Epidemiological review of TB disease in Sierra Leone

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1. Introduction

Sierra Leone is considered a high TB burden with 12,721 TB cases notified to WHO in 2014 and an estimated incidence rate of 310 (95% CI; 235-394) per 100,000 population[1]. The NTP has recently made an important advancement in TB surveillance and control by establishing a National Reference Laboratory for culture and drug sensitivity testing (DST), although this facility is not yet in use for TB as it was used to process samples for Ebola. Treatment success rates in the country appear to be high suggesting a relatively strong clinical infra-structure. Estimates of TB disease burden in Sierra Leone however are largely based on indirect estimation, with uncertainty around how accurately they may reflect the true burden of TB disease in the country. To date, the extent to which case notifications and reported deaths reflect Sierra Leone's incidence and mortality has not been well understood. The completeness and accuracy of routine TB surveillance and vital registration (VR) systems in Sierra Leone have also not been well assessed. This in turn challenges the ability to accurately estimate TB disease burden and objectively measure progress towards global and national targets, such as the MDGs.

Sierra Leone has been severely impacted by the current Ebola Virus Disease (EVD) epidemic in West Africa. In December 2013 the first cases occurred in Guinea and by May 2014 the epidemic had spread to Kenema and Kailahun in Sierra Leone. The country experienced 14089 EVD cases, 8704 of which were confirmed cases, and 3955 deaths[2]. The epidemic peaked in Q4 2014 but due to the large scale response from the national and international community cases began to decline from the beginning of 2015 and human to human transmission of the virus was declared to have ended in Sierra Leone on 7 November 2015. The outbreak is the largest, longest and most severe in the history of the diseases and has had a devastating impact on health and health systems as well as a significant socio-economic impact of individuals and the country. This has likely led to an increase in morbidity and mortality caused by other diseases and conditions, likely due to a multitude of factors affecting the delivery of essential health services, as well as the health information systems to capture this information. The impact of the EVD outbreak in Sierra Leone on TB control and services needs to be assessed in order to identify any areas that the NTP can address any missed opportunities for interventions.

The NTP needs accurate epidemiological information about the burden of TB in Sierra Leone to effectively plan, monitor, and assess the impact of interventions and progress towards targets. As a result, a review of the systems in place in Sierra Leone to collect and generate data on TB cases and deaths was planned. To do this review, the Ministry of Health in Sierra Leone requested the support of the World Health Organization (WHO) to examine the national and sub-national TB surveillance data. It was also considered crucial to assess the impact of Ebola on TB services and, if possible, on the TB epidemic. The assessment of the TB surveillance and VR systems was conducted using a standardized WHO checklist of TB surveillance standards and benchmarks. The expectation was that the results could be used to develop a monitoring and evaluation (M&E) investment plan designed to strengthen TB surveillance and VR systems to better measure trends in TB disease burden. The NTP, with the support of the Global Fund and other partners, can use the findings and recommendations of the TB surveillance system assessment to inform targeted M&E investments in Sierra Leone to strengthen underlying systems for data collection and systematically assess trends in disease burden and program impact.

2. Purpose

2.1 Objectives

- Describe and assess the current national TB surveillance and VR 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.
- Assess the level of, and trends in, TB disease burden (incidence, prevalence, mortality) using available surveillance, survey, programmatic and other data.
- Assess the impact of the EVD on TB surveillance systems and, if possible, the TB epidemiology in the country.
- Define the investments needed to directly measure trends in TB disease burden in the future.
- Define key populations that should be targeted with interventions to improve TB diagnosis and treatment success.

2.2 Proposed outcomes

- A formal performance assessment of TB surveillance based on WHO standards and benchmarks, with strengths and weaknesses (including data gaps and data quality problems) identified, and any unmet monitoring and evaluation needs described.
- A formal assessment of the level of, and trends in, TB disease burden.
- A formal assessment of the impact of Ebola on TB surveillance systems and, if possible, TB epidemiology.
- An M&E investment plan with specific recommendations for investment of funds for the improvement of measurement of TB trends in Sierra Leone.
- Identification of key populations that should be targeted with TB control interventions.

3. Methods

TB surveillance checklist: The TB surveillance checklist was implemented during a mission (14-29 October 2015) by WHO/Geneva (Laura Anderson) and WHO/Liberia (Esther Hamblion) in collaboration with the National TB Programme (NTP). The checklist of TB surveillance standards and benchmarks, the associated user guide and the methods to be used were shared with the WHO Country Office Sierra Leone, the NTP and the WHO Regional Office (AFRO) prior to the checklist implementation visit. A briefing presentation followed by discussion at the beginning of the visit was held to establish the purpose of the checklist and the logistics of carrying out the assessment. During the visit, discussions were held with NTP staff and other relevant stakeholders in order to complete the checklist with regards to Sierra Leone's national TB surveillance system (see Appendix 1 for list of all people met). Various methods were used to collate and analyse the data, including a desk review of documents and a review of all datasets either held at or made available to the national programme. A complete list of the documentation and data used for the assessment are provided in Appendix 2. The completed checklist is available in Appendix 3.

Epidemiological review of TB disease in Sierra Leone: During the same mission, the collation and analysis of additional TB surveillance (national and sub-national 2011-2015) and more general health system data were also undertaken. Only 6 months of data were available for 2015 and

therefore projections for the year were based on the first half of the year. Further analysis of TB notification, treatment outcome and the impact of Ebola was also carried out, specifically at the sub-national level.

A de-briefing presentation was held on October 29th at the NTP office in Freetown where preliminary analyses were shared with the NTP, Ministry of Health (MoH) and the WHO country office. During the presentation recommendations were discussed specifically relating to the capacity of the NTP for data management and routine analysis, how to progress with the development of a new web-based case based TB surveillance system, how to strengthen TB-HIV activities, detection and treatment of MDR-TB, improvements in diagnosis of childhood TB and how to reduce lost to follow up. The presentation slides are available in Appendix 4.

4. Assessment of surveillance of TB cases and deaths in Sierra Leone

4.1 Checklist of TB surveillance standards and benchmarks – Rationale

Surveillance of TB disease and deaths is essential for effective TB prevention and control. Timely, accurate, and complete recording and reporting of TB cases along with analysing trends in the number and distribution of TB cases is a necessity to monitor and evaluate TB prevention and control programs. It follows that a reliable TB surveillance system is therefore needed to guide policy decisions and develop national strategies and plans to track and report on progress in control efforts, including progress towards national or global targets.

In addition, a robust VR system, which includes causes of death, is needed to understand and monitor trends in mortality due to TB, identify health inequalities and priorities, and evaluate the impact and effectiveness of health programs, including TB control and prevention programs. Vital statistics are also needed in TB control to understand emerging health challenges (e.g. HIV/AIDS), and accurately measure progress towards global targets (e.g. the Millennium Development Goals).

The best methods for measuring TB incidence and mortality are through routine surveillance and VR systems that capture reliable and comprehensive data about new cases of TB and TB deaths. Having robust systems in place means TB notifications can be considered a direct measure (or a very close proxy) of TB incidence and mortality.

To assess a national TB program's ability to measure TB incidence and mortality, TB experts from the WHO Global Task Force on TB Impact Measurement[1] developed a checklist in 2012 following a two-year development and field testing phase ("The Standards and Benchmarks for TB Surveillance and Vital Registration Systems"[2]). This checklist is designed to be uniformly implemented in all countries to assess strengths and weaknesses of national TB surveillance systems and provide guidance to improve these systems so that TB notifications can more closely measure actual TB incidence and mortality. The checklist consists of 13 standards and their associated benchmarks, with nine standards related to measurement of TB cases and one related to measurement of TB deaths. The final three standards are supplementary standards that can be

[1] http://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/en/
[2] http://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/resources_documents/en/index.html

used to assess whether a country's TB surveillance system provides a direct measure of the number of MDR-TB cases, the number of HIV-positive TB cases, and the burden of paediatric TB. Note that the Checklist only assesses the surveillance system's ability to provide a direct measure of TB incidence and mortality. It does not assess the system's ability to fulfil programmatic requirements. The benchmarks are therefore different from those used in defining programmatic targets. Based on the assessment, gaps and unmet M&E needs in national surveillance systems can be identified and strategies then be developed to address these needs.

4.2 Characteristics of the TB surveillance and vital registration systems

The Sierra Leone NTP oversees a traditional, aggregate paper-based system which is well established in the field. The paper-based system relies on district supervisor staff to compile aggregate quarterly paper data reports which are brought to the national level where they are collated in an excel template. Aggregate data are stored in numerous excel spreadsheets which do not include validation checks. There is no single database which can be used for time trend analysis. All service delivery points systematically use standardized TB collection forms and tools to ensure uniformity but these tools have not been updated for WHO 2013 recording and reporting guidelines and no guidelines or training for recording and reporting exist. All non-NTP treatment providers, including prisons and military, are affiliated with a DOTs centre who are responsible for notifying the cases. Clearly defined goals for the TB surveillance system and team do not exist.

Supervisory visits are carried out by TB district supervisors on a quarterly basis when they compile the aggregate reports but there is no supervisory checklist which focuses on data quality and validation. Data are usually reliably transmitted on a quarterly basis from the district > national level but this is often untimely due to transport issues. Quarterly meetings are carried out between the district and the national level where epidemiological analysis is presented at the district level and discussed. There is no standard template for this and it does not include data quality indicators. No district analysis of data by facility is carried out. There is no systematic feedback on data quality or epidemiological analysis from the district to the facility level. A certain year's data is usually ready for analysis by June of the following year but no descriptive epidemiological annual report is produced.

TB-HIV indicators are missing from the TB register and have to be obtained from the HIV clinic. There is no routine cross-referencing between registers and data collection and reporting for the two diseases is not integrated.

Bacteriologically confirmed cases are recorded in the health facility (PHU) affiliated laboratories in paper registers. Laboratories do not produce aggregate paper reports. Currently the National TB Reference Laboratory (NTRL) does not process TB samples for culture and DST and therefore there is no data collection system, MDR-TB is not diagnosed and there is no MDR surveillance system.

A National Vital registration system does not exist.

Checklist of TB surveillance standards and benchmarks – Summary results

The TB surveillance system in Sierra Leone has some strengths but also important gaps that need urgent action. Of all the standards for TB surveillance, 2 were met, 4 were partially me, 6 were not met and 1 was not applicable (see Table 1). Based on the assessment, the greatest strengths of TB surveillance in Sierra Leone include 100% reporting including zero reporting; good data completeness; regular supervisory visits and experienced district supervisors; quarterly meetings between district and national level; surveillance data provide a direct measure of TB-HIV co-infection; high rates of HIV testing and treatment with ART; high treatment completion rate and data on key epidemiological indicators are internally consistent and accurate. The primary challenges of the system include the inappropriate storage of aggregate national TB surveillance data that make attempts to carry out time series analysis cumbersome; no single national database; no systematic data quality or validation checks at the national or district level; no monitoring of timeliness of reports; lack of routine analysis of TB data and systematic feedback of data quality and epidemiology to PHUs; no standard operating procedures, tools or template for monitoring data quality or epidemiological indicators; inconsistent data collection tools that do not capture the minimum dataset required at all levels; the limited capacity in the team to manage large datasets or carry out epidemiological analysis; no production of an epidemiological annual report; training gaps identified at all levels for M and E activities; no training materials or guidelines for recording and reporting; knowing that all diagnosed TB cases are reported especially for TB deaths; accurately monitoring the level of TB among children; no diagnosis or treatment of MDR-TB; no effective and efficient system for cross referencing TB-HIV co-infected cases with the HIV surveillance team; delays in starting TB-HIV patients on ART; no routine contact tracing or source case finding and no national vital registration system which can accurately measure TB deaths. During the EVD crisis TB services were maintained and TB cases continued to be diagnosed and treated, however, there were high proportions of childhood TB cases who were lost to follow and these patients have not yet been traced. Increased investment is required to address the gaps in TB surveillance and build a system that can accurately and efficiently measure TB incidence and mortality.

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 Appendix 3

Met	Partially met	Not met	Not applicable
B1.3-All scheduled periodic data submissions have been received and processed at the national level **B2.2-**Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases	**B1.1**-Case definitions are consistent with WHO guidelines **B1.4** -Data in quarterly reports (or equivalent) are accurate, complete, and internally consistent *(For paper-based systems only)* **B2.3** – Surveillance data for children reported with TB are reliable and accurate *OR* all diagnosed childhood TB cases are reported **B1.7**-Number of reported TB cases is internally consistent	**B1.2**-TB surveillance system is designed to capture a minimum set of variables for reported TB cases **B1.6**-TB surveillance data are externally consistent **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 **B2.1-** Surveillance data provide a direct measure of drug-resistant TB in new cases	**B1.5** (Electronic) – Data in national database are accurate, complete, internally consistent, and free of duplicates

4.3 Recommendations

4.3.1 Short-term, high impact

Strengthen activities and M&E capacity to improve data quality

National level

- National guidelines for recording and reporting of TB data should be developed and rolled out with training.
- All data reporting tools, including the treatment card, TB treatment register, aggregate reports and the national excel template, should be updated in line with WHO 2013 definitions and reviewed to ensure consistency.
- An assessment of training needs for TB recording and reporting should be carried out at the clinic and district level. TA support for this activity should be requested if required.
- M and E officers should develop a standardised quantitative supervisory checklist for district supervisors to carry out data quality checks at the facility level. This should include completeness and accuracy checks on key variables and cross-checking of laboratory, TB suspect and TB registers to ensure all cases are notified and followed up. Findings should be fed back to the national level at quarterly meetings.
- M and E officers should develop a standard template for district quarterly reporting and data presentation which should include key epidemiological and data quality indicators that can be monitored over time. Technical assistance for development of this material could be provided by WHO or CDC.
- M and E officers should develop a template for district supervisors to assist in feedback to facilities on data quality. Comparative analysis between health facilities may be beneficial.
- M and E officers should develop an excel tool to monitor timeliness of reports received at the national level should be implemented.
- A programme of training should be developed for all levels of the TB programme which should include diagnostics, treatment and clinical management and M and E activities. Delivery of training could be supported by Therapeutic Solidarity and Initiatives for Health (SOLTHIS) who provide onsite training and mentorship for healthcare staff.
- A descriptive epidemiology annual report should be produced on a yearly basis using data from the previous year.
- The national team should develop expertise in patient confidentiality and data protection in order to enable them to produce guidelines and associated training package.
- Expand the existing M&E team by;
    - recruiting an epidemiologist to carry out routine analysis of TB data, lead on the production of the annual report and carry out operational research
    - recruiting a database manager to develop a single database, implement data validation and data quality checks and to develop a TB module in DHIS2 in collaboration with the national DHIS2 team
    - enhance the team's capacity for M and E activities and through relevant courses and on-the-job training such as excel, the All Africa Leprosy Tuberculosis and Rehabilitation Training programmes (ALERT) course and TA from colleagues in Uganda and the CDC should be considered through collaboration with WHO HQ
    - Consideration should be given to the assignment of focal areas to the M and E staff particularly for high risk areas e.g childhood TB, drug resistant TB and TB-HIV co-infection

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- *District level*
- District supervisors should prepare presentations in advance which should be pre-submitted for discussion at the meeting using a standard template developed by the national team.
- District supervisors should carry out routine analysis by facility and provide feedback.
- Undertake training on updated recording and reporting tools, data quality and supervisory checklist, data analysis and computing skills.
- District supervisors should ensure facilities comply with appropriate patient confidentiality and data protection standards.

- *Facility level*
- Undertake training on updated recording and reporting tools and the importance of data quality.
- Comply with new guidelines on patient confidentiality and data protection developed by the M and E officers and ensure physical records are stored appropriately.

Development of national TB surveillance system and database

Short term

- An updated excel template should be developed in line with changes made to recording and reporting tools. Data validation checks should be developed within the template. This template should be filled at the district level by district supervisors and sent to the national level electronically. This may require additional laptops.
- At the national level an access database should be developed which data should be imported into. Data stored in excel from previous years should also be imported into this database to allow time trend analysis.

Improve direct measurement of TB disease burden

- All bacteriologically and clinically confirmed TB cases should be notified including primary defaulters and cases that die prior to starting on treatment.
- Implement a standard referral register in all facilities and establish a system to ensure that all referred cases are followed up and receive TB treatment. All referred cases lost to follow up should be notified in the TB register of the referral centre.
- Cases that are transferred out should have the clinic transferred to recorded in the TB register and the supervisor should follow up to ensure the patient reached the clinic. All patients lost to follow up should have an outcome recorded as such. A list of transferred patients should be maintained to facilitate follow up.
- Make an initial assessment of the number of cases diagnosed and treated in the private sector by producing a list of all private clinics by district (already completed by the private sector) and carry out an audit on the number of TB cases seen at each clinic within a given time period. TA support could be provided by WHO or NGO partners.
- All private clinics should report to the TB programme.
- Diagnosis of extra-pulmonary TB should be reviewed by district and appropriate action taken to improve diagnosis

Childhood TB

- Develop national guidelines for the diagnosis and management of childhood TB, including M and E activities, and roll out with appropriate training.
- Nominate a clinical focal person for childhood TB to work closely with the NTLP for the development of guidelines and to provide expertise in this area.
- Introduce a robust referral and feedback system to allow active follow up children to ensure continuity of treatment and care and recording of treatment outcome.
- Actively trace defaulters from Ola paediatric hospital who were lost during the EVD crisis.

MDR-TB

- In the short term routine testing for drug resistant TB should be carried out using GeneXpert followed by liquid culture and DST for first and second line antibiotics on rifampicin resistant cases. This should begin as soon as possible. The following should be considered for testing: Failure to culture convert at 2/3 months, treatment failures, all retreatment cases and contacts of confirmed MDR-TB cases.
- The number of GeneXpert machines required should be based on the expected number of cases.
- Laboratory staff require training on cultures and DSTs and on the use of GeneXpert at regional sites. This could be supported by the German Leprosy and Tuberculosis Relief Association (GLRA).
- Supply chain should be established to ensure all antibiotics are available.
- At least one clinician should be trained in the treatment of MDR-TB .
- An expert in MDR-TB programme management should be recruited to co-ordinate all activities in the country ranging from clinical and laboratory training, diagnostics, treatment, contact tracing and active case finding.
- An electronic case-based MDR-TB surveillance system should be established using DHIS2 in the reference lab at Lakka, regional labs generating data from GeneXpert and the treatment centre. A unique patient identifier should be used to link patients in the system. All centres should be able to view cases.
- Routine data analysis should be carried out to closely monitor the MDR-TB situation.

TB-HIV

- The TB programme should collaborate closely with the National AIDS Control Programme in the ministry and the National AIDs Secretariat to strengthen coordination of TB-HIV activities.
- Recording and reporting tools should be aligned between the 2 programmes e.g TB variables collected in HIV registers and HIV variables collected in TB registers.
- Validation of data across registers should be undertaken by district supervisors.

- TB screening should be carried out in HIV positive partners of those who are TB-HIV co-infected. WHO policy on collaborative TB/HIV activities: Guidelines for national programmes and other stakeholders should be followed to ensure patients start on treatment with ART within the first 8 weeks (http://apps.who.int/iris/bitstream/10665/44789/1/9789241503006_eng.pdf?ua=1)
- Treatment outcomes should be collected separately for TB-HIV co-infected patients and monitored over time.

High risk populations

- Implement a national policy for routine contact tracing of household or close contacts for all TB cases, including source case finding for children and for those with extra-pulmonary disease.
- Explore the possible use of Community Health Workers for routine contact tracing, sputum collection, defaulter tracing and TB symptom awareness raising.
- Patient advocacy groups could be utilized for counselling of TB patients as peer to peer support.
- The recording and reporting for cases from military and prison should be reviewed as well as the screening algorithm to ensure all those requiring screening are screened and that sputum smear status is recorded correctly.

4.4.2 Longer-term, high impact (2015-2017)

Development of national TB surveillance system and database

Medium term

- Consideration should be given to development of an internet case based real time electronic recording and reporting system e.g using DHIS2. This should be implemented at district level. Tablets could be used by district supervisors for monthly data facility collection to allow real time data collection and subsequent analysis.

Long term

- Data collection in DHIS2 should be considered at the facility level (case based system).

Childhood TB

- Ensure close monitoring of childhood TB surveillance activities through dedicated M and E supervision, including TB-HIV co-infection rates by geography.

- Introduce routine household source contact tracing and contact tracing of adults focusing on potentially exposed children. The use of trained Community Health Workers or a district outreach worker should be considered.
- Investigate the reasons for default through operational research with the aim to increase understanding and to enable appropriate public health action.

MDR-TB

- A DRS should be carried out using standard methodology and with TA from WHO-HQ.

TB-HIV

- TB and HIV should be collected in the same electronic recording and reporting system e.g DHIS2.
- TB-HIV services should be integrated within the same clinic to facilitate treatment in co-infected patients and a robust referral system between TB and HIV clinics should be established.

High risk populations

- Pregnant women with TB symptoms that are smear negative should have a sample tested by GeneXpert to confirm TB.
- Introduce monitoring of TB in mining communities through collection of data at the facility level.

5. TB epidemiology

5.1 TB case notifications

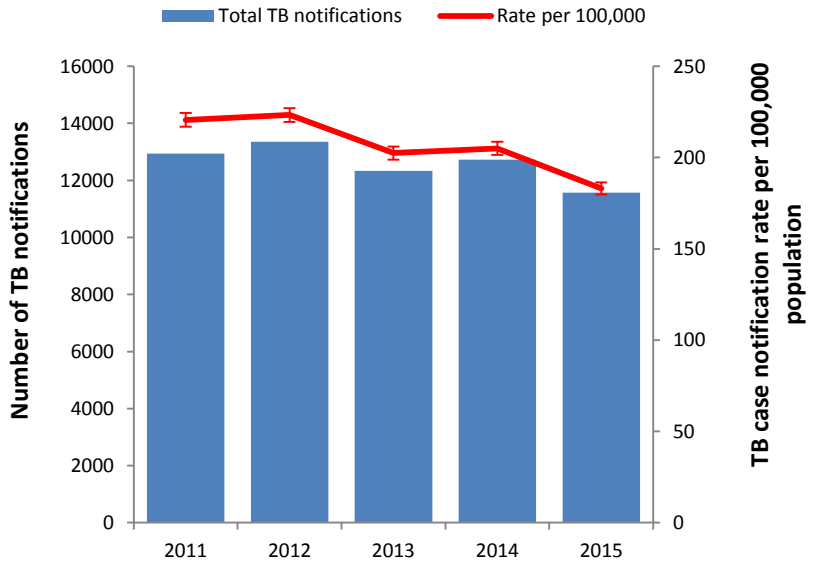
The first point of reference in any investigation to understand TB disease burden in the country is its case notification system. The trends of time series of case notifications, especially in countries where the surveillance system is expanding coverage and intensifying case finding activities, do not necessarily reflect trends in true disease burden, but provide an extremely useful insight during any epidemiological assessment of TB disease in the country. It is then only through further investigation of notification data at national and sub-national levels, including a detailed analysis of the recording and reporting system, the analysis of mortality data, as well as a study of changes in determinants of TB over time, that one acquires a more comprehensive understanding of TB epidemiology and the shortcomings of routine TB surveillance in a country. The following analysis was carried out using the aggregate data obtained from the paper reporting system. Data collection forms are still currently based on 2006 WHO case definitions.

5.1.1 Time trends, national level

Figure 1 and Table 2 presents national time trends in TB case notification numbers and rates in Sierra Leone, 2011-2015. Numbers and case notification rates (CNRs) of TB decreased over the last 5 years from 12, 943 cases (220.7 per 100,000 population) in 2011 to 11,572 cases (183.1

per 100,000 population) in 2015. Significant decreases in CNR were observed in 2013 and 2015 of 9.4% and 10.7%, respectively. The decrease in 2013 was due to a decrease in TB notifications in second quarter across all districts. This should be investigated further as without a clear explanation this decrease suggests that there are errors in recording and reporting. The decrease in 2013 also makes it appear that TB notifications increased in 2014 during the EVD crisis, which may be an inaccurate reflection of the situation.

