

TUBERCULOSIS EPIDEMIOLOGICAL IMPACT ANALYSIS AND ASSESSMENT OF TB SURVEILLANCE SYSTEM OF KAZAKHSTAN, 2017



ABSTRACT

An excellent understanding of the level of, and trends in, disease burden and how these have been (and can be) influenced by the implementation of prevention and treatment interventions is of considerable importance to national health programmes, as well as international donor agencies. It can help to ensure the appropriate allocation of funding and ultimately help to save more lives in the future. This report delivers TB epidemiological and impact analyses for the “epidemiological stage” of the Global Fund’s when supported by the CCM of Kazakhstan.

Keywords

PUBLIC HEALTH

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Abbreviations

ART	antiretroviral treatment
BMU	basic medical unit
CNR	case notification rate
CPT	co-trimoxazole preventive treatment
DST	drug susceptibility testing
EP	extrapulmonary
GDP	gross domestic product
H	isoniazid
HIV	human immunodeficiency virus
ICD	International Classification of Diseases
IIN	individual identification number
IPT	isoniazid preventive therapy
IQR	interquartile range
LFU	lost to follow-up
LJ	Löwenstein–Jensen medium
LPA	line-probe assay
Lzd	linezolid
MDR-TB	multidrug-resistant tuberculosis
M&E	monitoring and evaluation
Mfx	moxifloxacin
MoH	Ministry of Health
MTB	<i>Mycobacterium tuberculosis</i>
N&R	new and relapse
NRL	National Reference Laboratory
NRTB	National Register of TB Patients
NTP	National Tuberculosis Programme
OOP	out-of-pocket
PLHIV	people living with HIV
PTB	pulmonary tuberculosis
RDP	Register of Dispensary Patients
RFP	Register of the Fastened Population
R&R	recording and reporting
RR	rifampicin-resistant
SES	Sanitary–Epidemiological Service
SLDs	second-line drugs
SOPs	standard operating procedures
TB	tuberculosis
USAID	United States Agency for International Development
VR	vital registration
WHO	World Health Organization
XDR-TB	extensively drug-resistant tuberculosis

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Executive summary

The purpose of the epi-review mission to Kazakhstan that took place in August 2017 was to assess the completeness and accuracy of routine tuberculosis (TB) surveillance and vital registration (VR) and to investigate the plausible drivers of the TB epidemic in the country.

Objectives

The objectives of the epi-review were:

- to 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, the TB disease burden (incidence and mortality), through implementation of a TB surveillance checklist;
- to assess the level of, and trends in, the TB disease burden (incidence, prevalence, mortality) using available surveillance, survey, programmatic and other data;
- to assess whether recent trends in TB disease burden indicators are plausibly related to changes in TB-specific interventions, taking into account external factors such as economic or demographic trends.

Methods

The checklist and associated user guide from *Standards and benchmarks for tuberculosis surveillance and vital registration systems* were applied for the assessment.¹ Methods of data collection included: (1) desk review of available TB control-related policy papers, manuals, guidelines and forms; (2) interviews and discussions with TB authorities and health care providers at national and district level; (3) review and cross-check of TB records, laboratory registers and electronic surveillance systems at TB dispensaries; (4) review of electronic databases to assess the level of incompleteness of core variables, invalid entries, etc.; and (5) analysis of notification/surveillance data over time and space to identify trends in disease burden and programmatic efforts.

Key findings

Performance of surveillance and VR system

Of the 12 standards for TB surveillance that were applied, four were met, four were partially met, and four were not met (Table 1), indicating that there is scope to improve the TB surveillance system. We can therefore assume that the surveillance system cannot provide a direct measure of the number of TB patients detected. Furthermore, notification is not a good proxy for TB incidence, because of the population's limited access to health care services and failure to ensure the integrity of collected data in the annual national surveillance report.

¹ WHO Global Task Force on TB Impact Measurement. Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide. WHO/HTM/TB/2014.02. Geneva: World Health Organization; 2014 (<http://www.who.int/tb/publications/standardsandbenchmarks/en>).

Table 1 Summary of standards for TB surveillance in Kazakhstan, September 2017

STANDARD	MET	PARTIALLY MET	NOT MET	NOT APPLICABLE
B1.1 Case definitions consistent with WHO guidelines		X		
B1.2 TB surveillance system designed to capture a minimum set of variables for reported TB cases	X			
B1.3 All scheduled periodic data submissions received and processed at the national level		X		
B1.4 Data in quarterly reports are accurate, complete, and internally consistent				Not applicable
B1.5 Data in national database accurate, complete, internally consistent, and free of duplicates	X			
B1.6 TB surveillance data are externally consistent			X	
B1.7 Number of reported TB cases internally consistent	X			
B1.8 All diagnosed cases of TB are reported		X		
B1.9 Population has good access to health care			X	
B1.10 Vital registration system has high national coverage and quality		X		
B2.1 Surveillance data provide a direct measure of drug-resistant TB in new cases			X	
B2.2 Surveillance data provide a direct measure of the prevalence of HIV infection in TB cases	X			
B2.3 Surveillance data for children reported with TB are reliable and accurate			X	

Strengths

- Presence of an established web-based real-time electronic database at all levels.
- Availability of effective data quality assurance mechanisms at all levels.
- High access to culture testing, drug susceptibility testing (DST) and HIV testing.
- High coverage and quality of the VR system.
- Strong linkage between the VR system and the TB surveillance system.
- Adequate numbers of highly skilled staff.
- Adequate government commitment and funding for TB surveillance.

Gaps/weaknesses

- Non-compliance with all WHO definitions.
- Failure to include all notified TB cases that occurred in the country in the annual national surveillance report.
- Challenges to produce reliable indicators for laboratory confirmation based on a combination of all methods of TB laboratory diagnostics.

- Challenges to produce reliable drug-resistance surveillance data based on a combination of all DST methods.
- Lack of external consistency and limited validity of surveillance data for childhood TB.

Disease burden and key drivers of the TB epidemic

Since 2004, both TB notification and mortality in Kazakhstan have steadily decreased. The mean annual decline in notification between 2005 and 2016 was 8.7%. Decline in mortality was even faster, reaching 17.8% per year in the same period. Because the VR system in Kazakhstan has adequate quality and coverage, this decline reflects a true reduction of the TB burden in the population. The fact that the decline in mortality is about twice as fast as the decline in notification indicates that the reduction of TB deaths is due not only to a fall in TB transmission in the population (a fall in TB incidence), but also to a decline in case fatality, caused by an increase in the treatment success rate and increased TB case detection.

The observed decline in notification could be attributed mainly to a true decrease in TB incidence in the population, and partly to the fact that some groups of patients, such as smear-negative relapse cases, prisoners and foreigners, are not included in the final total of notified TB cases. The hypothesis of a true decline in TB transmission in the population is supported by a number of factors: the faster decline in the age-specific notification rate among younger age groups; the change in the age structure of TB patients towards older groups; and a more or less consistent trend of decline across all geographical areas, and when disaggregated by type, sex, and site of disease. On the other hand, the increase in bacteriologically confirmed TB cases over time and the large geographical variation in the proportion of laboratory-confirmed pulmonary TB (PTB) cases indicate that the decline in TB notification could in part be due to a change/inconsistency in diagnosis of clinically diagnosed PTB cases.

The key trends of TB disease observed in Kazakhstan are as follows:

- In the period 2012–2016 TB notification decreased across all geographical regions and in prisons.
- The proportion of bacteriologically confirmed PTB cases among new PTB cases increased from 48.5% in 2012 to 84.7% in 2016.
- There is a wide geographical variation in the proportion of smear-positive new PTB cases, ranging from 33% to 58%.
- The absolute number of clinically diagnosed new PTB cases varies sharply from year to year, suggesting inconsistencies in TB diagnosis.
- The proportion of extrapulmonary cases among new TB cases is stable over time but with notable geographical variation, ranging between 7.3% and 20.5% in 2016.
- TB notification decreased in both males and females, but the decrease in females was much more rapid, resulting in an increase in the male-to-female ratio over time.
- In the period 2011–2016 the proportion of retreated cases among all notified cases remained high, ranging between 36.1% and 39.5% without any clear trend over time.
- Age-specific notification rates of new TB cases in the period 2011–2016 decreased across all age groups except among those aged over 65, where there was a slight increase; the slope of decline in TB notification decreased with increase in age.
- The proportion of child TB cases among new cases in the period 2011–2016 decreased from 4.3% to 3.4%.

The main factors related to TB programming that drive the TB epidemic downwards include: an increase in treatment success rate among new and relapse cases, multidrug-resistant TB (MDR-TB) cohorts, and previously treated cases; universal access to DST and MDR-TB treatment; and an impressive increase in TB funding.

The external factors that are expected to drive the TB epidemic downwards, by reducing TB transmission and population vulnerability and by increasing protection and prevention at health system level, include: economic growth (increase in GDP per capita); health system strengthening (decrease in under-5 mortality); and reduction in the size of the prison population.

Factors that are likely to prevent a faster decline in the TB epidemic include: an increase in HIV prevalence in the general population; low antiretroviral treatment (ART) coverage of people living with HIV (PLHIV) in the general population; an increase in diabetes prevalence; late detection of HIV cases; high prevalence of smoking; and high out-of-pocket (OOP) health expenditure.

Main recommendations

- Revise the TB definitions in line with the WHO 2013 recording and reporting (R&R) framework; relapse cases that are smear-negative should be included in the national notification.
- Ensure data integrity and consistency between the national TB register and data submitted to the WHO global TB database.
- Enhance TB database with standard automated reports to calculate notification of all bacteriologically confirmed cases, based on a combination of all available methods of laboratory diagnostics (smear microscopy, culture on solid and liquid media, LPA, GeneXpert MTB/RIF), and drug resistance based on a combination of all methods of drug-sensitivity testing (GeneXpert MTB/RIF, LJ, BACTEC, LPA).
- Add a unique identifier for each district/city across all TB databases to facilitate subnational analysis; where possible, this identifier should be standardized across health programmes and/or adopted from the national statistics department.
- Build the capacity of data managers at national and regional levels to analyse and interpret collected data and use it for informed planning.
- Expand the responsibilities of data managers at national level, with the aim of coordinating all aspects of TB data collection, including patient information, laboratory, drug-management modules, prison and VR data.
- Process all TB cases occurring in Kazakhstan at national level and include in national reporting.

1 Introduction

The Republic of Kazakhstan, situated in central Asia, is the ninth largest country in the world, with a population of about 17 million. Kazakhstan is an upper-middle-income country, with a per capita gross domestic product (GDP) of US\$ 7510 in 2016. The economy is growing well thanks to the country's vast natural resources; this has resulted in a substantial decrease in poverty. Despite this growth, tuberculosis (TB) remains a serious public health challenge in Kazakhstan: it is one of 30 countries globally with a high burden of multidrug-resistant tuberculosis (MDR-TB) and the reported TB case notification rate (CNR) in the country is one of the highest in the WHO European Region.

The National Tuberculosis Programme (NTP) has made a number of important advances in controlling the disease: Kazakhstan was one of the first countries in the Region to establish a countrywide case-based electronic surveillance system; to introduce and roll out rapid diagnostic molecular testing across the country; and to ensure high access to MDR-TB treatment with uninterrupted supply of second-line drugs (SLDs) and high access to patient-centred care integrated with the primary health care system. The government of Kazakhstan has increased public funding of TB care several times over, such that almost 99% of costs in recent years have been covered by the national budget. As of 2016, Kazakhstan reported the highest treatment success rate of the 18 high-priority countries in the Region, reaching 90.6% in most recent cohorts of new and relapse cases and 76.2% in RR/MDR (rifampicin/multidrug-resistant) cases. However, sharp year-to-year variations in the notified number of incident TB cases, RR/MDR cases, and cases of HIV/TB-coinfection submitted to the global TB database by the Kazakhstan surveillance system created some uncertainty about how accurately the submitted figures reflect the true burden of TB disease in the country. The epi-review mission was designed to assess completeness and accuracy of routine TB surveillance and vital registration (VR) and the plausible drivers of the TB epidemic in the country.

2 Objectives

The objectives of the current review were:

- to 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 implementation of a checklist of TB surveillance;
- to assess the level of, and trends in, TB disease burden (incidence, mortality) using available surveillance, survey, programmatic and other data;
- to assess whether recent trends in TB disease burden indicators are plausibly related to changes in TB-specific interventions, taking into account external factors including economic or demographic trends;
- to identify geolocation of TB, MDR-TB and TB/HIV hotspots at subnational level.

3 Methods

Methods of data collection included: (1) desk review of available TB control-related policy papers, manuals, guidelines and forms; (2) interviews and discussions with TB authorities and health care providers at national and district level; (3) review and cross-check of TB records, laboratory registers and electronic surveillance systems at TB dispensaries; (4) review of electronic databases to assess the level of incompleteness of core variables, invalid entries, etc.; and (5) analysis of notification/surveillance data over time and space to identify trends in disease burden and programmatic efforts.

Most of the TB control-related data were obtained from electronic databases. Information from statistical yearbooks and databases of the Agency of the Republic of Kazakhstan on Statistics was used heavily to obtain data on population size, mortality, TB determinants and other health issues. In addition, other resources were utilized, such as AIDSInfo, WHO Global Health Observatory and the World Bank. All data sources are presented in the text and footnotes.

Analysis conducted includes plotting of annual data followed by visual observation; computation of slopes by linear regression to describe/compare the speed of change of various indicators; and ecological analysis of TB CNR and trend of external factors. District-level data were mapped to identify spatial patterns.

The standard WHO-recommended assessment checklist and associated user guide, from *Standards and benchmarks for tuberculosis surveillance and vital registration systems*, were applied.² For analysis and interpretation of the influence of TB predictors and external factors, instructions from the handbook *Understanding and using tuberculosis data* were followed.³ The TB surveillance checklist was implemented during a country visit (20–26 August 2017) by WHO Technical Officer Andrei Dadu and a team of WHO temporary consultants including Anisora Ciobanu, Inna Motrich and Arax Hovhannesian, in collaboration with the NTP. Spatial analysis was performed by Mirjam Bakker, KIT senior epidemiologist, and Elena Arbuzova, NTP data manager. Mapping was done following the MATCH approach.⁴

4 Results

4.1 Assessment of TB surveillance and VR systems in Kazakhstan and their capacity to measure TB burden

4.1.1 Description of the VR system

The current law concerning marriage and family matters requires registration of civil status acts to be carried out in seven instances: birth; paternity; marriage; divorce; adoption; change of surname, name or patronymic; and death. Registration is performed by the Department of Civil Status Acts in 208 districts and the Departments of Justice in Astana and Almaty.

If there is no established Department of Civil Status Acts, then the law allows registration of civil status acts to be carried out by the local government and the consular offices of the Republic of Kazakhstan. Citizens living in rural village districts can therefore contact these administrations regarding the

² WHO Global Task Force on TB Impact Measurement. Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide. WHO/HTM/TB/2014.02. Geneva: World Health Organization; 2014 (<http://www.who.int/tb/publications/standardsandbenchmarks/en>).

³ WHO Global Task Force on TB Impact Measurement. Understanding and using tuberculosis data. WHO/HTM/TB/2014.09. Geneva: World Health Organization; 2014 (http://www.who.int/tb/publications/understanding_and_using_tb_data/en).

⁴ MATCH: Mapping and Analysis for Tailored disease Control and Health system strengthening. The MATCH manual for TB can be downloaded from <https://www.kit.nl/health/service/kit-match-approach-enhancing-tb-care-coverage>.

registration of birth, paternity, marriage and death. Kazakh citizens who are permanently or temporarily residing abroad can use the consular offices of Kazakhstan abroad.⁵

Registration of death is made upon submission of the following documents:⁶

- (1) an application for registration of death;
- (2) a document that establishes the cause of death issued by a medical institution, or entry into legal force of a court decision establishing the cause of death or declaring a person deceased;
- (3) a document identifying the deceased;
- (4) a notarized power of attorney in the case of a representative of the applicant;
- (5) a certificate from the registration authority at the place of death and/or place of residence of the deceased concerning the absence of the registration of the assembly record of death (other than persons who died after 2008 on the territory of the Republic of Kazakhstan);
- (6) an enforceable court decision establishing the cause of death or declaring a person deceased in the case of registration on the basis of a court decision;
- (7) the military identity card of the deceased (if any);
- (8) if necessary, a document confirming kinship.

The statement of death is submitted in writing according to Annex 16, “On approval of rules of organization of state registration of acts of civil status, changes, recovery, cancellation of records of acts of civil status”. The persons indicated in Annex 16 are mentioned in Article 270 of the Code “On marriage (matrimony) and family”.⁷ The applications for registration of death and attached documents are then checked for accuracy according to Article 268 of the Code. After this, the verification officer registers a statement in the journal of recording statements; this is entered electronically into the information system “Records of acts of civil status” (ZAGS). After the state registration of death is made on the system, two copies of the death certificate are then printed. The data specified in the certificate of death are recorded in the expenditure journal, after which the applicant receives the death certificate (Fig. 1).

The information system “Records of acts of civil status” (ZAGS) contains details of all civil status acts of the population of the Republic of Kazakhstan – namely, birth, death, imprisonment, divorce, adoption, paternity and change of name. The data on birth and death of individuals are transferred to the state database information system “Physical persons”. The main tasks of the system “Records of acts of civil status” is to record, process and store the civil status acts of citizens of Kazakhstan; also, to process registration statements, to deal with requests for consistency checks on the information content in the database fields, and to form consolidated reporting in the context of different time periods. The system is integrated with 16 other information systems in different departments and state structures of the Republic of Kazakhstan. Each department and state structure approves the rules of data transmission on

⁵ Order of the Minister of Justice of the Republic of Kazakhstan of 25 February 2015, No. 112, “On approval of rules of organization of state registration of acts of civil status, changes, recovery, cancellation of records of acts of civil status” (<http://adilet.zan.kz/rus/docs/V1500010764>).

⁶ Order of the Minister of Justice of the Republic of Kazakhstan of 17 April 2015, No. 219, “About approval of standards of state services on registration of acts of civil status and apostilization” (<http://taraz-gov.kz/?p=4970>).

⁷ Code of the Republic of Kazakhstan of 26 December 2011, No. 518-IV, “On marriage (matrimony) and family” (<http://adilet.zan.kz/rus/docs/K1100000518>).

the basis of which one carried out the integration between systems.⁸ In the near future, it is planned that issue of death certificates will be provided through the “Electronic government portal” (<http://egov.kz/cms>).

The document certifying death or perinatal death is called the “medical death certificate”. This certificate is issued to relatives of the deceased or to persons residing with the deceased. In the absence of such a person, it is the staff of internal affairs who identified the deceased.

Issuing of a medical death certificate was established by the Resolution of the Government of the Republic of Kazakhstan of 18 September 2013, No. 983, “On approval of the registration of public services”; and by the Order of the Minister of Health of the Republic of Kazakhstan on 31 July 2012, No. 514, “About modifications and additions in the Order of the Acting Minister of Health of the Republic of Kazakhstan dated 23 November 2010, No. 907, ‘On the approval of forms of primary medical documentation of health care organizations’”.⁹

The recording form is a primary medical document, No. 106/u-12, “Medical death certificate”, in accordance with Appendix 25-2K to Order No. 907, certifying the fact of death. The medical certificate of death is issued by a doctor (medical worker), a medical organization, or a person engaged in private medical practice, on the basis of an examination of the body and existing medical records concerning prior monitoring of the patient or autopsy. The head of the medical organization is responsible for validation of the content in the medical death certificate and its prompt delivery to relatives of the deceased, as well as registration with the Department of Civil Status Acts with respect to burial of the deceased.

After its issue, the medical death certificate is registered in the information system “Register of the Fastened Population” (RFP) (Ministry of Health of the Republic of Kazakhstan). Thus, this information on patients’ death is imported into other Ministry of Health (MoH) registers, such as the National Register of TB Patients (NRTB) and the Electronic Register of Dispensary Patients (RDP). Some cases where people have died from TB are missing from the NRTB. The reason for this is lack of transmission of information about such patients from the RFP. They should be recorded using the relevant ICD-10 code.

Mortality data from the VR system should be referred on to the statistics committee of the Ministry of National Economy of the Republic of Kazakhstan. This is for the purpose of data analysis and formulation of management ideas/decisions. Unfortunately, the participants of the mission “Epidemiological Review of Kazakhstan National Tuberculosis Control Programme” did not have an opportunity to visit and comprehensively study the structures and processes of the VR system.

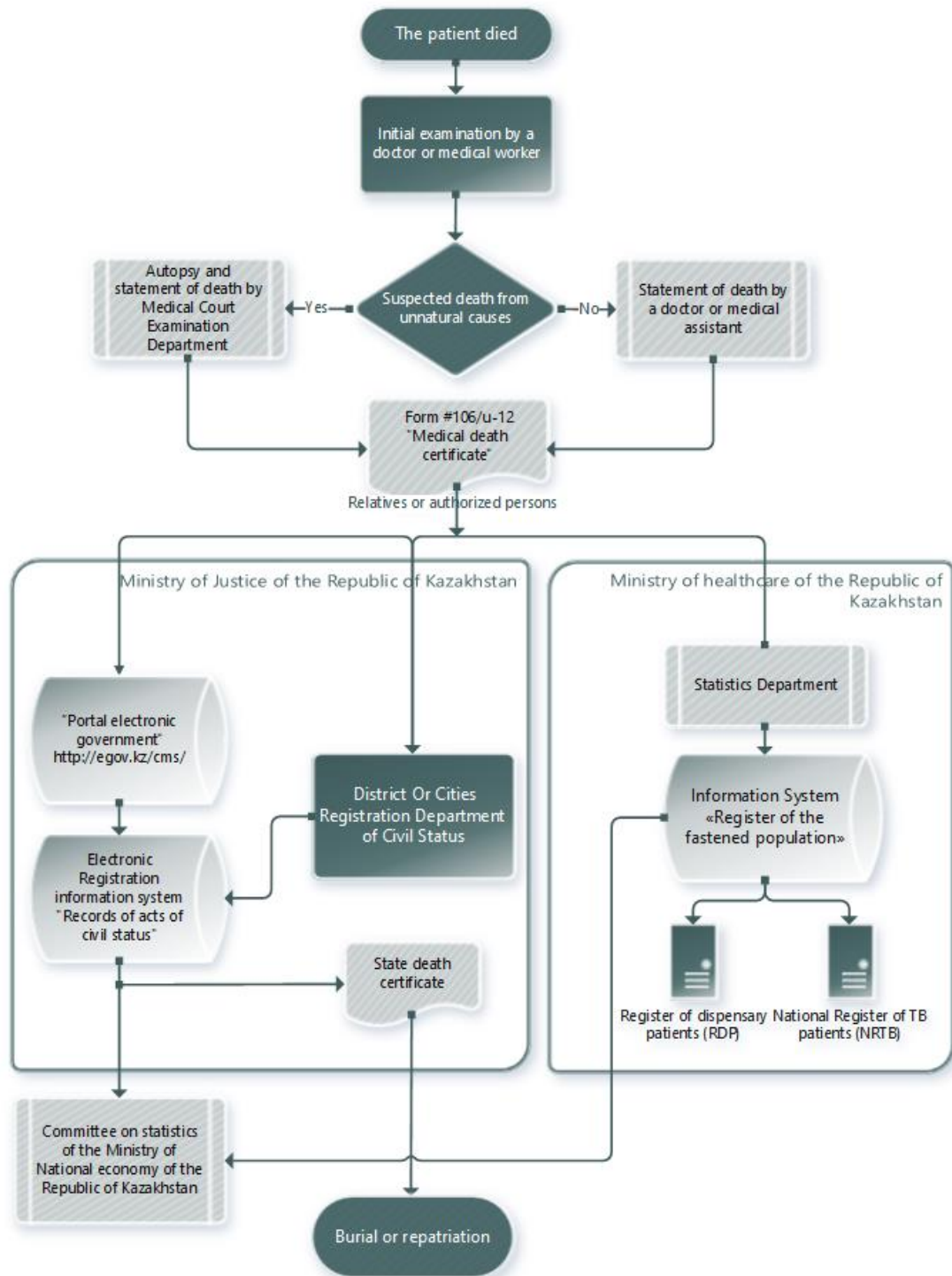
Recommended action

The VR system should be able to provide data on the death of these patients to the NRTB using the relevant ICD-10 code.

⁸ <http://www.nitec.kz/index.php/post/informatsionnaya-sistema-zapisi-aktov-grajdanskogo-sostoyaniya-is-zags>.

⁹ Order of the Acting Minister of Health of the Republic of Kazakhstan of 31 July 2012, No. 514, “About modifications and additions in the Order of the Acting Minister of Health of the Republic of Kazakhstan dated 23 November 2010, No. 907, ‘On the approval of forms of primary medical documentation of health care organizations’” (<http://adilet.zan.kz/rus/docs/V1200007898#z251>).

Fig. 1 Death registration information flow, Kazakhstan



4.1.2 Description of the surveillance system

When TB has been diagnosed by a TB doctor at peripheral level, the diagnosis is subject to confirmation by the medical commission of the TB hospital at district level, according to orders of the MoH.¹⁰ Management of TB patients is performed at a basic level by public health facilities.

Oversight of the TB surveillance system in Kazakhstan is carried out by two institutions: (1) the National Scientific Centre of Phthisiopulmonology of the Republic of Kazakhstan (part of the MoH); (2) the Sanitary–Epidemiological Service (SES).

Three parallel TB data reporting and recording systems are in use:

- a system inherited from the former Soviet Union, coordinated by the National Scientific Centre of Phthisiopulmonology of the Republic of Kazakhstan;
- a system compliant with WHO recommendations, coordinated by the National Scientific Centre of Phthisiopulmonology of the Republic of Kazakhstan;
- a system coordinated by the SES.

As of today, staff of the state-administered TB services use former Soviet forms (No. 89, No. 58 and No. 8) and forms recommended by WHO. All TB data are recorded on paper at district and regional levels. Data are recorded for all individual TB cases at the service delivery level and service delivery points, mostly using standardized TB data collection forms. Data are recorded electronically on the NRTB, a national internet-based system, which holds personal details of citizens from the RFP.

All TB cases from all parts of the country are included in the national TB surveillance data. However, TB cases among foreign nationals, in prisons and in the city of Baikonur are excluded from the TB CNR in Kazakhstan. Patient-level data that identify multiple episodes of TB in the same person are available at the district level in paper form and are also available on the national internet-based TB system. TB doctors at district level do not have full access to the national internet-based system, which includes important information such as patients with multiple episodes of TB; this makes it difficult for district TB doctors to determine the type of TB case.

The frequency of data transmission from the first subnational administrative level to the national level is real-time for the national internet-based system. The frequency of data transmission from the first subnational administrative level to the regional level is quarterly for the national paper recording system and the reporting system recommended by WHO. The frequency of data transmission from the first subnational administrative level to the national level is annually for the paper and electronic reporting TB system (reporting form No. 8), which includes only new TB cases. Staff at the national level use only electronic data from the national internet-based system in their work.

TB data are reviewed during supervisory monitoring visits to service units and at subnational levels, and data are reviewed at meetings with TB staff during TB reporting. Monitoring visits are carried out in accordance with the approved plan of the MoH, and once a year employees at national level carry out monitoring visits to each region. Staff at regional level carry out monitoring visits to each district area twice a year. Checklists for monitoring visits have been approved by the MoH, and these visits are financed by the state budget. There is a national internet-based system which includes a script for

¹⁰ Order of the Minister of Health and Social Development of the Republic of Kazakhstan of 22 August 2014, No. 19, “On approval of the instruction on organization and implementation of preventive measures for tuberculosis” (https://online.zakon.kz/Document/?doc_id=31618648#pos=0;290).

checking the required fields that need to be completed in the database. There are no quality controls in place for the electronic surveillance system (automated checks at data entry and batch checking, plus standard operating procedures (SOPs)).

Feedback on TB data quality is provided, systematically and quarterly, to all lower reporting levels. National TB case data for a given calendar year are available before March the following calendar year for national analysis and reporting.

There are national guidelines (instructions) for recording and reporting (R&R) of TB data; these are posted on the internet. Unfortunately, there is only one reporting form (No. 8) which is approved by the MoH.¹¹ There are “Guidelines on monitoring and evaluation of TB control activities in the Republic of Kazakhstan”, which were approved by the MoH in 2008.

In 2013, the NTP had a training plan which included all staff involved in data collection and the reporting process. In 2017, at the time of the mission, training had only been received by two or three individuals at district level, and this was on an ad hoc basis.

The National Scientific Centre of Phthisiopulmonology includes the Department of Strategic Development, Epidemiology, Monitoring and Evaluation. It is staffed by a total of 21 employees, though not all of these work on TB surveillance at the national level. The departments are staffed by the full-time head of department; a full-time national coordinator of staffing; two full-time doctor statisticians; two full-time medical data managers; two full-time doctor hospital epidemiologists; a coordinator of treatment; a full-time coordinator of data quality officers; a full-time coordinator of epidemiological services; a full-time coordinator of bacteriological services; two full-time coordinators for provision of medicines; a full-time TB doctor; a full-time medical assistant; two full-time medical statisticians; a full-time infection control nurse; a full-time nurse; and a full-time pharmacist responsible for distribution of medicines. The monitoring and evaluation (M&E) staff of the Department of Strategic Development, Epidemiology, Monitoring and Evaluation provide overall policy guidance and coordination with respect to other components of the NTP; they maintain official communication with international partners and act as the official country contact point within the European TB Surveillance Network established jointly by the WHO Regional Office for Europe and the European Centre for Disease Prevention and Control. However, the M&E department structure does not include the data manager.

The national surveillance report is routinely produced and widely disseminated on an annual basis, but it is not posted on the website of the National Scientific Centre of Phthisiopulmonology, the MoH or other government agencies.

The TB national surveillance report usually includes many tables, which show (e.g.) the CNR of new cases, prevalence rate, mortality rate (by age group, sex, site of disease, region, etc.) and vaccination coverage. There are no tables containing indicators from the *Roadmap to implement the tuberculosis action plan for the WHO European Region 2016–2020* or indicators for laboratory strengthening under the End TB Strategy. Maps showing spatial variations are not included either.

The goals of the TB surveillance system are set out in the methodical recommendations for M&E of TB control activities in the Republic of Kazakhstan. For the most part, there are policies and procedures in place to protect the confidentiality of all surveillance data. Access to the NRTB electronic system is differentiated by role and level within the TB service. Individual usernames and passwords are provided

¹¹ Order of the Minister of Health of the Republic of Kazakhstan of 22 February 2017, No. 31, “On amendments to Order of the Minister of Health of the Republic of Kazakhstan dated 6 March 2013, No. 128, ‘On approval of the forms intended for collection of administrative data of the healthcare entities’” (https://online.zakon.kz/Document/?doc_id=32854304).

to enter information in the “Laboratory” and “Social support” components. All bacteriological laboratories input results of TB examinations. Each bacteriological laboratory is attached to a specific TB organization and does not have access to edit data from other laboratories. The system allows the regional level to view its own districts only, while the national level is able to view all districts and regions of Kazakhstan.

