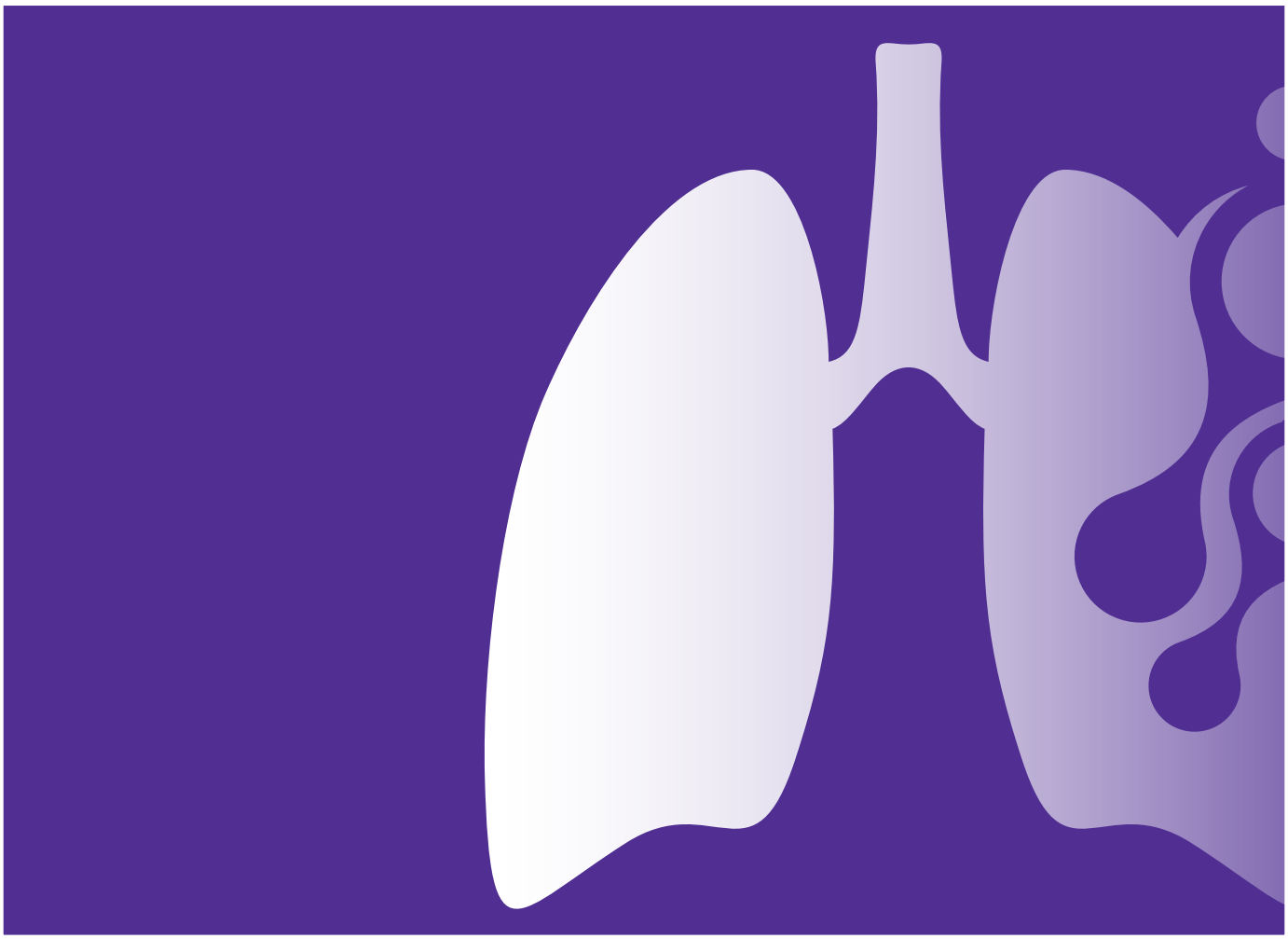


TOOLKIT FOR ANALYSIS AND USE OF ROUTINE HEALTH FACILITY DATA

Guidance for tuberculosis programme managers

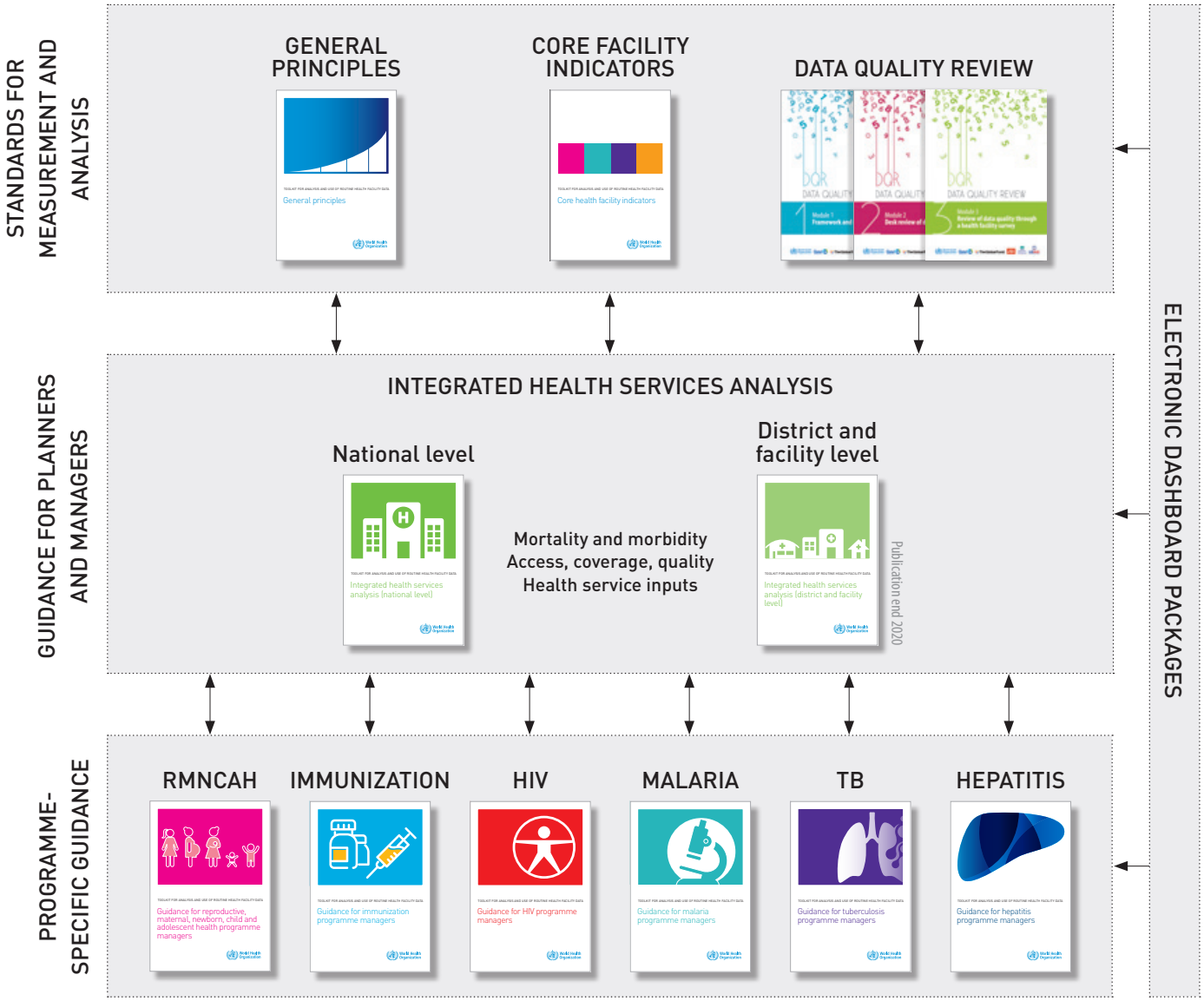
WORKING DOCUMENT, DECEMBER 2019

World Health Organization

WHO TOOLKIT FOR ANALYSIS AND USE OF ROUTINE HEALTH FACILITY DATA

This document is part of the WHO *Toolkit for analysis and use of routine health facility data* – a set of capacity-building resources to optimize the analysis and use of data collected from health facilities through routine health information systems (RHIS).

The Toolkit is a collaborative effort by multiple WHO technical programmes and partners. It promotes an integrated, standards-based approach to facility data analysis, using a limited set of standardized core indicators with recommended analyses, visualizations and dashboards.



The Toolkit consists of a series of modules that can be used individually or together:

- *General principles* introduces key concepts in routine facility data analysis that are applicable to all modules.
- *Core facility indicators* is a compendium of the indicators from the various modules.
- The *Data quality review (DQR) toolkit* includes guidance and tools for systematic review of the quality of routine facility data.
- *Integrated health services analysis* targets general health service managers, providing a comprehensive, integrated analysis of tracer indicators across multiple health service components and programmes.
- The *programme-specific guidance* modules are customized according to the needs of the programme. Each module contains a guidance document, training materials and an electronic configuration package for automated dashboard production.

The materials within the Toolkit will be periodically updated and expanded.

Further details: https://www.who.int/healthinfo/tools_data_analysis_routine_facility/en/

TOOLKIT FOR ANALYSIS AND USE OF ROUTINE HEALTH FACILITY DATA

Guidance for tuberculosis programme managers

World Health Organization

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Key contributors: Laura Anderson (TB Monitoring and Evaluation Unit, Global TB Programme); Charalampos Sismanidis (TB Monitoring and Evaluation Unit, Global TB Programme).

Abbreviations

ART	antiretroviral therapy
BMU	basic management unit
CPT	co-trimoxazole preventive therapy
DHIS	District Health Information Software
DR-TB	drug-resistant TB
DS-TB	drug-sensitive TB
DST	drug susceptibility test
HIV	human immunodeficiency virus
HMIS	health management information system
M&E	monitoring and evaluation
NTP	national TB programme
RR/MDR-TB	rifampicin-resistant/multidrug-resistant TB
TB	tuberculosis
WHO	World Health Organization
XDR-TB	extensively drug-resistant TB

Guidance overview and references

Learning objectives

This document provides guidance on the analysis and use of routine tuberculosis (TB) surveillance data collected at the facility level. The guidance reviews core facility indicators and analysis, provides suggestions for questions on data quality, as well as considerations and limitations for using the data and analysis.

By the end of this guidance document, participants will be able to:

- Describe which key TB epidemiological and data quality indicators are presented on the dashboards of the TB module in the DHIS2 (District Health Information Software) for routine analysis.
- Understand the key indicators and why they are important in terms of monitoring TB care and control.
- Understand how to interpret changes or differences in trends in key indicators over time or by geography and how this can be used to inform programmatic action.

Audience

This guidance document is relevant for different members of the health workforce working on TB including:

- ministry of health decision-makers, epidemiologists and data users such as national TB programme (NTP) staff and health information system managers or analysts at national and subnational levels;
- staff of partner organizations supporting the strengthening of the NTP or health system strengthening;
- consultants supporting in-country training workshops on analysing and using TB data following the implementation of the TB DHIS2 module.

Suggested references

Definitions and reporting framework for tuberculosis. 2013 revision. Geneva: World Health Organization; 2013 (https://www.who.int/tb/publications/definitions/en/, accessed 12 November 2019).

Implementing the End TB Strategy: the essentials. Geneva: World Health Organization; 2015 (http://www.who.int/tb/publications/2015/The_Essentials_to_End_TB/en/, accessed 12 November 2019).

Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide. Geneva: World Health Organization; 2014 (http://www.who.int/tb/publications/standardsandbenchmarks/en, accessed 12 November 2019).

Understanding and using tuberculosis data. Geneva: World Health Organization; 2014 (http://www.who.int/tb/publications/understanding_and_using_tb_data/en/, accessed 12 November 2019).

Note: This document will be reviewed and updated periodically to ensure that it remains aligned with the most recent guidelines and evidence. Feedback on the document will contribute to its evolution and improvement over time.

1. About the data

Analysis of TB surveillance data is essential for programme evaluation, which helps guide decisions about case management and policy. It allows NTPs to monitor trends in the number and distribution of TB cases across the country. This enables NTPs to report on the country's TB epidemic and progress in reaching NTP goals and objectives. It also helps NTPs to develop targeted national strategies and funding plans.

Due to the limitations of current TB diagnostic tools, the long latency period from infection to disease, and the diverse ways that TB manifests, the direct measurement of TB incidence in the general population is both impractical and resource intensive. Instead, TB programmes rely on notifiable disease reporting systems to track TB epidemics. Incidence is typically derived from routine TB case notifications, even though there is uncertainty about the number of cases diagnosed but not reported, as well as the number of cases not diagnosed at all.

Since the 1990s a standardized system for paper-based recording and reporting of the number of individuals diagnosed with TB and their treatment outcomes have been used worldwide. Within this system, TB data are reported in aggregate form (i.e. the total number of cases account for the basic unit of recording). Typically, health care staff record information about a patient's treatment history on individual TB treatment cards. Demographic, clinical and bacteriological information are collected for TB cases (individual episodes of TB disease) based on an internationally agreed common framework for recording and reporting.[1] These data are then transcribed into TB registers that list information for all cases treated within a particular health care facility and/or basic management unit (BMU). Notification and treatment outcome data for all cases from the registers within a particular geographical area are then compiled and aggregated into reporting forms. These reports are sent to higher administrative levels (up to the national level), usually on a quarterly basis; reports can be paper-based or electronic. At the national level, NTPs report on these aggregated data, which form the basis of analyses for annual reports. Details on individual cases are not known.

