



GHANA



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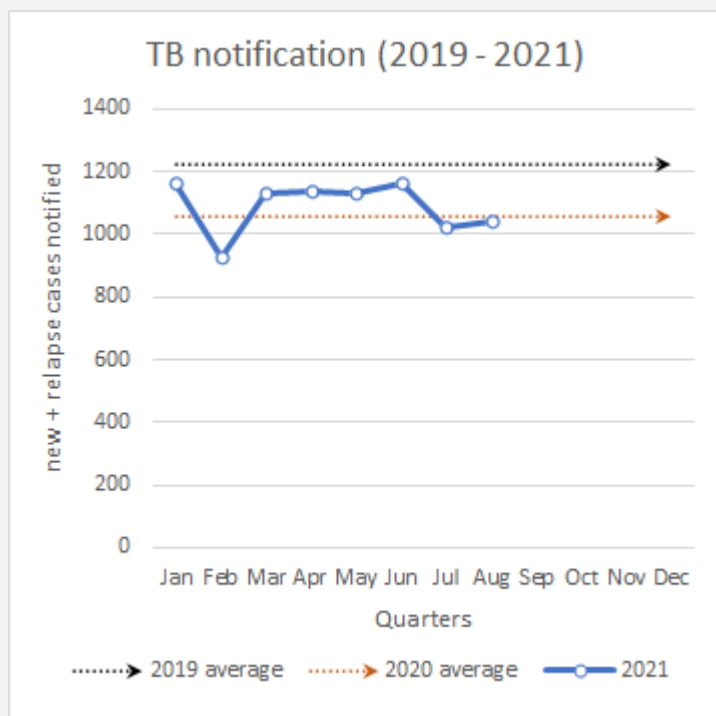
BACKGROUND

According to WHO estimates, of the 44,000 people with TB in 2020 (Global TB report, 2021), 12,922 were notified. With 8,100 of all people with TB also infected with HIV, Ghana is one of the 30 TB/HIV high burden countries. Children in Ghana account for nearly 5% of all cases. [1]

The recent TB prevalence survey reported a prevalence of smear-positive TB of 111 (95% CI: 76–145) per 100,000 among adult population. The prevalence of bacteriologically confirmed TB was 356 (95% CI: 288–425) per 100,000 population.[2]

The TB epidemic in Ghana is generalized, with geographic variation in case notification linked with better access to health facilities. Case notification rates are particularly high among people living with HIV (PLHIV), prisoners, miners, pregnant women, and people with diabetes. [3]

Affected by the COVID19 pandemic, country's TB case notification dropped in 2020-21, however, in 2021, the health system is making efforts to revive its TB surveillance practices rapidly and the case notification is steadily improving to reach near the level of 2019 average figures.



Source: <https://www.who.int/teams/global-tuberculosis-programme/data>

TB mortality rate in Ghana is considered high with a Case Fatality Rate of 37%. [1] To reduce this burden, detection and treatment gaps must be addressed, funding gaps closed, and new tools should be developed.

The year 2020 began with the focus of the HIV/TB program on development of National Strategic Plan 2021-25 and Global Fund grant

applications for NFM 3. Despite the damages it caused, COVID-19, presented an opportunity to build better and resilient health systems.

To support this effort, the NTP has taken a lead in leveraging digital innovations for TB surveillance and monitoring through platforms like **DHIS 2** also known as the DHIMS, which is a web-based system centrally hosted by the Central Health Information Management (CHIM) unit within the Planning Policy Monitoring & Evaluation (PPME) division of Ghana Health Service. This provides a platform for managing health service data nationwide across all service delivery points. This includes data from public, some private, faith-based and quasi-government health facilities. This system is implemented nation-wide.

Apart from this, **TB care e-Tracker** developed by the Policy Planning, Monitoring and Evaluation Division of the Ghana Health Service, in collaboration with the National Tuberculosis (TB) Control Program, is being implemented for individual case management to collect, manage and analyze transactional case-based records for TB screening, TB care & Treatment and adherence from 325 high TB burden district hospitals using the DHIS2 Tracker capture. This system, called TB care e-Tracker, has been deployed in Ghana especially in high TB burden districts. [4]

Additionally, to complement the existing national HMIS data systems, the TB Data from DHIS2 is integrated as indicators which enable comprehensive data review and analysis of TB data nationally.