There is no long-term financial plan in place to support TB surveillance activities. There is a partial budget in the framework of the Global Fund budget. The TB surveillance system was last evaluated in 2012, but the assessment was not conducted in accordance with WHO’s 2014 recommendations.¹² In 2015, there was a mission which had the following objectives:

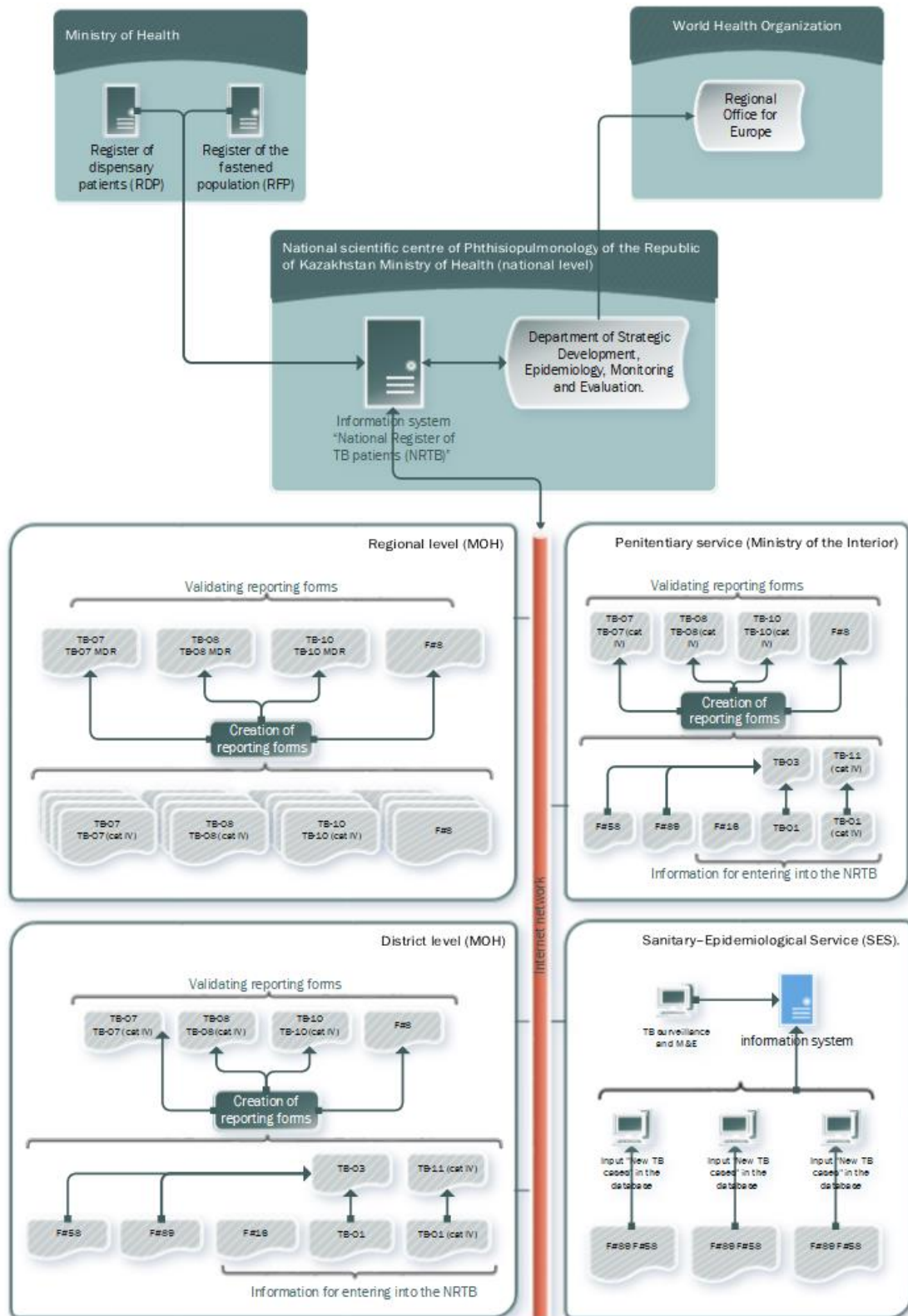
- to describe and assess current national TB surveillance and VR systems, with particular attention to their capacity to measure the level of, and trends in, TB disease burden (incidence and mortality) in Kazakhstan;
- to assess the level of, and trends in, TB disease burden (incidence, prevalence, mortality) using available surveillance, survey, programmatic and other data in Kazakhstan;
- to define the investments needed to strengthen surveillance and directly measure trends in TB disease burden in Kazakhstan in future.

The TB R&R system is divided into three levels (national, regional and district). The Department of Strategic Development, Epidemiology, Monitoring and Evaluation coordinates work at the national level. The regional level comprises 14 regions and three cities – Almaty, Astana and Baikonur (and the penitentiary sector). The district level comprises 209 districts/cities, but not all registered patients in 2016.

The primary sources of TB surveillance data are form No. 89 for new cases; form No. 58 for all cases with positive sputum smear; and TB patient record cards (TB 16, TB 01 and TB 01 cat. IV (Second-line TB treatment card)) for all cases which follow the patient through all levels. TB doctors must send forms No. 58 and No. 89 to the SES. TB 01 and TB 01 cat. IV are used at district level. Individual patient data are captured in the district TB registers (TB 03 and TB 11 (Second-line TB treatment register)). Staff at M&E regional departments duplicate district TB registers (TB 03 and TB 11 (Second-line TB treatment register)) at regional level. Once a quarter, TB specialists use the district registers to prepare reports on notification of TB and RR/MDR-TB (TB 07, TB 07 MDR); on interim results for MDR-TB cases (TB 10 MDR); and on treatment outcome for TB and MDR-TB (TB 08 and TB 08 MDR). Flow of TB data collection and reporting forms is presented in **Fig. 2**.

¹² WHO Global Task Force on TB Impact Measurement. Standards and benchmarks for tuberculosis surveillance and vital registration systems: checklist and user guide. WHO/HTM/TB/2014.02. Geneva: World Health Organization; 2014 (<http://www.who.int/tb/publications/standardsandbenchmarks/en>).

Fig. 2 Flow of TB data collection and reporting



In 2014 the R&R forms for TB were revised, but they were still not fully compliant with the WHO recommendations 2013.¹³

In 2001 a project under guidance of the Centers for Disease Control and Prevention, with funding assistance from USAID in Kazakhstan, created the NRTB. Since 2003 this register has been integrated with new forms of data collection. It began operating on the Visual Basic platform developed by MedInform LLP. In 2007 all data for accounting and reporting in the NRTB were brought up to international standards. In 2013, with financial support from the Global Fund and technical support from MedInform LLP, the electronic register was transferred to online mode. All patient data contained in the old FoxPro-based database were fully transferred into real-time operation. In addition, more components were developed for the “Laboratory” and “Social support” modules, which were directly related to the national register. The “Medicine warehouse” module was introduced, but it was not directly associated with registered TB cases.

The NRTB database integrated two Republican databases:

- the Register of Dispensary Patients (RDP) database, which contains information about all persons in the Republic of Kazakhstan, consisting of a dispensary account for any disease;
- the Register of the Fastened Population (RFP) database, which contains data on all persons who are attached to the territorial medical institutions at primary level.

Information about new TB cases is accessed via a patient search in three databases. First, the procedure is to search for patients in the NRTB database. If they are not found there, a search is made in the RDP and then in the RFP. A patient search can be performed by surname, first name and individual identification number (IIN).

If the patient is found, information is entered from standardized recording forms. The input forms for the register are:

- TB 16 – Card of follow-up of contingent
- TB 01 – Health card of TB patient
- TB 01 cat. IV – Medical records of category IV TB patients.

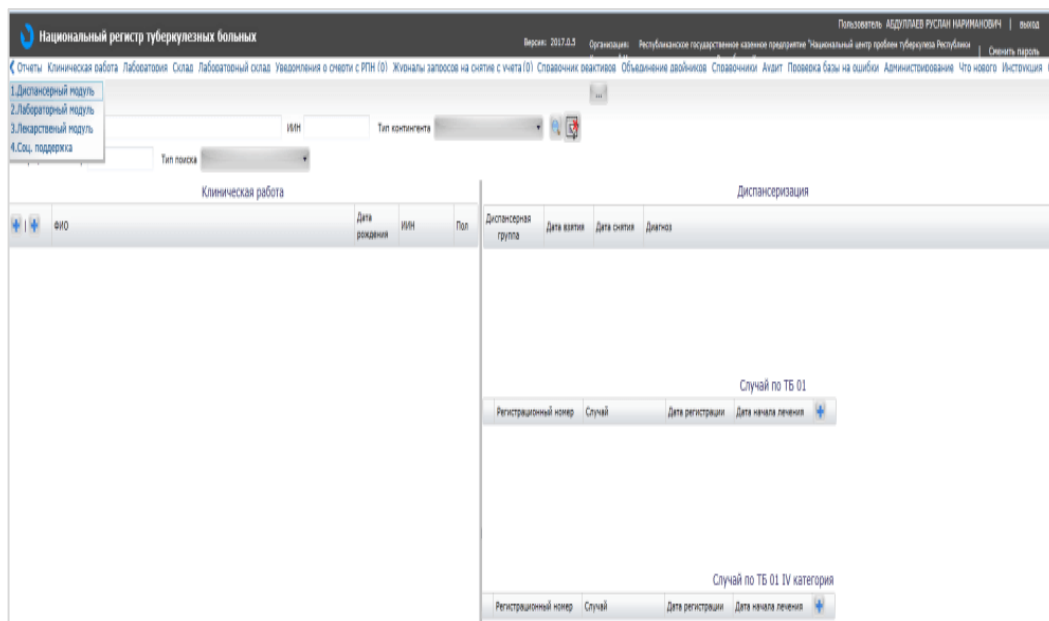
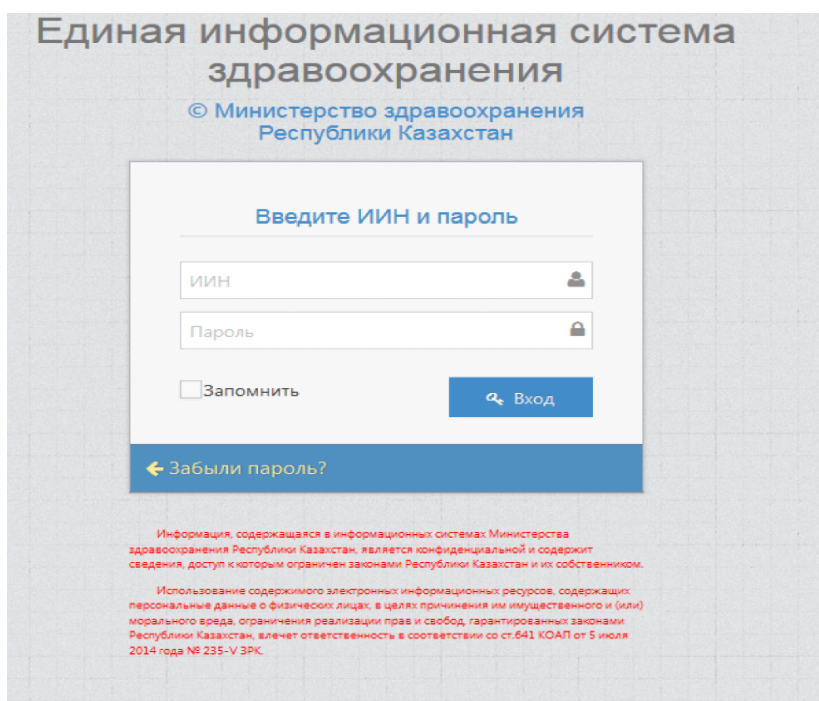
The primary document is form TB 16, which has information about TB contingent population for the NRTB. If the patient is prescribed treatment, the information in the register is entered from TB 01 or TB 01 cat. IV. Screenshots from the NRTB are presented in Fig. 3.

The NRTB is dedicated to the management of TB and TB cat. IV cases. It allows the user to search, notify, follow, close, transfer and validate cases and to perform many other functions. This electronic TB register has a dispensary module, laboratory module, medicinal module and social support module. Also, there is a reports section which allows a user to generate and print TB/MDR reports, reports of medicines in the warehouse and laboratory reports and to manage data export. The “Clinical” module of the NRTB includes a detailed personal profile of each TB patient in the country, including their sociodemographic status, results of TB examinations, and information about treatment regimen and its outcome. The “Clinical work” section allows registration and management of TB and TB category IV cases. The “Laboratory” section allows a user to enter all results of TB examinations in the electronic

¹³ Definition and reporting framework for tuberculosis, 2013 revision (updated December 2014). Geneva: World Health Organization; 2013. WHO/HTM/TB/2013.2 (<http://www.who.int/tb/publications/definitions/en>, accessed 27 June 2018).

register, including patients who are not in the NRTB. The NRTB section in the laboratory component allows the user to input all results of examinations of biological specimens: microscopy, Expert MTB/RIF, culture (liquid or solid), drug susceptibility testing (DST) (liquid or solid), and line-probe assay (LPA). Unfortunately, there is no function in the laboratory module that allows selecting and filtering data for patients who have positive test results for TB but are not registered as a TB or MDR-TB case in the NRTB. The laboratory module includes the stock of consumables (laboratory warehouse), but it does not have a function to notify the user about the end of their shelf life; and there is no function to calculate supplies in the laboratory warehouse. There is a directory of chemicals which includes a code for biological material. It is very flexible and allows staff to add items.

Fig. 3 Screenshots from the NRTB



There are many reports in the laboratory module, but during validation of data held in paper and electronic registers errors are found. Also, there is a report on the resistance profile of MTB (TB 20, TB 21) which has errors and does not include some SLDs (Mfx, Lzd). The “Medicine warehouse” section has functions to record, search, follow and authorize medicines received, transfers, dispensing, movements and stock position, consumption of drugs, remnants of drugs, funding source of drugs, batch numbers, certificate numbers, etc. This section does not allow calculation of TB drugs, given the resistance profile, and makes no connection between a particular TB case and use of medicines. During validation, data were found to contain errors in reports between paper and electronic registers. In the “Notification of death” section, users get information about TB patients who died and were registered in the external electronic database. If the TB case is not registered in the NRTB, the death of a patient is not received from an external information source. The section “List requests removal from the register” allows deregistration of TB cases to be submitted, approved and monitored. When multiple sources of information (databases) need to be combined, users can control and merge duplicate records using the “Merge duplicates” function. The “Reference” section includes functionality for working with sources of standardized information (list of medications, list of regions, cities, etc.). The “Checking database for errors” section is part of a system of data quality control, enabling users to detect missing entries in the passport part of TB cases. As the TB register develops, expanding this section is an important element of data quality control. The administration section allows the user to manage the system in order to add, remove or change users. The system has a “What’s new” section to inform users about new functions of the TB register and a “Users’ instructions” section.

MedInfo developed a user interface including menus/forms to extract data from the database. Form No. 8, for example, provides the number of new and relapse cases, combining data from TB 03 and TB 11. On the one hand, this enables relatively easy extraction of sets of patients; on the other hand, it limits the type and sets of data that can be extracted from the database to what the menus/forms allow. The tables extracted from MedInfo with district aggregated data do not contain a unique identifier for each unit (district/city); only the name of each district/city is provided, which is not unique across Kazakhstan (for example, there are three districts called Esil).

Recommended actions

1. Cancel parallel use of duplicative ex-Soviet recording forms (No. 89, No. 58).
2. Consolidate the ex-Soviet R&R form for TB (No. 8) and the set of R&R forms recommended by WHO, which allow all TB surveillance/data management and ensure NSP 2016–2020 monitoring.¹⁴
3. Upgrade all modules and sections in the NRTB to fix errors (bugs) according to international recommendations; and update all TB/MDR-TB R&R forms according to recommendations of WHO 2013–2014.
4. Change completion deadline for all national TB cases so they are available for analysis and reporting before April (now in February) the following calendar year.
5. Update the laboratory module by adding functions to select and filter data for patients and to search for patients according to a range of source data.
6. Review checklist for monitoring visits.

¹⁴ Комплексный План по борьбе с туберкулезом в Республике Казахстан на 2016–2020 годы.

7. Develop SOPs for the NRTB to enhance data quality control and ensure their implementation at all levels.
8. Provide training on the revised R&R forms for TB and MDR-TB.
9. Add tables to the national TB surveillance report to reflect the indicators of the monitoring framework based on the *Roadmap to implement the tuberculosis action plan for the WHO European Region 2016–2020*.
10. Update and approve the national M&E guide on recording and reporting of data; this should include targets such as a TB surveillance system and a long-term M&E plan with indicators and budget.
11. Add a unique identifier for each district/city across all TB databases to facilitate subnational analysis; where possible, this identifier should be standardized across health programmes and/or adopted from the national statistics department.
12. Encourage greater flexibility of data managers in requesting and formatting data (e.g. custom tables) in the MedInfo database; requests for changes or additional indicators should be facilitated by MedInfo without restriction.
13. Build the capacity of data managers at national and regional levels to analyse and interpret collected data and use it for informed planning.
14. Expand the responsibilities of data managers at national level, with the aim of coordinating all aspects of TB data collection, including patient information, laboratory, drug-management modules, prison and VR data.
15. Post a national TB surveillance report on relevant websites to make it available to the public.

4.1.3 Capacity of the national TB notification and VR system to provide a direct measure of TB disease burden

Standard B1.1 Case definitions are consistent with WHO guidelines

All benchmarks should be satisfied to meet this standard:

- *Laboratory-confirmed cases are distinguished from clinically diagnosed cases.*¹⁵
- *New cases are distinguished from previously treated cases.*
- *Pulmonary cases are distinguished from extrapulmonary cases.*

To assess the benchmarks mentioned above, the following documents were reviewed: “Instruction on organization and implementation of preventive measures for tuberculosis”; reporting form No. 8 on TB; recording forms on TB/MDR-TB (TB 01, TB 03, TB 01 cat. IV, TB 11 cat. IV, and others); and reporting forms on TB/MDR-TB (TB 07, TB 07 cat. IV, TB 08, TB 08 cat. IV, TB 10 cat. IV).

Definitions of laboratory-confirmed cases are distinguished from clinically diagnosed cases only by sputum smear. The laboratory-confirmed cases do not include positive results of GeneXpert MTB/RIF, culture results and LPA results.

In the R&R forms, new cases are distinguished from previously treated cases. However, the definition of relapse includes only cases with a positive microscopy result.

¹⁵ i.e. by smear, culture or WHO-endorsed molecular test, e.g. GeneXpert MTB/RIF.

The definition of pulmonary TB cases includes only cases of TB involving the lung parenchyma and do not include cases involving the tracheobronchial tree. This is not in accordance with the WHO definition, which stipulates TB cases involving the lung parenchyma or the tracheobronchial tree.

Conclusion

The key policy document (“Instruction on organization and implementation of preventive measures for tuberculosis”, 2014) does provide TB case definitions (laboratory-confirmed cases are distinguished from clinically diagnosed cases only by sputum smear; new cases are distinguished from previously treated cases; pulmonary cases are distinguished from extrapulmonary cases), but they are not in accordance with WHO recommendations 2013–2014. R&R forms (e.g. No. 8, TB 07, TB 08) do not include bacteriologically confirmed cases identified by culture, GeneXpert MTB/RIF or LPA.

Therefore, the system in Kazakhstan only **partially satisfies** all three benchmarks.

Recommended actions

- The TB and MDR-TB R&R forms should be revised in accordance with WHO recommendations 2013–2014.
- The R&R framework must include results of culture and molecular genetic tests (GeneXpert MTB/RIF and LPA) as methods of laboratory confirmation.
- The definitions of the classification based on history of previous TB treatment (patient registration group) and TB pulmonary cases and extrapulmonary cases should be revised.

Standard B1.2 TB surveillance system is designed to capture a minimum set of variables for all reported TB cases

Benchmarks:

Data are routinely collected for at least each of the following variables for all TB cases:

- *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.*

In Kazakhstan, the surveillance system is both paper-based and electronic. Patients’ data are collected and recorded in TB registers. Once a quarter, TB specialists use the district TB registers to prepare reports on TB and MDR-TB notification, TB and MDR-TB treatment outcome, and smear conversion at the intensive phase of treatment.

Aggregated paper reports are compiled at district level and sent to the regional-level TB services. At regional level, M&E specialists and district doctors cross-check data between paper and electronic registers. Once a year, during monitoring visits, there is a specialist national-level cross-check of data between paper and electronic registers at regional level.

The annual report (form No. 8) and quarterly reports (form TB 07) were reviewed in order to assess whether the minimal set of variables is being utilized to capture data for all TB cases in Kazakhstan. Data

are collected on sex, year of registration, and disease site (pulmonary or extrapulmonary), and history of previous treatment, along with other variables prioritized by the NTP. Data are collected in paper reports on laboratory-confirmed cases, but only by sputum smear; positive results of culture, GeneXpert MTB/RIF and LPA are not included.

The NRTB electronic register has all the essential variables, including age, sex and year of registration; bacteriological results of TB tests (microscopy, culture, GeneXpert MTB/RIF and LPA results); history of previous treatment; site of disease for all notified TB patients; and identification number (computer number) for all cases. Unfortunately, the NRTB cannot consolidate all positive results of TB tests in bacteriologically confirmed cases.

Based on the assessment, the minimum set of variables is captured for all cases, so this standard is **met**.

Conclusion

The NRBT is a more advanced system than the paper R&R system, but it should be improved in accordance with WHO recommendations 2013–2014.

Standard B1.3 All scheduled periodic data submissions have been received and processed at the national level

Benchmarks:

- *For paper-based systems: 100% of expected reports from each TB basic medical unit (BMU) have been received and data aggregated at the national level.*
- *For national patient-based or case-based electronic systems that import data files from subnational (e.g. provincial or regional) electronic systems: 100% of expected data files have been imported.*

In Kazakhstan, there are paper-based and electronic systems in use. National-level staff use only the electronic system in their work, and for this reason the first benchmark will not be assessed.

The second benchmark applies to electronic systems that import data from subnational feeder systems and therefore does not apply to the integrated real-time systems in Kazakhstan, i.e. systems where BMUs and other providers (such as the prison service), both inside and outside the NTP, enter their individual TB case records directly onto a national system. Assessing the effectiveness of these integrated systems is best done through inventory studies.

During the epidemiological review of all levels, it was revealed that not all cases of TB were included in the national TB surveillance system. There were TB cases detected in the penitentiary system, migrants with TB, foreign nationals with TB and residents of Baikonur city with TB that were not included in the national TB surveillance system in 2016.

In consideration of the amount of TB cases that were not included (approximately 10%), this standard was **partially met** for 2016.

Conclusion

In 2016, the national TB surveillance system did not include all TB cases that occurred in Kazakhstan in its notification calculation.

Recommended action

The national TB surveillance system should be revised to include all TB cases.

Standard B1.5 Data in the national database are accurate, complete, internally consistent, and free of duplicates (for electronic case-based or patient-based systems only)

All benchmarks should be met to reach this standard:

- *Data validation checks are in place at the national level to identify and correct invalid, inconsistent and/or missing data in the minimum set (Standard 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.*

Since 2013 the NTP has used a real-time web-based electronic recording system, which currently also contains historical case-based TB data collected in Kazakhstan after 2001. Technical management of the system is provided by MedInform LLP. The database is linked to the RFP and the RDP, and IINs serve as patient identifiers for the national TB electronic register. The IIN is a mandatory field, and once an IIN has been entered, the fields related to demographic information are populated automatically. This feature minimizes errors, inconsistencies and missing information for most core variables, and prevents double entries. Because the entire population of Kazakhstan, including children, have IINs, the completeness of demographic data in the TB register is close to 100% and duplicate entries are almost excluded. Exceptions are members of the population without a definite place of registration (homeless people) and foreigners, to whom special Identification numbers are assigned, but the system allows multiple episodes of TB to be followed up in such people as well.

The electronic database is designed in such a way that data validation checks are undertaken to prevent errors during data entry. For example, for most variables (case type, previous history, laboratory results) only predefined options that appear on a drop-down menu can be entered. Fields are limited so that only numbers can be entered in number fields, and only dates in date fields.

Duplicates are detected during data entry. Name, surname and IIN are used for this purpose. As the user types a name, records with a similar name already in the system are displayed, allowing the user to avoid duplication. In addition, the system has a “Merge duplicates” function that allows duplicate entries to be detected and merged. The system also has standard functions such as “Checking database for errors”, allowing data quality-related problems (bugs) to be fixed and missing entries to be detected.

In view of the above, it can be concluded that, for 2016, Kazakhstan’s electronic surveillance system satisfied all three benchmarks and that standard B 1.5 was therefore **met**.

Standard B1.6 TB surveillance data are externally consistent

Benchmark:

- *Percentage of children diagnosed with TB is between 5% and 15% in low- and middle-income countries, and <10% in high-income countries.*

The World Bank classifies Kazakhstan as a country with an upper-middle-income economy.¹⁶ The expected percentage of children diagnosed with TB among all notified new TB cases in Kazakhstan should therefore be between 5% and 15%. Of 9381 new TB cases notified in 2016, 323 were children aged 14 years and below, representing 3.4% of the total. This is below the acceptable range of values for a middle-income country. Thus, this benchmark is not satisfied and the standard is **not met**.

Recommendations

- The reason for the low proportion of child TB cases should be investigated further and possible explanations put forward, in collaboration with paediatric experts.
- The NTP should focus attention on childhood TB reporting, organizing bespoke training on diagnosis of childhood TB for paediatricians throughout the country and promoting child TB diagnostic algorithms for children with severe diseases.

B1.7 TB surveillance data are internally consistent over time

If VR data are available, then the following benchmark should be satisfied for this standard to be met:

- *Year-to-year change in the national number of reported TB cases is consistent with the year-to-year change in national TB mortality (HIV-negative, from national vital registration), i.e. trajectories with the same direction.*

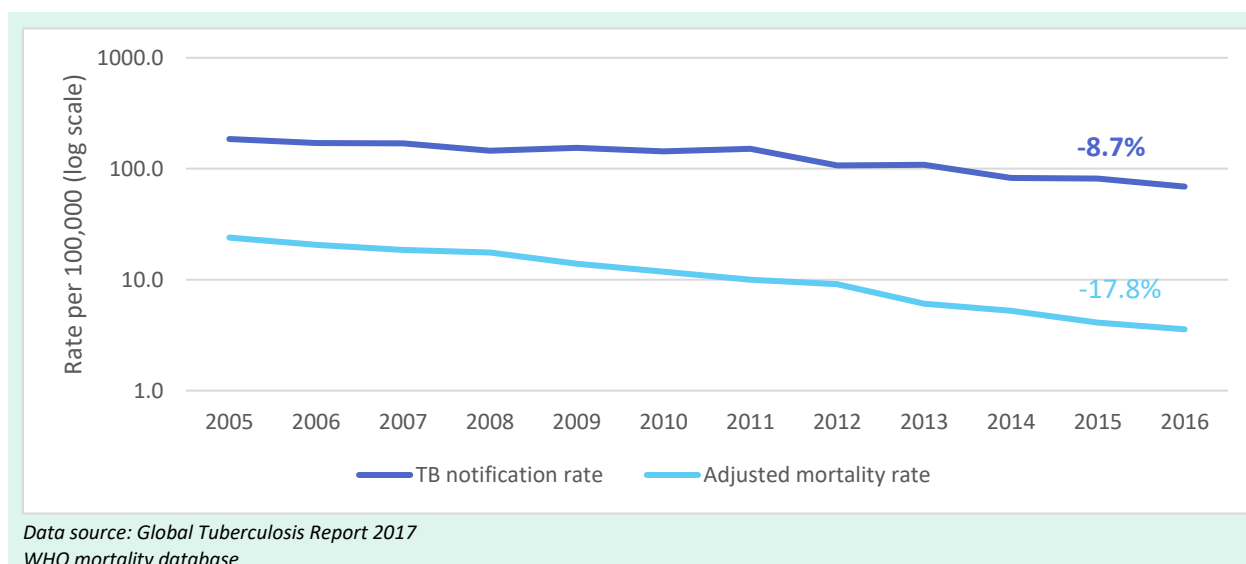
In the case of quality surveillance and VR systems, trends in TB case counts are expected to follow the same trajectory as trends in measured TB mortality (Table 2). The table provides the CNR of TB cases (new and relapse), as well as adjusted TB mortality rates based on data reported by the VR system during the 12-year period 2005–2016. To calculate the average rate of change, a linear regression model was fitted to log-transformed CNRs and to log-transformed TB mortality rates. Then a slope was extracted from each model. The average year-to-year decrease in CNR over the 12-year period is 8.7%, while the average year-to-year change in mortality rate is 17.8%, suggesting that notification and mortality follow a similar trajectory, but that mortality is decreasing faster than notification. This is the expected outcome given recent improvements in TB control, such as increased access to second-line treatment and an increase in treatment success rate (Fig. 4). Thus, this benchmark is considered to be **satisfied**.

¹⁶ World Bank country and lending groups (<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>, accessed 21 August 2017).

Table 2 TB case notifications and adjusted mortality rate per 100 000, Kazakhstan, 2005–2016

Year	Number of new and relapse cases ¹⁷	Number of TB deaths ¹⁸	Proportion of deaths with “garbage” codes ¹⁹	CNR per 100 000	Adjusted TB mortality rate per 100 000
2005	28 629	3571	3.6%	185.3	23.9
2006	26 619	3107	3.8%	170.6	20.7
2007	26 710	2800	4.4%	169.5	18.6
2008	23 140	2644	5.5%	145.4	17.5
2009	24 905	2055	9.0%	154.7	13.9
2010	23 399	1730	11.3%	143.5	11.8
2011	25 074	1389	19.3%	151.5	10.0
2012	17 997	1251	22.2%	107.0	9.1
2013	18 599	976	6.6%	108.8	6.1
2014	14 368	854	7.0%	82.7	5.3
2015	14 406	687	5.0%	81.7	4.1
2016	12 322	607	5.0%	69.0	3.6

Fig. 4 Log-transformed trends of TB CNR (new and relapse) and adjusted TB mortality rate, Kazakhstan, 2005–2016



¹⁷ Global TB database.

¹⁸ WHO mortality database (<http://apps.who.int/healthinfo/statistics/mortality/whodpms>, accessed 21 August 2017). Source of 2016 TB death data is Global TB database; percentage of “garbage” for 2016 is imputed.

¹⁹ Ibid.

Standard 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 past 10 years).*

Kazakhstan's health system is currently regulated by the Code on People's Health and the Health Care System (President of Kazakhstan, 2009). The Code is a comprehensive legal document regulating a broad range of issues related to the functioning of the health system. The Code supplemented MoH Order No. 19, signed 22 August 2014, which stipulates the requirements of TB reporting.

There was no formal inventory study conducted in Kazakhstan; however, there are routine strong data quality control mechanisms that are in place to ensure external data validation on a regular basis across all TB facilities using standard operating procedures. External routine data validation includes cross-check of the laboratory register against the TB register, as well as the TB register against the electronic register. In addition, on a monthly basis death certificates with a diagnosis of TB are checked against the TB electronic register, and once a post-mortem TB diagnosis is detected, it is included in the electronic register and actions are undertaken to investigate contacts. All this ensures that all diagnosed TB cases in the civilian population are accounted in the surveillance system.

During the country visit, epi-review team members visited randomly selected facilities in two selected oblasts and Almaty city to verify and compare the number of TB cases from the BMU TB register with the number of cases reported in the BMU quarterly report (TB 07). In addition, the number of positive cases in the laboratory register identified by sputum smear were compared with the number of cases reported in the BMU quarterly report (TB 07). The figure of 99.3% of TB cases recorded in the BMU TB registers matched the number in the quarterly reports, and the figure of 98% of positive cases identified by sputum smear in the laboratory register matched the number of cases reported in the BMU quarterly reports (TB 07). While the accuracy of data collection was very high, however, this assessment cannot replace a formal inventory study.

It is also known that identified cases of TB at the penitentiary sector, despite their availability, are not included in the overall TB surveillance system. In addition, foreigners, migrants with TB, and the entire population of Baikonur city (which is rented and administered by the Russian Federation) are not included in the surveillance system. Thus, of the two benchmarks only one is met; the standard is therefore considered only **partially satisfied**.

Recommendation

All TB cases identified in Kazakhstan should be included in the national surveillance system, including TB cases from the penitentiary system and foreigners. The NTP should have responsibility for TB data collection, analysis, interpretation and feedback for all cases occurring the country.