Analysis of routinely collected health management information system (HMIS) data, in the context of a TB disease programme, involves an investigation of changes in rates over time, followed by attempts to understand their underlying causes. Interpretation of trends in TB burden is an essential part in evaluating a country's performance on TB control and prevention.

When trends are considered inconsistent (i.e. notification rates change rapidly or unpredictably) NTP managers should look for the possible causes. In some cases, unexpected inconsistencies represent true changes in the TB epidemic but these fluctuations may also be the result of changes in other TB determinants (i.e. urbanization, socioeconomic situation, implementation

[1] *Definitions and reporting framework for tuberculosis. 2013 revision*. WHO; 2013 (http://www.who.int/tb/publications/definitions/en/, accessed 12 November 2019).

of health insurance schemes, or specific TB control activities). Before drawing such conclusions, inconsistencies in trends must be investigated to be able to rule out factors influencing data quality such as changes in case definitions or in the recording and reporting system. Once the underlying causes for changes in trends have been determined, programmatic or corrective action can be taken to improve TB surveillance, care and control. A handbook, *Understanding and using tuberculosis data*[2] was developed to assist NTPs with the routine analysis and interpretation of TB surveillance data for programmatic action. This handbook informed the exercises on analysis and interpretation of TB surveillance data using the DHIS2 TB module dashboards which are presented in this document and the accompanying *Guidance for tuberculosis programme managers: exercise book*.

[2] *Understanding and using tuberculosis data*. WHO; 2014 (http://www.who.int/tb/publications/understanding_and_using_tb_data/en, accessed 12 November 2019).

2. Data quality

Data are only as good as the system in which they are captured and reported. Factors determining data quality are diverse (e.g. accuracy, precision, plausibility, consistency and validity). Assessing the quality of notification data is necessary to determine how well these data provide an accurate measure of the national TB burden and its trends over time. The *Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide* provides a systematic approach to assess the quality of notification data.[3] The list of standards related to data quality monitoring for electronic systems are shown in Table 2.1, highlighting the issues which are most relevant to data captured in routine HMIS.

Table 2.1 Standards for TB data quality monitoring in electronic systems

Data quality standards	
Standard B1.1	Case definitions are consistent with WHO 2013 definitions and reporting framework for tuberculosis (http://www.who.int/tb/publications/definitions/en/)
Standard B1.2	System designed to capture a minimum set of variables for all reported TB cases
Standard B1.3	All scheduled periodic data submissions have been received and processed at each management level (e.g. district, regional, national)
Standard B1.5	Data in electronic databases are accurate and complete
Standard B1.6	TB surveillance data are externally consistent (between 5–15% of all new TB cases are children under 15 years old)
Standard B1.7	Number of reported TB cases is internally consistent over time

Source: Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide. WHO; 2014.

Detailed information on how to do the assessment of the TB surveillance system can be found in the checklist; the assessment should be performed as part of an epidemiological review. Some of the following data analyses contributing to this assessment have been built into DHIS2 to allow routine data quality checks to be carried out.

[3] *Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide.* WHO; 2014 (http://www.who.int/tb/publications/standardsandbenchmarks/en, accessed 12 November 2019).

2.1 Data entry

Standards B1.1 and B1.2

The data collection forms in the DHIS2 TB module have been based on the WHO 2013 recording and reporting framework. Countries should ensure paper data collection forms are in line with this framework and the TB module in DHIS2. Data analysts should be aware of any differences between paper forms and electronic collection forms to allow them to interpret data correctly. For example, the indicator for HIV testing in TB cases should be based on new and relapse cases but countries which do not adhere to the framework may collect data on all TB cases. It is important for the data analyst to be aware of this when reporting on or interpreting this indicator. For data users in the country, any differences should be reported back to the NTP to allow recording and reporting tools to be aligned.

Standard B1.3

Due to the dependence on trends in analysis of TB data from HMIS, it is critical to track changes in the completeness of reporting that may occur over time due to changes in resource availability for reporting; administrative adjustments to the number of facilities offering services or catchment areas associated with reporting units; and participation rates of reporting units, especially when private providers are included. Completeness of reporting is available in the data visualization app or by using the pivot table function where the denominator is the total number of TB facilities and the numerator is the number of facilities that submitted reports (Fig. 2.1). Note, in order for a report to be counted the report must be submitted through the system. The presence of a report also does not mean that all data elements are completed – there may still be missing data.

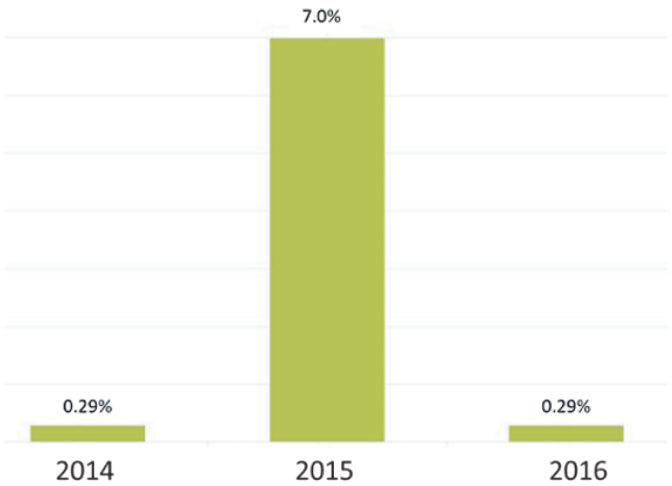


Fig. 2.1 Percentage of reports received by year, shown for Benin

100% of reports were truly received by the NTP, but as the report was not submitted to the system, it falsely appears that very few reports were received.

2.2 Data validation

Standard B1.5

At the point of data entry, validation rules have been built into the system to alert the user to any inconsistencies or inaccuracies in the data. The list of validation rules are shown in Table 2.2.

After running the data validation, validation violations will be reported in cases where the condition defined through the validation rule expression is not met, i.e. the condition is false. Data should be investigated at a subnational level and corrected in the system.

Table 2.2 Data validation rules

Validation rules	
Presumptive cases	• Bacteriological examinations performed should be greater than or equal to positive bacteriological examinations.
Age and sex disaggregation	• New and relapse cases by age and sex should equal the total new and relapse cases by type. • New extrapulmonary cases by age and sex should equal total new extrapulmonary cases. • New pulmonary smear-negative/smear-unknown/smear not done by age and sex should equal total new pulmonary smear-negative and new pulmonary smear-unknown/smear not done. • New pulmonary smear-positive by age and sex should equal total new pulmonary smear-positive.
TB/HIV activities	• TB patients HIV tested should be greater than or equal to TB patients HIV positive. • HIV-positive TB patients on antiretroviral therapy (ART) should be less than or equal to the number of HIV-positive TB cases. • HIV-positive TB patients on co-trimoxazole preventive therapy (CPT) should be less than or equal to HIV-positive TB cases.
Rifampicin-resistant/ multidrug-resistant TB (RR/MDR-TB)	• Laboratory-confirmed RR/MDR-TB cases identified should be greater than or equal to laboratory-confirmed MDR-TB cases identified.
Treatment outcomes versus notification	• Bacteriologically confirmed cases registered in the cohort should equal cases evaluated for outcomes. • Clinically diagnosed cases registered in the cohort should equal cases evaluated for outcomes. • New pulmonary smear-positive cases registered in the cohort should equal cases evaluated for outcomes. • New pulmonary smear-negative cases registered in the cohort should equal cases evaluated for outcomes. • Previously treated (excluding relapse) cases registered in the cohort should equal cases evaluated for outcomes. • Re-treatment cases registered in the cohort should equal cases evaluated for outcomes. • HIV-positive cases registered in the cohort should equal cases evaluated for outcomes. • TB/HIV re-treatment cases registered in the cohort should equal cases evaluated for outcomes. • TB/HIV new smear-positive cases registered in the cohort should equal cases evaluated for outcomes. • TB/HIV new smear-negative or extrapulmonary cases registered in the cohort should equal cases evaluated for outcomes. • Cases in cohort for treatment outcomes for HIV-positive cases should be less than or equal to number cases in cohort for all cases. • Treatment outcomes evaluated for HIV-positive cases should be less than or equal to number evaluated for all cases. • HIV-positive RR/MDR-TB cases registered in the cohort should equal cases evaluated for outcomes. • Cases in cohort for treatment outcomes for HIV-positive RR/MDR-TB cases should be less than or equal to number of cases in cohort for all RR/MDR-TB cases. • Treatment outcomes evaluated for HIV-positive RR/MDR-TB cases should be less than or equal to number evaluated for all RR/MDR-TB cases. • RR/MDR-TB cases registered in the cohort should equal cases evaluated for outcomes. • Extensively drug-resistant TB (XDR-TB) cases registered in the cohort should equal cases evaluated for outcomes.

3. Core facility indicators

Core indicators	Definition	Disaggregation
Notifications (numbers and rates)		
TB notifications	Number of TB cases notified in a specified time period, usually 1 year	By case type: pulmonary bacteriologically confirmed or pulmonary clinically diagnosed By treatment history: new and relapse (incident cases) or previously treated, excluding relapse Age group (0–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65+, other/unknown) Sex (M, F, other/unknown)
TB notification rate (per 100 000 population)	TB cases notified in a specified time period, usually 1 year, per 100 000 population N: Number of TB cases notified in a specified time period D: Estimated population in the same time period Calculation: (Numerator/Denominator) × 100 000	By case type: pulmonary bacteriologically confirmed or pulmonary clinically diagnosed By treatment history: new and relapse (incident cases) or previously treated, excluding relapse
Notifications (percentages and ratios)		
New extrapulmonary TB (%)	N: Number of new extrapulmonary TB cases notified in a specified time period, usually 1 year D: All new TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
Previously treated including relapse (all forms TB) (%)	N: Number of previously treated TB cases notified in a specified time period, usually 1 year D: All TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
Ratio male : female (new and relapse, all forms TB)	N: Number of male new and relapse TB cases notified in a specified time period, usually 1 year D: Number of female new and relapse TB cases notified in the same time period Calculation: Numerator/Denominator	
0–14 year olds (new and relapse, all forms TB) (%)	N: Number of 0–14 year old new and relapse TB cases notified in a specified time period, usually 1 year D: All new and relapse TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
Ratio 0–4 : 5–14 year olds (new and relapse, all forms TB)	N: Number of 0–4 year old new and relapse TB cases notified in a specified time period, usually 1 year D: Number of 5–14 year old new and relapse TB cases notified in the same time period Calculation: Numerator/Denominator	
New pulmonary bacteriologically confirmed TB (%)	N: Number of new pulmonary bacteriologically confirmed TB cases notified in a specified time period, usually 1 year D: Number of new TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	

Core indicators	Definition	Disaggregation
Previously treated (including relapses) pulmonary bacteriologically confirmed TB (%)	N: Number of previously treated (including relapses) pulmonary bacteriologically confirmed TB cases notified in a specified time period, usually 1 year D: Number of previously treated TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
Outcomes		
TB treatment success rate (%)	Percentage of TB cases successfully treated (cured plus treatment completed) among TB cases notified to national health authorities during in a specified time period, usually 1 year N: Number of TB cases notified in a specified time period that were successfully treated[a] D: Number of TB cases notified in the same time period[b] Calculation: (Numerator/Denominator) × 100	By treatment outcome: cured, completed, died, failed, lost to follow up, not evaluated By case type: bacteriologically confirmed or clinically diagnosed By treatment history: new and relapse (incident cases) or previously treated, excluding relapse For TB/HIV-positive cases By drug sensitivity: all (DS + DR), DS-TB and DR-TB
TB treatment success rate in new and relapse HIV-positive cases (%)	Percentage of HIV-positive TB cases successfully treated (cured plus treatment completed) among TB/HIV-positive cases notified to national health authorities during a specified time period, usually 1 year N: Number of new and relapse HIV-positive TB cases notified in a specified time period that were successfully treated[c] D: Number of new and relapse HIV-positive TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	By treatment outcome: cured, completed, died, failed, lost to follow up, not evaluated
TB treatment success rate in RR/MDR-TB cases (%)	Percentage of RR/MDR-TB cases started on second-line treatment and successfully treated (cured plus treatment completed) among laboratory confirmed RR/MDR-TB cases notified to national health authorities during a specified time period, usually 1 year N: Number of laboratory confirmed RR/MDR-TB cases notified in a specified time period that started on second-line treatment and were successfully treated (cured plus treatment completed)[d] D: Number of laboratory confirmed RR/MDR-TB cases notified in the same time period that started on second-line treatment Calculation: (Numerator/Denominator) × 100	By treatment outcome: cured, completed, died, failed, lost to follow up, not evaluated For HIV-positive TB cases For XDR-TB cases
Notifications vs treatment outcome cohort for DS-TB	Number of drug-sensitive TB (DS-TB) cases notified during a specified time period whose treatment outcomes were reported (registered with a treatment outcome) vs Number of TB cases (DS-TB and DR-TB) notified during the same time period	