It is empirical that technology penetration plays a vital role in enabling the evolution of information systems from paper to digital solutions. With the high political commitment of the government in Ghana to improve the country's digital architecture, Ghana has reached one of the highest mobile penetration in West Africa. With nearly 132.8% of the population having a cell phone, i.e., at least 1 mobile device per person, and the smartphone use is about 98%. Internet penetration also shows decent figures, i.e., approximately 78.3%. [5] It provides a good opportunity to the country to leverage the friendliness of its population with digital tools, which can set a strong ground to implement advanced solutions and ensure adequate uptake.

This country TB digital surveillance assessment report aims at providing strategic recommendations and way forward to country leadership in developing and scaling a comprehensive case-based TB surveillance system while leveraging the existing infrastructure, in-house capacity and assets. Detailed recommendations are provided in the later section of this country report.

STATUS OF CASE BASED TB NOTIFICATION

Currently the National TB program has been implementing primary two tools for TB surveillance:

DHIS2 based aggregated data collection system, which is being used at all 260 districts in Ghana. Typically, the data from e-tracker is compiled and entered in DHIS2 at the district level. The data is aggregated and reported upwards to regional and national level.

The current system generates monthly reports which are being accessed used at district, provincial and national program managers.

TB care E-tracker tool allows capturing of case-based TB data through the entire cascade of care only for TB confirmed cases starting from Notification, monitoring, treatment outcome. The system works both online and offline. However, scale at which e-tracker is implemented is limited. It is implemented in 325 high burden TB district hospitals only.

One of the biggest challenge highlighted by the NTP is that these two systems (DHIS2 and E-tracker) are not integrated and hence currently both the systems are being used in parallel.

The vision for implementing a case-based TB surveillance on DHIS2 will be an important way forward to have a unified case-based TB surveillance system for both DS TB and DR TB cases.

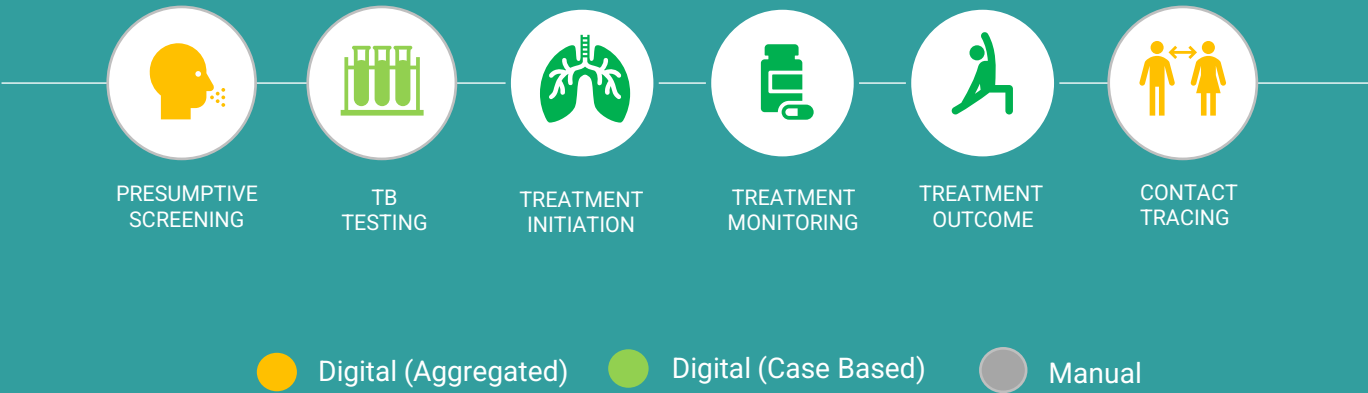
SUCCESS STORIES

Ghana has implemented a unique strategy to get access to TB testing data from private bodies. In order to ensure a complete reporting of all TB positive cases, data from Civil society organizations (along with that from Private sector service providers) is captured from the site of sample testing itself, i.e., government labs. As per the TB service delivery guidelines, Private providers/CSO's collect sputum from community and deposit at the public health facilities for testing (GeneXpert), and results are sent back to these CSOs. The identified positive cases get reported along with the other local cases of that public health facility in the national TB reporting system and hence none of the cases get missed from the final report.

