National Tuberculosis Epidemiological Review, Rwanda

3-14 September 2018

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END TB

Objectives of the review

1. Describe and assess the capacity of national TB surveillance and vital registration systems to measure TB burden (incidence and mortality)
2. Assess level/trends in TB disease burden
3. Assess whether recent trends are plausibly related to changes in TB-specific interventions considering external factors (economic/demographic trends)
4. Define the investments needed to directly measure trends in TB disease burden in future

WHO Implementation guidance for national tuberculosis epidemiological reviews

Rationale of the TB epi review

- Understanding the level and trends of TB burden and how these are influenced by interventions is critical for
  - TB control, development of National Strategic Plans
  - Appropriate allocation of funding
- Part of the "Concept Notes" for funding applications to the Global Fund

→ In 2013 the WHO Global Task Force on TB Impact Measurement developed **standardised ToR for TB epidemiological and impact analyses**

http://www.who.int/tb/advisory_bodies/impact_measurement_tag/about/en/

Methods

- Implementation of Standards and Benchmarks for TB surveillance and vital registration systems checklist
- Interviews: TB&ORD, HIV division, CVRS, National Reference Lab
- Field visits: hospitals (Kabgayi, Kibagabaga), health centers (Kivumu, Kanyinya, Muhanga prison), La Médicale private clinic
- Data analysis: TB&ORD, WHO Global TB database, Global Health Observatory, World Bank, UNAIDS,
- Desk review: TB&ORD, DHS, CVRS

Rwanda

	2016
Population	12 million
Estimated TB incidence	50 (42-59) per 100,000 pop
Notified TB cases	6018
Proportion of notified out of all estimated TB cases	98.5%
Estimated TB mortality (excluding HIV)	1.7 (1.6-3.2) per 100,000 pop
Estimated HIV TB mortality	1.1 (1.6-1.7) per 100,00 pop
Treatment success	88%
MDR prevalence among new cases	1.4% (0.7-2.1)
MDR prevalence among retreated cases	10.7% (5.0-19.4)%
HIV prevalence in adults 15-49 years old	3%

Objective 1

Describe and assess the capacity of national TB surveillance and vital registration systems to measure TB burden (incidence and mortality)

Abbreviations

ART	Anti-Retroviral Therapy
DOTS	Directly Observed Therapy Short-course
DRS	Drug Resistance Survey
DST	Drug Susceptibility Test
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
HIS	Health Information System
ICD	International Classification of Diseases
IOM	International Organization for Migration
LIS	Laboratory Information System
M & E	Monitoring and Evaluation
MDGs	Millennium Development Goals
MDR-TB	Multi-Drug Resistant TB
NGO	Non-Governmental Organization
NISR	National Institute of Statistics of Rwanda
NNS	Number Needed to Screen
PAL	Practical Approach to Lung Health
PLHIV	People Living with HIV
PPM	Public-Private Mix
RBC	Rwanda Biomedical Center
PMEBS	Planning, M&E, business Strategy Division
RTLO	Regional TB and Leprosy Officer
SOPs	Standard Operating Procedures
STIs	Sexually Transmitted Infections
TB	Tuberculosis
TB&ORD	Tuberculosis and other respiratory communicable diseases Division
VR	Vital Registration
WHO	World Health Organization
XDR-TB	Extensively-Drug Resistant TB

Summary

Background and Methods

The 2018 Rwanda National Tuberculosis (TB) Epidemiological Review (Epi Review) was conducted to 1) describe and assess the capacity of national TB surveillance and vital registration systems to measure TB burden (incidence and mortality), 2) assess the level and trends in TB disease burden by geographic area and demographics, and 3) assess the relation of these trends to changes in TB-specific interventions considering external factors. Based on the findings, 4) an investment plan was developed to strengthen the surveillance system in its capacity to directly measure trends in TB disease burden.

The Epi Review followed the WHO Terms of References for TB epidemiological and impact analysis and implemented the Checklist of Standards and Benchmarks for TB Surveillance and Vital Registration Systems. We performed a desk review of documents related to TB notification/surveillance and population statistics such as the National Strategic Plan (NSP), annual TB program reports, program tools and manuals, Demographic and Health Survey (DHS), among others. During the first week of the in-country visit, we interviewed key Ministry of Health authorities and staff at the TB & Other Respiratory Communicable Diseases Division (TB&ORD), HIV/AIDS and STIs Diseases division, National Institute of Statistics of Rwanda (NISR) regarding the civil registration and vital statistics (CRVS), and the National Reference Lab. We also visited two hospitals, three public health facilities (including one in a prison), and one private health facility. During the second week, we analyzed data from the Health Management Information System (HMIS) and other TB&ORD sources, the WHO Global TB database, Global Health Observatory, World Bank and UNAIDS. Finally, we presented findings to the TB&ORD Division and agreed on recommendations to strengthen the surveillance system.

Key findings

TB Surveillance System and Standards & Benchmarks Checklist

The TB&ORD Division, the National TB Program in Rwanda, organizes active case finding, which involves community health workers actively seeking presumptive TB cases in their catchment area in all villages (1 CHW for an average of 250 persons, or 3 CHWs per villages) and referring them to health facilities; patients self-presenting to health facilities are also screened for TB symptoms. For the majority of presumptive TB cases, diagnosis is done with smear microscopy. Those with a positive smear, have an Xpert MTB/RIF done to diagnose drug resistance. In addition, Xpert MTB/RIF is used as the first line test for all presumptive TB cases in Kigali and for key populations (e.g. PLHIV, prisoners, Contact of Index TB case, children, elderly and high risk for MDR TB) outside Kigali. HIV screening is

conducted among all presumptive and confirmed TB cases with unknown status. TB and HIV services are integrated; therefore, TB/HIV co-infected patients receive treatment for both diseases in the TB clinic. At facility level, outpatient clinics screen children, persons over 55 years old, persons living with HIV and contacts of known TB cases for TB symptoms. Active case finding with TB symptom screening and chest radiograph followed by Xpert MTB/RIF occurs in high burden HIV clinics and in prisons.

TB is reported at health facility level on paper registers (TB case register book, presumptive TB register, TB Lab register) for presumptive and confirmed TB cases. Data are manually aggregated in quarterly reports, which are checked for quality, completeness, and consistency during 2-day meetings conducted quarterly at the district hospital level with TB&ORD supervisors. Once validated, the aggregated quarterly reports are updated by a data manager at the health facility in the Rwanda Health Management Information System (RHMIS), an electronic database with dashboards in DHIS2 platform managed by the HMIS unit at MoH. The Planning, Monitoring and Evaluation, and Business Strategy (PMEBS) Division conducts a biannual assessment of availability and readiness of health facilities to deliver the intended services (the Integrated Supportive Supervision & Data Quality Assessment), including data quality assurance for TB&ORD.

In 2015, the TB&ORD developed a case-based electronic system (eTB) within DHIS2 that will soon be replaced with a new improved version, still within DHIS2. After three years of implementing eTB, coverage is 70% of confirmed TB cases notified in aggregated reports. The shortcomings of the old version of eTB include too many required variables for each case, not being able to enter people without an ID number, and the workload imposed by requiring case-based entry of all presumptive TB cases in addition to the confirmed TB cases. At the health facility level, a data manager uses a computer with internet connection to report individual presumptive and confirmed TB cases in eTB. There are ongoing discussions regarding the use of a unique identification and the interoperability of electronic health systems (e.g. eTB, the laboratory information systems, CRVS). The Civil Registration and Vital Statistics systems (CRVS) has increasing the reporting coverage of hospital/health facility deaths and is piloting a system to capture community deaths. The TB&ORD publishes an annual report on National Strategic Plan progress and the TB epidemiology situation including notification, prevention and treatment based on data from eTB and RHMIS.

In 2013, the Rwanda TB surveillance system (i.e. aggregate data entered in RHMIS was considered the formal system) met 6 of the 13 standards of the TB Standard & Benchmark Checklist, partially met 4 and did not meet 2. In 2018, 8 standards are met, 2 partially met and 2 not met. The table below shows the results from the 2013 and 2018 S&B assessments. Although there are multiple indications that the TB surveillance system coverage is high, reporting TB is not formally a legal requirement and no inventory study has been done in the last 10 years to determine potential under-reporting as the standard requires, therefore standard B1.8 is partially met. The standard to evaluate

the system coverage with two health care access indicators (an under 5 mortality rate < 10 per 1000 live births and an out-of-pocket expenditure out of all health expenditure < 25%) was also partially met (B 1.9). The CRVS is currently being piloted to strengthen the notification and classification of health facility and community deaths. However, as of 2018, the CRVS does not yet have high national coverage and quality, therefore standard B1.10 is not met. Standard B2.3 requires that the ratio of TB cases in children ages 0-4 years old to 5-14 years old to be within the range of 1.5-3.0 and 90% or more of childhood TB cases are notified as determined by an inventory study. Since the ratio peaked at 1.3 in 2017 and no inventory study has been conducted, standard B2.3 is not met. Due to the transition from the old eTB to the new eTB, we considered standard B1.5 not applicable, yet efforts should be made so the new case-based system meets this standard as soon as possible.

Standard		2013	2018
Data quality	B 1.1: case definitions are consistent with WHO guidelines	Met	Met
	B 1.2: the TB surveillance system captures a minimum set of variables for all reported TB cases	Met	Met
	B 1.3: all scheduled periodic data submissions are received and processed at the national level	Met	Met
	B 1.4: data in quarterly reports are accurate, complete and internally consistent	Partially Met	Met
	B 1.5: data in national database are accurate, complete, internally consistent, and free of duplicates (*electronic case-based or patient-based systems only*)	NA	NA
	B 1.6: TB surveillance data are externally consistent	Met	Met
	B 1.7: TB surveillance data are internally consistent	Partially Met	Met
System coverage	B 1.8: All diagnosed cases of TB are reported	Partially Met	Partially Met
	B 1.9: Population has good access to health care.	Partially Met	Partially Met
Vital registration	B 1.10: Vital registration system has high national coverage and quality	Not Met	Not Met
Special subpopulations	B 2.1: surveillance data provide a direct measure of drug resistant TB in new cases	Met	Met
	B 2.2: surveillance data provide a direct measure of the prevalence of HIV infection in TB cases	Met	Met

	B 2.3: surveillance data for children reported with TB are reliable and accurate, and all diagnosed childhood TB cases are reported	Not Met	Not Met

TB Epidemiology and Influencing Factors

In the last decade, TB specific interventions as well as external factors have resulted in a decline of TB mortality and TB incidence in Rwanda. Estimated TB incidence went down from 64 (49-81) per 100,000 population in 2013 to 57 (44-72) per 100,000 population in 2017. In the same period, TB mortality decreased from 8.7 (6.5-11) to 7.5 (5.5-9.8) and the TB mortality rate excluding HIV/TB decreased from 5.3 (3.4-7.7) to 4.9 (3.2-7.1). In general, in the last five years, TB notification and notification rates have decreased for all forms of TB. There was a slight increase in notifications of bacteriologically confirmed cases in 2016 probably resulting from the implementation of Xpert MTB/RIF as first line test in Kigali and among high-risk populations. When disaggregating TB notifications by age and sex, we observed more TB cases among males than among females. Although most TB cases occur among young adult males, the rates are higher among older male. Among women, TB rates are similar across all age groups above 25 years old.

In 2016, TB notification rates in Kigali are three times that of the country (147 versus 51 TB cases per 100,000 population). TB notification rates for the other provinces were similar or lower than the national average (48 TB cases in the South, 45 in the East, 34 in the West and 27 in the North, per 100,000 population). In Kigali, TB notification rate is higher among men than women. Contrasting the age distribution of TB cases nationwide, TB notification rates in Kigali are higher among young adults for both men and women. The different age/sex distribution of TB, higher TB rates, and higher prevalence of HIV and HIV/TB in Kigali, compared to the other provinces, suggests two different TB epidemics. The proportion of TB notifications among children <15 years is above the 5% lower range expected in low and middle-income countries. A similar or higher proportion is found in all provinces except Kigali where it was below 5% in the 2013-2017 period. Considering Kigali has a higher burden of TB especially among younger adults, there may be under-diagnosis or underreporting of TB among younger children. Rwanda's TB surveillance system notified 81% of all TB cases estimated to occur in 2017 (reported in 2018). When comparing notifications to estimations by sex, the proportion of notified out of estimated TB cases was lower among women than among men, and lower among children 0-14 years old than among adults.

It is plausible that TB incidence, mortality and TB notifications are declining in Rwanda as a result of TB specific interventions as well as external factors. There is political commitment to control TB at all levels of the Ministry of Health and the Rwanda Biomedical Center (RBC), and the TB program

has a NSP with an assigned budget. Related programs, divisions, and institutions work in coordination to increase efficiency of interventions and provide patient-centered care. Notable TB specific interventions include: the nationwide reach of community and health facility based case detection and treatment services free of cost to patients, the active case finding activities among high risk groups, and the strong HIV/TB service integration.

The proportion of TB treatment success is high in Rwanda. In 2017, 88% of bacteriologically positive pulmonary TB patients, 81% of extrapulmonary and clinically diagnosed TB cases, and 75% among HIV/TB patients were successfully treated. Only five of the 30 districts in Rwanda had treatment success proportions below 85% in 2017: Gasabo in Kigali (83%), Gakenke (75%) and Burera (80%) in the North, Gisagara (83%) in the South, Rubavu (78%) in the West and none in the East. Mortality among HIV/TB, clinically diagnosed and EPTB cases was higher than among all TB cases (15% in the categories cited, as compared to 6% for all TB cases).

Multidrug-resistant (MDR) TB among new cases was 1.4% (0.7-2.1) according to the drug resistant survey (DRS) 2015 survey, which is lower than what was found in the 2005 DRS. MDR TB among retreated cases did not increase and was 10.7% (5.0-19.4) in 2015. This controlled MDR TB epidemic is probably a result of high quality TB program: most notably, high quality treatment of drug sensitive TB cases and early case detection of drug resistant cases. In 2017, 86% of all bacteriologically confirmed cases had a known drug susceptibility test (DST) result.

TB and HIV programs were integrated in 2005, and since 2007, over 80% of TB patients have a known HIV status. Coverage of ART among all PLHIV was 81% in 2017 and among HIV/TB was 90%. HIV coinfection among TB patients is higher (32%) in Kigali than in other provinces (16-20%). Overall, more than 90% of PLHIV in care are screened for TB symptoms at each clinical encounter.

Enhanced and active case finding strategies are in place in Rwanda, which have likely affected TB incidence in recent years. In addition to community health workers providing TB health education and identifying presumptive TB cases in villages, TB symptom screening at facilities is routine among PLHIV, prisoners, household and close TB contacts, children < 15 years and persons 55 years and older. The selection of these groups was based on the findings of the 2012 prevalence survey. In addition to routine screening upon prison entry, a first phase of active case finding in prisons (2013-2015) found that 154 prisoners were needed to be screened in order to find one TB case while in a second phase (2016-2018) the number needed to screen was 378 (based on available results, second phase of active case finding in prisons was still ongoing).

Among the external factors that are likely contributing to TB control in Rwanda are economic growth (gross domestic product annual growth in the last decade averaged 7.8%), poverty reduction

(44% in 2011 to 39% in 2014), high access to health care (widespread health insurance, low out-of-pocket expenditure and declining under 5 mortality) and high antiretroviral treatment coverage which reduces the number of people vulnerable to TB.

Key Recommendations

Rwanda has a well-established TB program with a surveillance system producing high quality data and good monitoring of HIV/TB coinfection and drug-resistant TB. Its main weakness relates to the ongoing extended transition to a case-based electronic online system, ongoing transmission and a high proportion of HIV coinfection in Kigali City, the probable under-diagnosis of TB in children and women, and a weak vital registration system. Multiple strategies are addressing several of these weaknesses and, considering the achievements in other areas, Rwanda is on track to have a surveillance system that directly measures TB incidence and mortality. The following recommendations aim to guide the TB program towards that goal:

1. Transition to case-based electronic surveillance system: Complete the transition to a case-based electronic TB surveillance system setting clear objectives and timelines to implement it nationwide. A unique identifier that allows entering all people in TB registers and that can identify more than one episode of TB should be used for a case-based system. The database should allow entering cases with no identifier, and auto-generate a unique identifier, in order to prevent under-reporting of people with missing IDs. Ensure that historic and current aggregated data of TB cases and presumptive TB cases are available to be analyzed with future data in order to understand trends. Discontinue the case-based entering of presumptive TB cases, while continuing to capture aggregate presumptive TB numbers. In the medium term, consider entering individual close/household contacts, especially those eligible IPT.
2. Ensure interoperability of systems: In coordination with key divisions and institutions ensure interoperability electronic systems: new eTB, laboratory information system (LIS), CRVS, HIV case-based database and HMIS, among other relevant systems so that TB surveillance is optimized, data are available in real time, data entry workload is reduced, and quality of data increases.
3. Increase M&E capacities: Strengthen M&E capacity of the TB&ORD division to record, analyze and use TB data at national and subnational level. Due to the imminent implementation of the new eTB system, additional staff with fully dedicated time to eTB will be required for training, data cleaning, data management, and supervision for a fast and smooth implementation. There should also be dedicated staff for analyzing and interpreting data, including the use of visual dashboards in the new eTB. Among the advantages of case-based data are the increased

possibilities of analysis. We recommend including subnational analysis to monitor TB specific interventions at the national level, but also province, district, and health facility level.

4. Continue data quality assessments: We recommend continuing the biannual Integrated Supportive Supervision & Data Quality Assessment and TB&ORD quarterly meetings where data quality is checked, among other supervisory activities. We also recommend prioritizing variables and indicators during supervisory activities, such as comparing total number of cases between paper and electronic case reports, correctly registering the age, sex, type and site of TB, HIV and drug resistant status, and documenting findings. The data quality assessment SOP for the new eTB should be updated.
5. Strengthen vital registration: Strengthen national vital registration system to capture all TB deaths. The TB&ORD can encourage and collaborate with NISR in the implementation of the new CRVS to document all hospital and community TB deaths using ICD-10 codes.
6. Improve TB notification in children: Case estimations suggest children, especially those <5 years old are not being notified. We recommend strengthening case finding among children. Work with paediatricians and primary care physicians to develop strategies to improve TB detection in children, especially <5 and in Kigali. In selected sites, extending active case finding up to 1-2 years after exposure, among household contacts <5 years old, could provide estimates of children that may be missed.
7. Increase drug resistance surveillance: Ensure that the new eTB allows routine surveillance of drug resistance among new and previously treated TB cases. Utilize GeneXpert platforms to full capacities. Additionally, in the medium term, consider using Xpert MTB/RIF as the first diagnostic test among all presumptive TB cases beyond Kigali. Use of phenotypic and genotypic methods beyond Xpert MTB/RIF are necessary for patients at higher risk for DR TB in order to determine drug resistance patterns (outside of rifampicin) circulating in the population and inform empiric treatment strategies.
8. Continue active case finding strategies: We recommend to continue the excellent efforts of active case finding strategies, and to analyze data to tailor strategies based on TB rates and characteristics of the populations. For example, develop differential strategies to increase and speed up case finding in Kigali versus other provinces, and among women and children <5 years old. Continue active case finding efforts among PLHIV and prisoners and consider strengthening household contact investigation to increase proportion of children detected.
9. Improve early diagnosis and management of TB among PLHIV to decrease mortality rate particularly among PLHIV presenting with advanced disease in hospital settings.

1. Introduction

Rwanda is located in East Africa with a population in 2017 of 12 million projected from the 2012 census. In 2012, 83% of the population was living in rural areas and the population density for the country was 415 inhabitants per km² and a population growth rate of 2.6% per year. Rwanda has achieved impressive economic and social progress with a GDP per capita at 748.39 US$ in 2017 up from 216.17 US$ in year 2000, the percentage of the population living below the national poverty lines dropped from 58.9% in 2000 to 39.1% in 2013 and the under-five child mortality from 152 per 1000 live births in 2005 to 50 in 2014-2015 (Rwanda DHS 2014-2015).

Rwanda is divided in five provinces (i.e. East, West, North, South and Kigali City) and thereafter in districts and villages (i.e. Umudugudu). Health centers provide primary care as well as TB diagnosis and treatment and district hospitals provide higher level care. At national level, there are four referral and 3 teaching hospitals providing specialized care to patients referred by district and provincial hospitals. The Tuberculosis & Other Respiratory Communicable Diseases Division (TB&ORD division) of the Rwanda Biomedical Center of the Ministry of Health leads the TB control efforts in Rwanda. The TB&ORD requested this Epi Review as a follow up from the one conducted in 2014 to assess the changes in the TB surveillance system and the TB trends as well as the progress made on the recommendations. Strong TB surveillance and vital registration systems are key to reach the goals of End TB Strategy and understanding the level and trends of TB burden and how these have been influenced by interventions is critical to policy making.

2. Objectives

The four objectives of this National TB Epidemiological Review include:

1. Describe and assess the current national TB surveillance and vital registration systems, with particular attention to their capacity to measure the level of, and trends in TB disease burden (incidence and mortality), through the implementation of a checklist of TB surveillance.

2. Assess the level of, and trends in, TB disease burden (incidence, prevalence, mortality) using available surveillance, survey, programmatic and other data.

3. Assess whether recent trends are plausibly related to changes in TB-specific interventions considering external factors (economic and demographic trends).

4. Define the investments needed to directly measure trends in TB disease burden in the future.

3. Methods

The Terms of Reference for TB epidemiological reviews and the TB surveillance checklist was implemented during a visit (3-14 September 2018) by WHO and CDC consultants in collaboration with the TB&ORD, the WHO Country Office Rwanda and the CDC Country Office. The Terms of Reference for TB Epi Review, the checklist of TB surveillance standards and benchmarks, the associated user guide and the methods to be used were shared with the TB&ORD prior to the visit. A presentation was given at the beginning of the visit on the purpose of the checklist and how each benchmark could be measured. During the visit, discussions were held with TB&ORD staff, the HIV division, PMEBS division, NISR, National Reference Lab as well as TB supervisors and nurses delivering care in two health centers (Kivumu, Kanyinya), the Muhanga prison clinic, a private clinic (La Médicale) and two hospitals (Kabgayi, Kibagabaga) in order to complete the checklist regarding Rwanda's national TB surveillance system. See Appendix 1 for the complete list of the documentation and data used for the assessment, Appendix 2 for background on the Checklist, Appendix 3 for the agenda of the visit, Appendix 4 for the list of all people met, and Appendix 5 for the completed checklist.

During the same visit, we collated and analyzed TB surveillance (national and sub-national) data as well as general health system data (e.g. Global Health Observatory, World Bank, UNAIDS). Published estimates of TB incidence and mortality were compiled (WHO Global TB database) as well as TB notification, HIV/TB, MDR TB, and treatment outcomes (data provided by the TB&ORD) and analyses to assess the level of, and trends in, TB disease burden (both nationally and, when data available, sub-nationally). A de-briefing presentation was held on September 13 at the TB&ORD office in Kigali where preliminary analyses were shared with the TB&ORD inviting discussion and providing opportunity for feedback. During the presentation recommendations were discussed on the transition to electronic case-based system and the interoperability with other such systems, M&E capacities, data quality, vital registration system, paediatric TB, drug resistance and active case finding in Rwanda. The presentation slides are available in Appendix 6. On September 14 2018, a condensed version of the presentation was given to Dr. Jeanine U. Condo, Director General of the Rwanda Biomedical Center as well as to partners invited by the TB&ORD.

4. Results

4.1. Assessment of current national TB surveillance and vital registration systems with particular attention to their capacity to measure the level of, and trends in, TB disease burden

4.1.1. Characteristics of the TB surveillance system and vital registration. Checklist, Part A

TB surveillance system

TB treatment centers (CT) (n=362) and TB diagnostic and treatment centers (CDT) (n=200) are the entry point for TB case detection either enhanced by referral of community health care workers. Cases can be identified by either passive or active surveillance. Passive surveillance includes self-presenting presumptive TB cases being screened at outpatient clinics and active surveillance includes

case detection efforts in prisons and among key populations. At facility level, outpatient clinics screen children, persons ≥ 55 years old, persons living with HIV and contacts living with bacteriologically confirmed TB case, for TB symptoms. Active case finding occurs also in prisons. Both CTs and CDTs identify presumptive TB cases, but only CDTs can provide TB laboratory and diagnostic services. Each CDT provides TB laboratory services to presumptive TB patients referred by CTs in its catchment area. Once a patient diagnosed with TB at the CDT, TB treatment can be administered in either a CDT or a CT. TB treatment is monitored in CTs and CDTs but all laboratory evaluations during treatment are conducted by the CDTs. Diagnosis is done with smear microscopy in most cases. Xpert MTB/RIF is the first line test for presumptive TB cases in Kigali and in key populations (e.g. PLHIV, prisoners, contact living with bacteriologically confirmed TB case, elderly and children) outside Kigali. Additionally Xpert MTB/RIF is used to rule out drug resistance among those with a positive smear. HIV screening is conducted among all TB cases with unknown status. The TB and HIV program are integrated, therefore coinfected patients receive treatment for both diseases in a single site.

Figure 1 shows the roles and responsibilities for CTs, CDTs without Xpert, CDTs with Xpert and district hospitals in regards to recording and reporting for the TB surveillance. Figure 2 and 3 show the data flow and reporting system. CDTs are responsible for the registration of all TB cases identified in the "TB case notification register"; they are also responsible for completing the quarterly report of aggregate TB cases before they are recorded in the RHMIS which is an internet based health information system with dashboards in DHIS2 platform and managed by the HIS units at MoH and RBC. Both CDTs and CTs are responsible for the registration of presumptive TB cases in the "presumptive TB register" and for reporting quarterly the aggregate presumptive TB cases that are also recorded in the RHMIS. To ensure completeness and improve quality of TB data collected in facilities and reported to the program, quarterly report of aggregate TB data prepared in health facilities are verified and signed by both the health care worker in charge of TB activities in the facility and the data manager responsible for data entry in the RHMIS. At the end of each quarter, during the district TB review meeting, data from all facilities are reviewed again and cross-checked with data from TB case notification register. All discrepancies are resolved during the quarterly meeting before data are uploaded into the RHMIS for use at all levels.

The Planning, Monitoring and Evaluation, and Business Strategy (PMEBS) Division conducts a biannual assessment of availability and readiness of health facilities to deliver the services they intend to (the Integrated Supportive Supervision & Data Quality Assessment), including data quality assurance for TB&ORD.

Since 2014, the TB program has been piloting the implementation of an electronic TB case-based surveillance using the RHIMS. In this system, all registered presumptive TB cases and all TB cases registered in TB register are individually recorded in the RHIMS. Data verification for completeness and quality are also assessed during quarterly TB program review meeting. Unfortunately, the data collected in this system is not yet being used by the program for TB notification because of concern for its completeness (coverage is reported to be 70%) and quality. A new version of this case-based

electronic system in DHIS2 exists addressing shortcomings of the former version, but it has not yet been rolled out.

Figure 1. Roles & Responsibilities for TB recording and reporting, TB surveillance system, Rwanda 2018.

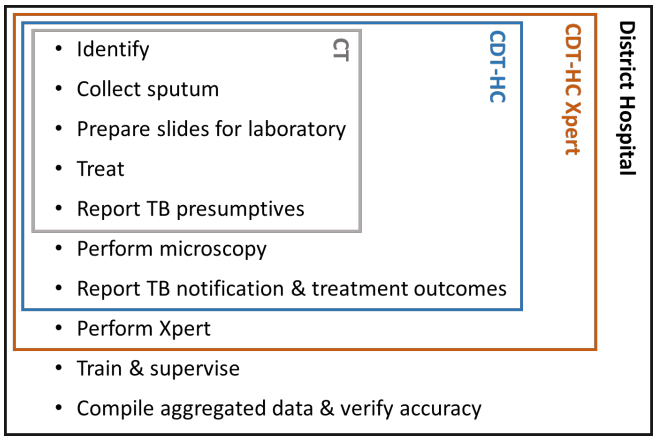


Figure 2. Health facilities, data, patient/data flow, TB surveillance system, Rwanda 2018.

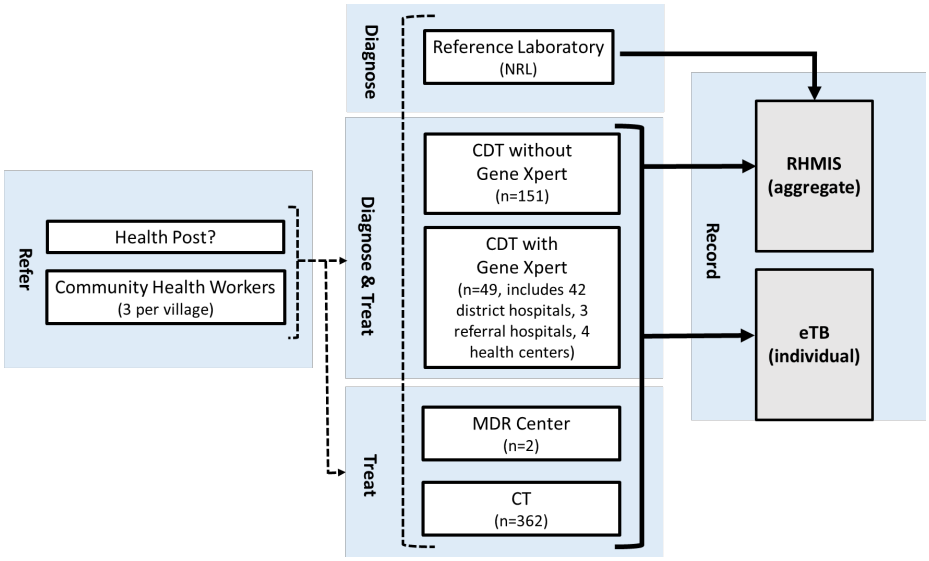
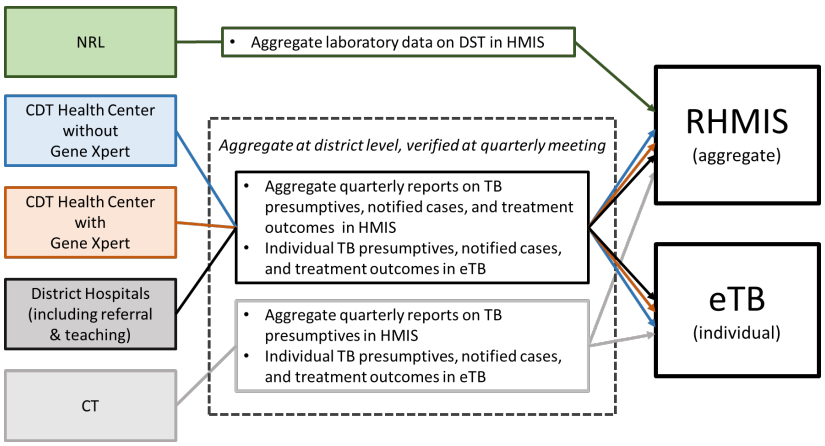


Figure 3. TB reporting system, Rwanda 2018



Vital registration system

A Rwanda Civil Registration and Vital Statistics Systems Comprehensive Assessment conducted in 2014 (the Final Report Volume I was reviewed) recommended enabling a legal and policy environment, putting in place a high-level coordination and oversight mechanism for the production and use of vital statistics, restructuring CRVS key institutions, improving the processes by switching from a paper to an electronic system, ensuring sufficient funds are available and aligning the recording of cause-of-death to WHO guidelines; and the application of verbal autopsy for community deaths until most deaths can be medically certified. Furthermore, it recommended to enforce the law on burials which makes them mandatory to report all deaths as well as enhancing statistical quality of data and standards. Improving quality of registration information by analyzing statistics from civil registration regardless of the level of completeness as a means to establish the state of the system and improve its development.

The National Institute of Statistics of Rwanda reported progress in birth registration since the strengthening of the system started in 2015, but noted that death registration was still challenging. By comparing data on deaths obtained in the census to that reported in hospital, the Institute estimates that 70% of deaths occur in the community and these are more common among elderly population. Several interventions are in place to improve the coverage and quality of health facility death registration data by 2019.

In the current CRVS system, the cause of death written by the physician in the death certificate includes information on the deceased, cause of death (first and underlying) as coded by data managers using the Startup Mortality List (SMOL) system. During a visit to a hospital in Kigali, we observed the data entry interface and discussed the entry process and challenges of the system with the data manager. The data manager was familiar with its use and considered the system user friendly. She

noted that in the electronic system, three causes of death (first, underlying, contributory), had to be filled even if only one cause of death was filled in the paper certificate. In those cases, she would repeat the same cause of death in every of the four fields. Health facilities report their progress in implementing the CRVS in performance reports and during supervision from NSIR. On the other hand, there are no incentives for people to register deaths. Enforcing death reporting would require mandatory reporting of TB deaths by burial offices, and would thus substantially increase the deaths reported.

Current status of TB data analysis and use at all levels

The TB&ORD publishes an annual report on the progress on the National Strategic Plan progress and the TB epidemiology situation including notification, prevention and treatment based on data from eTB and HMIS. Key indicators on case detection, treatment outcomes and HIV/TB are discussed in quarterly meetings at district level. HMIS (and eTB) have dashboards installed and accessed at all peripheral and central levels;however, its use at district level is limited.

4.1.2. Standards and Benchmarks checklist for TB surveillance – Summary of Part B

Table 1 presents the results from Part B of the Standards and Benchmarks assessment of the TB surveillance system in Rwanda. In total, eight benchmarks were met, two were partially met and two were not met, while one standard was not applicable to Rwanda, as the electronic case-based TB surveillance system is not used as the formal reporting system yet.

TABLE 1. A SUMMARY OF THE SURVEILLANCE CHECKLIST RESULTS, LISTED BY WHETHER STANDARDS WERE MET, PARTIALLY MET, NOT MET, OR WERE NOT APPLICABLE. THE COMPLETED CHECKLIST CAN BE FOUND IN PART B (SECTION 1): CHECKLIST FOR TB SURVEILLANCE AND VITAL REGISTRATION SYSTEMS

Met	Partially met	Not met	Not applicable
B1.1 – Case definitions are consistent with WHO guidelines **B1.2** – TB surveillance system is designed to capture a minimum set of variables for reported TB cases **B1.3** – All scheduled periodic data submissions have been received and	**B1.8** – All diagnosed cases of TB are reported **B1.9** – Population has good access to health care	**B1.10** – Vital registration system has high national coverage and quality **B2.3** – Surveillance data for children reported with TB (defined as ages 0-14 years) are reliable and accurate AND all	**B1.5** (Electronic) – Data in national database are accurate, complete, internally consistent, and free of duplicates

processed at the national level **B1.4** – Data in quarterly reports (or equivalent) are accurate, complete, and internally consistent *(For paper-based systems only)* **B1.6** – TB surveillance data are externally consistent **B1.7** – Number of reported TB cases is internally consistent **B2.1-** – Surveillance data provide a direct measure of drug-resistant TB in new cases **B2.2** – Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases		diagnosed childhood TB cases are reported	

In 2013, the Rwanda TB surveillance system (i.e. aggregate reporting system in RHMIS) met 6 of the 13 standards of the TB Standard & Benchmark Checklist, partially met 4 and did not meet 2. Table 2 shows the results from the 2013 and 2018 S&B assessments.