Core indicators	Definition	Disaggregation
Drug-resistant TB (DR-TB)		
Drug susceptibility test (DST) coverage for TB cases (%)	Percentage of TB cases with DST results for at least rifampicin resistance, during a specified time period, usually 1 year[e] N: Number of TB cases notified with DST results for at least rifampicin resistance in a specified time period D: Number of TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	By treatment history: new, previously treated, unknown history
TB cases with laboratory-confirmed rifampicin resistant/multidrug-resistant-TB (RR/MDR-TB) (%)	Percentage of TB cases with laboratory-confirmed RR/MDR-TB among cases with DST results in a specified time period, usually 1 year N: Number of laboratory-confirmed RR/MDR-TB cases notified in a specified time period D: Number of TB cases notified with DST results for at least rifampicin resistance in the same time period Calculation: (Numerator/Denominator) × 100	For laboratory-confirmed MDR-TB cases separately
Laboratory-confirmed RR/MDR-TB cases started on a second-line MDR-TB treatment regimen (%)	Percentage of laboratory-confirmed RR/MDR-TB cases notified and started on a second-line MDR-TB treatment regimen, among all cases with confirmed RR/MDR-TB notified in a specified time period, usually 1 year N: Number of laboratory-confirmed RR/MDR-TB cases notified and started on a second-line MDR-TB treatment regimen in a specified time period D: Number of laboratory-confirmed RR/MDR-TB cases notified in the *same time* period Calculation: (Numerator/Denominator) × 100	
TB/HIV[f]		
HIV tested new and relapse TB cases with a documented HIV status (%)	Percentage of new and relapse TB cases who had a HIV test result recorded in the TB register among all TB cases notified during a specified time period, usually 1 year N: Number of new and relapse TB cases notified in a specified time period who had a HIV test result recorded in the TB register[g] D: Number of new and relapse TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
HIV-positive new and relapse TB cases (%)	Percentage of HIV-positive new and relapse TB cases among TB cases notified in a specified time period, usually 1 year, with an HIV test result recorded in the TB register N: Number of new and relapse TB cases notified in a specified time period that are documented as HIV positive D: Number of new and relapse TB cases notified in the same time period with a documented HIV status Calculation: (Numerator/Denominator) × 100	

Core indicators	Definition	Disaggregation
HIV-positive new and relapse TB cases on ART during TB treatment (%)	Percentage of HIV-positive new and relapse TB cases who received ART during TB treatment, among all HIV-positive new and relapse TB cases notified in a specified time period, usually 1 year N: Number of HIV-positive new and relapse TB cases notified and started on TB treatment in a specified time period who are already on ART or started ART during TB treatment D: Number of HIV-positive new and relapse TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	
HIV-positive new and relapse TB cases on co-trimoxazole preventive therapy (CPT) during TB treatment (%)	Percentage of HIV-positive new and relapse TB cases on CPT during TB treatment among all HIV-positive new and relapse TB cases notified in a specified time period, usually 1 year N: Number of HIV-positive new and relapse TB cases notified and started on TB treatment in a specified time period who are already on CPT or started CPT during TB treatment D: Number of HIV-positive new and relapse TB cases notified in the same time period Calculation: (Numerator/Denominator) × 100	

Notes:

[a] Treatment outcomes are defined by the time period of notification, e.g. "2015 cases successfully treated" reflects those for which notifications were reported in 2015, even though treatment may have extended into 2016. For this reason, treatment outcome data follow at a lag of 1 year.

[b] The number of cases registered with a treatment outcome should equal the number of cases notified for the same period.

[c] *Definitions and reporting framework for tuberculosis – 2013 revision*. Geneva: World Health Organization; 2013 (ww.who.int/tb/publications/definitions/en/, accessed 5 November 2019).

[d] Treatment outcomes are defined by the time period of notification, e.g. "2015 cases successfully treated" reflects those for which notifications were reported in 2015, even though treatment may have extended into 2017. For this reason, treatment outcome data for DR-TB cases follow at a lag of 2 years.

[e] This indicator includes results from molecular (e.g. Xpert MTB/RIF) as well as conventional phenotypic DST results.

[f] All of these indicators should be a sum of information collected at notification and at treatment outcome in order to capture those who are tested, found to be HIV positive and started on ART or CPT treatment during TB treatment. Currently, information displayed in DHIS2 is based on information collected at notification and information collected at treatment outcome is displayed separately for monitoring and evaluation purposes.

[g] Results from TB cases newly tested for HIV and those with a known HIV status at the time of TB diagnosis should be included.

ART – antiretroviral therapy; CPT – co-trimoxazole preventive therapy; DR – drug-resistant; DS – drug-sensitive; DST – drug susceptibility test; MDR – multidrug-resistant; RR – rifampicin-resistant; XDR – extensively drug-resistant.

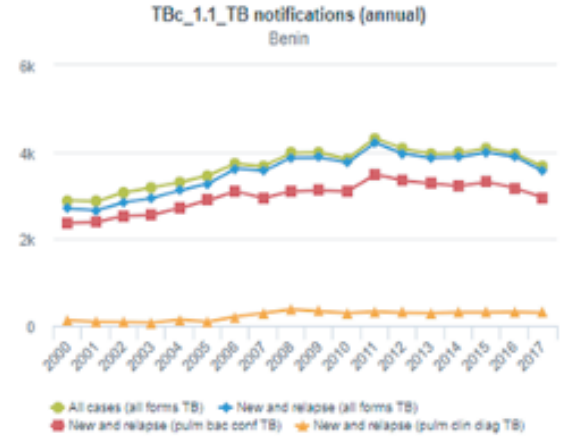
4. Analysis of core set of indicators

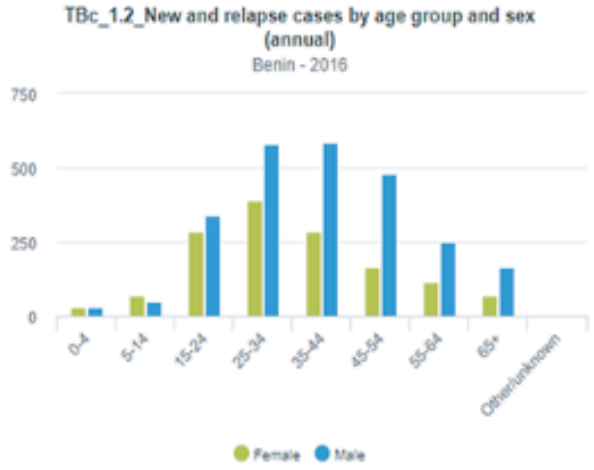
4.1 Notifications (numbers) dashboard

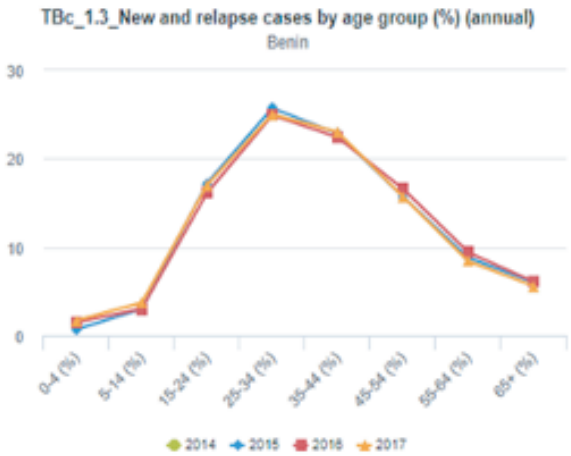
Interpretation of analysis of TB surveillance indicators – numbers and rates per 100 000 population

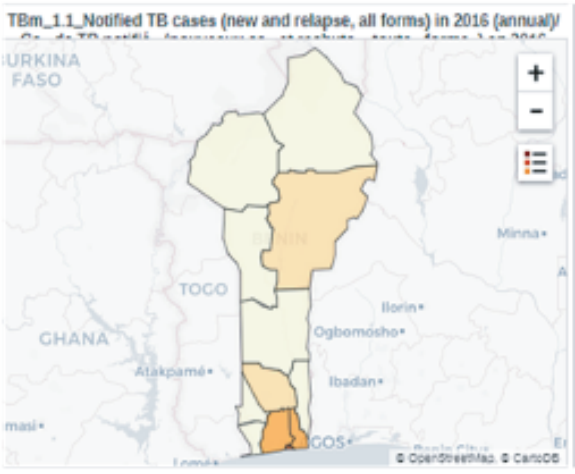
See Exercise book: Exercise 1

This section provides some key considerations for the interpretation of trends in TB notifications disaggregated by age, sex, bacteriologically confirmed or clinically diagnosed and treatment history.









TBt_1.1_TB notifications (annual)

Organisation unit	Data / Period	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Benin / Atacora-Donga	New and relapse (all forms TB)	99	108	107	121	123	123	174	193	205	233	210	243	272	253	331	327
	Previously treated (all forms TB)	0	1	3	1	5	2	4	6	2	7	5	8	11	6	7	4
	All cases (all forms TB)	99	109	110	122	128	125	178	199	207	240	215	251	283	259	338	331
Benin / Atlantique-Littoral	New and relapse (all forms TB)	1 032	994	1 110	1 137	1 191	1 234	1 464	1 326	1 514	1 568	1 457	1 603	1 435	1 433	1 513	1 512
	Previously treated (all forms TB)	62	105	117	123	81	78	46	49	45	36	35	43	39	30	31	48
	All cases (all forms TB)	1 094	1 099	1 227	1 260	1 272	1 312	1 510	1 375	1 559	1 604	1 502	1 646	1 474	1 463	1 544	1 560

Fig. 4.1 Notification (numbers) dashboard

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB1. Notifications (numbers)	TBc 1.1 TB notifications	Time series to examine trends in TB notifications by case type	1. Detect problems with recording and reporting 2. Monitor progress towards achieving TB elimination or meeting national targets, e.g. improving case notification from the private sector through strengthening surveillance 3. Assess impact of interventions, e.g. roll out of GeneXpert or active case finding activities
	TBc 1.2 New and relapse cases by age group and sex	To examine distribution of TB notifications by age group and sex	1. Detect and correct erroneous data 2. Understand the TB epidemiology and groups most at risk or those under-reported
	TBc 1.3 New and relapse cases by age group (%)	To examine the percentage of TB cases attributed to each age group over time	1. Detect and correct erroneous data 2. Understand changes in TB epidemiology over time 3. Assess the impact of interventions targeted at specific age groups, e.g. > 65 years old or children
	TBm.1.1 New and relapse (and history unknown)	Data visualization of TB notifications by province/ region	1. Easily identify geographical areas with the highest or lowest case notifications which may suggest higher TB burden or better/worse access to care or diagnosis 2. Compare TB burden between different geographical areas across the country for resource planning
	TBt 1.1 TB notifications	Time series to examine trends in TB notifications by treatment history and geography	1. Assess trends in new and previously treated cases by geography 2. Detect issues with recording and reporting or patient management 3. Assess impact of interventions, e.g. active case finding

Considerations/issues for interpretation

Time trends

This dashboard presents two time series (by year) of absolute numbers of TB notifications to assess changes in overall reported TB cases (TBc 1.1 and TBt 1.1). Changes in trends in the epidemiology of TB are expected to move relatively slowly. Large changes (> 10% increase or decrease) in reported cases are more likely to be due to artefacts or factors outside the control of the TB programme such as:

- data entry errors
- batch reporting or missing reports
- an increase or decrease in the number of treatment/reporting sites
- sudden mass referrals from one site to another
- poor completeness of reporting of diagnosed cases
- small numbers of cases which often results in large fluctuations over time (common at the facility level)
- cross-border migration
- large changes in the background population, for example, as a result of conflict
- no reporting or diagnosis due to natural disasters or worker strikes.

Rapid changes, however, could also be directly related to activities implemented by the TB programme or the TB epidemic such as new screening or diagnostic practices, active case finding or ongoing transmission in the community. Examining the data should be a starting point for generating hypotheses and investigating the reasons behind the observations.

A common recent observation in trends is the simultaneous increase in bacteriologically confirmed cases and a decrease in clinically confirmed cases. This usually reflects the change from WHO 2006 recording and reporting definitions, which were based on smears, to the WHO 2013 case definitions[4] which are based on bacteriological confirmation. This means that many smear-negative cases or those without a smear (previously classified as clinically diagnosed) are now classified as bacteriologically confirmed if they have a positive laboratory test for TB (culture, GeneXpert or LPA). This leads to an increase in bacteriologically confirmed TB cases.

[4] *Definitions and reporting framework for tuberculosis.* 2013 revision. WHO; 2013 (http://www.who.int/tb/publications/definitions/en/, accessed 12 November 2019).

The recent roll out and scale up of GeneXpert in countries means that an increased number of previously clinically diagnosed cases will move into the bacteriologically confirmed category (Fig. 4.2). If the number of bacteriologically confirmed cases does not increase following the roll out of GeneXpert this may indicate that previously diagnosed clinical cases were not TB, the screening algorithm is ineffective, target groups have been poorly selected, roll out of GeneXpert is incomplete, adequate training has not been carried out, or that there is erroneous recording and reporting of bacteriologically confirmed cases. If old guidelines or recording and reporting forms are still in use then bacteriologically confirmed cases cannot be captured. This means that the impact of GeneXpert cannot be assessed and therefore it is essential that recording and reporting tools are updated to reflect diagnostic practices in the country.



Fig. 4.2 TBc 1.1 Notifications, all forms of TB

Between 2014–2016 the number of clinically diagnosed cases decreased whilst bacteriologically confirmed cases increased due to the introduction of GeneXpert and the re-categorization of smear-negative cases as bacteriologically confirmed.

Age and sex disaggregation

TBc 1.2 and TBc 1.3 on the dashboard showing the age and gender distribution of TB notifications help managers to assess which population has the highest TB burden, if the distribution is changing over time (Fig. 4.3) and whether cases among a particular age group, for example children, are likely to be under-reported or under-diagnosed (further investigation into under-reporting/under-diagnosis in children can be found under dashboard TB3. Notifications (% and ratios).