Figure 1: Time-series of national TB notifications and rates in Sierra Leone, 2011-2015*



* The TB notifications for 2015 are estimated for the year based on the first 6 months of data and therefore may change

Table 2: Time-series of national TB notifications in Sierra Leone, 2011-2015

Year	Total TB notifications	Rate per 100,000	95% CI		% rate of change
2011	12943	220.7	216.9	224.5	
2012	13354	223.4	219.6	227.2	1.2
2013	12334	202.5	198.9	206.1	-9.4
2014	12724	205.0	201.5	208.6	1.3
2015	11572	183.1	179.8	186.5	-10.7

In 2014, 95.9% (12,209/12,724) of notified TB cases were pulmonary and a very low proportion of 4.0% (515/12,724) were extra-pulmonary. 62.6% (n=7,971) of TB cases were pulmonary sputum smear positive, 23.5% (n=2,990) were pulmonary sputum smear negative and 9.8% (1, 248) were pulmonary cases with no smear results.

TB notifications and CNRs for pulmonary sputum smear positive, smear not done and extra-pulmonary TB decreased over time (Figure 2). In 2014 there was an increase in pulmonary sputum smear negative cases; a 22% increase in CNR from 39.3 per 100,000 to 48.2 per 100,000 population. This was followed by a large decrease of 41% in CNR to 28.4 per 100,000 population in 2015. This is mostly due to dramatic changes in the number of smear negative cases in Bonthe (See section 1.5.3). This finding suggests that there were either inconsistencies in reporting by sputum smear status, for example clinically treated cases were misclassified as smear negative rather than pulmonary cases without a smear results, there were more clinically treated cases during the EVD crisis that may have been identified through active case finding in the community, there was significant misdiagnosis of TB or TB cases were referred to Bonthe from another district. This requires further investigation so that either inaccurate data can be corrected or patients can be reviewed if they have been erroneously treated for TB and remain on treatment.

Cases were only disaggregated reliably by new and retreatment categories for pulmonary smear positive cases. In 2014, 93.5% (7451/7971) of smear positive cases were new and 6.6% (520/7971) had a history of previous treatment. The proportion of cases that were new and retreatment were relatively consistent from 2011-2015 with a very small and steady decrease in the number and proportion of new cases (Table 3). In 2015 there was a very small increase in the proportion of cases that were retreatment after default suggesting that more cases were lost to follow up in 2014 and re-engaged with health care services in 2015.

Figure 2: Time-series of national TB notifications by site of disease in Sierra Leone, 2011-2015

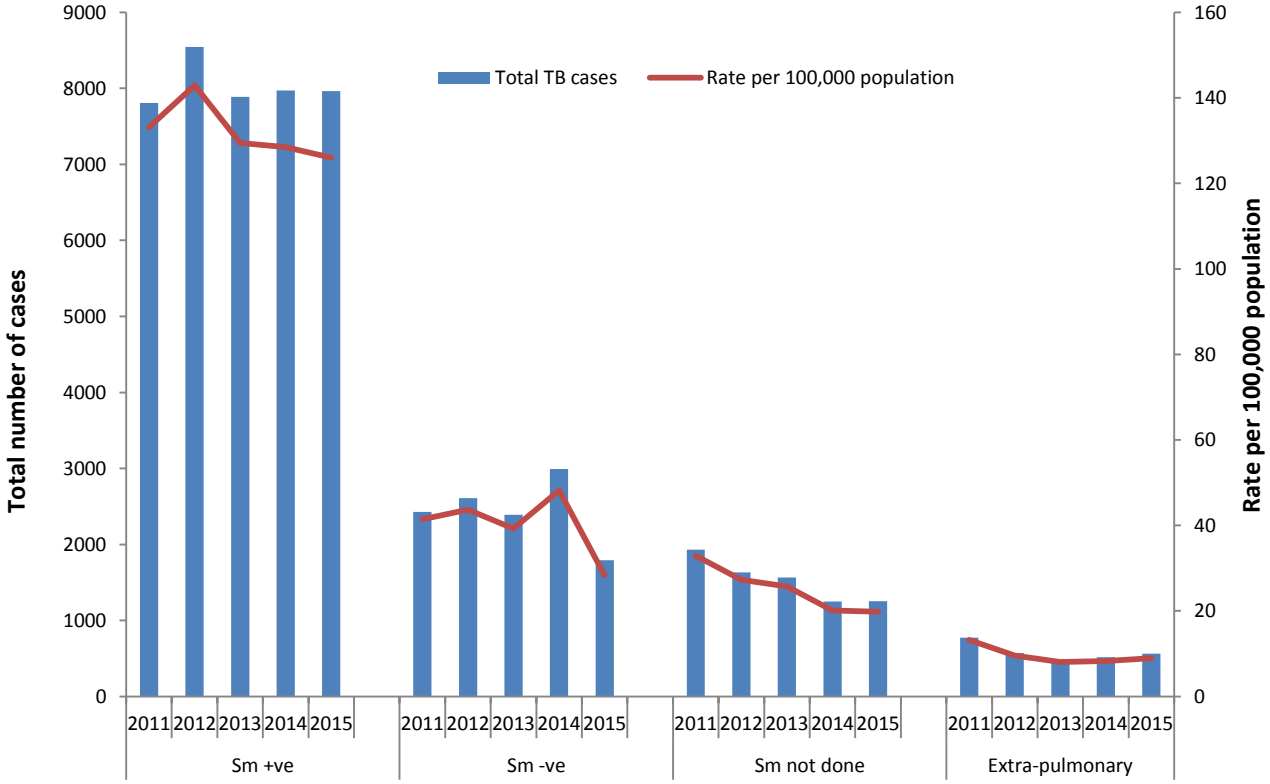


Table 3: Time-series of national pulmonary smear positive TB notification numbers and rates by treatment category in Sierra Leone, 2011-2015

Year	New		Treatment after relapse		Treatment after failure		Treatment after default		Total
	n	%	n	%	n	%	n	%	
2011	7435	95.2	166	2.1	64	0.8	145	1.9	7810
2012	8031	94.0	276	3.2	106	1.2	138	1.6	8543
2013	7390	93.7	235	3.0	69	0.9	193	2.4	7887
2014	7451	93.5	276	3.5	106	1.3	138	1.7	7971
2015	7436	93.4	268	3.4	94	1.2	164	2.1	7962

In 2014, for both men and women the highest numbers of TB cases were in 25-34 year olds (Figure 3) and the number of TB cases decreased as age increased. For men, rates were high in all age groups over the age of 15 (>250 per 100,000 population) but the highest rates were in 45-54 year olds (404 per 100,000 population). For women, rates were highest in 35-44 year olds (182 per 100,000). For both men and women rates decreased after the age of 54 years old. The difference in rates between men and women may be due to differences in risk of exposure in terms of social risk factors or due to differences in access to health care. Over the last 5 years there was a slight decrease in rates in men and an increase in rates in women (Figure 4).

Figure 3: TB notifications and CNRs by age and sex in Sierra Leone, 2014

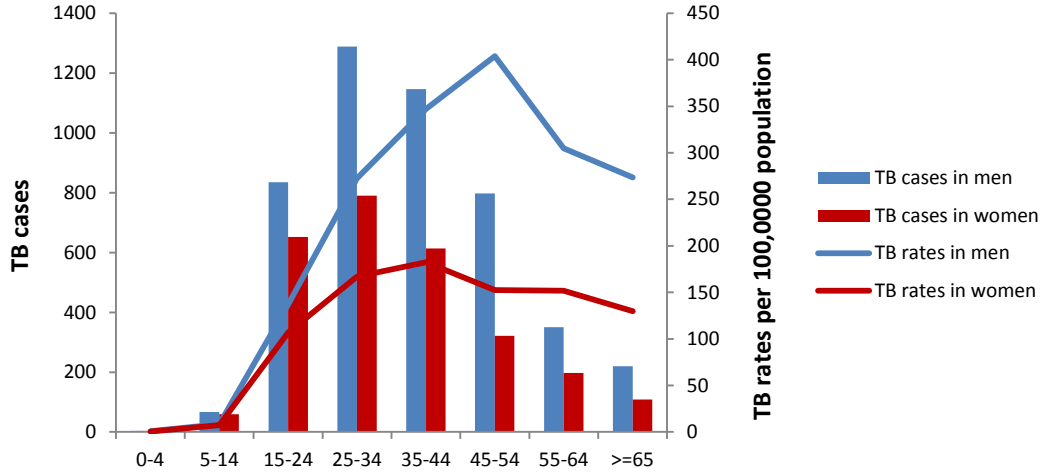
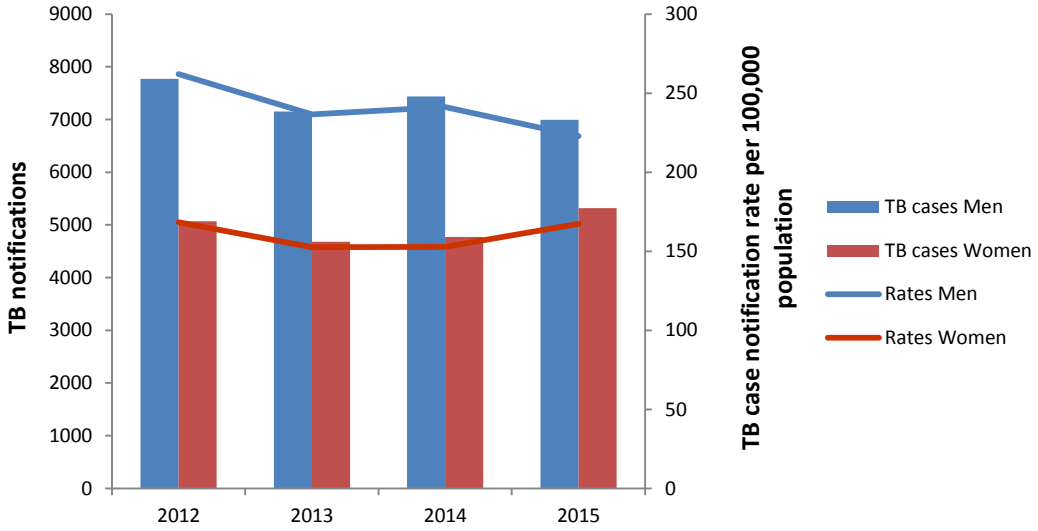


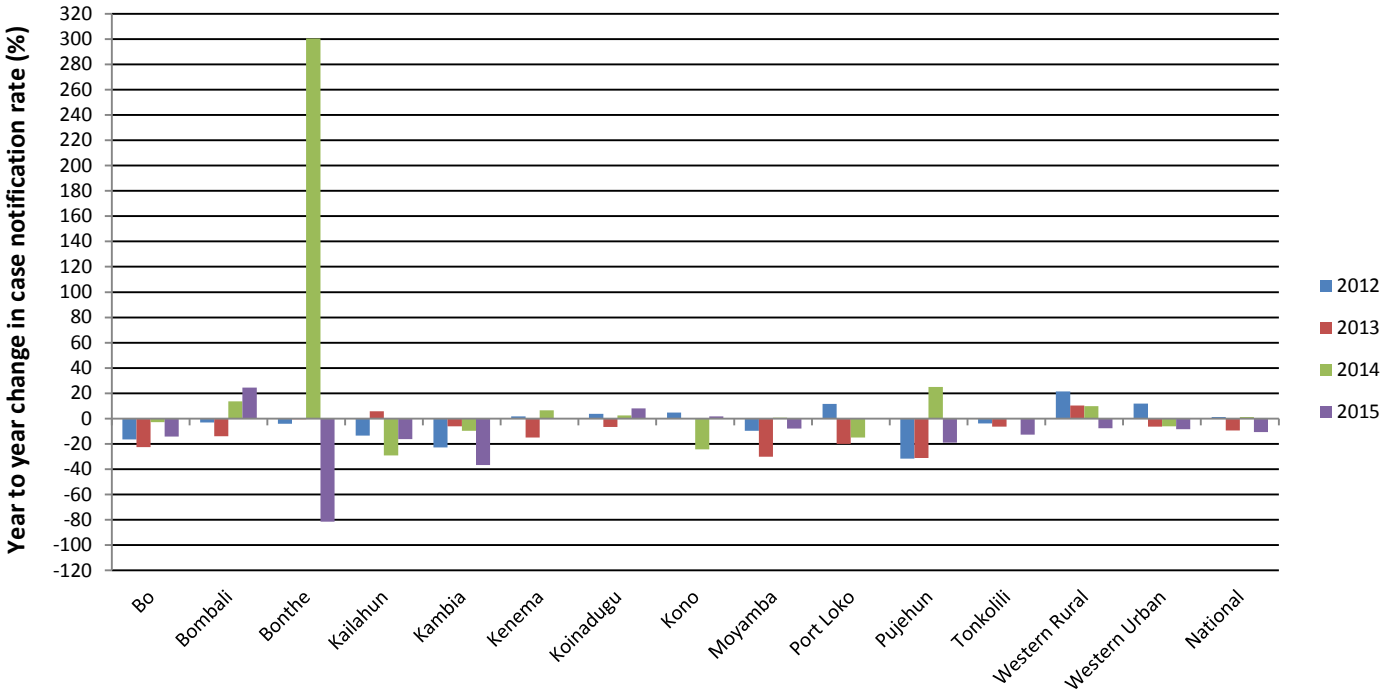
Figure 4: Time series of number and rates of TB notifications in males and females, Sierra Leone, 2012-2015



5.1.2 Internal consistency of data

The interpretation of time series of TB case notification rates (CNRs) requires careful consideration of reasons why rapid changes are observed. Observed spikes (both increase and decrease) in series of case notifications are likely due to related data entry error or a change in reporting coverage and not due to a sudden increase in TB disease burden because TB incidence rarely changes faster than 10%/year. The internal consistency of notification data can be investigated by examining the percentage change in CNRs in each year compared to the previous year and through observation of ratios of different groups of TB case notifications. Comparison of percentage change in CNR shows that nationally there was a decrease in CNR by more than 10% in 2015 (Figure 5). At sub-national level Bonthe district had an increase of 300.5% in 2014 followed by a decrease of 81.5% in 2015. All other districts with the exception of Koinadugu and Kono had fluctuations of more than 10% over time. The reasons for these fluctuations should be investigated further, particularly for Bonthe as discussed in section 5.1.1. A large decrease could indicate a problem such as under reporting or under diagnosis or it could be due to the impact of TB control activities. A large increase may suggest improvements in reporting or active case finding.

Figure 5: Percentage rate of change by year at national and sub-national level



The trends in rations of male to female, pulmonary to extra-pulmonary and presumptive cases to sputum smear positive TB notifications are consistent between 2012 and 2014 (Table 4). In 2015 there was a reduction in the number of men compared to women and in pulmonary cases compared to extra-pulmonary cases. The ratio of new to previously treated smear positive TB cases has decreased from 15.7 new cases for every retreatment case to 14.1 over the last 4 years. It is important to investigate the increase in retreatment cases further because it implies more cases are either lost to follow up, failing treatment, relapsing or becoming re-infected. The proportion of children out of all TB cases decreased overtime and a larger decrease was observed in 2014 and 2015 suggesting that diagnosis or reporting of TB in children was affected by the EVD crisis. This should be investigated further.

Table 4: Internal consistency by age, sex, site of disease, treatment history and presumptive cases

	Male: Female	Pulmonary : Extra-pulmonary	New: Retreatment*	Ppn 0-14 year olds**	Suspects:Notifications
2012	1.5	22.4	15.7	14.1	2.8
2013	1.5	24.2	14.9	13.6	3.1
2014	1.6	23.7	14.3	11.2	2.6
2015	1.3	19.5	14.1	10.3	2.7

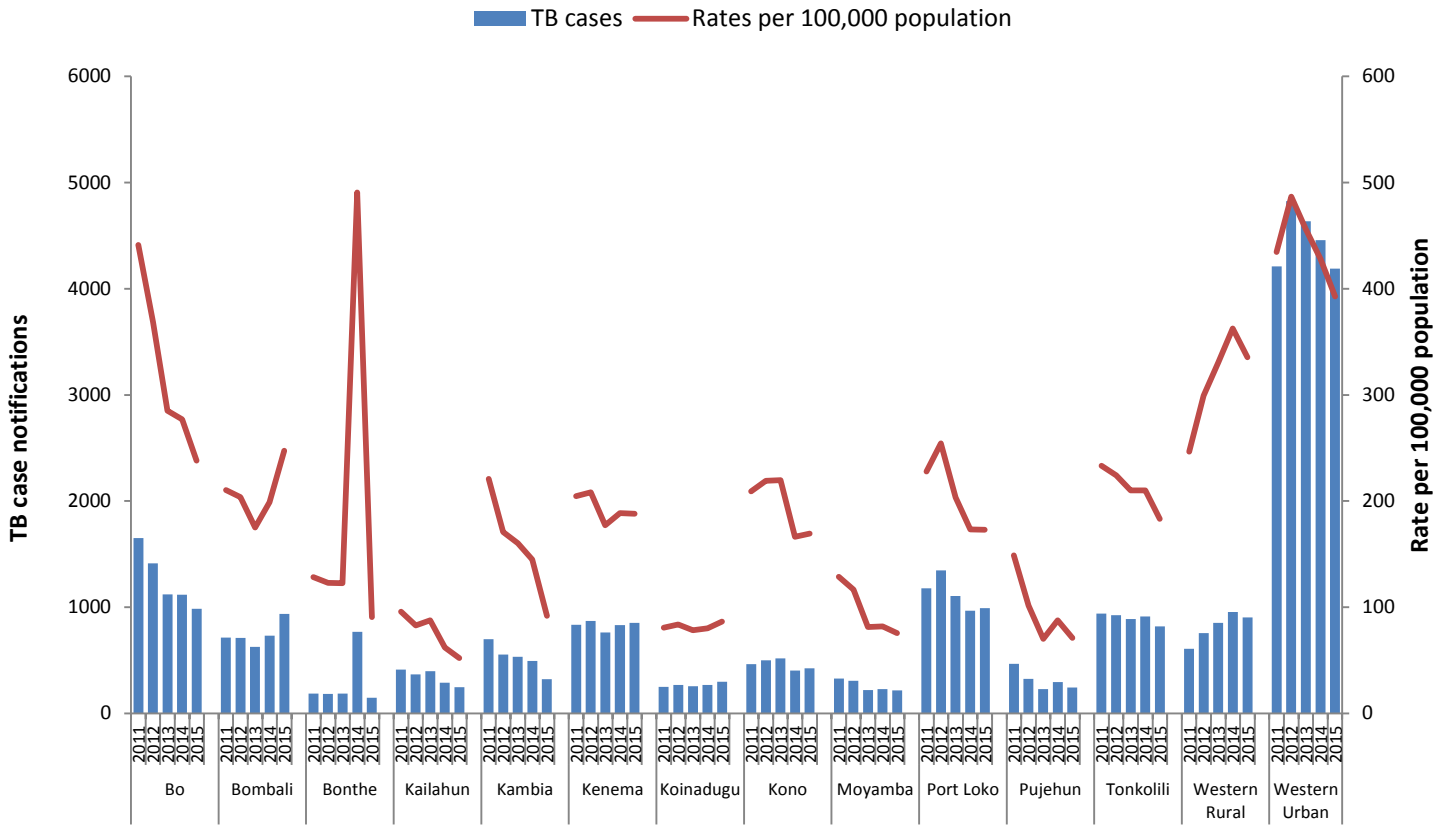
* Smear positive only

** Excludes retreatment cases

5.1.3 Time trends, district level

Between 2011-2015 numbers and rates of TB cases were highest in the Western Urban district with 4188 notified cases and a rate of 393 per 100,000 population in 2014 (Figure 6). In the Western Rural district numbers of cases were significantly lower than in the Western Urban district but rates were still high at 363 per 100,000. Number of TB cases and rates decreased over the last five years in eight districts; Bo, Kailahun, Kambia, Kono, Mayamba, Port Loko, Tonkili and Western Urban whereas TB increased in the Western Rural district. Increases in the Western Rural District were mainly due to increases in pulmonary TB (Table 5) which may be as a result of active case finding activities. In 2014 and 2015 during the EVD crisis increases in TB notifications were observed in Kenema, Kariadugn, Pujehun, Bombali and Bonthe. The largest increase was observed in Bonthe where rates increased from 123 per 100,000 in 2013 to 491 per 100,000 in 2014. This was due to an increase in smear negative TB cases from 20/187 (10.6%) in 2013 to 636/769 (82.7%) in 2014. This demonstrates that these cases were clinically treated without bacteriological confirmation. As discussed in section 5.1.1, possible explanations for the increase in Bonthe are misdiagnosis of TB, referral of TB cases from other districts for diagnosis and/or treatment or increased community surveillance which led to active case finding. This requires further investigation as individuals may have been treated for TB who did not have the disease. If the cases are however true TB cases that have been found as a result of active case finding this is of concern as it indicates there is usually under diagnosis of TB in Bonthe and TB rates may actually be extremely high.

Figure 6: TB notification numbers and rates by district in Sierra Leone, 2011-2015

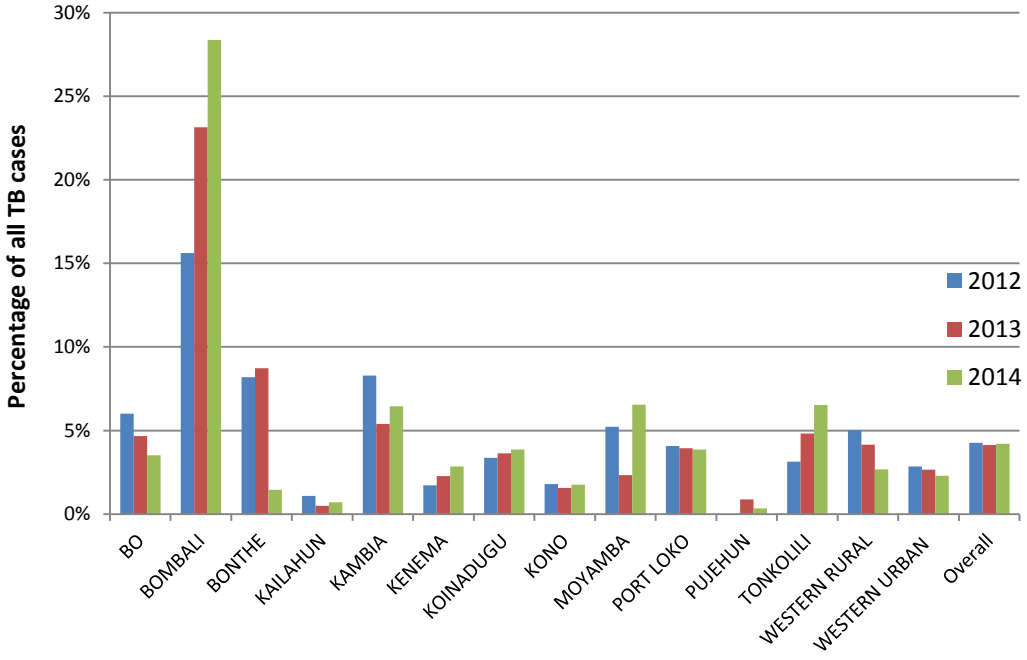


There is large variation in TB rates by site of disease by district (Table 5). In the majority of districts extra-pulmonary TB comprised less than 5% of all TB cases which is much lower compared to other countries in the region. In Bombali however more than a quarter of TB cases were extra-pulmonary in 2014 and the proportion of extra-pulmonary cases increased between 2012-2014 (Figure 7). Extra-pulmonary cases were not more likely to be children. This suggests that there are differences in diagnostics in this area of the country and this should be investigated further.