The two standards that progressed from 2014 to 2018 are standard 1.4 and 1.7, both on data quality. Standard 1.4 involves data in quarterly reports to be accurate, complete, and internally consistent by meeting three benchmarks: the sub-totals of TB cases by age group, sex and case type equals the total number of reported TB cases in ≥95% of quarterly reports from BMU, the number of TB cases in ≥95% of quarterly reports matches the number of cases recorded in TB registers and source documents and confirming that data for a minimum set of variables are available for ≥95% of the total number of reported TB cases in TB registers. The source for the benchmark is a nationally representative independent data audit or a Service Availability and Readiness Assessment (SARA).

The TB&ORD conduct quarterly data quality assessments at district level and since 2014, the M&E unit of the Planning, Monitoring and Evaluation and Business Strategy (PMEBS) implements a biannual Integrated Supportive Supervision & Data Quality Assessment (ISS&DQA), based on SARA. The DQA component involved reviewing the accuracy of aggregated data reports. In the ISS&DQA report from July 2017 reviewed for this Epi Review (ISS&DQA 2017), the indicators for TB were as follows:

- Treatment success rate for bacteriologically confirmed new and relapse TB cases,
- Proportion of diagnosed TB cases tested for HIV infection,

- Proportion of HIV positive TB cases given ART during TB treatment,
- New PTB with positive smear registered cases,
- New PTB with positive smears that completed treatment,
- New PTB with positive smear cured,
- Relapses registered cases, completed treatment and cured, and
- TB HIV new and relapse.

Table 2. Standards and Benchmarks Checklist for TB Surveillance, Rwanda 2013 and 2018.

Standard		2013	2018
Data quality	B 1.1: case definitions are consistent with WHO guidelines	Met	Met
	B 1.2: the TB surveillance system captures a minimum set of variables for all reported TB cases	Met	Met
	B 1.3: all scheduled periodic data submissions are received and processed at the national level	Met	Met
	B 1.4: data in quarterly reports are accurate, complete and internally consistent	Partially Met	Met
	B 1.5: data in national database are accurate, complete, internally consistent, and free of duplicates (*electronic case-based or patient-based systems only*)	NA	NA
	B 1.6: TB surveillance data are externally consistent	Met	Met
	B 1.7: TB surveillance data are internally consistent	Partially Met	Met
System coverage	B 1.8: All diagnosed cases of TB are reported	Partially Met	Partially Met
	B 1.9: Population has good access to health care	Partially Met	Partially Met
Vital registration	B 1.10: Vital registration system has high national coverage and quality	Not Met	Not Met
Special subpopulations	B 2.1: surveillance data provide a direct measure of drug resistant TB in new cases	Met	Met
	B 2.2: surveillance data provide a direct measure of the prevalence of HIV infection in TB cases	Met	Met
	B 2.3: surveillance data for children reported with TB are reliable and accurate, and all diagnosed childhood TB cases are reported	Not Met	Not Met

Discrepancies were found in less than 5% of district quarterly reports reviewed. This standard was considered met; however we recommend including the three indicators recommended by the Checklist

(1. sub-totals of TB cases by age group, sex and case type equals the total number of reported TB cases in ≥95% of quarterly reports from health facilities, 2) the number of TB cases in ≥95% of quarterly reports matches the number of cases recorded in TB registers and source documents and 3) data for a minimum set of variables are available for ≥95% of the total number of reported TB cases in TB registers.

Standard 1.7 measures the internal consistency of the TB surveillance system by comparing the year-to-year change in the national number of reported TB cases with the year-to-year change in national TB mortality (HIV-negative, from national vital registration). If trajectories are in the same direction, the benchmark is met. When vital registration data is not available for this benchmark, six benchmarks on the consistency of TB data should be met: the number of reported TB cases is consistent in the last five years for:

1. Ratio of notified pulmonary to extrapulmonary TB cases
2. Ratio of male to female TB cases
3. Proportion of childhood TB cases out of all TB cases
4. Year-to-year change in the case notification rate for all forms of TB
5. Year-to-year change in the case notification rate for new smear-positive TB
6. Year-to-year change in the ratio of presumptive TB cases to total TB notifications.

In the 2014 Epi Review, benchmark 1 and 2 were met, but 3 was not met as there was a sharp drop in one of the years. Benchmark 4 and 5 were considered partially consistent. Benchmark 6 was not evaluated. In the 2018 review, the ratio of PTB to EPTB, of male to female and the proportion of children with TB out of all TB cases was consistent from 2013-2017 (Table 3). The year to year change for all new TB forms had minor changes in the last five years. The year to year change of smear positive TB had slightly more changes probably a result of the implementation of Xpert in some diagnostic sites. The ratio of presumptive TB to total TB notifications was relatively stable in the last five years.

Table 3. Internal consistency of the Rwanda TB Surveillance system

Year	PTB: EPTB	Male: Female	% of children TB cases out of all TB cases	Year to year change in the CNR for all forms of TB	Year to year change in the CNR for new smear positive TB	Ratio of presumptive TB to total TB notifications
2013	3.5	1.6	7.7%	NA	NA	30.9
2014	5.1	1.9	5.7%	-1.4	+4.9	39.9
2015	5.3	1.5	6.0%	-4.4	-3.0	32.2
2016	6.2	2.0	5.8%	+1.2	+0.9	27.2
2017	6.1	2.0	7.1%	-2.5	+2.5	27.9

These results show that by progressing in two standards partially met in 2014, Rwanda now meets the six standards related to data quality for an aggregated surveillance system. Due to the transition from the old eTB to the new eTB, we considered standard B1.5 not applicable. It is important to note that if the case-based electronic system would have been used as the formal reporting system

in this Epi Review, several standards would not have been met. Considering the long roll out period for this system and the upgraded version that will soon replace it, the TB&ORD should aim to have this as the formal reporting system meeting all six standards and evaluated in the next epidemiological assessment.

Regarding the two standards on system coverage that were partially met in 2014, there has been little progress in this. Standard 1.8 is partially met because although there are multiple indications that the TB surveillance system coverage is high, reporting TB is not formally a legal requirement and no inventory study has been done in the last 10 years to determine potential under-reporting as the standard requires. A Public Health Act makes TB reporting mandatory, but it was not clear if there are legal consequences of not complying with the act. Even if reporting TB was a legal requirement, some under-reporting is inevitable and the level of TB under-reporting should be known by the TB&ORD division. Inventory studies can be used to obtain a direct measurement of under-reporting within TB surveillance. It is unlikely that underreporting is a large problem in Rwanda; however conducting an inventory study, especially where the private sector is large, such as in Kigali, would provide an objective assessment of underreporting.

The standard 1.9 to evaluate the system coverage was partially met as one of the two health care access indicators, the out-of-pocket expenditure out of all health expenditure was less than 25% as required, but the under 5 mortality rate was not less than 10 per 1000 live births as required, as it was 50 in 2014-2015 (Rwanda DHS). In 2016, the out-of-pocket expenditure was 26%; however, it was consistently below 25 from 2000 to 2014 except for a peak in 2005 where it was 28% (Figure 4 and 5).

Figure 4. Under five mortality per 1000 live births, Rwanda 2002-2016. Data Source: UNDP and World Bank

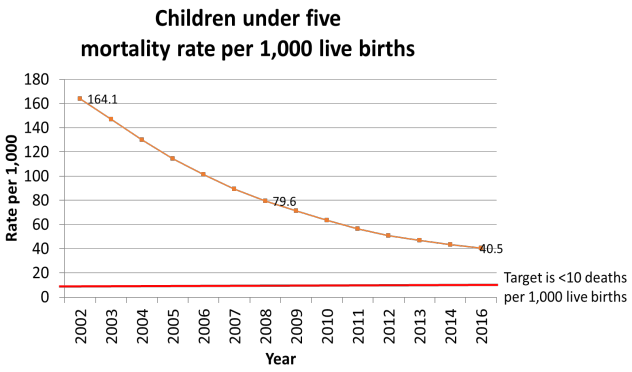
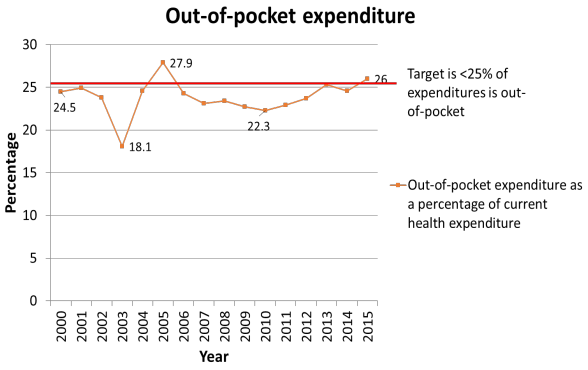


Figure 5. Out-of-pocket expenditure, Rwanda 2000-2016. Data Source: UNDP and World Bank



Standard 1.10 on the coverage of the vital registration system was not met as a CRVS is currently being piloted to strengthen the notification and classification of health facility and community deaths (description below), but it has not yet achieved high national coverage and quality. Standard B2.3 requires that the ratio of TB cases in children ages 0-4 years old to 5-14 years old to be within the range of 1.5-3.0 and 90% or more of childhood TB cases are notified as determined by an inventory study. Since the ratio peaked at 1.3 in 2017 and no inventory study has been conducted, standard B2.3 is not met.

Strengths and weaknesses

In summary, Rwanda has a solid TB surveillance system with political commitment at all levels, a National Strategic Plan with an assigned budget, and strong interaction between programs & institutions (PMEBS, HIV, National Reference Lab, NSIR). The current aggregated surveillance system meets many standards of the checklist and the surveillance system is in transition to an upgraded case-based electronic system. Data quality is biannually evaluated monitored by PMEBS and during quarterly supervision by the TB&ORD in which feedback of data quality is given at district level. Xpert MTB/RIF is the first-line TB test for all presumptive TB cases in Kigali City, for presumptive TB among key populations (including PLHIV, prisonners, contact living with bacteriologically TB case, elderly, children, high risk for MDR TB, etc.) in the rest of the country, and for active case finding activities among PLHIV and prisoners.

This strong background provides an excellent foundation to accelerate and strengthen the use of the case-based system and inter-operational systems (TB&ORD, HMIS, HIV division, LIS, National Identity Agency, NISR) with the use of unique case identification.

Table 4. Recommendations in the TB surveillance assessment conducted in 2014 and 2018 status and comments.

Recommendations in the 2014 TB surveillance checklist assessment	Current status/comments
Further enhance supervision and record verification and strengthen data auditing to solve the minor discrepancies that were observed.	ISS&DQA has been implemented biannually since 2014, and the TB&ORD conducts quarterly data quality assessments.
Further investigate the reason for the observed drop in proportion of childhood TB case after 2008 and the observed erratic pattern of annual change in case notifications.	See in objective 2
Recommendations for the new patient based electronic system	
Develop a phased roll out plan for the patient-based system and ensure that in the new electronic system (ETR) sufficient checks are built in for each verification and approval step now conducted manually, i.e. replacement of paper-based checks/stamps	The eTB was rolled out however it did not replace yet the paper system and a new version is about to replace the eTB.
Consider replacing the anticipated checklist form because of the risk of transcription error, consider entering directly from the TB patient cards/TB case register.	This was implemented in the eTB and is also implemented in the new version.
Carry out duplication checks not only on PINS but also do checks for duplicates using a combination of age, sex and name. Investigate usage of barcodes for patients cards.	Barcodes are not being used.
Conduct an extensive evaluation after the first year of implementation and decide on forehand on key indicators that need to be met in order to conclude the system is working.	An evaluation was conducted in 2016. This recommendation is repeated in this review, so that the new eTB to be soon scaled up is evaluated after the first year
Develop Analysis Plan to use richer database, what additional information should it bring.	
Re-evaluate the role and responsibilities of all M & E staff in the new system, there is probably need for task shifting and new roles.	
Critically review all indicators that are planned to be collected, are they clearly defined and measurable and can they provide the information needed, will all be used?	The variables and indicators included in the old eTB were reviewed and reduced in the new eTB.
Consider hiring a full time in-house statistician to constantly work on analysis of data that will be generated through the ETR.	A full time statistician works at the TB&ORD but a larger team may be needed for the roll out of the new eTB.
Develop a scale-up plan for patient-based system	Scale plan of patient based system was done with the old eTB

Update the M&E plan to include task-shifting as a result of shifting to an electronic system	
Develop an operational research plan outlining key research questions to be answered (initial analysis using patient based data, prospective studies to be integrated etc.)	
Consider developing a scoring system for supportive supervision to better quantify results	Done
Conduct in-depth analysis of the surveillance data over the last 5-10 years (Epi-assessment)	Done
Every 5 years, evaluate the surveillance system and the data it generated linked to the external TB Programme Review	Done

Recommendations

On the basis of the above findings, the following four recommendations are given to strengthen the TB surveillance system in Rwanda:

1. Complete transition to a case-based electronic system

    a. Finalize new eTB and set a clear objective and timeline to implement it countrywide, using previous experience from the implementation of the old eTB.

    b. Ensure the use of a universal unique ID for all persons in Rwanda (including <16, foreigners, prisoners, homeless) that can reliably entered in the new eTB and allow flexibility to allow a small % of cases with no ID to be registered in the eTB. To optimize benefits of electronic case-based systems, each individual should be uniquely identified. However, in order to avoid missing the reporting of any TB cases, the system should be flexible and allow the inclusion and reporting of TB cases that may not have the required ID for multiple reasons (ex. Foreigners, Rwandans under 16 years old, persons living in the streets, prisoners, among others). The system should allow for reporting of those without an ID and have the ability to update IDs should an ID be obtained.

    c. Develop a plan for the transition and migration of historical data to DHIS2 to have historic and prospective data in different tables in a single system, so case based data can be aggregated and merged with the hostproc ahhrehated data. (This includes completing 2013 quarterly reports in HMIS, which were found incomplete in the analysis in objective 2).

    d. Continue the entry of presumptive TB to aggregated database and not case-based as was tried recently in old eTB. Requiring the entry of case-based presumptive TB is a major workload barrier considering there are approximately 170,000 cases to be entered per year. Therefore, although valuable, we recommend that only aggregated data on presumptive TB cases is monitored. Considering, TB incidence is decreasing in Rwanda, the investigation of

contacts, especially close/household contacts will gain more and more relevance as they will begin to represent a larger proportion of all TB cases, than in a more extended epidemic, where transmission can occur beyond or within the household. Therefore, medium term, the TB&ORD can consider entering close/household contacts on case basis, in order to monitor IPT use, completion and effectiveness. However, this should not be conducted at the cost of TB case reporting.

e. Work towards interoperable electronic systems: new eTB, HIV case-based database, LIS, National Identity Agency, CRVS, among other relevant health surveillance systems with a unique ID.

2. Strengthen M&E capacity to record, analyze, and use TB data at national and subnational level

   a. Increase the number of staff with full time dedication to M&E activities at national level, especially considering the implementation of new eTB.

   b. Train in data analysis and interpretation, using dashboards

   c. Analyze subnational data, per age/sex, to monitor case detection and treatment outcomes

3. Prioritize key indicators for data quality, in ISS&DQA and TB&ORD in meetings quarterly, document findings

   a. Develop plan update SOP for data quality assessment of the new eTB.

4. Strengthen national vital registration system

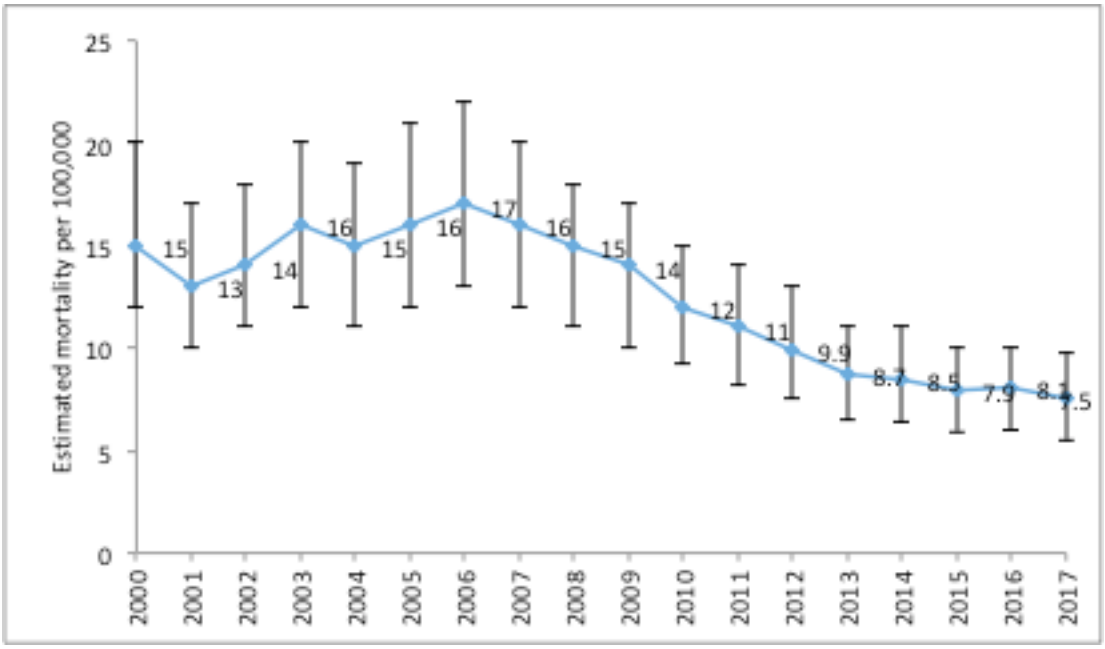
   a. Encourage the implementation of the new CRVS to document all TB hospital and community deaths using ICD-10 codes

4.2. Assess the level of, and trends in, TB disease burden using available surveillance, survey, programmatic and other data

TB Mortality

As the CRVS system is being scaled up and strengthened, the system will first focus on health facilities. Therefore currently direct measurement of TB mortality is not possible. Therefore, an indirect estimation of the levels of, and trends in, TB mortality needs to be employed (Figure 6). Mortality rates have remained stable since 2000 with a slight decreasing trend: the estimated TB mortality (TB/HIV and TB non HIV) per 100,000 population was 15 in 2000 and went down to 8.5 in 2014 and then a drop to 7.5 in 2017 (Figure 6).

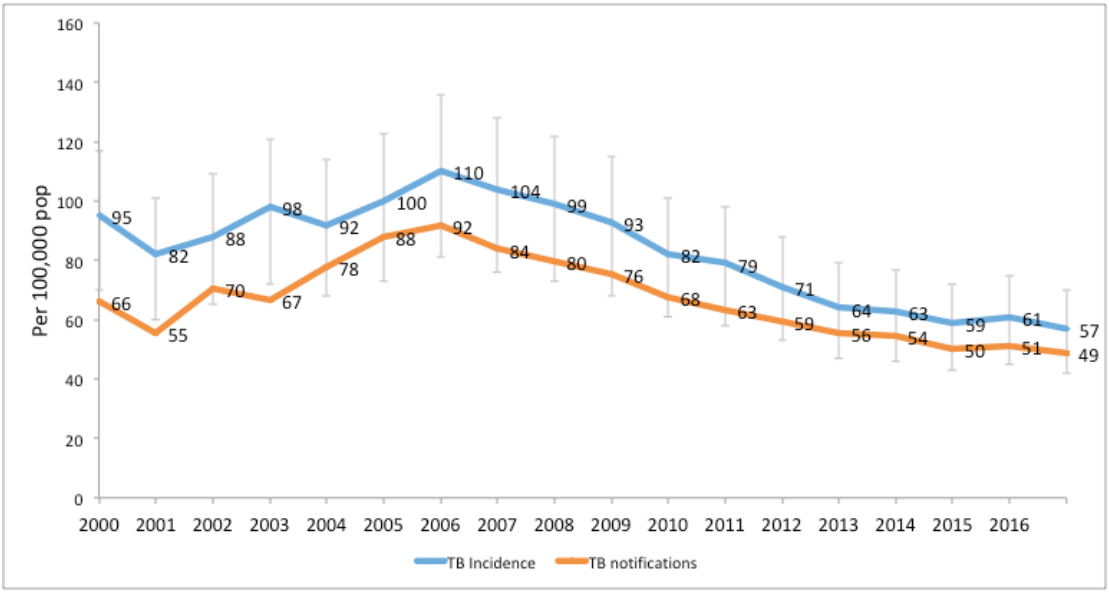
Figure 6. TB mortality per 100,000 population, Rwanda 2000-2017. Source: WHO Global TB database 2018



TB incidence and TB notifications

Figure 7, shows the trends in estimated TB incidence and notification rates from 2000 to 2017. Since a peak in 2006, both incidence and notification have consistency decreased in Rwanda. Incidence was estimated at 110 per 100,000 population in 2006 and went down to 57 in 2017, while the notification rate per 100,000 population went down from 92 in 2006 to 49 in 2017. The gap between estimated TB cases and notifications has also decreased from 30% in 2000 to 14% in 2017.

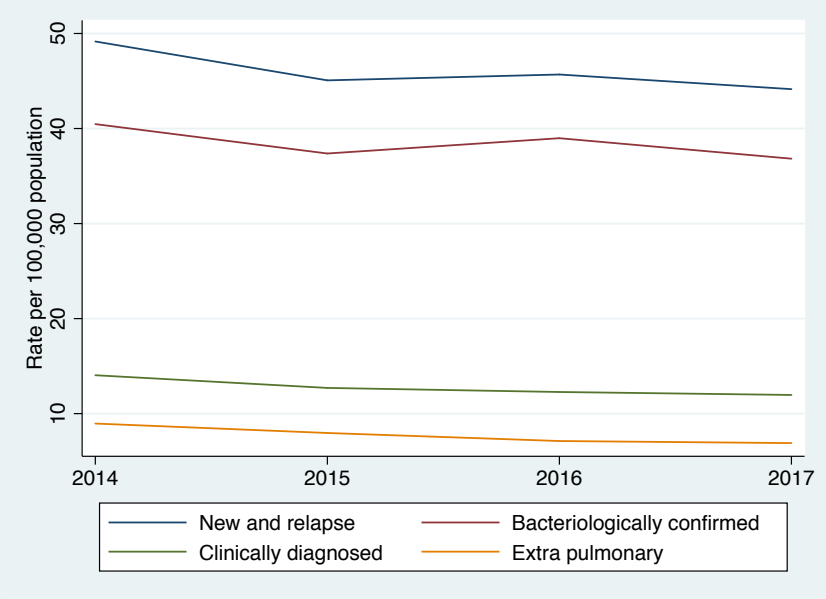
Figure 7. Estimated incidence and notification rates Rwanda 2000-2017.



When comparing the estimated TB incidence to the notifications disaggregated by sex (Figure 7, the proportion of TB notifications out of estimated TB cases among males and females was similar (82% and 81%, respectively). However, when analysing by age groups, most TB cases over 15 years old were detected (91%, CI 95% 74-119), while only 38% (CI 35-42%) of those under 15 were detected. Only 340 TB cases under 15 years old were notified while 890 were estimated to have occurred (CI95% 810-970). Among PLHIV, 80% of the estimated TB/HIV cases were notified, leaving a notification gap of 20%.

Figure 8 shows the trends in TB notification rates in Rwanda from 2014-2017. We observe a decline in all TB types, with a slight increase in TB notifications and bacteriologically confirmed cases in 2016, probably as a result of scale up of Xpert MTB/RIF, a more sensitive diagnostic tool, among key populations. Clinically diagnosed cases as well as extrapulmonary TB cases have also decreased slightly, probably as a result of decreased HIV/TB coinfection and increased ART coverage among those with the coinfection. Therefore, by reducing the number of people immunosuppressed because of HIV infection, the TB forms associated (clinically diagnosed and extrapulmonary TB) may also reduce.

Figure 8. TB notification rates Rwanda 2014-2017. Source: HMIS TB database



TB notifications from 2013 were available in the HMIS database but were excluded from the trend analysis because some quarters in Kigali have not been entered. The proportion of cases bacteriologically confirmed increased from 78% in 2013 to 87% in 2017. Figure 9 shows the TB notification rates per province for the 2014-2017 period compared to the national notification rate. In 2017, Kigali had three times the notification rate compared to the national notification rate and to each of the four provinces (North, South, East, West). Furthermore, although the period is short, there is no decreasing trend of TB cases in Kigali. The increase of TB notifications in Kigali probably reflects the

active case finding activities targeting high risk groups based on the Prevalence survey, as well as an increase in the bacteriologically confirmed TB notifications resulting from the universal use of Xpert MTF/RIF as first-line test in Kigali.

Figure 9. TB notification rates per province, Rwanda 2014-2017

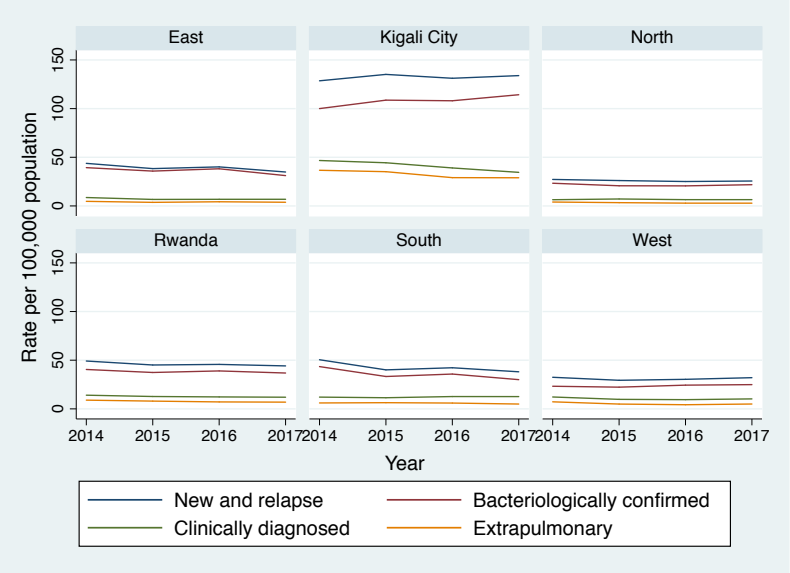
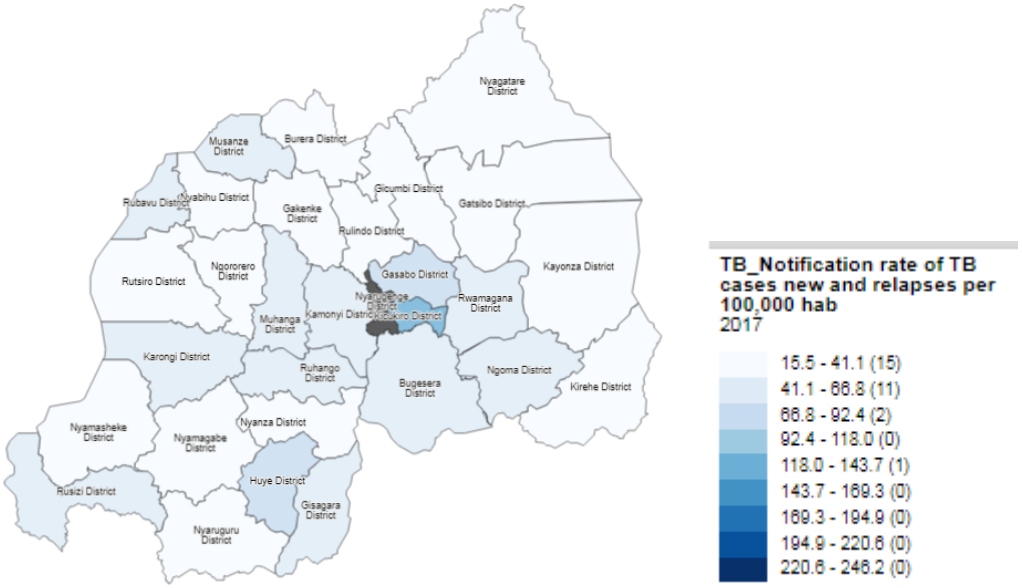


Figure 10. Map of TB Notification Rate New and Relapse, Rwanda, 2017



Although the rates in Kigali are three times as high as the rates in the South, West, East and North province (Figure 10), the absolute numbers in the East and South province are also very high (Figure 11). However both East and South show decreasing trends, as opposed to Kigali. The absolute

number of TB notifications are comparatively very low in the North. This is a result of the high proportion of the population living in rural areas outside Kigali, where TB may be easier to control than in a densely populated city such as Kigali. Figure 12 shows the proportion of the population living in each province compared to the proportion of TB cases reported by each province for 2017.

Figure 11. TB notification (absolute numbers) per province, Rwanda 2014-2017

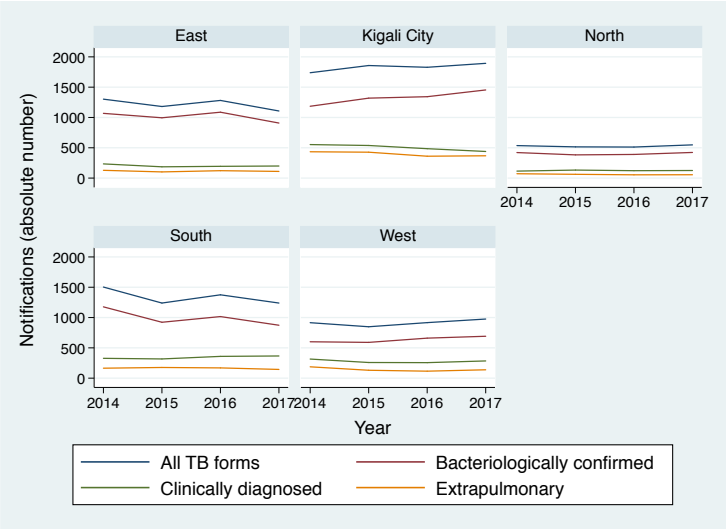


Figure 12. Contribution of provinces to TB notifications as well as to the total population in Rwanda, 2017.

Studying the trends of TB notification per age group can suggest patterns of transmission within different age groups. Figure 13, shows that in Rwanda, TB notification rates are highest among the older age groups (55+) followed by the 35-44, the 45-54, and notification rates are comparatively lower in the younger age groups including 15-34. This suggests a slowing TB epidemic where more of the TB

cases are occurring within older age groups likely as a result of reactivation rather than recent transmission. This "ageing" of the epidemic pattern is consistent with the decreasing incidence and notifications in the last decade and suggests that TB control interventions are working. When studying the notification rates per age group in Kigali (Figure 14), we observe TB notification rates are higher among younger age groups (35-44 followed by 25-34) and comparatively lower notification rates in the older age groups. This likely suggests ongoing transmission in Kigali compared to the other provinces. In Kigali, TB notification rates are similar to that of a high TB burden country with ongoing transmission in the households, community, and overcrowded areas compounded by higher HIV rates; while in the rest of the country, TB notification rates are similar to that of moderate TB incidence countries, with transmission mostly limited to the household and a higher frequency of reactivation in older age groups.

Figure 13. Trends in notification rates per age group, Rwanda 2014-2016

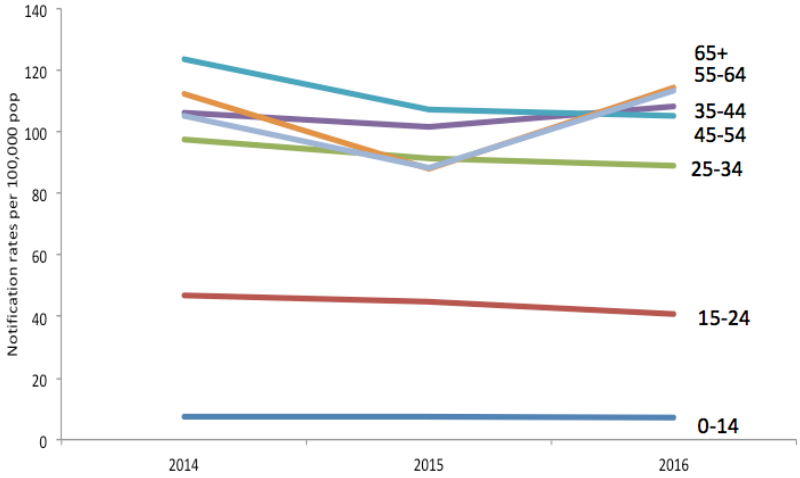


Figure 14. Trends in notification rates per age group, Kigali 2014-2016

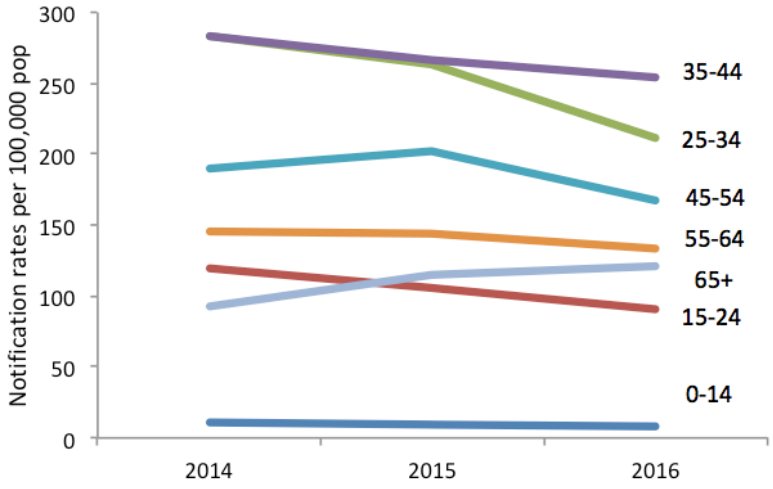


Figure 15 shows a cross-sectional analysis of TB notification and notification rates per age group and per sex for Rwanda from 2016. Figure 16 shows the same analysis for Kigali. In Rwanda, we observe increasing TB notification rates by age group among men, while the notification rate stabilizes around 70 per 100,000 among adult women. In Kigali, we observe highest rates in younger age groups of both sexes (although much higher rate among men than among women) and lower rates in the older age groups. Notably, TB notification rate peaks among 35-44 year old males in Kigali at almost 400 per 100,000. In terms of notification case burden, the majority of notifications occur among younger age groups both nationwide as well as for Kigali. In Rwanda, 63% of male notifications and 62% of female TB notifications, occurred in the 15-44 age groups. In Kigali, these proportions were 74% of the male and 76% of the female TB notifications. Therefore, different strategies may be needed to continue addressing the large, but decreasing number of TB cases in younger age groups, and the very high rate, but smaller absolute numbers of TB in older age groups.

