, spanning district, regional, and national TB offices where designated officers are responsible for respective geographic zones. In the traditional system, data is submitted on a quarterly basis using different data collection tools. To enable standardized reporting and monitoring of disease trends, the World Health Organization (WHO) develops recording and reporting tools that are often adapted by reporting countries.

Several types of TB electronic data capture systems are being developed in different settings to respond to local and internal concerns. The WHO consequently developed a document to guide countries in developing electronic systems *(3)*. Due to the perennial challenges faced by the TB control programme in ensuring timely, complete, and accurate data, in 2006 Kenya embarked on a mission in partnership with USAID to develop a unique nationwide electronic data transmission system that would ensure that data collected is of the highest quality. The TB programme christened the new innovation "TIBU" which means "Treat" in the local Kiswahili language, while at the same time standing for "Treatment Information from Basic Unit". This system was fully developed by September 2012, when it was officially launched and used *(4)*. The system is able to capture patient-level data that includes demographic characteristics of the patients, type of TB, laboratory results and treatment outcome data. *(5, 6)*.

The electronic system uses an android-based platform to create fields of variables in the paper-based system. These variables have traditionally been collected by TB programmes and include recent additions on MDR- and XDR-TB variables. Once data from each of the reporting health facilities has been entered into a tablet (device) by the sub-county coordinator, this data is then synched with the national database through a local service provider with a wide national coverage. Logistics

data is also uploaded onto the system. The data is transmitted to a national server where it is stored for aggregation, and further analysis for management. Data integrity is ensured through security levels that are provided to those who should access the system and encrypting data during transmission. System upgrades are sent out from the national level to the devices in the field. Once the device has downloaded the software, the user can easily install it with minimal navigation. The programme ensures availability of enough data bundles that can be used by the sub-county coordinators in transmitting data.

Apart from transmitting data, the system has been configured so that health education materials can be pushed from the national level to the sub-county coordinators. The materials are used in training healthcare workers and patients on care. Patients failing to attend clinics are reminded through the system. In addition, patients who are supported by the programme to attend clinics receive funds directly through their phones (Mpesa system). Mpesa is a local innovation that uses handheld mobile phones to transfer funds or pay for services. When the need arises, the devices are also used to transmit scanned copies of documents and pictures.

Once the system had been pre-tested and found to be working, retrospective data from 2010 to 2011 was entered into the electronic system from paper-based reports available at different levels of reporting to create a complete database that was henceforth updated in real-time as data was collected in the field.

From 2012 to date, the system database has been able to manage a total of 360,731 TB cases (359,528 total new TB cases, 1,200 MDR-TB and 3 XDR-TB cases). A total of about US$ 250 million has been transacted through the electronic system using the Mpesa payment system.

## Discussion

The transition by Kenya from a paper to an electronic system for recording and reporting of TB data has led to several benefits, hitherto unknown. Healthcare workers using the devices have had to undergo basic computer training so as to handle the devices in the field. Use of the devices boosted field staff morale and encouraged them to frequently update data by visiting peripheral health facilities according to policies. The frequent visits have impacted on peripheral healthcare worker performance and consequently improved case holding of patients started on treatment.

The paper-based system traditionally used includes several separate tools often filled in by one overworked healthcare worker. These tools include a patient appointment card which is carried by patients for identification at treatment sites and contains a summary of type of TB and stage of treatment. TB treatment cards are commonly filled in and stored at the health facility where the patient was diagnosed and seeks care. This tool is most often filled in only at the time of initiation of treatment and whenever patients' weights are taken. Rarely is this tool used after initiation of TB treatment, despite the tool containing additional and useful variables for patient care. A TB treatment register forms the basis of patient treatment as it contains the most information about the patient and is commonly what healthcare providers use daily during the intensive phase of TB treatment and, subsequently, monthly during the continuation phase of treatment. The facility-based TB register data is updated every time a patient is served. There are other reporting forms often filled in by the sub-county coordinator for submission to the higher levels of reporting, such as quarterly reporting forms for sending summaries of aggregated data on notifications and treatment outcomes for all cases within a particular geographical area to higher administrative levels.