Table 5: Trends in TB CNR per 100,000 population by site of disease, by district, Sierra Leone, 2012-2014

	Pulmonary TB Rate			Extra-Pulmonary TB Rate		
	2012	2013	2014	2012	2013	2014
BO	346.3	272.4	267.6	22.2	12.7	9.4
BOMBALI	171.9	142.2	154.9	31.8	32.9	43.9
BONTHE	113.0	112.7	483.7	10.1	9.8	7.0
KAILAHUN	82.0	87.3	61.7	0.9	0.4	0.4
KAMBIA	156.7	144.4	136.1	14.2	7.8	8.8
KENEMA	204.7	173.3	183.5	3.6	4.0	5.2
KOINADUGU	80.9	75.5	77.2	2.8	2.8	3.0
KONO	215.0	216.2	163.6	3.9	3.4	2.9
MOYAMBA	110.4	79.5	76.9	6.1	1.8	5.0
PORT LOKO	244.0	195.7	166.7	10.4	7.7	6.5
PUJEHUN	101.7	69.5	87.3	0.0	0.6	0.3
TONKOLILI	217.0	200.3	197.3	7.0	9.7	12.9
WESTERN RURAL	284.3	317.3	353.2	15.1	13.2	9.5
WESTERN URBAN	472.8	444.4	418.7	13.9	11.8	9.6
Overall	237.4	214.0	215.5	10.6	8.9	9.1

Figure 7: Proportion of TB cases that are extra-pulmonary TB by district, Sierra Leone, 2012-2014



5.1.4 Treatment outcome

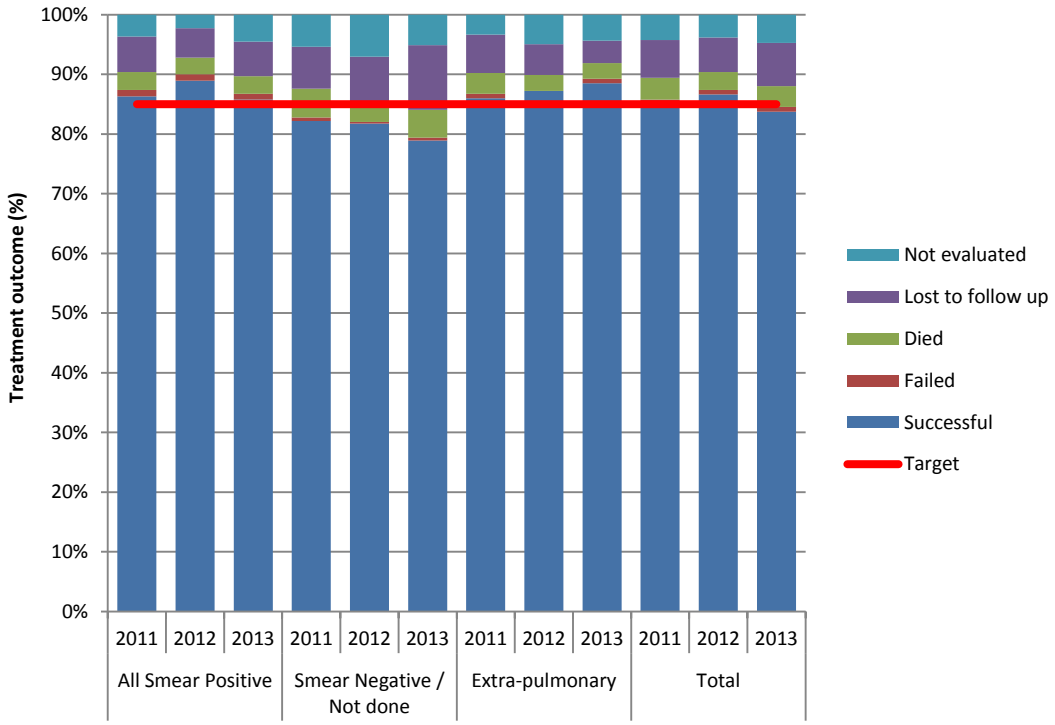
The number of treatment outcomes reported did not correspond to the number of TB cases notified (Table 6). In 2011 there were less treatment outcomes recorded and therefore these additional cases were counted as “not evaluated”. In 2012 and 2013 there were additional treatment outcomes reported. It is possible that these cases are due to errors in recording and reporting or that they were missed from notification reports from the previous year. For these years the number of cases with a registered outcome was used as the denominator. Routine data validation and follow up should be introduced to improve this data.

The national treatment success percentage over time is shown in Figure 8. The global 85% treatment success target was met since 2012 (from when data are available). Treatment success remained high in 2013 at 85.7% (10830/12933). In 2013 the main reasons for not completing treatment were lost to follow up (7.3%, 940/12933), followed but not evaluated (4.7%; 610), death (3.5%; 448) and treatment failure (0.8%; 105). In 2013, treatment success was lowest in pulmonary TB cases that were smear negative/smear not done (78.9%) (Figure 8). This was due to higher rates of loss to follow up (10.8%).

Table 6: Difference between TB cases notified and reported treatment outcomes

	2011	2012	2013
Notified as a case	12943	13354	12334
Registered outcomes	12707	13431	12933
Missing or Extra cases	-236	77	599

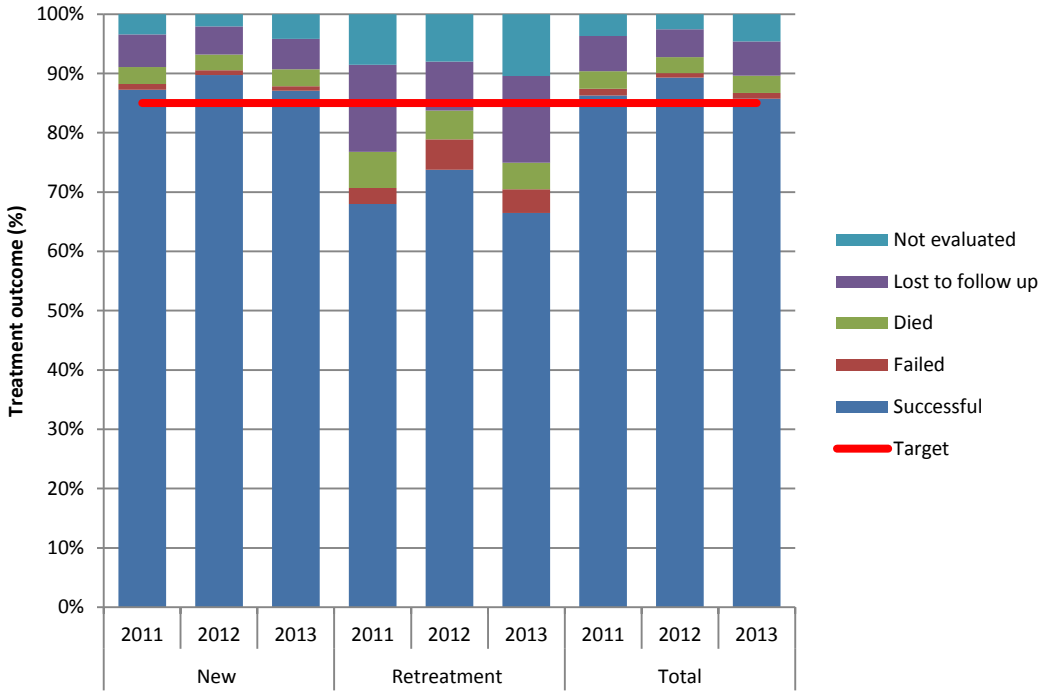
Figure 8: Treatment outcome by site of disease, Sierra Leone, 2011-2013*



*The 85% target of treatment success is shown in red

Treatment success was high in new cases (87.1%; 6788/7794) compared with retreatment cases (66.5%; 369/555) (Figure 9). Retreatment cases were more likely to be lost to follow up, fail treatment, die and not be evaluated compared with new TB cases.

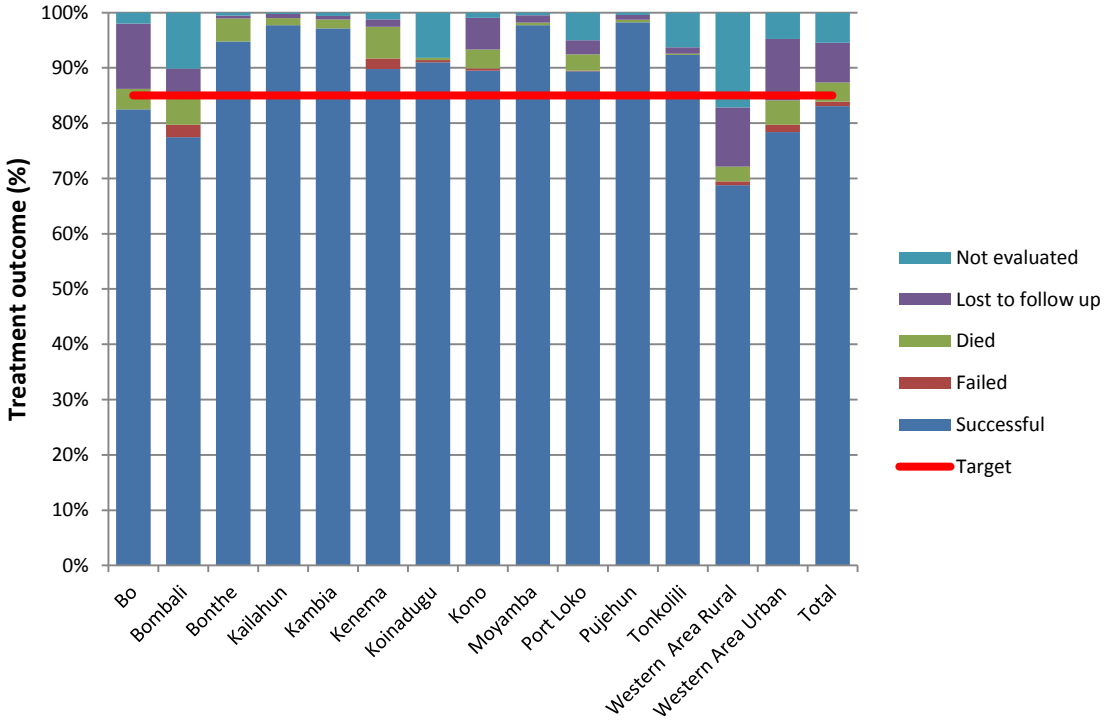
Figure 9: Treatment outcome by treatment history, Sierra Leone, 2011-2013*



*The 85% target of treatment success is shown in red

Treatment outcome varies substantially by district. In 2013 treatment success was highest in Punjehun (98.2%). Treatment success was below 85% in Bo, Bombali, Western Urban and Western Rural districts. Bombali had the highest rates of treatment failure (2.3%) and death (5.5%). Bo, Western Urban and Western Rural districts had the highest rates of lost to follow up (11.8%, 11.1% and 10.7%, respectively). Western Rural and Bombali districts had the highest rates of cases that had no evaluated treatment outcome (17.2% and 10.1%, respectively).

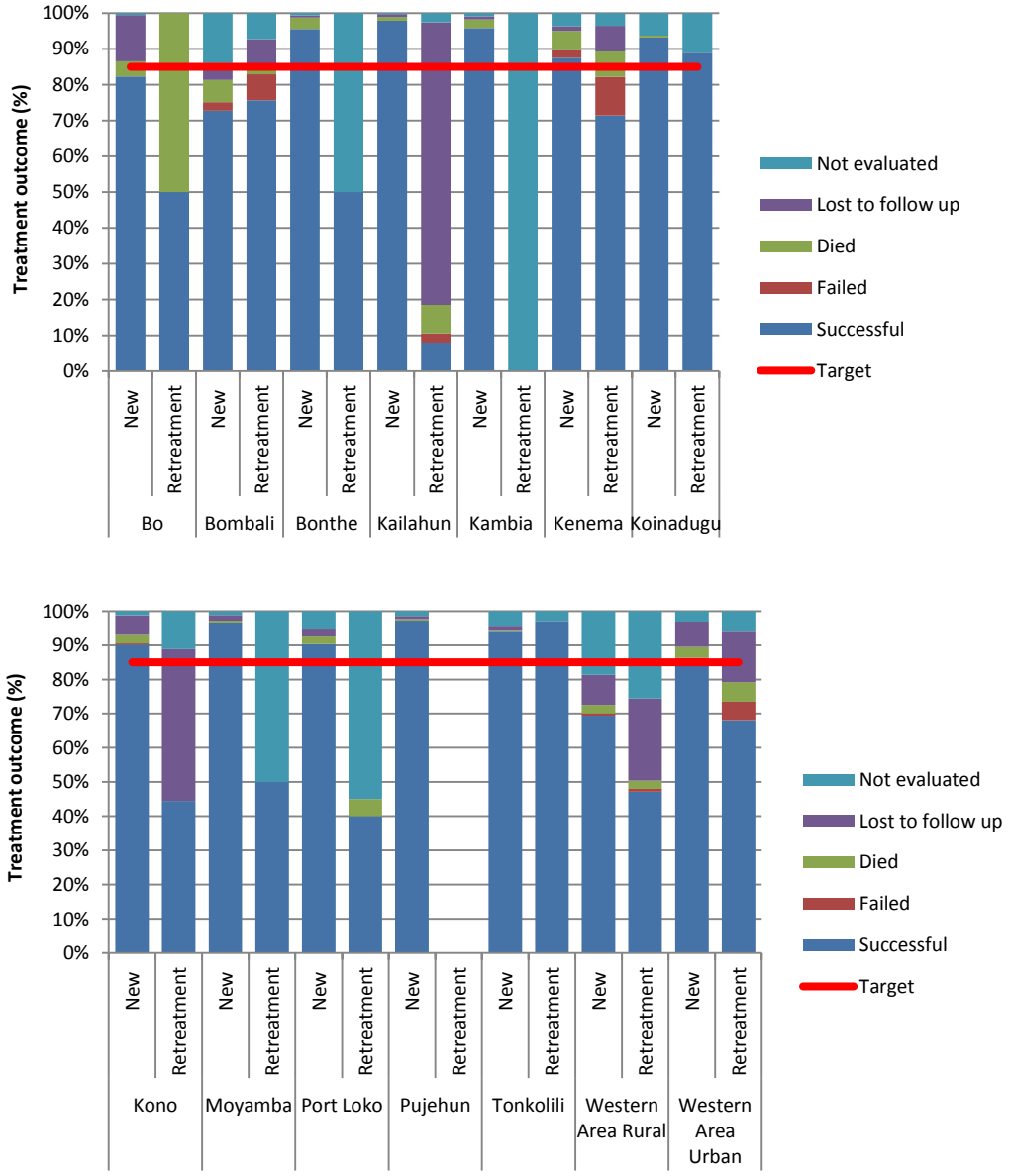
Figure 10: Treatment outcome by district, Sierra Leone, 2013*



*The 85% target of treatment success is shown in red

By district treatment outcome also varied by treatment history (Figure 11). Almost half of all retreatment cases in Bo died whereas Kailahun and Kono had high proportions of retreatment cases that were lost to follow up and in Kambia, Moyamba and Port Loko the majority of retreatment cases were not evaluated. These results should be interpreted with caution for Bo, Bonthe, Kambia and Punjehun where there are less than 5 retreatment cases reported. Koinadugu had no poor outcomes recorded for retreatment cases as all of those that did not complete treatment were recorded as not evaluated.

Figure 11: Treatment outcome by district and treatment history, Sierra Leone, 2013



*The 85% target of treatment success is shown in red

5.1.5 Childhood TB

Guidelines for the treatment and management of paediatric TB are currently being developed. At the moment there is no standard national guidelines for paediatric TB but WHO guidelines are followed. The use of WHO guidelines is not consistent throughout the country and many clinicians treating childhood TB in the districts require training on diagnosis and treatment of paediatric TB patients. Sputum and gastric washes are not currently taken from children under 6 years old and there is no source contact tracing for the infectious person. If an adult with active disease is identified the regimen of the adult is not taken into account when deciding on the treatment regimen that the child should receive.

The ratio of 0-4 to 5-14 year olds is within the expected range for 2012, 2013 and 2015 (Table 7). However, during 2014 the ratio dropped to 1.3 which suggests that during the EVD crisis 0-4 year olds were under diagnosed or under reported. For all TB cases the percentage of children was within the expected range of 5-15% for lower income countries at 11.2% in 2014. This was a decrease from 13.6% in 2013 suggesting that fewer children were diagnosed or reported compared with adults during the EVD crisis (Table 7). The proportion of cases that are children varies by district (Table 8). In Kailahun, Kono, Port Loko and Pujahun the proportion is below the expected range which suggests that there is under diagnosis of children in these districts. In Kambia, Moyamba, Tonkilli and Western Urban districts the proportion of TB cases that were children was exceptionally high in 2015 suggesting either under diagnosis of adults or over diagnosis of TB in children. This should be investigated further.

On a visit to the largest referral hospital in the country for paediatric TB, Ola in the Western Urban district, a register review was conducted which indicated high numbers of lost to follow up. In Q1 of 2014, 22% (39/117) were recorded as lost to follow up and in Q1 of 2015 this had increased to 33% (30/135). On review of all 2014 data from the same hospital 24.9% (92/369) (Figure 12) were lost to follow up. This is much higher than the national average for the same period of 7% (940/13032). Only 65% (240/369) of children treated at Ola successfully completed treatment in 2014 which is lower than the national average of 83% (10830/13032). During the EVD crisis this hospital closed for a brief period and there were no reports of TB cases in June 2014. Staff reported there was also a large increase in the number of defaulters during this time which is of great concern. Patients have not yet been traced.

At Ola it was also observed that there was a high proportion of children with TB-HIV co-infection of 14% (19/135) amongst 0-14 year olds in Q1 2014 and 29% (34/117). Of these, 79% (15/19) in Q1 2014 were in those less than 2 years old and in Q1 2015 44% (15/34) were in those under 2 years old.

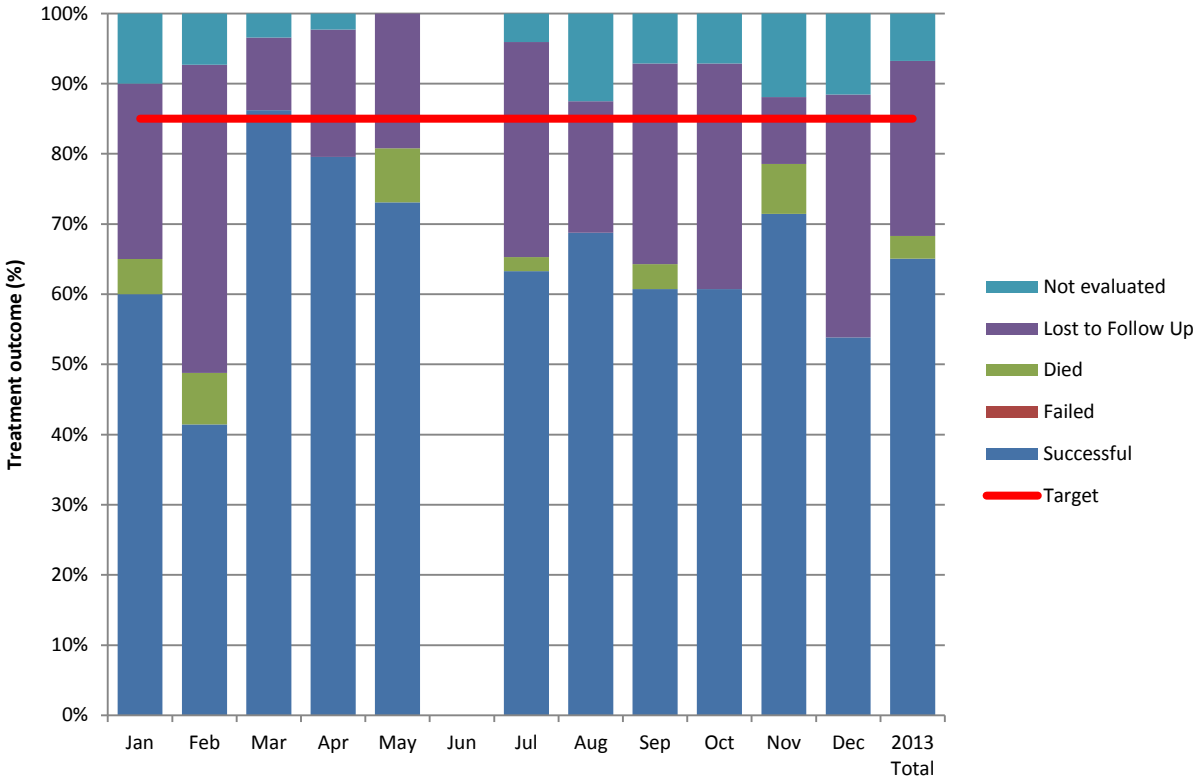
Table 7: Proportion of TB cases that are 0-14 years old and ratio of 0-4 to 5-14 year olds (excludes pulmonary smear positive retreatment cases)

	0-14 year olds		Total TB cases	Ratio 0-4:5-14 year olds
	n	%		
2012	1810	14.1	12842	1.7
2013	1771	13.6	11837	1.7
2014	1372	11.2	12207	1.3
2015	1138	10.3	11046	2.0

Table 8: Proportion of TB cases that are 0-14 years old (excludes pulmonary smear positive retreatment cases)

	2013	2014	2015
BO	12.3	10.5	10.7
BOMBALI	9.5	11.8	22
BONTHE	4.9	7.4	16.7
KAILAHUN	4.1	1	0
KAMBIA	18.9	14.2	20.2
KENEMA	12.4	9.3	11.9
KOINADUGU	3.8	5.4	6.8
KONO	1.8	3.8	3.8
MOYAMBA	3.2	7.1	17.1
PORT LOKO	3.3	3.1	5.1
PUJEHUN	7.8	5.1	3.2
TONKOLILI	4.7	7.8	18.8
WESTERN RURAL	9.9	3.8	5
WESTERN URBAN	23	18.7	24.8

Figure 12: Treatment outcome for those diagnosed at the Ola During Children's Hospital, Freetown, 2013



5.1.6 HIV-associated TB

It was observed in the field that WHO TB-HIV guidelines were not being followed. Urgent training needs were identified at the clinic level. TB-HIV co-infected patients were not started on treatment for ART until 2-5 months after starting treatment for TB. Currently partners of individuals who are TB-HIV co-infected are offered a test for HIV but not for TB. Treatment of TB and HIV are mostly managed by separate clinics throughout the country which makes life more difficult for patients and creates difficulties in follow up. The TB-HIV collaboration should be strengthened for all activities and patients should be able to be managed for co-infection at the same clinic. There is a future plan to upgrade DOTs sites to HIV/ART sites. The NGO SOLTHIS (Therapeutic Solidarity and Initiatives for Health) provides training and on site mentorship to clinical staff on HIV diagnosis and treatment. The NTP should consider engaging with this NGO to provide training in the field for TB- HIV and Monitoring and Evaluation activities.