Figure 15. TB notifications and notification rates (all forms), by sex and age group, Rwanda 2016

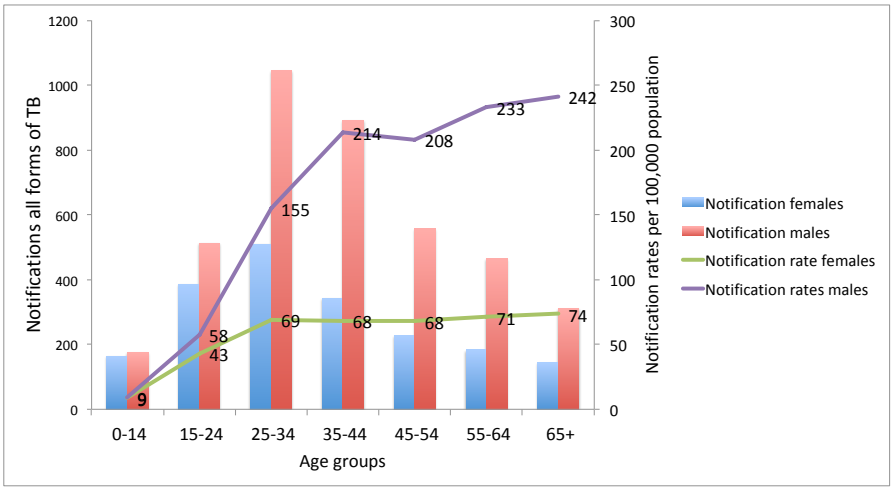
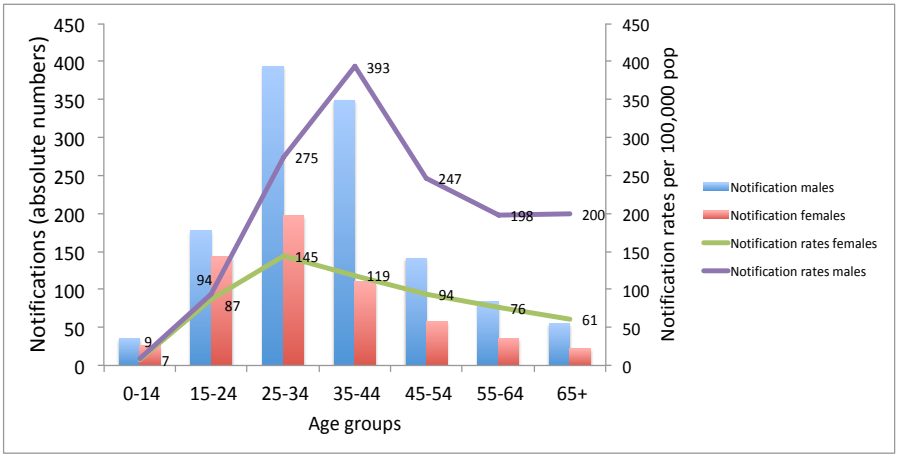


Figure 16. TB notifications and notification rates (all forms), by sex and age group, Kigali 2016



Pediatric Tuberculosis

The proportion of TB notifications among <15 years old went down from 10.8% in 2007 to 6.9% in 2013 (2014 Epi Review) and has been stable since then, at 6% in 2017 (Figure 17). When examining the same proportion by province (Figure 18), all provinces except Kigali have had proportions of pediatric TB above 5%. This is the minimum expected for medium and high incidence settings. On the other hand, the ratio of TB notifications of 0-4 years old and 5-14 years old, suggesting that TB is underdiagnosed in the group 0-4 years old. When comparing the WHO estimates of TB incidence by age group, the largest gap is observed in the <5 years old. Figure 19 shows the proportion of childhood TB 0-4 years old and 5-14, out of all TB notifications per province in 2017. The absolute numbers were low, especially for the <5 group, for example, the 8% cases 0-4 years old in the North, represent 11 cases. Therefore, this should be interpreted with caution. However, we observe disproportionately low proportions for both age groups in Kigali.

The NSP 2018-2020 extension set the objective of strengthen diagnostic capacities for childhood TB so that the proportion of TB cases among children increases from 5% in 2015 to 8% by mid-2021, with multiple activities such as screening all children at any contact with the health facility, finalizing childhood TB guidelines, training clinicians in diagnosis, and strengthening effectiveness of contact investigation and use of isoniazid preventive therapy. The result of these efforts may be seen in the next years; however, close supervision and mentoring of the implementation of these activities and monitoring of their effectiveness will be needed considering the challenges of pediatric TB diagnosis.

Figure 17. Proportion of TB notifications among children <15 years old out of all cases, Rwanda 2013-2017

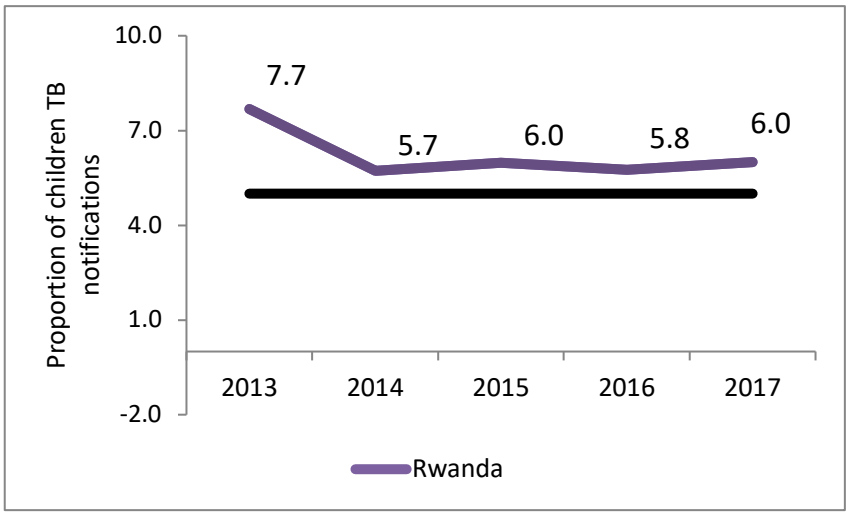


Figure 18. Proportion of TB in <15 years old out of all TB cases per province, Rwanda, 2013-2017

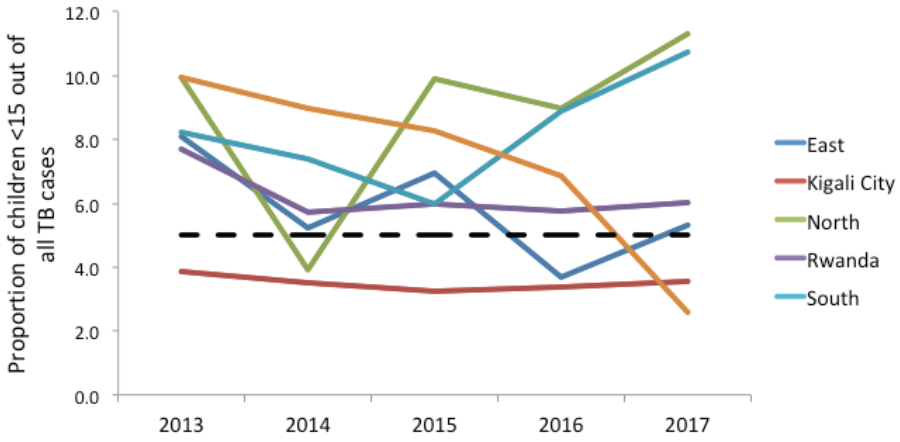
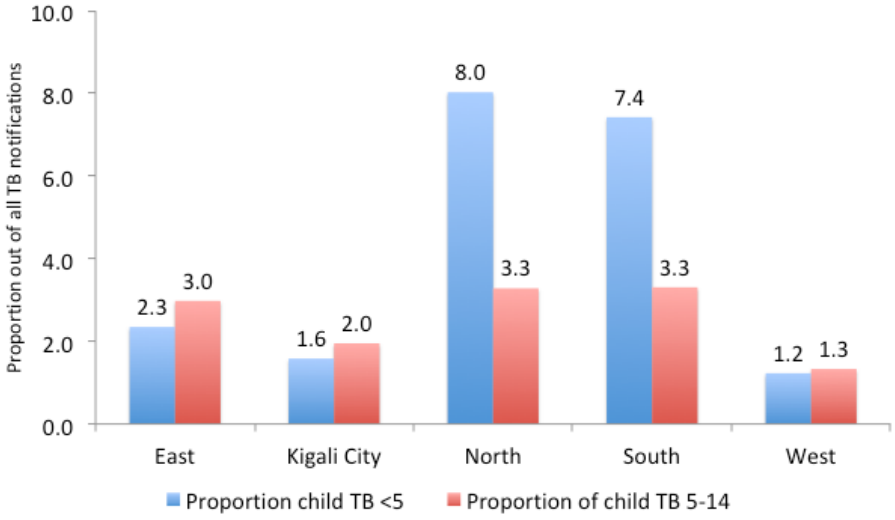


Figure 19. Proportion of childhood TB in Rwanda per province 2017



4.3. Assess whether recent trends in TB disease burden indicators are plausibly related to changes in TB-specific interventions taking into account external factors including economic or demographic trends

TB specific interventions

After a surge in TB notification and notification rates from 1995 to 1999, a drop and then another increase up to 2006, TB notifications and notification rates have consistently decreased up to year

2015, with a recent slight increase in the number of cases and rates in 2015 and 2016, as observed in Figure 20. These trends have resulted from TB specific interventions conducted by the TB&ORD in collaboration with key partners such as the HIV division and the National Reference Laboratory, as well as from broader health system changes and changes in social and economic determinants. Figure 20 shows the 1995-2017 trends in TB notifications and TB notification rates as well as a selection of key TB interventions in recent years. A longer list of TB specific interventions is in Table 5. Integration of TB/HIV activities over 10 years ago, as well as HIV division activities to reduce HIV incidence and increase ART coverage, must have contributed to the reduction of TB cases in the last decade. In the last two years, the slight increase of cases is probably related to the extensive active case finding activities and increased access to more sensitive diagnostics in Rwanda targeted to specific high risk populations identified from the TB prevalence survey in 2012.

Figure 20. TB notifications, notification rates and key events in TB control (full list in Table 5).

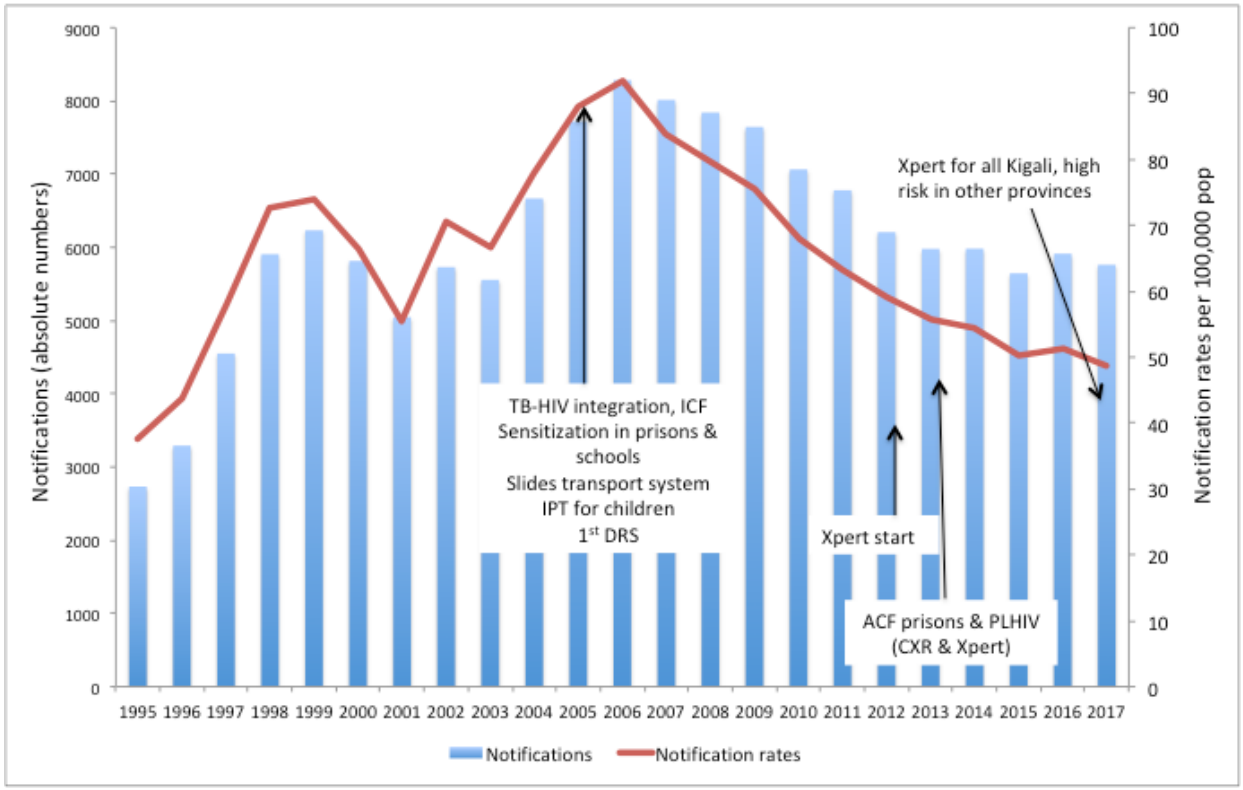


Table 5. Key events in TB control and surveillance, Rwanda 1995-2018.

Year	Key events TB control & surveillance
1995	○ Restart of TB program
1996	○ Start TB control in prisons through ACF
	○ Start scale up of CDT, training & supervision scale up
1998	○ MOH established Health Management Information System (HMIS) department

2002	○ ART delivery via 4 hospitals in the country; treatment outcome evaluation meetings at district level
2003	○ TB-HIV activities started (countrywide - whole package) ○ First specific TB training for doctors since 1995 ○ Laboratory training
2004	○ Performance-based financing (PBF) pilot in Rwanda; sensitization of OPD clinicians to look for chronic coughers
2005	○ Start TB-HIV collaborative activities formally guidelines published; (HIV testing TB patient, CPT, ART (for those CD4<350) but also ICF among PLHIV ○ TB screening among PLHIV; community DOT in 3 districts ○ MDR treatment started (GoR funded) ○ Sensitization of prisoners & prison authorities on TB risk ○ School sensitization program ○ Transport system for slides from CT to CDT ○ IPT for children started ○ First DRS
2008	○ Surveillance system uses MS Access (previous MS Excel)
2011	○ IPT for PLHIV pilot (2011-2016)
2012	○ Surveillance system moved to DHIS2 ○ December –introduction of Xpert MTB/RIF
2013	○ ACF in Prisons & PLHIV (screening with Xray & Xpert MRB/RIF) ○ Pilot of aggregated TB reporting to HMIS DHIS2
2014	○ Routine healthcare worker screening for TB; Division of Planning, M&E, and Business Strategies started integrated supportive supervision and data quality assessments (conducted twice a year for all programs including TB) ○ Shorter MDR regimen introduced ○ Aggregated TB reporting to HMIS DHIS2 officially began
2015	○ Reporting of individual TB presumptive and cases to eTB started ○ Second DRS
2016	○ MDR TB reporting integrated in HMIS since July (previously reported via MS Excel) ○ Started HIV test and treat for all HIV positive patients since July ○ ACF in prisons (second round)
2017	○ Routine screening for community health workers ○ Introduction of Xpert MTB/RIF as initial test in Kigali for all TB presumptive and outside Kigali depending on certain criteria ○ TB reporting based on new WHO definitions
2018	○ New eTB to launch ○ National Strategic Plan 2018-2020 extension

Health facilities providing TB services

The number of health facilities providing TB services (CDTs and CTs) has increased substantially over the years from 30 CDTs in 1995 to 200 in 2013. In 2017, 151 CDTs with smear microscopy and 49 CDTs with GeneXpert machines can diagnose TB. The distribution of health facilities is unequal in the Rwanda, with the highest number of health facilities offering TB treatment services (both CTs and CDTs) per 100,000 population in the North province (2.8), where the incidence and absolute numbers of TB cases are the lowest. However, geographic access in the North, as well as in the West, is difficult, for which there is an larger number of CDT. The distribution of diagnostic centers (CDTs) is the lowest in Kigali and the South, where TB rates are the highest. However, this indicator does not take into account the patient capacity of the health facilities, collapsing together a referral hospital with a primary care health center. Therefore, the comparison of the North, West, East and South provinces with Kigali is less valid considering Kigali has larger hospitals and health facilities.

Figure 21. Number of TB diagnostic centers (CDTs) for 100,000 population by province, 2017

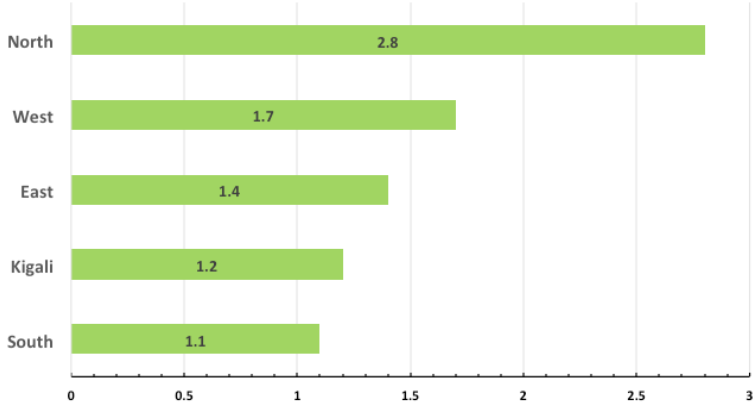


Figure 22. Number of TB treatment center (CT + CDTs) for 100,000 population by province, 2017

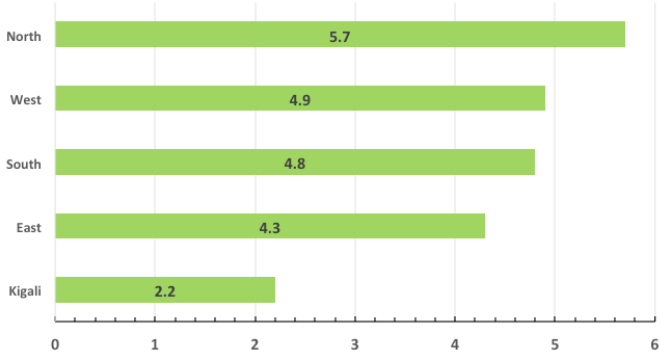
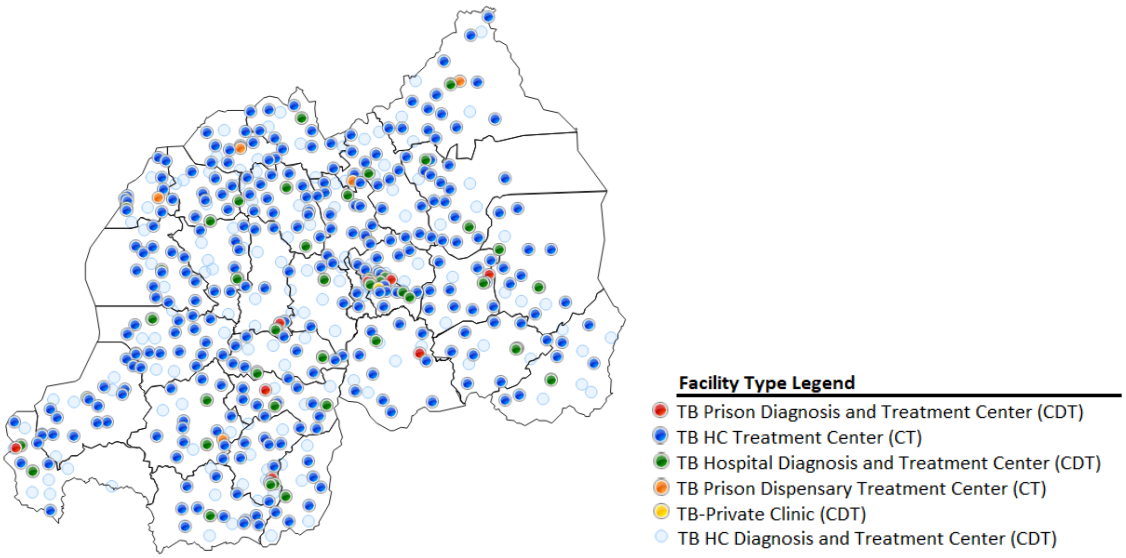


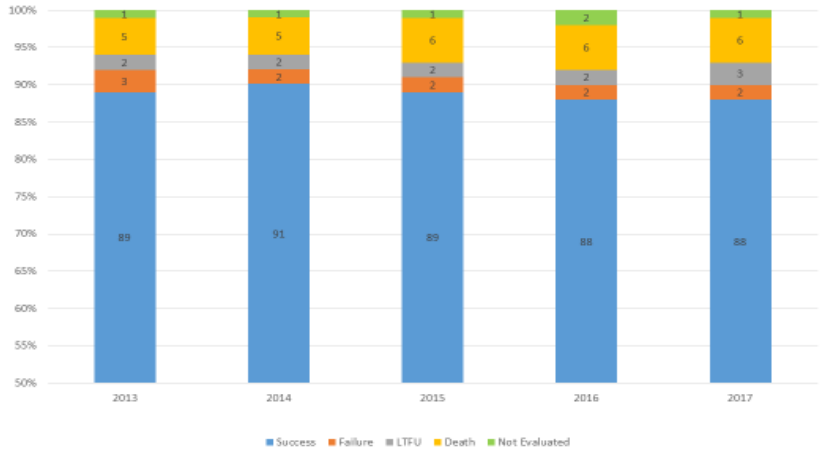
Figure 23. Health Facility map: CDTs and CTs, Rwanda, 2017



Treatment outcomes

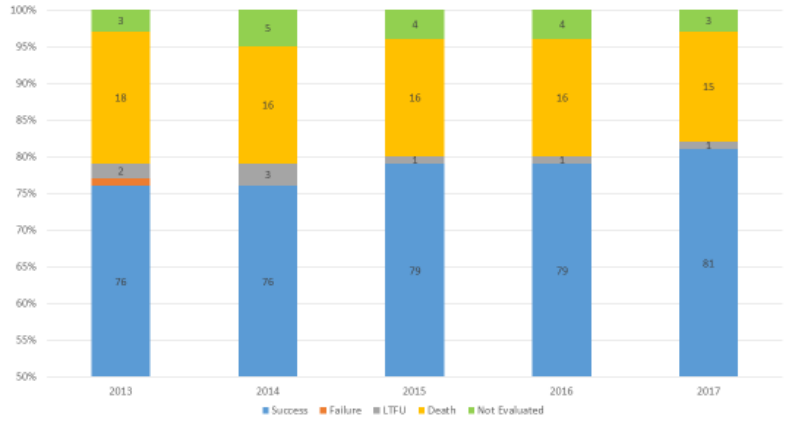
Prompt appropriate treatment of all persons diagnosed with bacteriologically confirmed TB is one of the most important interventions to control TB as it stops transmission to the community. TB treatment success has been high in Rwanda since more than a decade, which has likely contributed to the reduction of TB incidence. We analyzed treatment outcome data from 2013 to 2017. Among bacteriologically positive TB patients, treatment outcome has constantly exceeded the global target of 85% treatment success rate, despite a slight decrease during this period (from 91% in 2014 to 88% in both 2016 and 2017) (Figure 24). During the same period, death rate was stable around 6% and treatment failure and lost to follow-up remained at 2%.

Figure 24. TB treatment outcome among bacteriologically confirmed, Rwanda 2013-2017



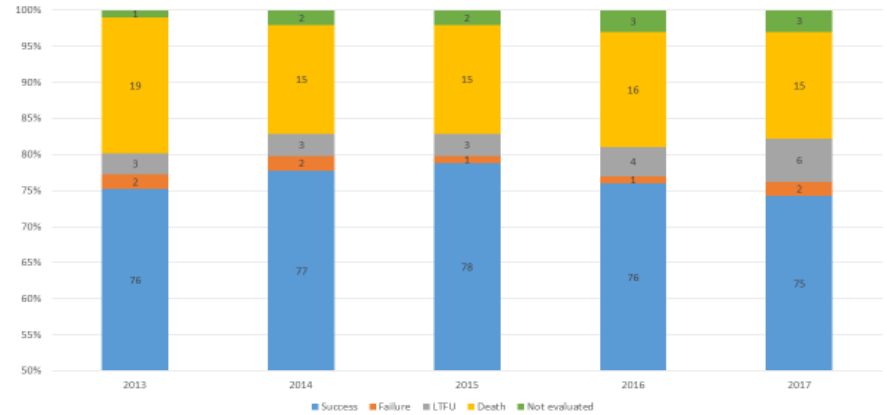
For patients with extrapulmonary TB or clinically diagnosed TB, treatment success rate was below the global target and increased from 76% in 2013 to 81% in 2017 (Figure 25). Although death rates among these patients decreased from 18% in 2013 to 15% in 2017, it remained more than twofold higher than the death rate among bacteriologically confirmed TB cases during the 5 years. For HIV positive TB patients (Figure 26) treatment outcome was almost identical to that of patients with extrapulmonary TB or clinically diagnosed TB during the same period, and treatment success rate was 6% lower in 2017 as compared to that of patients with extrapulmonary TB or clinically diagnosed TB (75% versus 81%) likely driven by the higher LTFU among people living with HIV (PLHIV). The similarity in treatment outcome in these two groups is certainly related to the high prevalence of HIV among extrapulmonary TB cases and the difficulty of TB diagnosis among PLHIV.

Figure 25. TB treatment outcome among clinically diagnosed and extrapulmonary cases*, Rwanda 2013-2017**



*Clinically diagnosed and extrapulmonary cases include HIV positive
**2017 outcome data are for half year

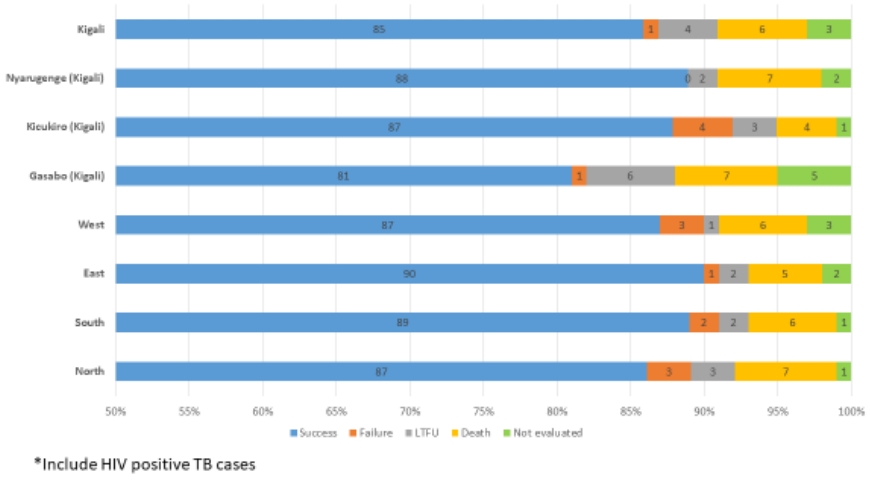
Figure 26. TB treatment outcome among TB/HIV cases,** Rwanda 2013-2017*



*2017 outcome data are for half year
** TB/HIV cases include all forms

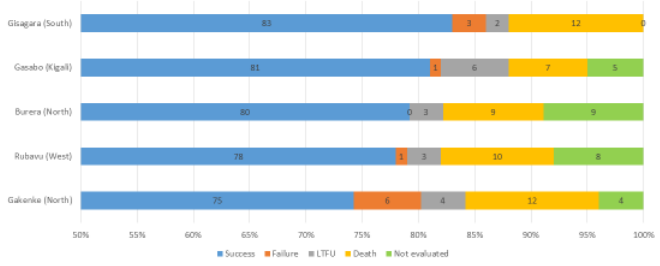
For treatment outcome at the subnational level, we analyzed cohort data for 2016, which was the last year with complete treatment outcome data. In 2016, treatment outcome for bacteriologically confirmed TB cases varied by province, but treatment success rate exceeded the global target in all provinces ranging from 85% in Kigali to 90% in the East Province (Figure 27). Very few patients (≤3%) failed treatment, and the proportion of deaths was relatively low, ranging from 5% in the East province to 7% in the North province. Even at the district level, only five districts had proportions of treatment success less than 85%, including Gasabo in Kigali, Burera and Gakenke in the North province, and Gisagara in the South province (Figure 28).

Figure 27. Treatment outcome among bacteriologically confirmed pulmonary TB cases*, by Province, Rwanda 2016



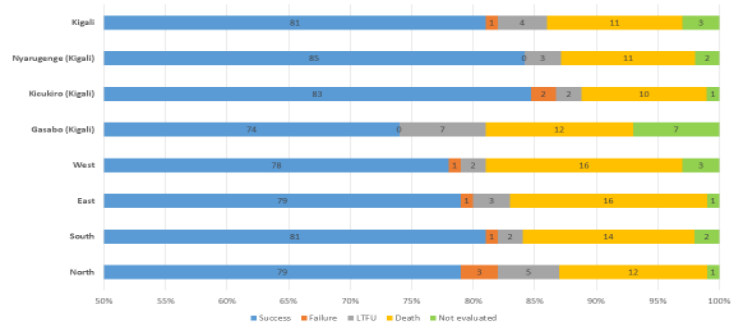
*Include HIV positive TB cases

Figure 28. Underperforming districts for treatment outcome among bacteriologically positive pulmonary TB cases



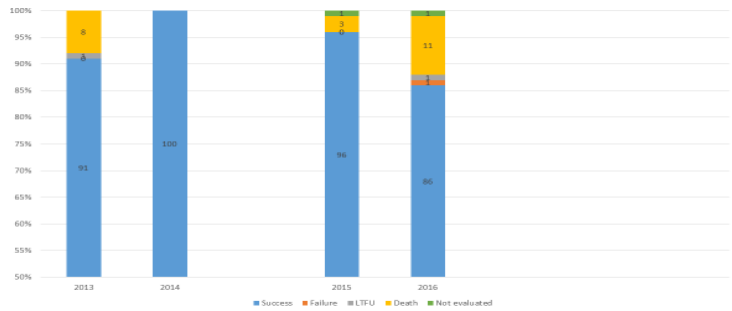
However, among HIV positive TB patients the proportion of deaths was high in all provinces in 2016, ranging from 11% in Kigali to 16% in East and West Province (Figure 29). For Kigali City, death among TB/HIV co-infected cases was relatively low and treatment success was comparable to other provinces. The district of Gasabo in Kigali had the lowest treatment success (74%) when compared to the other two districts of Kigali and to other Provinces with similar number of TB cases. This was the result of a higher proportion of patients who were lost to follow up/not evaluated. The high proportion of deaths among HIV positive TB patients is probably due to late access to health services for these patients and the challenge to diagnose TB in patients with advance HIV disease. It is important for the TB program to investigate these deaths to determine in which facilities they are more likely to occur and provide appropriate resources for prevent these deaths. The program could also provide access to point-of-care urine-based TB diagnostics which have higher sensitivity among severely ill patients.

Figure 29. Treatment outcome among TB/HIV cases by Province, Rwanda 2016



The number of patients identified with MDR TB has been increasing in the past few years; it was 75 in 2013, 57 in 2014, 135 in 2015 and 146 in 2017. Rwanda initiated the short-course MDR TB regimen in 2014 and provides in-patient care at two facilities in the intensive phase. Treatment success, during this period, was higher than 90% and higher than treatment success for patients on treatment for drug-susceptible TB until 2016, when treatment success fell to 86% (Figure 30).

Figure 30. Treatment outcome for patients receiving treatment for MDR, Rwanda 2013-2016



*Include long and short treatment regimens

Presumptive TB cases and active case finding activities

Since 2005, there has been an increase in the number of TB presumptives investigated, from 28,637 in 2005 to as high as 204,667 in 2014. A sharp increase in the ratio of presumptive to notified TB cases since 2010 is attributable to the policy of engaging community health workers (CHW) in the detection of presumptive TB cases in the villages and their referral to health facilities (Figure 31). As a result of the increased number of TB presumptives investigated, the percent yield of TB cases among them has gone down from 20.5% in 2005 to 3.6% in 2017. Another way to think about percent yield is to calculate the inverse, the number needed to screen (NNS) to find one TB case. The NNS to screen has greatly increased since 2005. This trend should be monitored carefully and the presumptive TB cases diagnosed as a TB case should be characterized to best optimize the screening strategy. This can be done at a more granular level, such as by district or province. For example, Figure 32 shows that the ratio of presumptive to notified TB cases in the West Province has decreased in the last four years.

Rwanda TB&ORD conducts various community and active case finding activities. Health facility based screening is conducted among high risk groups including: children (under 15 years), elderly (55 years or over), prisoners, PLHIV, and contacts of TB cases (both under 5 years, and 5 years or over). The data gathered on these high risk groups is from the laboratory register. The NNS for health facility based screening among these high risk groups is shown in Table 6 below. Screening contacts of TB cases, especially contacts under 5 years, provides high yield for TB case finding. The very low NNS for presumptive TB cases referred by CHW is very low because CHW are active in all villages in Rwanda, they conduct targeted referral for all persons with TB symptoms in the community, including those in high risk groups.