ELECTRONIC TB NOTIFICATION DATA COLLECTION AND USE

	TARGET	CURRENT SCALE	COLLECTION TOOLS	DATA TYPE	DATA USAGE
National level 	Data not collected at this level				DHIS2 Dashboard
Regional level 	16	Data not collected at this level			DHIS2 Dashboard
District/ Municipal/ Metro 	260	260	DHIS2	DHIS2: Aggregate	e-Tracker Dashboard DHIS2 dashboard
Sub District level and Facility level 	1365	1252	DHIS2	DHIS2: Aggregate	DHIS2 dashboard
		325	e-Tracker	e-Tracker: Case Based	e-Tracker Dashboard
Community level 	Data not collected at this level				No Data usage at this level

CASCADE OF CARE MONITORING



KEY DATA VARIABLES

	YES/NO
Demographic details (Age, DOB, Gender)	✓
Address and contact details (Country, Province, District, House address)	✓
Geolocation (GPS coordinates of the household)	✓
Contact details (Phone number/Mobile number, WhatsApp, Email etc.)	✓
Health Facility address	✓
Type of health facility (Public, Private etc.)	✓
Site of TB (Pulmonary, Extra-pulmonary)	✓
Type of diagnostic test (Microscopy, GeneXpert, TruNaat, CXR, etc.)	✓
Date of test result	✓
Drug susceptibility (DSTB, DRTB)	✓
Treatment Regimen	✓
Treatment start and end date	✓
Co-morbidity (HIV, Diabetes, COVID-19 etc.)	✓
Treatment monitoring	✓
Treatment outcomes	✓

KEY INDICATORS

	YES/NO
Presumptive screening (proportion)	✓
Treatment initiation (proportion)	✓
Treatment monitoring	✓
Treatment outcome (proportion)	✓
Spatial distribution of TB notification	
Age-group & sex wise aggregate numbers and proportions notified	✓
Basis of diagnosis wise aggregate numbers and proportions notified	✓
Type/site/drug resistance wise aggregate numbers and proportions notified	✓
Provider source-wise aggregate numbers and proportions notified	✓
Comorbidity wise aggregate numbers and proportions notified	✓
Key-population wise aggregate numbers and proportions notified	
Estimate/Target wise notification/treatment coverage (proportions)	✓
Provider-type disaggregated treatment outcomes (proportions)	✓
Comorbidity disaggregated treatment outcomes (proportions)	
Key population disaggregated treatment outcomes (proportions)	✓