Most health facilities use TB treatment registers to monitor the progress of patient response to treatment. The other TB stationery, such as patient record cards, are hardly filled in or used in subsequent patient visits to health facilities *(5)*. This is likely to be due to perceived duplication of capturing the same data in different tools. In a facility with a shortage of human resources, coupled with increased workload, healthcare workers have to choose between filling in the tools and responding to patient needs. The Kenyan electronic system captures the data of patients on first- and second-line treatment (MDR-TB and XDR-TB). Use of the electronic system has drastically reduced dependency on several paper-based tools and has offset the need to print manual data capture tools that are bulky and hardly used in health facilities. The system has no doubt substantially reduced workload.

The system is fitted with an "intelligent" dashboard that assists the user in analysing data for health facilities by type (private or public) and BMU. System reports have greatly minimized errors of calculation and omissions. The system allows provision of immediate feedback to the facilities in terms of performance on case holding and other patient-monitoring parameters.

The national programme has been enabled to collect timely and accurate data as required at the end of every quarter. Where there are errors, the national team is able to zero in on the source of errors and quickly correct the problem before it scales up. Like other electronic systems in use elsewhere, the quality of routine data collected is good, with negligible missing data *(6)*.

As the system is robust, it has been linked to the Laboratory Management Information System (LIMS) to create a seamless flow of data and link laboratory results to patient-level data.

Results from the laboratory are therefore quickly relayed to attendant clinicians through emails and short message services (SMS) to reduce delay in initiation of treatment. In addition, the system has been linked to the Ministry of Health District Health Information System (DHIS2) so as to inform policy-makers through dashboards and summary reports on performance of the programme at any time. Policy-makers are now, more than ever before, able to make informed decisions and face the pressure to frequently provide updates on progress made in the control of tuberculosis.

## Limitations

The system is not without limitations as it is still at infancy stage of development and use. Immediate concerns have been raised on concordance and completeness of data reaching the national level from the field. Some cases are missed when the data is entered by the sub-county coordinators due to transcription errors and poor counting. This will be resolved when all patient data in health facilities is made electronic and properly linked to the national database. At the moment, few health facilities have computerised systems for data collection. Electronic data systems in health facilities need to be quickly developed and linked to TIBU so as to have a seamless data collection system from the lowest level.

A regular routine review of the system, data collected and provision of immediate feedback to users of the electronic surveillance system will improve the quality of data captured by the system and its usefulness. The Kenyan system is currently unable to link programmatic performance to resources used. This gap needs to be addressed in a system upgrade so that the global country picture of performance is complete and comprehensive.

Transmission of data through the internet needs an elaborate countrywide coverage of connectivity. Kenya is still spreading internet connectivity and this limits data transmission, especially in areas without connectivity. The devices have to be transported to a place with connectivity, therefore delaying the real-time transmission of data.

In the early stages of introducing the use of electronic devices in the periphery, challenges with the handling of the devices were noted. Commonly, problems occurred because the coordinators have to travel to peripheral health facilities by motorcycle and the bad state of the roads led to device damage, as did bad weather and manhandling. However, since data is stored in the cloud server, any lost data could easily be restored. Tablets are fragile devices that need proper care when handling and when staff are new to using the devices, frequent mishandling of the equipment occurs.

## Conclusion and recommendations

Kenya's TB electronic recording and reporting system (TIBU) has greatly improved the quality of data collected. The system has demonstrated an improvement in the speed of data collection and transmission and it has also shown that aggregation and analysis of TB data can be efficiently done with minimal errors. Since the electronic system allows for surveillance of MDR- and XDR-TB development, it can be adapted and used in countries for monitoring and surveillance of other antimicrobial-resistant pathologies, as recommended in the global plan of action. In any case, the system can provide real-time information for decision-making at a time when antimicrobial resistance is setting a global agenda.

The system can be used to link support to TB patients in need and prompt appropriate patient behaviour. However, establishment of appropriate mechanisms to periodically evaluate completeness of data collected and quality should be put in place. ■

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