Figure 31. Ratio of presumptive to notified TB cases in public and private health care facilities, Rwanda, 2005–2017. Source: HMIS data from TB&ORD

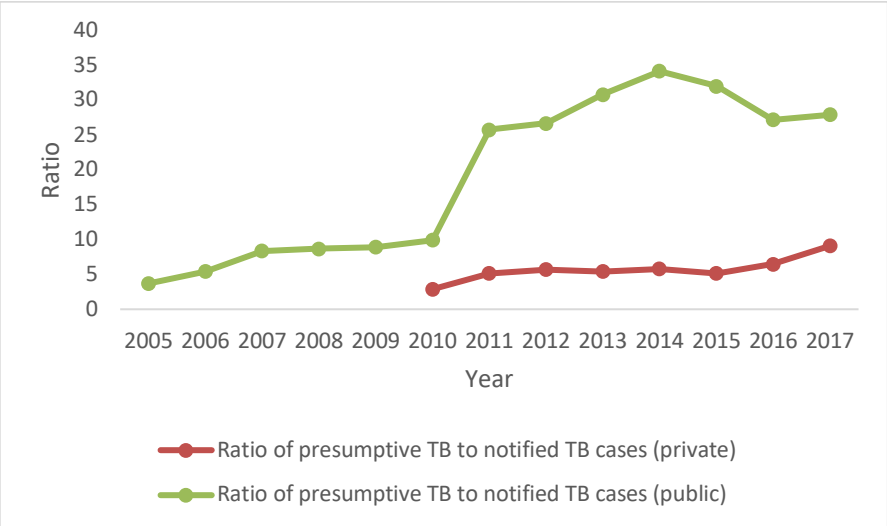


Figure 32. Ratio of presumptive to notified TB cases by district and province, Rwanda, 2014–2017. Source: HMIS data from TB&ORD

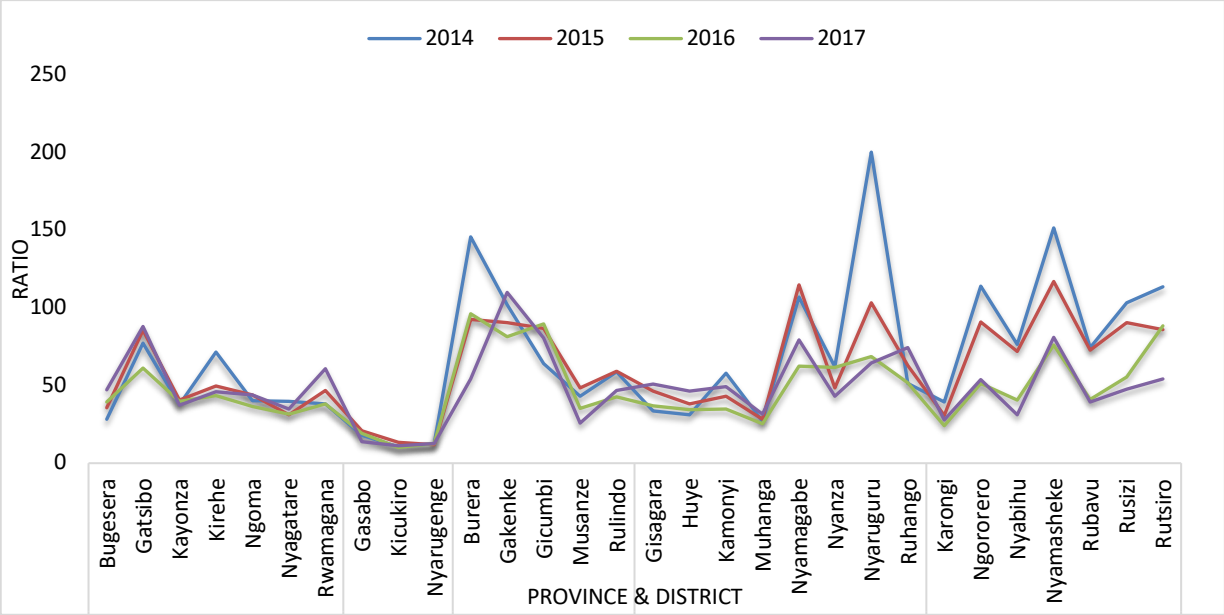


Table 6. Health facility based TB screening and number needed to screen to find a TB case among high risk groups, Rwanda, 2015–2017. Source: HMIS data from TB&ORD

Risk group	NNS 2015	NNS 2016	NNS 2017
Children < 15 yrs	7984	5863	5040
New Prisoners admitted in prisons	549	731	2112
Elderly ≥ 55 years	1196	1151	1226
Prisoners at the end of the quarter	417	518	867
HIV+ persons	500	509	558
Contacts of TPB+ ≥ 5 years	246	246	130
Contacts of TPB+ < 5 years	49	99	76
Referred by CHWs	81	57	62

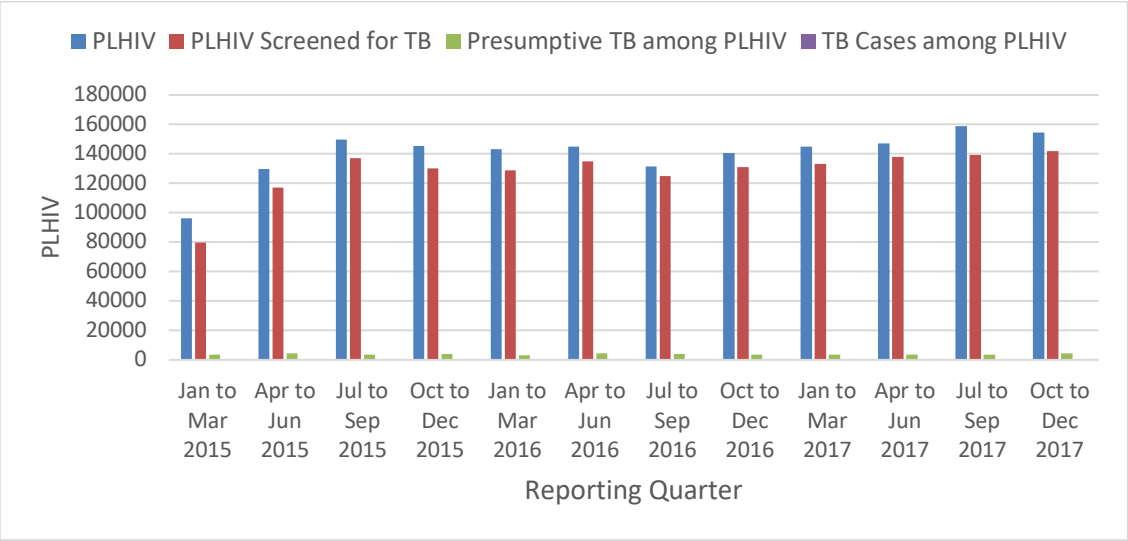
The NNS can be compared to the weighted mean and range of NNS found based on a systematic review conducted by WHO and stratified by the background incidence of the setting where the studies were conducted, as shown in Table 7. Since the TB epidemic is different in Kigali compared to the rest of Rwanda, the weighted mean and range NNS is shown for both moderate incidence settings (as represented by Rwanda) and medium incidence settings (as represented by Kigali). While it is important to pursue strategies that optimize the NNS, it is also important to balance benefits, priorities, and realities of screening (i.e. time, location, hard to reach populations, etc.) as it should not happen at the cost of reducing the quality and coverage of facility-based screening.

Table 7. Systematic screening for active TB, number needed to screen (NNS) based on a systematic review. Source: WHO Systematic Screening for Active TB

Population screened (Number of studies)	Weighted mean and range Number Needed to Screen to find 1 case of TB	
	Moderate incidence settings (30-100/per 100,000 pop)	Medium incidence settings (100-300/ per 100,000 pop)
General population (98)	669 (15-5594)	603 (25-4286)
Health care workers (16)	1613 (30-5500)	506 (25-842)
Prisoners (44)	155 (19-191)	110 (7-2762)
General outpatients (14)	758 (42-30000)	269 (19-806)
PLHIV (74)	61 (5-316)	13 (2-120)
Household contacts (89)	40 (7-355)	25 (3-568)

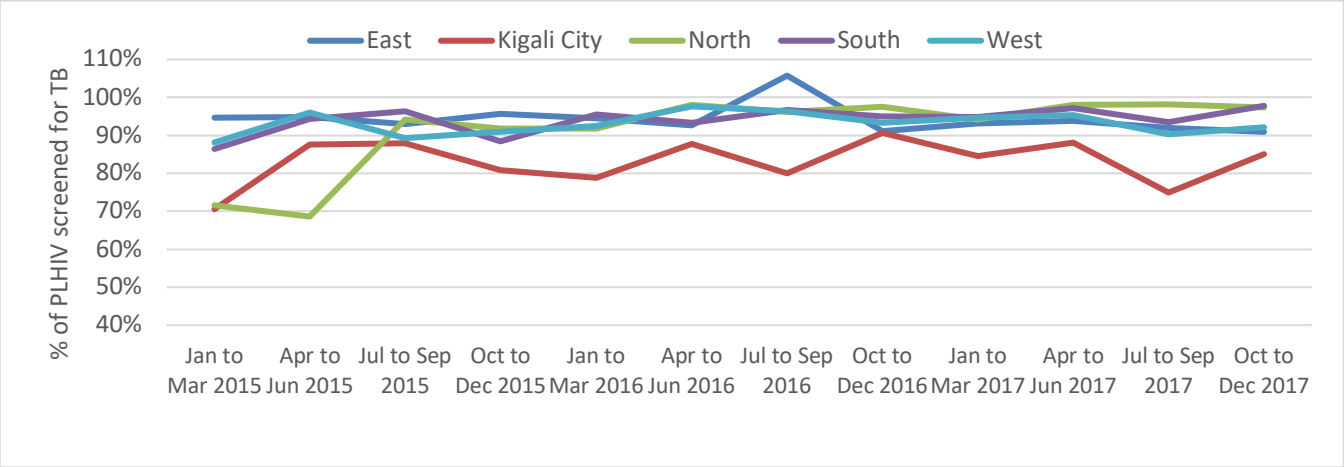
Since 2005, TB symptom screening among PLHIV has been a routine case finding activity. From the start of 2015, 83-95% of PLHIV visiting the HIV clinic each quarter were screened for TB symptoms (Figure 33). Among those that were screened for TB symptoms 3-4% had presumptive TB. Among presumptive TB cases, 4-9% were diagnosed with TB. Overall, the notification rate among PLHIV screened for TB ranged from 142 (April-June 2015) to 235 (Jan-March 2016) per 100,000 PLHIV. The number needed to screen to find one case was higher than expected for PLHIV, ranging from 426 to 726. This indicates either a relatively well population of PLHIV (low risk for active TB disease) because of early HIV diagnosis resulting from combined community based and facility based HIV testing strategies, or possible issues with symptom screening and/or diagnostics. However, the missing TB/HIV cases could be among the PLHIV who do not know their status and/or are not in HIV care.

Figure 33: TB Symptom Screening, Presumptive TB, and Confirmed TB among PLHIV at routine clinic visits. Rwanda, 2015-2017. Source: HMIS



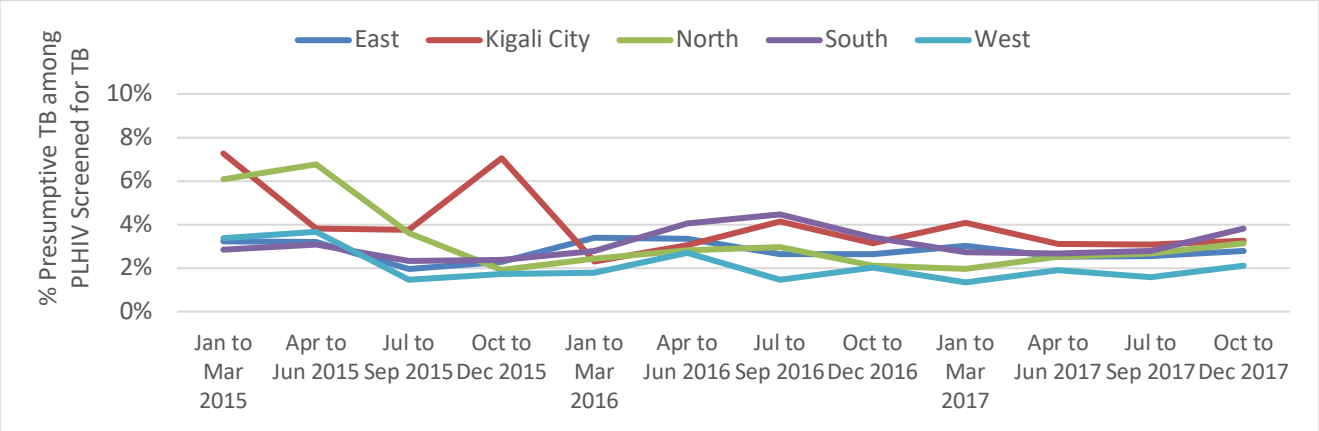
By province, the coverage of TB screening is high, however, Kigali City has continuously lower proportion of PLHIV screened for TB during quarterly visits (85% in final quarter of 2017) (Figure 34).

Figure 34: Routine TB Symptom Screening among PLHIV during clinic visits by province, Rwanda 2015-2017. Source: HMIS



Among those screened, the proportion with TB symptoms ranged from 2.1% (West) to 3.8% (South) in the final quarter of 2017 (Figure 35). The highest proportion was in Kigali City (Oct-Dec 2015) and the lowest was in 1.3% in West province (Jan-March 2017). Among ART-naïve PLHIV or PLHIV newly initiated on ART, we would expect anywhere from 23-71% of these individuals to have any TB symptom (Khan et al, Modi et al, Rangaka et al, Roy et al). These studies varied in TB incidence, but are mostly from high TB incidence settings. Among PLHIV on ART, lower proportions have been described (Rangaka et al). However, these studies only reported results from one-time TB symptom screening and not the rate after routine quarterly screening. In Rwanda, PLHIV on ART receive TB symptom screening upon entry into care and at each clinical encounter. In a stable population of PLHIV receiving routine TB symptom screening, the rate can be as low at 2-5% (unpublished data from Cowger et al).

Figure 35: Routine Presumptive TB among PLHIV screened for TB symptoms by province, Rwanda 2015-2017. Source: HMIS



Kigali City consistently had the highest proportion of presumptive TB PLHIV with confirmed TB (7-24%) compared to all other provinces (Figure 36) which is expected considering it has a TB notification rate among all cases (HIV positive or negative) at least three times higher than in the provinces.

Overall, the TB notification rate among PLHIV screened for TB stayed relatively stable at around 200 per 100,000 PLHIV from 2015-2017 (Figure 37). The notification rate among PLHIV screened for TB was consistently high in Kigali City ranging from 305 (Apr-June 2015) to 792 (Oct-Dec 2015) per 100,000 PLHIV with an average around 400 per 100,000 PLHIV.

In addition to routine health facility based screening, active case finding is conducted in prison settings and among PLHIV using symptom screen, chest radiograph, and Xpert MTB/RIF. Active case finding in prisons started in 2013 and involves two phases: the first phase 2013–2015 and the second phase 2016–2018. As expected, the yield decreased in the second phase (Table 8). Yet despite decreasing yield, the percent yield for active case finding in prisons is still higher than upon entry screening in prisons. The NNS upon prison entry was 549–1,898 in 2013–2015 and 731–2,112 in 2016–2018.

Figure 36: TB cases detected among presumptive TB by province, Rwanda 2015-2017. Source: HMIS

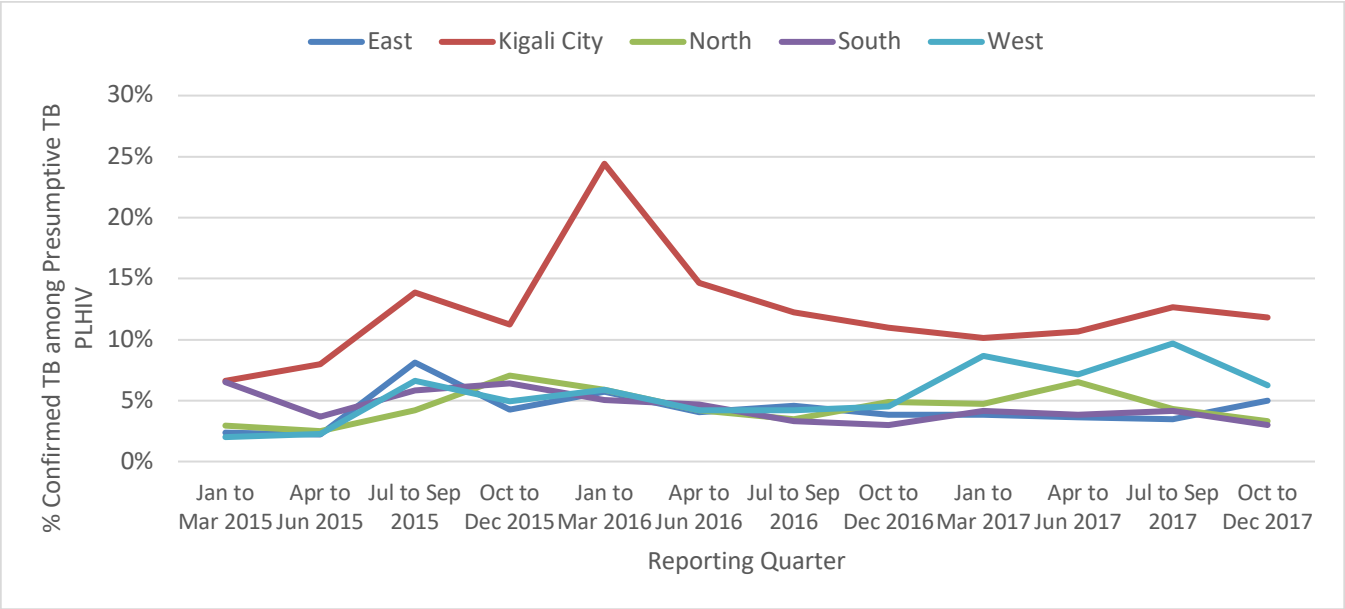


Figure 37. TB notification rate per 100,000 PLHIV screened for TB, overall and by province, Rwanda 2015-2017. Source: HMIS

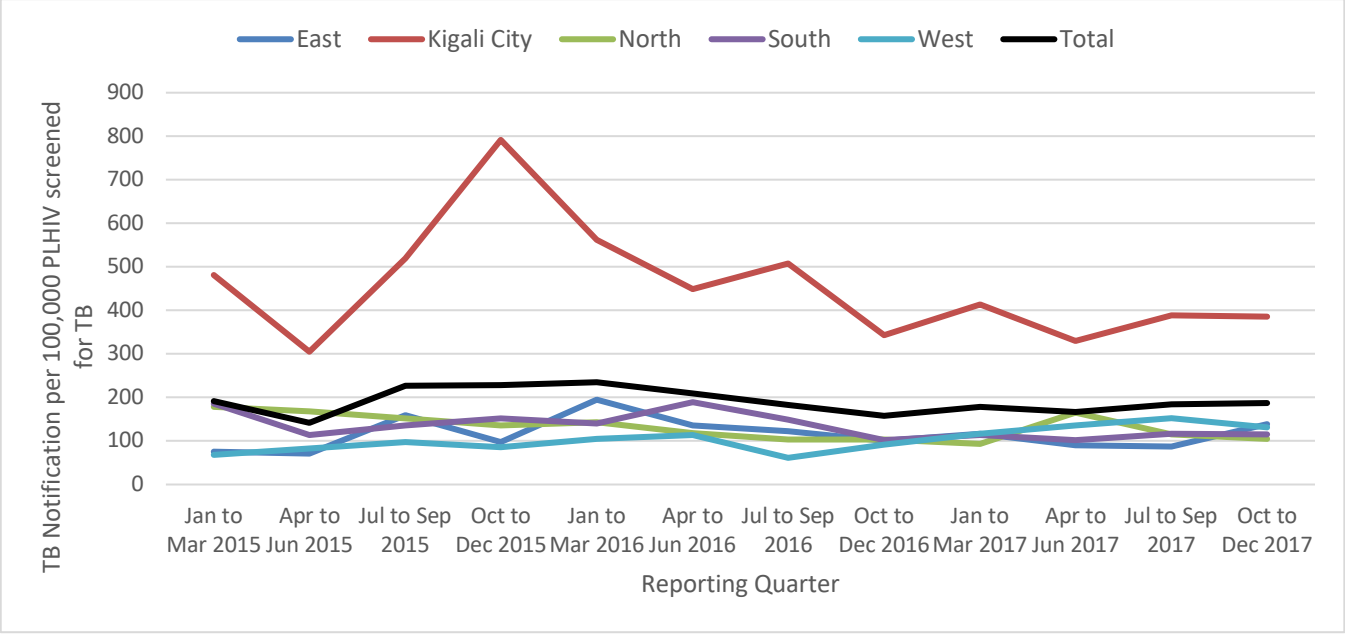
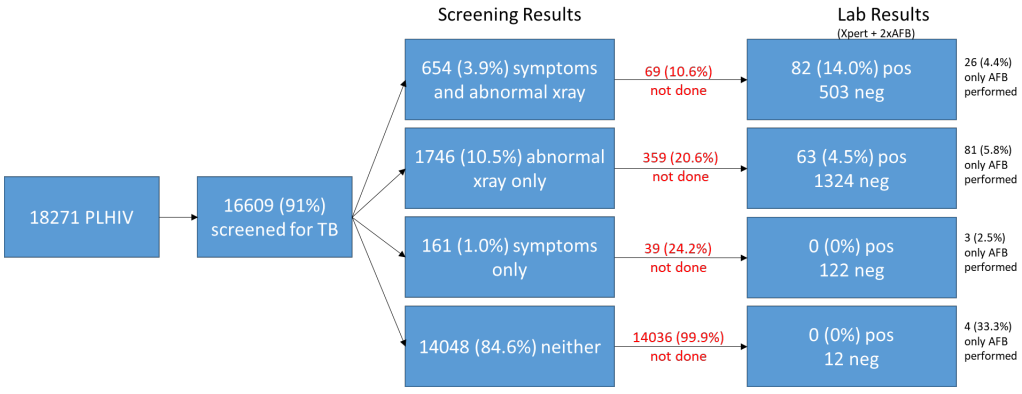


Table 8. Number needed to screen (NNS) to find one TB case during active case finding in prisons, Rwanda, 2013–2018. Source: ACF data from TB&ORD

Prison	First Phase NNS	Second Phase NNS
Nyarugenge/PCK	172	365
Gasabo	224	352
Huye	136	252
Bugesera	108	367
Ngoma	445	468
Musanze	225	452
Rusizi	702	633
Nyamagabe	250	1942
Nyanza	177	506
Muhanga	109	ACF ongoing
Rwamagana	112	ACF ongoing
Rubavu	144	ACF ongoing
Gicumbi	308	ACF ongoing
Nyagatare*	no cases	ACF ongoing
Total	**154**	**378**

Figure 38: Active case finding among PLHIV using TB symptoms, x-ray, smear, and Xpert MTB/RIF, Rwanda FY14/15. Source: ACF PLHIV excel file from TB&ORD



Active case finding among PLHIV with mobile teams using symptom screening, mobile chest radiograph, smear, and Xpert MTB/RIF started in 2013. The active case finding team visits high burden health facilities and performs TB symptom screening and chest radiograph for all PLHIV receiving services. In FY14/15, the team visited eleven facilities with 18271 PLHIV visits during the active case finding activity (Figure 38). Among 16,607 (91% of all PLHIV) PLHIV screened using TB symptom

screening and chest radiograph, 145 TB cases were bacteriologically confirmed (873 per 100,000 PLHIV). The number needed to screen to find one TB case was 114 and the yield among PLHIV screened was 0.9%. The yield among presumptive TB (any TB symptom and/or abnormal chest x-ray) was 5.7%. With the addition of chest x-ray, 63 additional TB cases were identified that would have been missed by using TB symptom screen alone. Among those reporting any symptom or sign (n=815, 4.9%), nearly all reported cough (97.2%), 9.6% reported fever, 7.9% reported weight loss, 0.3% reported known contact with TB case, and no one reported night sweats (Table 9). The proportion of symptoms other than cough seems quite low compared to published data.

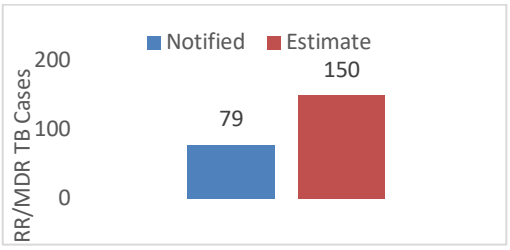
Table 9: Reported symptoms/signs during active case finding among PLHIV using symptom screen and x-ray, Rwanda FY14/15. Source: ACF PLHIV excel file from TB&ORD

Symptom/Sign	Frequency
Cough	792 (97.2%)
Fever	78 (9.6%)
Night sweats	0
Weight loss	64 (7.9%)
Known Contact with TB Case	2 (0.3%)

Multidrug-resistant tuberculosis

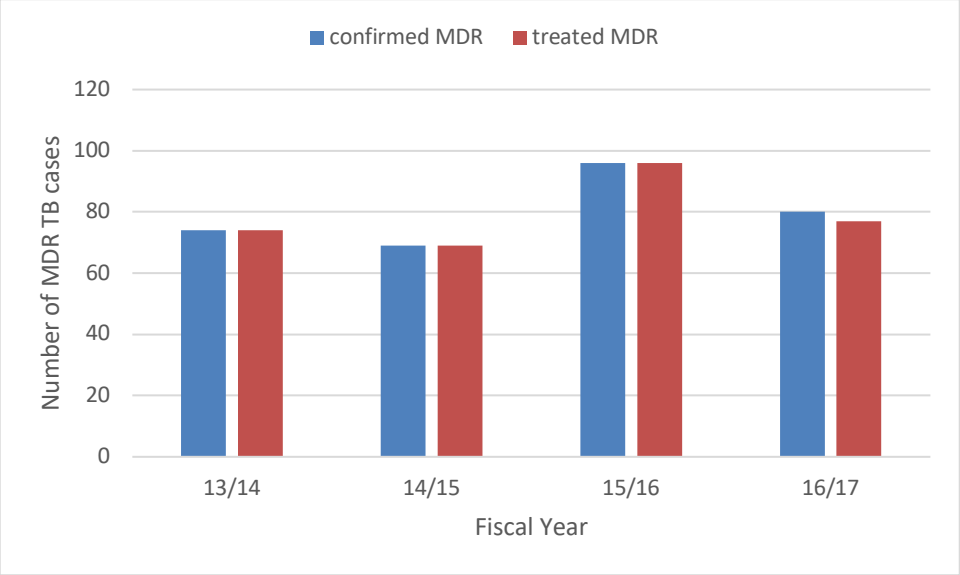
MDR-TB treatment coverage (comparing the number detected and treated with the estimated number of cases among notified TB patients and describing the size of waiting lists) and treatment outcomes among MDR-TB patients were evaluated. These metrics are especially relevant in countries in which MDR-TB cases account for a relatively large share of the total number of TB cases. The burden of RR/MDR TB is relatively low in Rwanda with an estimated proportion of RR/MDR among new TB cases of 1.5% and among previously treated TB cases of 5.1% according to 2017 WHO estimates. In 2017, there were an estimated 150 RR/MDR TB cases among the notified cases; however, only 79 RR/MDR TB cases were diagnosed and started on treatment (figure 39). That leaves a gap of 71 (47%) missing (undiagnosed, untreated, or unreported) RR/MDR TB cases.

Figure 39. WHO estimated RR/MDR TB cases and RR/MDR TB notifications (absolute numbers). Rwanda, 2017.



Among patients confirmed to have MDR TB, nearly 100% started MDR TB treatment (Figure 40). In FY16/17, two patients died and one patient was lost to follow-up prior to starting treatment. Treatment for all MDR-TB patients is initiated at two MDR TB centers where the patients receive in-patient care for the intensive phase of treatment. The continuation phase is provided by the CT or CDT closest to the patient's home. Providers from the local CT/CDT are provided with supervision and mentoring prior to providing care for MDR TB patients to assure high quality care and treatment success.

Figure 40. Confirmed MDR TB cases and MDR TB cases started on treatment by fiscal year, Rwanda 2013-2017. Source: Annual Report, TB&ORD



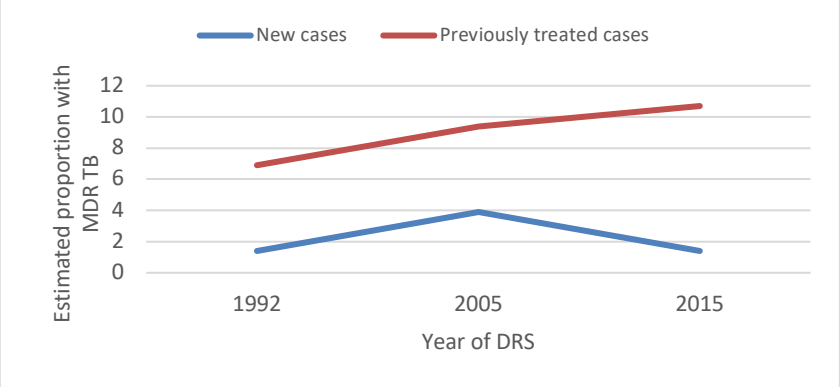
The most recent TB drug resistance survey was completed in 2015 (Table 10). Among new TB cases, 1.5% (0.8-2.4%) had any rifampicin (RIF) resistance and 1.4% (0.7-2.1%) had MDR TB. Among previously treated TB cases, 10.7% (5.0-19.4%) had any RIF resistance and 10.7% (5.0-19.4%) had MDR TB.

Table 10. Proportion of drug resistance among new and previously treated TB patients, Rwanda, 2015. Source: DRS 2015

	New patients		Previously treated patients	
	Proportion (%)	95% CI	Proportion (%)	95% CI
Any RIF resistance	1.5	0.8-2.4	10.7	5.0-19.4
Any INH resistance	2.3	1.5-3.4	12.0	5.9-21.0
MDR TB	1.4	0.7-2.1	10.7	5.0-19.4

There have been three TB drug resistance surveys conducted in Rwanda about every 10 years (Figure 41). The proportion of MDR TB among new TB cases in 1992 and 2015 is relatively stable at 1.4-1.5%; however, there was an increase to 3.9% in the 2005 survey. Over time, the proportion of previously treated TB cases with MDR TB has increased from 6.9% to 10.7%.

Figure 41. Trend in proportion of MDR among TB cases by treatment history according to drug resistance surveys. Source: Carpels et al, 1995, Umubyeyi et al, 2007, DRS Report 2015, TB&ORD



Eventually, as access to affordable, timely, and easy DST increases (i.e. Xpert MTB/RIF, etc.), surveillance of drug resistance will be in real time. According to FY17/18 data, 72% of new TB cases were bacteriologically confirmed of whom 86% had a known DST result (62% of all new TB cases) (Table 11). Among previously treated cases, 84% were bacteriologically confirmed and 86% of them had known DST result (72% of all previously treated TB cases).

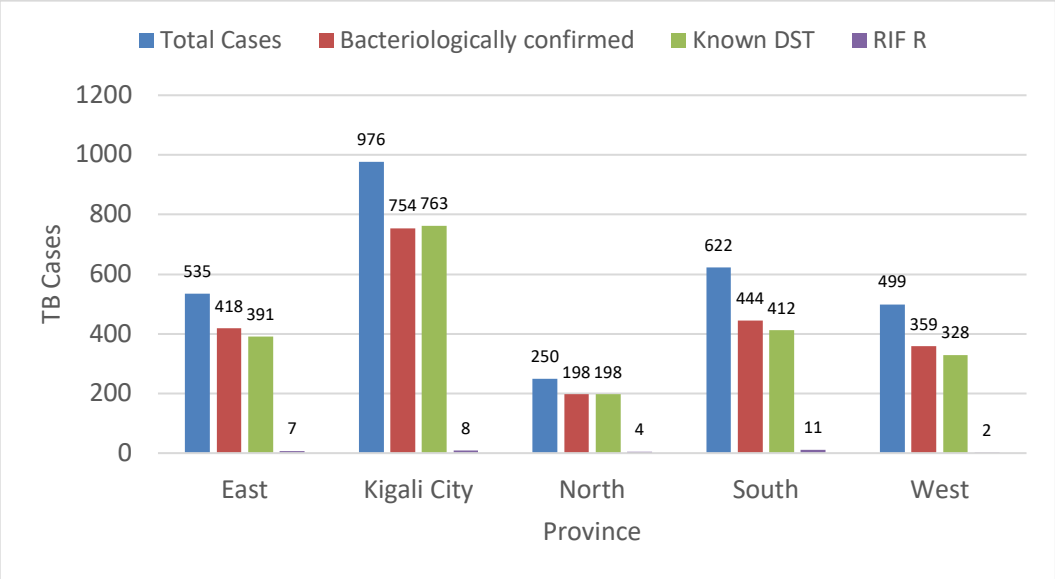
Table 11. Proportions of bacteriologically confirmed and with DST by treatment history, Rwanda, July 2017-June 2018. Source: HMIS

	New	**Previously Treated**
Total TB Cases	5263	563
Bacteriologically confirmed	3808 (72%)	474 (84%)
Proportion with DST result among bacteriologically confirmed	3260 (86%)	407 (86%)

By province, the proportion of all TB cases that are bacteriologically confirmed TB ranges from 71% (South) to 78% (East) (Figure 42). Among those bacteriologically confirmed, 91% (West) to 101% (Kigali City) have known DST. Among those with known DST, the proportion with RIF resistance ranged

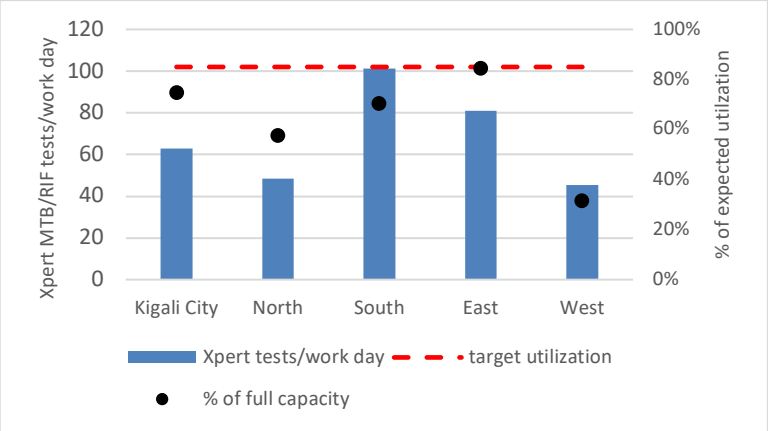
from 0.6% (West) to 2.7% (South). There may be some reporting issues since the number with known DST is higher than the number bacteriologically confirmed.

Figure 42: Drug susceptibility coverage and result by province, Rwanda, July-December 2017. Source: HMIS



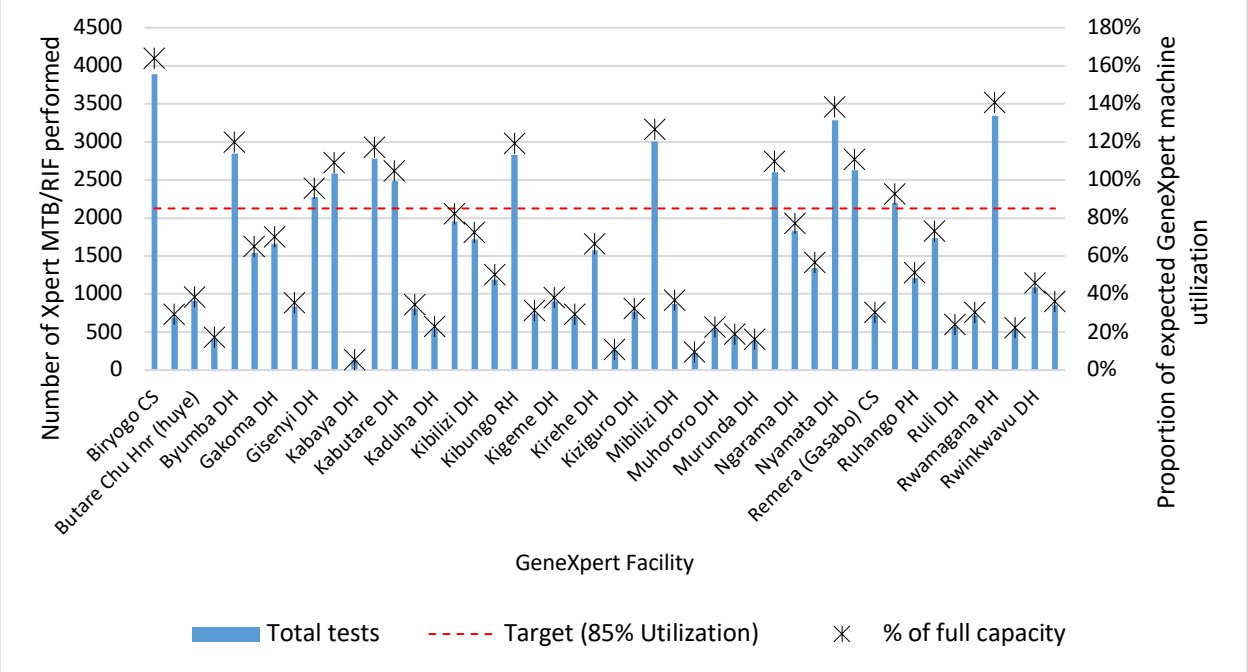
Use of Xpert MTB/RIF in Rwanda has greatly expanded with 47 functioning GeneXpert machines in FY16/17. In FY16/17, over 45,000 Xpert MTB/RIF tests were performed. Without an increase in number of machines, the number of Xpert MTB/RIF tests performed rose to over 67,000 tests. Despite this increase in tests, the machines are still underutilized in some locations. In order to evaluate GeneXpert machine utilization, we analyzed data of annual Xpert MTB/RIF tests per facility and quarter. We made several assumptions: a) each facility had only one GeneXpert machine, b) there were five working days per week, and c) number of tests that can be completed in one day per machine during normal work hours is 12. Q3 was excluded from the analysis due to country-wide Xpert MTB/RIF cartridge stock outs during this period. By province, only the eastern province reached close to 85% of expected tests (or 10 tests per day per machine) during FY17/18 (Figure 43). In addition to the number of tests done, other factors of utilization such as the number of health facilities covered by each center with a GeneXpert, as well as the logistics to transport samples and results, should also be taken into account in the strengthening of the use of Xpert MTB/RIF.