Standard B1.9 Population has good access to health care

Both benchmarks should be satisfied to meet this standard:

- *Under-5 mortality rate (probability of dying by age 5 per 1000 live births) is <10.*
- *<25% of total health expenditure is out-of-pocket.*

For notification data to provide a direct measurement of TB incidence – assuming that reporting of diagnosed TB cases is accurate (standard B1.8) – the number of *undiagnosed* cases must be a small or negligible fraction of the total number of TB cases. To ensure that all TB cases that occur in a country are

diagnosed and reported (in other words, that notification is a proxy for incidence), the population must have good access to a well-functioning health care system. The under-5 mortality rate and the percentage of health expenditure that is out-of-pocket provide a very broad, overall indication of the quality and coverage of health care, as well the affordability and accessibility of services.

According to the UNICEF data repository,²⁰ the under-5 mortality rate in Kazakhstan in 2015 was 14.1 per 1000 live births, suggesting suboptimal access to good-quality health care. Moreover, in 2014 out-of-pocket expenditure was 41% of total health expenditure,²¹ suggesting the existence of some financial barriers to health services in Kazakhstan.

In such a situation, it is likely that there are people with TB in Kazakhstan who are not diagnosed and are therefore not included in the TB notification data. Thus, Kazakhstan does not satisfy either of the two benchmarks and the standard is **not met**.

Standard B1.10 VR system has high national coverage and quality

Both benchmarks should be satisfied to meet this standard:

- *Cause of death documented in $\geq 90\%$ of total deaths recorded in: (a) national VR system or (b) sample VR system.*
- *<10% of deaths have ICD codes for ill-defined causes (defined as ICD-9 780–99 and ICD-10 R00–R99).*

According to WHO estimates,²² completeness of cause of death data information in Kazakhstan in 2015 was 86%, which is slightly below the first benchmark.

Between 2005 and 2015, the proportion of deaths with ill-defined causes with codes R00–R99 ranged between 3.6% and 22.2%, according to the WHO mortality database.²³ In 2015 only 4.1% of total registered deaths had codes with ill-defined cause of death. This suggests that data quality with respect to cause of death is **satisfactory**.

Thus, of the two benchmarks, only one is satisfied; the standard is therefore **partially met**.

Standard 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 $\geq 75\%$ of new pulmonary TB cases.*

²⁰ UNICEF Data. Monitoring the situation of children and women: under-five mortality (<https://data.unicef.org/topic/child-survival/under-five-mortality>, accessed 24 August 2017).

²¹ Global Health Observatory data repository (<http://apps.who.int/gho/data/view.main.HEALTHEXPRATIOKAZ>, accessed 24 August 2017).

²² Global Health Observatory data repository. SDG Target 17.19 – statistical capacity-building: data by country (<http://apps.who.int/gho/data/node.main.SDG1719?lang=en>, accessed 24 August 2017).

²³ WHO mortality database (<http://apps.who.int/healthinfo/statistics/mortality/whodpms>, accessed 21 August 2017).

- *Rifampicin susceptibility status (positive/negative) documented for a nationally representative drug resistance survey of new pulmonary TB cases.*

According to Kazakh policy, all bacteriologically confirmed TB patients are subject to DST. However, because the national electronic surveillance system produces no standard report on DST results combining and summarizing all DST results by patient's category (including BACTEC, LPA, MGIT and GeneXpert), existing DST data are not properly analysed, reported and interpreted at national level. Thus, in 2016 the Kazakhstan surveillance system reported to the WHO global TB database a total of 8178 new pulmonary tuberculosis (PTB) cases;²⁴ of these, 6930 (84.7%) cases were bacteriologically confirmed. Of the 6930 bacteriologically confirmed new PTB patients, only 3264 (47.1%) had documented DST results for rifampicin susceptibility in their report. Thus, the percentage of new PTB patients with documented rifampicin DST results in 2016 was 39.9% (3264/8178). This result is most probably based on one DST method only. Because there is no capacity to collate DST results from other methods, the overall national indicator is below the recommended 75%, therefore the standard is considered **not met**.

Recommendation

The NTP/MoH should request MedInfo to supplement the national electronic surveillance system with a standard report on DST results, combining the results of all available methods sortable by period and location. As an interim solution, the data should be calculated manually by exporting individual case results into spreadsheet software.

Standard 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) is documented for ≥80% of all notified TB cases.*
- *HIV status is available from a representative sample of all TB cases notified in settings with a low-level epidemic state²⁵ or where it is not feasible to implement routine surveillance.*

WHO recommends that all patients with presumptive or diagnosed TB should receive HIV testing and counselling to ensure early case detection and rapid initiation of treatment.²⁶ Data on HIV status among TB cases should be collected through routine surveillance in all settings regardless of the HIV epidemic state.

In 2016 a total of 12 322 new and relapse TB cases (all forms) in Kazakhstan were notified to the WHO global TB database. Of these, 10 616 TB patients had their HIV status documented; this is 86.2% of all cases, so the standard can be assumed to be **fully met**. However, it should be noted that HIV test coverage relates only to TB cases from the civilian population and excludes smear-negative relapse cases and foreigners.

²⁴ Global TB database (<http://www.who.int/tb/data/en>, accessed 26 September 2017).

²⁵ Low-level epidemic state: HIV prevalence has not consistently exceeded 5% in any defined subpopulation.

²⁶ WHO policy on collaborative TB/HIV activities (WHO/HTM/TB/2012.1). Geneva: World Health Organization; 2012 (http://whqlibdoc.who.int/publications/2012/9789241503006_eng.pdf).

Standard B2.3 Surveillance data for children reported with TB are reliable and accurate, and all diagnosed childhood TB cases are reported

Both 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 authorities, as determined by a national-level investigation (e.g. inventory study, conducted in the past 10 years).*

TB is often not considered as a possible diagnosis in cases of child disease and therefore often goes undetected. Diagnosing TB in children is challenging, as it is rarely laboratory-confirmed and therefore difficult to establish as a definitive diagnosis. Children can present with TB at any age, but the most common age is between 1 and 4 years. Children aged 0–4 have the highest risk of contracting TB, therefore TB cases occur more often in this age group than in the 5–14 age group. According to routine notification data in Kazakhstan, in 2016, of 326 children diagnosed with TB, 84 were under 5 years and 242 were 5 to 14 years. Thus, the number of children aged 0–4 with TB is much lower than the number of children aged 5–14, suggesting that many cases of TB in children under 5 years in Kazakhstan probably remain undetected and/or underreported. The ratio of TB cases in age groups 0–4 and 5–14 in 2015 was 0.4; this is far below the expected level and one of the lowest in the European Region. Thus, the first benchmark is considered **not satisfied**. Given that no inventory study has been undertaken in Kazakhstan in the past 10 years, the second benchmark is also considered to be **not satisfied**. As a result, the standard B 2.3 is **not met**.

Recommended actions

- Possible reasons for underdetection of childhood TB cases should be put forward and discussed with paediatricians, intensive care physicians from paediatric hospitals, pulmonologists, family practitioners, and all those who make and report diagnoses of childhood TB.
- In light of this discussion, corrective actions may be required, including training of health care providers, revision of the differential diagnostic algorithm adopted at general hospitals, etc.

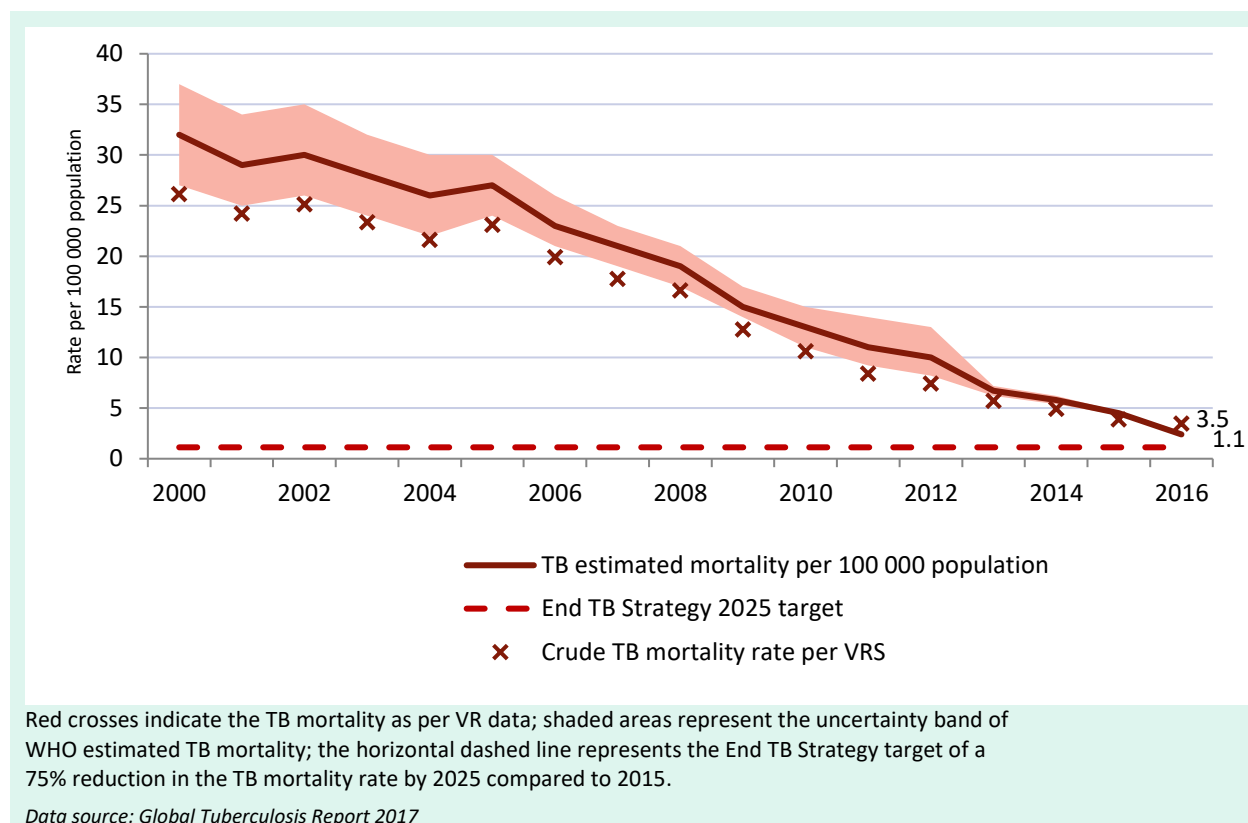
4.2 Assessment of the level of, and trends in, TB disease burden using available surveillance, survey, programmatic and other data

4.2.1 Analysis of the level of, and trends in, TB mortality

Estimation of the TB mortality rate in Kazakhstan is based on VR information.²⁷ Thus, in 2000 the TB mortality rate was estimated at 32 per 100 000 population. Since then, the rate has steadily declined, with an average annual fall of 11.8%. By the end of 2015, the estimated TB mortality rate in Kazakhstan was reported as 4.4 per 100 000 population, as against a crude mortality rate of 3.9 per 100 000 reported by the VR system. In 2016, by contrast, the estimated TB mortality rate was 2.4 per 100 000 (versus a crude mortality rate of 3.5), which is lower by 45% compared to the previous year. Such a sharp year-to-year fall is not plausible. WHO therefore judged that the TB mortality rate for 2016 was likely to be a very significant underestimation and needed to be revised (Fig. 5).

²⁷ Global TB database 2017.

Fig. 5 Estimated and crude TB mortality rates (excluding TB/HIV mortality) in Kazakhstan, per 100 000 population (2000–2016)



The overall decline in the crude TB mortality rate in Kazakhstan based on the VR system shows a sharp but steady decline over time. Because the VR system in Kazakhstan has adequate quality and coverage, this decline reflects a true reduction of the TB burden in the population. The fact that the decline in mortality is about twice as fast as the decline in notification indicates that the reduction of TB deaths is due not only to a fall in TB transmission in the population (a fall in TB incidence), but also to a decline in case fatality, caused by an increase in the treatment success rate and increased TB case detection. It should also be noted that the WHO estimated mortality rate for 2016 is underestimated.

Recommendation to WHO

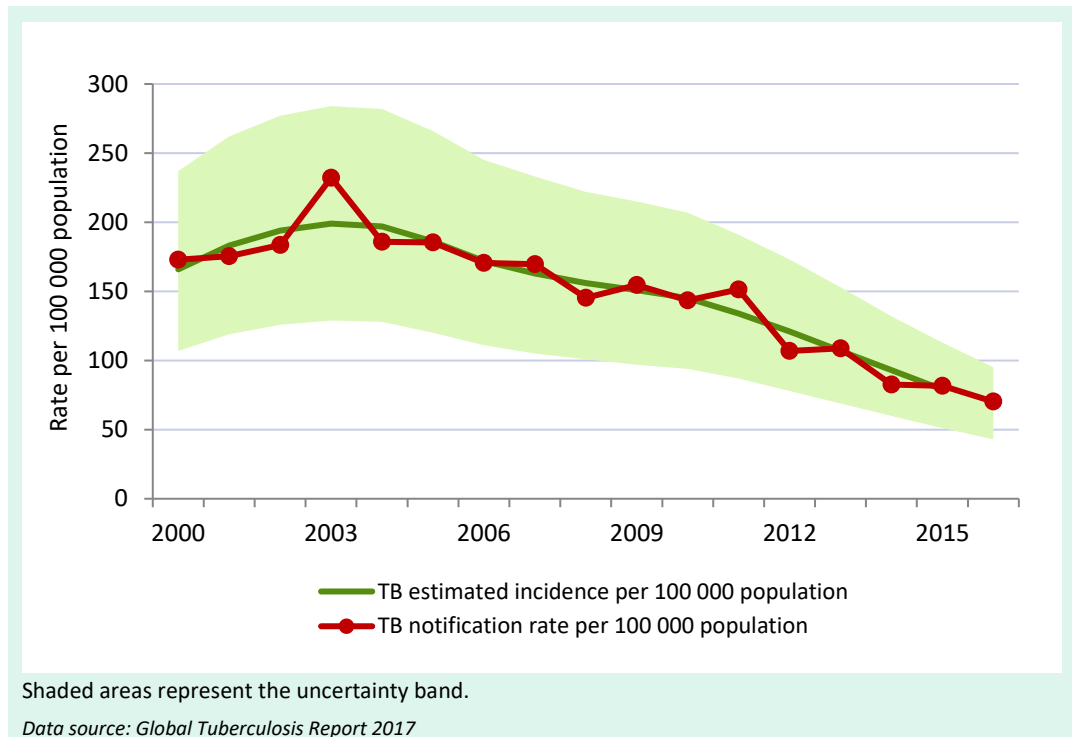
The WHO estimated number and rate of TB mortality in Kazakhstan for 2016 is much lower than the number of TB deaths (440 (range: 400–480) vs 607 recorded) and the crude mortality rate (2.4 (2.2–2.7) vs 3.5) reported by the VR system. The epi-review team recommends revising the mortality estimates for Kazakhstan based on recent VR data.

4.2.2 Analysis of the level of, and trends in, TB incidence

TB incidence in Kazakhstan peaked in 2003, reaching 199 cases per 100 000 population. Since 2004, TB incidence has declined at an average rate of 7.9% a year. In 2016, there were an estimated 12 000 incident cases of TB (range 7700–17 000) in Kazakhstan, equivalent to a rate of 67 (43–95) per 100 000 population (Fig. 6). WHO reckoned that the notified number of TB cases was a proxy for incidence, in view of the very high coverage of active case finding, such as systematic screening reaching about 50% of the general population every year, which is not a WHO recommendation. There is therefore a possibility of significant overreporting of false positive cases (screen positive (like chest X-ray TB

suggestive) cases with no bacteriological confirmation of PTB, despite high coverage with modern sensitive diagnostic methods). WHO assumed that underdetection of TB cases was still occurring in Kazakhstan (as outlined in Section 1), but it is very likely that TB is also overreported. This gives rise to wide uncertainty ranges with respect to the TB estimated incidence rate, as shown in Fig. 6.

Fig. 6 Estimated TB incidence rate and notification of incident TB cases (new and relapse) in Kazakhstan, per 100 000 population (2000–2016)



Recommendation to WHO

More in-depth review of the existing data during the epi-review showed that underreported cases include the entire prison TB population in Kazakhstan (5–10% of total TB cases), relapse cases that are not smear-positive (14–18%), foreigners, and TB cases in Baikonur city. Although these data are collected, they are not processed at national level, leading to underestimation of TB notification. In light of this, the epi-review team recommends that the best estimates of TB incidence are revised to take account of the described underreporting in the range of around 20–25%.

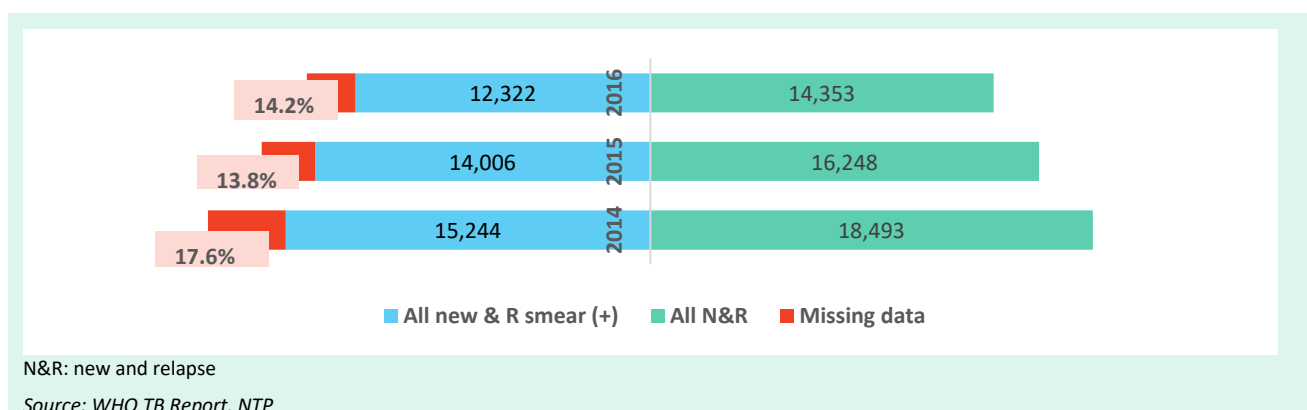
4.2.3 Analysis and interpretation of the level of, and trends in, TB case notifications

Analysis and interpretation of data on TB case notification present some difficulties in understanding correctly the TB burden at national level. In this regard, some issues have been noted that have led to a misunderstanding of the national rate of TB case notification, namely:

- The NTP does not have full information on TB case notification at national level. The reporting system focuses in particular on notified cases in the civil sector and does not include those in the penitentiary system (about 5–10%) and the Baikonur region. Limited access to information makes it impossible to compile a comprehensive report.
- The reporting system informing the CNR includes all new cases but only positive microscopic relapses, leading to the omission of about 14–18% of cases for the civil sector (Fig. 7).

In these circumstances, given limited access to data, the analysis set out below covers only the civil sector (excluding the Baikonur region).

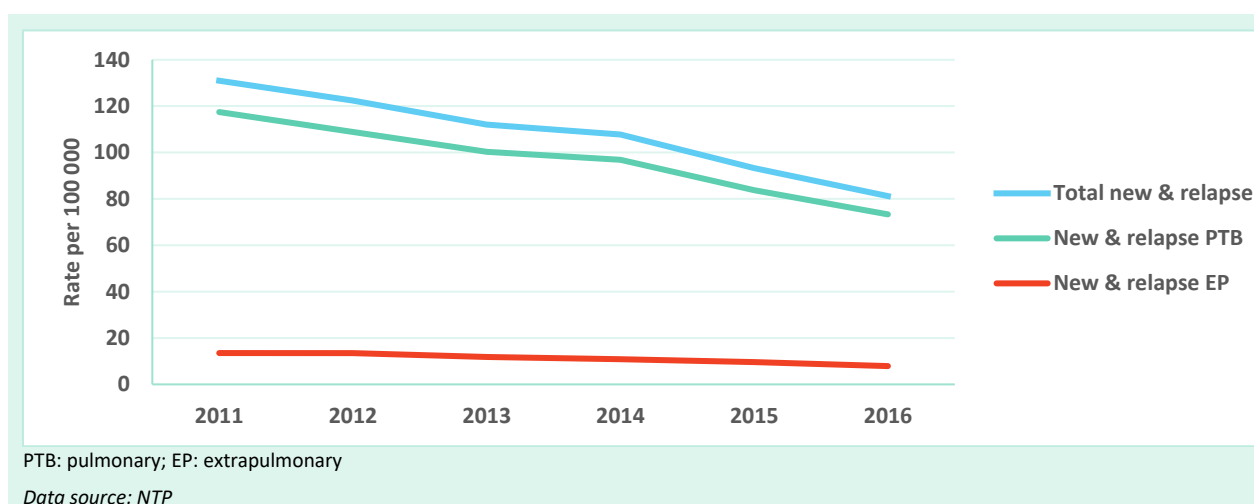
Fig. 7 New and relapse cases, civil sector, Kazakhstan, 2014–2016



4.2.3.1 Overall TB case notifications and time trends

The number of notified incident TB cases in Kazakhstan decreased in the period between 2011 and 2016. The number of notified new and relapse TB cases decreased from 21 533 (equivalent to 131 per 100 000) in 2011 to 14 353 (81.2 per 100 000) in 2016, with an average rate of decrease of 9.0% per year. The decline was especially sharp between 2014 and 2015 (Fig. 8).

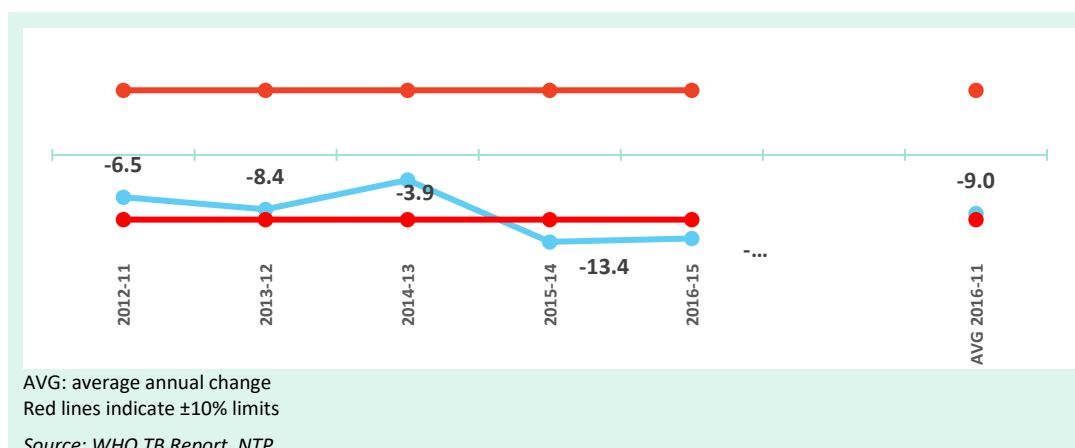
Fig. 8 CNR of new and relapse TB cases, Kazakhstan, 2011–2016



The downward trend in CNR is similar for new cases and relapses with pulmonary and extrapulmonary location, with an average rate of decrease of –8.9% and –10% per year, respectively.

Analysis of the annual variation in the decline of the CNR shows that, in the period 2011–2014, it was stable, within a limit of 10%. A deviation of –13.4% and –12.9% was observed between 2015–14 and 2016–15 respectively, indicating a problem of notifying new cases and relapses in the period 2014–2016 (Fig. 9).

Fig. 9 Annual changes in CNR of incident TB, Kazakhstan, 2011–2016

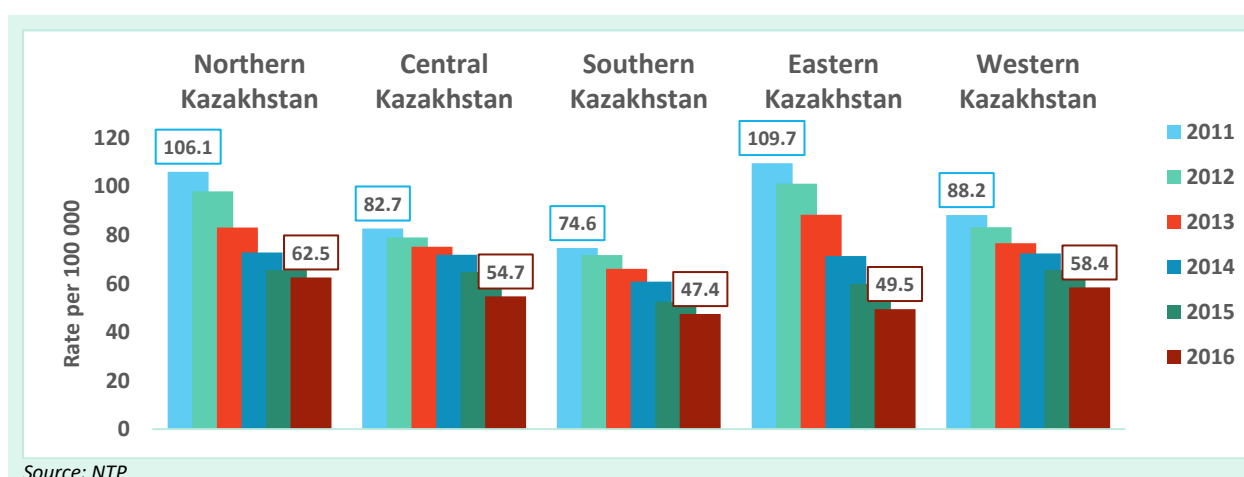


4.2.3.2 Level and trend of TB by geographical area

Analysis of the geographical distribution of TB incidence included the CNR of new cases in the civil sector, excluding the Baikonur region (part of southern Kazakhstan).

At country level, over the years 2011–2016, the number of new cases decreased by 35%, from 14 344 (equivalent to 87.2 per 100 000 population) to 9381 (equivalent to 58.9 per 100 000 population). The average annual variation was –9.6% and the most pronounced decline of –12.0% was between 2015 and 2014. The CNR for new cases is declining in all five regions of the country. The most notable reduction in the number of new cases over the past six years has been observed in the east and north. In these two regions the number of new cases decreased by 55% and 38%, respectively: from 1533 (equivalent to 109.7 per 100 000 population) to 691 (equivalent to 49.5 per 100 000 population), and from 3870 (equivalent to 106.1 per 100 000 population) to 2393 (equivalent to 62.5 per 100 000 population); the average annual variation was –14.6%, correspondingly (Fig. 10 Fig. 11).

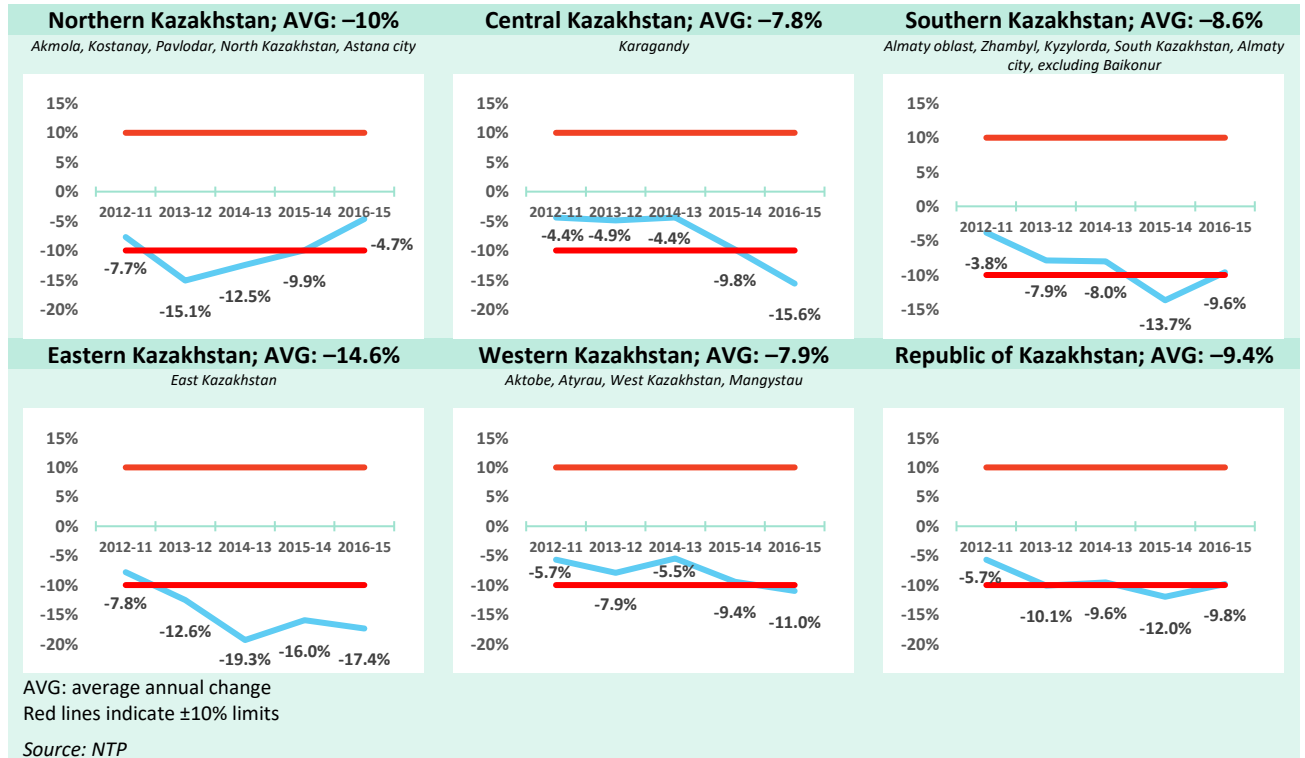
Fig. 10 CNR of new TB cases per 100 000 population by region, Kazakhstan, 2011–2016



A sharp decline in the CNR of new cases was observed in all regions of the country and ranged between –3.8% (southern region) and –19.3% (eastern region). At the same time, the largest negative variations (below –10%) are accentuated between 2013 and 2012 in the northern region (–15.1%) and the eastern

region (−12.6%); between 2014 and 2013 in the eastern region (−19.3%); between 2015 and 2014 in the eastern region (−16.0%) and the southern region (−13.7%); and between 2016 and 2015 in the eastern region (−17.4%) and the central region (−15.6%) (Fig. 11).

Fig. 11 Annual changes in CNR of new TB cases, by region, Kazakhstan, 2011–2016



Analysis of the change in rate of notification of new cases by region, year by year, highlights that the northern region shows the most pronounced deviations from −18.6% to −33.1% in the city of Astana in 2011–2014, while the southern region shows the most pronounced deviations, from −11.6% to −19.3%, in the city of Almaty. Contrasting the CNR for new TB cases with the new smear-positive notification rates also highlights these two cities, Astana and Almaty, with variations between 78.9% and −29.4% and 83.2% and −32.1% for 2013–2015, respectively

Fig. 12, Fig. 14). These oscillatory deviations may be due to several factors, including population concentration and the migratory aspect of both the domestic and the external population.