From aggregate reports, the proportion of cases with HIV tested and/or status known is documented for 86.8% and 92.7% of all notified TB cases in 2014 and 2015, respectively (Table 9). This may be underestimated because it was observed that HIV tests that are carried out during TB treatment are not always updated in the TB registers. Of these, the proportion that were HIV positive between 2011-2015 was consistently between 11 and 13%. The proportion of patients placed on ART or CPT increased over time. In 2015 70% and 64% of TB-HIV co-infected patients were placed on ART and CPT, respectively. In 2015 HIV testing was higher in sputum smear positive patients (94.4%) but the proportion that were co-infected with HIV was lower at 8.4% (Table 10). HIV testing did not appear to be significantly affected by the EVD crisis. HIV testing remained above 85% for TB cases in all districts in 2014 apart from in Bonthe and Bombali where only 21.6% and 76.1% of TB cases were tested, respectively (Figure 13 and Table 11). Western Urban and Western Rural districts had the highest proportions of TB-HIV positive cases; 20.9% and 18.0% respectively. Bonthe had the lowest proportion of co-infection of 0.6% but this is likely due to lack of testing. Bombali and Western Rural districts had very low numbers of cases treated with ART or CPT (Figure 14). ART and CPT are not currently collected in the TB registers and are collected by the TB district supervisor from the HIV register. There are TB-HIV patients in the HIV register who are missing from the TB register and there is no robust cross-referencing system for data validation between HIV and TB registers. The proportion of TB-HIV co-infected cases placed on ART is therefore likely to be inaccurate. This is demonstrated by the reporting error in Tonkolili where more than 100% of HIV positive cases were placed on treatment.

Data from the HIV programme is collected in a paper based system and sent from the PHU > District > National level on a monthly and quarterly basis. TB and HIV variables should be introduced into both paper registers and a robust system should be established for cross referencing between registers. It would be beneficial for the TB programme and the HIV programme to use the same electronic data collection system such as DHIS2 in the future.

Table 9: HIV testing, HIV status and treatment with ART and CPT in TB patients, Sierra Leone

	Total TB case notifications	Tested for HIV		HIV positive		ART		CPT	
		n	%	n	%	n	%	n	%
2011	12943	5022	38.8	456	9.1	126	27.6	121	26.5
2012	13354	11655	87.3	1343	11.5	569	42.4	344	25.6
2013	12334	11,190	90.7	1,417	12.7	901	63.6	719	50.7
2014	12724	11048	86.8	1308	11.8	890	68.0	805	61.5
2015	11572	10728	92.7	1378	12.8	964	70.0	882	64.0

Table 10: HIV testing, HIV status and treatment with ART and CPT in smear positive TB patients, Sierra Leone

	Total smear positive cases	Tested for HIV		HIV positive	
		n	%	n	%
2011	7435	5308	71.4	365	6.9
2012	8031	7224	90.0	567	7.8
2013	7390	6729	91.1	545	8.1
2014	7451	6862	92.1	553	8.1
2015	7436	7016	94.4	590	8.4

Figure 13: HIV testing in TB patients by district, Sierra Leone, 2014

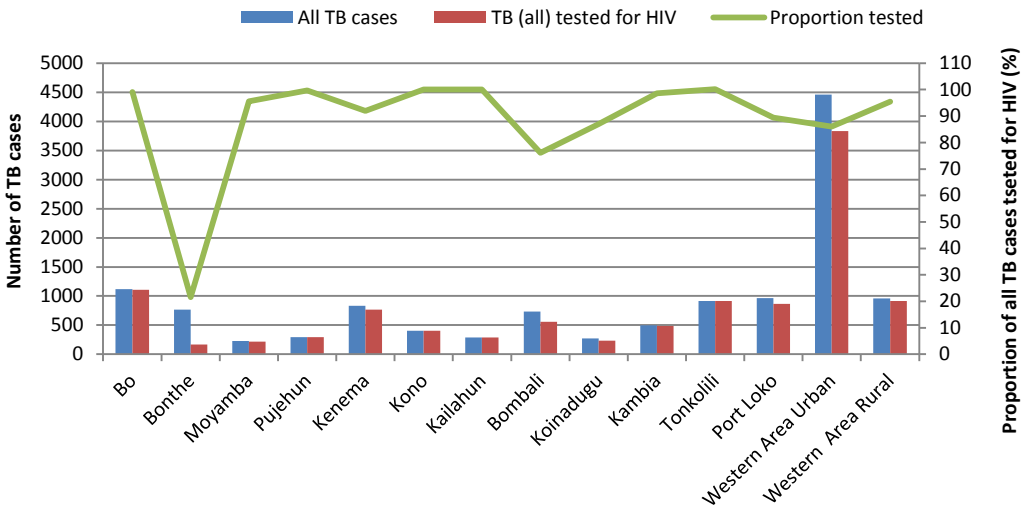
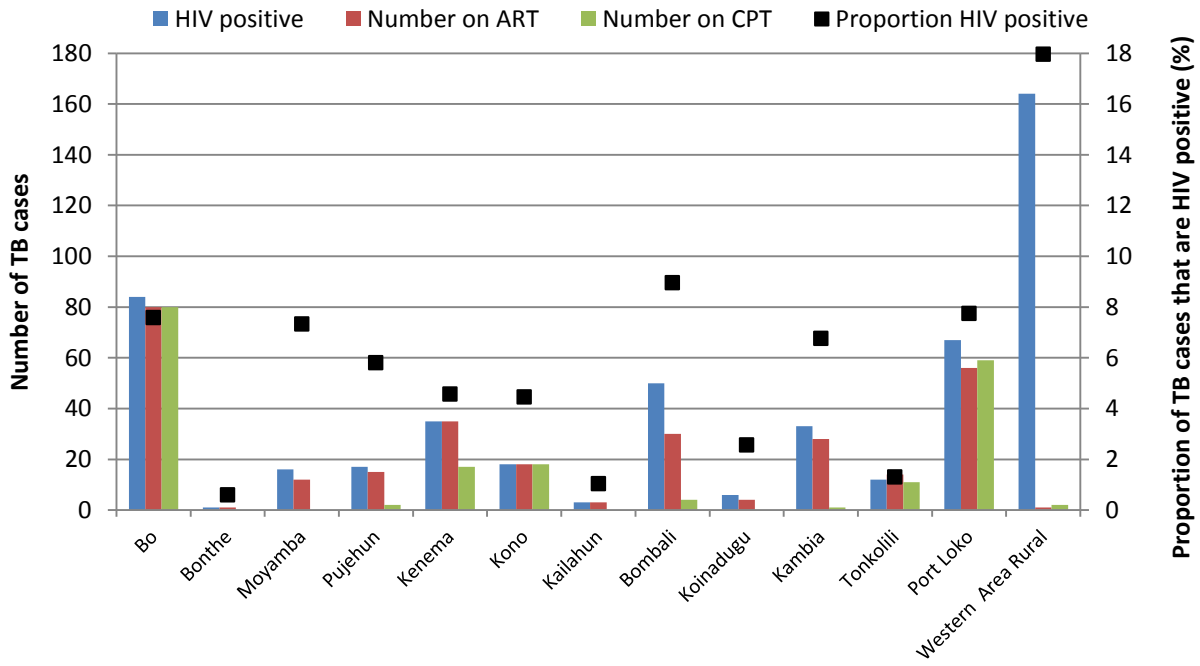
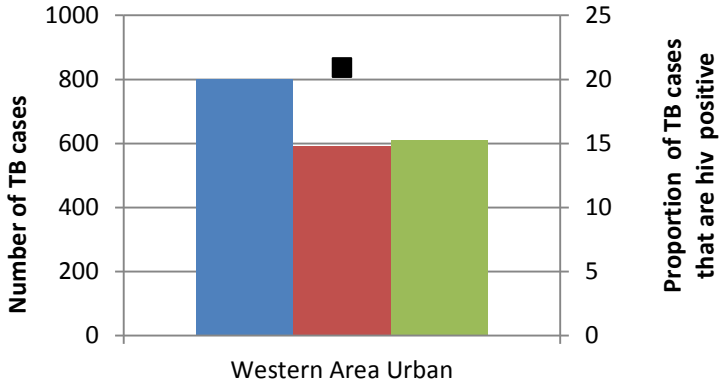


Table 11: Proportion of TB cases tested for HIV by district in 2013 and 2014

District	2013	2014
Bo	87.4	99.1
Bonthe	75.5	21.6
Moyamba	90.9	95.6
Pujehun	96.5	99.7
Kenema	93.8	91.9
Kono	89.2	100.0
Kailahun	56.3	100.0
Bombali	99.8	76.1
Koinadugu	98.2	87.0
Kambia	91.3	98.6
Tonkolili	97.4	100.2
Port Loko	98.0	89.4
Western Area Rural	91.0	86.0
Western Area Urban	91.6	95.5

Figure 14: Treatment with ART and CPT for TB-HIV co-infected patients by district, Sierra Leone, 2014





5.1.7 Anti-TB drug resistance

Currently the National TB Reference laboratory does not perform culture or DST. The laboratory was used to process Ebola samples during the EVD crisis and therefore requires decontamination before it can be used for TB. Laboratory staff require training in laboratory techniques and general knowledge on drug resistant TB. The current SNRL is Borstel but it is recommended that the NTRL explore options within the region. No nationally representative drug resistance survey of new pulmonary TB cases has been carried out. There are future plans to use GeneXpert for MDR-TB suspects and those confirmed with MTB that are rifampicin resistant will be confirmed by culture and DST. It is important to develop an algorithm for GeneXpert testing and estimate how many cases need to be screened in order to determine the number of machines and cartridges required.

Currently it is recommended that countries should aim to carry out DST on all retreatment cases. The TB data is currently only disaggregated by treatment history for pulmonary smear positive cases. In order to determine the total number of retreatment cases, the proportion of smear positive cases that are retreatment cases was applied to the number of smear negative/not done and extra-pulmonary cases. MDR-TB suspects also include those that fail to convert at 2/3 months and those that fail treatment (Cat I or Cat II) regardless of treatment history. Pregnant women who currently cannot have TB confirmed by chest X-ray if they are smear negative could also have TB confirmed with GeneXpert. Based on current data it is estimated that approximately 1094 cases are eligible for screening per annum (Figure 15).

Figure 15: High risk groups for screening with GeneXpert and the estimated number of cases to screen based on these groups

High risk groups to screen with GeneXpert for RMP resistance and TB

MDR-TB Suspects
Retreatment cases
Failed to convert at 2/3 months
Failed at the end of treatment (Cat I and Cat II, new and retreatment)

GeneXpert
Pregnant women notified with TB non-smear positive

Retreatment cases
Number of smear positive retreatment + ppn of retreatment cases* smear negative + ppn of retreatment cases* smear not done + ppn of retreatment cases* extra-pulmonary TB

Estimated number to screen with GeneXpert for RMP resistance and TB

2014	Smear positive retreatment cases	520 (6.5%)
	Smear negative/ND retreatment cases	276
	Extra-pulmonary retreatment cases	34
2014	Failed to convert	107
2013	Treatment failures	105
2014	Pregnant women	52
Total		1094

The number of MDR-TB cases were estimated in order to effectively resource treatment and patient management. WHO has provided estimates on the number of MDR-TB cases among pulmonary notified cases (1.7% in new cases; 200 (35-360) and 17% in retreatment cases; 89 (23-160))[1]. WHO estimates for retreatment pulmonary cases were applied to the estimated retreatment cases for all sites of disease. Based on the estimated number of retreatment cases for all sites of disease this would equate to 141 cases (0.17 *830).

From the current TB programme data it is not possible to accurately calculate the number of MDR-TB cases. New TB cases on Cat I treatment and retreatment cases on Cat II treatment, that fail treatment, are more likely to have drug resistant TB. Without DST testing it is unclear how many there are. In 2013, the following failed treatment: 22 smear positive cases on Cat II treatment, 60 smear positive cases on Cat I treatment, 19 smear negative/not done and 4 extrapulmonary cases on Cat I or Cat II treatment. In addition 52/725 (7.0%) cases on Cat I treatment and 159 (31.8%) cases on Cat II treatment either died, were LFU or transferred out. A proportion of these may also have been infected with drug resistant TB.

The NTP should aim to test 100% of the risk groups outlined above over a specified time period and ensure that the resources are available to treat and manage the number of MDR-TB patients based on WHO estimates. The number of expected cases can be revised once there is data available which directly measures the burden of MDR-TB in the country. The NTP should consider carrying out a DRS using GeneXpert and before the laboratory is at full capacity samples could be sent to the SNRL for culture and DST. Protocols shoud be developed using standard methodology and technical assistance from WHO. This approach could also be used for routine processing of samples. An expert in MDR-TB programme management should be recruited to co-ordinate all activities in the country ranging from clinical and laboratory training, diagnostics, treatment, contact tracing and active case finding. A MDR-TB surveillance system should be established in the national reference laboratory, sites using GeneXpert and the treatment centres. A case based electronic recording and reporting system for MDR could be developed in DHIS2 which will be used to record aggregate data for TB.

5.1.8 High risk groups and private sector

Prisoners and the Military

The transmission of TB in prisons is a known public health concern. In Sierra Leone prisons are integrated into the NTP as each prison is affiliated with a DOTs centre. Data is however difficult to analyse due to errors in reporting. In 2013 and 2014 64-65% of all notified cases from the Prison Hospital in Freetown were smear positive, similar to the national figure of 63% **(**Table 12**).** In addition to the figures below a further 9 cases were reported from 4 districts (Bombali, Kenema, Punjehun, Koinadugu) during 2014. Since 2011 there has been a rapid increase in number of smear positive cases notified from prison facilities from 4 to 62 in 2014 **(**Figure 16**).** However the number notified in 2015 appears to have decreased to 26.

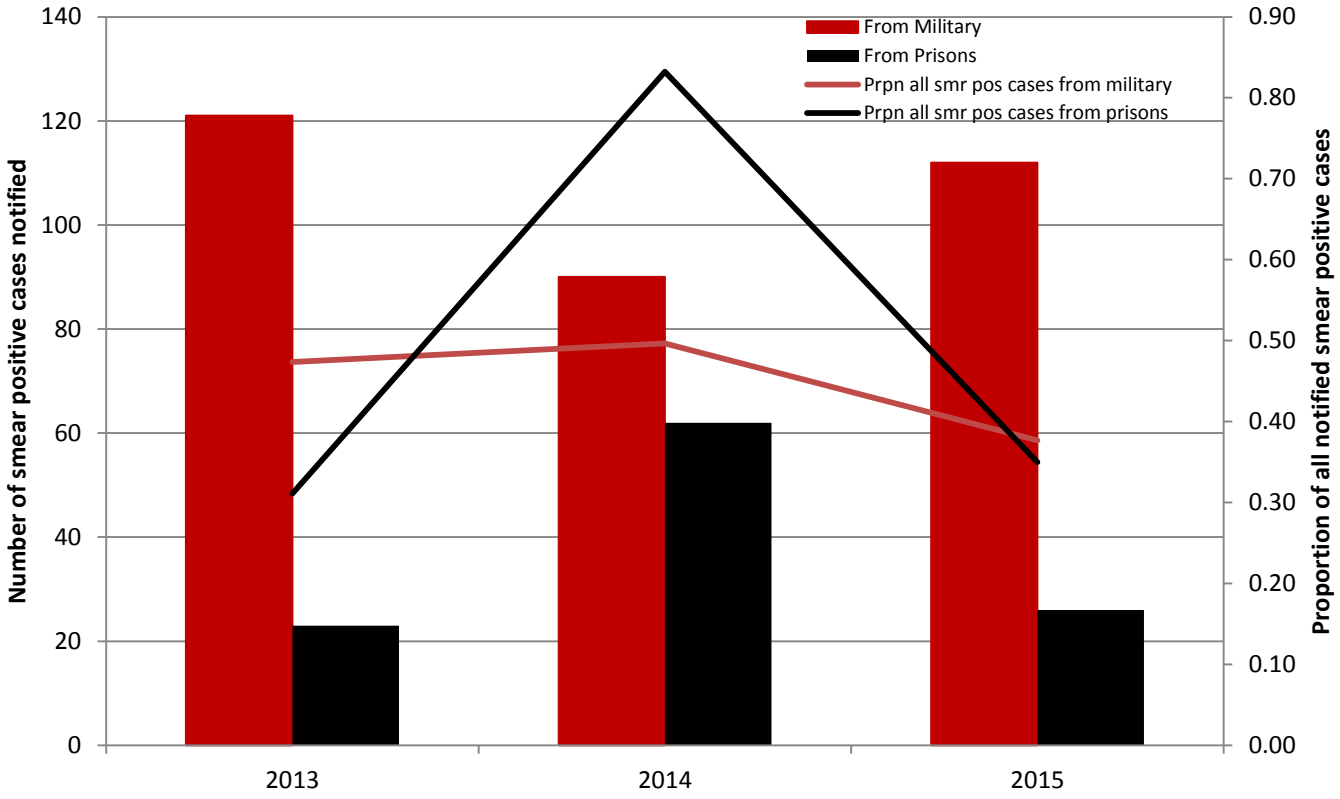
Table 12: Number of TB suspects screened, notified and smear positive, Prison and Military Hospitals, Sierra Leone

	Prison Hospital		Military Hospital	
	2013	**2014**	**2013**	**2014**
No. screened	114	209	483	410
No. (%) notified	36 (32%)	82 (39%)	295 (61%)	267 (65%)
No. (%) smear positive	23 (64%)	53 (65%)	113 (38%)	84 (31%)

The military hospital is also reporting to the TB programme. Around 300 cases are notified per year from the military hospital. In both 2013 and 2014, the years for when this data is available (Table 12) a high proportion (>60%) of those screened for TB are notified as having TB and conversely the number with smear positive TB is low compared to the national mean. Therefore it is recommended that the screening and diagnosis policy is reviewed at the military hospital to ensure all those are classified as non-smear positive are indeed so and that all those requiring screening are screened.

The overall proportions of all smear positive cases that come from the military and prison systems is low. Without data on the number of people in prison or the military the burden of TB in these institutions cannot be calculated. Outcome data is not reported for prisons and those in military which would be recommended to ensure treatment completion rates remain in line with those for the whole country.

Figure 16: Notified cases from military and prison systems; Sierra Leone, 2013-2015



Pregnant women

Data on pregnancy in women diagnosed with TB is lacking. The only data available is from 2014. Of those who were pregnant 29% had smear positive TB and nearly 60% were smear negative. GeneXpert testing is imminent in country and when this is available it can be used to confirm TB in pregnant women with TB symptoms that are smear negative. Information about HIV co-infection could not be extracted as the information system does not record data disaggregated by person.

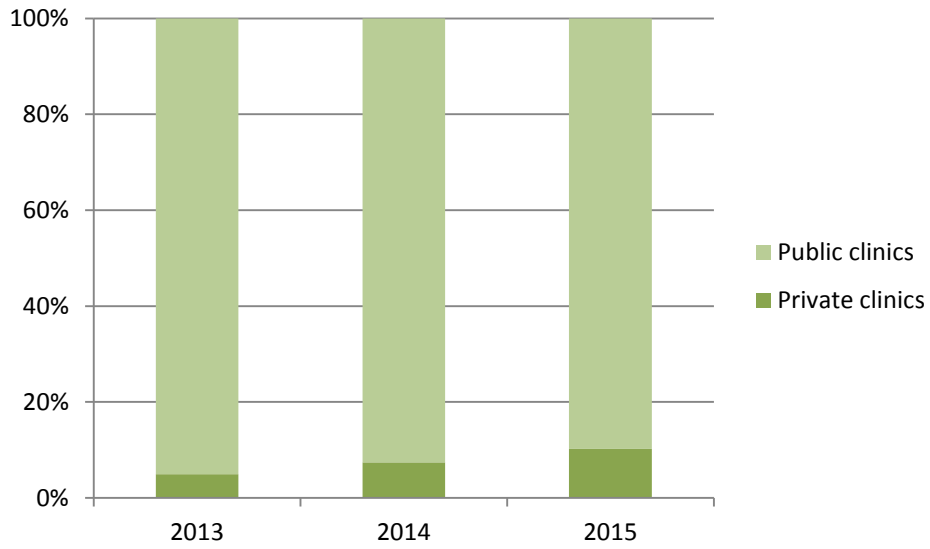
Health Care Workers

No data was available on whether a TB case was a health care worker. Transmission of TB is a recognised risk in a health care setting most commonly from those with undiagnosed TB. Infection control practices should be in place to minimise the risk to any staff and this data should be collected as part of the NTP.

5.1.9 Private Sector

The private sector in Sierra Leone contributes to the TB service. In 2013 5% of smear positive TB cases were notified from the private sector, this rose to 7% in 2014 and is estimated at 10% in 2015 (Figure 17). It is reported that individuals do not trust public hospitals for sensitivity and confidentiality regarding their diagnosis leading to an increase in attendance at private clinics. Currently private clinics receive drug treatment stocks via the NTP, however starting in 2016 they will receive them directly which could result in a lack of reporting to the NTP. There are currently 169 private clinics registered with the Medical and Dental Counsel however not all of these will diagnose and treat TB patients, although this proportion is unknown. A dataset on suspect and confirmed TB cases is not collected from private clinics therefore an assessment needs to be carried out by the NTP on which private clinics do see TB patients and the number of cases diagnosed and treated in the private sector. There is concern that as the private sector grows it must be integrated into the NTP which will require successfully engagement and collaboration with the clinics to enable TB recording and reporting otherwise estimates of the TB burden in Sierra Leone are under representative.

Figure 17: Proportion of TB smear positive cases notified from the private sector, Sierra Leone, 2013-2015



5.1.9 The impact of the Ebola outbreak on TB

The impact on the Ebola Virus Disease (EVD) epidemic in Sierra Leone has not previously been assessed. Nationally TB case notifications declined during Q3 and Q4 2014 and started to rise again in Q1 and Q2 2015. This drop in notifications corresponds to the increase in EVD cases being notified, with the highest number being reported as TB case notifications were at their lowest point (Figure 18). It is likely the reasons for this are multifaceted but reportedly include fear of visiting health care facilities and being around people with symptoms that may be EVD rather than TB. This aligns when the data on the number of TB suspects screened is examined alongside EVD notifications where a decline in the number of TB suspects screened is observed as EVD notifications increase (Figure 19). Conversely some individuals also reported that a reason TB symptomatic individuals wanted to be tested was to demonstrate to their family and community that they were sick from something other than TB and therefore would not be ostracised by the community due to being suspected of having EVD. It is reported that the majority of health facilities stayed open in Sierra Leone during the epidemic and TB clinic staff were not repurposed to assist with the EVD outbreak however there is a concern that reporting was hindered during this period and treatment drugs may not have been as readily available. Furthermore the National Reference Laboratory for culture and drug sensitivity testing (DST) was not in use for TB samples as it was used to process samples for EVD which may have led to an increase in clinical diagnosis and a lack of bacteriological confirmation.