Figure 43. Xpert MTB/RIF tests and GeneXpert machine usage by province, Rwanda, 2017-2018 fiscal year. Source: GXP Tests Excel file, TB&ORD



When evaluated by facility, only thirteen of 46 facilities (28%) reached at least 85% of the expected utilization during FY17/18 (Figure 44). Most GeneXpert machines were underutilized. Greater adherence to Xpert MTB/RIF testing eligibility criteria could help improve the utilization and detection of TB and RIF resistance.

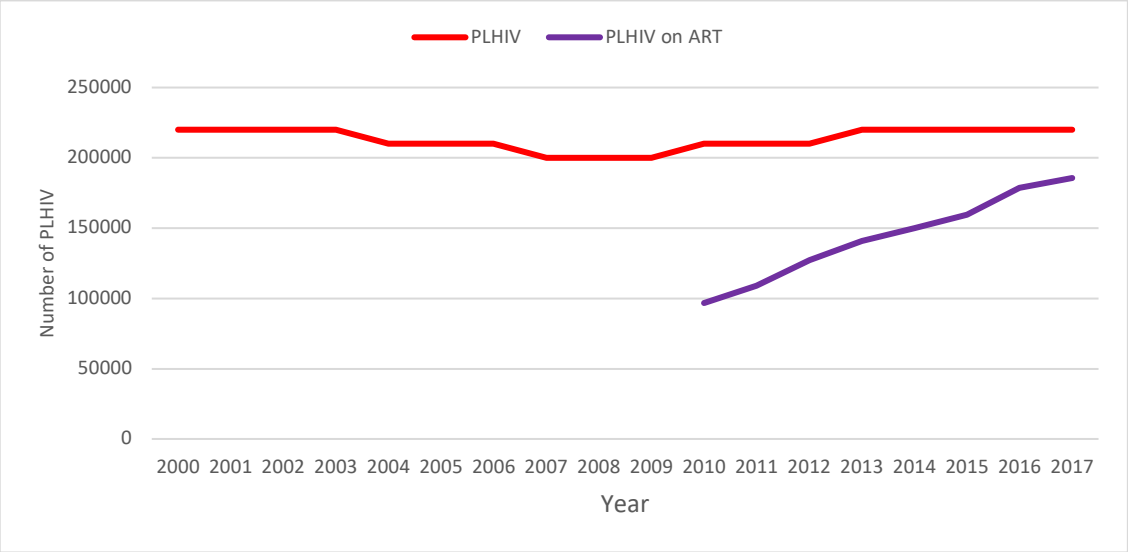
Figure 44. Xpert MTB/RIF tests and GeneXpert machine usage by facility, Rwanda, 2017-2018 fiscal year. Source: GXP Tests Excel file, TB&ORD



HIV and HIV/TB coinfection

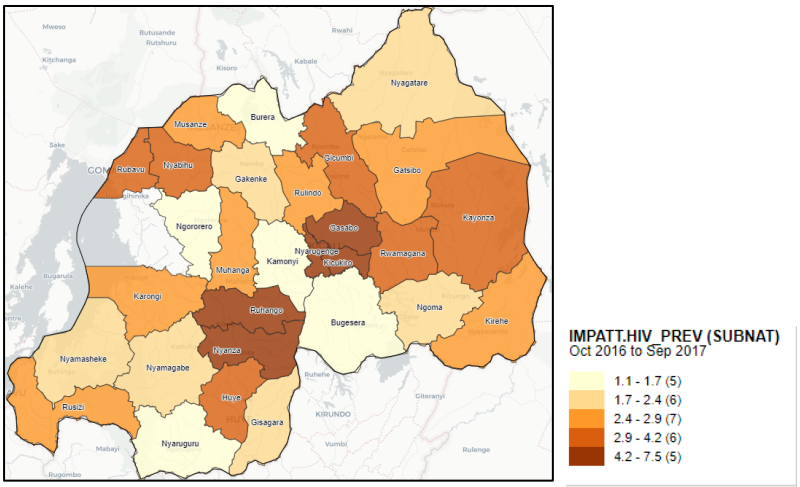
Overall, there are an estimated 220,000 people living with HIV (PLHIV) in Rwanda (Figure 45). The estimate of ART coverage among all PLHIV is increasing from 46% in 2010 to 84% in 2017.

Figure 45. Estimated People Living with HIV (PLHIV) and antiretroviral treatment (ART) coverage, Rwanda 2000-2016. Source: UNAIDS



In 2017, estimated HIV prevalence in Rwanda was moderate at 3% (RDHS 2014-15) % of adults aged 15-49 . However, there is a heterogeneous epidemic with some districts as high as 7.5% (mostly in Kigali City) and others as low as use DHS data % (Figure 46).

Figure 46. HIV prevalence in Rwanda by district, 2016/2017. Source: UNAIDS via Spectrum



Among TB cases, HIV testing is high with over 80% (Benchmark target) of TB cases having known HIV status since 2007 and over 95% (PEPFAR 2018 target) since 2008 (Figure 47). The proportion of TB cases with HIV infection has been decreasing over time from 48% in 2004 to 22% in 2017. The HIV prevalence among MDR TB cases is much higher than among all TB cases, ranging from 41% to 49% (Figure 48).

For more than a decade, TB disease has been an indication to start ART for HIV infected individuals. However, ART coverage has been below 90% until 2016 (Figure 49). It was only in 2017 that ART coverage has been at 90%. CPT coverage has been higher than 95% since 2010.

Figure 47. HIV testing and prevalence of HIV among TB cases, Rwanda, 2004-2017. Source: HMIS

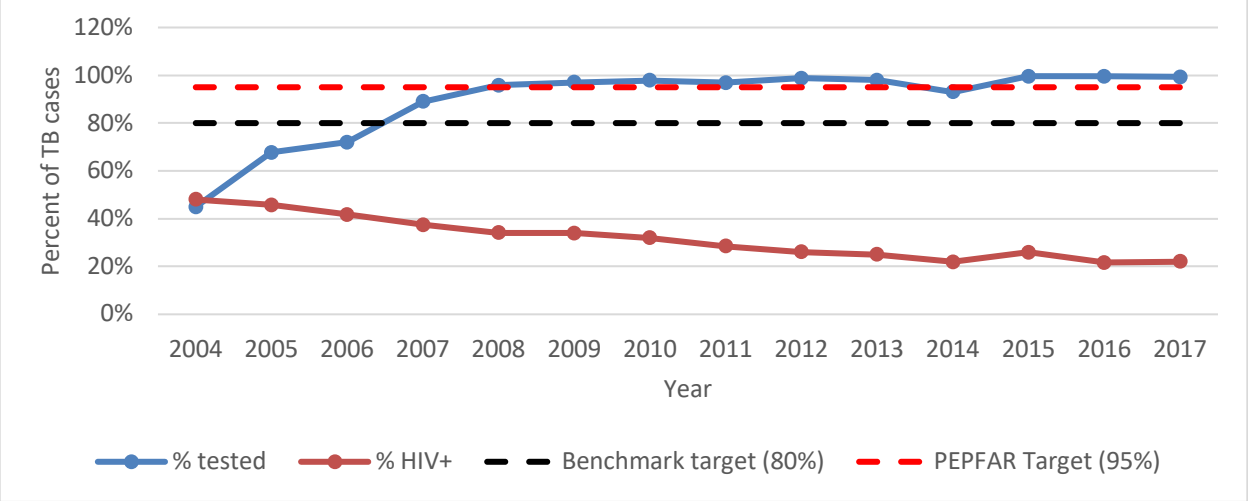


Figure 48. HIV prevalence among MDR TB cases, Rwanda, FY14/15-FY16/17. Source: Annual Report, TB&ORD

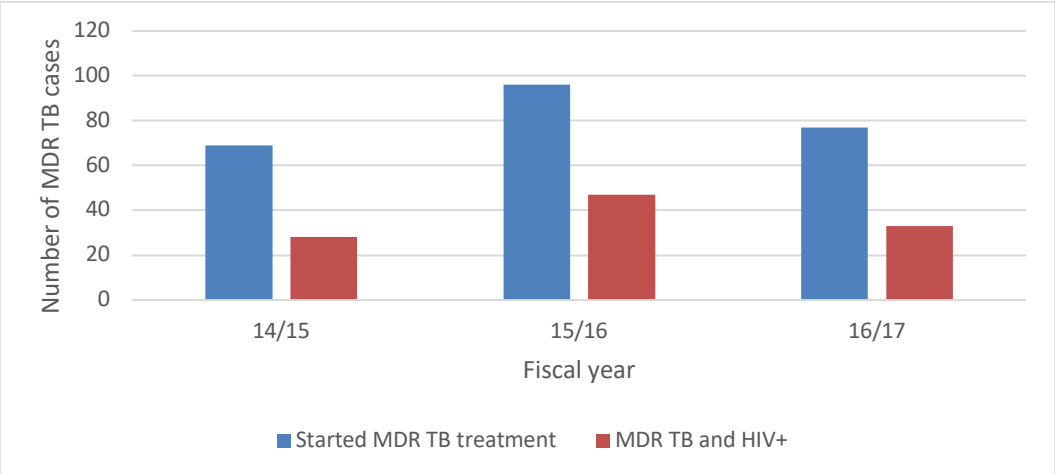
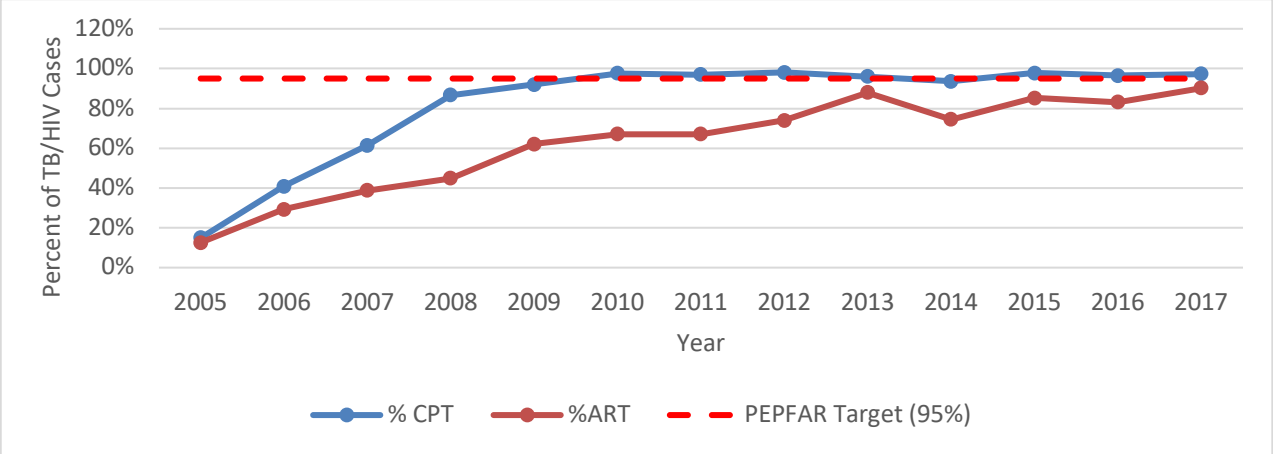
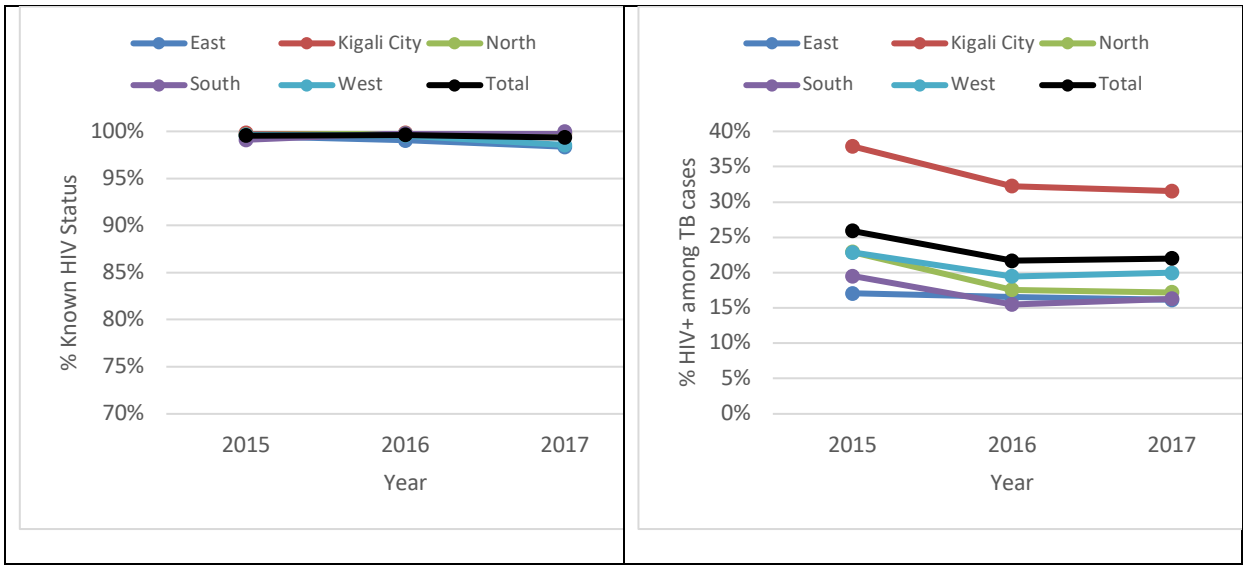


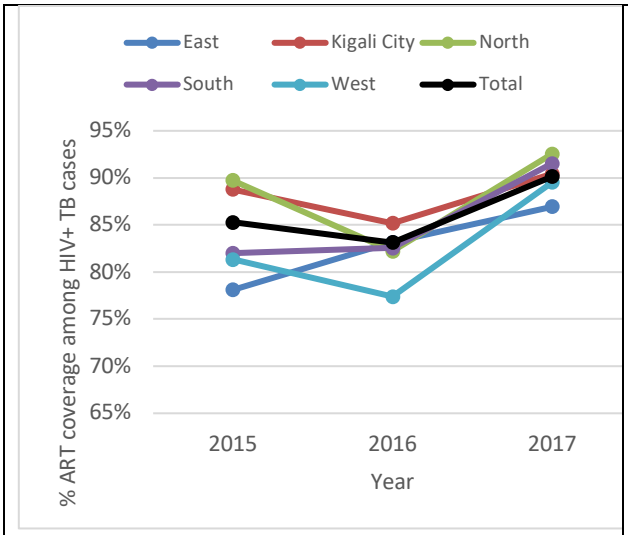
Figure 49. CPT and ART coverage among TB/HIV cases, Rwanda 2005-2017. Source: HMIS



In the past 3 years, there has been little difference in known HIV status among TB cases by province (Figure 50). However, the proportion of TB cases that are HIV infected is highest in Kigali City (32%) compared to the national proportion (22%). All other provinces have less than 22% of TB cases with HIV infection with East and South provinces with the lowest at 16%. Among TB/HIV cases, ART coverage is highest in the North province (93%) and lowest in East province (87%).

Figure 50. HIV testing, prevalence and ART coverage among TB cases by province, Rwanda, 2015-2017. Source: HMIS



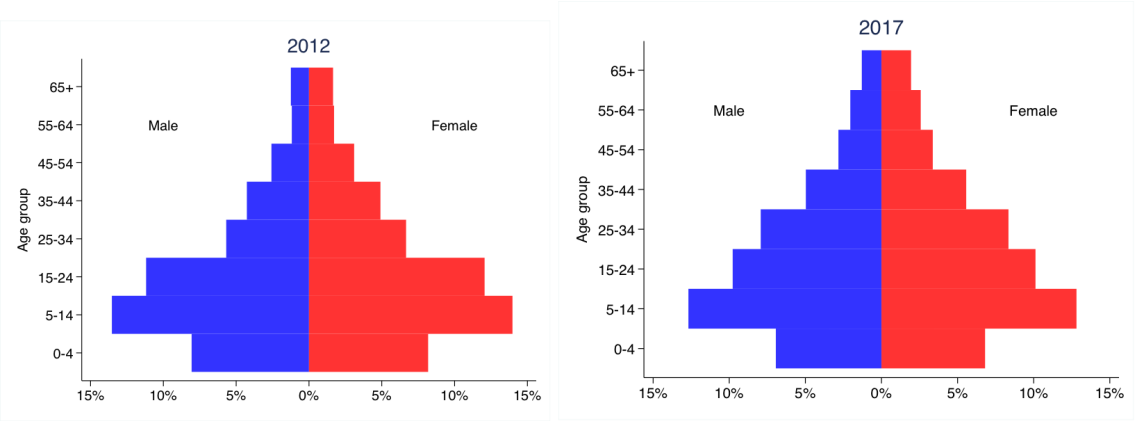

East
Kigali City
North
South
West
Total
95%
90%
85%
80%
75%
70%
65%
% ART coverage among HIV+ TB cases
2015
2016
2017
Year

External factors

Demographic changes

The fourth Rwanda population and housing census conducted in 2012 found the population to be 10,515,973, with 52% of residents to be female and 48% male. Rwanda has one of the highest population densities in Africa and population density has steadily increased, from 183 inhabitants per square kilometer in 1978 to 415 in 2012. In 2017, 39% of the population was under 15 years, while in the 2012 census 44% of the population was under 15 years. The proportion of the population aged 65 years and over has increased from 2.8% in 2012 to 3.9% in 2017 (Figure 51). The total fertility rate has slightly decreased from 4.6 and 4.2 from 2010 and 2015, respectively (DHS). Under five mortality went from 152 in 2005 to 50 in 20114/2015(Rwanda DHS 2014-2015).

Figure 51. Population pyramids, Rwanda 2012 and 2017, Source: census projections



Economic indicators

Rwanda has been experiencing steady increased economic development in the last 10 years (Figure 51). The National Institute of Statistics of Rwanda (NISR) conducts the Integrated Household Living Conditions Survey or Enquête Intégrale sur les Conditions de Vie des ménages (EICV) every five years, gathering information on changes in the well-being of the population such as poverty, inequality, employment, living conditions, education, health and housing conditions, household consumption, among others. The EICV calculates poverty incidence as the share of the population whose total consumption is below the poverty line (Rwf 159,375 in January 2014 prices), or the share of the population that cannot afford to buy a basic basket of goods (food and non-food). According to the follow up analysis linking EICV3 and EICV4, the proportion of Rwandans living in poverty fell from 46.0% of the population in 2010–2011 to 39.1% in 2013–2014, based on the updated poverty line of 159,375 RWF per adult equivalent per year (in January 2014 prices) (Table 12). This represents a reduction in poverty of 2.3% points per year.

Figure 51. Gross national income per capital, Rwanda 2008–2016. Source: World Bank

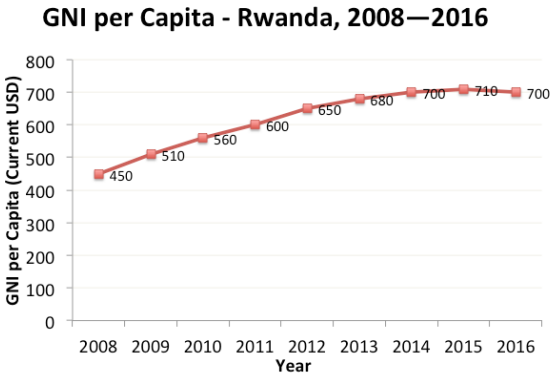


Table 12. Trends in percent poverty from EIVC3 and EICV4, Rwanda. Source: NISR Poverty Trend Analysis Report 2010/11–2013/14

Table ES.1. Poverty Headcount Rates by Province

	2010/11 (EICV3)	2013/14 (EICV4)	Change
	Percentages, total poverty line		
Rwanda	**46.0**	**39.1**	**-6.9***
Area of Residence			
Urban	17.7	15.9	-1.9
Rural	51.0	43.7	-7.2*
Province			
Kigali City	27.5	20.9	-6.6*
Southern Province	49.8	38.4	-11.4*
Western Province	44.7	45.2	0.5
Northern Province	55.1	45.9	-9.2*
Eastern Province	44.0	38.0	-6.1*
	Percentages, food poverty line		
Rwanda	**21.8**	**16.3**	**-5.45***

Note: * indicates change is statistically significant at 5% level of significance. Totals may not add exactly due to rounding errors

Despite increased economic development 39.1% of the population remain under the national poverty line, with a discrepancy between urban (15.9%) and rural (43.7% below poverty) (Table 12). These discrepancies can be seen geographically, with poverty most concentrated in areas of the Northern, Western, and Southern Provinces (Figure 52 and Figure 53). Additionally, 16.3% of Rwandans live in extreme poverty (spending less than 105,064 RWF per adult equivalent per year).

Figure 52. Poverty level in Rwanda by cell, 2013–2014. Source: NISR Poverty Mapping Report 2013–2014

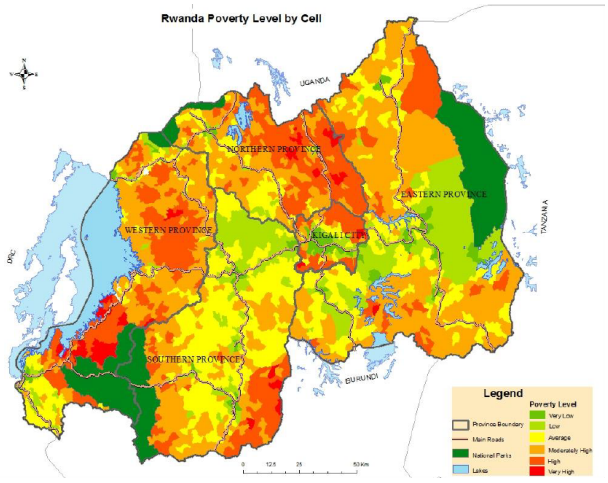
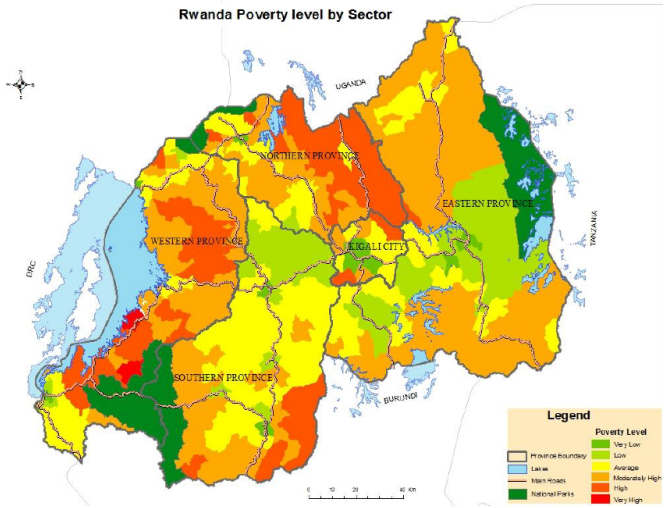


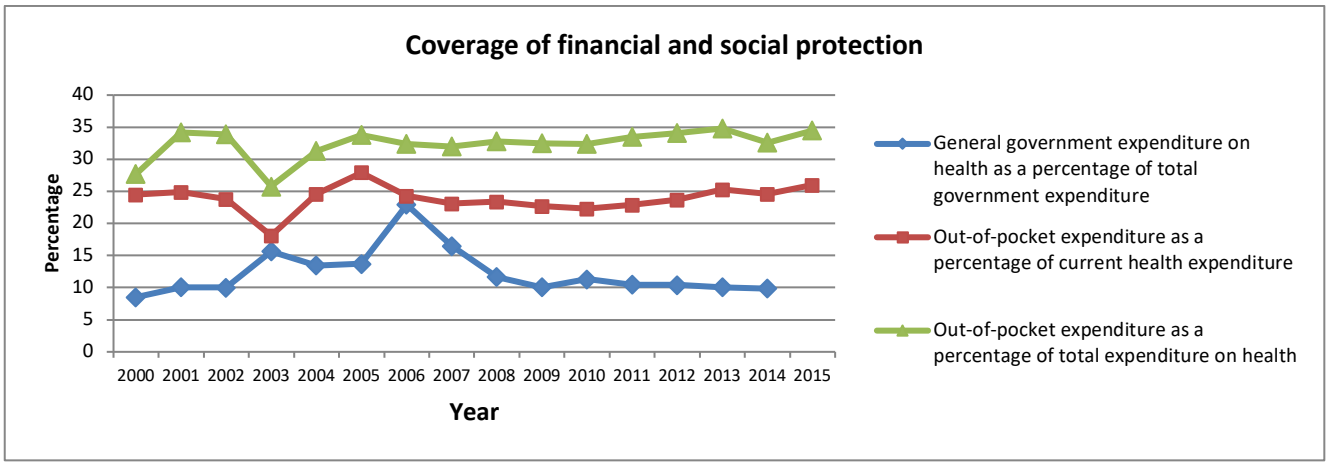
Figure 53. Poverty level in Rwanda by sector, 2013–2014. Source: NISR Poverty Mapping Report 2013–2014



Coverage of financial protection for health care costs

Rwanda is the country with the highest enrolment in health insurance in Sub-Saharan Africa (Chemouni, 2018). Rwanda introduced a community health insurance system (CBHI) called Mutuelle de Santé in 1999 to increase access to healthcare. By 2010, CBHI covered over 90% of its population. Currently, Rwanda has expanded health insurance coverage to people outside the formal sector. Coverage for people outside the formal sector is at 92% (Republic of Rwanda Ministry of Health, 2013). A catalyst for such high rates of CBHI coverage may be due to performance-based financing priorities, including a target priority of 90% coverage of CBHI at health centers (Nahimana et al, 2016). Out-of-pocket health expenditure has generally been below 25% since 2000, and currently stands at 26%.

Figure 54. Coverage of financial and social protection, Rwanda, 2000–2015, Source: Global Health Observatory,



Under-5 mortality rate

The under 5 mortality rate in Rwanda has shown a rapid decrease over the last two decades (Figure 55). Comparing the data from the last four RDHS indicates that infant mortality has substantially decreased in the past decade, from 86 deaths per 1,000 live births in 2005, to 62 per 1,000 in 2007–2008, to 50 per 1,000 in 2010, and 32 per 1,000 in 2014–2015. Under 5 mortality has also declined during this period from 152 deaths per 1,000 live births in 2005, to 103 per 1,000 in 2007–2008, to 76 per 1,000 in 2010, and 50 per 1,000 in 2014–2015. The decrease in infant mortality and under 5 mortality result mainly from the high coverage or antenatal care, implementation of integrated management of childhood illness in health facilities and communities, as well as the high coverage of vaccines (93% of children aged 12–23 months have received all basic vaccines).

Figure 55. Under 5 mortality rate, Rwanda 2002–2016. Source: Global Health Observatory of the World Health Organization.

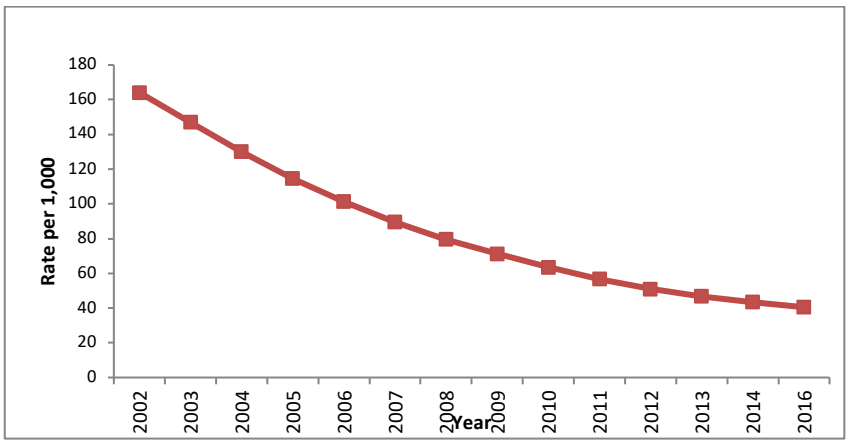
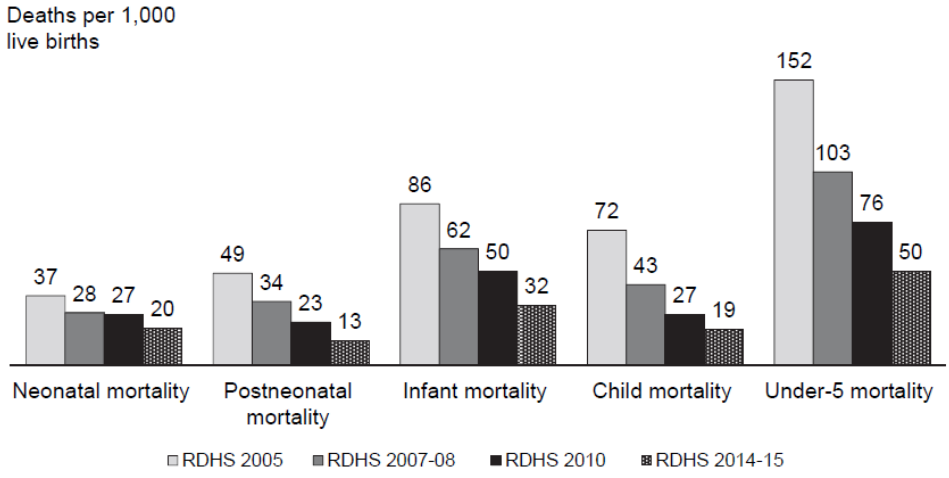


Figure 56. Trends in under five mortality rates as captured by the last four RDHS, Rwanda. Source: DHS 2014–2015



Diabetes

The STEPS Non-communicable Disease Risk Factor Survey is a survey methodology involving a questionnaire, physical measurements, and biochemical measurements to monitor and fight against non-communicable diseases. The Rwanda STEPS survey 2012–2013 measured fasting blood glucose by finger prick capillary blood draw with a point-of-care machine (CardioChek, PA). As shown in Table 13, impaired fasting glycaemia is rare and raised blood glucose is uncommon, affecting just 3.06% of the Rwandan population aged 15–64 years. The prevalence of diabetes in 2017 was 4.3% of the Rwandan population aged 20–79 years, according to World Bank indicators reporting on diabetes prevalence (International Diabetes Federation, Diabetes Atlas). The prevalence of diabetes increases with age and there is a disparity between rural and urban residence, with a higher prevalence of diabetes among those living in urban areas.

Table 13. Fasting Blood glucose classification, Rwanda. Data source: STEPS report 2012–2013

Table 18: Fasting Blood glucose classification

Background characteristics		Impaired fasting blood glucose (>=5.6 AND <6.1"mmol)		Raised fasting blood glucose (>= 6.1 mmol)	
	n	%	95%CI	%	95%CI
Overall	6,662	**1.59**	**[1.2,2.0]**	**3.06**	**[2.4,3.8]**
Age					
15-24	1,363	1.1	[0.6,2.1]	2.6	[1.6,4.1]
25-34	2,190	1.8	[1.2,2.5]	2.8	[2.1,3.8]
35-44	1,447	1.5	[1.0,2.2]	3.3	[2.5,4.5]
45-54	980	2.2	[1.4,3.5]	4.3	[3.1,5.8]
55-64	682	2.6	[1.5,4.2]	4.3	[2.9,6.4]
Sex					
Male	2,470	1.8	[1.2,2.7]	3.3	[2.4,4.5]
Female	4,192	1.4	[1.0,1.8]	2.8	[2.3,3.6]
Residence					
Rural	5,238	1.6	[1.2,2.1]	2.5	[2.0,3.2]
Semi-Urban	564	0.6	[0.2,2.3]	1.9	[1.0,3.6]
Urban	860	2.2	[1.3,3.5]	6.6	[3.6,11.6]

Tobacco use

Smoking as a risk factor for TB has been well documented. The Rwanda Demographic and Health Survey 2014–2015 asked participants questions regarding tobacco use and "Tobacco smoking" including cigarettes, cigars, pipes or any other smoked tobacco products. Only 2% of women and 10% of men aged 15–49 years reported use of tobacco products. Approximately 5.6% of surveyed participants aged 15–49 smoke tobacco. Those that smoke are often older in age, lower education-level, and lower wealth quintile, as shown in Table 14. The STEPS survey 2012–2013 found that overall 12.8% of survey respondents aged 15–64 declared themselves as “current smokers”, either smoking daily or currently smokers who do not smoke on a daily basis. The percentage of those that smoke in STEPS survey 2012–2013 is not comparable with that calculated in the Demographic and Health Survey 2014–2015, since the population surveyed in the STEPS survey includes those ages 50–64 and the percentage of current smokers increases with age.

Table 14. Smoking by background characteristics, Rwanda. Source: Rwanda DHS 2014–2015

Table C.17 Smoking

Percentage of respondents age 15-49 who smoke cigarettes, a pipe, or smoke other tobacco, according to background characteristics, Rwanda 2014-15

Background characteristic	Percentage who smoke			Does not smoke	Number of respondents[2]
	Cigarettes	Pipe	Other tobacco[1]		
Age					
15-19	0.6	0.0	0.0	99.4	2,654
20-24	2.1	0.1	0.3	97.5	2,217
25-29	5.4	0.4	0.3	93.9	2,091
30-34	5.8	1.3	0.4	92.5	2,054
35-39	6.9	2.0	0.0	91.2	1,346
40-44	7.0	4.3	0.0	88.7	1,122
45-49	7.2	6.1	0.0	86.7	880
Residence					
Urban	4.2	0.2	0.3	95.3	2,456
Rural	4.3	1.6	0.2	93.9	9,908
Province					
City of Kigali	4.3	0.4	0.4	94.9	1,694
South	5.8	1.7	0.2	92.3	2,935
West	1.9	0.2	0.1	97.7	2,697
North	3.9	1.9	0.1	94.2	1,967
East	5.1	2.2	0.1	92.6	3,071
Education					
No education	6.9	3.7	0.1	89.4	1,359
Primary	4.8	1.4	0.2	93.5	7,982
Secondary and higher	1.7	0.1	0.1	98.1	3,023
Wealth quintile					
Lowest	6.9	2.9	0.2	90.0	2,068
Second	4.5	1.9	0.1	93.6	2,306
Middle	4.7	1.3	0.3	93.7	2,438
Fourth	3.2	0.9	0.1	95.8	2,613
Highest	2.9	0.2	0.2	96.6	2,939
Total	4.3	1.3	0.2	94.2	12,364

[1] Exclude those who chew tobacco.
[2] Estimates are calculated from respondents in the subsample of households selected for male survey.