Fig. 12 CNR of new TB cases per 100 000 population and year-on-year change in TB CNR by oblastes, Kazakhstan, 2011–2012 to 2015–2016

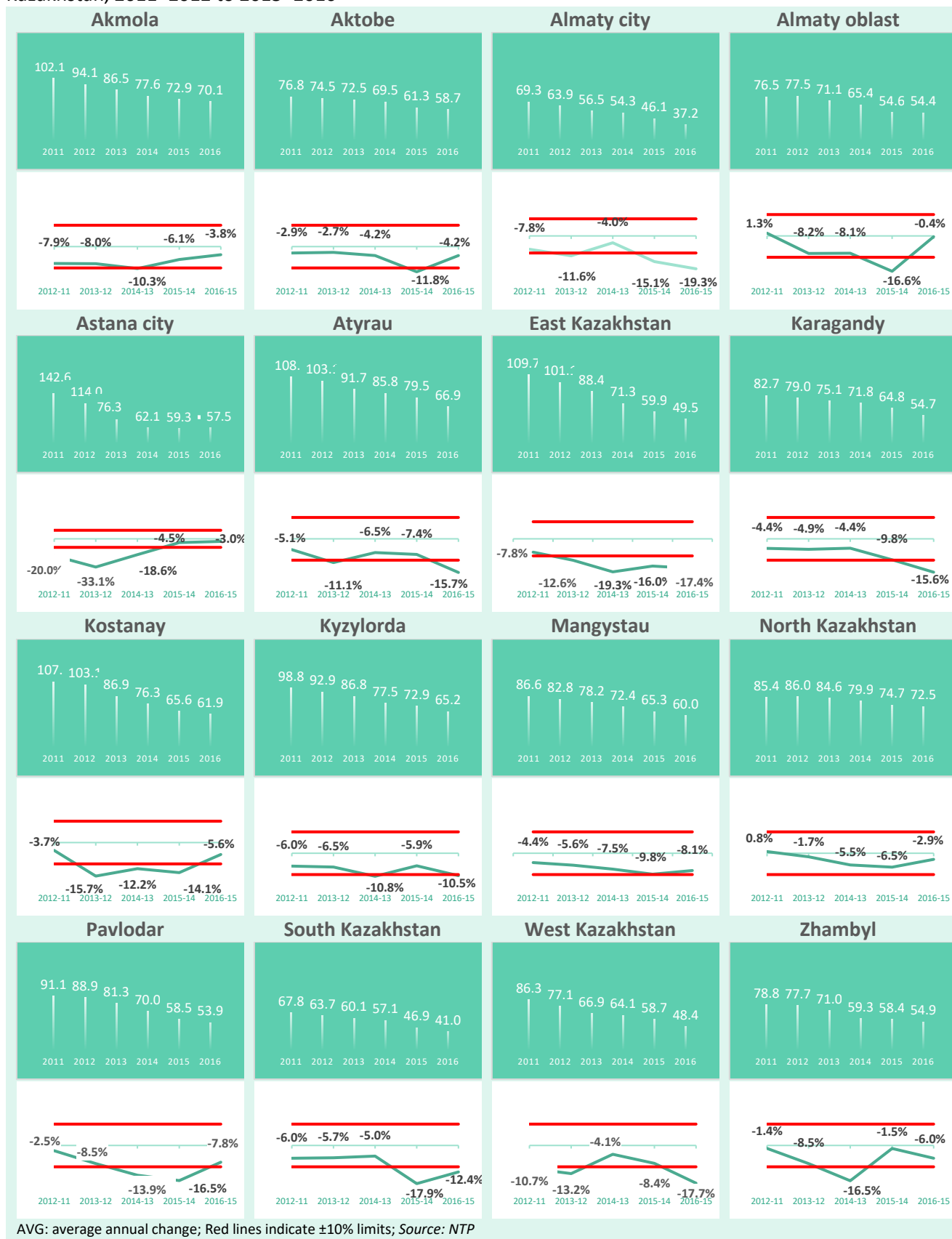
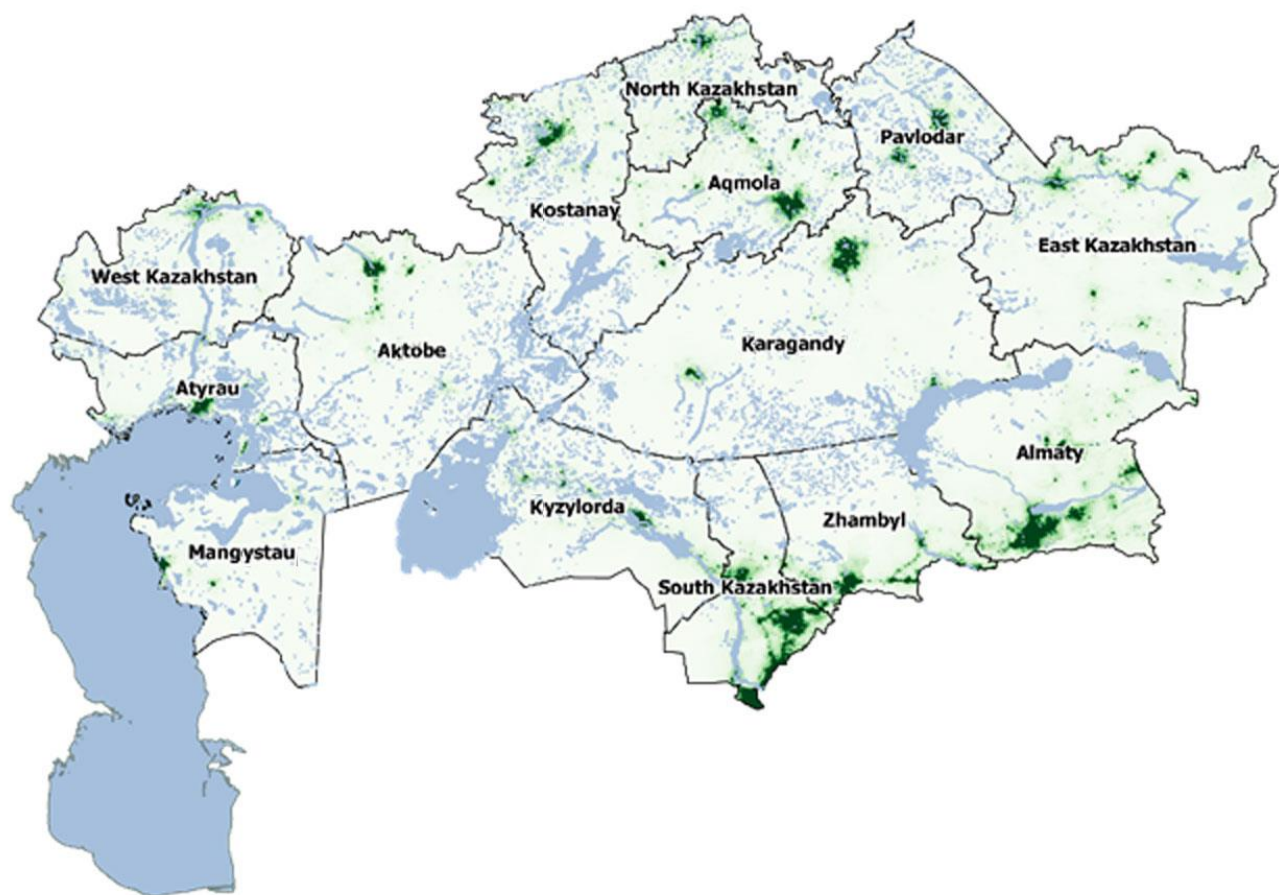


Fig. 13 Map of Kazakhstan showing the borders of oblasts and population density (green dots)

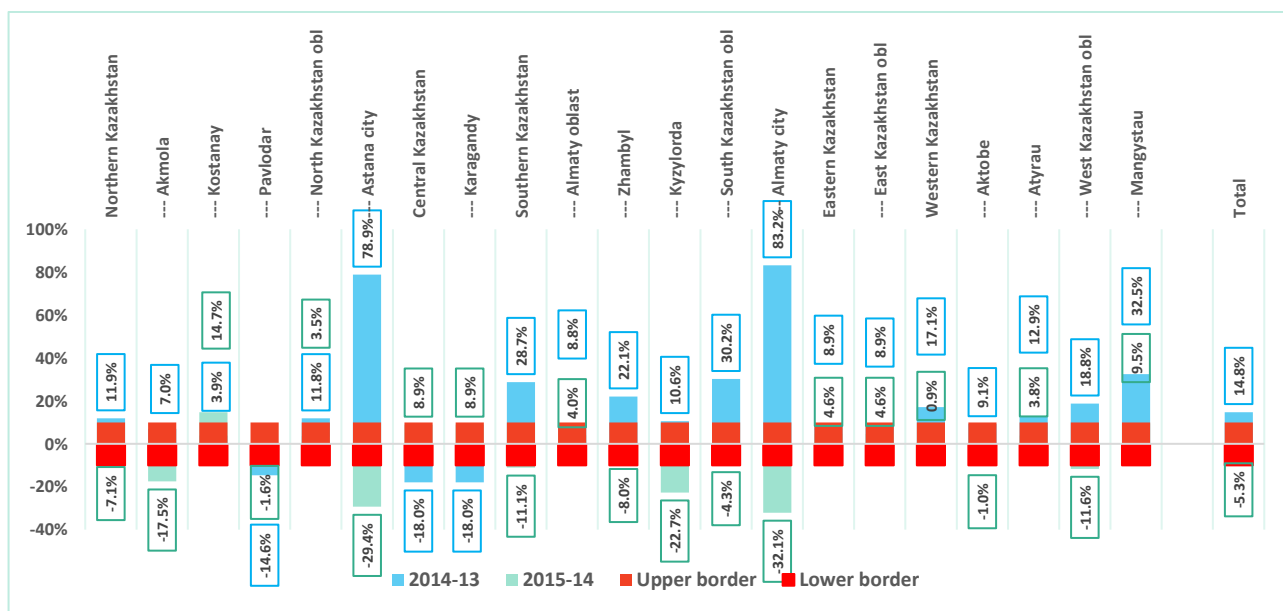


In this connection, the counterbalancing analysis of annual data on the CNR of new TB cases with percentage variations among new TB cases (Fig. 11,

Fig. 12) and among new cases of positive microscopy TB (Fig. 14) demonstrates sudden changes in the other geographical regions. For example, in the centre of the country, represented by Karagandy oblasty, there is a decrease in the new positive pulmonary cases with positive microscopy of –18% between 2014 and 2013, followed by an increase of 9% between 2014 and 2015, while the new CNR between 2014 and 2015 is –10%. Similar significant deviations are also seen in Akmola and Pavlodar in the northern region, and in all the southern and western regions.

In this context, sudden annual changes could indicate the persistence of a problem related to the diagnosis and/or notification of TB cases, as well as to the generation and interpretation of specific indicators. These aspects need to be discussed and clarified at the level of the monitoring unit.

Fig. 14 Year-on-year change in the new smear-positive TB CNR by region and oblates, Kazakhstan, 2013–2015



Source: NTP

Kazakhstan is divided into 209 districts/cities. The bureau of statistics of Kazakhstan provides population estimates for these administrative areas (second level). Also, the NTP data are organized by the same administrative units (with the difference that some districts did not register patients, making the total number of cities/districts slightly below 209). Unfortunately, a shapefile showing the boundaries of these 209 districts/cities is not available; there is only one with 172 districts. Most of the cities are not represented in this shapefile – the data for these cities are collapsed with their surrounding district. With so-called “link table” NTP data, the population data and the map data are merged with each other based on a common geographical identifier.

Notification of new and relapse TB cases at district level in 2016 ranged from 26 per 100 000 (Irgiz district) to 200 per 100 000 in Aitekeb district. Median of notification was 87.1/100 000 (IQR: 65–102). These raw rates do not show a clear geographical pattern of distribution of disease: many districts with high TB CNRs share borders with districts with low CNRs (Fig. 15). To get more stable estimates, a simple smooth has been applied to the 2016 CNRs by taking the average of the district and its neighbouring districts without applying any weights (see Fig. 16). The smoothed rates show a clear geographical pattern of TB notification with rates decreasing from west to east across Kazakhstan. Cluster analysis identified hot spots in western Kazakhstan and some cold spots in the east and south.

Fig. 15 New and relapse TB CNR by district, Kazakhstan, 2016

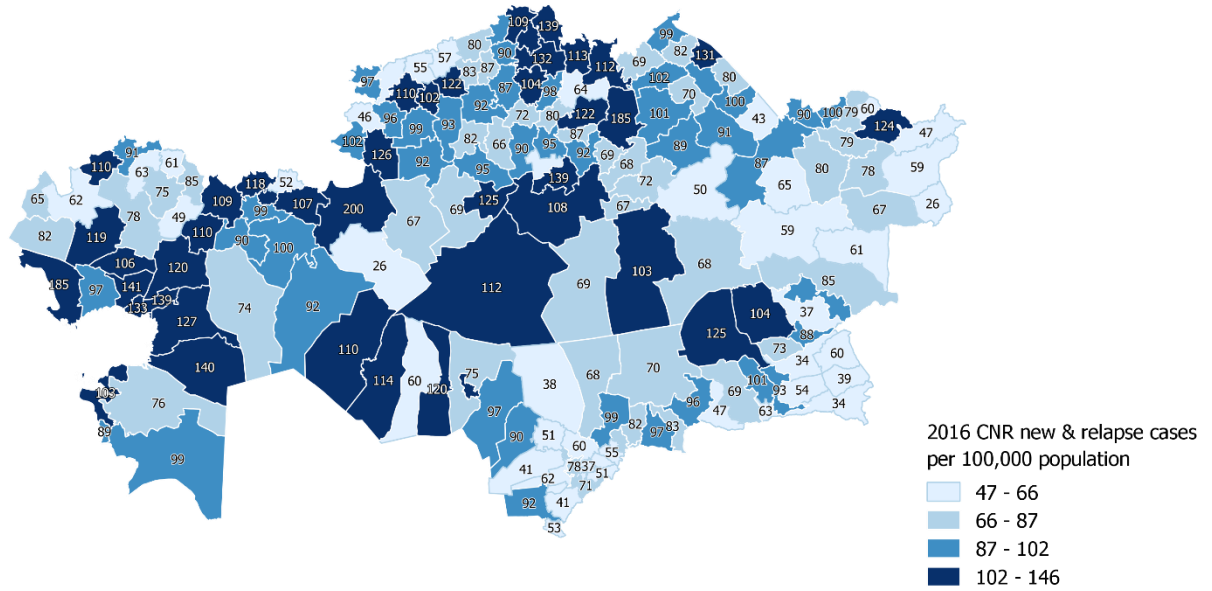
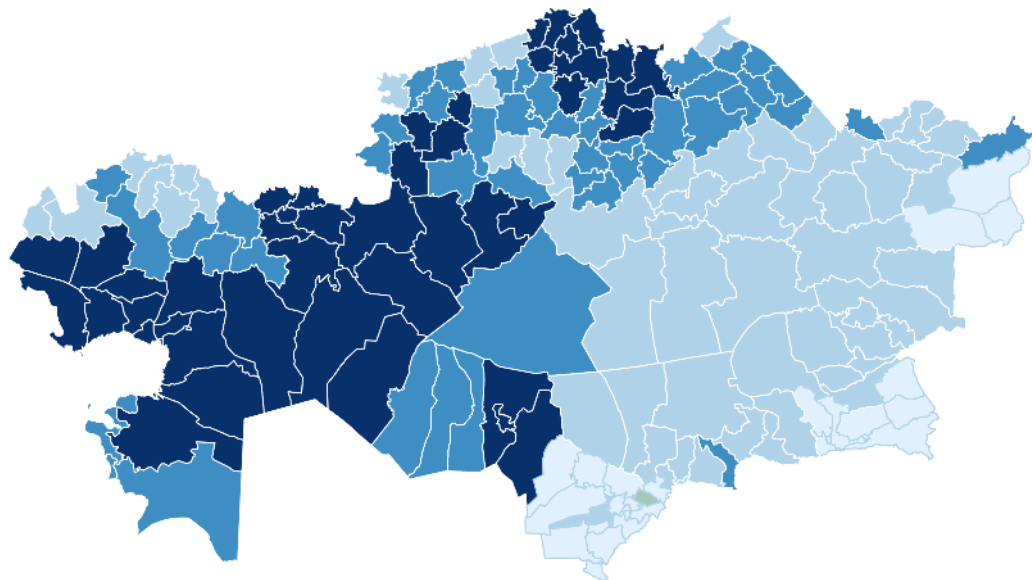
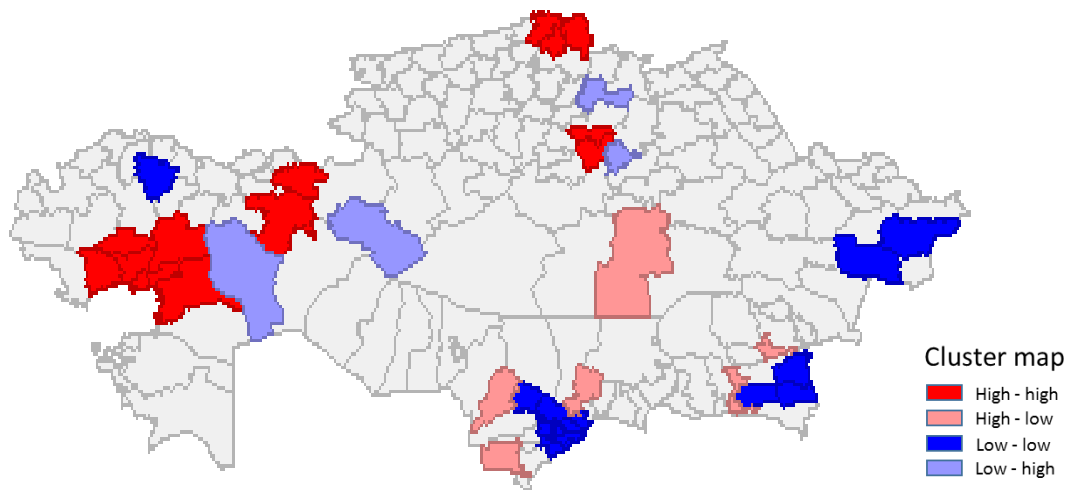


Fig. 16 Smoothed CNRs of new and relapse cases, Kazakhstan, 2016



Same legend as Fig. 15; smoothed rates based on averaging the area value and its neighbouring values (no weights applied)

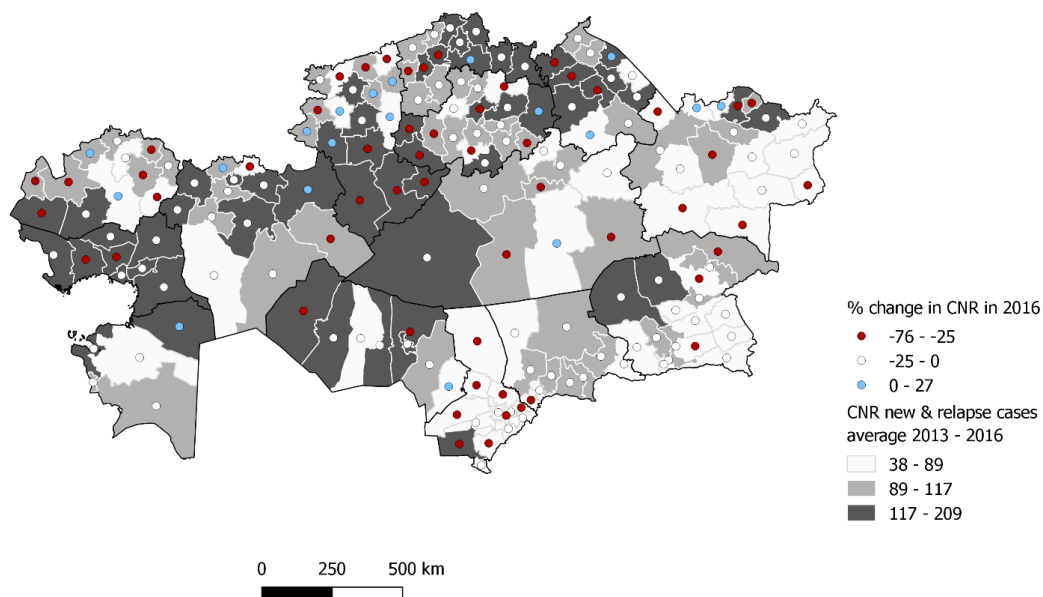
Fig. 17 Hot and cold spots of CNRs of new and relapse cases, Kazakhstan, 2016



Using local Moran's I (LISA); areas deviating from their neighbours are also indicated.

In 160 of 172 districts, the CNR shows a negative trend (with a maximum of -54.5) in the period 2013–2016. In 153 districts, the 2016 CNR was lower than the four-year average. There was no clear geographical pattern in the trend across districts. Visual observation indicates some clusters of districts with slow decline in Kostanay and the southern Kazakhstan oblasts (**Fig. 18**).

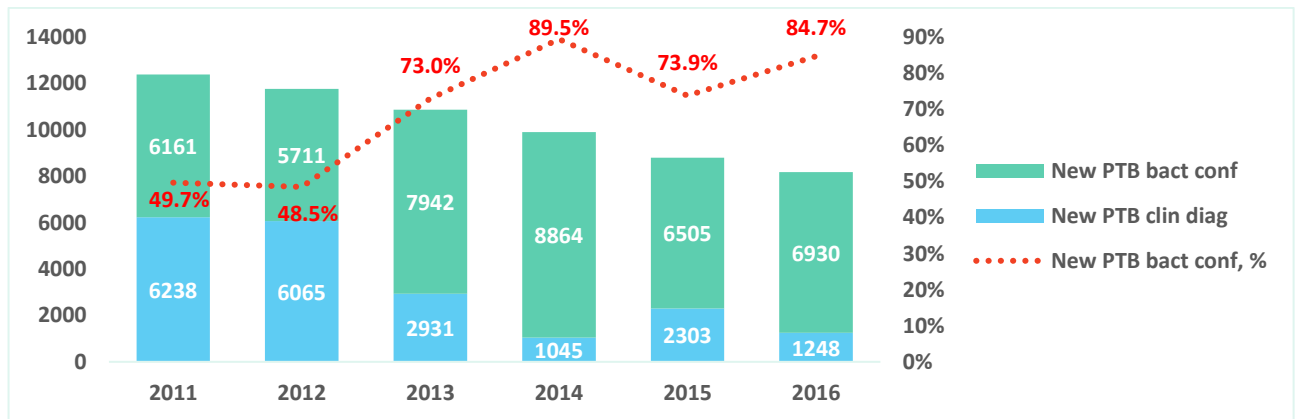
Fig. 18 New and relapse CNR: four-year average (2013–2016) and percentage change in 2016



4.2.3.3 Trend of new and relapse TB notification by bacteriological confirmation

The proportion of cases with bacteriologically confirmed PTB has been increasing since 2013, which could be a consequence of implementation of rapid diagnostic methods such as GeneXpert (Fig. 19). The number of new bacteriologically confirmed pulmonary cases increased by about one third in 2013 compared to 2012; this was followed by an increase of 10% in 2014 compared to 2013, which was due to the decreasing incidence of new pulmonary cases. Between 2014 and 2015, the number of new clinically diagnosed cases doubled compared to those recorded in 2014, then fell by a half in 2016. This variation led to relative increases and decreases in the proportion of new cases with bacteriologically confirmed PTB.

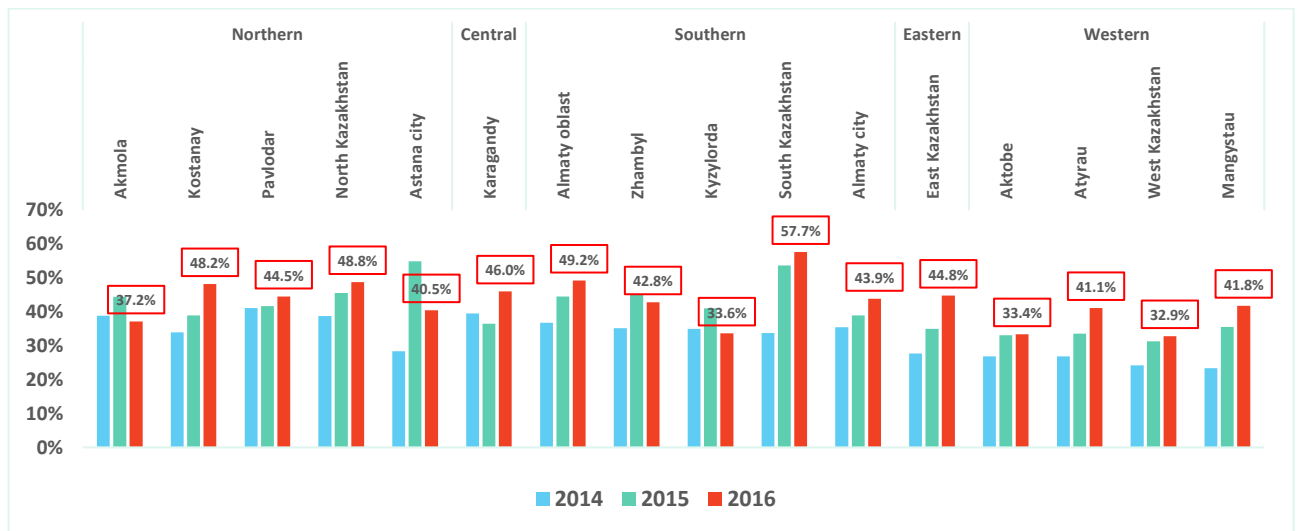
Fig. 19 Notification of bacteriologically confirmed and clinically diagnosed TB among new pulmonary TB cases and the proportion of bacteriologically confirmed TB cases, Kazakhstan, 2011–2016



Source: NTP

The geographical distribution of positive microscopy cases among new pulmonary cases, analysed over the period 2014–2016, shows a weight that ranges from 33% in a western Kazakhstan oblast to 58% in a southern Kazakhstan oblast. At the same time, in 2016 an increase over previous years in the proportion of cases with positive microscopy among new pulmonary cases is observed in most regions, with the exception of Astana city, Kyzylorda and Akmla oblast (Fig. 20).

Fig. 20 Proportion of new smear-positive pulmonary TB cases among new pulmonary TB cases, by oblast, Kazakhstan, 2014–2016



Source: NTP

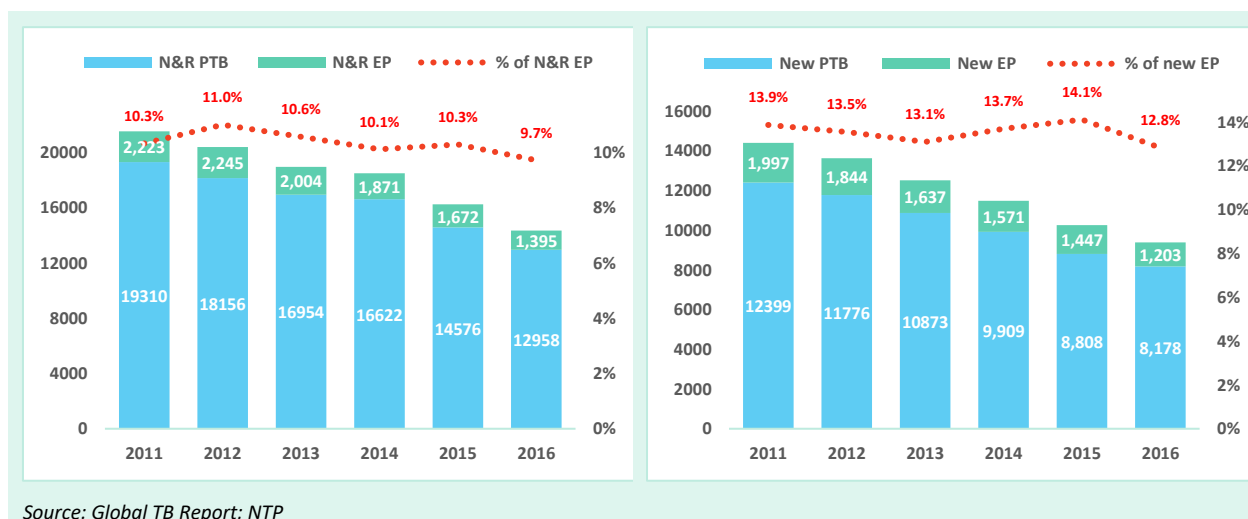
In light of these findings, as well as those reported in the previous chapter, the probable explanations of variations in bacteriologically confirmed pulmonary cases could be: implementation of rapid diagnosis methods and/or reduction of the TB burden at national level. At the same time, however, this phenomenon could also be encouraged by omission of cases from national reporting, such as cases notified in the penitentiary system and in Baikonur city, and also, possibly, by erroneous ratings in the case-by-case assessment and/or errors of interpretation and generation of specific reports.

4.2.3.4 Trend of new and relapse TB notification by site of disease

Analysis of case notification data according to location of disease reveals a tendency of decreasing pulmonary and extrapulmonary TB (Fig. 8Fig. 21). The proportion of extrapulmonary cases among new cases and relapses remained relatively stable during 2011–2016, constituting between 10% and 11%.

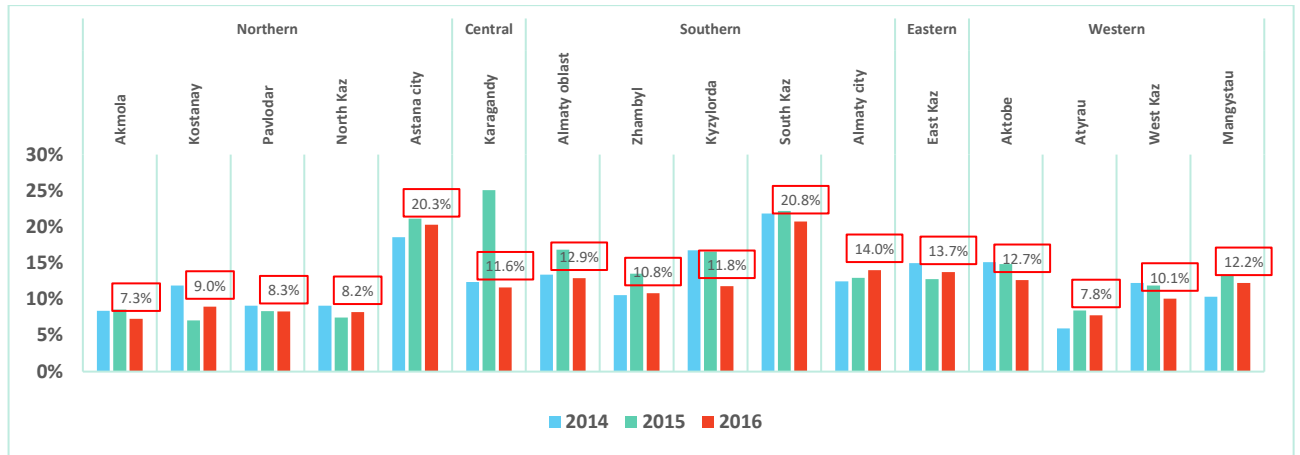
The ratio of pulmonary and extrapulmonary cases among new cases in 2011 was 6 to 1; in 2016, 7 to 1. Thus, the proportion of extrapulmonary cases among new cases of TB varied between 13% and 14% during the period 2011–2016 (Fig. 21).

Fig. 21 Trend in notifications of new and relapse pulmonary and extrapulmonary TB cases, and proportion of extrapulmonary cases among new and relapse cases



Distribution by geographical area shows over 15% of extrapulmonary cases among new cases in the southern Kazakhstan region during 2014–2016. At the same time, in the South Kazakhstan oblast and Astana city, extrapulmonary cases account for about one fifth of new cases. In the central region, represented by Karagandy oblast, extrapulmonary cases accounted for about one quarter (25%) of new cases in 2015; in 2014 and 2016, about 12% (Fig. 22).