Figure 18: TB and EVD cases notified, Sierra Leone, 2014-2015

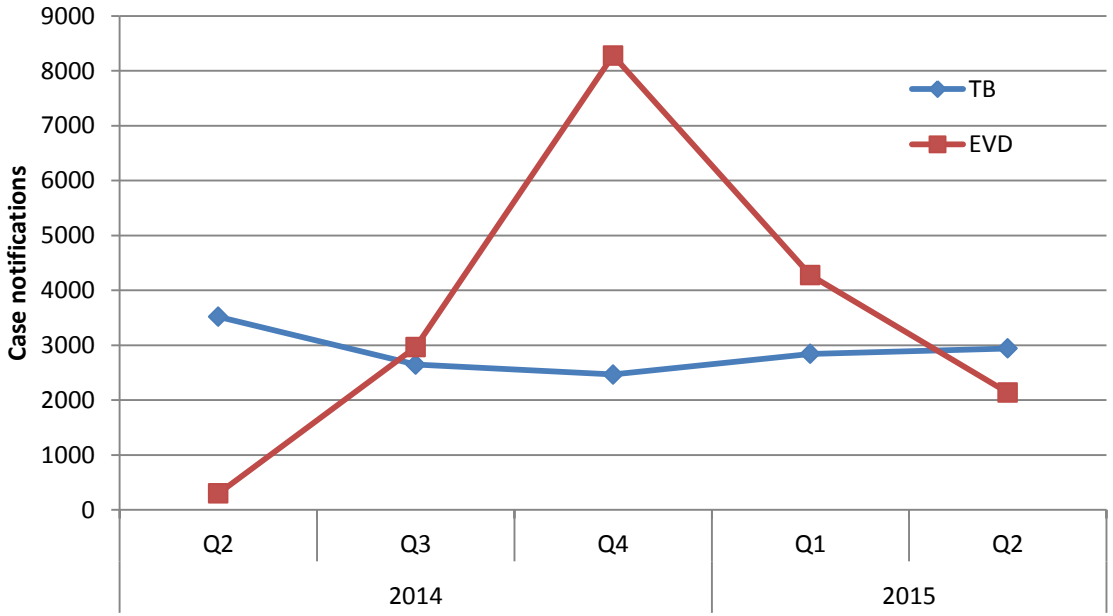
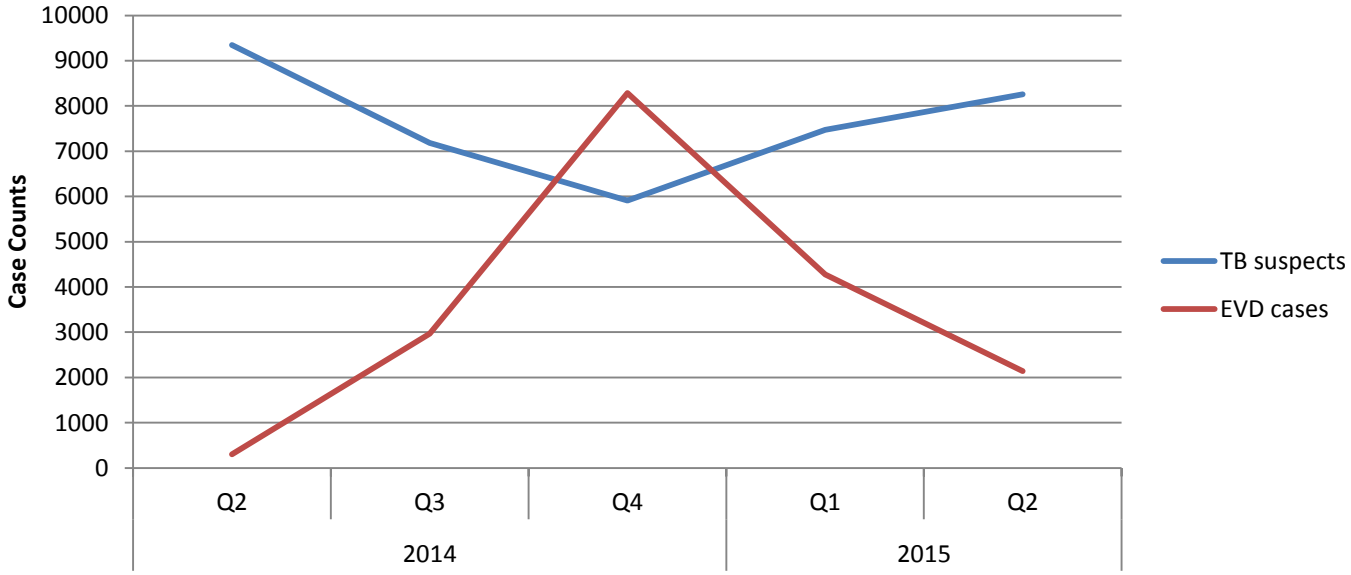
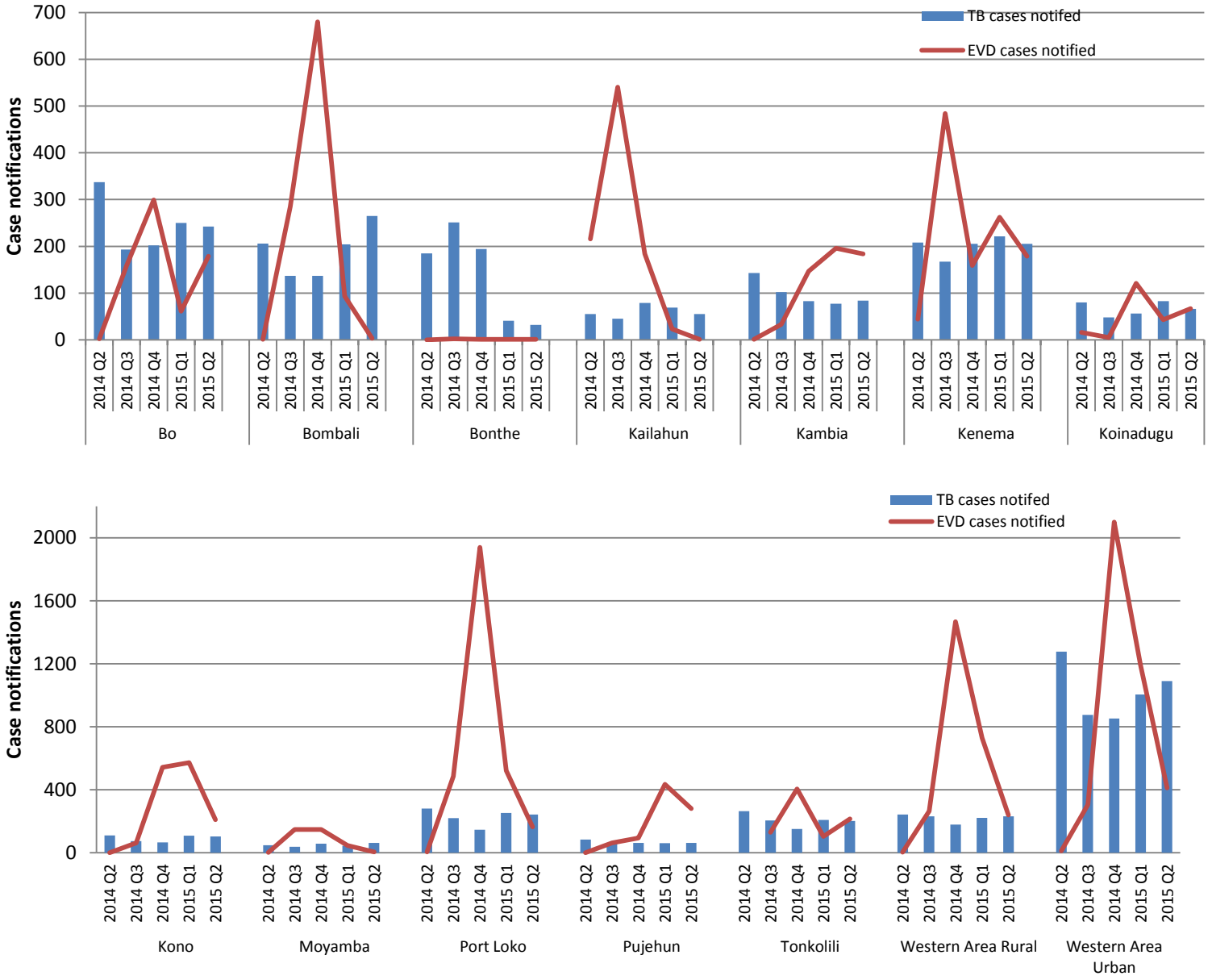


Figure 19: Suspected TB cases screened and EVD cases notified, Sierra Leone, 2014-2015



The peak of the EVD epidemic did differ by district, in Kailuhun, the first EVD affected district in Sierra Leone, the peak in EVD case notifications was in Q2 2014 and a drop in TB notifications in seen during the same period(Figure 20). The same pattern is seen across the majority of districts, when EVD case notifications were at their highest TB notficiations dropped. In Bombali TB notifications were lower in Q3 and Q4 2014 as EVD notifications were at their highest. In Kambia a gradual decline is seen from Q2 2014 to Q1 2015 as a gradual increase in EVD are reported. The highest number of EVD case notifications per quarter were seen in Port Loko and the Western Urban Area and the same pattern is demonstrated, that TB notifications decreased during the same period. If individuals were not seeking health care then it is likely that there has been under-diagnosis of TB. The NTP should consider active case finding and awareness raising in the communities that are most affected. Bonthe did not report many cases of Ebola but had a huge increase in TB notifications which again suggests that perhaps these TB cases were not true TB cases. In a worst case scenario these cases were Ebola but were misdiagnosed as TB. Treatment outcome data was not yet available for the time period of the EVD outbreak and it will be important for the NTP to review treatment outcomes for this time period to ensure that an increase in cases lost to follow up, died or not evaluated is not seen. Interventions should be undertaken if increases in lost to follow up or not evaluated are recorded. Further RDTs for HIV co-infections were not able to be undertaken due to the risk of taking blood during the EVD outbreak therefore any persons that were not tested for HIV should be have this test carried out when recommended by authorities that it is safe to do so.

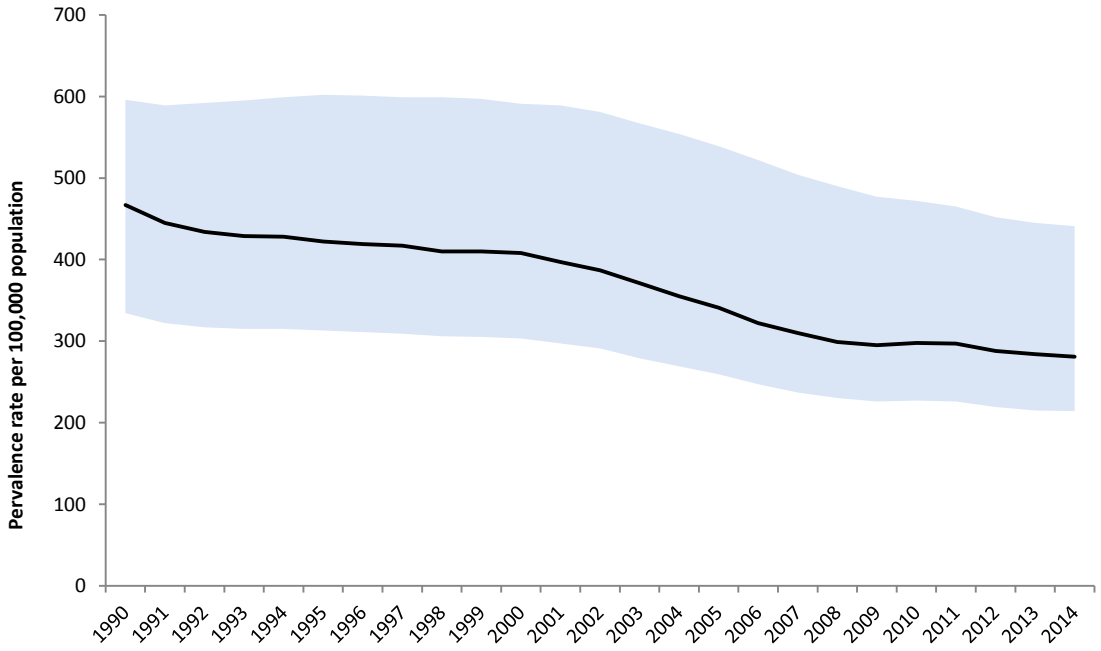
Figure 20: TB and EVD cases notified, Sierra Leone districts, 2014-2015



5.2 Prevalence

For 2014 WHO estimates a prevalence of 441 (95% CI: 228-722) per 100, 000 population. This means that around 28,000 (95% CI: 14,000-46,000) have active TB in the country at any one time. The prevalence rate has continued to decline slowly since 1996 (Figure 21).

Figure 21: TB prevalence (includes HIV positive TB) in Sierra Leone, 1990-2014



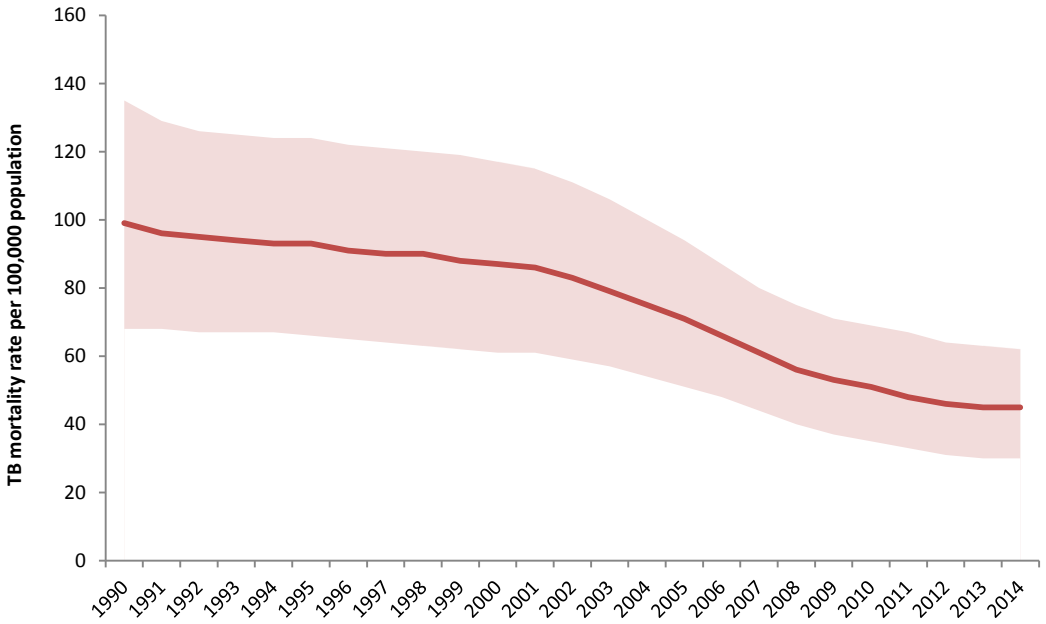
Source: WHO TB database

*The blue ribbon denotes the uncertainty around TB prevalence estimates

5.3 Mortality

There is no well-functioning VR system of deaths with standard cause of death in Sierra Leone. This means direct measurement of TB mortality among those HIV-negative is not currently possible. Therefore, an indirect estimation of the levels of and trends in TB mortality needs to be employed (Figure 22). Mortality rates steadily declined between 1990-2014 from 99 per 100,000 population to 45 per 100,000 population. Since then TB mortality has decreased from reflecting the trend in incidence and case notification rate. Sierra Leone met the Stop TB Partnership's target of 50% reduction in mortality by 2015, compared with 1990 in 2013.

Figure 22: TB mortality (excludes HIV positive TB) in Sierra Leone, 1990-2014



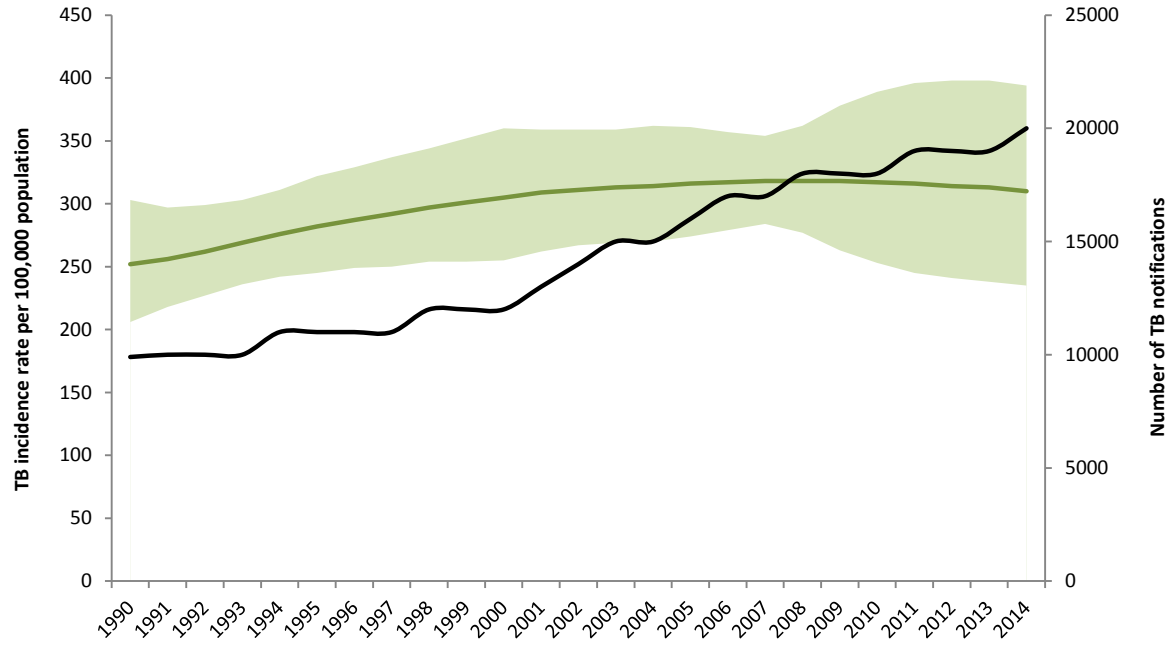
Source: WHO TB database

*The red ribbon denotes the uncertainty around TB mortality estimates.

5.4 Incidence

Figure 23 shows the time trend of the estimated incidence rate in Sierra Leone. The incidence rate increased from 252 (95% CI: 242-311) per 100,000 population in 1990 to 318 (95% CI: 263-378) in 2009. Incidence has since fallen to 310 (95% CI: 235-394). Over the last 25 years TB notifications increased from 9900 to 20000 cases per year.

Figure 23: TB incidence (includes HIV positive TB) in Sierra Leone, 1990-2014



Source: WHO TB database

*The green ribbon denotes the uncertainty around TB incidence e stimates.

These estimates are based TB case notifications which are unlikely to be correct as there is evidence of under-reporting of primary defaulters and deaths. Although these estimates are adjusted for under-reporting this is also estimated and the true level of under-reporting and under-diagnosis is unknown. Strengthening surveillance is crucial in order to directly measure TB notifications and TB incidence.

5.5 Determinants of TB

The key determinants of TB in Sierra Leone that were explored include time changes in the size of the economy (GDP and GNI per capita) as well as wealth distribution (GINI index), demographic characteristics of the general population, the performance of health systems (under-5 mortality rate), HIV burden (HIV prevalence in the adult population) and plausible impact of TB control. Data on other risk factors for TB, such as malnutrition, diabetes, alcohol misuse, smoking and the rural, urban divide are also discussed. Table 13 shows a summary of prevalence for each risk factor in the population.

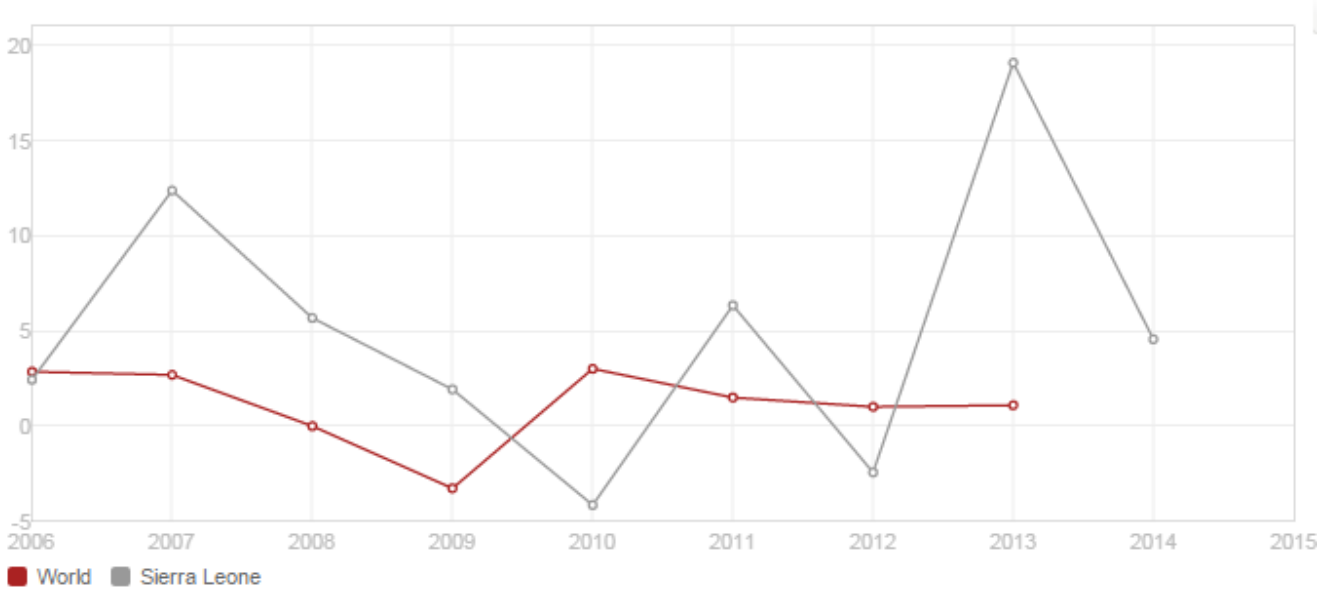
Table 13: Prevalence of selected TB risk factors, Sierra Leone

Risk Factor	Population	Prevalence (95% CI)
HIV (2014)	15-49 year olds	1.4% (1.2-1.6)
Under-weight (2013)	< 5 year olds	18.1%
Diabetes (2014)	>18 year olds	5.7% (2.5-8.7)
Problem alcohol use	>15 years old	8.9% (6.8-11)
Smoking	15 years old	32.2% (23.3-41.9)

Data sources: World Bank, UNAIDS, WHO Global Health Observatory

Sierra Leone is a low income country with a GDP per capita of US$775 in 2014 (source: World Bank) and a GNI per capita of US$480.8 (constant 2005 US$) (source: World Bank). Changes in its economy can be discerned from percentage annual growth of GNI (Figure 24). Sierra Leone's GNI per capita growth declined by 4.2% between 2009 and 2010, it increased by 6.3% in 2011 and declined again between 2011 and 2012 by 2.5%. GNI per capita grew by 19.1% in 2013 and in 2014 growth was at 4.5%. The slower growth rate in 2014 is likely attributable to the impact of Ebola.

Figure 24: Gross National Income per capita (2006-2014), Sierra Leone



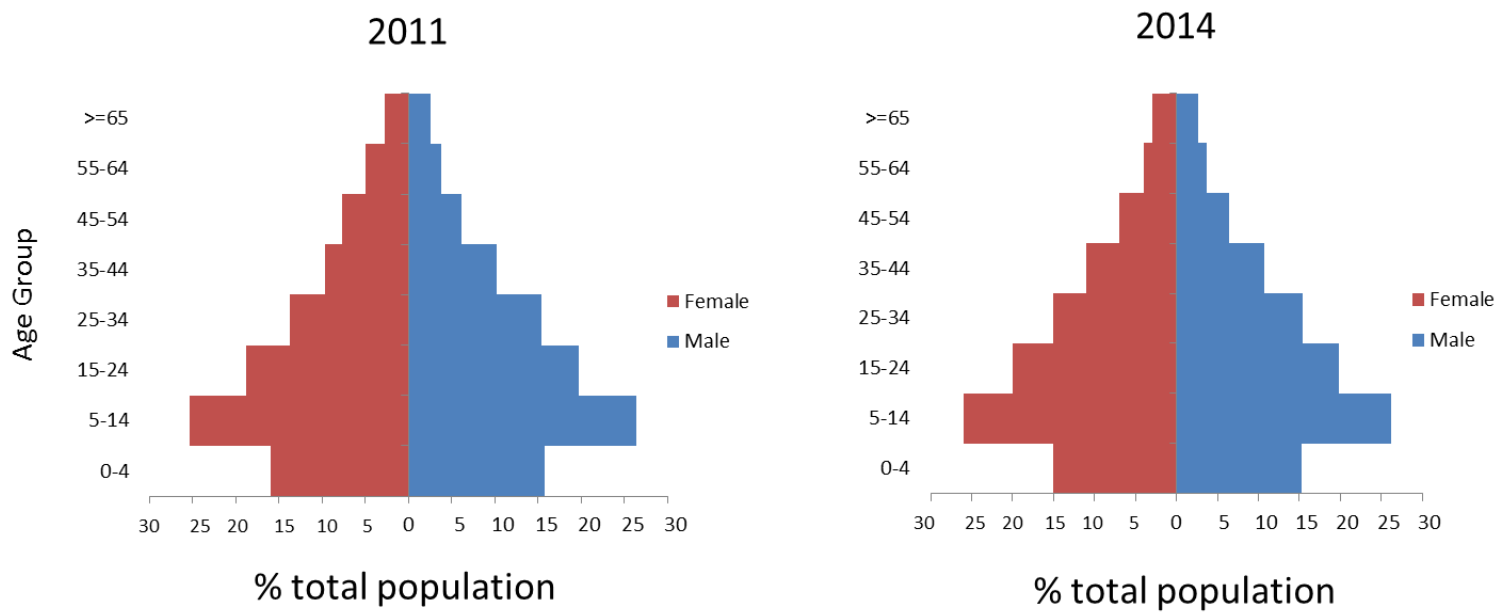
Data source: World Bank

Tuberculosis has long been associated with poverty and the associated socioeconomic factors[3]. The Gini Index - which measures wealth inequality from 0 (perfect equality) to 100 (perfect inequality) – was 34.0 in Sierra Leone in 2011 (only data point available). This was similar to that of neighbouring country Guinea in 2012, 33.7.