Under-nutrition

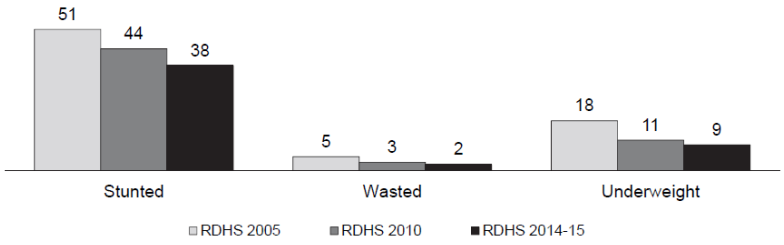
The Rwanda Demographic and Health Survey 2014–2015 conducted anthropometric measurements to evaluate nutritional status of participants. The mean BMI among women was found to be 22.8, and among men, 21.1. Analysis by background characteristics shows that the mean BMI falls in the normal range (18.5-24.9) in all background categories. Only 1% of women are considered to be moderately or severely thin (BMI below 17). Overall, 13% of men aged 15-49 years are underweight or thin (BMI less than 18.5 kg/m^2), about twice the percentage of underweight women (7%).

Nationally, 38% of children under age 5 are stunted, and 14% are severely stunted. Variation in children's nutritional status by province is quite evident, with stunting being highest in West (45%) and lowest in the City of Kigali (23%). Mother's level of education and wealth quintile both have a clear inverse relationship with prevalence of stunting. Stunting reflects chronic malnutrition, wasting reflects acute malnutrition, and underweight reflects chronic or acute malnutrition or a combination of both. Trends in nutritional status of children age 5 between 2005 and 2015 are shown in Figure 57 below, and indicate improvements in the nutritional status of children, as measured by percentage of stunted, wasted, or underweight children under 5 years, over the past decade. Young children may now be

receiving sufficient food on average, but the extent of stunting suggests that it is not the right food and further interventions may be needed (Abbot et al, 2015).

Two other forms of malnutrition, overweight and obesity may be on the rise among children in Rwanda. Overall, 8% of children below aged 5 years are overweight or obese (weight-for-height more than +2 SD). There are no substantial differences by sex, but differences are observed by area of residence (11% in urban areas and 7% in rural areas).

Figure 57. Trends in nutritional status of children under age 5, Rwanda 2005-2015. Source: Rwanda DHS 2014-2015



5. Summary of epidemiological analysis and recommendations

Continuing a sustained decrease since 2006, estimated TB incidence in Rwanda went down from 64 (49-81) per 100,000 population in 2013 to 57 (44-72) per 100,000 population in 2017. The TB mortality rate excluding HIV/TB also decreased from 5.3 (3.4-7.7) to 4.9 (3.2-7.1) in the same period. TB notification and notification rates have decreased for all forms of TB in the last five years except for a slight increase in notifications of bacteriologically confirmed cases in 2016, likely a result of the scale up of Xpert MTB/RIF as first line test in Kigali and among high-risk populations. TB notification rates in Kigali are three times than of the country: 147 vs 51.3 TB cases per 100,000 population in 2016. TB notification rates per 100,000 population were 48 in the South, 45 in the East, 34 in the West and 27 in the North. In Rwanda, TB notifications are more frequent among males than among females. Although most TB cases occur among young adult males, the rates are higher among older males, while TB rates among females are similar across all age groups above 25 years old. On the other hand, TB notification rates in Kigali are higher among young adults for both men and women. The different TB rates in Kigali and other provinces as well as the distribution of TB notifications by age group suggest ongoing transmission in Kigali, while in the other provinces, the reactivations from older infections plays a more important role. The proportion of TB notifications among children <15 years is above the 5% lower range expected in low and middle-income countries. A similar or higher proportion is found in all provinces except Kigali where it was below 5% in the 2013-2017 period. Considering Kigali has a higher burden of TB especially among younger adults, there may be under-diagnosis or underreporting of TB among younger children. When comparing notifications to estimations by sex, the proportion of notified out of all TB cases was lower among women than among men and lower among children 0-14 years old than among adults.

In the last decade, TB specific interventions as well as external factors have resulted in a decline of TB mortality and TB incidence in Rwanda. The country is undergoing a demographic transition with ageing of the population, increased life expectancy and reduced fertility rate. HIV transmission has decreased, and diabetes prevalence remains low. Economic growth as evidenced by an average annual growth of 7.8% in the gross domestic product in the last decade and a slow but consistent reduction in the proportion of people living under the poverty line (44% in 2011 to 39% in 2014) in synergy with high access to health care (as evidenced by widespread health insurance, low out-of-pocket expenditure and a declining under 5 mortality) as well as an HIV epidemic under control as observed in the reduction of HIV and HIV/TB prevalence in recent years and a very high antiretroviral treatment coverage are all in favour of collaborating to the reduction of TB incidence and mortality.

Furthermore, multiple TB specific interventions, have also had an impact in the observed progress. There is political commitment at all levels of the Ministry of Health and the Rwanda Biomedical Center (RBC) to control TB, and the TB program has an NSP extension for 2018-2020 with an assigned budget. Related programs, divisions, and institutions work in coordination to increase

efficiency of interventions and provide patient-centered care. Among the most notable TB specific interventions are: the nationwide reach of community and health facility based case detection and treatment services free of cost to patients, the active case finding activities among high risk groups, and the strong HIV/TB integration. TB treatment success is high in Rwanda. In 2017, 88% of bacteriologically positive pulmonary TB patients, 81% of extrapulmonary and clinically diagnosed TB cases, and 75% among HIV/TB patients were successfully treated. Only five of the 30 districts in Rwanda had treatment success proportions below 85% in 2017: Gasabo in Kigali (83%), Gakenke (75%) and Burera (80%) in the North, Gisagara (83%) in the South, Rubavu (78%) in the West and none in the East. Mortality among HIV/TB, clinically diagnosed and EPTB cases was higher than among all TB cases (15% in the categories cited, as compared to 6% for all TB cases). Multidrug-resistant (MDR) TB among new cases was 1.4% (0.7-2.1) according to the drug resistant survey (DRS) 2015 survey, which is lower than what was found in the 2005 DRS. MDR TB among retreated cases did not increase and was 10.7% (5.0-19.4) in 2015. This controlled MDR TB epidemic is probably a result of high quality TB program: most notably, high quality treatment of drug sensitive TB cases and early case detection of drug resistant cases. In 2017, 86% of all bacteriologically confirmed cases had a known DST result.

TB/HIV programs were integrated in 2005, and since 2007, over 80% of TB patients have a known HIV status. Coverage of ART among all PLHIV was 81% in 2017 and among HIV/TB was 90%. HIV coinfection among TB patients is higher (32%) in Kigali than in other provinces (16-20%). Overall, more than 90% of PLHIV in care are screened for TB symptoms at each clinical encounter. Enhanced and active case finding strategies are in place in Rwanda, which have likely affected TB incidence in recent years. In addition to community health workers looking for presumptive TB cases in villages, active case finding is routinely done among persons living with HIV, prisoners, household and close TB contacts, children and persons 55 years and older. The selection of these groups was based on the findings of the prevalence survey. In addition to routine screening upon prison entry, a first phase of active case finding in prisons (2013-2015) found that 154 prisoners were needed to be screened in order to find one TB cases while in a second phase (2016-2018) the number needed to screen was 378.

In this scenario of external and internal (TB-specific) factors aligned in favour of TB control in Rwanda, the implementation of a robust case-based electronic system for TB surveillance that interoperates with the National Reference Laboratory data and with a robust Vital Registration system to measure TB mortality, will provide high quality data for detailed subgroup and subnational analysis to guide the TB&ORD in selecting and monitoring key interventions to reach TB elimination in Rwanda.

Key Recommendations

The following recommendations aim to guide the TB program to strengthen the surveillance system:

1. Transition to case-based electronic surveillance system: Complete the transition to a case-based electronic system setting clear objectives and timelines to implement it nationwide. A unique identifier that allows entering all people in TB registers and that can identify more than one episode of TB should be used for a case-based system. The database should allow entering cases with no identifier, and auto-generate a unique identifier, in order to prevent under-reporting of people with missing IDs. Ensure that historic and current aggregated data of TB cases and presumptive TB cases are available to be analyzed in trends with future data. Discontinue the case-based entering of presumptive TB cases, while continuing to capture aggregate presumptive TB numbers. In the medium term, consider entering individual close/household contacts, especially those eligible IPT
2. Ensure interoperability of systems: In coordination with key divisions and institutions ensure interoperability electronic systems: new eTB, LIS, CRVS, HIV case-based database, among other relevant systems so that TB surveillance is optimized, data are available on real time, data entry workload is reduced, and quality of data increases.
3. Increase M&E capacities: Strengthen M&E capacity of the TB division to record, analyze and use TB data at national and subnational level. Due to the imminent implementation of the new eTB system, additional staff with fully dedicated time to eTB will be required for training, data cleaning, data management, and supervision for a fast and smooth implementation, as well as for analysing and interpreting data, including the use of visual dashboards in the new eTB. Among the advantages of case-based data are the increased possibilities of analysis. We recommend including subnational analysis to monitor TB specific interventions at country but also province, district, and health facility level.
4. Continue data quality assessments: We recommend continuing the biannual Integrated Supportive Supervision & Data Quality Assessment and TB&ORD quarterly meetings where data quality is checked, among other supervisory activities. We also recommend prioritizing variables and indicators during supervisory activities, such as comparing total number of cases between paper and electronic case reports, correctly registering the age, sex, type and site of TB, HIV and drug resistant status, and documenting findings. The data quality assessment SOP for the new eTB should be updated.
5. Strengthen vital registration: Strengthen national vital registration system to capture all TB deaths. The TB&ORD can encourage and collaborate with NISR in the implementation of the new CRVS to document all hospital and community TB deaths using ICD-10 codes.

Based on the epidemiological analysis, we also give the following recommendations:

6. Improve TB notification in children: Case estimations suggest children, especially those < 5 years old are not being notified. Therefore we recommend strengthening case finding among children. Work with pediatricians and primary care physicians to develop strategies to improve TB detection in children, especially < 5 and in Kigali. In selected sites, extending active case finding

up to 1-2 years after exposure, among household contacts <5 years old, could provide estimates of children that may be missed. Activities proposed in the 2018-2020 of the National Strategic Plan "Strengthen diagnosis capacities for childhood TB so that the proportion of TB cases among children increases from 5% in 2015 to 8% by mid-2021" require monitoring and follow up and focus in reducing underdiagnosis in the 0-5 years old group.

7. Increase drug resistance surveillance: Ensure that the new eTB allows routine surveillance of drug resistance among new and previously treated TB cases. Utilize GeneXpert platforms to full capacities. Additionally, in the medium term, consider using Xpert MTB/RIF as the first diagnostic test among all presumptive TB cases in all Rwanda.

8. Continue active case finding strategies: We recommend to continue the excellent efforts of active case finding strategies to reach Objective 1.1 of the 2018-2020 extension of the National Strategic Plan. Analyze data to tailor strategies based on TB rates and characteristics of the populations to develop differential strategies to increase and speed up case finding in Kigali versus provinces where TB transmission patterns are different. Continue efforts active case finding efforts PLHIV and prisoners and consider strengthening household contact investigation to increase proportion of children detected.

9. Improve early diagnosis and management of TB among PLHIV to decrease mortality rate particularly among PLHIV presenting with advanced disease in hospital settings.

Investment plan

Recommendations	Activities	Responsible	Timeline	Budget	Funding source
Complete transition to a case-based electronic system					
Finalize new eTB and set a clear objective and timeline to implement it countrywide	Proceed with the roll out of the new eTB and the training to all TB coordinators and data managers following a timeline for its implementation countrywide	TB &ORD M&E team	End July 2019		
Ensure the use of a universal unique ID for all persons in Rwanda (including <16, foreigners, prisoners, homeless) that can reliably entered in the new eTB	Define with RHMIS and other relevant divisions in RBC, the use of a universal unique ID for all in Rwanda. Develop a system of unique ID for those who do not have a Rwandan ID	MoH	End December 2019		
Flexibility to allow a % of cases with no ID to be registered in the eTB	Include a general guidance in the SOP of the new eTB that prioritizes the registration of cases, over the registration of cases with an available ID	TB &ORD M&E team	End May 2019		
Develop a plan for the transition and migration of data (including completing 2013 reports in HMIS)	Ensure aggregated data is migrated to the new eTB and aggregated analysis of the case-based data can be studied in trends with aggregated historic data	HIS Unit and TB&ORD M&E team	End December 2019		
Continue the recording of presumptive TB to aggregated and not case-based as was done recently	Halt the electronic entering of case-based presumptive TB cases. Analyze aggregated data on presumptive TB cases by risk group.	continuous			
Medium term: consider entering close/household contacts case-based (but not at the cost of TB case reporting). Prioritize eligible IPT to follow up start, completion and effectiveness.	Discuss the implications (work load, data quality, relevance) of entering case-based data on contacts. Consider entering this after the new eTB is well implemented nationwide				

Interoperate electronic systems: new eTB, HIV case base database, LIS, National Identity Agency, CRVS, among other relevant - with a unique ID	Continue discussions stated in the extended NSP of interoperating with the LIS and HIV division. Start discussions with NIA and CRVS to interoperate the new eTB with them (to validate identifiation data with the NIA, and to register all TB deaths with the CRVS)	PMEBS			
Strengthen M&E capacity to record, analyze and use TB data at national and subnational level					
Increase the number of staff with full time dedication to M&E activities at national level, especially considering implementation of new eTB	Recruit additional staff to assist in the rolling out of the new eTB including training activities and troubleshooting during the implementation, data quality reviews and data analysis				
Train in data analysis and interpretation, using dashboards Analyze subnational data, per age/sex, to monitor case detection and treatment outcomes	Train TB coordinators and staff at province, district and health facility level in the analysis and interpretation of key TB indicators, using dashboards in the new eTB	Division Manager TB&ORD	End December 2019		
Prioritize key indicators for data quality, in ISS&DQA and TB&ORD in meetings quarterly, document findings	Include indicators of standard 1.4 in the ISS&DQA	Division Manager TB&ORD	Every year		
Develop plan update SOP for data quality assessment of the new eTB, specially during the transition	Develop an SOP for data quality assessment at all levels	TB &ORD M&E team	End May 2019		
Strengthen national vital registration system					
Encourage the implementation of the new CRVS to document all TB hospital and community deaths using ICD-10 codes	Interoperate the new eTB with the new CRVS electronic system (even if coverage is still low) to register all TB deaths reported to the CRVS	PMEBS and HIS at MoH			
Strengthen case finding among children					

Work with paediatricians and primary care physicians to improve TB diagnosis in children, especially < 5 and in Kigali	Finalize, implement and monitor the implementation of pediatric TB guidelines to improve diagnosis, especially among those <5	Director of care and treatment unit			
Consider ACF among household contacts <5 up to 1-2 years after exposure in selected sites –specially among those not on IPT	Select a small number of sites (such as those with a high number of TB notifications) and follow up household contacts <5, with or without IPT to quantify the number of TB cases arising among them up to two years after exposure as many cases may be missed in the initial contact investigation	Director of care and treatment unit			
Drug resistant tuberculosis					
Ensure new eTB allows routine surveillance of drug resistance (% of rifampicin resistant among new and previously treated)	Interoperate laboratory data with the new eTB in order to have all Xpert tests and other DST, registered for each TB case	Director of MDR TB unit			
Utilize GeneXpert platforms to full capacities	During quarterly meetings, analyze the reasons for which GeneXpert platforms are not used to its full capacities and conduct corrective actions based on the findings for each province/districts				
Medium term: scale up Xpert MTB/RIF to all presumptive, beyond Kigali	In modelling the projections of TB incidence based on specified conditions, analyze the impact of Xpert MTB/RIF as first line test in all presumptive TB cases in Rwanda, as well as the number and location of Xpert MTB/RIF platforms required to avoid diagnostic delays or drop outs because of transportation issues and other aspects affecting turnaround time when the test is not available at the facility where the case is detected.				
Continue efforts of ACF strategies guided by data analysis					

Differential strategies. Ex.: Kigali vs other, women, children < 5	Conduct routine data analysis of active case finding activities (consider including a dashboard in the new eTB for the aggregated data base				
Continue efforts among PLHIV, household contacts and prisoners	Strengthen active case finding community activities among all high risk groups in Kigali, while in the other provinces, prioritize household contacts and PLHIV over other groups				

Appendices

Appendix 1. List of data sources and other information required for the Tuberculosis National Epidemiological Review

Description of the TB surveillance system and data sources

- Data acquisition, data flows, data quality checks, paper-based versus electronic, case-based versus aggregated at the central level, frequency of reporting to the central level, local and national databases, recording and reporting forms, TB registers, laboratory registers
- TB surveys (drug resistance surveys, surveys of HIV in TB and TB in HIV) conducted in the past 10 years
- Surveillance audits, surveys and data quality assessments
- Supervisor checklist

TB Programme - National Level

- National TB Programme manual
- TB case definitions
- National guidelines for TB, TB/HIV, MDR-TB, and TB in children
- NTP monitoring and evaluation plan
- WHO guidelines for treatment of TB, surveillance of drug resistance in TB, and HIV surveillance among TB patients
- Most recent annual report(s) of TB
- Blank data collection forms for TB, MDR-TB, laboratory specimens (e.g. treatment card, reports forms, registers)
- Most recent complete years' compiled reports of TB cases (paper and/or electronic)
    - Quarterly reports of TB cases sent to the NTC from districts over the period of one year
- Documentation for surveillance system (data dictionary, user manual)
- Documentation and/or Standard Operating Procedures (SOPs) for electronic surveillance systems
    - Examination of automated checks run at the time of data entry
- Any reports or publications on data quality, inventory studies, or surveillance evaluations that have been done in past 5 years
- Surveillance-related training documents including a presentation
- List of all TB Districts in country
- Results from a drug resistance survey conducted in last 5 years (including documentation of results of proficiency testing conducted at the Supranational TB Reference Laboratory)
- National surveillance data from the last year for which complete data are available
    - Dataset of minimum set of variables (see B1.2)
    - Records in the national patient- or case-based database for TB, TB/HIV, MDR-TB, and TB in children

- # and rates of reported TB cases at national level, first sub-national levels (and Districts , if available)
    - Case-rates TB at national and first subnational level, results of investigations conducted to identify reasons for any observed rapid changes
    - Distribution of case notification rates between subnational areas
    - National laboratory register
    - National MDR-TB register

External to TB Programme

- Country income grouping from World Bank website.
- Results from a survey of HIV infection among a sample of TB cases conducted (in last 3 years, if possible) or data prevalence of HIV among newly detected TB cases
- Latest country-specific estimates of the under-5 mortality rate from WHO publication World Health Statistics (issued annually) or WHO's Global Health Observatory website
- Proportion of national health expenditures that are out-of-pocket from WHO's national health accounts database or WHO Global Health Expenditure Atlas
- National VR system information (e.g. description, national coverage and quality) from national statistics office or WHO Mortality Database

Analysis and interpretation of the output of TB surveillance

- Time trends in case numbers and rates.
- Time trends in change in case numbers.
- Time trends in the proportion of pulmonary and extra-pulmonary TB.
- Time trends in rates by sputum smear status.
- Time trends in the proportion of retreatment cases out of the sum of new and retreatment cases.
- Time trends in the proportion of new paediatric TB cases out of the sum of all new cases.
- Time trends in the proportion of TB cases by sex.
- Percentage of TB cases tested for HIV and the percentage of HIV-positive TB cases at sub-national level.
- Time trends in treatment outcome.
- Time trends in HIV prevalence.

Appendix 2. Completed checklist of standards and benchmarks

CHECKLIST OF STANDARDS AND BENCHMARKS FOR TB SURVEILLANCE AND VITAL REGISTRATION SYSTEMS

INTRODUCTION

Background

A major goal of TB surveillance is to provide an accurate measure of the number of new TB cases and TB deaths that occur each year, and to be able to assess these trends over time. In some countries, TB surveillance already meets the standards necessary to do this, but in others, there are important gaps in the TB surveillance system that does not make this possible. For example, TB cases that are diagnosed in the private sector go unreported in many settings, and in many countries with a high burden of TB, people with TB may not access health care and therefore not be diagnosed at all. Furthermore, many countries lack VR systems with the geographical coverage and quality required to accurately measure deaths caused by TB. Therefore, the *checklist of standards and benchmarks for TB surveillance and vital registration systems* (the Checklist) was developed with the following objectives:

- To assess a national surveillance system's ability to accurately measure TB cases and deaths
- To identify gaps in national surveillance systems that need to be addressed in order to improve TB surveillance.

The results of a national assessment by use of the Checklist can be used to identify which countries have surveillance systems that already provide an accurate measure of the number of TB cases and deaths that occur each year, and to define the actions necessary to strengthen surveillance in countries in which gaps are identified. Following the 2012 recommendations of the Global Fund's Technical Evaluation Reference Group (TERG) and a collaborative agreement between the Global Fund and WHO, there was a new aim to integrate assessments of TB surveillance using the Checklist within Global Fund grant mechanisms. As such, assessments with the Checklist should be timed to coincide with periodic reviews, programme reviews or Global Fund phase II grant renewals, with results used to develop M&E investments plans that can be supported through subsequent Global Fund grants. This collaboration has great potential to help strengthen TB surveillance in more than a hundred countries receiving Global Fund grants for TB care and control worldwide.

The Checklist was developed by a team of experts in disease surveillance in conjunction with expert advice from meetings organised by WHO in September 2011 and May 2012. The Checklist underwent two rounds of field-testing in eleven countries, including Brazil, China, Egypt, Estonia, Japan, Kenya, the Netherlands, Myanmar, Uganda, the United Kingdom and the United States of America, and was revised accordingly.

What does the Checklist specifically assess?

The Checklist has two parts: part A is a checklist that provides a general description of the TB surveillance system that is being assessed; part B (section 1) is a checklist for TB surveillance and VR systems which includes three sections covering data quality, system coverage, and TB mortality data from VR systems. Part B (section 2) includes the supplementary standards for surveillance of TB/HIV cases, drug resistant cases and TB cases in children.

Part A consists of eighteen questions that characterise the national TB surveillance system and sets the background for Part B which consists of thirteen standards and their associated benchmarks. The standards are general statements about the characteristics that define a high-performance TB surveillance system; nine standards are related to the measurement of TB cases and one is related to measurement of TB deaths. There are three supplementary standards that can be used to assess whether a country's TB surveillance system can be certified as providing a direct measure of the number of drug resistant TB cases, HIV-positive TB cases, and child TB cases.

For each of the thirteen standards, benchmarks define (in quantitative terms wherever possible) the level of performance considered sufficient to meet its respective standard. To ensure time for the most complete data to be available for review, the assessment of TB surveillance and VR systems is designed to use data for the most recent complete calendar year, unless otherwise stated in the user guide. Depending upon the timeliness of the reporting and finalisation of data validation procedures in the system, the lag time may range from no delay to one year. In some instances, data from additional years are needed to assess trends over time, or data from only a single quarter are required to reduce the burden of data collection. It is anticipated that an assessment of a TB surveillance system using the Checklist would take place every 3 to 5 years.

For part A and B of the Checklist, key actions, if required, should be recorded that will 1) address the identified gaps in the surveillance and VR systems that prevent them from accurately measuring TB cases and deaths and 2) help the system improve TB surveillance based on well-established best practices. An estimated budget to support activities that could bridge these gaps will assist in developing an M&E investment plan.

The data, materials and personnel required to assess each standard and associated benchmark(s) are listed below, followed by the user guide. The user guide was developed to provide instructions to implement the associated checklist of standards and benchmarks in an accurate and standardised way. The rationale for each standard and associated benchmark(s), and the methods that should be used to assess the benchmarks, are explained in the user guide. Specifically, the user guide provides a description of how and what data should be collected. For elements that require reviewing a sample of records, the user guide also explains how the sampling should be conducted. Examples are used to illustrate the methods described in the user guide, as well as recommended corrective actions to take if

the benchmarks are not met. The user guide also defines key terms used in the Checklist, and further lists the supporting appendices.

It is recognised that the standards and benchmarks related to health system coverage (Standard B1.9) and vital registration (Standard B1.10) are outside the purview of the TB programme. However, to assess the capacity of the surveillance system to accurately estimate TB burden, these two standards and associated benchmarks are deemed necessary.

In a few instances e.g. Standards B1.4 and B1.8, where compilation of the necessary evidence may be difficult or impossible on a regular basis, it is acceptable to use evidence from the literature, reports of special studies or other related health surveys carried out in recent years to demonstrate that a standard is met, provided results from the assessment of other standards show that data quality within the system has not subsequently declined. This is explained in more detail in the user guide.

This Checklist may also be used at the sub-national level, but this is not the primary purpose for which the tool was developed. It should also be noted that the Checklist only assesses one part of a system's capacity and is *not* intended to assess the system's ability to fulfil other programmatic requirements, e.g. patient care, delivery of lab results, or drug stock management (see Box 1). Furthermore, the standards assess the outputs rather than the inputs or processes of the surveillance system which will vary by country. Box 2 below highlights best practices for TB surveillance systems. Using this along with information collected in the Checklist's Table A, countries can identify areas where additional resources can be targeted to effectively strengthen their surveillance systems.

What is a certified TB surveillance system?

For a country's TB surveillance systems to be *certified* as providing a direct measurement of TB cases and TB deaths, all 10 standards and their associated benchmarks (Part B, section 1) should be met. The three supplementary standards in part B (section 2) can be used to assess whether a country's TB surveillance system can be certified as providing a direct measure of the number of drug-resistant TB cases, HIV-positive cases of TB, and TB in children specifically.

Certification provides an objective situational analysis of the current TB surveillance system. It is meant to provide a baseline and a framework which can be used to support improvements (if required) in the system. Subsequent assessments can be used to determine if targets are met based upon the initial assessments. Certification is based on the review of the system from the assessed time period. External peer review and endorsement of the findings by the WHO Global Task Force on TB Impact Measurement will be necessary for a country's system to be certified.

Who can undertake the Checklist?

The Checklist can be used by in-country national TB programme staff for self-assessment. All parts of the checklist should be undertaken by someone with an informed and current knowledge of the system that may include all or some of the following people:

- NTP manager
- NTP programme officer
- NTP monitoring and evaluation office
- NTP statistician/epidemiologist
- NTP data manager
- WHO TB programme officer

What methods are required and how long does it take to complete the Checklist?

The Checklist requires an accurate and a thorough collection of data from available sources. Therefore, a desktop review of all documents related to the Checklist, including datasets and electronic surveillance systems, is necessary, and data audits at selected basic management unit (BMUs) may be required as well. Interviews with the relevant stakeholders and partners may also be necessary to obtain the necessary information. Depending on how this information is stored, i.e. paper-based or electronic-based, it may take several weeks for the appropriate data to be extracted. Electronic-based data generally require less time to complete the Checklist than paper-based systems. Time should also be allocated to summarise the findings of the Checklist before dissemination.

NOTE: ASPECTS OF A SURVEILLANCE SYSTEM NOT ADDRESSED BY THE CHECKLIST

Published surveillance evaluation guidelines have provided criteria against which surveillance systems can be assessed[1]. These include:

— Acceptability
— Data quality
— Flexibility
— Positive predictive value
— Representativeness
— Sensitivity
— Simplicity
— Stability
— Timeliness
— Usefulness

While these are important criteria to evaluate the performance of TB surveillance systems, some of these are not covered by and are outside the scope of the objectives of this checklist. For example, this checklist is not intended to assess the ability of a surveillance system to detect outbreaks in a timely

manner, or its simplicity, flexibility, acceptability or positive predictive value, since these aspects do not directly measure a systems ability to provide an accurate measure of the number of TB cases and deaths that occur each year.

[1] Centers for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group. MMWR 2001;50(No. RR-13):1–35.

Appendix 3. Agenda of the visit

Agenda for Epi Review of NTP Rwanda: 03-14 September 2018					
Week 1: 03-07 Sept 2018					
Days	**Activity**	**Time**		**Comments**	**Staff involved**
Monday	Meeting with NTP	PM			TB&ORD Division Manger, Directors of TB&ORD Units, TB&ORD M&E Team, TB Drug management Senior Officer, Representative of CDC-Rwanda, Representative of WHO-Rwanda.
	Desk review of NTP tools and resources				
	Standard and Benchmark check list				
Tuesday	Meeting with CDC	AM &PM	08:30-09:00	We plan this on Tuesday because the Monday will be a holyday for CDC: Consultants	TB&ORD Division Manger, Directors of TB&ORD Units, TB&ORD M&E Team, TB Drug management Senior Officer, Representative of CDC-Rwanda, Representative of WHO-Rwanda.
	Field visit out of Kigali (Kabgayi DH-CDT)		10:30-12:00		
	Visit a Prison-CDT: Muhanga Prison		01:00-02:00	Request letter to RCS	
	Field visit out of Kigali (Kivumu HC-CDT)		02:30-03:30	To discuss if we maintain this or find another public one, since Kivumu is agree.	
	Departure to Kigali		04:00-05:00		
Wednesday	Meeting with IHDPC Head	AM &PM	08:30-09:00		TB&ORD Division Manger, Directors of TB&ORD Units, TB&ORD M&E Team, TB Drug management Senior Officer, Representative of CDC-Rwanda,
	Field visit in Kigali (Kibagabaga DH-CDT-MDR Center)		09:30-12:00		
	Field visit in Kigali (Kanyinya HC-CT)		02:00-03:00		
	Visit a private Clinic-CDT (La Medicale-kwa Kanimba)		04:00-05:00		

					Representative of WHO-Rwanda.
Thursday	Meeting with NRL	AM &PM	08:30-10:30		TB&ORD Division Manger, DG Planning/Moh, Directors of TB&ORD Units, Director of HIV Epidemiological Surveillance system, Director of Health Information System Unit, TB&ORD M&E Team, TB Drug management Senior Officer, Representative of CDC-Rwanda, Representative of WHO-Rwanda
	Meeting with NISR		11:00-12:30		
	Meeting with PMEBS (HIS, …)		02:30-04:00		
	Meeting with HIV		04:00-05:00		
Friday	Presentation of the case-based surveillance system (e-TB): Old and new one.	AM &PM	08:30-10:00		
	Meeting with NTP/ M&E for data analysis		10:00-05:00	Other TB related data will also be analyzed (DHS, HIV, HH Surveys, ...)	

Week 2: 10-14 Sept 2018

Days	**Activity**	**Responsible**		**Comments**	
Monday	TB data analysis cont	AM &PM			TB&ORD Division Manger, Directors of TB&ORD Units, TB&ORD M&E Team, TB Drug management Senior Officer, Representative of CDC-Rwanda, Representative of WHO-Rwanda.
Tuesday	TB data analysis cont	AM &PM			
Wednesday	TB data analysis cont	AM			
	Prepare out brief presentation and preliminary recommendations	PM			
Thursday	Preliminary debrif with NTP	AM			
	Finalize debriefing presentation	PM			
Friday	Debriefing with MoH and CCM and partners	AM			
	Final discussion with NTP and next steps	PM			

Appendix 4. Persons interviewed during the visit

Name	Title	Organization/Affiliation
Dr. Patrick Migambi	Division manager	TB&ORD division, Rwanda Biomedical Center
Dr. Yves Mucyo	Director of MDR-TB Unit	TB&ORD division, Rwanda Biomedical Center
Augustin Dushime	TB Statistician	TB&ORD division, Rwanda Biomedical Center
Dr. Jules Mugabo	HIV/TB/Hepatitis NPO	World Health Organization, Rwanda Country Office
Dr. Claude Bernard Uwizeye	CDC Rwanda TB/HIV Evaluation and Research Specialist	CDC Rwanda
Dr. Gene MacDonald	CDC Rwanda Country Director	CDC Rwanda
Jean Pierre Kubwimana	E-TB System Administrator	TB&ORD division, Rwanda Biomedical Center
Felix Murego	TB Evaluation and Research Officer	TB&ORD division, Rwanda Biomedical Center
Ida Kandkindi	CDC Rwanda HIV Specialist	CDC Rwanda
Dr Avit Mutaganzwa	Kibagabaga District Hospital Director	Kibagabaga District Hospital
Dr Ivan E. Mwikarago	Division manager	National Reference Laboratory, Rwanda Biomedical Center
Semuto Jean Claude	TB lab researcher	National Reference Laboratory, Rwanda Biomedical Center
Mukanyonga Apolline	Health and Social Statistics Team Lead	National Institute of Statistics of Rwanda
Ngomitute Xavier	Civil Registration and Vital Statistics Team	National Institute of Statistics Rwanda
Dr. Byiringiro Rusisiro	Director of TB Infection Prevention Control Unit	TB&ORD division, Rwanda Biomedical Center
Grace Mutembayire	Director of TB Care and Treatment Unit	TB&ORD division, Rwanda Biomedical Center
Caniscous Musoni	Care & Treatment Team Lead	CDC Rwanda
Dr. Sabin Nsanzimana	Division manager	HIV & Bloodborne Pathogens Division, Rwanda Biomedical Center
Dr. Albert TUYISHIME	Division manager of Planning M&E and Business Strategies	PMEBS, Rwanda Biomedical Center
Teasan De Voux	Business Strategy director	PMEBS, Rwanda Biomedical Center
Mr BYIRINGIRO J.Baptiste	Director of HIS Unit	PMEBS, Rwanda Biomedical Center

Appendix 5. Standards and Benchmarks

PART A: CHARACTERISTICS OF THE TB SURVEILLANCE SYSTEM

Before completing the checklist, it is important to characterise the national TB surveillance system. Please provide answers to the following questions.