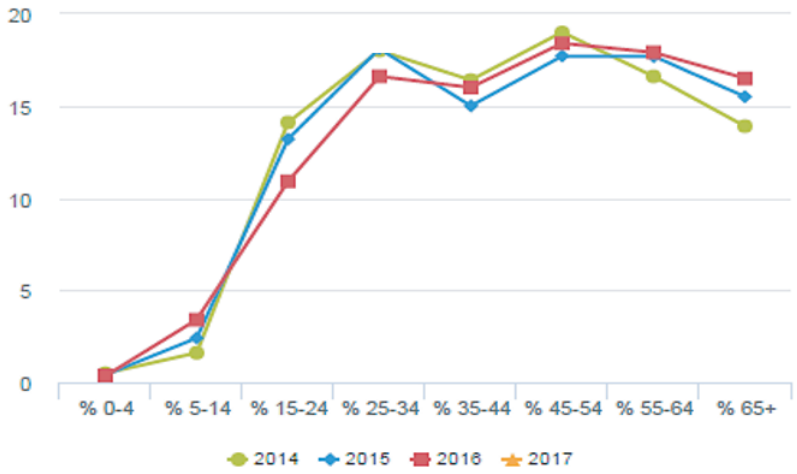


Fig. 4.3 TBc 1.3 New and relapse cases by age group

In 2014 and 2015 around 18% of all new and relapse cases were 25–34 year olds which decreased to 16% in 2016. Meanwhile, the proportion of new and relapse cases that were 65 years or older increased from 14% in 2014 to 16% in 2016. These results may indicate that the age distribution of incident TB cases is changing. The root causes should be investigated further, taking into consideration possible changes in active case finding activities targeting specific age groups, changes in diagnostic or reporting practices or changes in the underlying population structure.

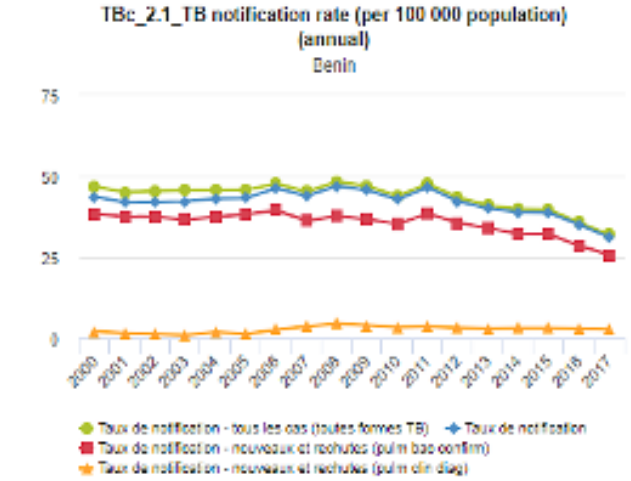
TBm 1.1 can be used to compare TB notifications (new and relapse cases) at the subnational level. This is important to understand the TB burden across the country and for resource planning, which is usually based on the number of TB notifications reported.

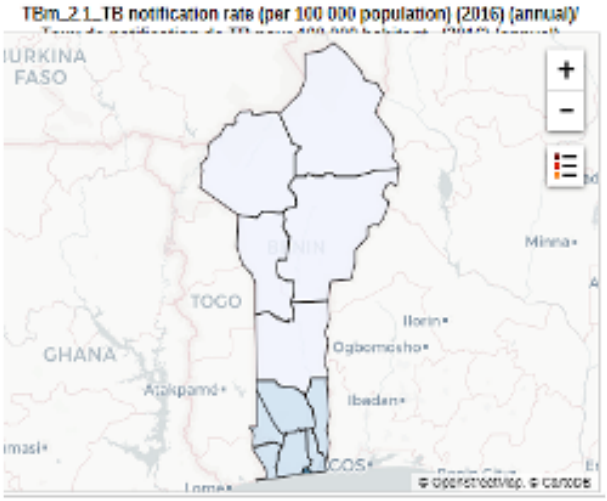
4.2 Notifications (rates) dashboard

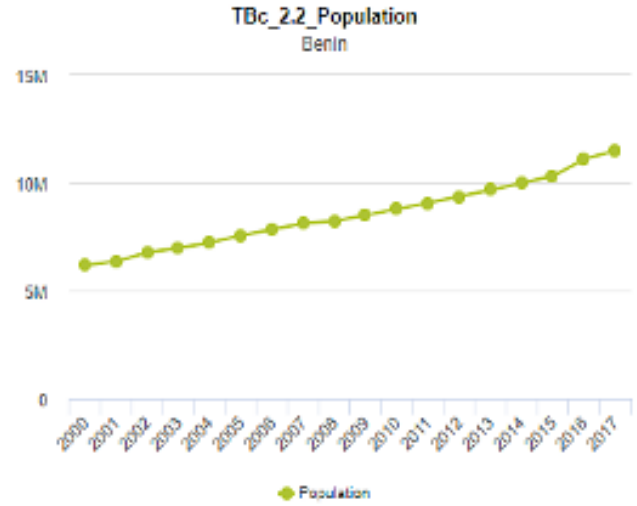
Interpretation of analysis of TB surveillance indicators – numbers and rates per 100 000 population

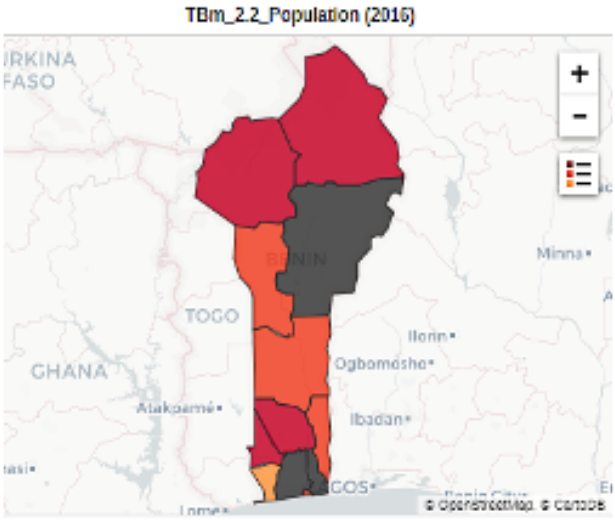
See Exercise book: Exercise 1

This section provides some key considerations for the interpretation of trends in TB case notification rates for new episodes of TB (new and relapse), adjusted for population size.









TBt_2.1_TB notification rate (per 100 000 population) (annual)

Organisation unit	Data / Period	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Benin	Taux de notification - tous les cas (toutes formes TB)	46.7	46	45.4	45.6	45.6	45.7	47.6	45.2	46.2	45.8	43.6	47.6	43.4	40.8	39.6
	Taux de notification	43.6	41.6	42	42.2	43	43.2	46.2	43.9	45.6	45.6	42.5	46.5	42.2	40	38.6
	Taux de notification - nouveaux et rechutes (pulm bac confirm)	38.3	37.6	37.4	36.6	37.4	38.2	39.4	36.2	37.6	36.7	35.2	38.4	35.6	33.9	32.2
	Taux de notification - nouveaux et rechutes (pulm clin diag)	2.1	1.5	1.3	1	1.9	1.3	2.6	3.6	4.5	4	3.4	3.6	3.2	3	3.1

Fig. 4.4 Notifications (rates) dashboard

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB2. Notifications (rates)	TBc 2.1 TB notification rate (per 100 000 population)	To examine trends in TB notification rates over time by case type	1. Detect problems with recording and reporting 2. Monitor progress towards achieving TB elimination or meeting national targets, e.g. improving case notification from the private sector through strengthening surveillance 3. Assess impact of interventions, e.g. roll out of GeneXpert
	TBc 2.2 Population	To examine changes in population over time	1. Detect and correct problems in population data 2. Helps data users to interpret trends in TB notification rates and why they may differ from the trend in notification (numbers)
	TBm 2.1 TB notification rate (per 100 000 population)	Data visualization of TB notification rates by province/region	1. Easily identify geographical areas with the highest or lowest case notification rates which may suggest high- or low-risk areas for TB transmission or access to care/diagnosis 2. Compare TB rates between different geographical areas across the country for targeted interventions
	TBm 2.2 Population	Data visualization of population by province/region	1. Helps data users to interpret differences in TB notification rates and why they may differ from the pattern seen
	TBt 2.1 TB case notification rate (per 100 000 population)	To examine raw data on TB notification rates by case type and geography over time	1. Assess trends in bacteriologically confirmed and clinically diagnosed cases by geographical area 2. Use figures for routine recording and reporting purposes to stakeholders for TB notifications (numbers)

Considerations/issues for interpretation

Time trends

This dashboard shows time series (by year) for TB case notification rates (TBt 2.1 and TBc 2.1) for all, new and relapse cases and pulmonary bacteriologically confirmed or clinically diagnosed new and relapse TB cases. Reviewing TB notifications that are standardized to the general population size helps programme managers to distinguish between areas with a higher risk of TB disease and compare data across geographic areas more meaningfully (TBm 2.1). Population standardized analyses can be done where up-to-date population estimates at subnational level can be obtained (TBc 2.2 and TBm 2.2). In some countries a recent census is not available and previous population projections do not reflect large shifts or growth in the underlying population within the country. In other countries a recent census is available but historic data have not been retrospectively corrected, which may result in an apparent rapid decrease or increase in rates following the census, which is incorrect (Fig. 4.5). Countries should ensure population estimates are retrospectively adjusted following a census in order to produce

accurate time trends in rates. Countries often do not have population estimates by age and sex, which are important for assessing populations at risk and changes in the epidemic over time.

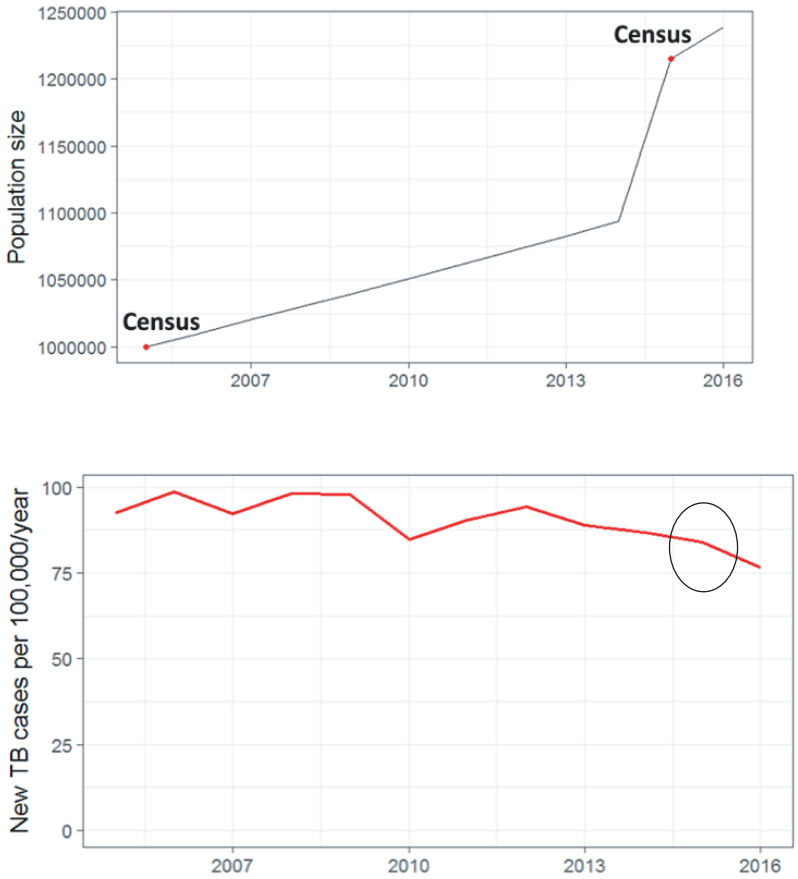


Fig. 4.5 Population size from census figures

As shown in Fig. 4.5, in 2015 a census was carried out which showed that the population was much higher than estimated from the previous census. The estimates were not adjusted retrospectively, making it appear that the TB case notification rate has decreased, although this is not the case.

Rates by geography

By geography, case notification rates should be examined alongside TB notifications (Fig. 4.6). Whilst notification data are important for understanding overall TB burden for resource planning, rates give a better indication of populations at high risk of TB and help to target interventions. In most settings, population estimates for health facility catchment areas are not available, limiting this analysis and the comparison of TB notification rates to national, regional and district levels.

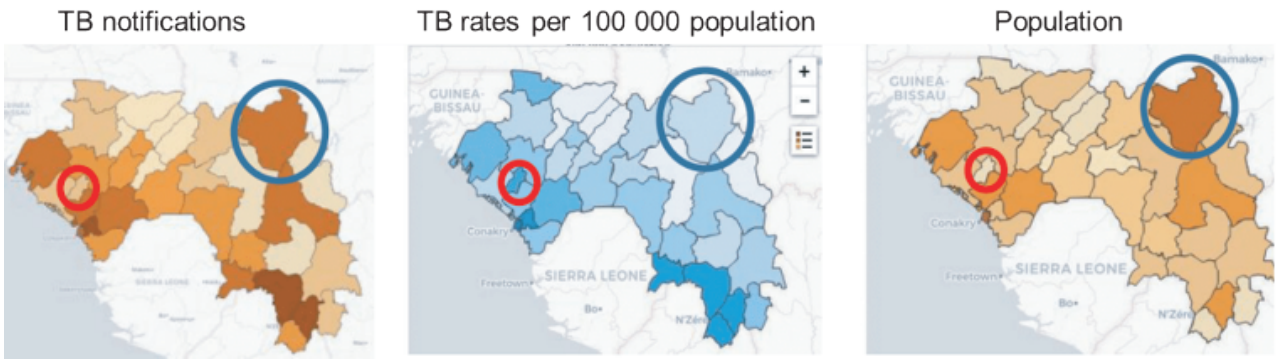


Fig. 4.6 TB notification rates by geography

The blue circles indicate a district that has a high number of TB notifications (numerator) but a lower TB case notification rate due to a high population (denominator). The red circles show a district with a low number of TB notifications but a high TB notification rate due to a low population.