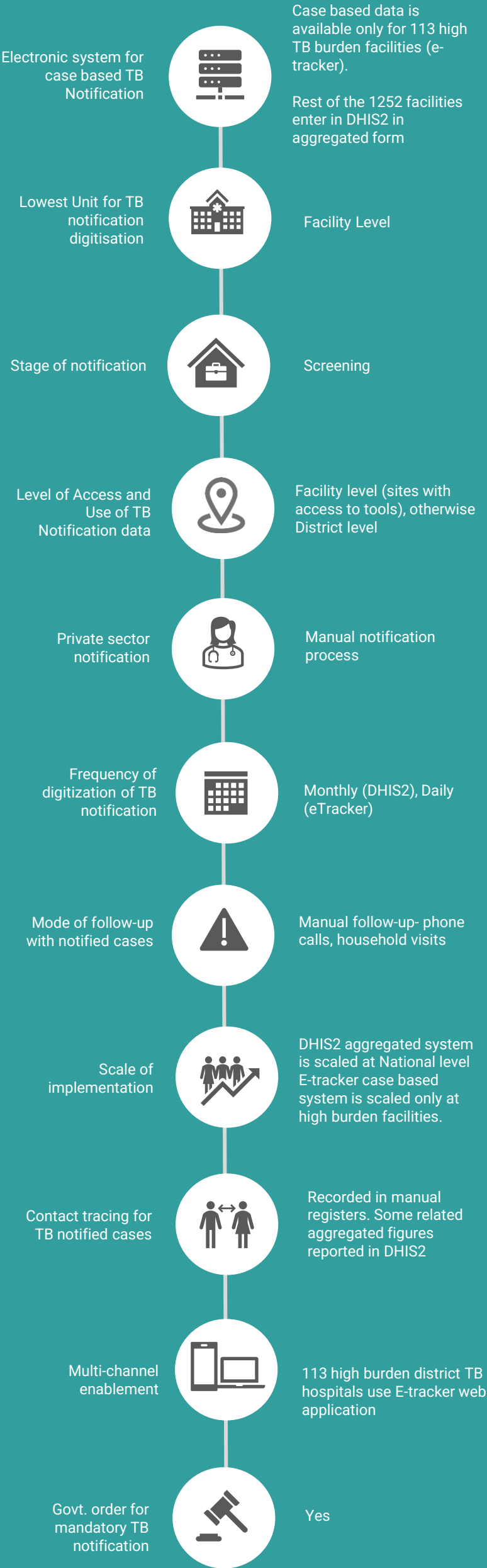
✓

Digital (aggregated)

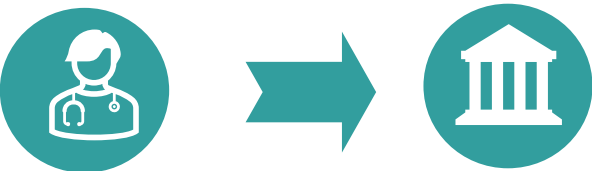
✓

Digital (case based)

STATUS OF ELECTRONIC CASE BASED TB SURVEILLANCE



PRIVATE SECTOR NOTIFICATION



As per NSP 2015-2020, only 2.6% of the notified cases are from the Private Sector and CBOs. 135 CSOs have partnered with the NTP to perform case finding and treatment support activities in all regions of the country.

COUNTRY IT CAPACITY

Country Server
Both system are hosted and managed by the Planning Policy Monitoring & Evaluation (PPME) division of Ghana Health Service

Interoperability
DHIS2 as a platform provides interoperability features like API and data export, but yet to be integrated

Country IT team
In-house IT country team is present in Ghana Health Service, but would like dedicated IT personnel under NTP

ENABLING ENVIRONMENT

132.8%
Mobile penetration (Jan 2021) ^[5]