COUNTRY NAME: Rwanda DATE OF ASSESSMENT: 3-14 September 2018

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
A1. How are data recorded for individual TB cases at the service delivery level (e.g. in TB diagnostic units, health centres, clinics)? *(Tick all that apply)*	☒ Data are recorded electronically on a national internet-based system ☐ Data are recorded electronically on a state/provincial/regional internet-based system ☐ Data are recorded electronically on a local system ☒ Data are recorded on paper ☐ Data are not recorded	TB cases are registered in CDT in paper books (Presumptive TB, TB register), treatment cards and clinical files at health facilities. The TB Focal Point prepares the aggregated report quarterly. The Data Manager vaildates key indicators (TB notifications, outcomes and the lab section) and then enters the aggregated data into an RHMIS database. Since 2016, a case-based electronic database (eTB) was developed and aimed to be implemented nationwide but has reached 70% coverage by 2018. The Data Manager enters data from the lab register and TB register to the eTB. This is expected to be done on a weekly basis. The eTB had several shortcomings including too many variables, difficulty entering patients without a unique ID, among others, for which a new version electronic case-based system has been developed also in DHIS2 with support from HISP (and is expected to be launched before the end of 2018.	
A2. Do all service delivery points systematically use standardised TB data	☒ Yes, completely ☐ Mostly ☐ Partially ☐ No, not at all	The printing and distribution of the new version of the TB registers is pending.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
collection forms and tools?			
A3. Which TB cases are included in the national TB surveillance data? (*Tick all that apply*)	☒ All TB cases from all parts of the country ☐ Some TB cases are excluded ☐Some part(s) of the country are excluded (one district does not report) ☐Some case types are excluded ☐Some care providers, e.g. non-NTP providers, prisons, private practitioners, are excluded. ☐ Others: _____	In the aggregated data all TB cases notified are registered. The gap between the number of notified cases and the point estimate incidence of WHO for 2017, was 14%. The private sector in Rwanda does not seem to play an important role in TB, however this has not been formally quantified. In Kigali city, 3 CDT of the private sector report to the TB&ORD and they receive TB drugs from the program. TB cases not started on treatment: Patients diagnosed but not started on treatment (because they are early lost to follow up or because of early deaths) are recorded as stated by the TB&ORD central team and confirmed in field visits. The TB register book is a TB case register and not a treatment register. Quarterly, TB cases in the lab book are matched to the TB case register book, and if they find one on the TB lab and was not on the book, they register the TB case. TB in prisons are all registered and reported to the TB&ORD. In the old eTB database: Those with no ID are not registered (<16 years old, prisoners, foreigners, homeless) Authorization to use the “application number” for a Rwandan ID has been given which would reduce the number of persons with no ID	Continue working with non CDT private providers, especially where the proportion of this is high, such as in Kigali, for the earlier referral of presumptive TB cases. Allow the new eTB to register people who do not have ID.
A4. What types of TB	☐ Patient level data that allow multiple episodes	Aggregated data is available for all the country.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
data are available at the national level? *(Tick all that apply)*	of TB in the same person to be identified are available ☐ Case level data are available for all of the country ☒ Case level data are available for parts of the country ☒ Aggregated data are available, i.e. summaries for groups of cases	The old eTB is a case level database that allow multiple episodes of TB in the same person has a ~70% coverage. It is about to be replaced by a new version.	
A5. What is the expected frequency of data transmission from the first sub-national administrative level to the national level? *(Tick all that apply)*	☐ Real-time ☐ More often than monthly ☐ Monthly ☒ Quarterly ☐ Less often than quarterly	Aggregated data is submitted from all CDT to the district level (hospital) and then to the central level quarterly. Data on the (old) eTB is entered with different periodicity, depending on the workload (can be daily, weekly or less frequently).	
A6. At what levels of the system are TB	☒ From the service unit upwards	2-day quarterly meetings are systematically conducted at 42 hospitals and all the CDT and CT reporting to that hospital attend with their paper registers.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
data systematically verified for accuracy, timeliness and completeness ? *(Tick all that apply)*	☐ From the 1st administrative level upwards ☐ From the 2nd administrative level upwards ☐ Only at the national level ☐ Not at any level	For the quarterly meetings, most supervisory staff cover 2 district hospitals and some 3 hospitals.	
A7. What types of quality assurance procedures are systematically undertaken for TB data? *(Tick all that apply)*	☐ Quality controls are in place for the electronic surveillance system (automated checks at data entry and batch checking, plus SOPs) ☒ Data are reviewed during supervisory monitoring visits to service units and sub-national levels (How often?) ☒ Data are reviewed during meetings with TB staff ☐ Other (specify: _____)	Quarterly meetings are systematically conducted at 42 hospitals and all the CDT and CD reporting to that hospital attend with they paper registers. Data from paper registers, aggregated reports and eTB is cross checked for accuracy and completeness and feedback is given. Once the quality of the quarterly report is checked, it is entered in the electronic aggregated database. During quarterly meetings, they also check the best practices so they share it. The meetings are systematized in reports.	Develop SOP for quality assurance of the new eTB considering the learning lessons of the old eTB.
A8. Is feedback on TB data	☒ Yes, completely ☐ Mostly ☐ Partially	A mandatory document guidance states that before reporting aggregated data to HMIS, the data manager and health care providers have to sit together discuss and validate their data, before 5th of their next month.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
quality systematically provided to all lower reporting levels?	☐ No, not at all	All data from paper registers to aggregated reports and eTB is checked in quarterly meetings and feedback is given. This is not systematically documented.	
A9. When are national TB case data for a given calendar year considered ready for national analyzes and reporting?	☐ Before April the following calendar year ☐ Before May the following calendar year ☐ Before June the following calendar year ☒ On or **after** beginning of June the following calendar year	The fiscal year in Rwanda starts in July and finishes in June. Therefore, annual data is considered to be ready at the end of June. In September/October they present the annual report and M&E indicators to all district hospitals.	
A10. Are there national guidelines for recording and reporting of TB data e.g. documentation or instructions?	☒ Yes. They are posted on the internet. ☐ Yes. They are available in a manual or other reference document, e.g. training materials ☐ No	Yes. http://www.rbc.gov.rw/IMG/pdf/guidelines_tb_2009_and_post_2009_instructions.pdf	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
(Tick all that apply)			
A11. Does the national TB programme have a training plan which includes staff involved in data collection and reporting at all levels of the reporting process?	☒ Yes ☐ No	The SOP for M&E activities was updated in 2013 including the new WHO definitions. A training for TB Managers and data entry staff will be conducted for the new e system.	
A12. How often do TB programme staff receive training specifically on TB surveillance (i.e. recoding and reporting of TB data)?	☐ Training is routinely received at national and sub-national levels (How often?) ☒ Training is received on an ad hoc basis ☐ Staff receive training when they are hired ☐ No routine training is received	There is a new system for e training for HIV, TB, other divisions. Every nurse can use the elearning and they validate the number of hours trained and receive credits for it. They aim to have at least a video conference in each hospital. They expect to have this fully implemented by the end of this fiscal year. No formal training for new staff It depends on each facility or the district hospital can request the need of training to the national level or the hospital can organize an ad hoc training. There is a plan to train people every two years but it does not have an assigned budget. In the current fiscal year, the MoH has changed the structure of health facilities staff, so they have had TB staff changes and they will need to be retrained.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
(Tick all that apply)			
A13. How many staff work on TB surveillance at the national level? *(Tick all that apply)*	☒ Epidemiologist, full-time 1 ☐ Epidemiologist, part-time ☒ Statistician, full-time 1 ☐ Statistician, part-time ☒ Data manager IT/developer, full-time 1 ☐ Data manager, part-time ☐ Data quality officers, full-time planned but not currently in post. Data quality officers, part-time ☐ Other (specify:)	Three staff work on TB surveillance at the national level: 1 Statistitian Full time paid by government who does the data management of both the aggregated and eTB data, supervises data quality control and data analysis. 1 Epidemiologist full time by government, who does planning and supports with calculation of Global Fund indicators. 1 IT staff in charge of IT administrating eTB and HMIS, full time. Contract for one year from HMIS, but assigned full time to TB program. Approximately 20 TB staff with sufficient knowledge on indicators and data analysis assist in the quarterly meetings. All trained in analysing data in DHIMS analysis etc. At provincial level: 1 TB person per province, which is in charge of no less than 4, and up to 7-8 districts.	
A14. Is a national TB surveillance report routinely produced and disseminated on an annual basis?	☒ Yes ☐ No	The annual report is disseminated in the September/October meetings. The 2016 and 2017 version are not yet available on line.	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
A15. Are there written goals of the surveillance system?	☐ Yes ☒ No	The M&E SOP describe the rationale of TB surveillance, however clear goals related to TB surveillance in the community and in the health facilities as well as TB reporting considering the transition from the old eTB to the new eTB and the parallel period with the aggregated RHMIS, would benefit the monitoring of activities taken to reach these goals by the TB&ORD.	
A16. Policies and procedures are in place to protect the confidentiality of all surveillance data e.g. records, registers.	☐ Yes, completely ☐ Mostly (names only appear on TB registers/treatment cards/lab registers at facility level) ☒ Partially ☐ No, not at all	The HMIS department provides passwords for the eTB and aggregated data in HMIS. New users fill a log book, and sign an agreement of confidentiality. When a staff leaves, there is not system for their password to be cancelled and they may share it with the new staff who may have not signed an agreement. To address this, recently, to make sure passwords are owned by active staff and not former staff the HIMS deactivates all users periodically so that staff has to request the new password. The place where they keep paper registers have keys and this is checked periodically though there could be more details in the SOP.	Enforce the update of password to make sure that former staff or their automatic cancelation once their contract expires and data sharing for surveillance purposes excluding names and encrypting data that contains ID or other identifiers.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
A17. Is there a long term financial plan and budget in place to support TB surveillance activities?	☒ Yes ☐ No	Yes. They have (HMIS and TB) secure funding until 2020. Surveillance is integrated in the system and does not have an isolated budget.	The implementation and scaling up of the new eTB will require substantial dedication from human resources. A staff fully dedicated will need to manage the new eTB, conduct data audits, solve issues, questions from users, among others. Routine analysis of data (to have the full benefit of the new eTB) and training of

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
			staff at CDT in data analysis and use for decision making requires a dedicated person
A18. When was the last time the TB surveillance system was evaluated?	☒ Within the past 5 years ☐ Within the past 5-10 years ☐ Never (in a systematic and standardised way, but as part of programme reviews)	A TB epidemiology review following the WHO S&B Terms of Reference, was done in 2014. In 2016, an M&E evaluation update was done, as part of the programme review done that year.	

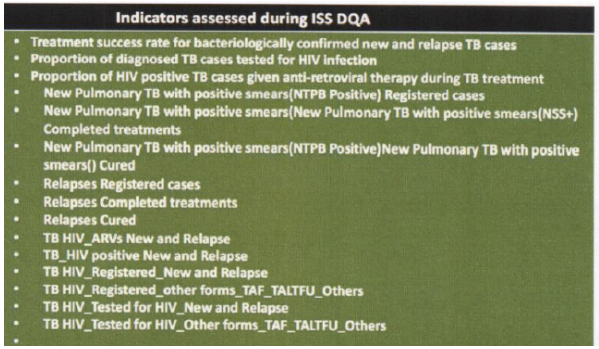
PART B (Section 1): CHECKLIST FOR TB SURVEILLANCE AND VITAL REGISTRATION SYSTEMS

For each standard, please assess whether the system is able to satisfy the associated benchmark(s), using the methods recommended in the user guide. Indic 'Met', 'Partially met', "Not met" or 'Not applicable' in the results column. Describe the key results and any action recommended to improve the quality of t system in the last two columns.

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
TB SURVEILLANCE SYSTEM DATA QUALITY				
B1.1 Case definitions are consistent with WHO guidelines	All three benchmarks should be satisfied to meet this standard: • Laboratory-confirmed cases[i] are distinguished from clinically diagnosed cases • New cases are distinguished from previously treated cases • Pulmonary cases are distinguished from extra-pulmonary cases	☒Met ☐Partially met ☐Not met	The updated TB manual for 2017 includes the case definitions consistent with WHO guidelines and the three benchmarks were met.	
B1.2 TB surveillance system is designed to capture a minimum set of variables for	Data are routinely collected for at least each of the following variables: • Age or age group • Sex • Year of registration • Bacteriological results	☒Met ☐Partially met ☐Not met	TB case paper formats include the standard set of variables and these are reported in the quarterly reports entered in HMIS aggregated database.	

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
reported TB cases	• History of previous treatment • Anatomical site of disease • For case-based systems, a patient identifier			
B1.3 All scheduled periodic data submissions have been received and processed at the national level	*For paper-based systems:* • 100% of expected reports from each TB basic management unit have been received and data aggregated at national level *For national patient-based or case-based electronic systems that import data files from sub-national (e.g. provincial or regional) electronic systems:* • 100% of expected data files have been imported	☒Met ☐Partially met ☐Not met ☐Not applicable	A completeness report comparing expected reports per each of the five provinces with the actual reports received as well as the timeliness of the reports is prepared quarterly by the NTP. For Oct-Dec 2017, 100% reports were received and 100% of reports from the West and North provinces were on time, while 95% of reports from the East province were on time, 98% of the South province and 85.2% of Kigali city were on time.	

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
B1.4 Data in quarterly reports (or equivalent) are accurate, complete, and internally consistent *(For paper-based systems only)*	All benchmarks should be satisfied to meet this standard: • Sub-totals of the number of TB cases by age group, sex, and case type equals the total number of reported TB cases in ≥95% of quarterly reports (or equivalent) from BMUs. • The number of TB cases in ≥95% of quarterly reports (or equivalent) matches the number of cases recorded in BMU TB registers and source documents (patient treatment cards and laboratory register) • Data for a minimum set of variables are available for ≥95% of the total number of reported TB cases in quarterly reports.	☒Met ☐Partially met ☐Not met ☐Not applicable	In Rwanda, TB data quality is assessed through two systems of the Rwandan Biomedical Center (RBC) of the MoH 1. A Integrated Supportive Supervision & Data Quality Assessment (ISS&DQA) which is cross cutting to all programs and conducted biannualy since 2014 by the M&E unit under PMEBS (Planning, Monitoring and Evaluation and Business Strategy). 2. The TBORD revision of consistency between data sources and hard copies of quarterly reports conducted at every district with all their CDT and CT attending. 1. The July 2017 ISS&DQA Report was reviewed for this epi review. The objectives of the ISS&DQA are to inform the health sector needs and supports of health care providers, build a culture of continous quality improvement, ensure quality of health data reports, compare trends in quality improvement and provide constructive feedback and recommendations to staff and programs. This is done by implementing a checklist at health facility levels where they conduct interviews, observations and data collection that captures information adapted from WHO SARA tool (Services Availability and Readiness Assessment) and TB services are among the 16 components they review. Furthermore, a standardized Excel sheet is used to collect data on the quality of selected indicators where source documents (registers, patient files and HMIS hard copies) are compared to data reported to electronic HMIS. A client satisfaction questionnaire and a community health checklist is also implemented. The 2017 assessment included 43 district hospitals and 42 health centers including community. For TB services they assessed the	Check SOP and documentation See indicators. See what could contribute to improve the current routine data quality assessment. Conduct a data audi for a national representative sample of health facilities once the new eTB is implemented.

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
			availability of TB management guidelines, algorithms and TB infection control practices. National TB guidelines were present in 95% of the health facilities included in the assessment. In the Lab component of the assessment, 98% had Xpert MTB/RF testing available and 98% had fluorescence microscopy. The following TB indicators were assessed by comparing sources and reports described above:  Indicators assessed during ISS DQA • Treatment success rate for bacteriologically confirmed new and relapse TB cases • Proportion of diagnosed TB cases tested for HIV infection • Proportion of HIV positive TB cases given anti-retroviral therapy during TB treatment • New Pulmonary TB with positive smears(NTPB Positive) Registered cases • New Pulmonary TB with positive smears(New Pulmonary TB with positive smears(NSS+) Completed treatments • New Pulmonary TB with positive smears(NTPB Positive)New Pulmonary TB with positive smears() Cured • Relapses Registered cases • Relapses Completed treatments • Relapses Cured • TB HIV_ARVs New and Relapse • TB_HIV positive New and Relapse • TB HIV_Registered_New and Relapse • TB HIV_Registered_other forms_TAF_TALTFU_Others • TB HIV_Tested for HIV_New and Relapse • TB HIV_Tested for HIV_Other forms_TAF_TALTFU_Others Source: 2017 ISS &DQA report For “new PTB with positive smears that completed treatment”, 96% health facilities had less than 5% discrepancies. For “new PTB with positive smears that were cured: 95% facilities had less than 5% discrepancies. The most frequent reason for discrepancies (this was reported for discrepancies of all indicators, not only for TB): 64% were attributed to counting errors, 11% to misinterpretation of indicator, 8% to missing data collection tool, 7% to missing information in registers, 6% to typing error, 3% to the use of outdated data collection tools and 1% to erasure in registers.	

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
			Before conducting each ISS&DQA, the PMEBS requests the TBORD their priority indicators. 2. The TB&ORD systematically reviews the quality of their quarterly reports during district meetings. During this meetings, discrepancies for key indicators from data sources (TB registers, lab registers and some treatment cards) and manually prepared quarterly reports, are registered in tables and progress is reviewed in the next quarterly meeting. Assessment of the standard during the 2018 epi review: During the epi review, data sources and HMIS quarterly reports for the Oct-Dec 2017 quarter were checked in 6 health facilities visited (Kabyagi hospital, Muhanga prison, Kivumu health center, La Médicale private clinic, Kibagababa hospital, Kanyinya health center). Data were consistent for subtotals of TB cases, age, sex and case types. However, we did not compare the data sources with the paper copies of the quarterly reports and only the electronic HMIS reports. In the TBORD quarterly meetings, data from paper quarterly report is checked with data sources, before being entered in HMIS, therefore, mistakes would have We consider the ISS & DQA to be a national representative assessment based on SARA. For which the standard would be met. However, the TB indicators assessed in 2017 could be changed for future ISS&DQA to match those requested for this standard: • Availability of age, sex, case type for each TB case registered in source documents. • Consistency between sub-totals of the number of TB cases by age group, sex, and case type equals the total number of reported TB	

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
			cases from data source to hard copy of quarterly reports to electronic HMIS version of quarterly reports. Once the new eTB is implemented, thorough data quality assessment should be conducted especially in the initial phases. This can be included in both the ISS&DQA and in the TB&ORD quarterly meetings.	
B1.5 Data in national database are accurate, complete, internally consistent, and free of duplicates *(For electronic case-based or patient-based systems only)*	All benchmarks should be met to reach this standard: • Data validation checks are in place at national level to identify and correct invalid, inconsistent, and missing data in the minimum set (B1.2) • For each variable in the minimum set (standard B1.2), > 90% of case records are complete, valid and internally consistent for the year being assessed • <1% of case records in the national dataset for the year being assessed are	☐Met ☐Partially met ☐Not met ☒Not applicable <u>but if we used the old eTB it would most likely not be met</u>	For the old eTB, which will be changed to the new eTB in the following month, duplicates were not possible to be assessed as ID were not available, and the use of unique ID is reported to be low in eTB. Data to assess the completeness of age, sex, year of registration, bacteriological status, history of previous treatment and site of disease in eTB was not available. Therefore, the standard was not met. Yet, this should be re evaluated for the new eTB. The new eTB contains validation for dates and consistency of data.	Monitor the completeness of age sex, year of registration, bacteriological status, history of previous treatment and site of disease upon implementation of eTB. Include validations i the new eTB Age: set limits from to 100. Include months for <1 year old. Year of registration: only allow the current year of registration

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
	unresolved potential duplicates.			Bacteriological statu should match the case definition. Allow the registratic of persons with no ID, develop an ID system for them tha can allow the registration of more than one TB case.
B1.6 TB surveillance data are externally consistent	• Among new TB cases, the percentage of children is between 5-15% in low- and middle-income and <10% in high-income countries	☒Met ☐Not met	The proportion of children <15 years old of all TB cases was 7.1 % in 2017, 5.8% in 2016 and 6.0% in 2015, 5.7% in 2014 and 7.7% in 2013, therefore the standard is met.	
B1.7 Number of reported TB cases is internally consistent	*If vital registration data are* available, then the following benchmark should be satisfied for this standard to be met: 1. Year-to-year change in the national number of reported TB cases is consistent with year-to-year change	☒Met ☐Partially met ☐Not met	Aggregated data entered in the electronic HMIS database was analyzed. This electronic system was piloted in 2013 and officially implemented in 2014. Pulmonary to extrapulmonary TB ratio: 2013: 3.5 2014: 5.1 2015: 5.3 2016: 6.2 2017: 6.1	Enter missing report for 2013 and if possible before 201 to be able to analyze trends.

<table>
<tr><th>STANDARD</th><th>BENCHMARK(S)</th><th>RESULTS</th><th>RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS</th><th>ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)</th></tr>
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<td>in national TB mortality (HIV-negative, from national vital registration) i.e. trajectories with the same direction.

If vital registration data are not available, then the following benchmarks should be satisfied for this standard to be met:
2. Ratio of notified pulmonary to extra-pulmonary TB cases
3. Ratio of male to female TB cases
4. Proportion of childhood TB out of all TB cases
5. Year-to-year change in the case notification rate for all forms of TB
6. Year-to-year change in the case notification rate for</td>
<td></td>
<td>Male to female TB ratio:
2013: 1.6
2014: 1.9
2015: 1.5
2016: 2.0
2017: 2.0

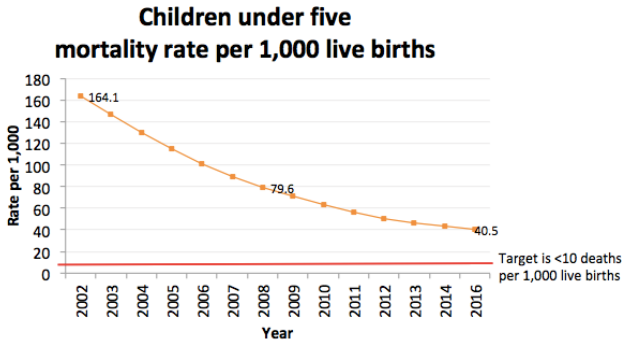
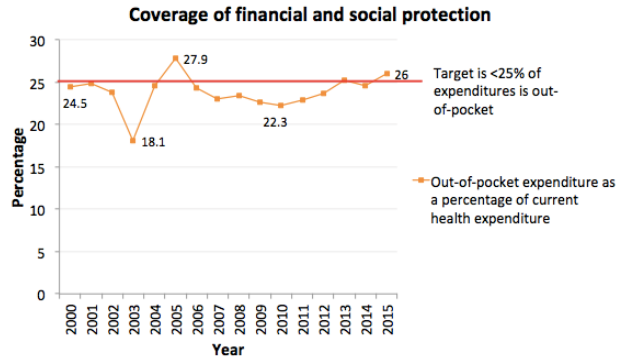
Child to all TB:
2013: 7.7%
2014: 5.7%
2015: 6.0%
2016: 5.8%
2017: 7.1%

Year-to-year change in the case notification rate for all forms of TB:
<table>
<tr><td></td><td>CNR</td><td>Change</td></tr>
<tr><td>2013</td><td>55.9</td><td>-</td></tr>
<tr><td>2014</td><td>54.5</td><td>-1.4</td></tr>
<tr><td>2015</td><td>50.1</td><td>-4.4</td></tr>
<tr><td>2016</td><td>51.3</td><td>+1.2</td></tr>
<tr><td>2017</td><td>48.8</td><td>-2.5</td></tr>
</table>

Year-to-year change in the case notification rate for new smear positive TB:
<table>
<tr><td></td><td>New sm TB</td><td>Change</td></tr>
<tr><td>2013</td><td>31.4</td><td></td></tr>
</table>
</td>
<td></td>
</tr>
</table>

<table>
<tr><th>STANDARD</th><th>BENCHMARK(S)</th><th>RESULTS</th><th>RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS</th><th>ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)</th></tr>
<tr><td></td><td>new smear-positive TB
and if data are available,
7. Ratio of the number of people with presumptive TB to total notifications of TB cases</td><td></td><td><table><tr><td>2014</td><td>36.4</td><td>+4.9</td></tr><tr><td>2015</td><td>33.3</td><td>-3.0</td></tr><tr><td>2016</td><td>34.3</td><td>+0.9</td></tr><tr><td>2017</td><td>36.8</td><td>+2.5</td></tr></table>
<u>For the next benchmark, the data source was the excel of aggregated national data:</u>

Ratio of the number of people with presumptive TB to total notifications of TB cases.
2013: 30.9
2014: 39.9
2015: 32.2
2016: 27.2
2017: 27.9</td><td></td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>B1.8 All diagnosed cases of TB are reported</td><td>Both benchmarks should be satisfied to meet this standard:
• TB reporting is a legal requirement
• <u>≥</u>90% of TB cases are reported to national health authorities, as determined by a national-level investigation (e.g. inventory study)</td><td>☐Met
☒Partially met
☐Not met</td><td>There is a Public Health Act Law and a list of epidemic prone diseases. It is not clear if this makes TB reporting legally mandatory.</td><td></td></tr>
</table>

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
	conducted in last 10 years			
B1.9 Population has good access to health care	Both benchmarks should be satisfied to meet this standard: • Under-5 mortality rate (probability of dying by age 5 per 1000 live births) is <10 • <25% total health expenditure is out-of-pocket	☐Met ☒Partially met ☐Not met	The first benchmarks is not met, under 5 mortality was 40.5 per 1000 live births in 2016, and 50 per 1000 live birth as per the Rwanda DHS 2014-2015.  The second benchmark was met from 2000 until 2005 where it went up to 27.9% and then again went below 25% until 2016 which was 26%.  	

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS	ESTIMATED BUDGET REQUIREMENTS TO ADDRESS KEY ACTION(S)
B1.10 Vital registration system has high national coverage and quality	Both benchmarks should be satisfied to meet this standard: • Cause of death documented in ≥90% of total deaths recorded in a) national vital registration system OR b) sample vital registration system • <10% of deaths have ICD codes for ill-defined causes (defined as ICD-9 780-799 and ICD-10 R00-R99)	☐Met ☐Partially met ☒Not met	The CRVS has recently been strengthened to register health facility deaths after a thorough assessment in 2014. Nevertheless, more than 70% of deaths are expected to occur in the community. A law on burials makes it mandatory to report all deaths by burial companies, however, this is not fully enforced yet.	

[i] i.e. by smear, culture or WHO-endorsed molecular test (e.g. Xpert MTB/RIF).

CHECKLIST SUMMARY – Rwanda, September 2018				
STANDARD	**MET**	**PARTIALLY MET**	**NOT MET**	**NOT APPLICABLE**
B1.1	☒	☐	☐	
B1.2	☒	☐	☐	
B1.3	☒	☐	☐	☐
B1.4	☒	☐	☐	☐
B1.5	☐	☐	☐	☒
B1.6	☐		☐	
B1.7	☒	☐	☐	
B1.8	☐	☒	☐	

B1.9	☐	☒	☐	
B1.10	☐	☐	☒	
B2.1	☒	☐	☐	
B2.2	☒	☐	☐	
B2.3	☐	☐	☒	

Appendix 6. *De briefing presentation*

Tuberculosis epidemiological review Rwanda, 3-14 September 2018

Kassim Sidibe (CDC) , Larissa Otero (WHO consultant), Lizzie Smith (CDC), Alice Wang (CDC)

END TB

Objectives of the review

1. Describe and assess the capacity of national TB surveillance and vital registration systems to measure TB burden (incidence and mortality)
2. Assess level/trends in TB disease burden
3. Assess whether recent trends are plausibly related to changes in TB-specific interventions considering external factors (economic/demographic trends)
4. Define the investments needed to directly measure trends in TB disease burden in future

WHO Implementation guidance for national tuberculosis epidemiological reviews

Rationale of the TB epi review

- Understanding the level and trends of TB burden and how these are influenced by interventions is critical for
  - TB control, development of National Strategic Plans
  - Appropriate allocation of funding
- Part of the "Concept Notes" for funding applications to the Global Fund

→ In 2013 the WHO Global Task Force on TB Impact Measurement developed **standardised ToR for TB epidemiological and impact analyses**

Methods

- Implementation of Standards and Benchmarks for TB surveillance and vital registration systems checklist
- Interviews: TB&ORD, HIV division, CVRS, National Reference Lab
- Field visits: hospitals (Kabgayi, Kibagabaga), health centers (Kivumu, Kanyinya, Muhanga prison), La Médicale private clinic
- Data analysis: TB&ORD, WHO Global TB database, Global Health Observatory, World Bank, UNAIDS,
- Desk review: TB&ORD, DHS, CVRS

Rwanda

	2016
Population	12 million
Estimated TB incidence	50 (42-59) per 100,000 pop
Notified TB cases	6018
Proportion of notified out of all estimated TB cases	98.5%
Estimated TB mortality (excluding HIV)	1.7 (1.6-3.2) per 100,000 pop
Estimated HIV TB mortality	1.1 (1.6-1.7) per 100,00 pop
Treatment success	88%
MDR prevalence among n ew cases	1.4% (0.7-2.1)
MDR prevalence among r etreated cases	10.7% (5.0-19.4)%
HIV prevalence in adults 15-49 years old	3%

Objective 1

Describe and assess the capacity of national TB surveillance and vital registration systems to measure TB burden (incidence and mortality)

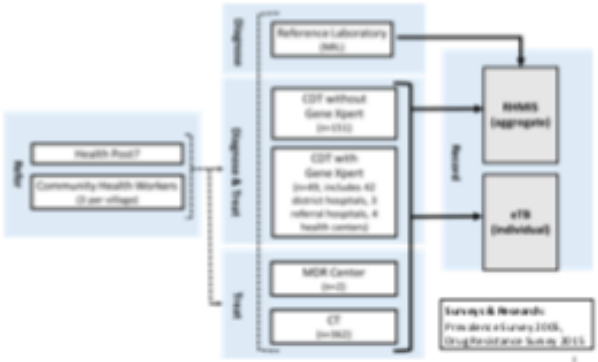
Standards and benchmarks for TB surveillance and vital registration systems - WHO

STANDARDS AND BENCHMARKS FOR TUBERCULOSIS SURVEILLANCE AND VITAL REGISTRATION SYSTEMS

CHECKLIST AND USER GUIDE

Part A:
Characteristics of the TB surveillance system
Part B:
Checklist for TB surveillance and and vital registration systems, 13 items

Health facilities, data, patient/data flow



Roles & Responsibilities for TB recording and reporting

TB reporting

Current status of data analysis and use at all levels

- An annual report is prepared at central level analysing data for case notifications, treatment outcomes, TB prevention – mostly at national level
- Key indicators are discussed in quarterly meetings at district level
- HMIS (and new eTB) have dashboards installed in all computers where data is entered

Strengths and opportunities of the TB surveillance system in Rwanda

- Strengths:
  - Political commitment at all levels
  - National Strategic Plan with assigned budget
  - Strong interaction between programs & institutions (PMEBS & HMIS, HIV, National Reference Lab, CVRS)
  - Data quality assurance: PMEBS & TB&ORD
  - Quarterly supervision, assessment and feedback of data quality at district level & mentorship
  - Extended use of Xpert MT/Rif
  - Routine active case finding
  - In transition to upgraded case based electronic system
- Opportunities:
  - Progress on the limited availability of unique ID
  - Working towards interoperability of electronic systems (TB&ORD, UHMIS, National Identify Agency, CVRS)
  - CVRS new system to register hospital and community deaths, in progress

TB surveillance checklist

Standards & associated benchmarks

	GROUPING	STANDARDS
core	Data quality	B1.1 Case definitions are consistent with WHO guidelines
		B1.2 TB surveillance system is designed to capture a minimum set of variables for all reported TB cases
		B1.3 All scheduled periodic data submissions, e.g. electronic data files or quarterly paper reports, have been received and processed at the national level
		B1.4 Data in quarterly reports (or equivalent) are accurate, complete and internally consistent (For paper-based systems only)
		B1.5 Data in national database are accurate, complete, internally consistent and free of duplicates (for electronic case-based or patient-based systems only)
		B1.6 TB surveillance data are externally consistent
		B1.7 Number of reported TB cases is internally consistent (within country)
	System coverage	B1.8 All diagnosed cases of TB are reported
		B1.9 Population has good access to health care
	Vital registration	B1.10 Vital registration system has high national coverage and quality
supplementary	Special sub populations	B2.1 Surveillance data provide a direct measure of drug resistant TB in new cases
		B2.2 Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases
		B2.3 Surveillance data for children reported with TB (defined as ages 0-14

Data quality B1.1-B1.7

- **B1.1 Case definitions are consistent** with WHO guidelines
  Met ✓
  - Lab confirmed/clinically diagnosed. New/previsouly treated, PTB/EPTB
- **B1.2** TB surveillance system is designed to **capture a minimum set of variables** for reported TB cases. Met ✓
  - Age, sex, year of registration, bacteriological results, history of previous treatment, site of disease
- **B1.3** All scheduled periodic **data submissions have been received and processed** at the national level. Met ✓
  - Completeness report, comparing expected vs received quarterly reports 2017 = 100%

Data quality B1.1-B1.7

- **B1.4** Data in quarterly reports **are accurate, complete, and internally consistent** *(For paper-based systems only)*. Met ✓
  - Sub-totals of TB cases by age group, sex and case type equals the total number of reported TB cases in ≥95% of quarterly reports from BMUs.,
  - Number of TB cases in ≥95% of quarterly reports matches the number of cases recorded in TB registers and source documents
  - Data for a minimum set of variables are available for ≥95% of the total number of reported TB cases in TB registers

Source data for this benchmark: independent data audit or a Service Availability and Readiness Assessment (SARA)

Findings:

- The M&E unit of the PMEBS (Planning, Monitoring and Evaluation and Business Strategy) implements a biannual Integrated Supportive Supervision & Data Quality Assessment (ISS&DQA), based on SARA since 2014
- Quarterly data quality assessments at district level

Data quality B1.1-B1.7

- **B1.5** Data in national database are **accurate, complete, internally consistent, and free of duplicates. NA**
  - Data validation checks are in place at the national level to identify and correct invalid, inconsistent and/or missing data in the minimum set
  - For each variable in the minimum set, ≥90% of case records are complete, valid and internally consistent for the year being assessed
  - <1% of case records in the national dataset for the year being assessed are unresolved potential duplicates

Not applicable because of current migration from old eTB to new eTB. Old eTB would not meet the standard.