Fig. 22 Proportion of extrapulmonary TB cases among new TB cases, disaggregated by geographical area and oblasts, Kazakhstan, 2014–2016

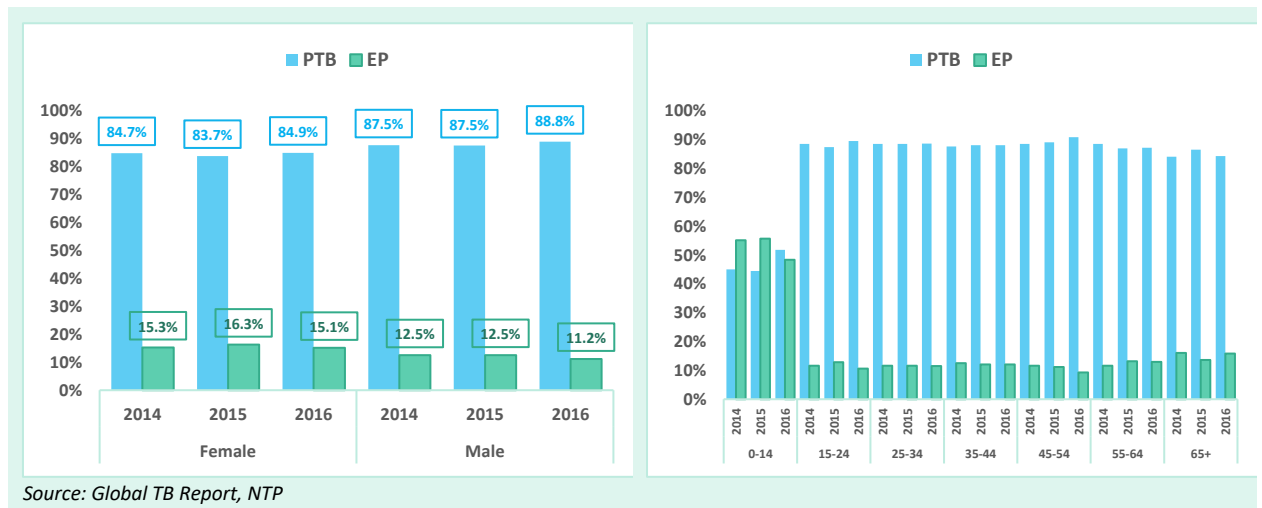


Source: National TB Program

Disaggregation of the trend in the proportion of extrapulmonary TB cases by sex shows that it is relatively stable, with values ranging from 11% to 12% among males and from 15% to 16% among females.

Further disaggregation of the proportion of extrapulmonary TB cases by sex and age group shows that the ratio of men to women in different groups remains almost identical. However, in 2015–2016 a relatively higher proportion is observed among women over 65 years of age. At the same time, in 2016, it is noticeable that in the 0–14 age group, the weight of pulmonary forms predominates over extrapulmonary ones (Fig. 23).

Fig. 23 Trend in the proportion of extrapulmonary TB cases disaggregated by sex and age group, Kazakhstan, 2014–2016

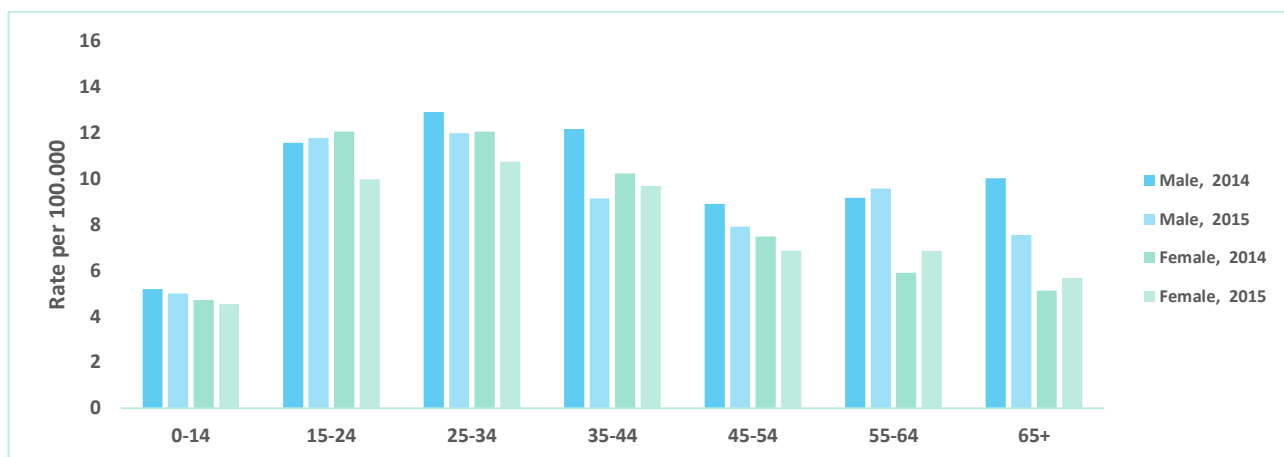


Source: Global TB Report, NTP

The predominance of TB forms with extrapulmonary localization affects, in particular, the population in the 15–34 age group. At the same time, while extrapulmonary TB is more common among women than men, relative to population the rate is higher among men than women (

Fig. 24).

Fig. 24 Rate of new extrapulmonary TB cases disaggregated by sex and age group, Kazakhstan, 2014–2015



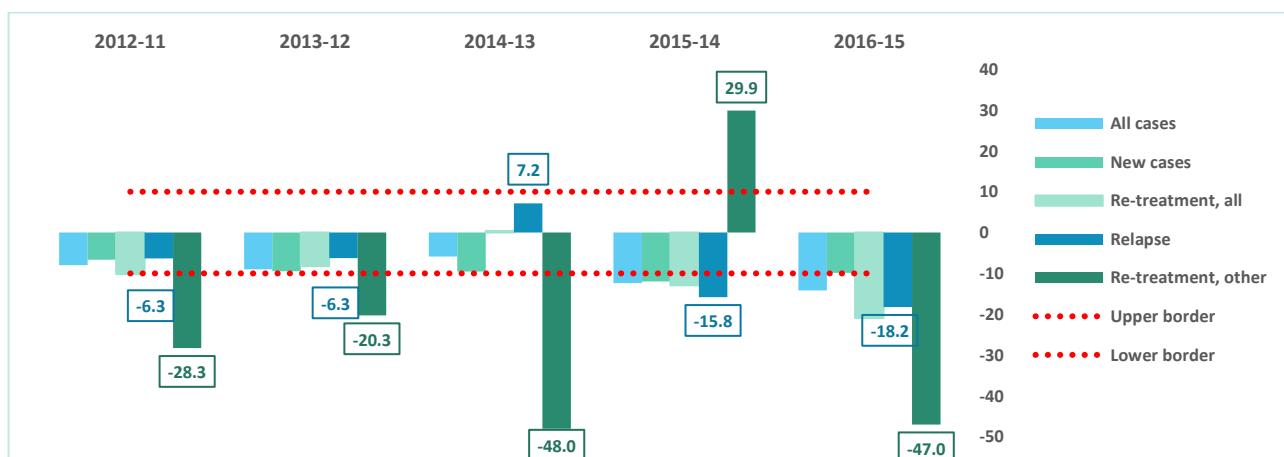
Source: NTP

4.2.3.5 Trend of TB notification by category

There is a decreasing trend among all notified cases of TB: new cases and cases with retreatment. The CNR for all cases of TB has decreased over the past six years, at a rate of about -9.9% annually. Cases reported with relapse decreased over the period 2011–2016, at an average rate of -7.9% annually. A remarkable reduction has been noted in retreatment cases; other than relapses of TB, they have fallen on average by -22.7% annually.

However, there is a large fluctuation in annual change of CNR of relapse TB cases from 7.2% to -15.8% , and of other retreated cases from -48% to 29.9% , between 2014–13 and 2015–14 respectively (Fig. 25). This could indicate some errors in notification of TB cases.

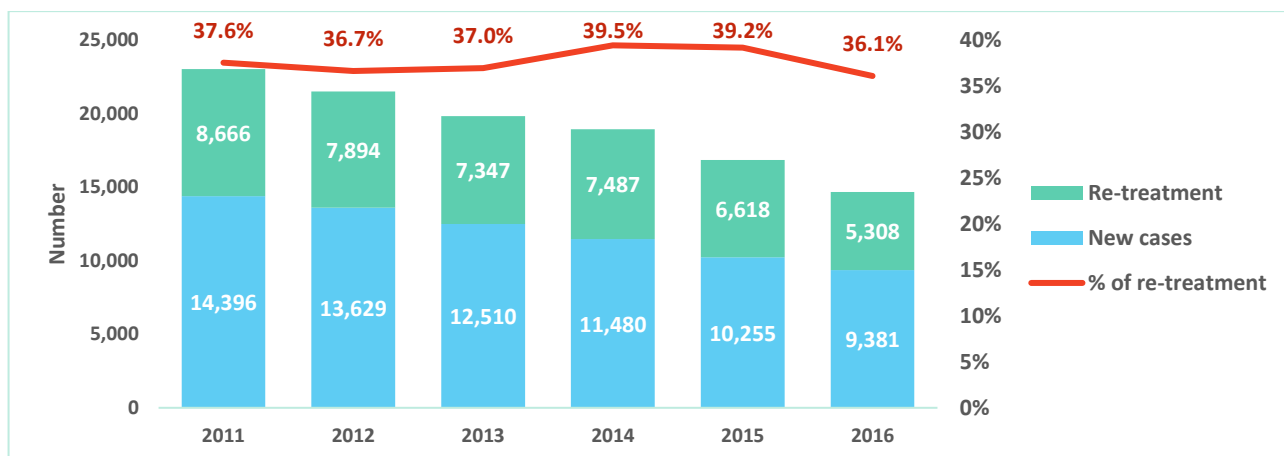
Fig. 25 Annual change in CNR of all TB cases, Kazakhstan, 2011–2016



Source: NTP

Retreatment cases accounted for over one third of all notified TB cases in the period 2011–2016 (Fig. 26). Their share remains relatively stable, and most retreatment cases are relapses. The proportion of relapses among all previously treated cases remains high, from 82.4% in 2011 to 93.6% in 2016; this is against a backdrop of a fall in other retreatment cases, which fell from 17.6% in 2011 to 6.3% in 2016.

Fig. 26 Notification of new and retreated TB cases and the proportion of retreated among all TB cases, Kazakhstan, 2011–2016

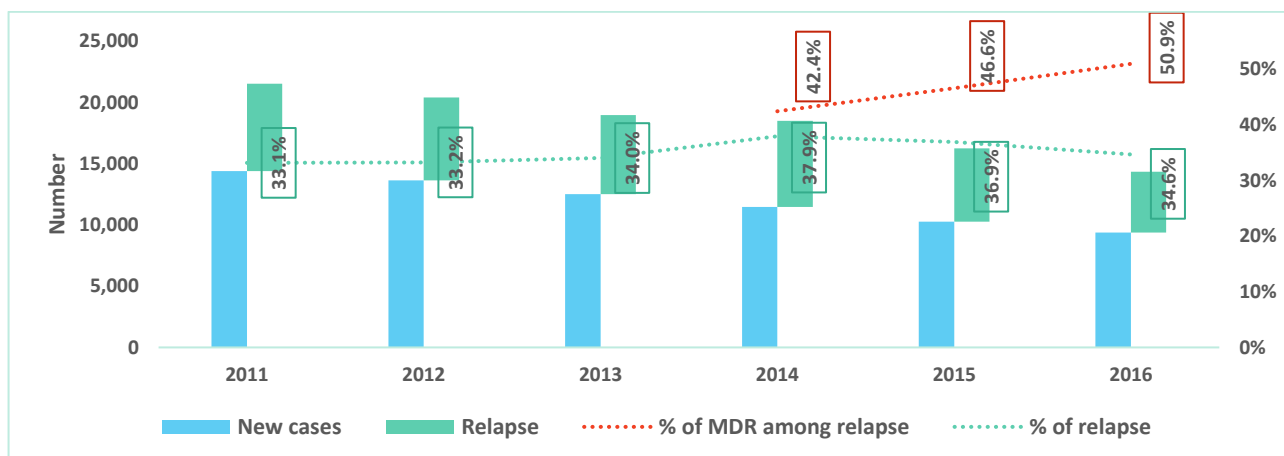


Source: NTP

Although the trend in the CNR for new and relapse cases is downward (Fig. 78), the proportion of relapse cases remained at more than 30% in the period 2011–2016. Thus, in 2011 their share was 33.1%; in 2014, 37.9%; and in 2016, 34.6%.

The proportion of MDR-TB forms among relapsed TB patients is increasing. Thus, while in 2014 they constituted 42.4%, by 2016 they constituted 50.9% (Fig. 27).

Fig. 27 Notification of new and relapse TB cases, proportion of relapses among notified TB cases, and proportion of MDR-TB cases among relapses, Kazakhstan, 2011–2016



Source: NTP

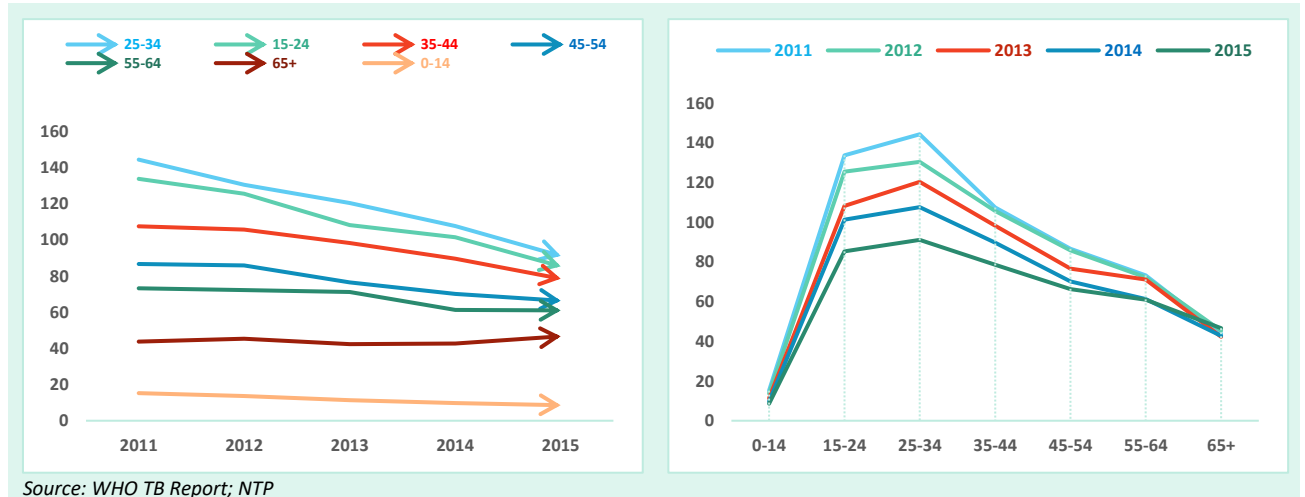
In this context, it is worth emphasizing that the ratio between new cases and relapses remained at 2 to 1 in the period 2011–2016, which is considered high in the WHO European Region. This suggests that, at the level of the NTP M&E unit, it is necessary to ensure there is proper understanding of TB case notification.

4.2.3.6 Trends in TB notification by sex and age group

In the five-year period 2011–2015, the trend in the CNR of new cases disaggregated by age showed a gradual decline across all age groups, with the exception of those over 65 years of age (Fig. 28). However, the rate at which TB notification declined decreased with age. Thus, the CNR of new cases

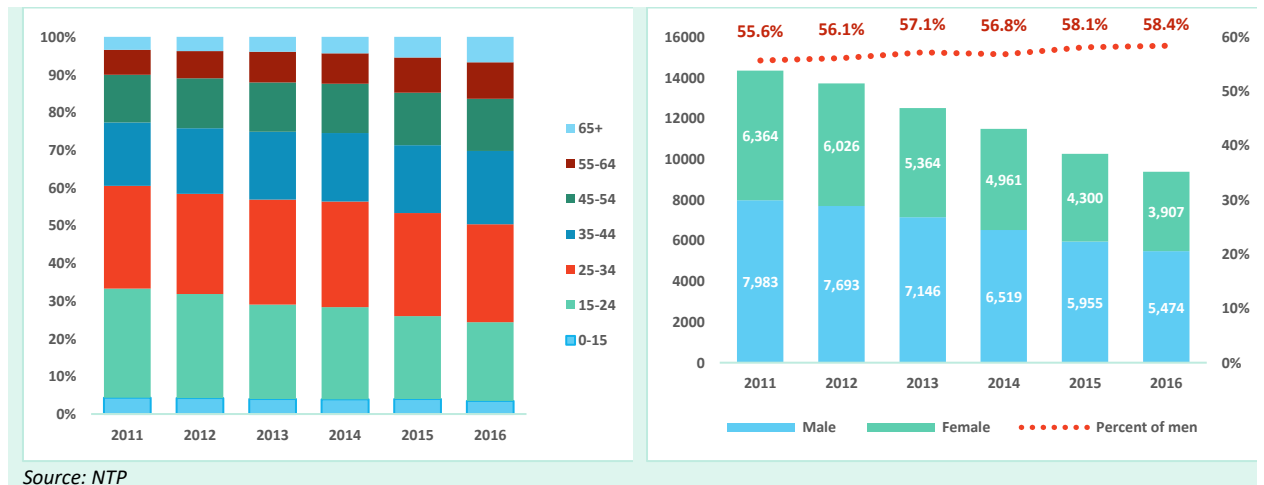
among children aged 0–14 decreased from 619 cases (equivalent to 15.2 per 100 000 population) in 2011 to 408 cases (equivalent to 8.6 per 100 000 population) in 2015, representing an annual change in the CNR of new cases of –13.3%. The average annual change of notification among the age groups 15–24, 25–34 and 35–44 was –10.8%, –10.5% and –7.5%, respectively. Much slower decline was seen in the 45–54 and 55–64 age groups, where the average change in the CNR of new cases was –6.4% and –4.3%, respectively. In contrast to other age groups, the CNR of new cases among the population aged over 65 rose from 497 (equivalent to 43.7 per 100 000 population) to 559 (equivalent to 46.6 per 100 000 population), with an average annual change of 1.8%.

Fig. 28 Trend and age-specific CNR of new TB cases by age group, per 100 000 population, Kazakhstan, 2011–2015



The highest age-specific CNR of new TB cases was observed in people between 15 and 34 years of age. This age group accounted for about half of all cases. However, because of “ageing” of the disease, the proportion of this age group gradually decreased from 56.2% in 2011 and 46.8% in 2015. At the same time, given the structure of age groups, the proportion of cases in people aged 35 to 44 increased from 16.8% to 19.4%, and for those aged over 45 it increased from 22.7% to 30.3% (Fig. 29).

Fig. 29 Proportion of age groups among new TB cases and the number of notified new TB cases by sex and percentage of males, Kazakhstan, 2011–2016

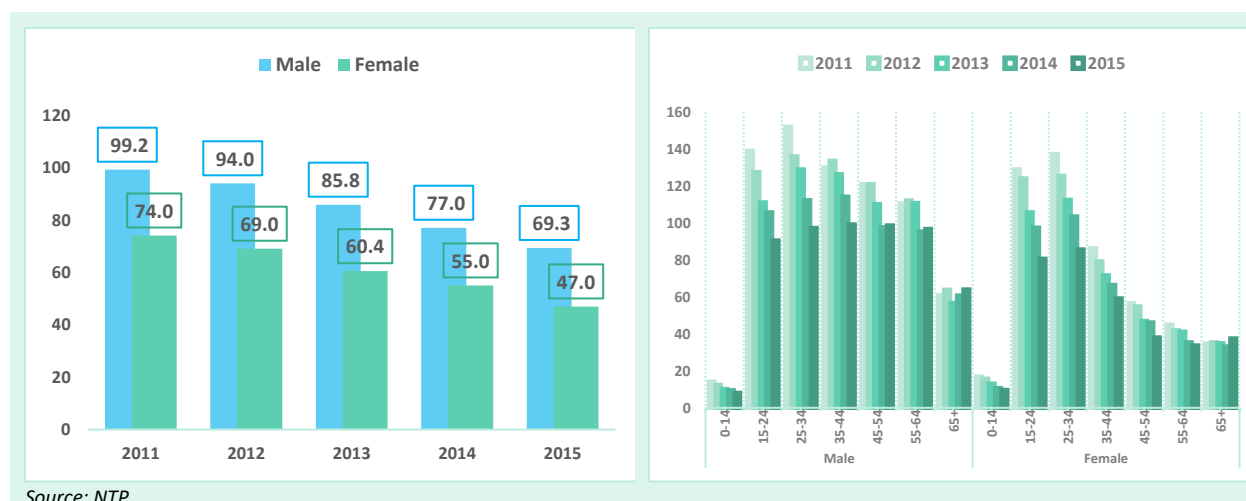


In this context, the decrease in the CNR of TB cases among younger people could be a sign of an annual decrease in the risk of infection, suggesting also a decrease in the risk of transmission of TB in the

general population. TB in the elderly results largely from reactivation of latent infection, so a decrease in the transmission rate in the population has little effect on the TB incidence in this age group.

The downward trend in the CNR of new cases is observed in both the male and the female populations. The CNR for new cases of TB has a faster downward trend among women than men. The average annual rate of decline among men was -8.5% , while among women it was -10.5% . Thus, between 2011 and 2015, the CNR for new cases of TB decreased from 99.2 to 69.3 per 100 000 population among males; and from 74.0 to 47.0 per 100 000 population among females. Thus, the proportion of males increased slightly, from 55% to 58%, among the total number of newly notified TB cases in 2011 and 2015, respectively (Fig. 29 and Fig. 30).

Fig. 30 CNR of new TB cases by sex and age group, per 100 000 population, Kazakhstan, 2011–2015



Source: NTP

The complex analysis of the five-year period 2011–2015 highlights the annual variations of the decline, both with respect to the different age groups and between the sexes. Thus, in the 0–14 age group, the average annual value was -13% and similar among both males and females. In the 15–24 and 25–35 age groups, the annual variation was -10% among men and -11% among women. In the 35–64 age group, the annual variation in notification of new TB cases was more pronounced among women and was 9% and -7% for 35–54-year-olds and 55–64-year-olds, respectively. Among men, the average annual variation was -6% in the 35–44 age group, -5% in the 45–54 age group, and -3% in the 55–64 age group. The CNR of new cases in the over 65 age group changed yearly by 1.5% and 2.2% among men and women, respectively (Fig. 30 and

Fig. 31).

The CNR of new cases of TB is decreasing in young male and female age groups. However, with the increase in age, the fall in CNRs is gradually slowing, and after 65 it is rising, among both women and men.

Fig. 31 Age and sex-specific TB CNR among new cases, per 100 000 population, Kazakhstan, 2011–2015 (overleaf)

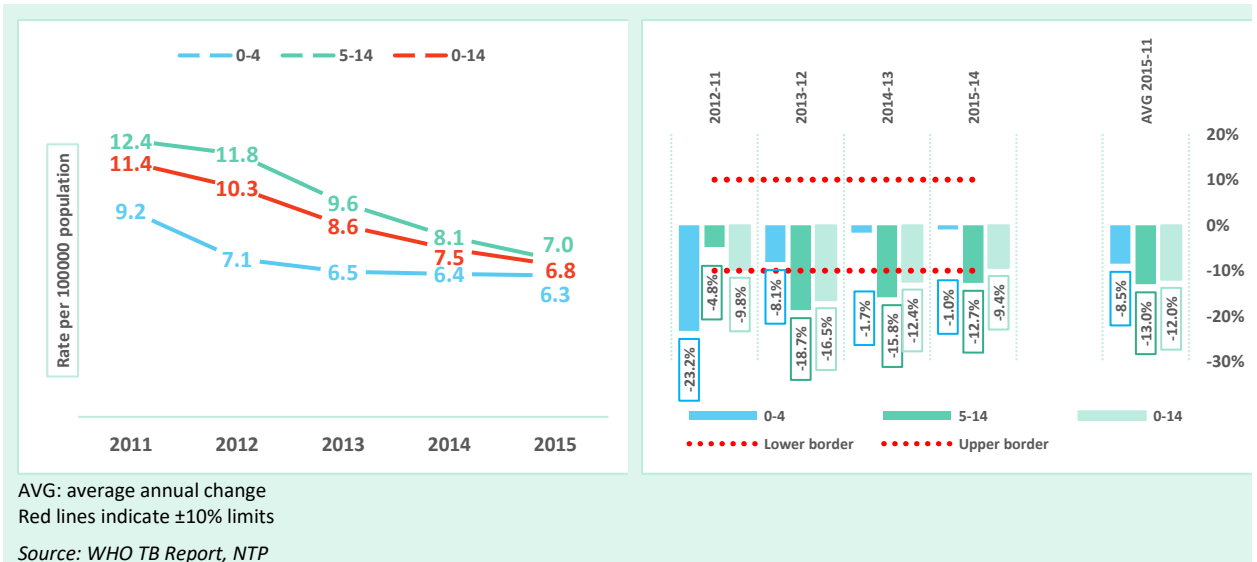


4.2.3.7 Trends in child TB

The trend in TB incidence in children is downward and similar to the decreasing trend in the overall incidence of TB. Thus, the absolute number of cases of TB in children in 2011–2016 practically halved, from 619 to 323 cases. The CNR of new cases of TB among children decreased from 11.2 per 100 000 population in 2011 to 6.8 per 100 000 population in 2015.

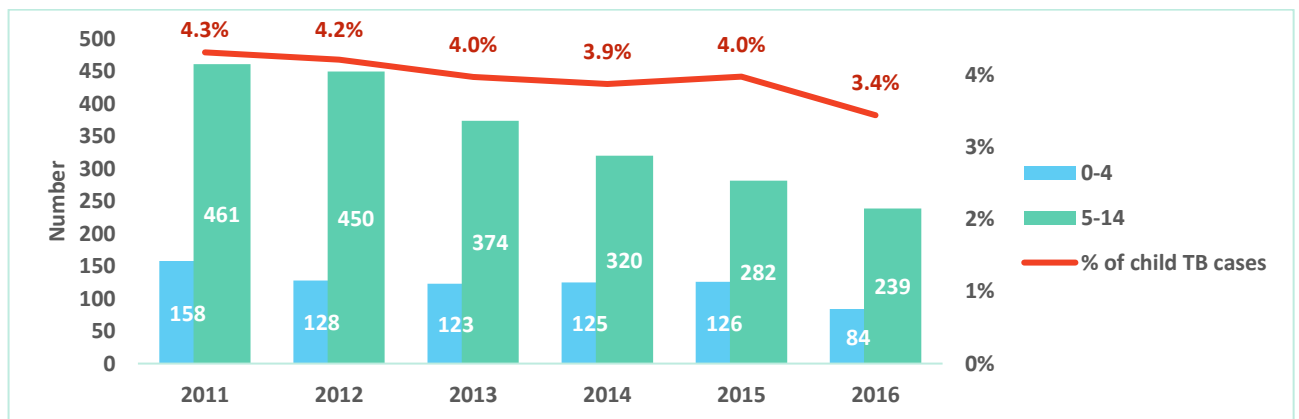
The CNR of new cases in children aged 0–14 declined on average by –12% annually between 2011 and 2015. The sharpest decline was between 2013 and 2012 and amounted to –16.5%. Over the same years, the annual average decline was –8.5% among children aged 0–4 and –13% among those aged 5–14. The sharpest reduction among 0–4-year-olds occurred between 2012 and 2011 (a reduction of –23.2%), and among those aged 5–14, between 2013 and 2012 (a reduction of –18.7%) (Fig. 32).

Fig. 32 Trend and annual change in CNR of new TB cases in children, Kazakhstan, 2011–2015



Between 2011 and 2015, the proportion of new cases of TB in children aged 0–14 was about 4% of all new reported TB cases. A lower share (3.4%) was recorded in 2016. Similarly, TB cases in the 5–14 age group predominate over those in children aged 0–4, the ratio being nearly 3 to 1 (Fig. 33).

Fig. 33 Trend in notified number of TB cases in children and proportion of child TB among all new TB cases, Kazakhstan, 2011–2016

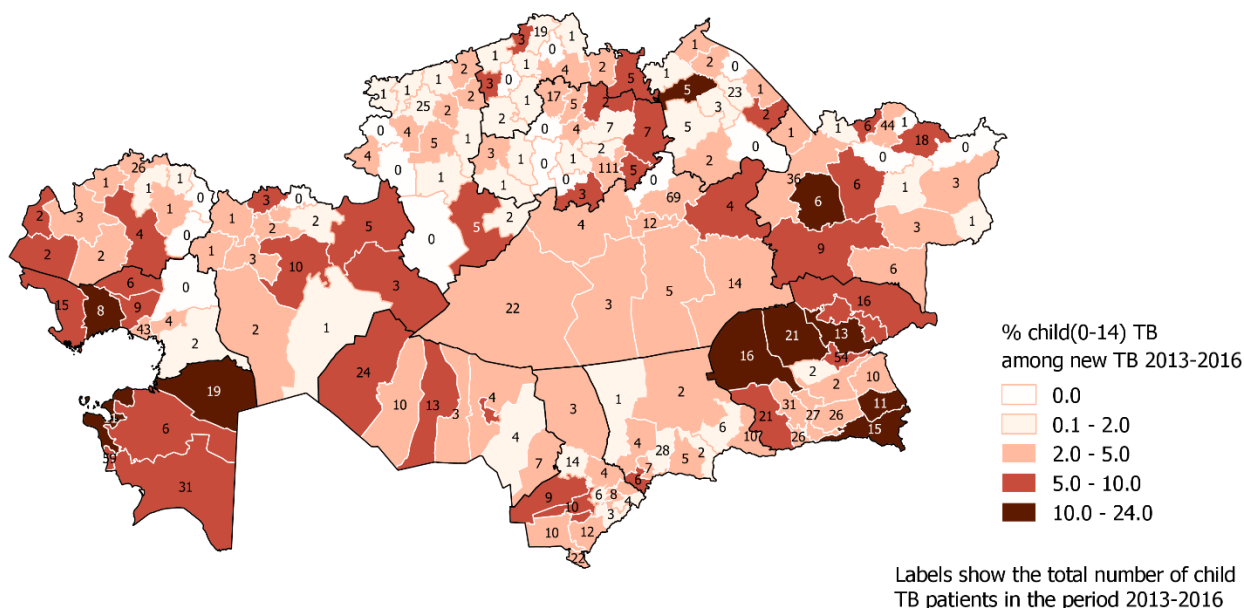


Source: WHO TB Report, NTP

In light of the above, the fall in the number of children with TB between 2011 and 2015 is more likely to be due to a reduction in the 5–14 age group, suggesting that diagnosis of TB among younger children should be improved. However, in 2016 the number of TB cases in the 0–4 age group decreased by a third compared to the previous year. According to current thinking about TB epidemiology, the number of children aged 0–4 with TB should exceed the number in the 5–14 age group.

In 2016, at district level, the proportion of children among new cases varied from 0% to 33.3%. As the number of new patients in certain districts is rather low, a four-year average of the proportion of children is shown in Fig. 34. In 17 districts no new child TB patients were notified in the period 2013–2016. No clear geographical pattern with respect to proportion of child TB cases was observed (Fig. 34), though there appears to be a cluster of low values in the north. The great variation in the proportion could be indicative of variation between districts in their ability to diagnose child TB and/or awareness of TB among children.