4.3 Notifications (percentages + ratios) dashboard

Interpretation of analysis of important epidemiological indicators and how they can also be used to assess internal consistency of TB data

See Exercise book: Exercise 2

This section provides some key considerations for the interpretation of key indicators for monitoring internal consistency of data and unexpected patterns with respect to site of disease, treatment history, age group, sex and bacteriological confirmation.

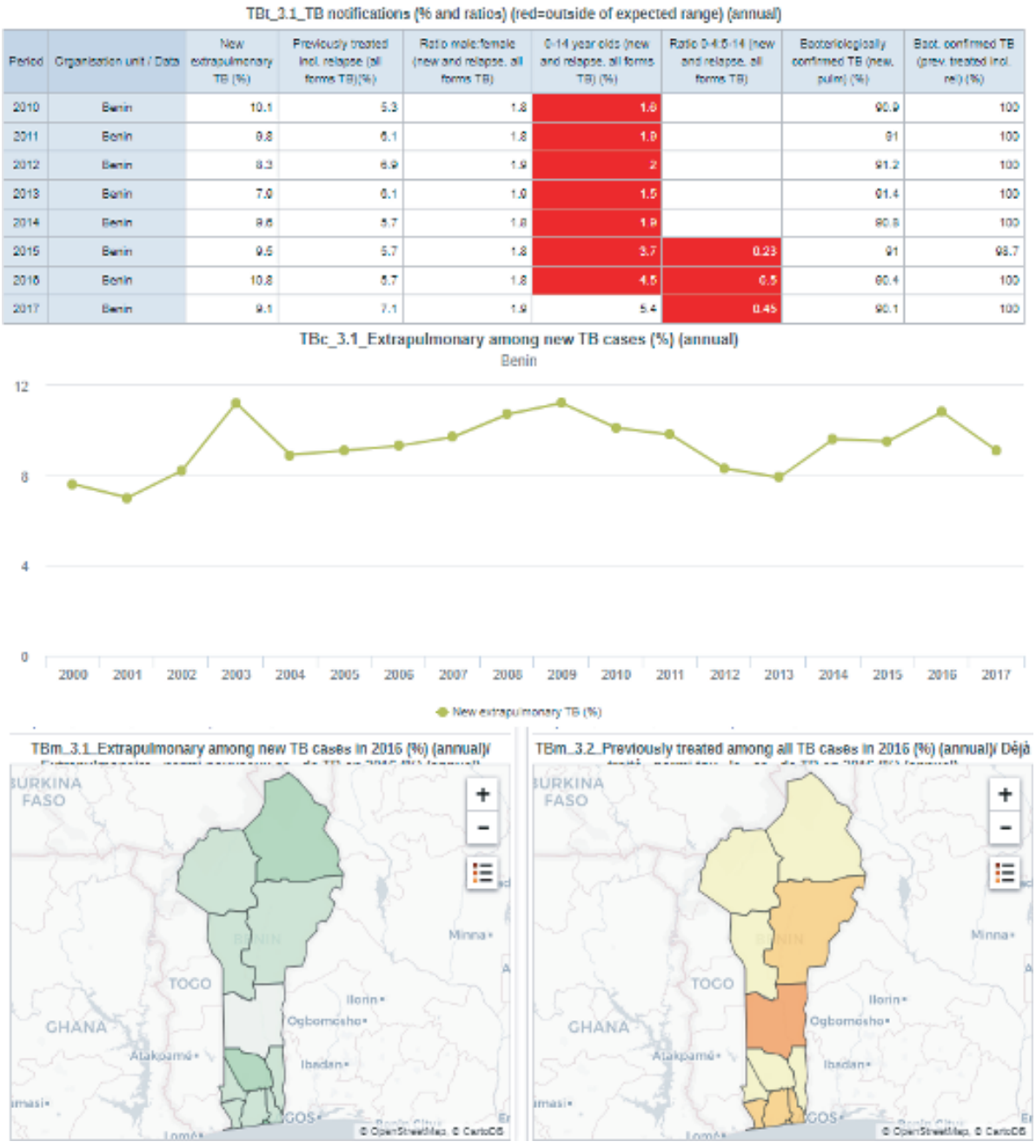


Fig. 4.7 Notifications (percentages + ratios) dashboard

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB3. Notifications (percentages and ratios)	TBt 3.1 Internal consistency for notified TB cases and TBc 3.1–3.6	To examine changes in the percentage of TB cases that are extrapulmonary, previously treated, children (0–14 years old) and bacteriologically confirmed (new and previously treated) and ratios of male : female and 0–4 : 5–14 year olds over time	1. Detect and correct problems with recording and reporting 2. Detect under-reporting or under-detection of TB in children 3. Detect and assess the impact of changes in diagnostic practices over time and take corrective action 4. Detect and assess the impact of changes in treatment practices over time and take corrective action 5. Measure whether standards B1.6, B1.7 and B2.3 from the standards and benchmarks checklist are met 6. Generate hypothesis for operational research
	TBm 3.1–3.7 Maps for indicators	To examine differences in the percentage of TB cases that are extrapulmonary, previously treated, children (0–14 years old) and bacteriologically confirmed (new and previously treated) and ratios of male : female and 0–4 : 5–14 year olds by geography	1. Detect and correct problems with recording and reporting 2. Detect differences in diagnostic practices by geographical area and take corrective action 3. Detect differences in treatment practices by geographical area and take corrective action 4. Detect under-reporting or under-detection of TB in children by geographical area 5. Generate hypothesis for operational research

Considerations/issues for interpretation

This dashboard displays ratios and percentages for key epidemiological indicators (TBt 3.1 and TBc 3.1–3.6) that can also be used to assess whether data are internally consistent[5] over time and across the country. Numbers of cases may vary by time and geography so one way to compare indicators more meaningfully is to use ratios (e.g. male : female) or percentages (e.g. male ÷ (male + female) × 100). All of these indicators should be relatively consistent over time in a robust and well-functioning surveillance system with good data validation unless a major intervention, or changes in diagnostic and treatment practices and/or services have occurred; especially those which target or affect specific populations. Identifying unusual patterns or unexpected values, either over time or in comparison with other geographical areas (TBm 3.1–3.7) or an established baseline (a selected specific year where data are reliable), allows us to detect improvements or problems with TB care and control or surveillance activities. Routine examination of the data should be a starting point for generating hypotheses, carrying out timely investigation and taking corrective action.

[5] *Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide.* WHO; 2014.

Extrapulmonary TB

Since the proportion of extrapulmonary cases varies widely across the world there are no expected values, but this indicator can be assessed internally over time. Variation by geographical area may indicate systematic problems such as inconsistencies in recording and reporting or differences in monitoring and evaluation (M&E) but it can also indicate that there are true differences in diagnostic or treatment practices or highlight the presence of large specialist centres for diagnosis of extrapulmonary TB. Extrapulmonary TB is also more common in young children, the elderly and those co-infected with HIV and therefore a higher proportion of TB cases that are extrapulmonary TB may be a result of the underlying demographics. Identifying the root causes can inform corrective action relating to M&E, clinical action, or a change in diagnostic practices. Operational research may be required to understand the root causes of the variation.

Previous treatment

Since the proportion of previously treated cases varies widely across the world there are no expected values, but this indicator can be assessed internally over time. Variation by geographical area may indicate systematic problems such as inconsistencies in recording and reporting or differences in M&E. A high proportion of previously treated cases may reflect an increase in relapses due to poor treatment management or non-adherence to treatment or an increase in re-infections due to increased or ongoing transmission. Conversely, a low proportion of previously treated cases could indicate good treatment management and low levels of transmission or it may also suggest under-reporting of these cases. Identifying the root causes can lead to corrective action relating to M&E, clinical action, or changes in treatment practices. Operational research may be required to understand the reasons for the root causes of variation.

Male and female

TB is more commonly found in men and although this can vary by geography, which may reflect differences in access to health care or an increase in the number of men with risk factors associated with TB (e.g. smoking, alcohol, drug use and homelessness). It is unlikely to vary over time. Large changes over time should be investigated.

Childhood TB

The ratio of TB cases among children 0–4 years old compared with cases among children 5–14 years old is expected to be in the range 1.5–3.0 (Standard 2.3; standards and benchmarks checklist). It is common to find data gaps in this indicator prior to 2014 because previous recording and reporting definitions did not include the 0–4 age group as a category and/or age disaggregated data were only collected for smear-positive cases. In high TB endemic settings, the majority of childhood TB cases will occur in young children (i.e. children under 5 years old) who tend to have paucibacillary disease and therefore there are usually no smear-positive TB cases reported for the 0–4 age group.

On average, among new TB cases, the percentage of children is between 5–15% in low- and middle-income countries, and < 10% in high-income countries (Standard B1.6; standards and benchmarks checklist). The percentage of cases occurring among children is also an indicator for the amount of recent infection in a country and/or the performance of the surveillance system to capture diagnosed cases of TB among children.

A **lower proportion of childhood cases than expected** suggests children are:

- under-detected/diagnosed and/or
- under-reported (Fig. 4.8).

The root causes should be investigated and corrective/programmatic action should be taken such as:

- introducing paediatric guidelines with training
- increasing the number of facilities that diagnose or treat childhood TB
- improving referrals to paediatric clinics
- implementing targeted interventions, such as active case finding.

A **higher proportion of childhood cases than expected**, for example:

- one area has a large paediatric hospital referral facility which accounts for a high proportion of childhood TB cases
- over-diagnosis of TB in children
- an outbreak in a setting such as a school
- under-diagnosis of TB in adults.

Again, the root causes should be investigated and corrective programmatic action should be taken, such as:

- introducing paediatric guidelines with training on diagnosis of TB in children
- if a specialist is not diagnosing childhood TB, discussion with paediatric specialists in other areas for advice
- carry out active case finding to identify adults with TB that may be under-diagnosed/under-reported.

Fig. 4.8 shows an example of districts with a low and high proportion of TB cases that are children (0–14 years old) as indicated by the red circles. The high proportion of more than 30% is due to the presence of a large paediatric referral centre. The reasons for a low proportion of childhood cases requires further investigation.

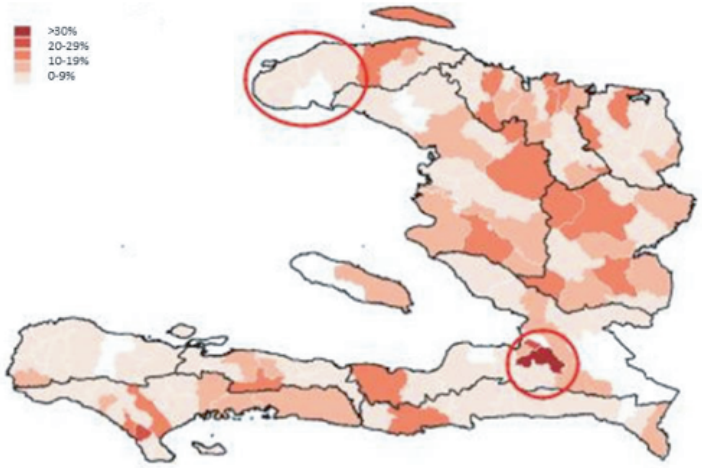


Fig. 4.8 Proportion of TB cases that are children (0–14 years old)

Bacteriologically confirmed cases

Since the proportion of bacteriologically confirmed cases varies widely across the world there are no expected values but this indicator can be assessed internally over time. With the roll out of GeneXpert it is expected that the proportion of bacteriologically confirmed cases will increase over time. Many countries first introduced GeneXpert for the diagnosis of TB in previously treated cases only, due to the associated increased risk of DR-TB. However, as the use of GeneXpert is expanded to test all new pulmonary cases an increase in bacteriological confirmation of these cases over time should be seen. By measuring bacteriological confirmation in new and previously treated cases countries can track the roll out and use of GeneXpert, if diagnostic algorithms have been updated to include all pulmonary cases. Prior to 2014, only smear-positive previously treated cases were reported and therefore 100% of cases will appear to be bacteriologically confirmed if new definitions are not being used, which is inaccurate.

4.4 Outcomes dashboard

Interpretation of analysis of TB outcomes data

See Exercise book: Exercise 3

This section provides some key considerations for the interpretation of trends in TB treatment outcomes over time and by geography to assess the performance of the TB programme.