Data quality B1.1-B1.7

- **B1.6** TB surveillance data are **externally consistent**
  - Among new TB cases, the percentage of children diagnosed with TB is between 5–15% in low- and middle-income. Met ✓

Data quality B1.1-B1.7

- **B1.7** Number of reported TB cases is **internally consistent**
  - Ratio of notified pulmonary to extrapulmonary TB cases
  - Ratio of male to female TB cases
  - Proportion of childhood TB cases out of all TB cases
  - Year-to-year change in the case notification rate for all forms of TB
  - Year-to-year change in the case notification rate for new smear-positive TB

Results in the next slide

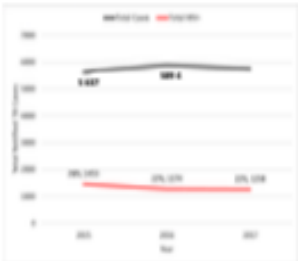
B1.7 Number of reported TB cases is **internally consistent.** Met ✓

Year	P:TB: EP:TB	Male : female	% child to all TB cases	Year-to-year change in the CNR for all forms of TB	Year-to-year change in the CNR for new smear positive TB	Ratio of presumptive TB to total TB notifications
2013	3.5	1.6	7.7%			30.9
2014	5.1	1.9	5.7%	-1.4	+4.9	39.9
2015	5.3	1.5	6.0%	-4.4	-3.0	32.2
2016	6.2	2.0	5.8%	+1.2	+0.9	27.2
2017	6.1	2.0	7.1%	-2.5	+2.5	27.9
	✓	✓	✓	✓	✓	✓

Data Consistency Check

Indicator (2016)	Reported WHO	HMIS	Difference
TB notifications	5763	5698	-102
% HIV+	2.5%	2.2%	0%

Source: WHO – by calendar year



Source: HMIS – by fiscal year

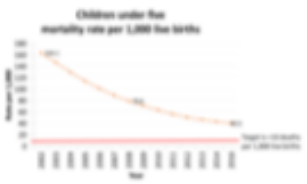
System coverage B1.8-B1.10

- **B1.8** All diagnosed cases of TB are reported
  - TB is a legal requirement ✗
  - ≥90% of TB cases are reported to NTP, as determined by a national level investigation (e.g. inventory study, conducted in the past 10 years) ✗

  Public Health Act requires reporting of epidemic prone diseases

System coverage B1.8-B1.10

B1.9 Population has good access to health care
- Under 5 mortality rate is <10 ✗
- <25% total health expenditure is out-of-pocket ✓



Data Source: UNDP and World Bank

System coverage B1.8-B1.10

- **B1.10** Vital registration system has high national coverage and quality. Not met
  - ≥90% documented in national vital registration system or sample vital registration system ✗
  - <10% of deaths have ICD codes for ill-defined causes (defined as ICD-9 780-799 and ICD-10 R00-R99) ✗

Subpopulations B2.1-B2.3

- **B2.1** Surveillance data provide a direct measure of drug resistant TB in new cases. Met ✓
  - Rifampicin susceptibility (Pos/Neg) documented for ≥75% of new pulmonary TB cases ✗
  - Rifampicin susceptibility (Pos/Neg) documented for a nationally representative drug resistance survey of new pulmonary TB cases ✓

Subpopulations B2.1-B2.3

- **B2.2** Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases
  - HIV status (Positive/Negative) is documented for ≥80% of all notified TB cases ✓

Subpopulations B2.1-B2.3

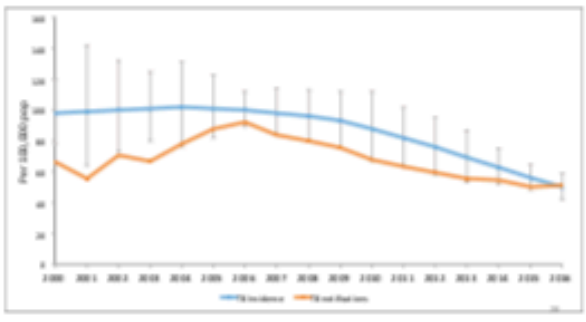
- **B2.3** Surveillance data for children (<14 y.o.) reported with TB are reliable and accurate or all diagnosed childhood TB cases are reported
  - Ratio of age groups 0–4 to 5–14 years is in the range 1.5–3.0 ✗ In 2016, it was 1.3
  - ≥90% of childhood TB cases are reported to NTP, as determined by a national-level investigation (e.g. inventory study) ✗

Rwanda TB surveillance S&B 2013 → 2018

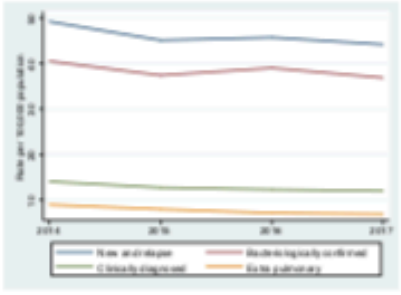
		S&B 2013			S&B 2018		
		Met	Partially met	Not met	Met	Partially met	Not met
Data quality	B 1.1	X			X		
	B 1.2	X			X		
	B 1.3	X			X		
	B 1.4		X		X		
	B 1.5	NA			NA		
	B 1.6	X			X		
	B 1.7		X		X		
System coverage	B 1.8		X			X	
	B 1.9		X			X	
Vital registration	P 1.10			X			X
Special subpopulations	B 2.1	X			X		
	B 2.2	X			X		
	B 2.3			X			X

Objective 2
Assess level/trends in TB disease burden

Estimated incidence and notification rates Rwanda 2000-2016



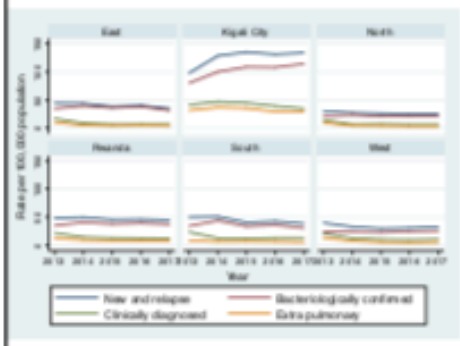
TB notification rates, Rwanda 2014-2017



Limitations for calculation of subnational and age/sex TB rates

- 2012 census and the projections for national and urban
- Population projections by sex and age groups were only available at national level
- For this analysis, projections at province level considered constant population growth from 2012 until 2017.
  - Kigali 13% growth per year
  - Rwanda 2.5% growth per year
  - Proportions of population per age group and sex were considered constant from 2012-2017, for Kigali and for non Kigali provinces.

TB notification rates per province, Rwanda **2013**-2017

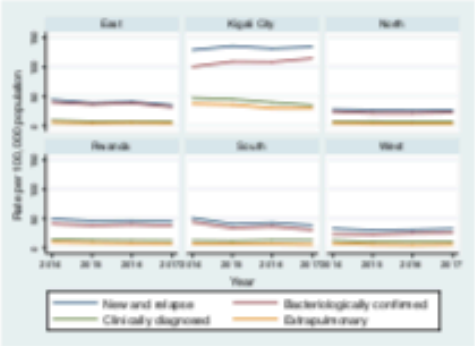


2013 data is incomplete because HMIS was officially implemented in 2014.

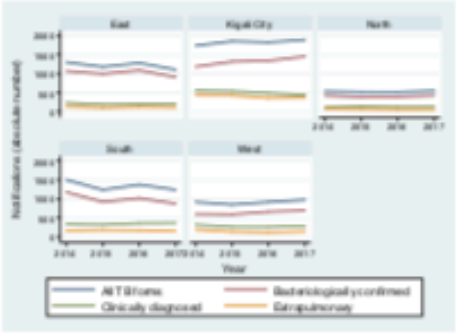
Seems to affect mainly Kigali.

Completing data entering for 2013 would allow long term monitoring of trends – especially in Kigali.

TB notification rates per province, Rwanda 2014-2017



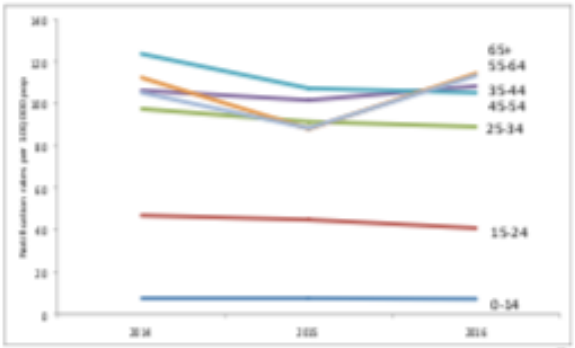
TB notification (absolute numbers) per province, Rwanda 2014-2017



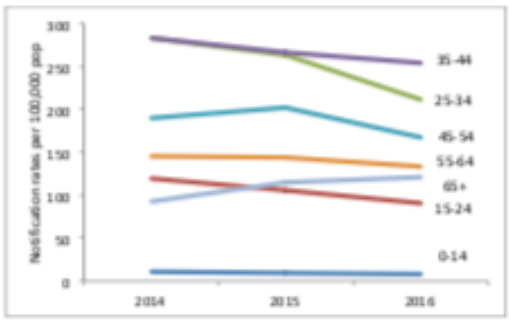
Contribution of provinces to TB notifications relative to the total population

TB notification rates in Kigali City, per district, 2014-2017

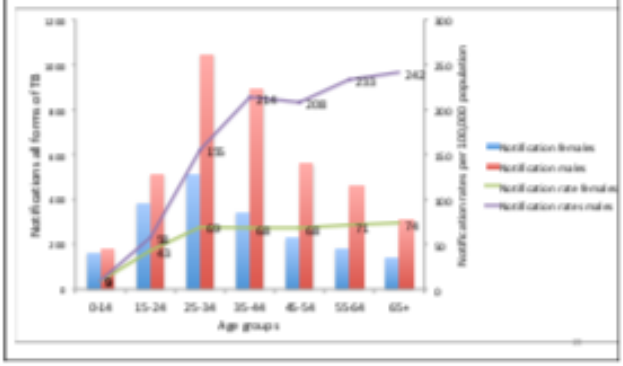
Trends in notification rates per age group, Rwanda 2014-2016



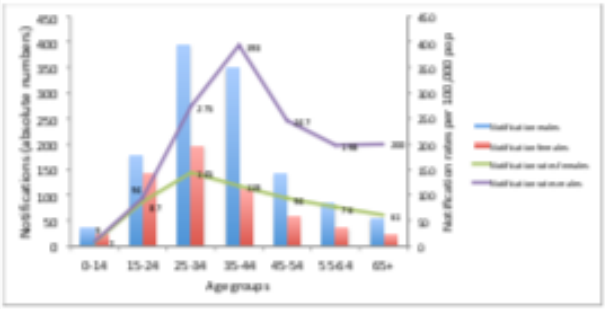
Trends in notification rates per age group, Kigali 2014-2016



TB notifications and notification rates (all forms), by sex and age group, Rwanda 2016



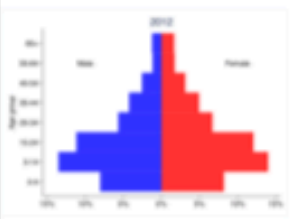
TB notifications and notification rates (all forms), by sex and age group, Kigali 2016

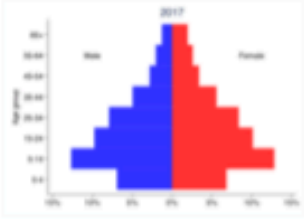


Childhood TB

Proportion of TB in <15 years old out of all TB cases per province, Rwanda, 2013-2017

Demographic changes in Rwanda 2012- 2017





- 44% were <15 years old
- 2.8% were 65+ years old
- U-5 mortality 2012: 50.9
- Fertility rate 2010: 4.6 (DHS)

- 39% were <15 years old
- 3.9% were 65+ years old
- U-5 mortality 2016: 40.5
- Fertility rate 2015: 4.2 (DHS)

GNI per Capita - Rwanda, 2008—2016

Percent of the Population Under the National Poverty Line 2013/2014 EICV

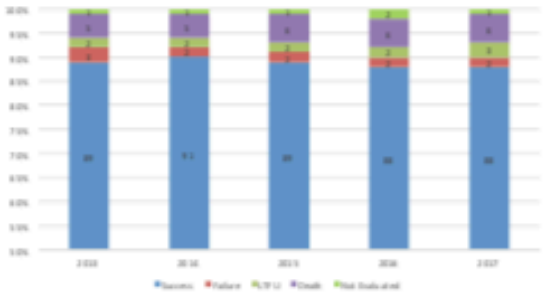
All	39.1%
Urban	15.9%
Rural	43.7%

All TB notifications and notifications rates Rwanda, 1995-2017

All TB notifications and notifications rates Rwanda, 1995-2017 Timeline of selected TB interventions

Treatment outcomes

Treatment outcome among bacteriologically confirmed pulmonary TB cased, Rwanda 2013-2017*



* 2017 outcome data are for half year

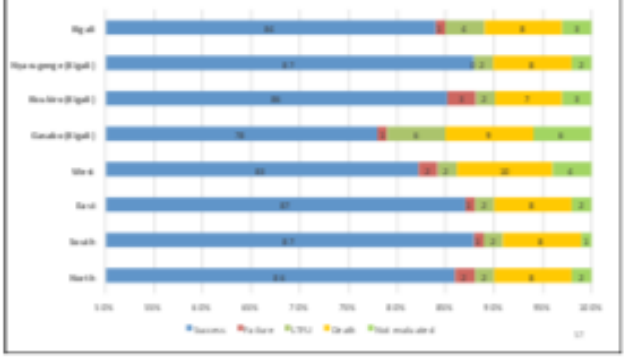
Treatment outcome among clinically diagnosed and extrapulmonary TB cases* , Rwanda 2013-2017**

*Clinically diagnosed and extrapulmonary cases **include HIV positive**
**2017 outcome data are for half year

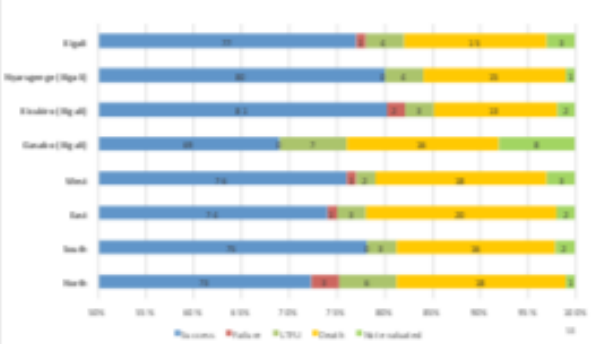
TB treatment outcome among TB/HIV cases,** Rwanda 2013-2017*

*2017 outcome data are for half year
** TB/HIV cases include all forms

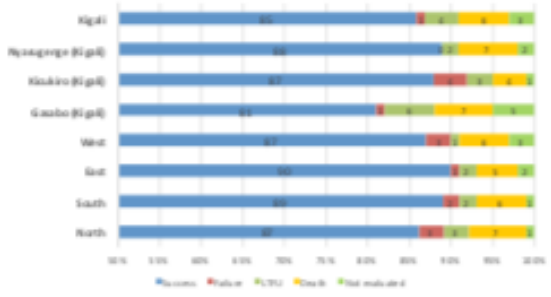
Treatment outcome among all TB cases notified, by Province, 2016



Treatment outcome among all HIV positive TB cases notified, by Province, 2016

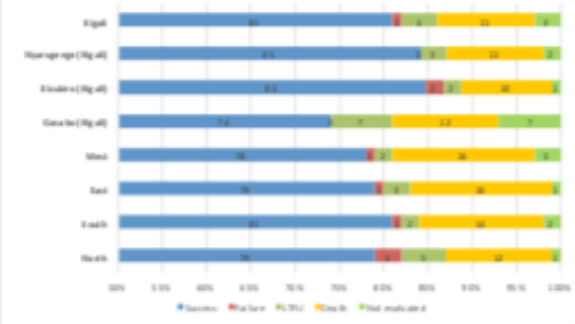


Treatment outcome among bacteriologically confirmed pulmonary TB cases* by Province, 2016

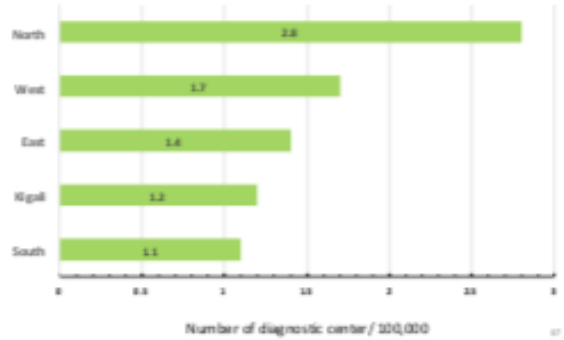


*Includes HIV positive TB cases

Treatment outcome, bacteriologically confirmed pulmonary TB/HIV cases by Province, 2016

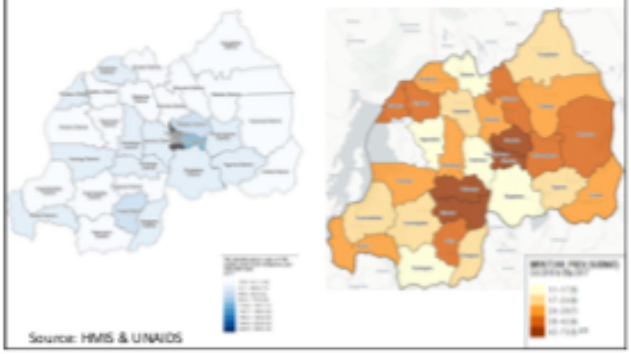


Number of TB diagnostic center (CDT) for 100,000 population by province, 2017



HIV and HIV/TB coinfection

TB notifications and HIV Prevalence Rwanda 2016/2017



Source: HMIS & UNAIDS

PLHIV and ART coverage in Rwanda

Source: UNAIDS

HIV Testing and ART Coverage among TB Cases

HIV Testing among TB Cases

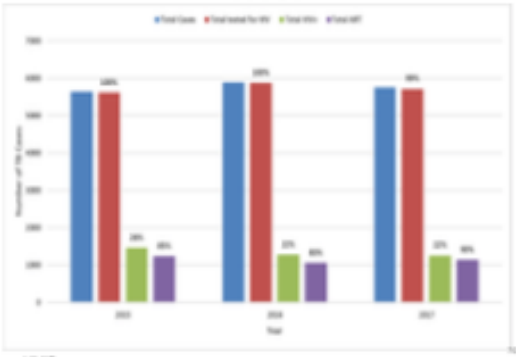
Benchmark	Status
82.2: Known HIV status ≥80% among TB cases	Met

Source: HMIS

Known HIV Status among TB Cases by province

Source: HMIS

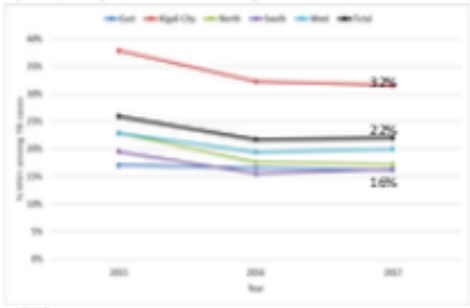
HIV Testing and ART coverage among TB cases



Source: HMIS

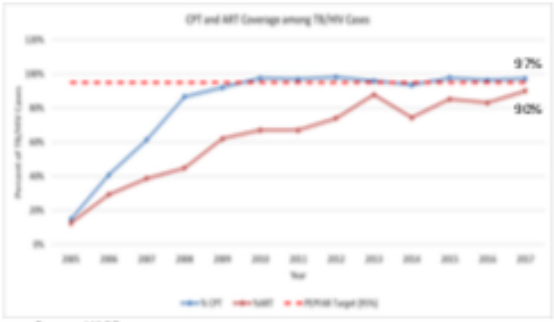
HIV infection among TB cases by province

- Kigali City has highest HIV infection among TB Cases (3.2%)



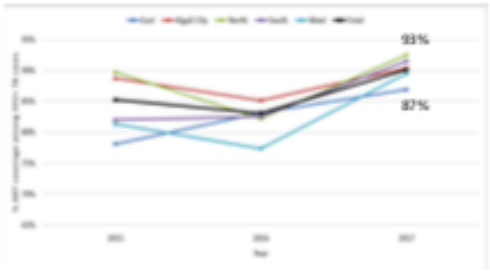
Source: HMIS

CPT and ART Coverage among TB/HIV Cases



Source: HMIS

ART coverage among TB/HIV by province



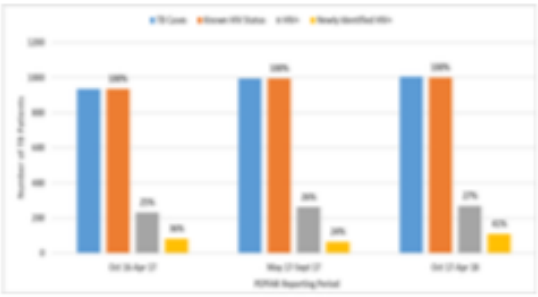
Source: HMIS

HIV Testing and ART coverage by province in 2017

Province	Total TB Cases	Total Tested for HIV	Total HIV+	Total on ART
Kigali City	1894	1889 (99.7%)	596 (31.6%)	539 (90.4%)
North	548	547 (99.8%)	94 (17.2%)	87 (92.6%)
South	1234	1234 (100%)	201 (16.3%)	184 (91.5%)
East	1107	1089 (98.4%)	176 (16.2%)	153 (86.9%)
West	970	956 (98.6%)	191 (20.0%)	171 (89.5%)
Total	**5753**	**5715**	**1258**	**1134**

Source: HMIS

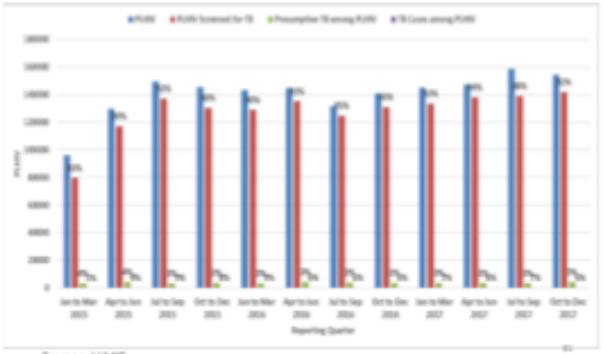
HIV testing and result among TB patients (PEPFAR)



Source: PEPFAR

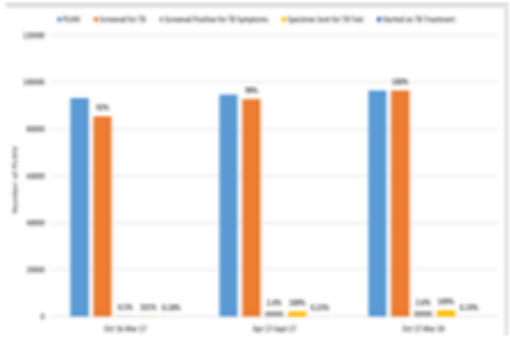
TB Service Integration in HIV Services

Routine TB Screening among PLHIV (all facilities in Rwanda)



Source: HMIS

Routine TB Screening among PLHIV (facilities supported by PEPFAR)



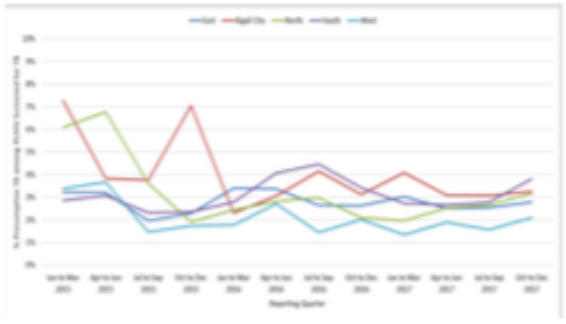
Source: PEPFAR

Routine TB Screening among PLHIV by province

Kigali City has consistently lower coverage of routine TB symptom screening

Source: HMIS

Presumptive TB among TB Screened PLHIV by province



Source: HMIS

TB Cases among TB Presumptive PLHIV by province

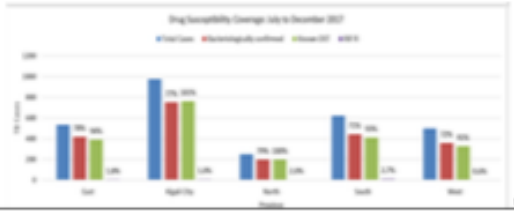
Source: HMIS

Drug resistant TB

Proportion of TB cases with DST

Benchmark B2.1: ≥75% of new TB cases have known DST

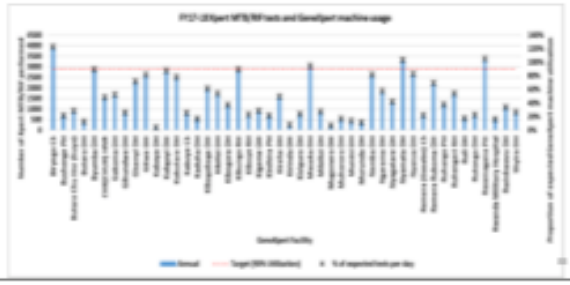
July 2017-June 2018	New	Previously Treated
Total TB Cases	5263	563
Bacteriologically confirmed	3838 (72%)	474 (84%)
Proportion with DST among bacteriologically confirmed	3260 (86%)	407 (86%)



GeneXpert machine usage

- Assumptions
  - 1 machine per facility
  - 5 working days per week
  - 16 Xpert MTB/RIF tests per day
  - QI excluded (Xpert MTB/RIF stock out)

Most GeneXpert machines are under utilized



DR TB among new and previously treated DRS survey 2015

Table 5. Prevalence of Rifampicin and Isoniazid resistant TB cases

	New patients		Previously treated patients	
	Proportion (%)	95% confidence interval	Proportion (%)	95% confidence interval
Any rifampicin resistance	1.5	0.8-2.4	10.7	5.0-19.4
Any isoniazid resistance	2.3	1.5-3.4	12.0	5.9-21.0
Multidrug-resistant TB (MDR-TB)	1.4	0.7-2.1	10.7	5.0-19.4

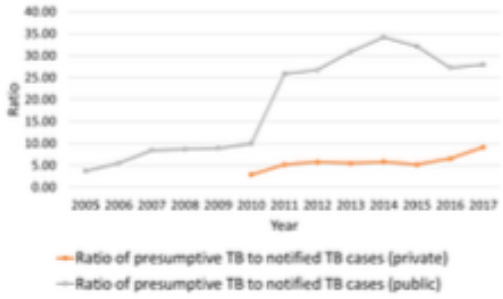
Active Case Finding

Yield of TB screening by facility type Rwanda 2013-2017

Year	2013	2014	2015	2016	2017
Public					
Number investigated as presumptive TB	184532	204667	181199	161038	161129
Number of notified TB cases (all forms)	5979	5982	5646	5914	5762
Ratio of presumptive TB to notified TB cases	30.9	34.2	32.1	27.2	28.0
Percent yield	3.2	2.9	3.1	3.7	3.6
Private					
Number investigated as presumptive TB	447	330	403	409	292
Number of notified TB cases (all forms)	82	57	78	63	32
Ratio of presumptive TB to notified TB cases	5.5	5.8	5.2	6.5	9.1
Percent yield	18.3	17.3	19.4	15.4	11.0

Data source: RHMIS

Ratio of presumptive to notified TB cases Rwanda 2005-2017



Systematic Screening for Active TB (based on a systematic review*)

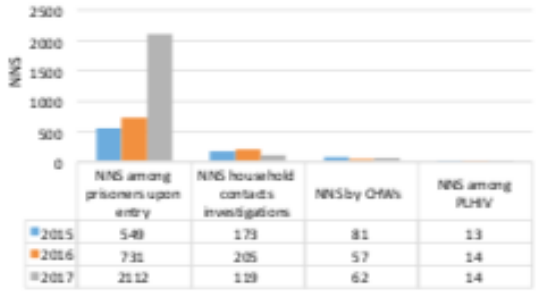
Population screened (Number of studies)	Weighted mean and range Number Needed to Screen to find 1 case of TB	
	Moderate incidence settings (30-100/per 100,000 pop) ~ Rwanda	Medium incidence settings (100-300/ per 100,000 pop) ~Kigali
General population (98)	669 (15-5934)	603 (25-4286)
Health care workers (16)	1613 (30-55000)	506 (25-8427)
Prisoners (44)	195 (29-1911)	110 (7-2762)
General outpatients (14)	758 (42-30000)	269 (19-8106)
PLHIV (74)	61 (5-326)	13 (2-120)
Household contacts (89)	40 (7-355)	25 (3-568)

Data source: *WHO Systematic Screening for Active TB

Health facility based screening NNS among high risk groups - Rwanda

Risk group	NNS 2015	NNS 2016	NNS 2017
Children < 15 yrs	7984	5863	5040
New Prisoners admitted in prisons	549	731	2112
Elderly ≥ 55 years	1396	1151	1226
Prisoners at the end of the quarter	417	518	867
HIV+ persons	500	509	558
Contacts of TPB+ ≥ 5 years	246	246	130
Contacts of TPB+ < 5 years	49	99	76

Number needed to screen 1 case (NNS) among routine ACF in high risk groups - Rwanda



Data source: TB&ORD routine ACF data from RHMIS

Percent yield of among routine ACF in high risk groups

Data source: NTP routine ACF data from RHMIS

Active Case Finding in Prisons

- Started in 2013
  - First phase 2013–2015
  - Second phase 2016–2018
- Yield decreased in second phase
- Despite decreasing yield, ACF yield is still higher than upon entry screening in prisons

NNS upon prison entry by year	
2013–2015	549–1,898
2016–2018	731–2,112

Prison	First Phase NNS	Second Phase NNS
Nyarugenge/PCK	172	365
Gasabo	224	352
Huye	136	252
Bugesera	108	367
Ngoma	445	468
Musanze	225	452
Rusizi	702	633
Nyamagabe	250	1942
Nyanza	177	506
Muhanga	109	ACF ongoing
Rwamagana	112	ACF ongoing
Rubavu	144	ACF ongoing
Gicumbi	308	ACF ongoing
Nyagatare*	no cases	ACF ongoing
Total	**154**	**378**

* Nyagatare is a facility for juveniles; smaller number at this facility, i.e. first phase 3 prisons enrolled all 2 (0) screened

Data source: NTP ACF Prisons

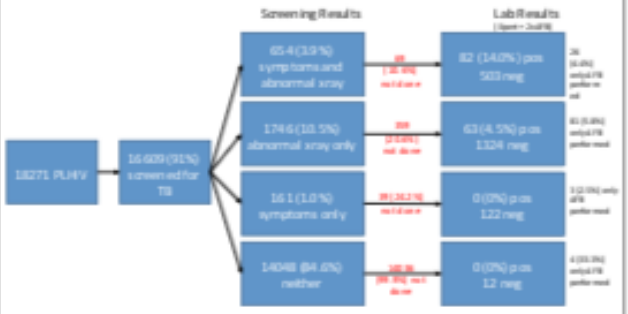
Active Case Finding among PLHIV

- ACF among PLHIV included a mobile xray unit visiting several high burden facilities
- Symptom screening and chest radiography were performed for all PLHIV receiving services

- In FY 14/15, among 16,609 PLHIV screened using symptom screening and then x-ray found 145 TB cases (873 per 100,000 PLHIV)
  - **Chest radiograph found 63 additional TB cases** that would not have been identified by TB symptom screen alone
  - Number needed to screen to find one TB case: 114
  - Yield among all PLHIV screened: 0.9%
  - Yield among PLHIV with presumptive TB: 5.7%

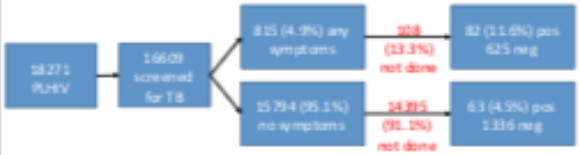
- Questions:
  - Why do some presumptive TB not have lab results?
  - Why were some PLHIV not screened with symptoms or chest xray?

ACF Results among PLHIV



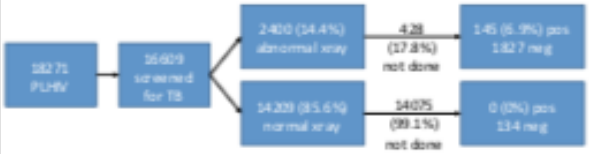
Source: ACF PLHIV Excel file from TB & CRD

TB Symptom Screening among PLHIV



Symptom/Sign	Frequency
Cough	792 (97.2%)
Fever	78 (9.6%)
Night sweats	0
Weight loss	64 (7.9%)
Known Contact with TB Case	2 (0.3%)

Chest Radiography Results among PLHIV



External factors (1/2)

- **Undernutrition**
  - mean BMI among women is 22.8, and among men is 21.1; both fall within normal range (18.5-24.9)
- **Diabetes**
  - raised blood glucose is uncommon, affecting just 3.06% of the population
- **Tobacco smoking**
  - 5.6% of surveyed participants smoke; those that smoke are often older in age, lower education-level, and lower wealth quintile

Data source: DHS 2014-2015

External factors (2/2)

- **Poverty**
  - steady increased in economic development
  - between EIVC3 2010/11 and EIVC4 2013/14, reduction in poverty of 2.3% points per year
  - 39.1% of the population remain under the national poverty line; urban (15.9%) and rural (43.7%)

Data source: NISR EICV surveys

Conclusions and recommendations

Conclusions

- TB burden in Rwanda is decreasing
- TB epidemic in Kigali is different than that in the rest of the country:
  - TB rates 140 vs 50 per 100,000 pop. More in younger pop especially men vs in older men
- Children <5 and women may be underdiagnosed
- Very good treatment outcomes, with some districts underperforming
- Higher mortality in HIV/TB, clinically diagnosed and EPTB
- Strong TB HIV program integration
- DR TB is not increasing
- High access to care, control strategies (case detection and treatment, supervision, active case finding) are likely contributing to decreasing TB burden
- Surveillance of TB mortality is suboptimal
- Extensive ACF activities with varying yields

Recommendations 1/3
Strengthen the surveillance system

- Complete transition to a case based electronic system
  - Finalize new eTB and set a clear objective and timeline to implement it countrywide
  - Ensure the use of a universal unique ID for all persons in Rwanda (including <16, foreigners, prisoners, homeless) that can reliably entered in the new eTB
  - Flexibility to allow a % of cases with no ID to be registered in the eTB
  - Develop a plan for the transition and migration of data (including completing 2013 reports in HMIS)
  - Continue the recording of presumptive TB to aggregated and not case based as was done recently
- Medium term: consider entering close/household contacts case based (but not at the cost of TB case reporting). Prioritize eligible IPT to follow up start, completion and effectiveness.
- Interoperate electronic systems: new eTB, HIV case base database, LIS, National Identity Agency, CVRS, among other relevant -with a unique ID

Recommendations 2/3
Strengthen the surveillance system

- Strengthen M&E capacity to record, analyse and use TB data at national and subnational level
  - Increase the number of staff with full time dedication to M&E activities at national level, especially consider implementation of new eTB
  - Train in data analysis and interpretation, using dashboards
  - Analyse subnational data, per age/sex, to monitor case detection and treatment outcomes
- Prioritize key indicators for data quality, in ISS&DQA and TB&ORD in meetings quarterly, document findings
  - Develop plan update SOP for data quality assessment of the new eTB, specially during the transition
- Strengthen national vital registration system
  - Encourage the implementation of the new CVRS to document all TB hospital and community deaths using ICD-10 codes

Recommendations 3/3
Strengthen the direct measurement of TB burden

Strengthen case finding among children

- Work with paediatricians and primary care physicians to improve TB diagnosis in children, especially < 5 and in Kigali
- Consider ACF among household contacts <5 up to 1-2 years after exposure in selected sites –specially among those not on IPT

Drug resistance

- Ensure new eTB allows routine surveillance of drug resistance (% of rif resistant among new and previously treated)
- Utilize GeneXpert platforms to full capacities
- Medium term: scale up Xpert MTB/RIF to all presumptive, beyond Kigali

Continue efforts of ACF strategies, and analyse recent data

- Differential strategies. Ex.: Kigali vs other, women, children < 5
- Continue efforts among PLHIV, household contacts and prisoners

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