Demographic characteristics of general population

Figure 25 shows age and sex population pyramids for Sierra Leone in 2011 and 2014. The population increased in size by 40 496 over the last 4 years. There were no changes in population structure that could explain any changes in TB trends at the national level.

Figure 25: 2011 (left) and 2014 (right) population pyramids of the general population in Sierra Leone representing the distribution of the population by age and sex.

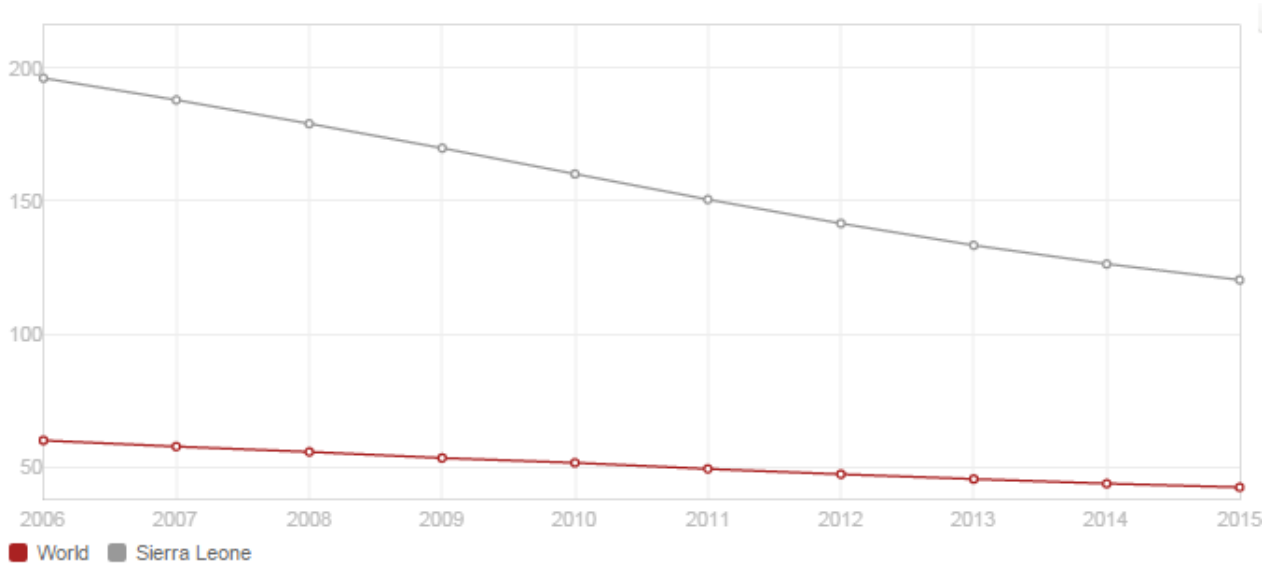


Data source: UNPD database

Under-5 mortality

The under-5 mortality rate per 1,000 live births is used as an indicator of overall performance of health systems. Figure 26 shows a time series of this indicator since 2006. The steadily declining under 5 mortality rate indicates ongoing improvement. The latest available mortality data (2015) is estimated at 120 per 1,000 live births.

Figure 26: Under-5 mortality rate per 1,000 live births, Sierra Leone, 2006-2015



Data source: World Bank

HIV burden

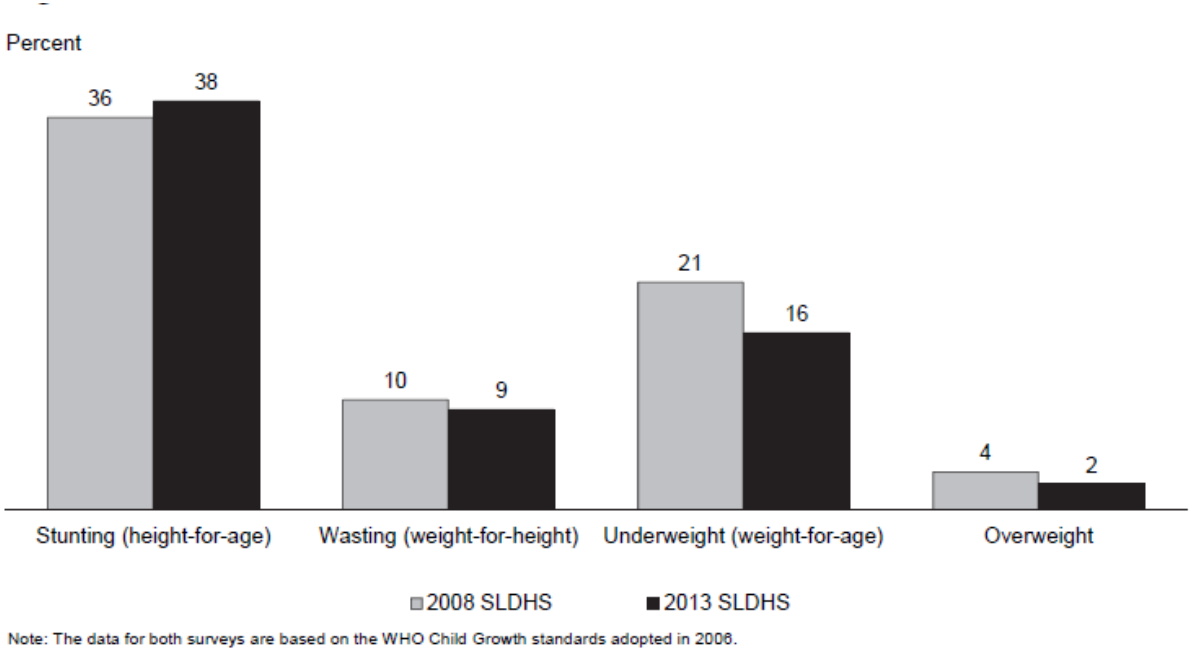
54,000 people were living with HIV in 2014, 4300 on them children aged 0-14. The HIV prevalence rate in those aged 15-49 was 1.4%, (1.2-1.6) in 2014, a steady decline from 1.7% in 2009. The number of children living with HIV also decreased from 4700 in 2013 to 4300 in 2014. The National HIV/AIDS secretariat (NAS) stated a number of key interventions that have assisted in this decline, namely an increasing in the number of health facilities that offer counselling and testing and an increase in testing carried out at antenatal clinics (ANC) to prevent mother to child transmission. The proportion of HIV patients placed on ART is estimated at 20% and the number of deaths due to AIDS was reported as 2700 (2100-3600) (Source: UNAIDS, WHO Global Health Observatory). There is momentum in country to strengthen the collaborations between the national treatment programmes for TB and HIV.

Malnutrition

Malnutrition is associated with an increased risk of progression from TB infection to active disease, and a strong, consistent negative relationship has been demonstrated between body mass index and TB incidence in different countries and time periods[4-5]. In 2013 18.1% of children under 5 years were under weight, a decrease from the 21.1% in 2010 (World Bank). In addition the Sierra Leone Demographic Health Survey using data carried out from selected households in 2013 reports that 38% of children under age 5 are stunted, 9% are wasted, and 16 percent are

underweight (Figure 27). A higher proportion of children in rural areas (40%) are stunted compared with urban children (29%)[6]. The number of childhood TB cases reported also deceased during this period however it is unclear the contribution of the improved nutrition.

Figure 27: Trend in nutritional status of children under 5 years, 2008 and 2013, source (Sierra Leone Demographic and Health Survey 2013)



Note: The data for both surveys are based on the WHO Child Growth standards adopted in 2006.

Smoking

The prevalence of smoking in Sierra Leone is high, 32.2% (23.3-41.9). Stark disparities by gender are also seen; in 2014 14.6% (8.8-21.4) of females over 15 years smoked and 49.4% (37.4-62.0) of males[7]. This could be partially attributable for the higher rates of TB seen in men compared to women. No data was available to assess trends in smoking over time.

Problem Alcohol use

There is a strong association between problem alcohol use and the risk of TB, both due to specific social mixing patterns and the impact on the immune system of the alcohol[8]. Problem alcohol use is high in Sierra Leone. In 2010 the per capita consumption of pure alcohol in litres in those

aged over 15 was 8.7 (7.7-9.8) this rose to 8.9 (6.8-11) in 2012. This was higher in men than women (14.0 (12.3-15.6) vs 3.6 (3.2-4.0) in 2010[7]. This could also attribute to the higher rates of TB in men than women. Alcohol consumption data by geography is not available.

Diabetes Mellitus

Diabetes mellitus not only predisposes to active TB disease, but also to TB treatment failure, relapse and death[9-10]. Data on diabetes in Sierra Leone is limited, however the estimated prevalence in 2014 in those over 18 years is 5.7% (95% CI 2.5-8.7)[7]

It is estimated that in 2015 there were 55,100 adults aged 20-79 years with diabetes in Sierra Leone and a prevalence among the same age group of 1.8 (1.3-4.2)[11]. This is a decrease from the prevalence of 3.9 in 2008 and 2.6 2010 (source International Diabetes Federation). It is unlikely that diabetes has had a large impact on TB trends.

Rural-Urban Disparity

Access to and quality of diagnosis and treatment for TB can often be poorer in rural areas.[12-13] More of the population in Sierra Leone live in rural areas compared to urban areas. There has been a slight increase in the percentage of the population living in urban areas since 2006 from 37% to 40% (Source: World Bank).

6. Summary of epidemiological analysis

There was a substantial decrease in TB case notification rates in Sierra Leone over the last 5 years. The most dramatic reduction was observed in 2015 as a result of the EVD crisis. The impact of Ebola on TB notifications is evident at the national and district levels where the lowest numbers of TB cases were reported during the peak of the Ebola outbreak. Since Sierra Leone impressively continued to diagnose and treat TB during this period, as well as maintaining M and E activities and TB reporting, the decrease in TB notifications was likely due to less patients accessing health care. This is supported by the decrease seen in the number of TB suspects and reports that individuals were frightened to attend clinics out of fear of being infected with EVD. The consequence of this is that TB went under-diagnosed in the community and it is therefore important that the NTP considers active case finding and awareness raising in the communities that were most affected.

During the EVD crisis a dramatic increase in pulmonary smear negative cases was observed in Bonthe whilst there were very few Ebola cases reported in this district It is possible that these clinically treated cases were not true TB cases or an alternative explanation is that smear negative prevalent TB cases were found by community health workers who were deployed to identify cases of EVD. If the former is true then perhaps individuals have been erroneously treated for TB but if latter is true it suggests that in the past TB has been significantly under-diagnosed in Bonthe which is of major concern. This requires urgent investigation as we can also not rule out recording and reporting errors or that Ebola cases were misdiagnosed as TB.

The deployment of community health workers for detection of EVD could also explain the increase in TB rates in the Western Rural and Bombali districts over time where access to health care may have previously been limited. In urban areas individuals are more likely to have easier access to diagnostic and treatment services which subsequently results in increased case detection and notification. This is one reason why urban areas often have higher rates of TB, such as in the Western Urban district; other reasons including increased transmission, poverty and overcrowding and an increased number of individuals with social risk factors.

Rates by site of disease also varied by geography where Bombali had an unusually high rate of extra-pulmonary TB cases. It is possible that there are better diagnostics for extra-pulmonary TB in this district which other district could learn from or alternatively these cases could be misdiagnosed as TB if there is a lack of expertise in the district. The investigation of this could lead to the identification of training needs and improved diagnostics across the country or alternatively indicate that corrective action is required in Bombali.

An indicator that is used to evaluate the success of the TB programme is the treatment success rate, which remains high at more than 85%. The inclusion of treatment outcomes for those who die or are lost to follow up before starting on treatment is likely to bring the treatment success rate down. In addition issues were found with treatment outcome reporting which makes the accuracy of this data questionable. The most common reasons for not completing treatment were lost to follow up, especially in retreatment cases and in children, which must be addressed in order to reduce TB deaths, TB transmission and to prevent development of drug resistant TB. There were higher rates of loss to follow up in clinically treated TB cases during the EVD crisis which may suggest that these cases did not return for treatment because they had less advanced disease or were asymptomatic. Confirmed cases of TB on treatment who were lost during the EVD outbreak should be traced and re-engaged with health care services as soon as possible.

Changes in TB associated factors over the last 5 years that could have led to a decline in the CNR and TB incidence are marginal. The demographic characteristics of the population have remained relatively unchanged and the prevalence of HIV and diabetes remains low. The decrease in HIV in the population may have contributed to a small decrease in the number of TB cases. GNI per capita grew substantially in 2013 and the under 5 mortality rate (an indicator for access to health care) has steadily decreased, both of which may have also contributed to the small decline in TB burden. A decline in malnutrition in children may have also had an impact on the number of childhood TB cases. The higher use of alcohol and smoking in men may be associated with higher TB rates in this population. It is clear that the largest influence on the TB epidemic in the country over the last two years has been the prolonged outbreak of Ebola. The review of health care services in the context of Ebola provided us with an opportunity to identify areas in TB surveillance and control in the country which could be improved to allow us to obtain more accurate TB burden estimates of incidence, prevalence and mortality.

The NTP should work towards obtaining accurate data in which to inform future interventions. The key areas of focus are;

1. **Provide a direct measure of incidence by improving the TB surveillance system and related activities** which ensures timely and accurate notification of all TB cases. This should be achieved through strengthening of the surveillance system which includes the

implementation of a national TB database, developing recording and reporting guidelines and tools and developing an electronic recording and reporting system, enhancing capacity on good data management and analytical practices of the M&E teams primarily at national, but also regional/district levels and carrying out routine analysis of data to inform progress towards achieving targets around key indicators and data quality.

2. **Find, diagnose, treat and notify "missing cases"** which includes; those treated in the private sector, children, all bacteriologically confirmed cases, primary defaulters, all TB deaths, all HIV positive cases and drug resistant TB cases. This will involve engagement of the private sector, good collaboration between TB-HIV partners, timely DST and culture/GeneXpert for all MDR TB suspects and review of drug resistant cases through implementation of an MDR-TB surveillance system, developing national guidelines on the diagnosis and management of childhood TB, universal contact tracing policy for household and/or close contacts for all TB patients and active case finding targeted at hard to reach and high risk populations.

3. **Reduce the proportion of cases lost to follow** especially in children by introducing a robust referral system for follow up and transfer of cases, tracing those lost to follow up through engaging community health volunteers, tracing TB patients who were lost to follow up during EVD, cross-referencing between TB and HIV registers and carrying out operational research to investigate the reasons for loss to follow up.

4. **Carry out a DRS** using standard methodology to provide a direct measure of the proportion of TB cases that are RMP resistant or MDR-TB.

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Appendix 1. Persons met

Person (s)	Title	Organization / Affiliation
Dr Anders Nordstrom	WHO Representative, Sierra Leone	WHO SL
Dr Louise Ganda	TB, Malaria, HIV Programme Manager	WHO SL
Boris Pavlin	Ebola Epi Surveillance Team Lead	WHO SL
Dr Lynda Foray	National TB Programme Manager	Ministry of Health and Sanitation, SL
Elijah	Monitoring and Evaluation Officer	Ministry of Health and Sanitation, SL
James Kattah	Monitoring and Evaluation Officer	Ministry of Health and Sanitation, SL
Mr Kromah	Programme Manager	Statistics Unit, MoHS
Sahr Joseph Tengbeh	Senior Registrar	Vital Statistics, MoHS
Abu George	Director	TB Reference Laboratory, MoHS
Ousma Conteh	Medical Lab Scientist	TB Reference Laboratory, MoHS
Wogba Kamara	Monitoring and Evaluation Specialist	HMIS Department, MoHS
Senesie Morgao	Clinic Supervisor	Connaught Chest Clinic, Freetown
Ibrahim Buuduka	Laboratory Supervisor	Connaught Chest Clinic, Freetown
Judith	HIV Focal Person	Connaught Hospital, Freetown
Assana Kamra	TB Supervisor	Bombali District
Dr Mustapha	Paediatric TB Focal Person	Ola During Hospital
Dr Momodu Sesay	Director General	National HIV/AIDS Secretariat, Freetown, SL
Dr Wurie	Director	Association of Public Health Laboratories (APHL)
Dr Yvonne Harding	Director	German Leprosy and TB Relief Association (GLRA)
Bruno Neto	Head of Mission	Therapeutic Solidarity and Initiatives for Health (SOLTHIS)
Dr Bisu	Director	West End Clinic (Private)
Dr Samuel Smith	Programme Manager	Malaria Control Programme
Anita Kamara	Technical Adviser	Malaria Control Programme
Abdulai Sesay	Director	Civil Society Movement Against Tuberculosis
David Mackieu	Board Member	Civil Society Movement Against Tuberculosis
Lionel Caruana	Fund Portfolio Manager	Global Fund to Fight AIDS, Tuberculosis & Malaria
Naomi Cambray	Public Health Specialist	Global Fund to Fight AIDS, Tuberculosis & Malaria

Appendix 2. Data sources and other information required for the 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
- TB surveys (prevalence surveys, drug resistance surveys, mortality surveys, inventory studies, surveys of HIV in TB) conducted in the past 10 years
- Staffing and budgeting of routine TB surveillance at central level
- Surveillance audits, surveys and data quality assessments
- Vital registration system

TB Programme - National Level

- National TB Programme manual
- TB case definitions
- National guidelines for TB, TB/HIV, MDRTB, and TB in children
- WHO guidelines for treatment of tuberculosis, surveillance of drug resistance in tuberculosis, and HIV surveillance among tuberculosis patients
- Most recent annual report(s) of TB, TB/HIV, MDRTB, and TB in children
- Blank data collection forms for TB, MDRTB, TB/HIV, and TB in children (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 NTP from BMUs over the period of one year
- Documentation for surveillance system (e.g. SOPs, data dictionary)
- Documentation and/or SOPs for electronic surveillance systems
    - System logs that show which data files were imported for the reporting year and when they were imported
    - List of automated checks run at the time of data entry
    - List of data queries used to check data quality at the national level
    - SOPs for detection and removal of duplicate TB cases at national level
- Any reports or publications on data quality, inventory studies, or surveillance evaluations that have been done in past 5 years
- Surveillance-related training documents
- List of all TB BMUs 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, MDRTB,and TB in children
- # and rates of reported TB cases at national level, first sub-national levels (and BMUs, 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

External to TB Programme

- Country income grouping from World Bank website.
- TB mortality rates (HIV-negative TB) at the national level from vital registration system over past 5 years.
- Classification of the national HIV epidemic (generalized, concentrated or low level)
- 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
- Documentation of legal and regulatory frameworks for TB reporting
- 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 vital registration system information (e.g. description, national coverage and quality) from national statistics office or WHO Mortality Database
- Epidemiological data on Ebola

Analysis and interpretation of the output of TB surveillance

TB surveillance and population data, if available, should be prepared in order to carry out the following analysis at the national and sub-national level

- 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 number and 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 pediatric 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.
- Time trends in Ebola and TB

Appendix 3. Completed checklist of standards and benchmarks

COUNTRY NAME: Sierra Leone **DATE OF ASSESSMENT: October 14-29, 2015**

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. Furthermore, the standards assess the outputs rather than the inputs or processes of the surveillance system which will vary by country. Using 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 CHACTERISTICS 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: Sierra Leone **DATE OF ASSESSMENT: 14/10/2015-30/10/2015**

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	**Figure 1** shows the data flow from the peripheral health unit (PHUs) to national level. **TB notifications** At the PHU TB suspects are recorded in a suspect register. When a patient starts on treatment a paper treatment card is opened and data are recorded in a paper TB register. This data is then used to produce aggregate reports on a monthly basis that are sent via district > national centre. The number screened is added to monthly aggregate. At the national level aggregate data are recorded in a standard excel template. Multiple excel sheets are used by year. **Laboratory** At the PHU level laboratory data are recorded in a paper register. The HIV data in aggregate reports on ART and CPT are collected from the HIV clinic attached to the TB clinic and are not collected in the TB register even though this information is available on the treatment card.	**Recommendations** **Monitoring of primary defaulters** All PHUs that refer cases should maintain a referral register and cases should be actively followed up to ensure they have been treated by the PHU they were referred to. Cases that are lost should be reported in the TB register at the referral PHU and have a treatment outcome recorded as lost to follow up. Cases that are transferred out should have the clinic transferred to recorded in the TB register and the supervisor should follow up to ensure the patient reached there. All patients lost should have an outcome recorded as lost to follow up. A list of transferred patients should be maintained to facilitate follow up. Bacteriologically confirmed cases who do not return to the clinic and are followed up by the supervisor should be recorded in a list and those which are not found should be recorded in the

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		The reference laboratory currently does not have any data collection as they are not processing samples. **DHIS2** A DHIS2 register collecting TB morbidity is filled in at the facility. This data is compiled into aggregate reports and entered into DHIS2 at the district level on a monthly basis. Forms have been developed for DHIS2 on aggregate TB data collection but their use was not observed in the field. **Issues identified** **Clinic** **Referrals and transfers** • Referred cases that do not start on treatment where they are diagnosed are not documented and there is no follow up to ensure patients reach the clinic they have been referred to. • In the suspect register cases that are referred have this recorded in the remarks column. No column exists for referrals. • Patients who started on treatment and transferred out had the district recorded but not the clinic. There was no follow up to ensure the patient had reached the clinic. No column exists to record place of transfer.	TB register as lost to follow up. Treatment card date should be added to the suspect register for each person who started on treatment. A weekly review of the suspect register against the lab and the TB treatment register for bacteriologically confirmed cases should be carried out. All bacteriologically confirmed cases not started on treatment should be recorded in the TB register. An alternative methodology is recommended for confirming the address to ensure ethical practise is maintained and to help build patient trust and reduce stigma. This approach could involve home visits with the intention of carrying out routine household contact screening, for example. **Treatment outcomes** Treatment outcomes should be accurately recorded on treatment cards and in the TB register in real time e.g .those with treatment outcomes of died or lost to follow up should have these recorded immediately. Aggregate reports should be adjusted to collect information on a patient cohort 12 months after TB registration and outcomes on smear not done recorded correctly. Outcomes should be calculated out of total TB cases registered in this cohort 12 months before.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		Tracing patients • Bacteriologically confirmed TB cases are followed up by the supervisor who carried out a home visit but this is based on laboratory reports. There is no list for tracing patients with feedback on outcome. • All pulmonary cases have addresses confirmed by staff "secretly" going to the properties of patients to check if they live there. The patient is unaware. **Dates** • A date for treatment card was added to the suspect register for those starting on treatment but this was not systematic. It is unclear from this register what the rate of primary default is but during an assessment it was calculated at between 12-15%. • The smear date on the treatment card is recorded as the date started on treatment (Connaught) rather than the sputum positive date. • At Stocco there was confusion between the registration date and the treatment start date e.g treatment start date was recorded in the registration date box on the treatment card. **Inpatients** • Patients treated on the ward are recorded in the TB register but it was unclear whether all patients were	**National database** **Short term** An updated excel template should be developed to take into account recommendations including data validation checks. This template should be filled at the district level by district supervisors and sent to the national level electronically. This may require additional laptops. At the national level data should be imported into a single access database. Data stored in excel from previous years should also be imported into this database to allow time trend analysis. **Medium term** Consideration needs to be given to an internet case based real time electronic recording and reporting system e.g using DHIS2. This could be implemented at district level (Figure 1). Tablets could be used by district supervisors for monthly data facility collection to allow real time data collection and subsequent analysis. **Long term** Data collection in DHIS2 should be considered at the facility level (case based).