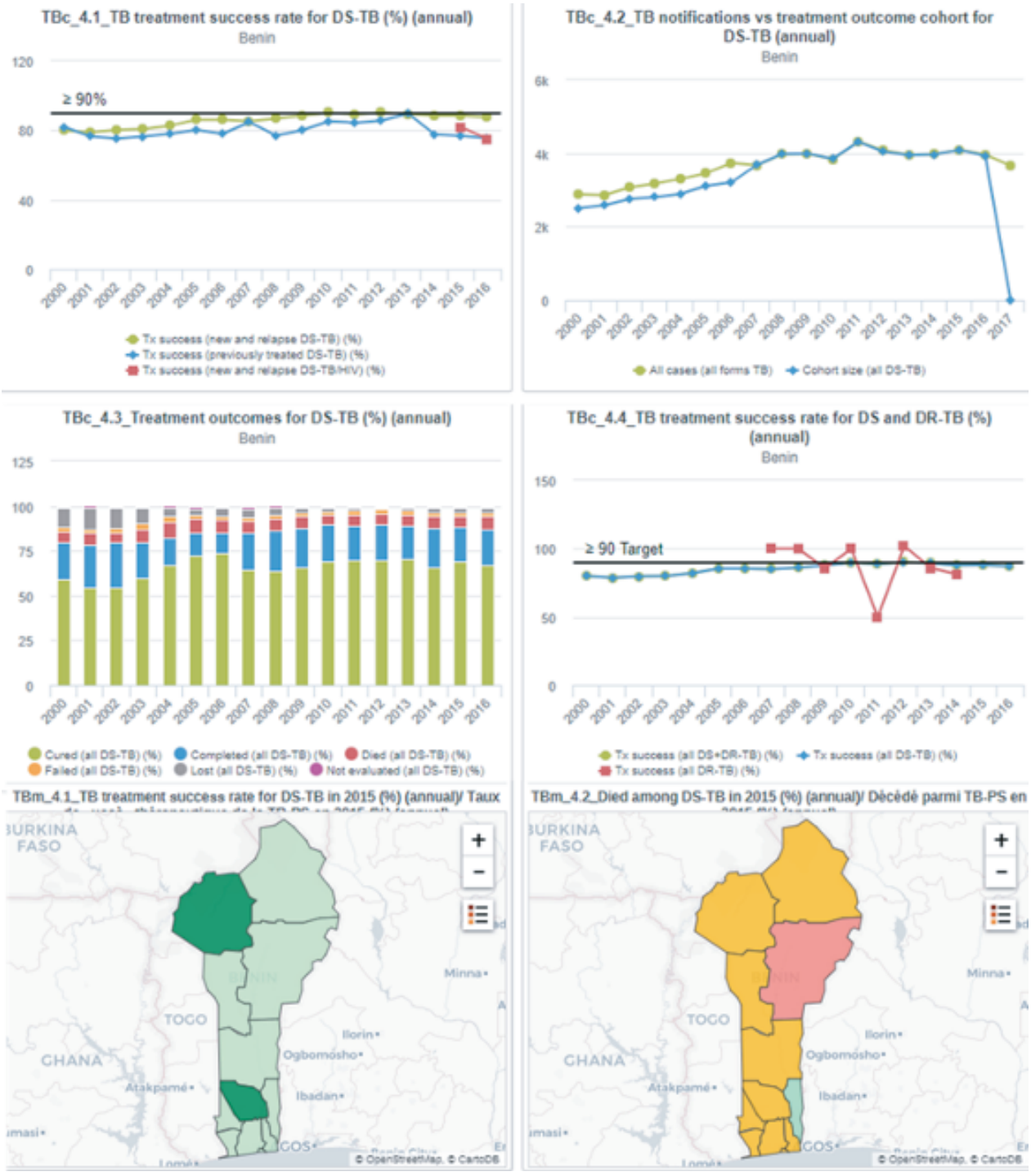


Fig. 4.9 Outcomes dashboard

TBt_4.1_TB treatment success for new and relapse DS-TB (%) (annual)

Tx success (new and relapse DS-TB) (%)

Organisation unit / Period	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Benin / Atacora-Donga	61.8	63.5	51.8	58.3	69.6	78.9	83.8	81.5	89.9	86.7	87.9	91.2	90.9	91.4	88.8	91.7	90.
Benin / Atlantique-Littoral	81.7	81.4	83.6	81.8	84.8	86.6	84.6	82.4	83.2	85.2	88.3	84.3	87.4	87.8	86.3	87	87.
Benin / Borgou-Alibori	65.4	65.4	66.8	66.3	71.2	76.1	77	77.2	81.2	86	83.9	87.2	89.4	87.3	87.8	85.9	82.
Benin / Mono-Couffo	85.8	81.2	83.3	86.8	85.9	84.5	87.5	89.8	89.7	90.7	92.3	93.5	90.1	89.4	87.3	88.8	83.
Benin / Ouémé-Plateau	84.4	82	85.1	84	85.8	91.8	91.4	91.4	91.8	92.6	93.9	94.5	94.4	93	92.8	89.1	88.
Benin / Zou-Collines	80.9	83.3	81.9	82.7	83.3	88.2	89.5	87.9	89.7	93.1	92.7	90.3	92.2	88.3	90.6	90.2	90.
Global TB / WARN-TB / Benin	79.9	78.9	80.3	80.7	82.7	86.1	86.1	85.2	86.8	88.5	90.2	89.2	90.3	89.4	88.5	88.4	87.

Fig. 4.9 Outcomes dashboard (continued)

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB4. Outcomes	TBc 4.1 Treatment success rate for DS-TB (%) (annual)	To examine and compare the trends in treatment success rate (defined as % of TB notifications cured or completed treatment) for all, new and relapse, previously treated, all DS-TB cases, all DR-TB cases and DS-TB/HIV co-infected cases over time. The End TB Strategy target of 90% is indicated by the black line	1. To evaluate the success of the TB programme for treating TB cases and whether this differs by treatment history, drug sensitivity or TB/HIV 2. To monitor whether treatment success is improving or getting worse over time 3. To monitor progress towards achieving the End TB Strategy target
	TBc 4.3 Treatment outcomes for DS-TB (%) (annual)	To examine treatment outcomes in detail for DS-TB over time	1. To identify the most common reasons for not completing treatment and whether there treatment and whether there, e.g. reductions in loss to follow up 2. To monitor completeness in treatment outcomes (% of not evaluated)
	TBt 4.1 TB treatment success for new and relapse DS-TB (%)	To compare % of treatment success across different geographical areas over time. 90% or above is shown in green indicating that the End TB Strategy target has been met	1. Assess trends in treatment success by geographical area 2. Use figures for routine recording and reporting purpose
	TBc 4.2 TB notifications vs treatment outcome cohort for DS-TB	To compare the number of TB cases with a registered treatment outcome to the number notified in the same time period	1. This can be used as an internal consistency check for treatment outcome data

Considerations/issues for interpretation

This dashboard shows treatment success over time (defined as % of TB notifications cured or completed treatment) for all, new and previously treated TB cases, DS-TB, DR-TB and TB/HIV cases (TBt 4.1, TBc 4.1, TBc 4.3 and TBc 4.4). Treatment success rates are also shown by geographical area for DS-TB cases (TBm 4.1–4.4). TBc 4.2 serves as a data quality check and allows the analyst to compare the number of cases with a registered treatment outcome to the original number of TB notifications for the same time period.

Treatment success is an important marker of disease control and service quality, as it measures the NTP's ability to maintain contact with patients over the course of 6 or more months. It allows countries to monitor progress towards meeting global and national targets and to determine whether more resources are required to improve treatment outcome by reducing death, loss to follow up and the proportion of cases with an outcome that is not evaluated.

Treatment success rates

The trend graphs show whether treatment success is improving or getting worse over time as well as comparing treatment success rates between DS-TB and DR-TB, TB/HIV and new and previously treated TB cases. These graphs are also useful for monitoring progress towards achieving the End TB Strategy target of 90% treatment success. TB programmes should be working towards improving treatment success in all patient groups, although it can be more challenging to achieve high treatment success in DR-TB and TB/HIV cases. Low treatment success rates may indicate problems with the treatment regimens being administered, poor treatment management, adverse side-effects or comorbidities leading to death or loss to follow up. An understanding of why treatment success may be low is important to be able to implement solutions for improving patient care.

Comparison of treatment outcomes across regions

It is important to look at treatment outcomes at the subnational level because some regions or districts may be underperforming which is masked by other geographical areas that have high treatment success rates. TBm 4.1–4.4 allow the comparison of treatment success, death, lost to follow up and not evaluated across different regions (Fig. 4.10). This can help the NTP to target under-performing regions with programmatic action. The root causes for high loss to follow up or death should be investigated which may require an operational research study. Geographical areas with poor treatment success rates could learn how to improve patient care from their neighbours with higher treatment success rates. It is therefore also important to understand how high treatment success rates are being achieved.

In Fig. 4.10 the region indicated by the red circle has low treatment success, mainly due to loss to follow up, whilst the region indicated by the blue circle has low treatment success, mainly due to death.

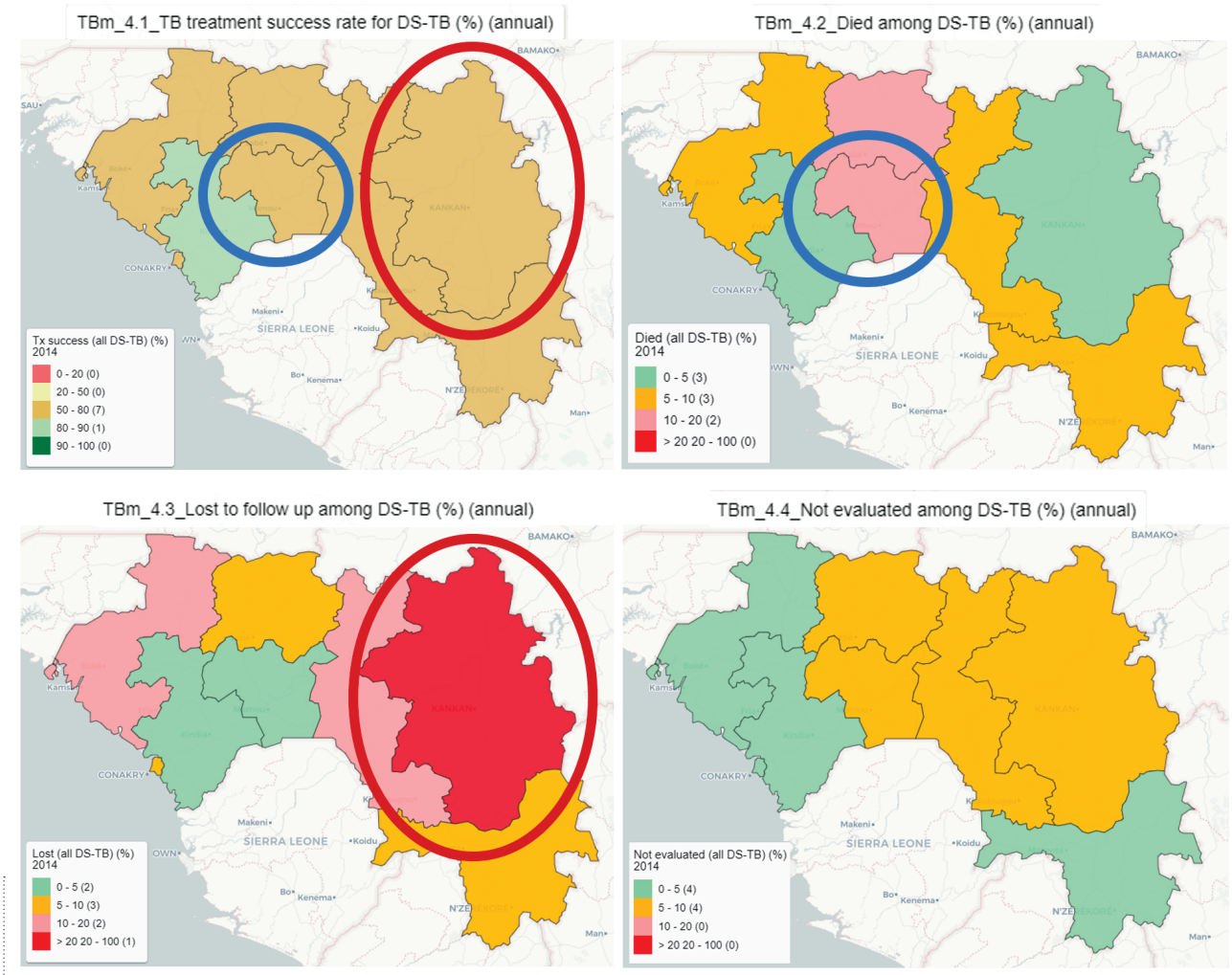


Fig. 4.10 Treatment outcomes across regions

Treatment outcomes (all DS-TB cases)

The stacked bar graph showing the proportion of TB notifications in each treatment outcome category (TBc 4.3) is used to highlight the extent to which loss to follow up, death and treatment failure contribute to the inability to achieve treatment success. It also provides information on the quality of treatment outcome reporting by showing the proportion of cases with an outcome that is not evaluated. If bars exceed 100% this means the sum of cured, completed, died, failed, lost to follow up and not evaluated adds up to more than the cohort with a registered treatment outcome, suggesting that there is a data entry error.

Loss to follow up

Loss to follow up may reflect poor patient management, a highly mobile patient population, patients with social risk factors affecting adherence to health care, problems with access to health care or a poor referral system. The reasons for loss to follow up should always be investigated through discussion with clinical staff. It is common to find high loss to follow up

in previously treated cases. Often the reason that they are previously treated is because they were lost to follow up during a previous TB episode and are therefore at higher risk of loss to follow up.

Death

Incomplete treatment due to death (related to TB), reflects the severity of disease at the time of diagnoses/reporting, or potentially a delay in initiating treatment following diagnoses. However, it should be noted that since cause of death is not recorded, deaths in TB patients may not always be due to TB. It is common to observe higher death rates in elderly populations due to other comorbidities, and in TB/HIV and DR-TB cases. Vital registration systems should be used for the accurate recording of TB deaths and also used to ensure that all deaths are notified to the TB programme.