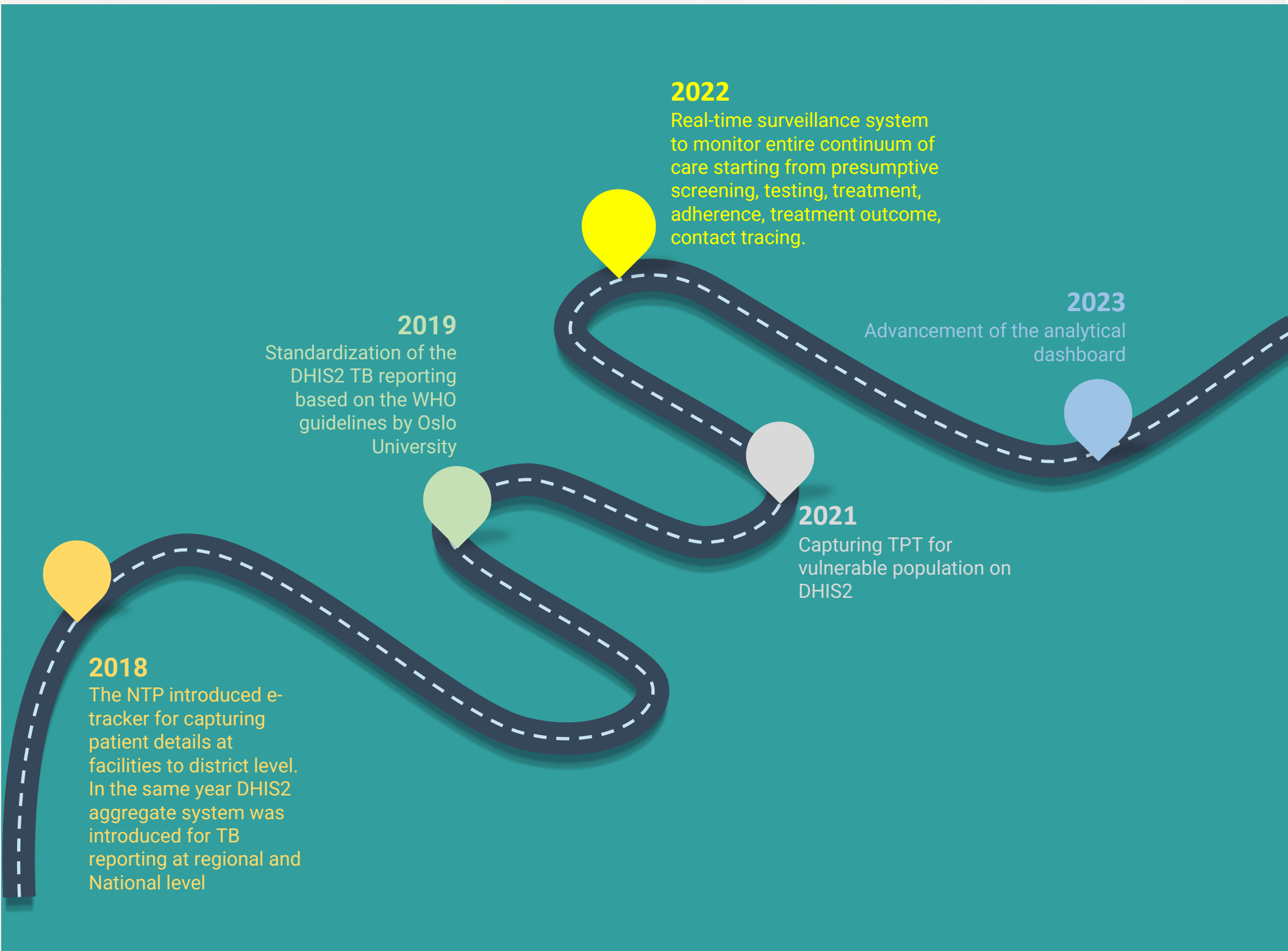
98%
Smartphone (2020) ^[6]

78.3%
Internet penetration (Jan 2021) ^[5]

CURRENT RESOURCES AVAILABLE

- ❖ A funding under RSSH is available for software extension and development for the enhancing the application.
- ❖ Digital TB case notification was included in the concept notes of National Strategic Plan 2020-23, with budget of USD 1 million.

MILESTONES ACHIEVED AND ROAD MAP



OTHER COMPLEMENTING DIGITAL TOOLS

PURPOSE	TOOLS	CHANNEL	DEVELOPED BY	SUPPORTED BY	SCALE
Digital Adherence	Nil	NA			
Logistic Management	Quant TB	Web Application	MSH (Management Sciences for Health)	The Global Fund	National
Laboratory Information Management	GxAlert	Web Application	System one	The Global Fund	Pilot
	ASPECT (upgraded GxAlert)	Web Application	System one	The Global Fund	Pilot
Community Led Monitoring (CLM)	Nil	NA			
Hospital Management System (EHR) for general hospital data	Lightwave Health Information Management System (LHIMS)	Web Application	Lightwave eHealth Solutions		Pilot
Contact tracing module	DHIS2 aggregated	Web Application	PPME, Ghana Health Service	The Global Fund	National



KEY CHALLENGES

- ❖ Individual patient level screening data is not captured, and hence a lot of presumptive TB cases get missed (dropouts) from reporting and follow-up.
- ❖ Capturing laboratory referral data (linking patient to care after initial diagnosis) is a bottleneck in getting data for the complete cascade of care.
- ❖ Limited coverage of eTracker. It is implemented only in 113 high TB burden district hospitals due to infrastructural challenges
- ❖ Real time data is not available for all the stakeholders, and this results in delays in planning interventions.
- ❖ Lack of a dedicated M&E, system management and software maintenance capacity with NTP.
- ❖ Capacity building at all levels is required but resources are inadequate.