Fig. 34 Proportion of children among new TB cases, Kazakhstan, 2013–2016



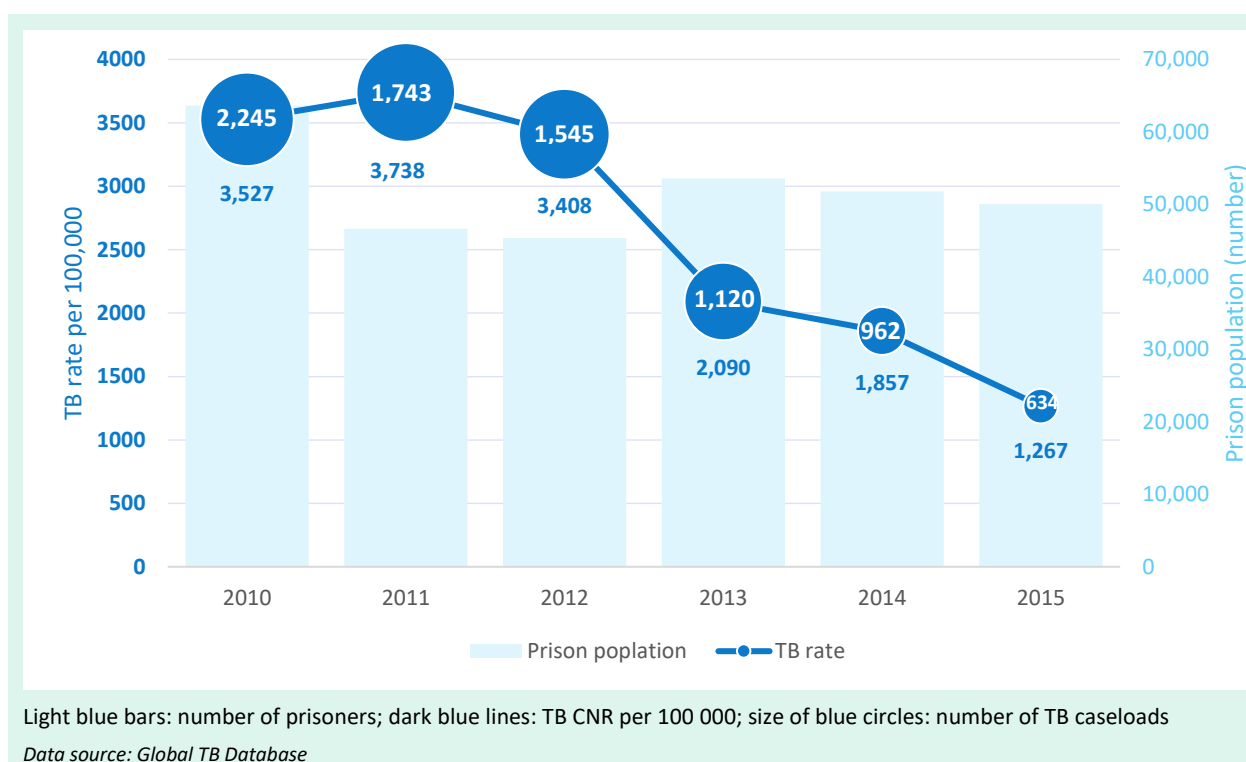
4.2.3.8 Trend of TB in the penitentiary system

Between 2010 and 2015 there was an impressive decline of the TB burden in prisons. The absolute number of notified TB cases in prisons declined by a factor of more than 3, from 2245 in 2010 to 634 in 2015. The CNR also declined in the same period, from 3527 to 1267 per 100 000 population (Fig. 35). The decline of the TB burden in prisons was even faster than in the general population; this is reflected in the percentage reduction of prison TB cases as a proportion of the country total, as well as in a decline in relative risk. In 2015 prison TB cases accounted for only 8.7% of all notified TB cases in Kazakhstan, while in 2010 prison TB cases accounted for 12.4% of the country total. Such a fall in TB cases was partially explained by a reduction in the country’s prison population; however, a faster rate of reduction compared to the general population was shown by a sharp decline in relative risk as well (Table 3).

Table 3 Trend of TB in prisons, Kazakhstan, 2010–2015

Year	Prison population	TB cases in prison (all forms)	TB CNR in prisons per 100 000	% of prison TB cases out of country total	TB relative risk (RR) in prisons
2010	63 643	2245	3527.5	12.4%	20.2
2011	46 629	1743	3738.0	14.2%	23.5
2012	45 335	1545	3408.0	15.8%	26.6
2013	53 586	1120	2090.1	10.5%	18.0
2014	51 792	962	1857.4	11.8%	20.5
2015	50 048	634	1266.8	8.7%	15.3

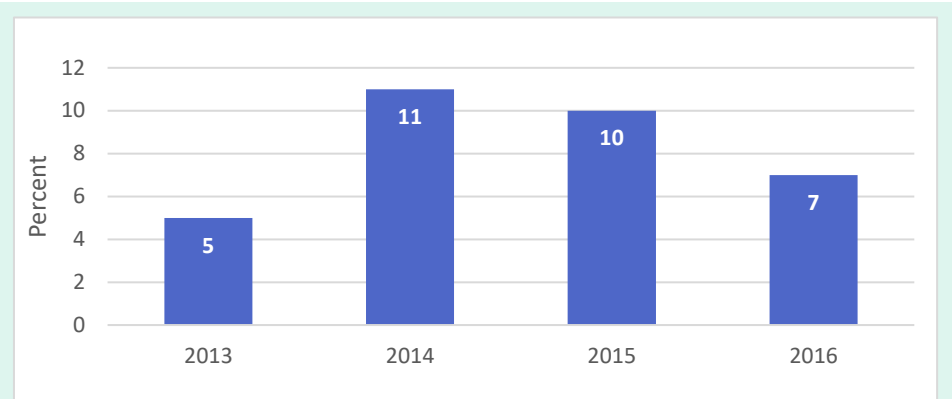
Fig. 35 Time trend in number of prisoners, TB CNR per 100 000, and number of TB caseloads in prisons, Kazakhstan, 2010–2016



4.2.3.9 Trend of TB among people living with HIV (PLHIV)

According to UNAIDS estimates, the proportion of PLHIV newly enrolled in HIV care with active TB disease rose from 5% to 11% in 2013–2014, and then steadily dropped to 7% between 2014 and 2016 (Fig. 36). In light of this, we may conclude that HIV is one of the leading causes driving the TB epidemic upwards.

Fig. 36 Proportion of PLHIV newly enrolled in HIV care with active TB disease, Kazakhstan, 2013–2016



Data source: Global TB Report 2017

Key findings

- TB mortality in Kazakhstan has shown a steady and sharp decline over time. Because the quality and coverage of the VR system in Kazakhstan is adequate, this decline must reflect a true reduction in the TB burden in the population. The fact that mortality has declined at roughly twice the rate of TB notification indicates that the reduction in TB deaths is due not only to a reduction in TB transmission in the population (a reduction in TB incidence), but also to a decline in case fatality resulting from an increase in treatment success rate and TB case detection.
- Since 2004 the estimated TB incidence in Kazakhstan has declined at an average annual rate of 7.9%.
- There is a similar downward trend in the CNR of new cases and relapses with pulmonary and extrapulmonary localization, with an average rate of decrease of –8.9% and –10% per year, respectively.
- In the period 2011–2016 TB notification decreased across all geographical regions and in prisons.
- The proportion of bacteriologically confirmed PTB cases among new PTB cases increased from 48.5% in 2012 to 84.7% in 2016.
- There is a wide geographical variation in the proportion of smear-positive new PTB cases, ranging from 33% to 58%.
- The absolute number of clinically diagnosed new PTB cases varies sharply from year to year, suggesting inconsistencies in TB diagnosis.
- The proportion of extrapulmonary cases among new TB cases is stable over time but with notable geographical variation, ranging between 7.3% and 20.5% in 2016.
- TB notification decreased in both males and females, but the decrease in females was much more rapid, resulting in an increase in the male-to-female ratio over time.
- In the period 2011–2016 the proportion of retreated cases among all notified cases remained high, ranging between 36.1% and 39.5% without any clear trend over time.
- Age-specific CNRs of new TB in the period 2011–2016 decreased across all age groups except among those aged over 65, where there was a slight increase. The slope of decline in TB notification decreased with increase in age. This reflected a gradual change in the age structure of the TB population towards older age groups. Such changes are an indication of a reduction in TB transmission in the population.

- The proportion of child TB cases among new cases in the period 2011–2016 decreased from 4.3% to 3.4%.

4.3 Are recent trends in TB disease burden plausibly related to changes in TB-specific interventions, taking into account other external factors?

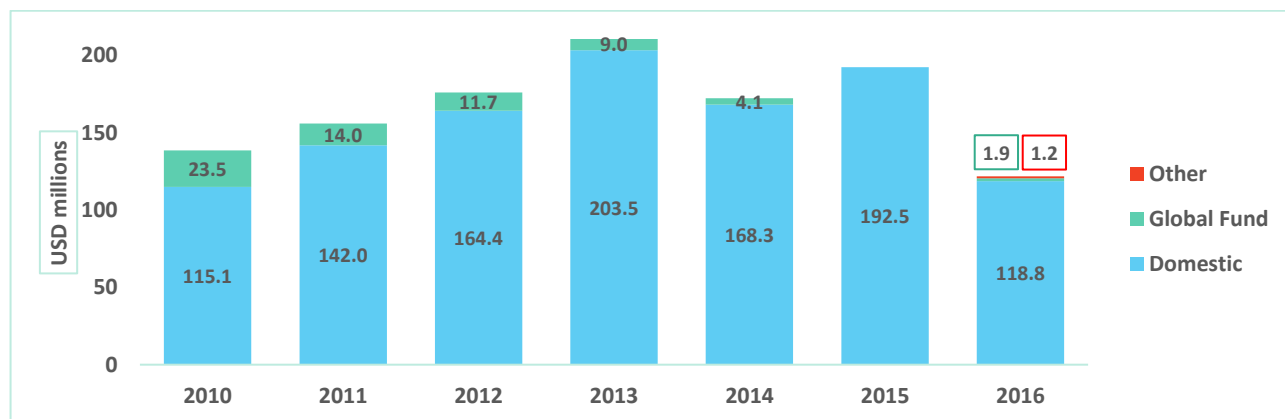
4.3.1 Factors related to the TB programme

4.3.1.1 Government and donor funding for TB care and control

Funding and implementation of high-quality TB-specific interventions should result in detection of people with TB and curative treatment for them. In turn, these actions should have a direct impact on TB mortality by reducing case fatality rates compared with no or substandard treatment.

Kazakhstan’s TB services are mainly funded from government sources. There was an increase in national financial allocations of about 20% annually, on average, over the years 2010–2013. After 2013 there was a fluctuation in financial allocations: a decrease of 17% in 2014, an increase of 14% in 2015, and a decrease of 38% in 2016 compared to the previous year. External allocations came, in particular, from the Global Fund to Fight AIDS, Tuberculosis, and Malaria. The largest allocation from the Global Fund came in 2010, when they provided 17% of the total amount allocated to TB services that year. Since 2011, allocations from the Global Fund have gradually, but substantially, reduced, so that by 2014 they accounted for only 2.4% of the total financial allocations for that year. The year 2015 was covered entirely by national funding. In 2016 national funding accounted for 97.5%, with the Global Fund providing 1.5% of the remainder (Fig. 37).

Fig. 37 Actual expenditure on TB control interventions in US\$ (millions), Kazakhstan, 2010–2016



Source: WHO TB Report, NTP

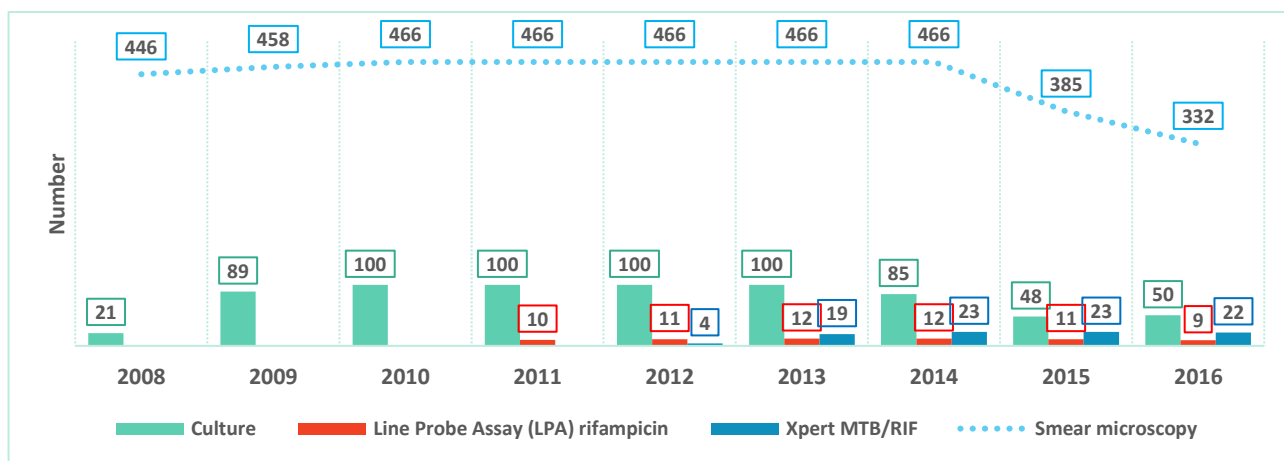
As increased TB funding coincided with a fall in TB notification in the country, it can be concluded that extra funding contributed to driving the TB epidemic downwards.

4.3.1.2 Number of health facilities providing TB diagnostic services

The TB laboratory network in Kazakhstan is well developed and comprises in total 22 culture/DST laboratories and 332 microscopy laboratories at three levels: national, regional and peripheral. The National TB Reference Laboratory (NRL), located at the National Centre of Tuberculosis in Almaty, coordinates the laboratory network. Although the total number of microscopy laboratories fell from 466 in 2010 to 332 in 2016, they still remain widely accessible to the population across the country. In 2016 the Kazakhstan TB laboratory network comprised, on average, one microscopy laboratory per 51 000

population, against WHO’s recommendation of (at least) one per 100 000 population; and one culture/DST laboratory per 1.2 million population, against WHO’s recommendation of (at least) one DST laboratory per 5 million population. This indicates that the laboratory network is highly developed in Kazakhstan. Moreover, in 2011 LPA was introduced in Kazakhstan, and in 2013 GeneXpert MTB/RIF. As was shown earlier, introduction and widespread use of rapid diagnostic tests could improve TB diagnosis, shorten time to start of treatment, and shorten time to detection of drug-resistant cases, thereby reducing TB transmission in the population and in hospital settings. Thus, we can conclude that improvement in diagnostic services also played an important role in reducing the TB burden in Kazakhstan.

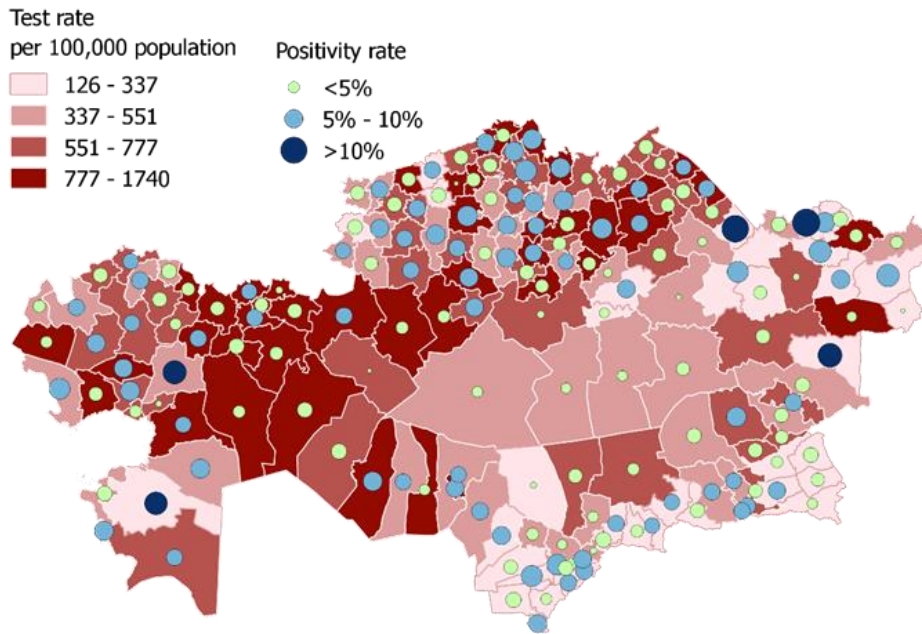
Fig. 388 Laboratory diagnostic services, Kazakhstan, 2008–2016



Source: WHO TB Report, NTP

Another way of looking at diagnostic coverage is to study the number of presumptive TB patients identified and tested across the total population (testing rate) and the proportion of smear-positive TB patients identified among persons tested for TB. For 2016, the number of people who were suspected of TB and examined by sputum smear and the number who tested positive were available by district. The testing rate varied from 126 persons tested per 100 000 population to 1740. Comparing the testing rate in Fig. 39 below with the smooth new and relapse CNR (Fig. 15) shows a similar pattern, with lower testing rates in the south where lower notification rates were also seen.

Fig. 39 Proportion of the population tested by smear microscopy (testing rate per 100 000 population) and the proportion tested positive, by district, Kazakhstan, 2016

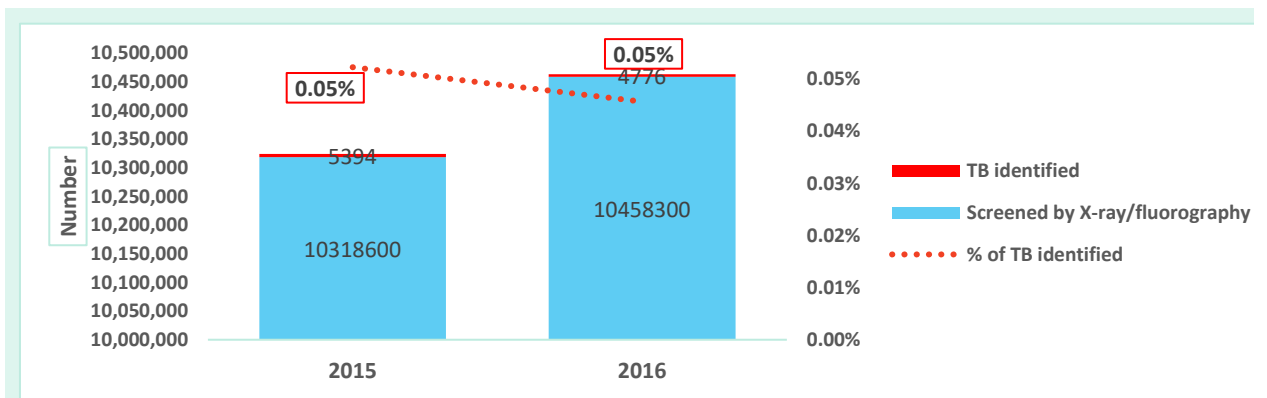


4.3.1.3 Active case finding (screening and contact tracing)

There is an impact on TB incidence if transmission can be reduced sufficiently and/or if preventive treatment of people with latent TB infection is implemented effectively on a large scale. Increased screening of the at-risk population can increase case detection, thus reducing TB transmission in the general population.

Radiological screening is organized as follows: annual X-ray/fluorography screening is conducted on a mandatory basis for defined risk groups. For this component, it should be emphasized that risk groups include a wide range of individuals, and the proportion of people found with TB in the examined population (civil sector, excluding Baikonur) did not exceed 0.05% in 2015 or 2016 (Fig. 40).

Fig. 40 TB identified among those screened by X-ray/fluorography, Kazakhstan, 2015–2016



Source: Global TB Report; NTP

According to the country’s reports from 2008 to 2016 on the WHO global TB database, the number of TB contacts ranged from 11 735 to 69 032, with the trend increasing and then decreasing over time. The

average number of contacts screened per notified sputum-smear-positive PTB case in the civilian population fluctuated from year to year, in a range from 0.8 to 7.7 in the period 2008–2016 (Table 4).

Table 4 Number of TB contacts screened and yield of TB cases among contacts, Kazakhstan, 2008–2016

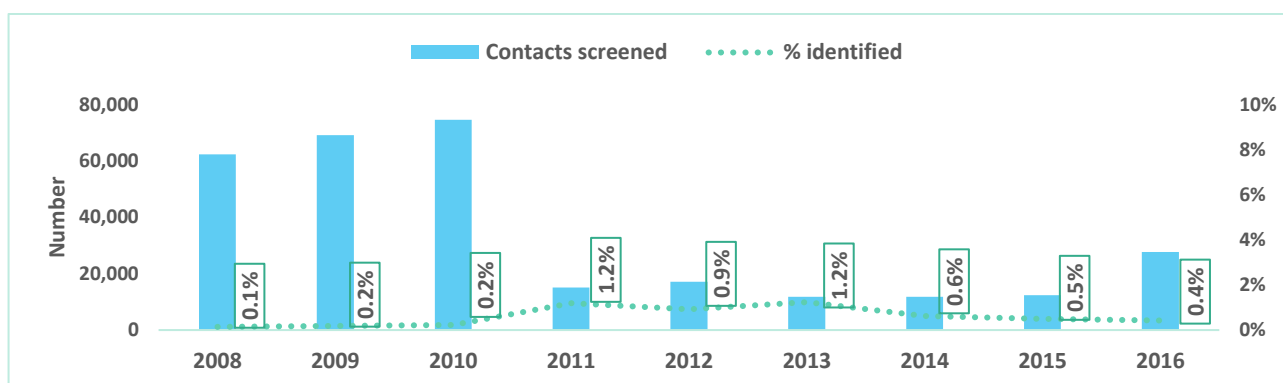
Year	Laboratory confirmed TB cases in civilian population			Contacts screened n	Contacts screened /case; mean	TB cases detected among contacts		Contacts who received IPT	
	New	Relapse	N&R			n	%	n	%
2008	6193	3418	9611	62 235	6.5	88	0.1	88	0.1
2009	5213	3698	8911	69 032	7.7	131	0.2	131	0.2
2010	6448	4062	10 510	74 552	7.1	169	0.2	169	0.2
2011	6161	4739	10 900	15 125	1.4	180	1.2	n/a	0.0
2012	5711	4377	10 088	17 075	1.7	156	0.9	n/a	0.0
2013	7942	5987	13 929	11 735	0.8	145	1.2	1820	15.5
2014	8864	3450	12 314	11 735	1.0	73	0.6	n/a	n/a
2015	6505	3526	10 031	12 403	1.2	61	0.5	1100	8.9
2016	6930	2749	9679	27 650	2.9	117	0.4	1117	4.0

Source: WHO TB Report; NTP

The proportion of persons detected with TB among contacts examined exceeded 1% only in 2011 and 2013. On the basis of the results of screening among TB contacts in the civilian population, there is no evidence that fewer TB cases are detected among contacts over time. Thus, the decrease in TB notification cannot be explained by changes in active screening (Fig. 41).

Contacts who had received isoniazid preventive therapy (IPT) in the period 2008–2010 constituted less than 1%. In 2013, their share increased to 15.5%, and in 2015 and 2016 they constituted 8.9% and 4.0%, respectively. In this respect, it is not clear whether IPT had any influence on the decline in TB incidence.

Fig. 41 Trend in number of TB contacts screened and percentage of TB diagnoses among TB contacts, Kazakhstan, 2008–2016



Source: WHO TB Report, NTP

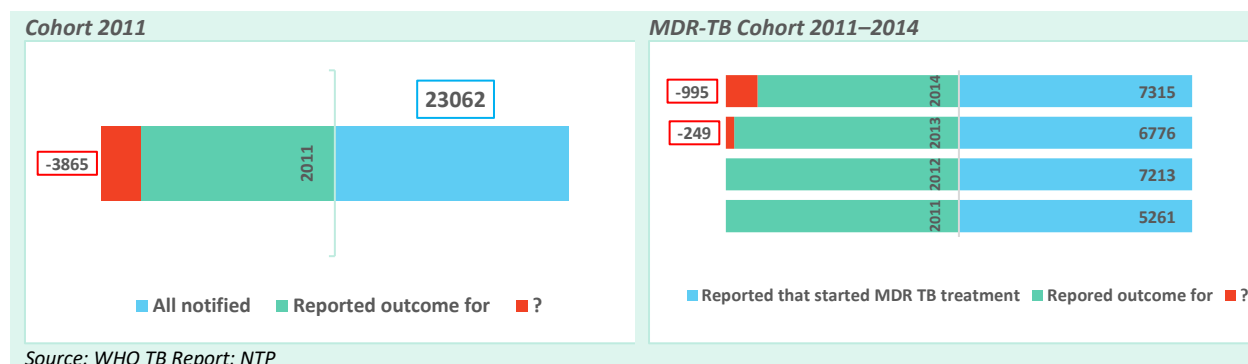
In this context, investigating individuals in risk groups for TB, including contact persons, is an important activity in the control of TB. However, national protocols need to be updated to international standards on formation of TB risk groups and methods for diagnosing latent TB infection.

4.3.1.4 Treatment outcomes

TB treatment is one of the most effective interventions in TB control to reduce prevalence of cases in the population and transmission of infection.

Treatment results were analysed among all cases of TB: susceptible TB and resistant TB. Before we analysed treatment results, we counted the number of notified cases enrolled in treatment and the number of cases for which treatment outcomes were assessed. Thus, we determined that results were omitted for 17% of notified cases in 2011, and for 3% and 13% of reported cases that initiated treatment for MDR-TB in 2012 and 2013, respectively (Fig. 42).

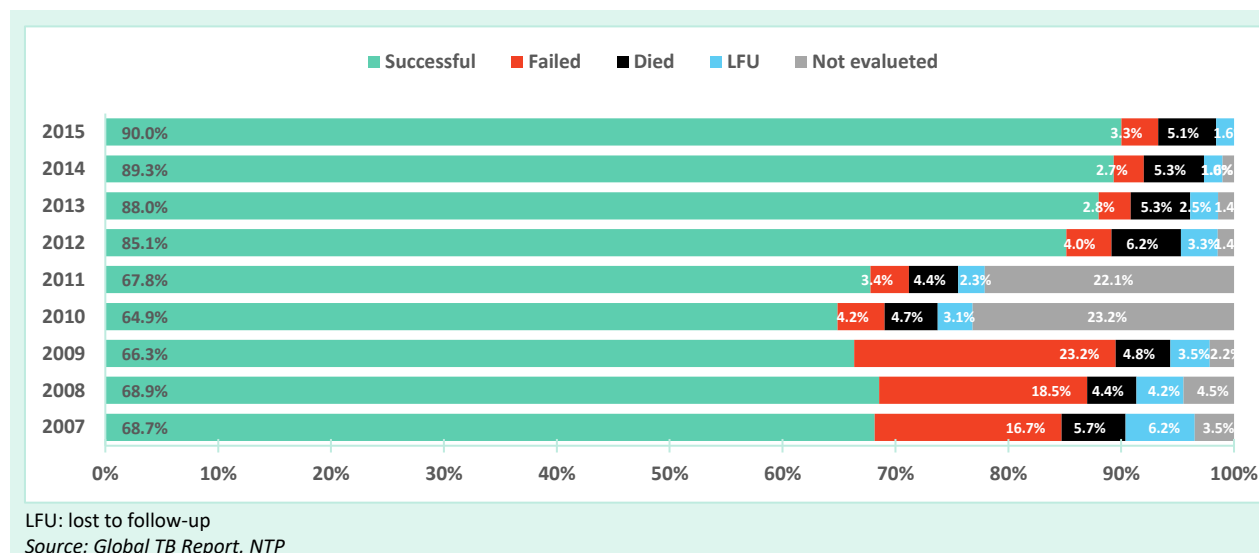
Fig. 42 Number of notified cases versus number of cases with treatment results, Kazakhstan, 2011–2014



Similarly, it should be noted that the cohort analysis reported to WHO does not include data for the penitentiary sector; it includes data for the civil sector only and excludes Baikonur city. Thus, the analysis below is based on country-reported data to WHO.

Fig. 42 and Fig. 43 show cohort analysis among all cases of TB, new and recurrent. It should be noted that, as of 2012, WHO had adjusted the definition of cohort analysis, including interpretation of treatment outcomes. Thus, by 2012, all cases of susceptible and resistant TB were analysed in the same cohort, and cases of MDR-TB were categorized as “failed” or “not evaluated” treatment results.

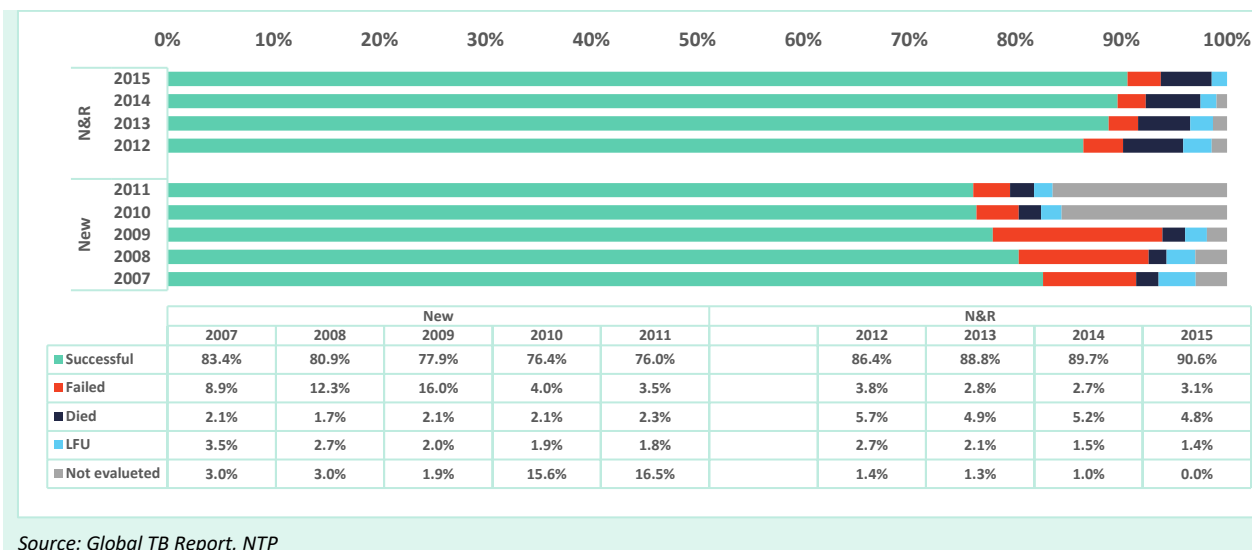
Fig. 43 Treatment outcomes of all TB patients, Kazakhstan, 2007–2015



The proportion of successfully treated cases for the 2007–2011 cohorts was relatively stable, lying between 65% and 69%, and failure to treat was caused, in particular, by the burden of MDR-TB. From 2012, an increase in the success rate from 85% to 90% was observed and the share of failed cases fell to 3.3%. At the same time, deaths remained at 5–6% (Fig. 43).

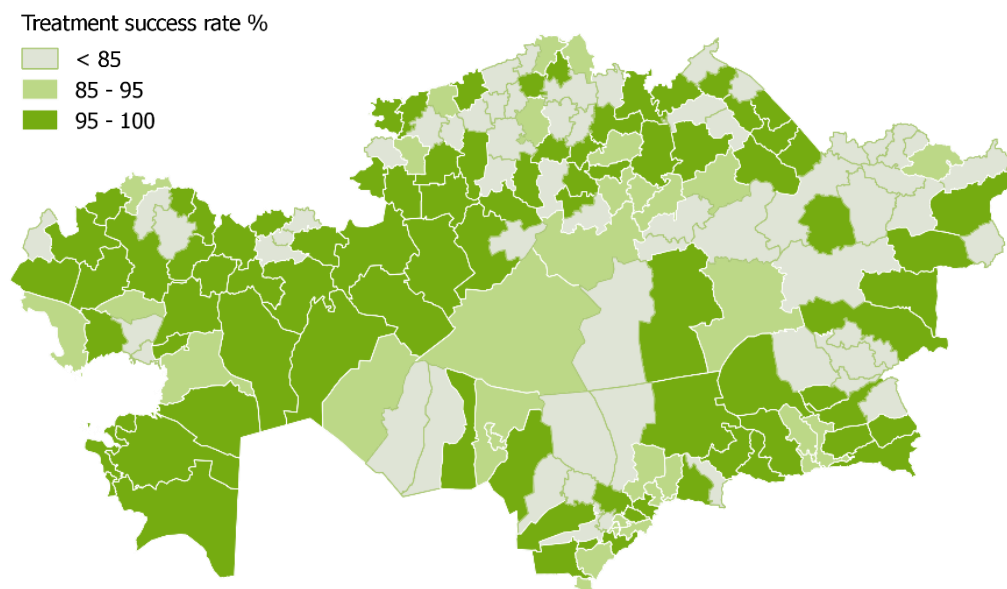
Analysis of outcomes among new TB cases and relapses shows the same rise after 2012. It is notable that treatment success increased from 84% for the 2012 cohort to 91% for the 2015 cohort – an indicator that exceeds WHO’s 85% target. The proportion of deaths remained stable for the 2012–2015 cohorts, at around 5% (Fig. 44).