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		recorded. • Ward patients do not have outcomes recorded in the register. **Other** • Treatment outcomes are not recorded on treatment cards at Connaught. • The HIV register does not include TB registration number so there is no easy way to cross-reference the registers. • No standardised terminology for recording in registers and lack of systematic recording between clinics and within the same clinic. • No standardisation for use of laboratory forms e.g one clinic used a separate sheet for each test and another recorded all three sputum results on the same sheet. • Poor record storage and lack of filing. • No copies of reports at facility level. **Laboratory** • A red pen has not systematically been used to record bacteriological positive cases in the lab register. **National** • There is no single national database. • Treatment outcomes from aggregate reports are not calculated correctly. Treatment outcomes received not compared to expected. • Treatment outcomes are collected 9-12	

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		months on the aggregate reporting form which is ambiguous. • No treatment outcomes for smear not done (recorded as smear negative) • Errors in reporting on prison-military and private	
A2. Do all service delivery points systematically use standardised TB data collection forms and tools?	☐ **Yes, completely** ☒ Mostly ☐ Partially ☐ No, not at all	• District supervisors have developed their own tools for data quality checking and adding up aggregate data which are not standardized. • Use of old and new treatment cards in the field. • Only some facilities use suspect registers. • A transfer in register was developed by the supervisor at Makeni but this is not used elsewhere.	**Recommendations** • Tools for district supervisors should be reviewed and standardized.
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 ☐Some case types are excluded ☒Some care providers, e.g. non-NTP providers, prisons, private practitioners, are excluded. ☐ Others: _____	**Patients who do not start on treatment** As for most countries who report using a TB *treatment* register, bacteriologically confirmed cases who die or are lost to follow up before starting on treatment are not reported. The extent of this problem is unknown. **Private clinics** All private doctors are governed by the Private Medical Practitioners Union. All TB drugs come from the government and therefore private clinics must be integrated with the NTP to get drugs for treatment. Patients can be diagnosed clinically at a private practise but must go to a	**Recommendations** • All bacteriologically confirmed cases who die or are lost to follow up before starting on treatment should be recorded in the TB register. • Make an initial assessment of the number of cases diagnosed and treated in the private sector by producing a list of all private clinics by district (already done by the private sector) and carry out an audit on the number of TB cases seen at each clinic within a given time period. This could be carried out with TA support from WHO or NGO partners. • All private clinics should report to the TB programme.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		government facility to have sputum taken. Treatment outcomes for patients treated in a private clinic are fed back to the PHU in the area. It is proposed in 2016 that drug stocks could be sent to the private clinics. Issues were raised about patient confidentiality in the public sector which led patients to be treated in the private sector. Also, public health staff have been reported to be insensitive. In addition patients cannot chose which public facility they can use as it is based on address. **Prisons** Prisons are integrated into the TB programme. Each prison is affiliated with a DOTs centre. In 2013 there were 36 cases notified from the prisons hospital and 82 in 2014. **Military** Military hospitals are reporting to the TB programme. Around 300 cases are notified per year from the military hospital. **Projects** There is currently one TB project being carried out in Kono which is run by Partners In Health. These cases are being reported to the district health team.	• Previous treatment in the private sector should be captured in the TB register and aggregate reports. • Public sector workers should be trained on patient confidentiality and communication skills. • The TB programme should consider allowing patients to choose the facility they want to be treated in to reduce stigma.
A4. What	☐ **Patient level data that**	National aggregate data are available in excel	• Consideration needs to be given to an

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
types of TB data are available at the national level? *(Tick all that apply)*	**allow multiple episodes 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	from 2011-2014 and first two quarters of 2015.	internet case based real time electronic recording and reporting system e.g using DHIS2. This could be implemented at district level.
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		• No further action
A6. At what levels of the system are TB data systematically verified for	☒ **From the service unit upwards** ☐ From the 1st administrative level upwards ☐ From the 2nd	The district carries out checks for data accuracy and completeness at the facility level on a quarterly basis. There are no SOPs or guidance on how to do this. At the national level data is entered into an	**Recommendations** • An excel tool to monitor timeliness of reports received at the national level should be implemented (see Table 1). • See recommendations in A7, A8 and A1 for further recommendations.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
accuracy, timeliness and completeness ? *(Tick all that apply)*	administrative level upwards ☐ Only at the national level ☐ Not at any level	excel template but verification checks are not incorporated. Data are checked by eye and any discrepancies are fed back to the district level. Data are expected at the district level by the 5th of the month and at the national level by the 15th of each month. Data are physically transferred on paper which can create delays. District supervisors are often unable to pick up reports due to lack of transport. When data are received at the national level the receipt of the report is logged by the secretary. There is no tool for tracking whether reports have been received, however, M and E officers follow up with districts if they are aware that a report is pending. A Whats app group is also used for follow up which should be commended.	
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	Although some supervisors carry out data quality checks at the facility level this is not standardised and there is no tool which incorporates checks for data quality. A supervisory checklist exists for quarterly supervision but is qualitative, does not have a guideline and does not cover data quality elements or indicators. Data are reviewed in quarterly meeting but this	• M and E officers should develop a standardised quantitative supervisory checklist for district supervisors to carry out data quality checks at the facility level. This should include completeness and accuracy checks on key variables and cross-checking of laboratory, TB suspect and TB registers to ensure all cases are notified and followed up. Findings should be fed back at quarterly meetings and to the health facility. Comparative analysis between health

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	(Quarterly) ☐ Data are reviewed during meetings with TB staff (Quarterly) ☐ Other (specify:_____)	is not specifically for data quality. There is no standard template or indicators.	facilities may be beneficial.
A8. Is feedback on TB data quality systematically provided to all lower reporting levels?	☐ Yes, completely ☒ Mostly ☐ Partially ☐ No, not at all	Quarterly meetings between national and district level are carried out where epidemiological analysis is presented at the district level and discussed. There is no standard template for this and it does not include data quality indicators. No district analysis of data by facility is carried out. Analysis is carried out by district M and E staff who cover all diseases. This analysis includes case notifications, treatment outcome and HIV-TB. There was no disaggregation by age and sex. Districts give feedback to the facility level during supervisory visits but there is no associated documentation or guidance. An M and E report is produced quarterly at the national level and shared with stakeholders, partners and funding bodies. District supervisors also analyse data on a quarterly basis and bring it to the national team for discussion. No national presentation or activity plan were	• M and E officers should develop a standard template for district quarterly reporting and presentation which should include key epidemiological and data quality indicators that can be monitored over time. Technical assistance could be provided by WHO or CDC. • District supervisors should prepare presentations in advance which should be pre-submitted for discussion at the meeting. • Prior to the meeting an analysis of national data should be carried out by the national team and presented at the meeting. • M and E officers should develop a template for district supervisors to assist in feedback to facilities on data quality (See table 2 for an example). • District officers should carry out routine analysis by facility and provide feedback.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
		available to review.	
A9. When are national TB case data for a given calendar year considered ready for national analyses 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		• No further action
A10. Are there national guidelines for recording and reporting of TB data e.g. documentation or instructions? *(Tick all that apply)*	☐ Yes. They are posted on the internet. ☐ Yes. They are available in a manual or other reference document, e.g. training materials ☒ No	National guidelines are currently being developed/re-developed but these were not provided for review.	• National guidelines for recording and reporting of TB data should be developed and rolled out with training.
A11. Does the national TB programme have a training plan which includes staff involved in data collection and	☐ Yes ☒ No		• An assessment of training needs for TB recording and reporting should be carried out at the clinic and district level. TA support should be requested if necessary. • A programme of training should be developed for all levels of the TB programme. • Training materials should be developed. • Training for M and E staff and how to deliver training should be undertaken.

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
reporting at all levels of the reporting process?			
A12. How often do TB programme staff receive training specifically on TB surveillance (i.e. recoding and reporting of TB data)? *(Tick all that apply)*	☐ 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	Individuals receive on the job training from existing staff if able. No training materials exist. Staff are not experienced in how to deliver training.	• It should be ensured that all staff undertake an essential training package in order to perform their roles. • Refresher training should be carried out on an annual basis. • Regular assessments of training needs should be undertaken.
A13. How many staff work on TB surveillance at the national level? *(Tick all that apply)* •	☐ **Epidemiologist, full-time** (0) ☐ Epidemiologist, part-time (0) ☐ **Statistician, full-time (0)** ☐ Statistician, part-time (#___0____) ☐ **Data manager, full-time** (#____0___) ☐ Data manager, part-time (#___0____) ☐ **Data quality officers, full-time** (0) ☐ Data quality officers,	• Currently the data clerk manages the data in excel and carries out data entry. • The M and E officers are responsible for quarterly supervision of district surveillance officers including quarterly meetings and regular communication, routine analysis at the national level and development of recording and reporting tools. • The secretary is responsible for recording timeliness of reports. • Training gaps were identified in relation to software usage and knowledge of TB epidemiology. • One of the M and E officer will attend the WARN-TB course on analysis of TB data.	• A full time epidemiologist should be employed to carry out routine analysis of TB data, lead on the production of the annual report and carry out operational research • Employment of a full time database manager • Training for all existing staff in TB epidemiology • Training of M and E officers on M and E activities either in country or in region e.g consider TA from Uganda and CDC through collaboration with WHO HQ. Consider the training course All Africa Leprosy Tuberculosis and Rehabilitation Training programmes (ALERT) • In the short term all staff should attend an

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	part-time (#_____) ☒ Other (2 M and E officers, 1 data clerk and one secretary)		excel training course
A14. Is a national TB surveillance report routinely produced and disseminated on an annual basis?	☐ Yes ☒ No		• An annual report should be produced on a yearly basis using data from the previous year. Please see below for web links of examples. England https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360335/TB_Annual_report__4_0_300914.pdf Nepal http://nepalntp.gov.np/theme/images/uploads/NTP_Annual_Report_2070-71_final.pdf New Zealand https://surv.esr.cri.nz/PDF_surveillance/AnnTBReports/TBAnnualReport2013.pdf WHO http://www.who.int/tb/publications/global_rep

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
			ort/en/ • An annual report team should be established which should involve a dedicated epidemiologist to carry out analysis, a database manager to ensure data accuracy and validation and staff to write and proof read the document. • The team should meet regularly to discuss analysis and progress of the report in order to meet deadlines. • An SOP for the annual report should be developed with sufficient detail to allow new staff to produce it in event of staff turnover.
A15. Are there written goals of the surveillance system?	☐ Yes ☒ No		• The national team should develop goals and objectives for TB surveillance in Sierra Leone (See Figure 2).
A16. Policies and procedures are in place to protect the confidentialit y of all surveillance data e.g. records,	☐ Yes, completely ☐ Mostly (names only appear on TB registers/treatment cards/lab registers at facility level) ☐ Partially ☒ No, not at all	Training of service providers on patient confidentiality and a verbal understanding of not to share information. No documentation or policies on data protection exist.	• The national team should develop expertise in patient confidentiality and data protection in order to enable them to produce guidelines and associated training package. This will ensure implementation of patient confidentiality at clinic, district and national levels. • TB registers and treatment cards should be kept in locked drawers at the PHU. • If an electronic recording and reporting system is implemented then associated

QUESTIONS	OUTCOMES (Best practises are in bold)	Description details	KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
registers.			documentation should be developed alongside this.
A17. Is there a long term financial plan and budget in place to support TB surveillance activities?	☐ Yes ☒ No		• Develop and M and E investment plan
A18. When was the last time the TB surveillance system was evaluated?	☐ Within the past 5 years ☐ Within the past 5-10 years ☒ Never		• Standards and benchmarks assessment 2015

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. Indicate '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 the system in the last two columns.

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
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 definitions are consistent with WHO definitions for laboratory confirmed cases and site of disease in the patient treatment card and the TB register. Case definitions however have not yet been revised for 2013 WHO case definitions and so unknown previous history of treatment is not collected. In addition treatment outcomes and HIV variables have not been revised for new definitions and miliary TB is not classed as pulmonary. There are no recording and reporting guidelines or training and it was observed in the field that recording is not standardized. **Recommendation** Develop recording and reporting guidelines with training and revise current tools to be in line with WHO 2013 definitions **http://apps.who.int/iris/bitstream/10665/79199/1/9789241505345_eng.pdf**

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
B1.2 TB surveillance system is designed to capture a minimum set of variables for reported TB cases	Data are routinely collected for at least each of the following variables: • Age or age group • Sex • Year of registration • Bacteriological results • History of previous treatment • Anatomical site of disease • For case-based systems, a patient identifier	☐Met ☐ Partially met ☒Not met	Data are routinely collected for a minimum set of variables for reported TB cases. Aggregate reporting forms follow 2006 WHO guidelines and therefore there is no disaggregation by age and sex for total TB cases or by site of disease. For smear negative, smear not done and extra-pulmonary cases there is no disaggregation by age for those more than 15 years old. Patient registration category is only available for pulmonary sputum smear positive cases. The TB suspect number is not recorded systematically in the register. It is not included in the laboratory reporting form or lab register. A TB suspect who becomes a case does not have the TB register number recorded in the suspect register. This makes it difficult to link patients across registers. There is a lack of variable consistency across all reporting tools e.g not all variables on the treatment card are in the register or aggregate reporting forms, not all variables in the aggregate reporting forms are in the national excel template or in the TB register. For example CPT, ART and place of referral are not on the TB register. Many more variables are collected on the treatment card are not included in the TB register such as contribution of community and healthcare partners, prison, military, private health care facility and enablers package. **Recommendations** • All data reporting tools including the national excel template should be reviewed to ensure consistency and updated in line with WHO 2013 definitions. • Include TB suspect number in the laboratory reporting form, and TB register. The TB register number should be the TB suspect register.
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	☒Met ☐ Partially met ☐Not met ☐Not applicable	Paper aggregate reports received at the NTLP were checked for 2014. 2/2,040 (0.1%) of reports were missing. However, these data had been entered into the excel template therefore this is likely a filing error. Zero reports are submitted. During the EVD crisis Kailahun during Q2 and Q3 2014 summarised reports covering all facilities rather than submitting individual health facility reports. For the Western Urban area that had a substantial drop in the number of cases in 2014, data were reviewed to check for submission of increased zero reports. All reports had TB cases reported. There is no evidence of under-reporting during the EVD crisis. There is no system in place to track whether a report has been received or not on a monthly basis.

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	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		**Recommendation** • Implement an excel tool to track and follow up reports in a timely manner (See Table 1). • A filing system and dedicated space needs to be developed for record storage.
B1.4 Data in quarterly reports (or equivalent) are accurate, complete, and internally consistent *(For paper-based*	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	☐Met ☒ Partially met ☐Not met ☐Not applicable	2 PHUs were visited to assess this benchmark. Connaught which is an urban high TB incidence area and Stocco which is a rural medium TB incidence area. **Sub-totals of cases-Met** Sub-totals of the number of TB cases by age group, sex, and case type equals the total number of reported TB cases in 100% of quarterly reports (Q3 and Q4 of 2014 and Q1 and Q2 of 2015). In Stocco there were inconsistencies in treatment outcome. **Total numbers of cases reported-Met** The number of TB cases in 100% of quarterly reports (or equivalent) matched the number of cases recorded in TB registers in Stocco and Connaught.

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
systems only)	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		In Stocco and Conaught more than 95% of treatment cards were available for registered cases. In Stocco Q1 2015 6/113 (5%) cases had a missing treatment card. In Conaught Q4 2014 3/225 (1.3%) had a missing treatment card and 9/270 (3.3%) in Q3 2015 were missing. **Completeness-Met** In Connaught June 2015 66 treatment cards were assessed for completeness. 4 (6%) were missing site of disease but this was available in the TB register. 1 was missing gender. In Stocco 10 treatment cards were assessed for completeness. 100% completeness on all variables assessed except for HIV (9/10). In Connaught and Stocco 10 cards were selected for accuracy on age, sex, site of disease, smear positivity, patient category and HIV status. 100% were accurate. TB registers were 100% complete for all variables in Connaught and there was only one case with missing patient category out of 386 cases in Stocco. **Cross-checking diagnosed cases against the treatment register- High primary default rate** In Connaught, of 27 smear positive cases 22 (81%) were in the TB suspect, laboratory and TB register. Only 1 case was not in the suspect register. This case had been referred for diagnosis. 4 (15%) were on the suspect and the lab register but had not started treatment between 1-3 weeks after being confirmed as a TB case (treatment cards were not available). In Stocco, of 15 sputum smear cases 13 (87%) were in all 3 registers. Of 50 smear positive cases in the suspects register, 13 were recorded as not starting treatment. However, a review of treatment cards revealed that 6 (12%) did not start treatment and 1 was referred. **Other issues identified** At Connaught the suspect register was missing for the last quarter of 2014. Staff had created a new register based on the lab but this is inaccurate and cannot be used. The number of TB suspects were consistently lower than the new cases tested by the laboratory. Staff thought this was due to people coming via HIV or other clinics. This requires further investigation. **Suspects** **Laboratory tests for new diagnosis** Q3 2014 526 543 Q1 2015 583 623

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	quarterly reports.		Q2 2015 574 615 No register was available in the ward. It is possible that cases discharged from inpatients default before reaching outpatients or cases who die may not be registered. **Culture conversion** The reporting of culture conversion is incorrect in some clinics. The number of cases registered for culture conversion does not equal the original number of smear positives from 3 months before. Some clinics are not reporting at all. Others are entering data for a quarter every month resulting in 3x the number cases for culture conversion. It is apparent by looking at the data that reporting method varies by clinic (See below).

		Smear positive notifications			**Culture conversion total registered**		
		Jan	Feb	March	April	May	June
Western Rural	Waterloo CHC	26	23	20	75	74	75
	Newton CHC	8	9	5	23	23	23
	Songo CHC	9	7	8	23	12	24
	Regent CHC	0	2	0	15	10	4
	Shepherd's Hospice	5	4	2	11	11	11
	Tombo CHC	6	5	8	22	21	19
	Kissitown CHC	14	5	7	26	26	26
	Fogbo CHC	6	3	6	15	15	15
	Hastings CHC	3	3	8	15	17	17
	Sub-total	**77**	**61**	**64**	**225**	**209**	**214**

<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></tr>
<tr><td></td><td></td><td></td><td>
Treatment outcome

The number of cases with treatment outcome does not equal the number of cases registered from the year before. In 2012 there are less cases with treatment outcomes which means that not evaluated cases are not being reported. In 2011 and 2013 there are additional cases which suggests either reporting errors for treatment outcomes or under-reporting of cases. Treatment outcomes are not recorded for smear not done and instead these cases have outcomes recorded as smear negative. Without recording and reporting guidelines this is likely to be inconsistent throughout the country.

<table>
<tr><th></th><th colspan="3">All cases</th></tr>
<tr><th></th><th>2011</th><th>2012</th><th>2013</th></tr>
<tr><td>Notified as a case</td><td>12943</td><td>13354</td><td>12334</td></tr>
<tr><td>Registered outcomes</td><td>12707</td><td>13431</td><td>12933</td></tr>
<tr><td>Missing/Extra outcomes</td><td>-236</td><td>77</td><td>599</td></tr>
</table>

Recommendations

• Overall data accuracy between the lab, treatment card, TB register and aggregate reports is good.
• All bacteriologically confirmed cases, including those who die or are lost to follow up before starting treatment should be registered as a TB case in the TB register. Cases who are treated elsewhere should have this clearly recorded in the laboratory register to enable cross checking.
• Training needs should be assessed and should be carried out with clinical staff and district supervisors on WHO 2013 definitions paying particular attention to recording of all bacteriologically confirmed cases, treatment outcomes including follow up of transferred out, prison/military/private and culture conversion.
• A data audit should be carried out between the ward and the outpatients clinic at Conaught to evaluate under-reporting.
• The number of primary defaulters should be assessed regularly at clinics and monitored. A small study could be carried out to investigate this further.
</td></tr>
<tr><td>B1.5 Data in national database are accurate, complete,</td><td>All benchmarks should be met to reach this standard:
• Data validation</td><td>☐Met

☐ Partially met</td><td>.</td></tr>
</table>

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
internally consistent, and free of duplicates *(For electronic case-based or patient-based systems only)*	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 unresolved potential duplicates.	☐Not met ☒Not applicable	

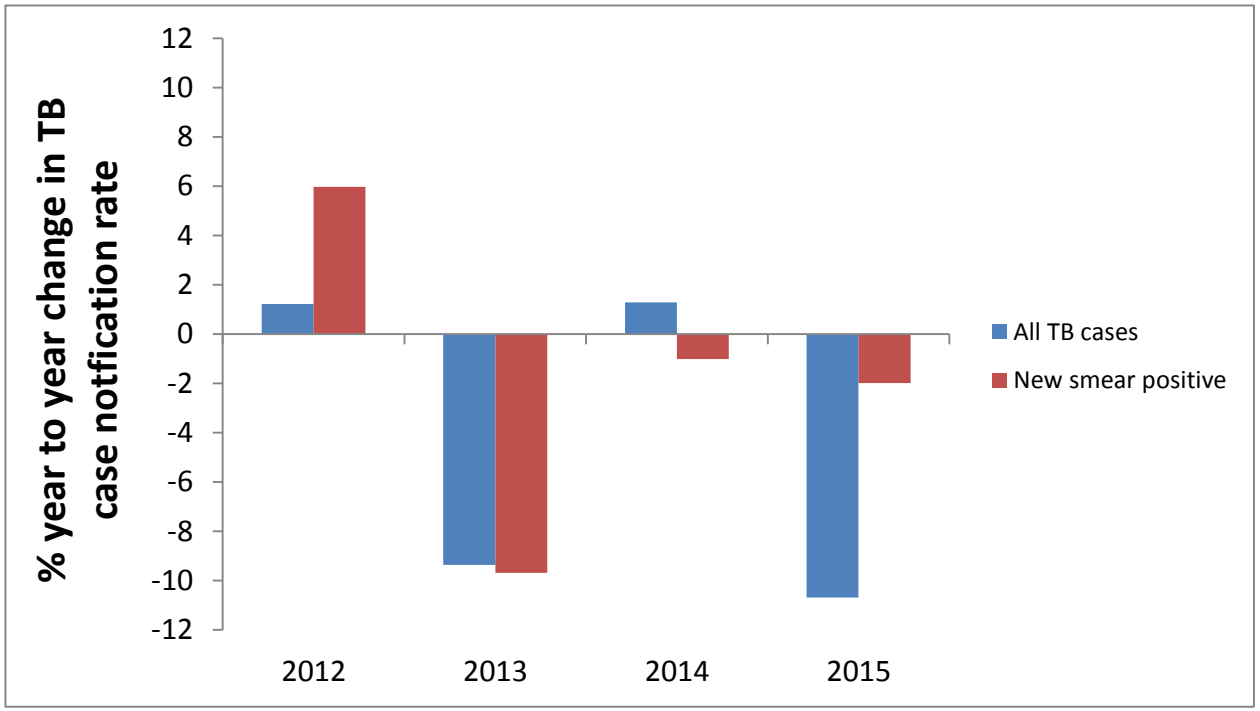
<table>
<tr><th>STANDARD</th><th>BENCHMARK(S)</th><th>RESULTS</th><th>RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS</th></tr>
<tr><td>B1.6 TB surveillance data are externally consistent</td><td>• Among new TB cases, the percentage of children is between 5-15% in low- and middle-income and <10% in high-income countries</td><td>☐Met
☐ Partially met
☒Not met</td><td>Cases are not disaggregated by new and retreatment for age group for all sites of disease. We could not assess the proportion of new TB cases in children as treatment history is only collected for pulmonary sputum smear positive cases and most children do not have a sputum smear.