NTP VISION

- ❖ To build a robust and comprehensive system that has both the systems integrated i.e., e-Tracker and DHIS-2 system
- ❖ Monitoring of entire cascade of care starting from presumptive case screening
- ❖ Provisioning a real time data availability and bi-directional feedback for taking timely actions at facilities, e.g., Patients alerts
- ❖ Improvement of IT infrastructure (both software and hardware) at Health facilities and laboratories.
- ❖ Better M&E, system management and software maintenance capacity with NTP



RESOURCE NEED

Based on multi-stakeholder discussions, country feedbacks and recommendations for full-filling country's vision, we have put together an estimated investment requirements and areas needing support for provisioning of a comprehensive case based digital TB surveillance system.

❖ Hardware and Infrastructure:

- Mobile Devices (for data collection): Ghana has 1050 sub-district facilities and 325 public facilities and to provision mobile device for every facility for case-based TB surveillance, **USD 206,250** will be needed assuming USD 150 per mobile devices.
- Tablet (for data use): Ghana has 1394 sub districts and 260 districts and to promote active data use, each district and region should be given a tablet which would cost roughly around **USD 330,800** assuming USD 200 per Tablet devices.
- Internet: In case WiFi is not available in each facility, then mobile internet cost of around **USD 908,700** should be considered (assuming USD 100 mobile data cost for the entire year per facility, district and regional user)
- Server: Based on the current volumes of new cases, Ghana would need an investment of **USD 24,000-30,000** for next 3 years for server and server maintenance.

Note: Existing devices available through other health programs can be leveraged. In that case, the above-mentioned costing can be accordingly considered.

❖ Software Development:

- Based on various multi-stakeholder meetings and given the fact Ghana already have a strong foundation for DHIS2 aggregated system for TB, around **USD 250,000-400,000** should be budgeted for a comprehensive TB surveillance system and analytical dashboard for data use.

❖ Capacity Building and Implementation:

- After the software development, a dedicated pool of technical resources will be needed to support platform administration, data management and support. A team of 4-6 skilled resources attributing to a cost of around USD 48,000-72,000 per annum should be budgeted (or **USD 144,000-216,000** for 3 years assuming USD 1,000 per month per resources). Additionally, reskilling of the current IT team should be budgeted.
- Training: This would involve training material development and onsite and remote training of the trainers. Training sessions should be planned for each of the 260 districts, which could cost roughly USD 100 per district, amounting to **USD 26,000** which will be further supported with e-Learning packages. Also, a dedicated trainer should be budgeted in case there is none.

TOTAL investment of around **USD 2.5 - 3 million for 3 years** will be needed on developing a comprehensive case-based digital TB surveillance system for Ghana

Disclaimer: The above budget is a function of number of facilities, districts and regions and expected volume of data. This only provides a ballpark figure of what is needed in terms of budget.



“Ghana will ride on opportunities presented to her doorsteps for gain. If Internet penetration is 78.3% and 132.8% of the population are having a cell phone, then with these friendly opportunities presenting as camels in a desert land, the first step is to hop on the camels’ back and to invite supporters for advanced digital solutions”

Dr. Yaw Adusi Poku
NTP Manager
Ghana

RECOMMENDATIONS

Following are some of the key recommendations suggested based on the findings of this assessment of country's digital ecosystem and infrastructure:

- ❖ **Strategic Costing Plan** : As a first step, it is important for the country to create a comprehensive costed action plan for development , implementation and scale of the TB case-based surveillance system.

Based on NTP's vision and the recommendations for improvements , the plan should clearly define targets with actionable interventions and funding requirements supported with a detailed work plan along with timelines. The plan will help the country to assess and monitor the progress to ensure that any risks can be duly mitigated.

Tentative timeline: Month 0-1

- ❖ **Implementation of Case Based TB Surveillance systems** : Ghana has already developed the core infrastructure in terms of the database and deployment of DHIS2 and e-Tracker platforms, which lays a strong foundation for executing the vision of creating a single comprehensive and integrated real-time case-based TB notification and surveillance system.