Failed

An increase in TB cases that failed treatment may suggest problems with patient management, non-adherence to treatment, development of DR-TB or initial undetected DR-TB.

Not evaluated

A high proportion of not evaluated cases demonstrates weaknesses in M&E and recording and reporting, which can be rectified with training and improved supervision. High proportions of not evaluated cases often arise when the transfer/referral system is poor and the place of transfer is not recorded in the TB register making follow up of treatment outcome difficult. The easiest way for a programme to improve treatment outcomes rapidly is to first ensure good follow up of reporting and reduce not evaluated cases to zero.

Notification versus cohort

TBc 4.2 provides an internal consistency check between the number of TB case notifications and the number of cases included in the DS-TB treatment outcome cohort. The number of TB case notifications should include both DS-TB and DR-TB cases. The treatment outcome cohorts should be examined separately. Therefore, the difference between the total number of TB notifications and the DS-TB treatment outcome cohort should be the number of cases with DR-TB moved to second-line treatment.

If there are more TB outcomes than TB notifications then this suggests a problem with the M&E system with possible late notifications. Additional notifications that were missed should be added to the original number of TB notifications so that the two cohorts match (for the correct reporting year), following validation with the health facility.

If there are more notified TB cases than the treatment cohort, the number of cases moved to second-line treatment should be calculated. The difference (those with a missing outcome) should be reported as not evaluated (Fig. 4.11)

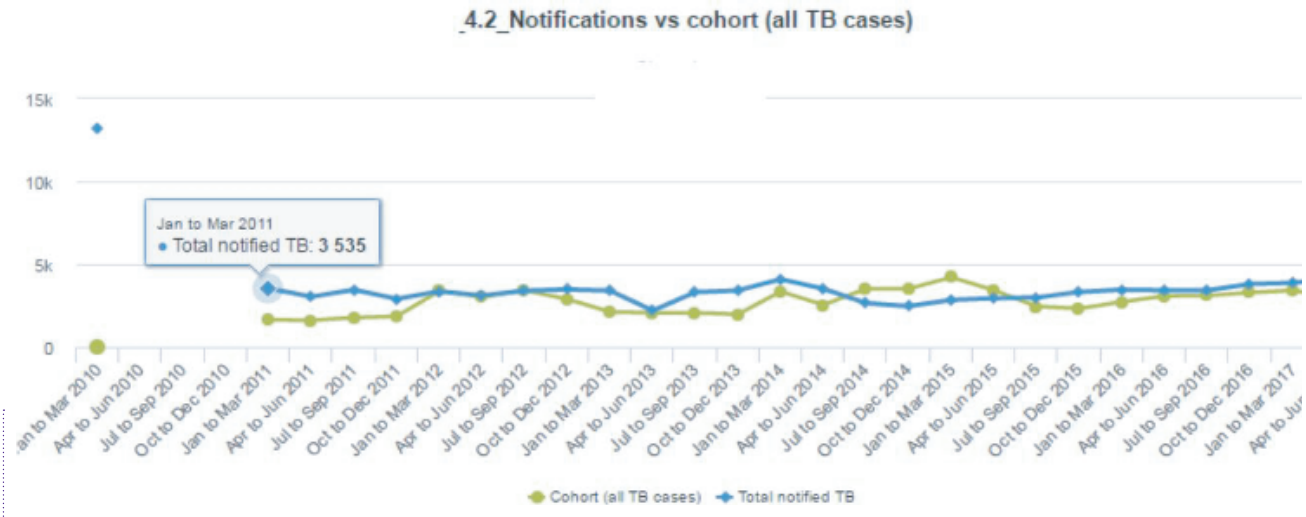


Fig. 4.11 Notification versus cohort

Between April to June 2013 and April to June 2014 there were more TB notifications than treatment outcomes registered. No cases had been moved to second-line treatment. These cases should have been recorded as not evaluated. Between July to September 2014 and April to June 2015 there were more treatment outcomes registered than original TB notifications. It is possible that these notifications were missed from the year before but, more likely in this case, it appears that the treatment outcomes have been reported under the wrong cohort/wrong time period. If the treatment outcome cohort was moved back by 1 year then the cohorts would match from 2013 onwards.

4.5 DR-TB dashboard

Interpretation of analysis of DR-TB data

See Exercise book: Exercise 4

This section provides some key considerations for the interpretation of trends in the testing of TB cases for susceptibility to rifampicin, confirmed RR/MDR cases and cases enrolled on treatment.



TBt_5.1_Drug resistance TB (annual)

Organisation unit	Data / Period	2012	2013	2014	2015	2016
Benin	Tested for RR-TB (new)	0	59	81	292	54
	Tested for RR-TB (previously treated)	0	203	185	243	226
	Tested for RR-TB (history unknown)	0	0	0	59	0
	Tested for RR-TB	0	262	266	594	280
	Lab-confirmed RR/MDR-TB	0	6	25	23	18
	Lab-confirmed MDR-TB	25	7	8	17	18
	Lab-confirmed RR/MDR-TB started MDR treatment	8	6	18	19	18
	Unconfirmed RR/MDR-TB started MDR-TB treatment	0	0	0	0	0

Fig. 4.12 DR-TB dashboard

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB5. DR-TB	TBc 5.1–5.4 and TBt 5.1 cascade of care for RR/MDR-TB	To examine the trend in the number and % of cases tested for RR-TB (new, previously treated and treatment history unknown), number of confirmed RR/MDR-TB and the number of those started on MDR-TB treatment and number of unconfirmed RR/MDR-TB started on MDR-TB treatment	1. To monitor coverage of drug susceptibility testing for new and previously treated cases over time 2. To determine whether routine surveillance provides a direct measurement of DR-TB in the country 3. To directly measure levels of drug resistance detected (RR and MDR – those receiving follow-up culture and drug susceptibility tests [DST]) over time 4. To directly measure the proportion of those confirmed starting on an appropriate treatment regimen over time 5. To directly measure the number of clinically diagnosed MDR-TB cases (e.g. high risk through contact with a DR-TB cases) over time

Considerations/issues for interpretation

The graphs on this dashboard show the key indicators for DR-TB; TB cases tested for rifampicin susceptibility (TBc 5.1–5.2); the number and proportion of confirmed DR-TB cases (TBc 5.1–5.3); and the coverage of second-line treatment for those found to have RR (including MDR) TB (TBc 5.4) using both absolute numbers (TBt 5.1) and percentages.

A high proportion of notified TB cases should have drug susceptibility test (DST) results documented for at least rifampicin to ensure that:

- continuous surveillance data are nationally representative
- DR-TB cases are rapidly detected and placed on the correct treatment regimen in a timely manner
- onwards transmission of DR-TB does not occur.

WHO requires that by 2025 100% of all TB cases notified in a national continuous surveillance system have documented DST results for at least rifampicin.[6]

[6] Implementing the End TB Strategy: the essentials. Geneva: World Health Organization; 2015 (http://www.who.int/tb/publications/2015/The_Essentials_to_End_TB/en/, accessed 15 November 2019).

Drug susceptibility test coverage, laboratory confirmation and cases started on MDR treatment

Drug susceptibility test coverage and laboratory confirmation combine results from GeneXpert, line probe assays and DST. Ideally the data should come from the same source, e.g. the TB register, to allow analysis of the cascade of care. Unfortunately, when analysing aggregated data the coverage statistics may be calculated with numerators and denominators from mismatched data sources and time periods. For example:

- TB patients may access different facilities at specific points from diagnosis to treatment, i.e. a patient may access facility A for initial diagnosis and treatment (DS-TB register), facility B for susceptibility testing and confirmation (laboratory register); and facility C for DR-TB treatment (DR-TB treatment register). In this scenario, if the original cohort of notifications are based on the DS-TB treatment register (denominator) and the number of cases with drug susceptibility testing comes from the laboratory register (numerator), then the patient cohorts are not the same. Furthermore, if the number of cases started on DR-TB treatment come from the DR-TB treatment register (numerator) and the number of confirmed cases come from the laboratory register (denominator), then the patient cohorts are not the same.

- TB cases may be initially diagnosed in 1 month, but do not receive the results of the DST or start on treatment until a subsequent reporting period. Again, if the numbers tested are based on laboratory registers and the numbers on treatment from the TB registers, the patient cohorts are not the same.

For this reason, the indicators based on percentages may not be accurate and it is possible to have more than 100% of cases tested or starting on treatment. It is also important to look at the numbers of cases because if they are small (< 10), percentages become less meaningful and even misleading when interpreting data. Ideally, countries should move towards case-based surveillance systems for DR-TB as soon as all requirements for such a system are met.

In many countries there are a small number of cases being treated for DR-TB in a few specialist centres, which receive referrals from all over the country. In this scenario DR-TB data are usually collated and only available at the national level. However, as routine testing and surveillance for DR-TB are established and treatment becomes decentralized, it is important to examine the key indicators at regional, district or facility levels.

Interpretation of the analysis of RR/MDR-TB data in country X – common findings

The example in Fig. 4.13 demonstrates common findings and the issues involved in the interpretation of the analysis of DR-TB data.

DST coverage: In country X the introduction of GeneXpert in 2013 followed by expansion led to a rapid increase in RR testing, in both new and previously treated cases, from 1 to 16% (TBc 5.2).

TBt_5.1_Drug resistance TB (annual)

Organisation unit	Data / Period	2011	2012	2013	2014	2015
Country X	Tested for R susceptibility, new cases			92	1 958	3 329
	Tested for R susceptibility, previously treated			397	737	1 454
	Tested for R susceptibility, unknown history			60	874	2 044
	Tested for RR-/MDR-TB			549	3 569	6 827
	Lab-confirmed RR-/MDR-TB	135	172	117	255	252
	Lab-confirmed MDR-TB	71	89	82	152	252
	Conf start MDR-TB treatment	7	41	110	189	253
	Unconf start MDR-TB treatment	0		89	24	0

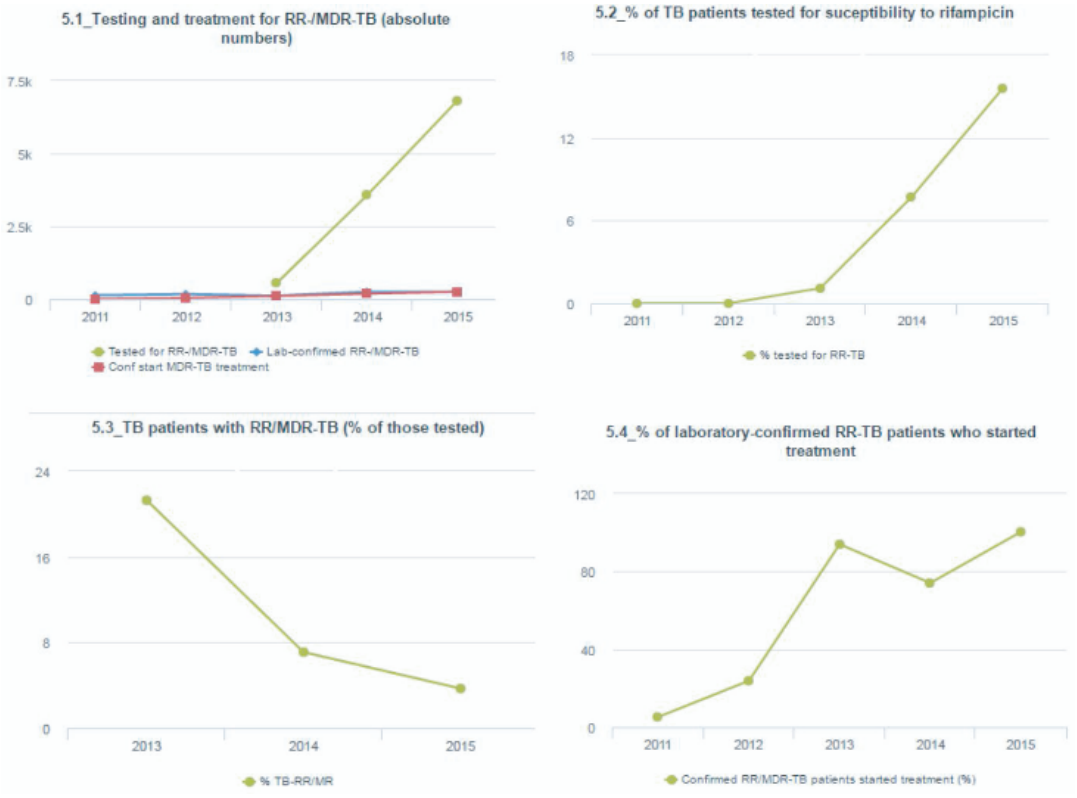


Fig. 4.13 Interpretation of analysis of DR-TB data in country X

Laboratory confirmation: The absolute number of RR/MDR-TB laboratory-confirmed cases increased as a result of more testing (TBc 5.1 and TBt 5.1), whilst the percentage of RR/MDR-TB laboratory-confirmed cases, out of those tested, decreased (TBc 5.3). This is because high-risk groups for DR-TB were initially targeted with GeneXpert and later testing was expanded to include those who were at lower risk of DR-TB.

The number of cases confirmed as MDR out of RR cases also increased over time due to expansion of follow up DST and culture (TBt 5.1). However, in 2015 the number of RR and MDR cases were the same, which is unlikely. Possible explanations are changes in definitions so that RR and MDR cases could no longer be distinguished in the dataset or perhaps there was a data entry error.