Fig. 44 Treatment outcomes of new and relapse TB patients, Kazakhstan, 2007–2015



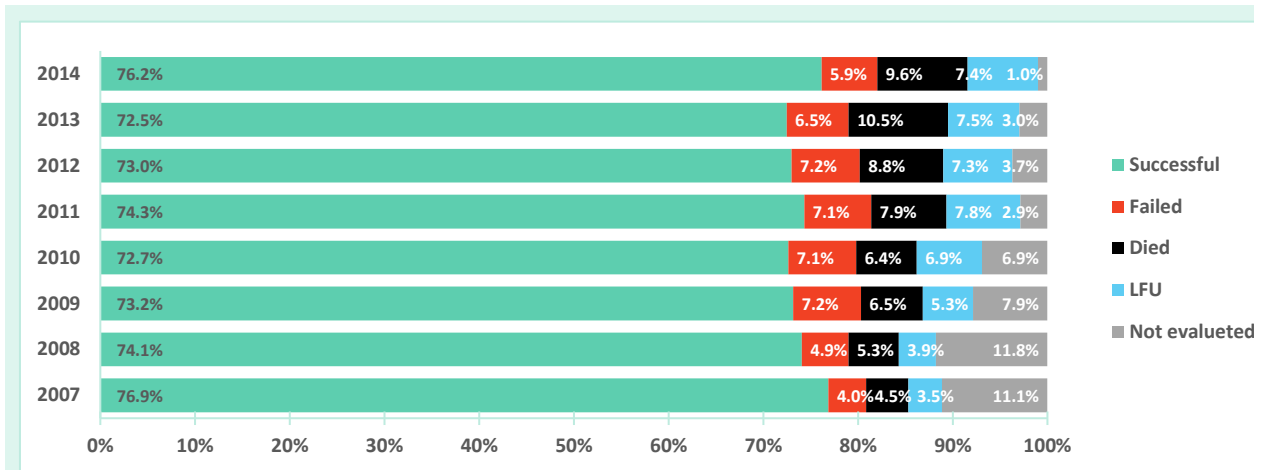
Source: Global TB Report, NTP

Fig. 45 Treatment success rate for new drug-sensitive sputum smear-positive patients registered in 2015



Kazakhstan records impressive results for MDR-TB. Treatment success rates were in a range between 72% and 77% in the period 2007–2014, exceeding the European average for this period. Failure to treat MDR-TB is mostly due to death, which reached about 10% for the final two cohorts, in 2013 and 2014. It is also noteworthy that the failure rate for treatment for MDR-TB was reduced to 6% for the same cohorts (Fig. 46), which is explained by application of treatment regimens for extensively drug-resistant TB (XDR-TB).

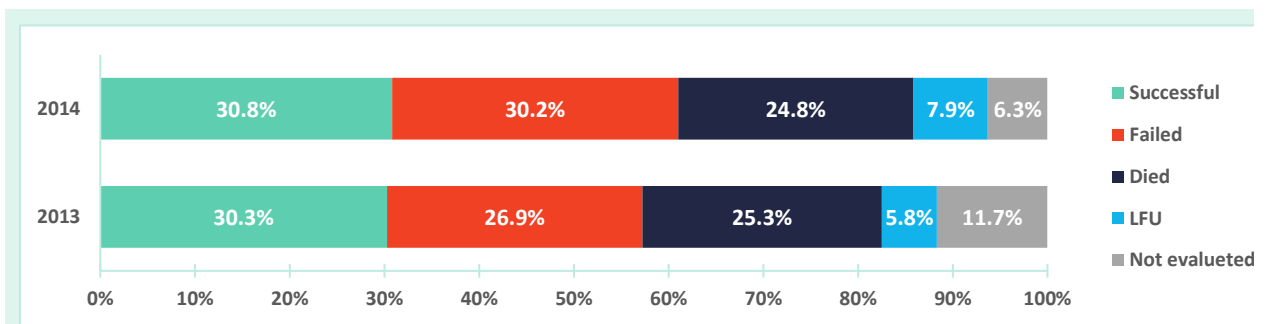
Fig. 46 Treatment outcomes of confirmed RR/MDR-TB patients enrolled into second-line treatment, 2007–2014



Source: Global TB Report, NTP

After 2013, treatment regimens for patients with XDR-TB were implemented in the country. Treatment was successful in about a third of cases, and failure was mainly due to treatment failure and death (Fig. 47 **Error! Reference source not found.**).

Fig. 47 Treatment outcomes of XDR-TB patients enrolled in treatment, Kazakhstan, 2013–2014



Source: Global TB Report, NTP

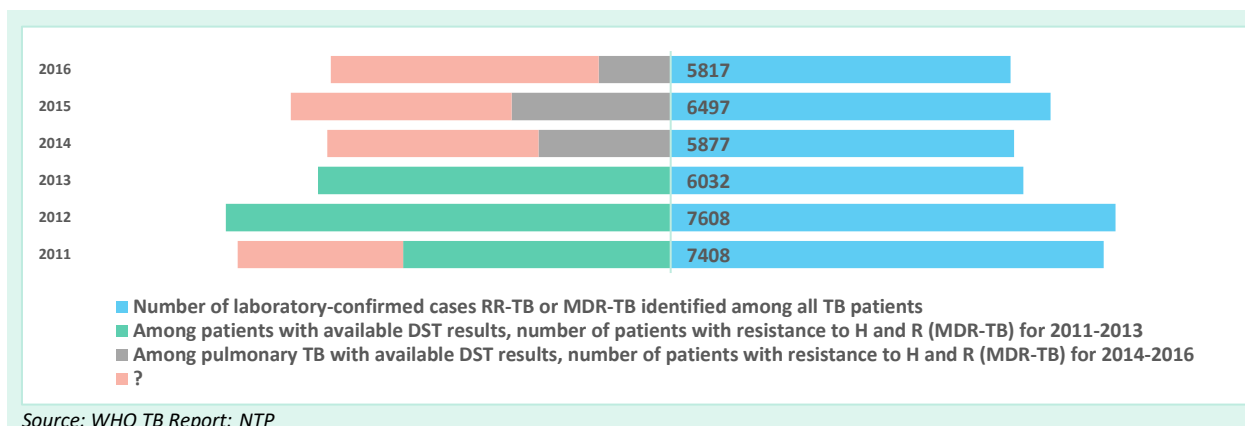
4.3.1.5 RR/MDR-TB

RR/MDR-TB represents a challenge because of the long duration and low effectiveness of available treatments. The increased RR/MDR-TB burden can be considered one of the key factors driving the TB epidemic upwards. Kazakhstan is one of 30 countries globally with a high burden of MDR-TB.

Kazakhstan has a routine drug-resistance surveillance system, universal access to DST, or GeneXpert MTB/RIF for all cases of bacteriologically confirmed PTB.

At the same time, analysis and interpretation of data on notified resistant TB cases present some difficulties for a correct understanding of the burden of MDR-TB at national level. Fig. 48 demonstrates a lack of clarity regarding reported data for RR/MDR-TB.

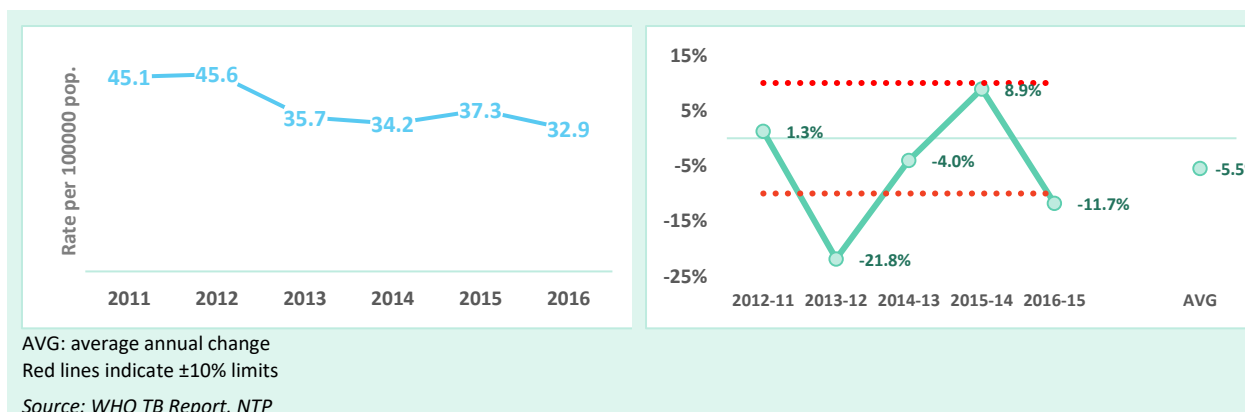
Fig. 48 Reported number of RR-TB or MDR-TB cases, Kazakhstan, 2011–2016



It is also worth mentioning that RR/MDR-TB data for the country are presented for the civil sector only (excluding Baikonur city) and do not include the penitentiary system. These omissions could cause an erroneous understanding of the burden of MDR-TB at country level.

However, the RR/MDR TB incidence rate declined from 45.1 per 100 000 population in 2011 to 32.9 per 100 000 population in 2016; the average annual decline over this period was –5.5%. At the same time, there is a variation in the incidence of RR/MDR TB of –21.8% between 2013 and 2012 and of –11.7% between 2016 and 2015 (Fig. 49).

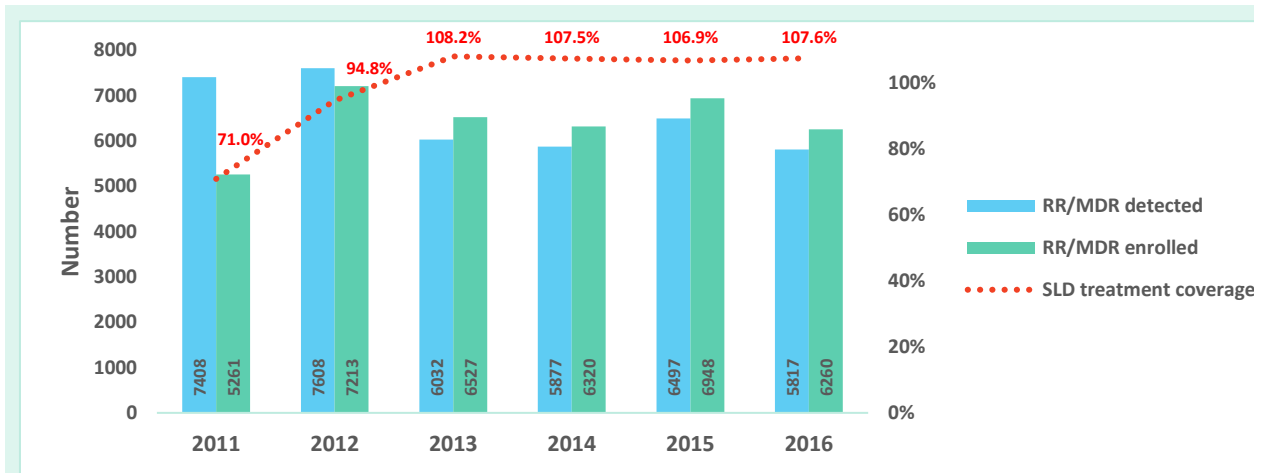
Fig. 49 Trend and annual change in CNR of RR/MDR-TB cases, Kazakhstan, 2011–2016



In this context, the RR/MDR-TB rate has oscillated over the years, which could indicate a notification problem.

Fig. 50 presents data on diagnosis of RR/MDR-TB and coverage with anti-TB treatment specific to these forms of TB. In the context, RR/MDR-TB treatment coverage is quite high, exceeding 100%. At the same time, the share of people enrolled in treatment for 2013–2014 could be over 112% and 125%, if the number of people indicated to have initiated treatment (6776 and 7315 respectively) is considered as a reference, rather than those presented at the cohort analysis. This needs to be clarified with the NTP M&E unit.

Fig. 50 Number of RR/MDR-TB cases detected, and number and proportion of these enrolled in second-line treatment, Kazakhstan, 2011–2016



Source: WHO TB Report; NTP

In 2016 the CNR of MDR-TB, by district level, ranged between 0 and 83 cases per 100 000 population. With respect to new TB patients, meanwhile, the proportion of MDR-TB ranged from 0 to 58.8%. There was no clear geographical pattern of MDR-TB distribution across the country; however, there was some clustering of districts by level of MDR-TB burden. At the same time, it is common to find districts with the highest and lowest levels sharing borders (Fig. 51 and Fig. 52), indicating large (spatial) variations in MDR-TB notification rates and percentage of new patients infected with MDR-TB.

Fig. 51 MDR-TB notification rate per 100 000 population, Kazakhstan, 2016

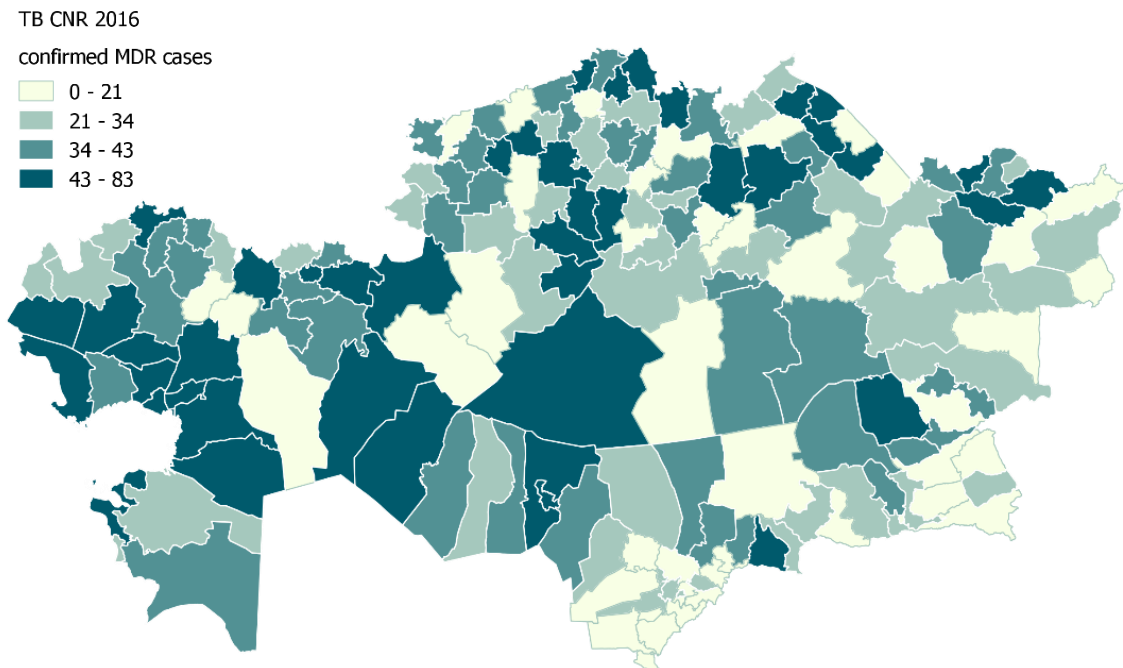
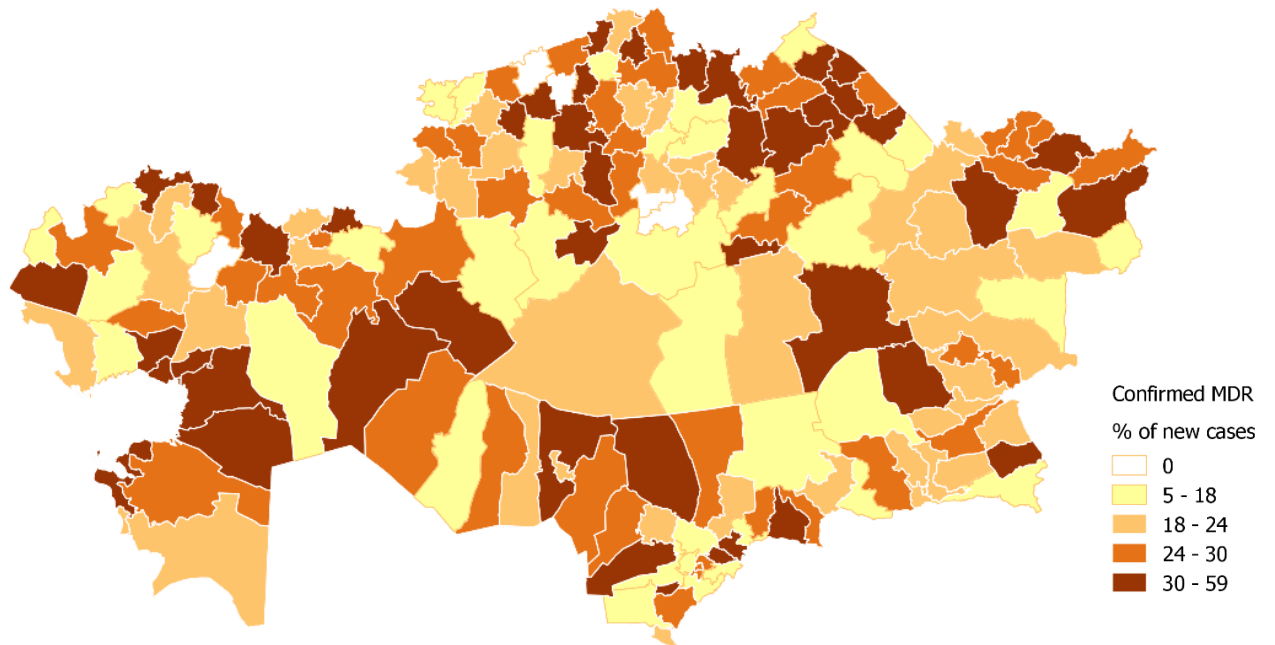


Fig. 52 Proportion of laboratory-confirmed MDR-TB cases among new TB patients, Kazakhstan, 2016

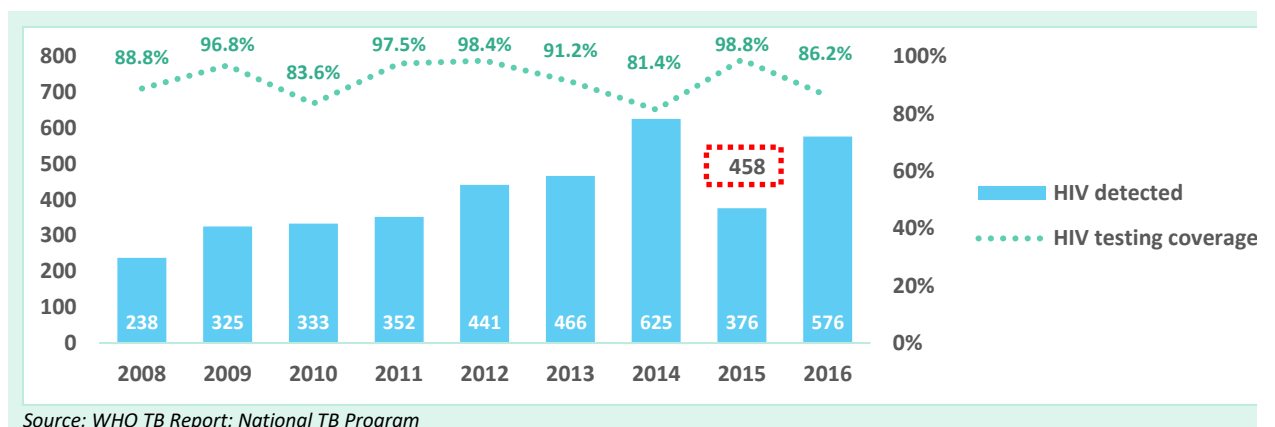


4.3.1.6 TB/HIV

To ensure effective and integrated TB and HIV service delivery, WHO recommends HIV testing for all TB patients; provision of antiretroviral treatment (ART) and co-trimoxazole preventive treatment (CPT) to HIV-positive TB patients; regular TB screening for PLHIV; and offer of IPT to PLHIV who do not have active TB.

HIV testing of TB patients registered in 2009 and 2011–2013 was over 90%; there were slight decreases in 2008 and 2010. In 2013 HIV testing was 91.2%, but by 2016 coverage had fallen to 86.2% (Fig. 53).

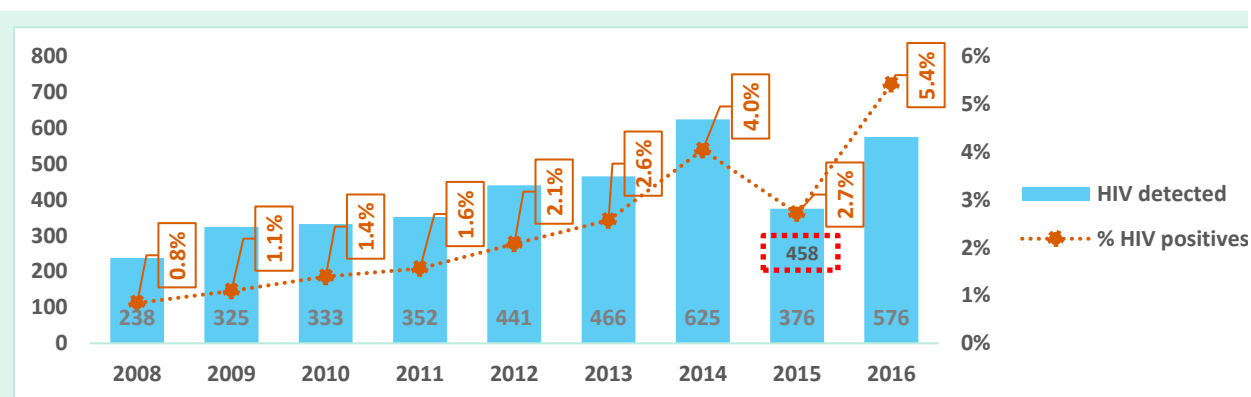
Fig. 53 Number of notified TB/HIV coinfections and HIV testing coverage among notified new and relapse TB patients, Kazakhstan, 2008–2016



The absolute number of HIV cases among TB patients gradually increased from 238 in 2008 to 576 in 2016. The highest figure – 625 people – was recorded in 2014. In 2015 the NTP presented a figure of 376, while the Republican Center on Prevention and Control of AIDS gave a figure of 458. Thus, there is no clarity about the number of HIV cases registered among people with TB in that year (Fig. 53).

The proportion of HIV cases among TB patients was only 0.8% in 2008. According to national surveillance data, the HIV burden gradually increased to 4.0% in 2014, and to 5.4% in 2016 (Fig. 54).

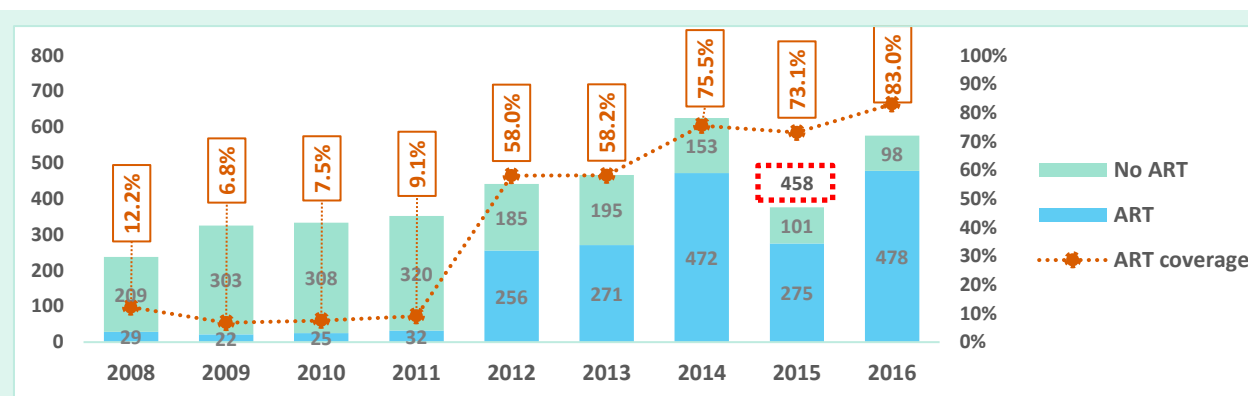
Fig. 54 Prevalence of HIV among incident TB patients, Kazakhstan, 2008–2016



Source: WHO TB Report; NTP

ART coverage among HIV-positive TB patients in Kazakhstan ranged from 7% to 12% between 2008–2011. In 2012 the proportion on ART increased significantly to 58%, and by 2016 it had reached 83% (Fig. 55).

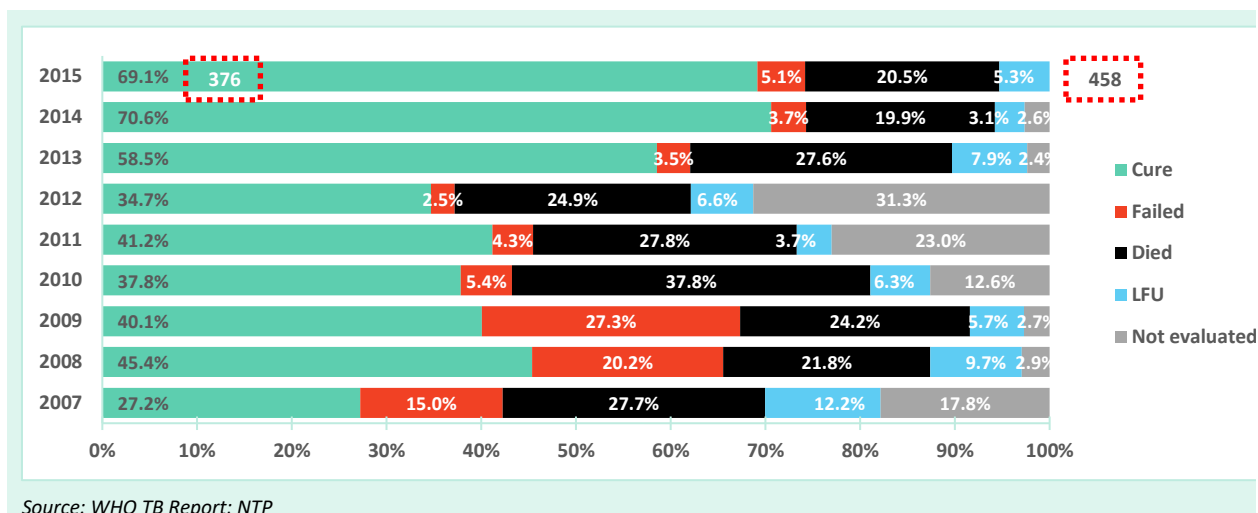
Fig. 55 Number and percentage of HIV-positive TB patients enrolled in ART, Kazakhstan, 2008–2016



Source: WHO TB Report; NTP

The success rate for anti-TB treatment of HIV-positive patients increased from 27% for the 2008 cohort to around 70% for the 2014 and 2015 cohorts. It should be noted, however, that a change in TB definitions introduced for the 2012 cohort increased the treatment success rate, as MDR patients who had previously been assigned a treatment outcome of “failed” were removed from the cohort. At the same time, treatment failure was mainly due to death of patients. The proportion of deaths ranged between 20% and 38% over the years 2007–2015 (Fig. 56).

Fig. 56 Treatment outcomes for TB/HIV patients, Kazakhstan, 2007–2015



4.3.2 External factors not related to the TB programme

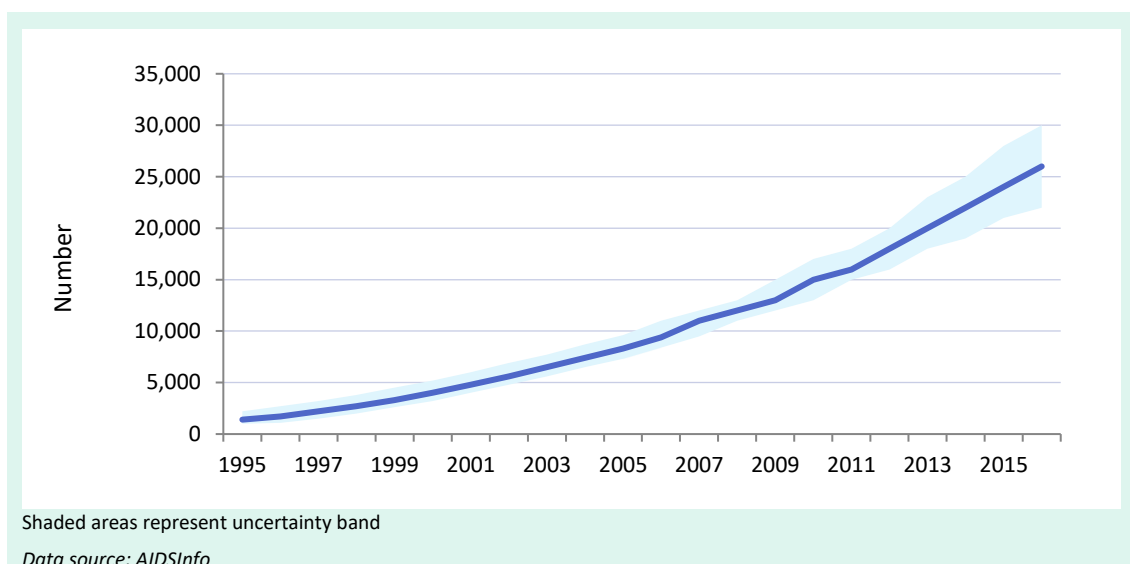
4.3.2.1 Prevalence of HIV in the general population and ART coverage

For the individual, HIV is the most potent risk factor for TB, so an increase in the number of PLHIV can drive the TB epidemic upwards. As in many other countries of eastern Europe and central Asia, the number of people newly infected with HIV continues to rise in Kazakhstan. Between 2005 and 2016 the estimated number of PLHIV rose by about 10% annually, from 8300 (range: 7300–9600) in 2005 to 26 000 (range: 22 000–30 000) in 2016, according to UNAIDS estimates;²⁸ the estimated prevalence in the 15–49-year-old population was 0.2% (range: 0.2–0.3%).²⁹ Fig. 57 shows the increase in the estimated number of PLHIV in Kazakhstan between 1995 and 2016. Such a rapid increase in HIV prevalence would drive the TB epidemic upwards.

²⁸ HIV estimates with uncertainty bounds 1990–2016. UNAIDS; 2017 (http://www.unaids.org/en/resources/documents/2017/HIV_estimates_with_uncertainty_bounds_1990-2016, accessed 1 September 2017).

²⁹ Ibid.