It is recommended that this existing capacity is leveraged for developing **e-tracker** for a comprehensive case-based surveillance system, which accommodates monitoring of entire continuum of care for **both DS TB and DR TB** patients starting from presumptive screening, referral, testing, treatment initiation, treatment adherence, treatment outcome and contact tracing in real-time. Additionally, inclusion of TB Preventive Treatment (TPT) module and inclusion of data from Lab Referrals and other key modules would make this a comprehensive solution.

The architecture should support adding all the above components in phases supported with versioning to ensure seamless upgrades and continuity.

Some of the existing templates of TB case-based tracking, currently being used by other countries (and standardized by WHO) can be helpful in fast-tracking the software development processes. ^[7]

Tentative timeline: Month 0-12

- ❖ **Data Integration** : One of the challenges highlighted by NTP is the leveraging the data collected from the multiple sources like e-Tracker into the main DHIS2 systems as a central warehouse for effective use.

To ensure that there is a seamless integration of data from multiple data systems like e-Tracker and other data sources like excel files maintained at facilities without any data loss , the DHIS2 data upload / transformation API should be explored. The same can even support the movement of case-based records to the central data warehouse or HMIS.

There may also be some other distributed data collection systems and processes which are existing, and it might be difficult to replace them, in such a scenario data can be extracted, transformed and loaded into the central database.

This DHIS2 data transformation API feature also offers creation of standard templates which can be easily mapped with external data collection tools. ^[8]

Apart from this it also supports batch upload for historical data in large volumes to ensure minimum disruption to the live systems.

Other source ETL tools over Postgres DB and / or WHO powered XMart ^[9] which can be installed within the current environment can also be considered.

Tentative timeline: Month 6-12

- ❖ **Data Use** : Building on the current DHIS2 visualization module which offers a comprehensive dashboard for reviewing of program and data indicators, additional features of pivot table , event reports which help in data analysis based on a range of dimensions , data aggregation reports and individual line lists and with timeline views are extremely useful.

Once a robust data analytics and data use model has been established with direct integration of E-tracker and enhancement of the current DHIS2 dashboard, then a more advanced analytical dashboard should be designed and implemented with providing monitoring access at all administrative levels.

RECOMMENDATIONS

To strengthen and expand the data visualisation scope and making effective use of data for predictive modelling, data science and for advanced analytics it is also recommended to use the best of the breed tools like Tableau, Power BI which offer these features. The current DHIS2 platform offers APIs which can be connected for these applications and be used as an extended analytical component of the data analysis framework. ^[10]

Tentative timeline: Month 6-12

- ❖ **System Integration:** One of the challenges highlighted by NTP is the leveraging the data collected from the multiple applications / systems into the main e-Tracker systems as a central system for effective use.

The current e-Tracker platform and infrastructure needs to be extended to support integration with external systems like GeneXpert, TruNat, Digital X-Ray outputs, Pill Boxes and other digital adherence tools which help in use the data effectively for the patient care continuum as highlighted by the NTP.

Recommended data exchange / ETL tools like Talend, Informatica which include these features make the data management task much easier and simultaneously improve data warehousing. ^[11]

The DHIS2 platform architecture is easily compatible with these standard tools and can be considered as an alternate route of system integration. ^[12]

Tentative timeline: Month 12-24

- ❖ **eLearning :** To address the challenges with periodic training of facility level staff to orient them on using DHIS2 for direct data reporting, the MOH must engage in development of a comprehensive eLearning module for app training.

While some platforms offer standard training modules on the application, training tools like Moodle^[13] built on standard Learning Management System (LMS) framework can be reviewed for application rollouts.

Additionally for training and updates on the latest manual of procedure and continued medical education on TB care modules can be developed for TB Health providers, administrators at facility and district level to develop and enhance M&E competencies for

ensuring a consistent program oversight, specially for the case-based tracker roll out within the existing applications.

Guide TB platform developed by WHO Philippines is a good example of eLearning module for health staffs involved in TB care.