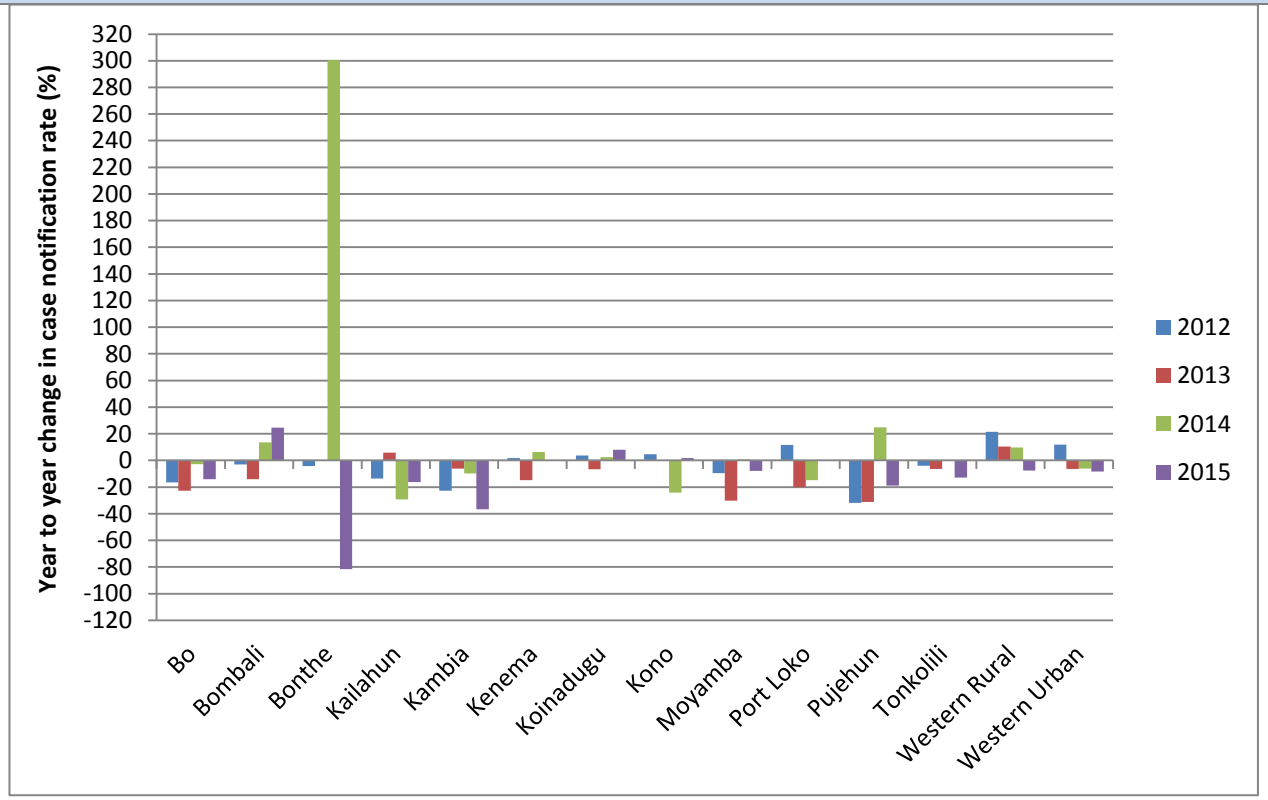
For all TB cases the percentage of children was within the expected range at 11.2% in 2014. This was a decrease from 14.8% in 2013 suggesting that fewer children were diagnosed or reported compared with adults during the EVD crisis. In 2015 the proportion decreased further

Recommendations
• Contact tracing, particularly around asking if there are children in the household should be introduced.</td></tr>
<tr><td>B1.7 Number of reported TB cases is internally consistent</td><td>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</td><td>☐Met
☒ Partially met
☐Not met</td><td>The ratio of male:female, pulmonary:extra-pulmonary, new:retreatment and suspects:notifications are consistent over time. The proportion of cases that are children however decreased in 2014 and 2015. This requires further investigation.

<table>
<tr><th></th><th>Male: Female</th><th>Pulmonary : Extra-pulmonary</th><th>New: Retreatment*</th><th>Ppn 0-14 year olds**</th><th>Suspects:Notifcations</th></tr>
<tr><td>2012</td><td>1.5</td><td>22.4</td><td>15.7</td><td>14.1</td><td>2.8</td></tr>
<tr><td>2013</td><td>1.5</td><td>24.2</td><td>14.9</td><td>13.6</td><td>3.1</td></tr>
<tr><td>2014</td><td>1.6</td><td>23.7</td><td>14.3</td><td>11.2</td><td>2.6</td></tr>
<tr><td>2015</td><td>1.3</td><td>19.5</td><td>14.1</td><td>10.3</td><td>2.7</td></tr>
</table>

In 2015 there was more than a 10% decrease in TB notifications and large decreases were also observed in 2013. Further investigation revealed that this decrease occurred in Q2. The reasons for this should be investigated further.</td></tr>
</table>

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	cases is consistent with year-to-year change 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		By district there are extremely large fluctuations in numbers of cases over time indicating inconsistencies in reporting. 

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	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 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		 **Recommendations** The reasons for fluctuations should be further investigated with the districts.
TB SURVEILLANCE SYSTEM COVERAGE			

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
B1.8 All diagnosed cases of TB are reported	Both benchmarks should be satisfied to meet this standard: • TB reporting is a legal requirement • ≥90% of TB cases are reported to national health authorities, as determined by a national-level investigation (e.g. inventory study) conducted in last 10 years	☐Met ☐ Partially met ☒Not met	TB reporting is not a legal requirement. The level of under reporting has not been assessed by an inventory study. **Recommendation** • Consider making TB a mandatory notifiable disease.
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	☐Met ☐Partially met ☒Not met	Under-5 mortality is 120 per 1,000 live births in 2015 (last available point) 61.3% out of pocket expenditure in 2013 (last available point)

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
	• <25% total health expenditure is out-of-pocket		
QUALITY AND COVERAGE OF VITAL REGISTRATION SYSTEM			
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 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	There is no national vital registration is Sierra Leone and ICD-10 codes are not used. All hospital facilities should register a death by law and the death certificates are brought to the PMISU for registration by the families. Districts also collect aggregate data on all deaths on a monthly basis and bring this to the PMISU. A review of the data shows that this is incomplete. Community deaths are registered by the chief in some chiefdoms but this is not consistent and most deaths ion the community are not recorded. There is no electronic system for data collection. CDC have recently carried out a workshop on the implementation of ICD-10 coding. There are no statisticians to carry out data analysis at PMISU. **Recommendations** • The NTLP should advocate for the implementation of a sample vital registration from all health facilities which should use ICD-10 codes and should be recorded electronically.

PART B (Section 2): SUPPLEMENTARY CHECKLIST FOR TB SURVEILLANCE

For each standard, please assess whether the system is able to satisfy the associated benchmark(s), using the methods recommended in the user guide. Indicate '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 the system in the last two columns .

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
B2.1 Surveillance data provide a direct measure of drug-resistant TB in new cases	One of the two benchmarks should be satisfied to meet this standard: • Rifampicin susceptibility status (positive/negative) documented for ≥75% of new pulmonary TB cases • Rifampicin susceptibility status (positive/negative) documented for a nationally representative drug resistance survey of new pulmonary TB cases	☐ Met ☐Partially met ☒Not met	Currently cultures and DST are not done. No nationally representative drug resistance survey of new pulmonary TB cases has been carried out. **Recommendations** • In the short term routine testing for drug resistant TB should be carried out using GeneXpert followed by culture and DST for first and second line antibiotics. The following should be considered for testing: Failure to culture convert at 2/3 months, treatment failures, all retreatment cases and contacts of confirmed MDR-TB cases. • Long term a DRS should carried out using standard methodology and with TA from WHO HQ.
B2.2 Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases	One of the two benchmarks should be satisfied to meet this standard: • HIV status (Positive/Negative) documented for ≥80% of all notified TB cases • HIV status is available from a representative sample from all TB cases notified in settings with a low-level epidemic state[ii] where it is not feasible to implement routine surveillance.	☒Met ☐Partially met ☐Not met	In 2014 86.8% of all notified TB cases had a documented HIV status and this increased to 92.7% in 2015.
B2.3 Surveillance data for children reported with TB (defined as ages 0-14 years) are reliable and	Both of the benchmarks should be satisfied to meet this standard: • Ratio of age groups 0-4 to 5-14 years is in the range 1.5-3.0 • ≥90% of childhood TB cases are reported to national health	☐Met ☒Partially met ☐Not met	The level of under-reporting has not been measured with a dedicated study (e.g. inventory study). The ratio of 0-4 to 5-14 year olds is within the expected range for 2012, 2013 and 2015. However, during 2014 the ratio dropped to 1.3 which suggests that during this period

STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
accurate AND all diagnosed childhood TB cases are reported	authorities, as determined by a national-level investigation (e.g. inventory study) conducted in last 10 years		0-4 year olds were under diagnosed or under reported. Year Ratio 0-4: 5-14 year olds 2012 1.7 2013 1.7 2014 1.3 2015 2.0 During a visit to Ola hospital it was found that pulmonary cases are not recorded by sputum smear status, there was no suspect register available. Transfers had the clinic recorded in the remarks column but there was no robust system for referring cases and ensuring follow up. Deaths were recorded in the remarks column and had not been entered into treatment outcomes in real time. It was also observed that drug stocks were not kept in the correct conditions in terms of temperature and security. **Recommendations** • Develop national guidelines for the diagnosis and management of childhood TB and roll out with appropriate training including M and E activities. • Nominate a clinical focal person for childhood TB to work closely with the NTLP for the development of guidelines and to provide expertise in this area. • Ensure close monitoring of childhood TB surveillance activities through dedicated M and E supervision.

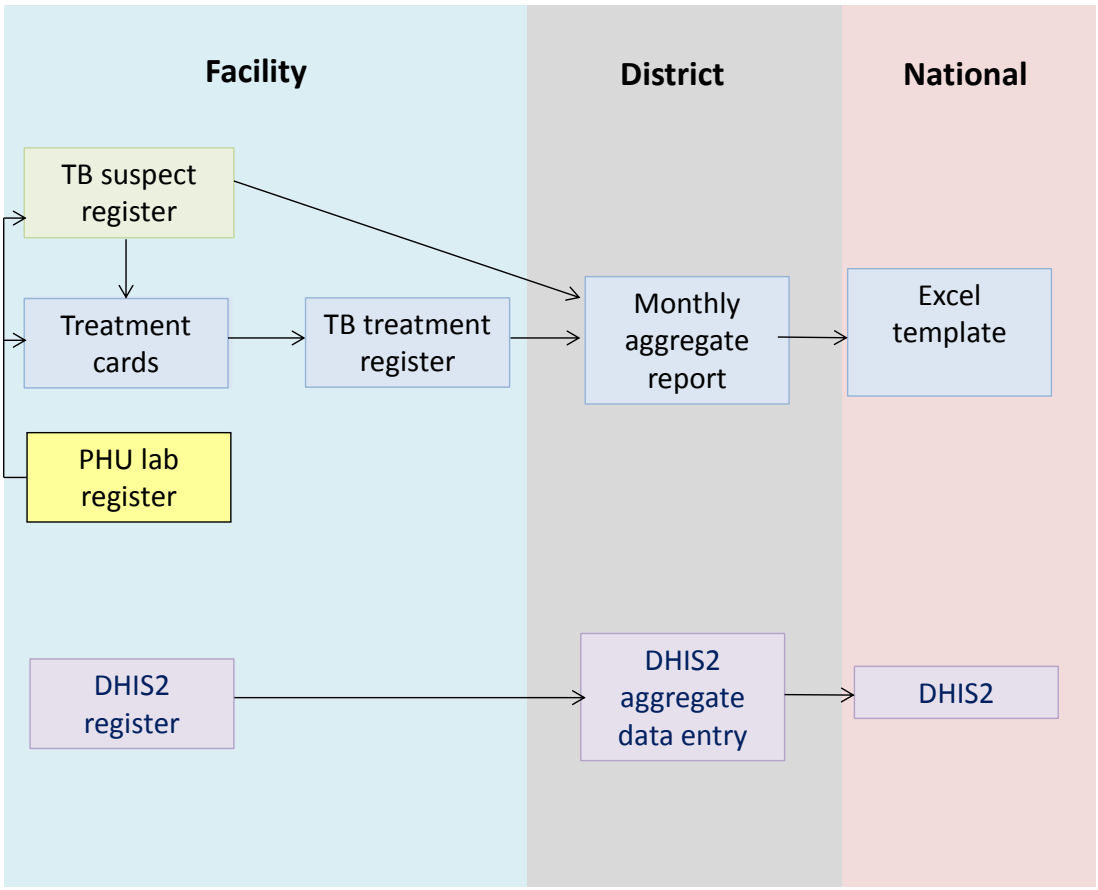
STANDARD	BENCHMARK(S)	RESULTS	RESULTS (DESCRIPTION) INCLUDING KEY ACTION(S) REQUIRED TO ADDRESS THE GAPS
			• Introduce routine household source contact tracing and contact tracing of adults focusing on potentially exposed children. The use of trained Community Health Workers or a district outreach worker should be considered. • Introduce a robust referral and feedback system to allow active follow up children to ensure continuity of treatment and care and recording of treatment outcome. • Investigate the reasons for default through operational research with the aim to increase understanding and to enable appropriate public health action.

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

[ii] Low-level epidemic state: HIV prevalence has not consistently exceeded 5% in any defined subpopulation.

CHECKLIST SUMMARY – Sierra Leone, October 2015				
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	☐	☒	☐	

Figure 1: Current (a) and suggested future TB data flow (b) in Sierra Leone
a)



b)

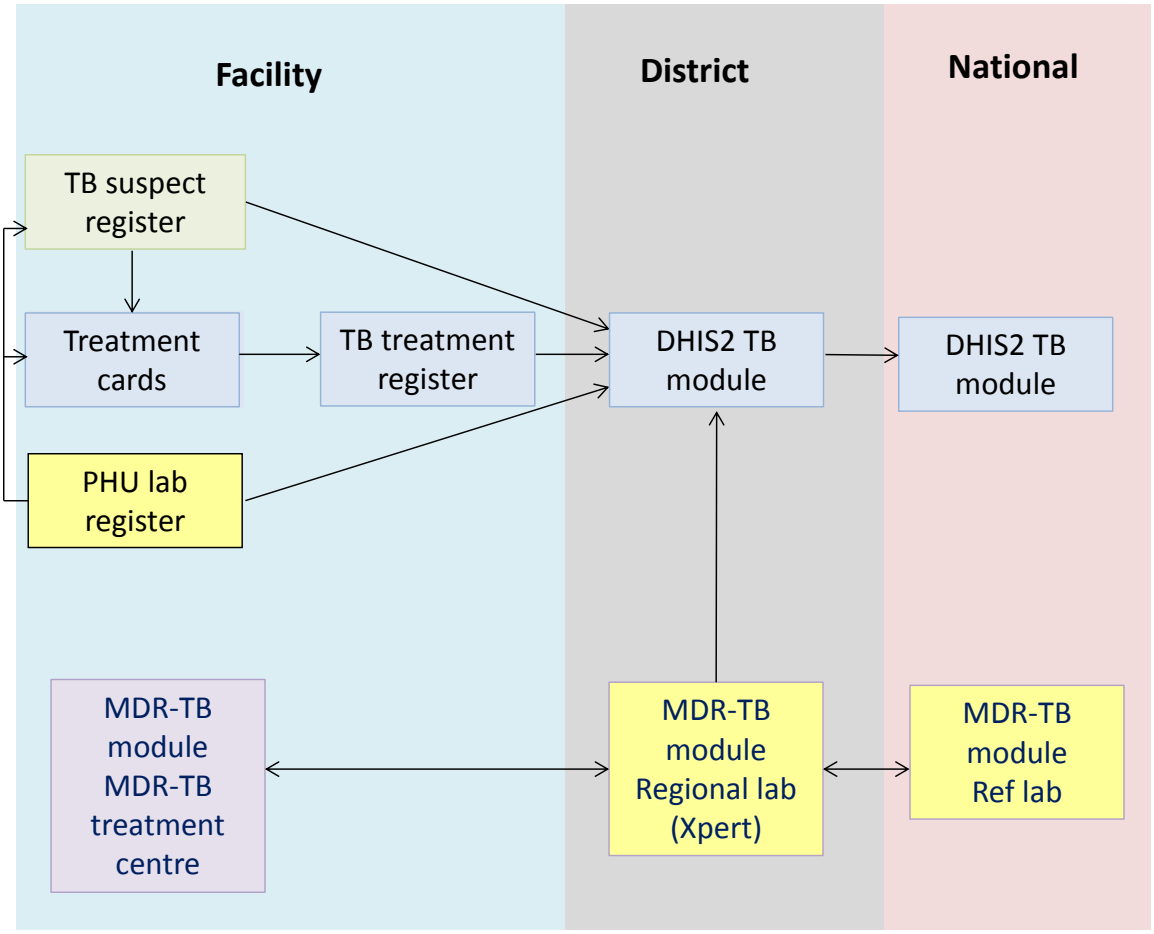

Facility
District
National
TB suspect register
Treatment cards
TB treatment register
DHIS2 TB module
DHIS2 TB module
PHU lab register
MDR-TB module MDR-TB treatment centre
MDR-TB module Regional lab (Xpert)
MDR-TB module Ref lab

Table 1: Example of timeliness of reporting from Uganda. This could be adapted for facility level

NTLP DISTRICT REPORTING TIMELINE

REPORTING TIMELINE: 14TH DAY OF MONTH FOLLOWING END OF QUARTER

14TH APRIL	14TH JULY	14TH OCTOBER	14TH JANUARY

District	Date report submitted	Total number of health facilities in the District	Number of facilities reported on	Number of Missing facility Data	Names of Facilities whose data are missing	Reasons for the missing data	Signature of DTLS

Table 2: Example of data completeness report by geographical region in the UK (annual and quarterly)

Completeness of key data fields, 2013

	Demographic					Clinical				Risk Factor						
	NHS Number	Ethnic group		UK Born/Non-UK born		HIV Testing[$]	Previous TB diagnosis		Previous TB treatment[^]	History of drug abuse		History of alcohol abuse		History of homelessness		
Country	Reported	Known*	Reported**	Known	Reported	Reported	Known	Reported	Reported	Known	Reported	Known	Reported	Known	Reported	K
England	75	98	99	97	100	87	96	99	79	93	98	93	98	94	98	
Wales	61	97	99	99	100	76	93	99	88	85	93	91	95	93	98	
Northern Ireland	74	96	100	95	100	79	99	100	88	95	100	93	97	96	100	
Scotland	-	-	88	-	82	-	-	86	91	-	-	-	-	-	-	
PHE Region/Centre																
North of England	92	97	98	94	99	67	94	98	78	90	97	91	97	91	97	
North East	98	96	100	87	100	66	96	98	78	89	98	93	96	93	98	
Cumbria and Lancashire	94	96	98	97	99	82	93	96	75	93	96	92	94	94	96	
Yorkshire and the Humber	95	95	98	92	99	45	94	99	76	92	98	93	98	91	98	
Greater Manchester	84	98	99	97	100	85	94	97	79	86	97	89	97	88	97	
Cheshire and Merseyside	97	99	100	97	100	97	91	99	88	91	98	91	98	92	97	
Midlands and East of England	86	98	99	97	100	84	94	99	83	90	98	91	98	91	98	
East Midlands	77	99	100	99	100	85	94	99	80	85	99	89	99	82	99	
West Midlands	86	98	99	97	100	82	93	99	83	92	98	91	97	93	98	
Anglia and Essex	96	98	99	97	100	87	95	98	100	91	98	93	98	92	99	
South Midlands and Hertfordshire	89	98	100	95	100	86	93	98	67	92	96	93	97	93	98	
London	56	99	100	99	99	99	97	99	81	97	99	94	98	98	99	
South of England	91	97	98	98	100	84	97	99	65	94	98	96	99	95	99	
Kent, Surrey and Sussex	81	97	97	98	100	89	96	99	65	94	98	95	97	96	98	
Thames Valley	94	100	100	100	100	96	99	100	77	97	99	97	99	97	99	
Wessex	94	98	99	100	100	84	99	100	80	94	97	97	100	98	99	
Devon, Cornwall and Somerset	95	97	99	88	100	71	92	100	67	86	99	91	100	85	100	
Avon, Gloucestershire and Wiltshire	95	94	96	96	100	65	96	99	50	92	98	96	98	92	98	
England, Wales and Northern Ireland	75	98	99	97	100	82	96	99	79	93	98	93	98	94	98	
UK	-	-	99	-	99	-	-	98	80	-		-		-		

* Data are reported and has a known value

** Data are reported but may be reported as unknown

[$] Excluding cases diagnosed post mortem

[^]Cases with previous TB diagnosis only

For Scotland, "-" data collection is not consistent with data from other countries for inclusion

Key:

99-100% complete | 95-98% complete | <95% complete

Figure 2: Aims of UK TB Surveillance

National TB surveillance contributes to the improved prevention and control of TB in the UK and worldwide. It requires the timely notification of TB cases and the collection of accurate demographic, clinical and social risk factor information, and linkage to laboratory data on the TB bacteria that the patient is infected with.

TB surveillance data are used for

- Monitoring TB trends over time, by geography and patient characteristics, to inform TB control activities, including targeting interventions and high risk populations
- Monitoring TB incidence and mortality to measure progress towards meeting global, European and UK national and local targets, and eventual TB elimination
- Identifying risk factors for TB to inform the targeting of control measures and awareness raising in high risk populations
- Early detection of national TB outbreaks using strain typing data, to direct rapid public health responses to prevent onward transmission
- Evaluating the success of TB control services, through treatment outcome monitoring and other monitoring indicators

Goals of the TB surveillance unit, TB section at the Centre for Infectious Disease Surveillance and Control

- To ensure TB surveillance data is of high quality, through ongoing data validation and cleaning
- To monitor TB trends and perform analysis of TB data to provide information to service providers, commissioning and policy makers
- To conduct ongoing development of the national TB Surveillance System to ensure data collected for TB surveillance is in line with national and international guidance
- To carry out international reporting of UK TB surveillance data to the European Centre for Disease Prevention and Control and the World Health Organization
- To detect national TB outbreaks of public health significance to inform appropriate public health responses

- To conduct detailed analyses of TB surveillance data to inform TB control efforts

- To inform improvements in TB control, by monitoring performance against agreed TB indicators

- To conduct enhanced surveillance of MDR/XDR TB

- To conduct teaching and training on TB / TB Surveillance and epidemiology

- To participate in TB research collaborations with academia, international institutions, third sector organisations and other government departments

- To follow up and review *M. bovis* cases to identify likely sources of infection and direct appropriate responses

- To monitor trends in infections with non-tuberculous mycobacteria

- To monitor the number of cases of leprosy and ensure patients are referred to a consultant expert in Leprosy and that contact tracing is carried out by the health protection team

TB epidemiological review and Standards and Benchmarks assessment

Sierra Leone 14th-29th October 2015

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