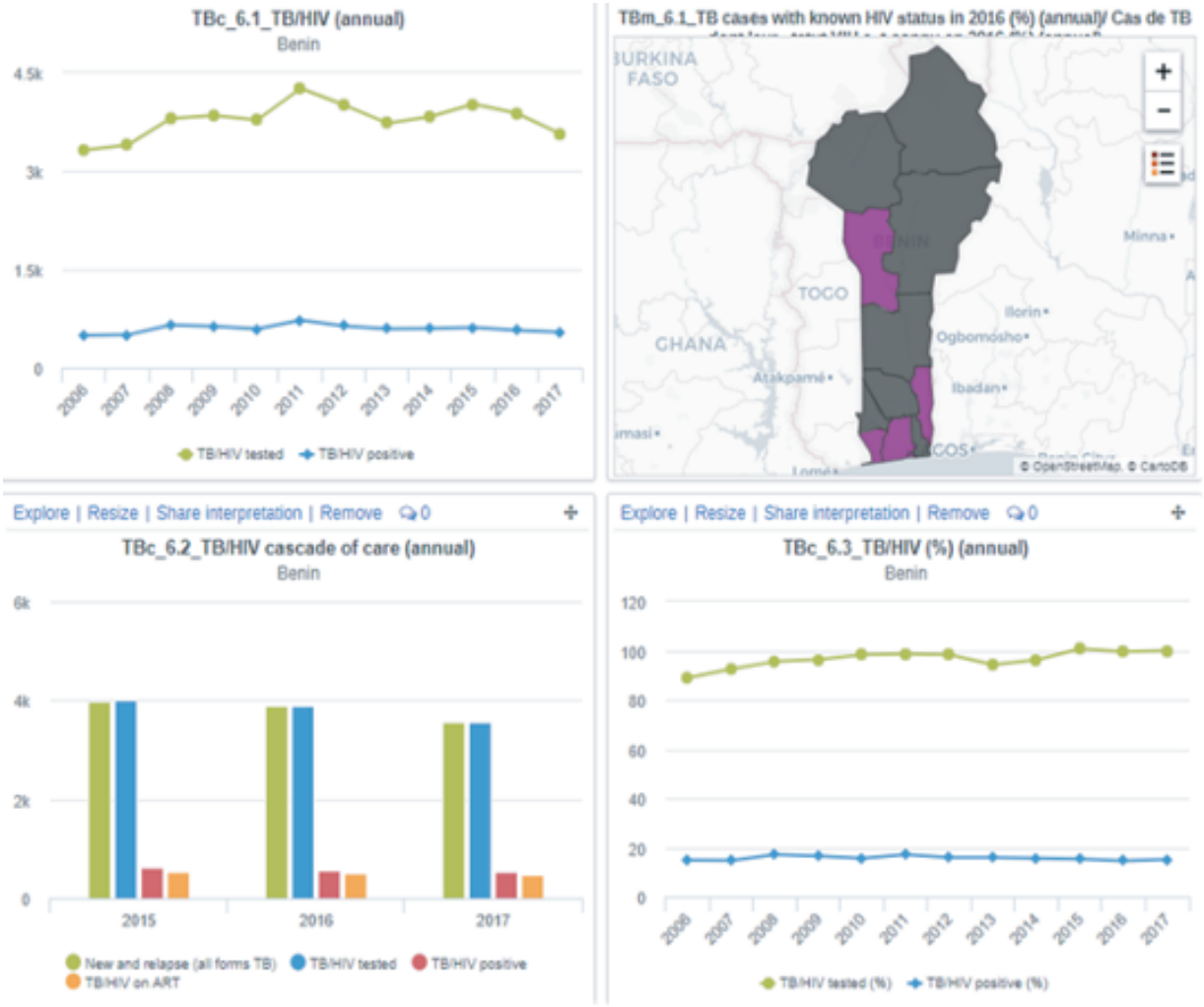
Cases started on MDR treatment: The proportion of confirmed RR/MDR cases on treatment increased to from 5.2% in 2011 to 100% in 2015 (TBc 5.4). This was achieved through decentralization of treatment. In 2015 there is one additional case on treatment than the number of cases that are confirmed. This is because the additional person started on treatment at the end of December 2015 (unconfirmed) and was confirmed by DST at the beginning of January 2016. This is a limitation of using data from different sources (laboratory register and DR-TB register) and of using aggregate rather than case-based data.

4.6 TB/HIV dashboard

Interpretation of analysis of TB/HIV data

See Exercise book: Exercise 5

This section provides some key considerations for the interpretation of trends in the detection and treatment of HIV in TB patients.



TBt_6.1_TB/HIV (annual)

Organisation unit	Data / Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Benin	All cases (all forms TB)	3 734	3 673	3 977	3 987	3 841	4 320	4 075	3 957	3 977	4 092	3 968	3 662
	New and relapse (all forms TB)	3 619	3 565	3 872	3 878	3 756	4 212	3 966	3 866	3 886	3 991	3 896	3 567
	TB/HIV tested	3 318	3 396	3 802	3 845	3 779	4 259	4 006	3 730	3 828	4 017	3 879	3 568
	TB/HIV positive	494	501	653	633	592	727	640	594	598	613	572	544
	TB/HIV on ART	48	161	261	276	340	537	553	530	549	531	504	486
	TB/HIV on CPT	337	451	635	622	572	709	628	579	592	591	557	521

Fig. 4.14 TB/HIV dashboard

Indicators on dashboard

Dashboard	Graphics (c = chart, m = map, t = table)	Purpose on dashboard	Value to programme
TB6. TB/HIV	TBc 6.1–6.4 and TBt 6.1 cascade of care for TB/HIV	To examine the trend in the number and % of TB cases tested for HIV (all, new and relapse), confirmed TB/HIV and treated with ART and CPT	1. To monitor coverage of HIV testing for TB cases 2. To directly measure levels of TB/HIV co-infection 3. To directly measure the proportion of TB/HIV co-infected cases on treatment with ART and CPT
	TBm 6.1–6.4 cascade of care for TB/HIV by geography	To examine differences in the % of TB cases tested for HIV, TB/HIV co-infected and % of TB/HIV cases treated with ART by geography	1. To monitor whether HIV testing coverage is adequate in all parts of the country (target of 100%) 2. To detect whether there are issues with kit or ART stock outs in particular geographic areas 3. To understand TB/HIV burden in the country and identify geographical areas with higher risk 4. To ensure TB/HIV co-infected cases are treated with ART
	TBt 6.2 TB/HIV recorded at the time of case notification and treatment outcome	To examine differences between the numbers recorded for the TB/HIV cascade of care at the time of notification with those recorded for the same cohort at treatment outcome. This serves as a data quality check as well as providing more accurate data on the numbers of cases tested, co-infected started on ART and CPT	1. To ensure all TB cases tested for HIV, TB/HIV co-infected and those treated with ART and CPT are accurately captured so that these indicators are not under-estimated 2. To calculate the number of TB cases that are tested for TB during treatment 3. To evaluate the quality of TB/HIV data

Considerations/issues for interpretation

Assessing the HIV status among new TB cases is critical for proper clinical management of both TB and HIV disease. This dashboard shows the number and percentage of new and relapse TB patients with a known HIV status (testing coverage), TB-HIV co-infection (TBc 6.1–6.3 and TBt 6.1), and coverage of CPT and ART among co-infected patients (TBc 6.2 and 6.4 and TBt 6.1). These indicators comprise the TB/HIV cascade of care.

Trends in TB/HIV cascade of care indicators

The percentage of TB patients with a known HIV status should be monitored closely over time to assess progress towards achieving the target of 100% by 2025. The percentage of TB patients who are HIV positive provides useful data to forecast treatment needs and support to help manage co-infected patients. Just as for other HIV patients, CPT and ART therapies are considered the standard of care. Tracking these indicators helps TB programme managers

identify weaknesses in collaborative activities between HIV and TB service providers which result in TB patients not being tested for HIV and co-infected patients not being treated with ART or CPT. It is important to monitor these indicators quarterly in order to take rapid corrective action in under-performing facilities or districts. As HIV testing coverage increases over time the percentage of TB/HIV co-infected cases is likely to decrease as the focus moves away from testing high-risk cases, which are more likely to be HIV positive, to all TB cases. It is also common to see a delay in the proportion of TB/HIV co-infected cases started on CPT or ART, but progress should be carefully and actively monitored to ensure 100% of patients receive adequate care.

TB/HIV cascade of care indicators by geography

It is useful to view these indicators on a map to rapidly identify regions or districts that may be under-performing and take corrective action. In low HIV burden countries the number of TB/HIV cases could be very small. TBm 6.3 shows the number of TB/HIV cases which helps to interpret the percentage of TB/HIV cases on ART (TBm 6.4). For example, if only 50% of TB/HIV cases are treated with ART, this looks very low. However, if there are only two cases then this is not as serious a problem to address as having only 100 out of 200 TB/HIV cases treated with ART.

A key consideration is that TB/HIV activities are collected during notification and also during treatment outcome reporting. This is to ensure that information on the proportion of TB cases tested, TB/HIV co-infected and those on CPT or ART is accurate because not all TB patients are tested for HIV at the start of treatment, but during treatment instead. Failure to collect this information at the treatment outcome stage will under-estimate HIV testing and TB/HIV co-infection. The numbers of TB cases tested or co-infected collected at the treatment outcome stage should be higher than the numbers reported at notification. The denominator should remain as the number of original TB cases notified in the cohort. These data are either currently collected incorrectly in many countries or combined with TB/HIV data received from HIV clinics. This results in more than 100% of TB cases being tested for HIV or on treatment with ART or CPT (Fig. 4.9). In the event that this is observed, the data collection process and forms should be reviewed and the data in the system should be corrected before these data can be analysed and interpreted.

The black areas in Fig. 4.15 show where there are more than 100% of TB cases with a known HIV status indicating that there are issues with recording and reporting of this variable.

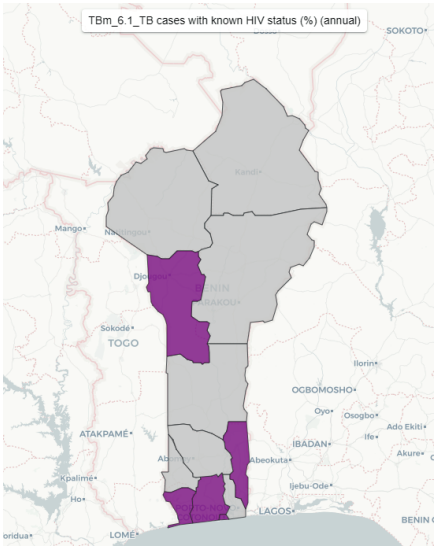


Fig. 4.15 TB cases with known HIV status

5. Data limitations

As mentioned in the introduction, TB notification data are a useful, readily available source for understanding the epidemiology of TB. Once a TB surveillance system achieves a certain standard, the case notification rate will approximate TB incidence. However, in countries where TB notification systems are still weak there may be a significant amount of under-reporting. If under-reporting cannot be quantified, the case notification rate will not directly measure the TB incidence. For this reason, it is important to compare the trends in TB notification data from the HMIS against the estimated TB incidence produced through epidemic models.

In every country, the potential bias of the TB notification system should be carefully reviewed. Some common areas of bias include:

- The under-representation of newly diagnosed cases from private sector providers.
- The lack of diagnostic capacity or accessibility within countries, leading to undiagnosed and untreated TB cases.
- The uncertainty of the specificity of TB diagnoses in countries which do not have capacity to bacteriologically confirm all cases.
- The uncertainty of the sensitivity of TB diagnoses in countries which are limited to the use of sputum smear microscopy.

The extent to which trends in TB notification reflect trends in the epidemiology of the disease is influenced by shifts in the effectiveness of active case finding. For example, where active case finding is improving, an increase in TB notifications is expected, independent of TB incidence. Similarly, where resources have been depleted and active case finding begins deteriorating, TB notifications should decline.

The data analysis covered in this document is for aggregated data. Aggregated reports have several limitations over case-based collection of notification data. Overall, a case-based TB surveillance system allows for more detailed, extensive and timely collection and analysis of information.

The main limitations of aggregate data collection are:

- Aggregate reports are usually based on manual case counts from multiple paper-based records on a quarterly basis. This is an intensive process that can lead to transcription mistakes as the information is transferred from one form to another. Collection and reporting of aggregate data from all health facilities to TB data management units is time-consuming, resulting in delays in compilation and analysis.

- As aggregate data collection is labour intensive, only limited information can be collected in these systems which means data cannot be disaggregated later to carry out more in-depth analysis to better understand the TB epidemic.

- Data on individual cases or patients are not readily available above the health facility level. Therefore, access to case-based data is restricted for programme directors and policy-makers, who are required to make informed programmatic assessments (e.g. diagnostic and treatment management of patients).

- It is not possible to link aggregate data to other databases. This minimizes the scope, potential and utility of the TB data collected in the system, and reduces the research, programmatic and policy linkages that could be made if case-based data were used.

- Data may not always be available or complete at the time of quarterly reporting which means these data will remain missing unless there is an effort to update quarterly reports at a later date.

6. Conclusion

This module reviewed the key indicators related to TB surveillance data that are collected at the health facility level. These indicators are presented in the TB module of the DHIS2 for monitoring epidemics and for routine data analysis. The importance of monitoring the quality of the data was also discussed, including potential limitations to data availability.

The core analyses presented in this guide could be developed further and included in existing country monitoring and evaluation plans. These analyses should be undertaken routinely by TB programmes to inform programmatic action. Additional detailed information can be found within the suggested references at the beginning of this document.

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