Tentative timeline: Month 0-3

- ❖ **Capacity building for application maintenance**

Planning for capacity building includes workforce assessment, ranging from ICT professionals to health workers providing care services. Since the application requires regular updates and adaptations, the system support team requires trained personnel on the technology stack in use.

Strengthening the NTP team with trained system administrators will help in improving and expediting the planned implementations.

Tentative timeline: Month 6-24

- ❖ **Mobile application introduction**

One of the challenges reported by the NTP during the assessment processes is the lack of availability of real time data to stakeholders. One effective way to overcome this is to support the current data collection processes by introducing a mobile application for e-Tracker, which is in line with the country's efforts of improving the overall digital ecosystem.

The mobile application should be developed such that it supports offline data collection, security, encryption, version management etc and multiple tools can be evaluated to access the suitability for easily extending to the current systems.

This would also ensure that the data structures are consistent. Also, the app should be supported with a configurable set up to support any updates / changes to the program.

Additionally, the mobile framework is recommended to use open-source technologies like Java, Postgres, React and Android, which are easily supported by country IT teams. Also, the standard best practices of mobile development like version management, data encryption etc should be a component to make this a more robust solution. ^[14]

Tentative timeline: Month 6-18

RECOMMENDATIONS

- ❖ **Device Procurement** : One of the limitation highlighted by NTP is the need to improve the hardware availability at the facility level. To streamline this, procurement, distribution and maintenance of the required data entry equipment like laptops, mobile/tablet devices should be done on an urgent basis. Improving the current infrastructure at the facilities is crucial for a complete transition to digital notification.

Tentative timeline: Month 0-6

- ❖ **Patient Interactive Systems** : Tracking the lost to follow-up cases is highlighted as one of the main challenges given the migrant population is sizable.

Establishing a direct and secured mechanism for engaging with patient has a potential for drastic improvements by tracking the patients lost to follow-up. Auto generation of notification and messaging by the system through communication channels like Social Media, IVRS and SMS outbound messages should be explored. Open-source applications like Open MRS ^[15] can be used for these activities.

Tentative timeline: Month 12-18

Strategic Technical Recommendations

- ❖ **Application Upgrades including Server Augmentation & Infrastructure Upgrades** : To make sure that systems implementation and scale up of application is supported well, the key need is to have a long-term strategic plan which would cover the technical and operational objectives.

The strategy recommended would cover the following core areas

- ✓ **Technical Upgrades**: Based on the architecture, the upgrade would be done with the database, a middleware system, the operating system or the hardware.

Additionally, the architecture should support the integration layer which would be needed for data exchange with other national / external systems.

The technologies that need to be brought in and the areas of inter-connection need special focus.

Recommended data system architecture would include updating the version of the current DHIS2 to 2.34 which offers better features on data management , encryption and data exchange standards.

Apart from this, version 2.34 also supports compliance with GDPR standards and offers more controlled data encryption practises. ^[16]

- ✓ **Performance Optimisation & Testing** : To support the national scale up and implementation strategies it is very essential to have system(s) and application testing done to enable full proof platform and which also helps in architecture updates and augmentation.

While core teams from the user community who are involved in the testing learn and automatically get trained, Automated System and Application Testing tools like Selenium and Appium also can be considered. Load Testing tools which help in data base sizing and planning need to be adapted for effective planning . ^[17]

- ✓ **Application & System Security Audit**

To strengthen the current systems framework and ensuring long term sustenance it is important to have regular evaluation of the security of the information and systems by measuring how well it conforms to an established set of criteria.

These would also include developing a framework which should outline policies in line with recommended standard policies like HIPAA^[18] / country specific policies to over

- Patient Data Management
- Server & Infra guidelines

Apart from application measures offered by DHIS2 ^[19] for patient data security , hosting solutions offered from Azure also cover these as part of their deployment options which can be considered as part of systems hosting. ^[20]

ACKNOWLEDGMENT

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CONTACT DETAILS

National Tuberculosis Control Programme (NTP)
Disease Control Block opp. School of Hygiene at Korle Bu
P.O.Box KB 493, Korle-Bu, Accra, Ghana
Tel. +233 302 660023
Email: ntp.phd@ghsmai.org
<http://www.tbghana.gov.gh/>

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