Fig. 57 Estimated number of PLHIV (adult and children), Kazakhstan, 1995–2016

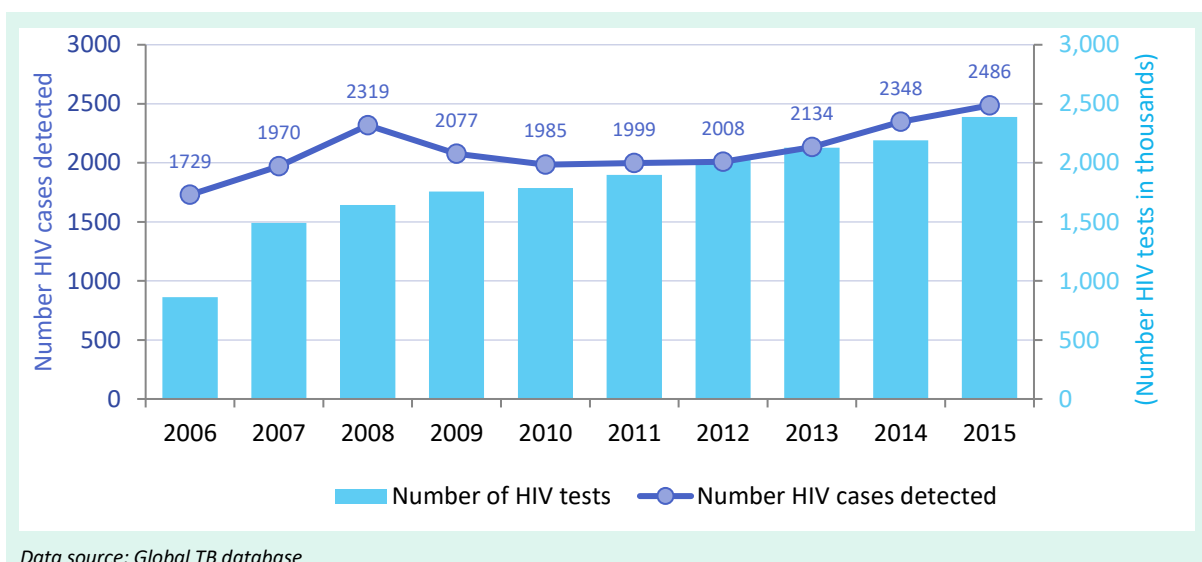


HIV control interventions such as early identification of people with HIV, enrolment in ART, and effective suppression of viral load among those receiving ART, as well as TB preventive treatment among PLHIV, could reduce the impact of the HIV epidemic on the TB epidemic. Thus, the number of HIV tests performed in Kazakhstan between 2006 and 2015 almost tripled.³⁰ During the same period, the number of HIV cases detected increased from 1729 to 2486 in 2015 (Fig. 58). Despite the upward trend in HIV testing coverage, it is estimated that only 74% (range: 64–87) of PLHIV are aware of their status, against a target figure of 90%.³¹

³⁰ European Centre for Disease Prevention and Control/WHO Regional Office for Europe. HIV/AIDS surveillance in Europe 2013. Stockholm: European Centre for Disease Prevention and Control; 2014.

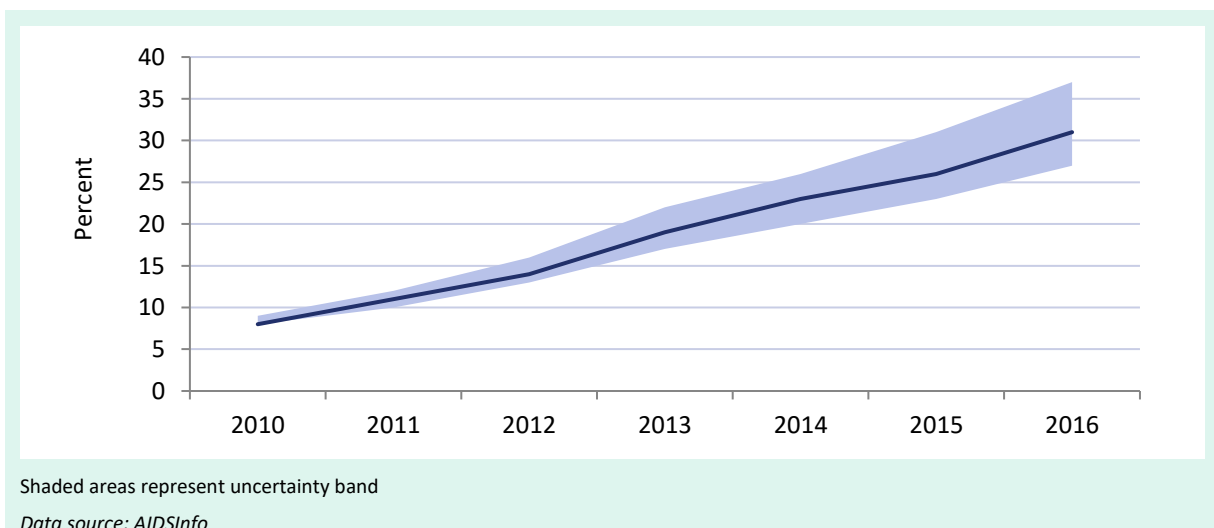
³¹ HIV estimates with uncertainty bounds 1990–2016. UNAIDS; 2017 (http://www.unaids.org/en/resources/documents/2017/HIV_estimates_with_uncertainty_bounds_1990-2016, accessed 1 September 2017).

Fig. 58 Number of HIV tests performed and HIV cases detected, Kazakhstan, 2006–2015



In 2016, new consolidated WHO HIV treatment guidelines were issued, reaffirming the 2015 recommendation that ART should be initiated in all PLHIV, irrespective of CD4 count.³² According to UNAIDS estimates, ART coverage among PLHIV in Kazakhstan increased from 8% (range: 8–9%) in 2010 to 31% (range: 27–37%) in 2016. Among people who know their HIV status, meanwhile, ART coverage in 2016 was 42%, which is alarmingly low (against a target figure of 90% for ART coverage) (**Fig. 59**

Fig. 59 Percentage of PLHIV receiving ART, Kazakhstan, 2010–2016

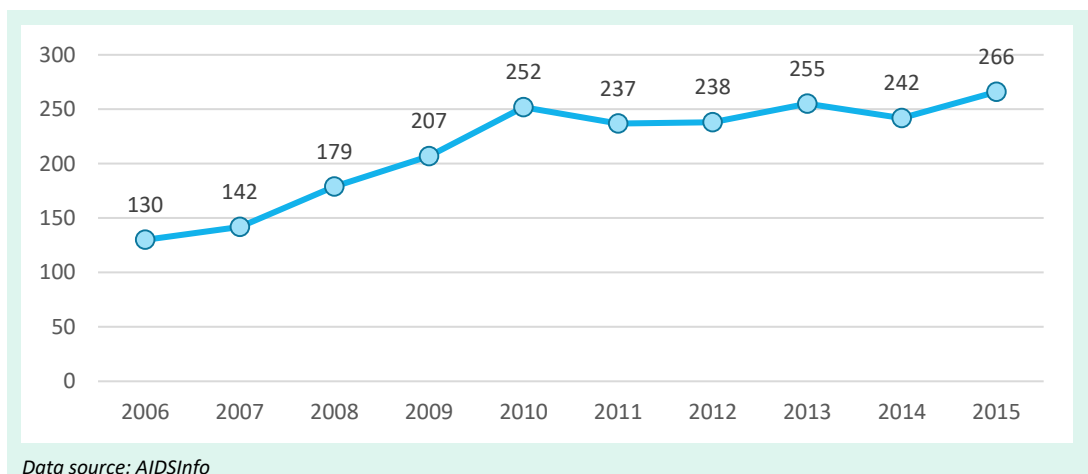


Among those who received ART, suppression of viral load was achieved in 64% only, which translates into a viral load suppression rate of 20% (range: 17–24%) among all PLHIV in Kazakhstan. However, even

³² Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach. Second edition. Geneva: World Health Organization; 2016 (http://apps.who.int/iris/bitstream/10665/208825/1/9789241549684_eng.pdf?ua=1).

with such a low yield of HIV interventions, there is some evidence that increased detection and ART have had an impact on the HIV epidemic by slowing development of AIDS. Between 2006 and 2010 the absolute number of AIDS cases detected increased by 10% annually, while between 2010 and 2015 the annual increase in AIDS cases fell dramatically to 1% annually, indicating that a considerable number of AIDS cases in Kazakhstan had been averted since 2010 (**Fig. 60**). It appears that such a development could be attributed to HIV control interventions.

Fig. 60 Number of AIDS cases detected, Kazakhstan, 2006–2016



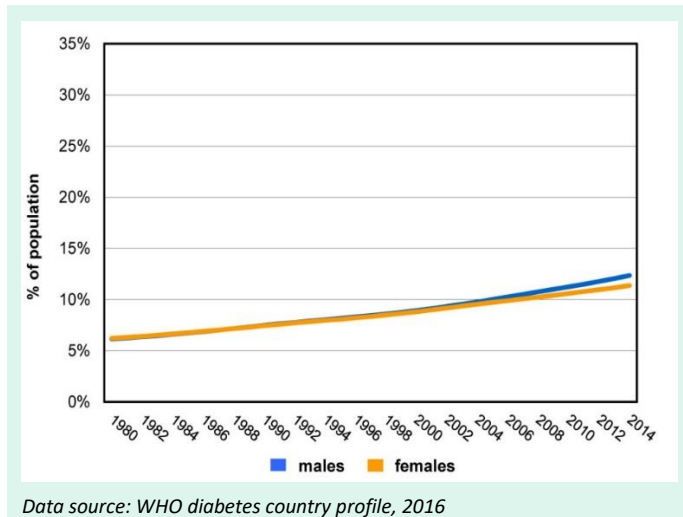
4.3.2.2 Trend of diabetes

According to a recent case-control study conducted in Kazakhstan,³³ there is a very strong association between diabetes and TB: individuals with TB are 14 times as likely to have diabetes as individuals without TB. The prevalence of diabetes in Kazakhstan continues to rise (**Fig. 61**). According to WHO estimates,³⁴ the age-standardized prevalence of diabetes in Kazakhstan in 2015 was 11.5%. It is expected that the increase in diabetes may impede the decline in the TB epidemic.

³³ Davis A, Terlikbayeva A, Aifah A, Hermosilla S, Zhumadilov Z, Berikova E et al. Risks for tuberculosis in Kazakhstan: implications for prevention. *Int J Tuberc Lung Dis.* 2017;21(1):86–92.

³⁴ World Health Organization. Diabetes country profile 2016 (http://www.who.int/diabetes/country-profiles/kaz_en.pdf, accessed 13 September 2017).

Fig. 61 Trend of age-standardized prevalence of diabetes, Kazakhstan, 1980–2016



4.3.2.3 Trend in alcohol consumption

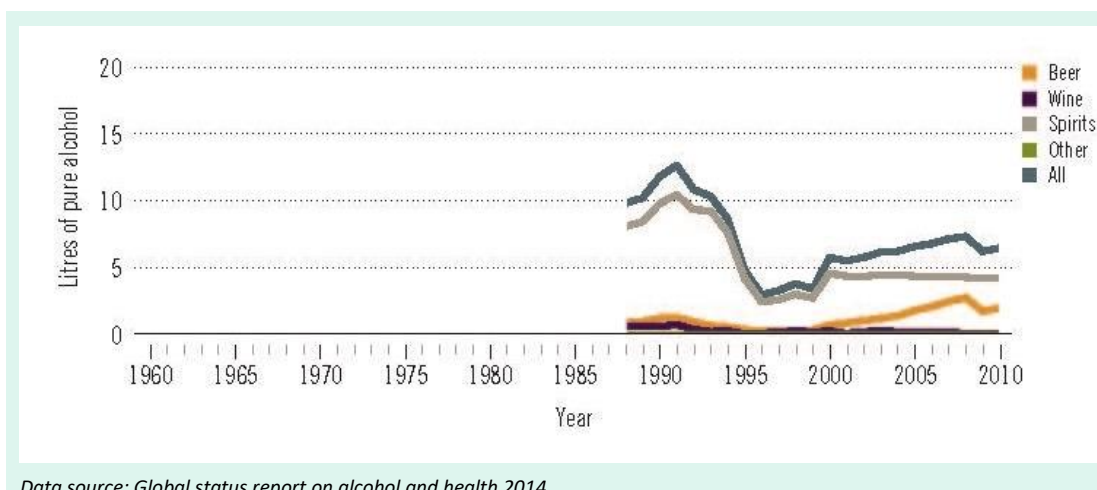
Heavy alcohol use and alcohol-related disorders increase the risk of active TB, because of increased risk of infection in the drinking environment and alcohol-related social drift. In addition, there is increased risk of progression to disease due to the direct effect of alcohol on immunity and the indirect effect of compromised immunity on alcohol-related disorders, such as malnutrition, malignancies and chronic diseases.

Although per-capita alcohol consumption in Kazakhstan is below the regional average, the prevalence of heavy episodic drinking is high, reaching 31.2% in the male population.³⁵ Studies indicate that alcohol consumption remains one of the major risk factors in Kazakhstan.³⁶ However, there is no recent published data on the prevalence of heavy drinking. The only available data on alcohol use are estimates of trends in per-capita alcohol consumption up to 2010, published in *Global status on alcohol and health 2014*. According to this, estimates of per-capita alcohol consumption in Kazakhstan declined dramatically up to the late 1990s, then started to increase slightly (Fig. 62). However, this is not sufficient to infer that the prevalence of drinking (especially heavy drinking) increased, or whether the change in alcohol consumption had any effect on the TB epidemic in Kazakhstan.

³⁵ Global status report on alcohol and health 2014. Geneva: World Health Organization; 2014 (http://www.who.int/substance_abuse/publications/global_alcohol_report/en).

³⁶ Davis A, Terlikbayeva A, Aifah A, Hermosilla S, Zhumadilov Z, Berikova E et al. Risks for tuberculosis in Kazakhstan: implications for prevention. *Int J Tuberc Lung Dis.* 2017;21(1):86–92.

Fig. 62 Recorded alcohol per-capita (15+) consumption, Kazakhstan, 1988–2010



4.3.2.4 Trend in tobacco consumption

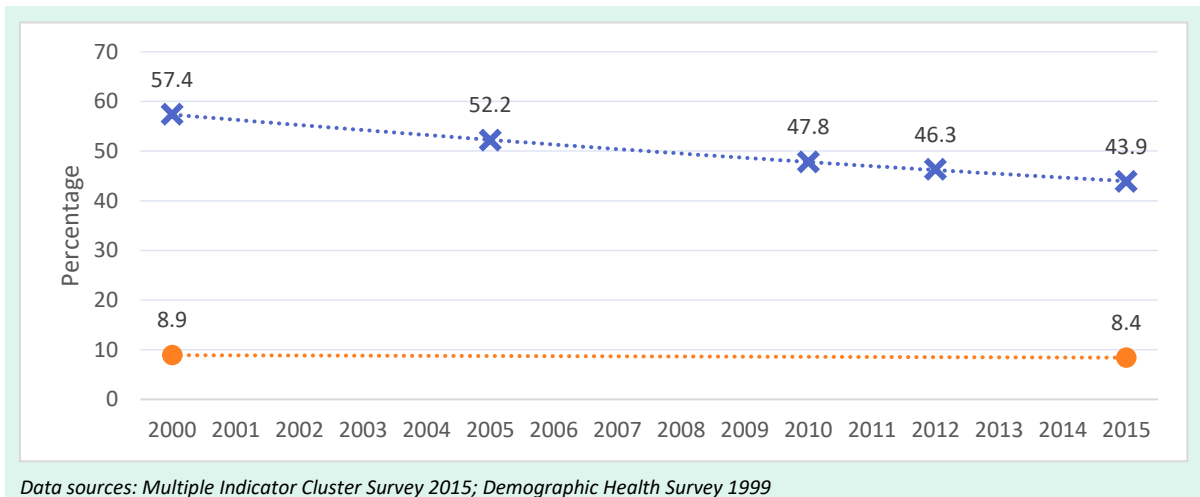
Tobacco smoking remains a serious health issue in Kazakhstan: about 43.9% of the male population³⁷ and 8.4% of the female population³⁸ aged 15 years and over are current smokers. In early 2000 the prevalence of tobacco smoking among adult males was even higher, at 57.4%, then it declined gradually, reaching 43.9% in 2014. This decline could be one of the factors contributing to the fall in the TB burden in the population. However, comparing estimates of the Demographic Health Survey 1999 and the Multiple Indicators Cluster Survey 2015 estimates,³⁹ prevalence of smoking among women remains stable (Fig. 63).

³⁷ World Bank data: smoking prevalence, males (<https://data.worldbank.org/indicator/SH.PRV.SMOK.MA>, accessed 21 September 2017).

³⁸ Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan (Statistics Committee of the MNE RK), United Nations Children’s Fund (UNICEF), United Nations Population Fund (UNFPA). 2015 Kazakhstan Multiple Indicator Cluster Survey, Final Report. Astana, Kazakhstan: Statistics Committee of the MNE RK, UNICEF and UNFPA; 2016 (<http://mics.unicef.org/surveys>, accessed 21 September 2017).

³⁹ Academy of Preventive Medicine [Kazakhstan] and Macro International Inc. 1999. Kazakhstan Demographic and Health Survey 1999. Calverton, Maryland: Academy of Preventive Medicine and Macro International Inc. (<https://dhsprogram.com/pubs/pdf/FR111/FR111.pdf>, accessed 21 September 2017).

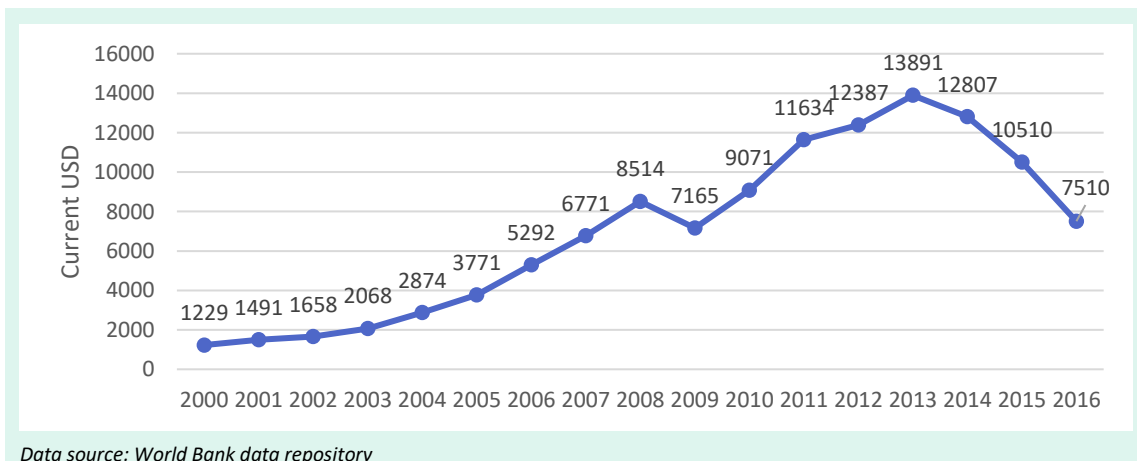
Fig. 63 Prevalence of tobacco smoking in the adult male and female populations, Kazakhstan, 2000–2015



4.3.2.5 Per-capita gross domestic product and poverty

Economic growth may have an important effect on TB determinants such as overcrowding, education, nutrition and health care-seeking behaviour, and thus contribute to reduced transmission of infection and a reduced risk of progression from infection to disease. Gross domestic product (GDP) per capita is the most commonly used measures of a country’s economic growth. Kazakhstan’s economy is powered by its extensive natural resources. Top industries include oil and natural gas production, with agriculture and manufacturing serving as other economic drivers. Kazakhstan has transitioned from lower-middle-income to upper-middle-income status in less than two decades. The country moved to the upper-middle-income group in 2006. Between 2000 and 2016 GDP per capita saw a sixfold rise and the incidence of poverty fell sharply (**Fig. 64**).

Fig. 64 GDP per capita (current USD), Kazakhstan, 2000–2016

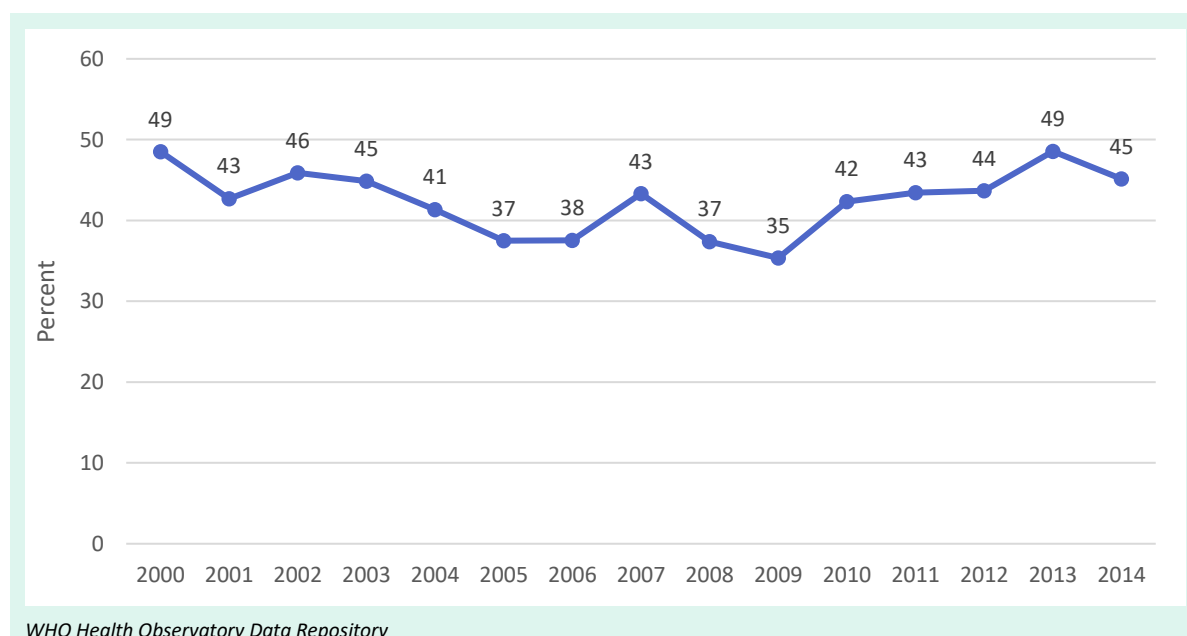


The kind of economic growth observed until 2014 would be expected to drive the TB epidemic downwards. Then, a global drop in the price of commodities pushed the country into recession, beginning in 2014; however, it is unlikely that the effect of economic recession on the TB epidemic will become apparent within such short period of time.

4.3.2.6 Coverage of financial protection for health care costs

Between 2000 and 2014 out-of-pocket (OOP) health expenditure as a percentage of total health expenditure varied between 35% and 49%, reaching its lowest level in 2009 and then increasing again till 2013. In 2014 OOP was 45%. This upward trend in OOP in recent years indicates that access to health services in Kazakhstan, especially for the most vulnerable populations, is not improving. As was noted, current OOP is high enough to ensure universal access to health services (Fig. 65); on the other hand, the trend of financial protection for health care costs is not likely to be one of the factors that contribute to the decline in the TB epidemic in Kazakhstan.

Fig. 65 OOP expenditure as a percentage of total health expenditure, Kazakhstan, 2000–2014



4.3.2.7 Demographic changes

Because TB is strongly associated with age (i.e. less common in children and more common in adults), changes in the age structure of the population can influence the TB burden in the country.

According to official resources, the population of Kazakhstan continued to increase after the collapse of the Soviet Union, peaking at 17 million in 1993 and then falling to 15 million in the 1999 census. The downward trend continued till 2002, when the estimated population reached its lowest point, at 14.9 million.⁴⁰ From 2002 the decline was halted and then reversed. In 2016, according to United Nations population estimates, Kazakhstan's population was about 17.8 million. Despite such fluctuations in the absolute number of the population, the shape of the population pyramid of Kazakhstan was relatively stable. Thus, between 2000 and 2015, the proportion of children under 15 years ranged between 24.1% and 27.6%, while the proportion of people aged over 65 ranged between 6.8% and 7.2%. Because the changes in child and adult populations are quite small, it is not likely that

⁴⁰ Population dynamics and ethnic composition of Kazakhstan in the second half of the 20th century, Demoscope Weekly, No. 103-104, 3–16 March 2003 (in Russian) <http://demoscope.ru/weekly/2003/0103/analit03.php>.

demographic changes would have had any significant impact on the TB epidemic in Kazakhstan (Fig. 66 and 67).

Fig. 66 Population structure (in thousands) by age group and sex, Kazakhstan, 2000, 2008 and 2015

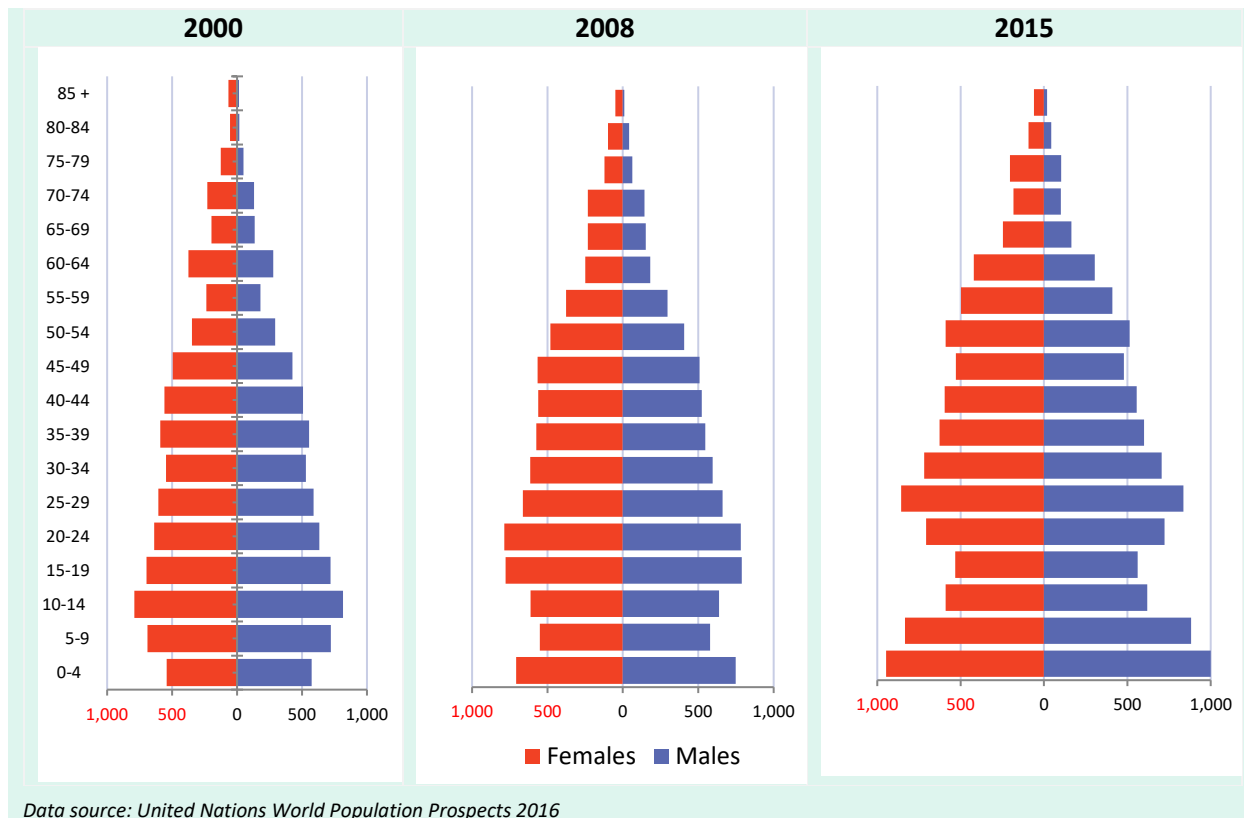
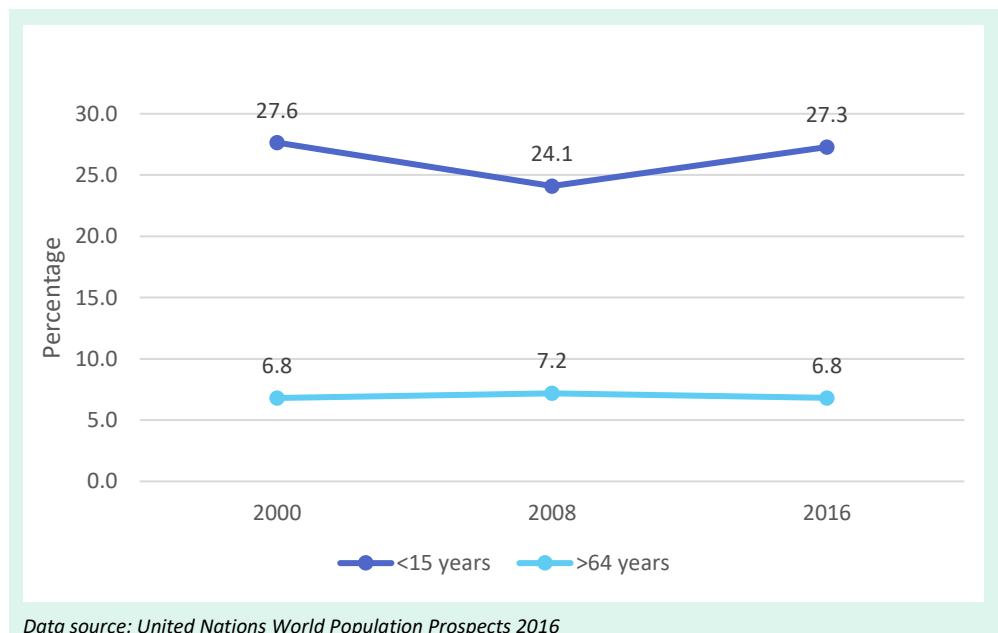


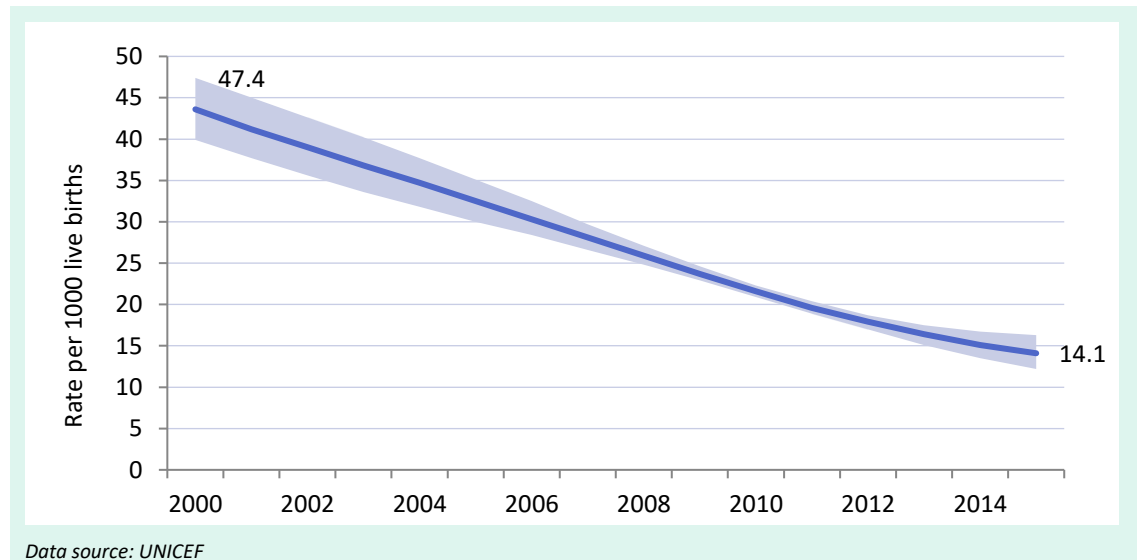
Fig. 67 Percentage of the population aged <15 years and >65 years, Kazakhstan, 2000–2016



4.3.2.8 Under-5 mortality

It is assumed that improvement in the general population's health is associated with a decreased TB burden. Under-5 mortality is commonly used as a proxy indicator of overall population health and can, therefore, serve as a measure of progress in the general population's health and access to health services. Fig. 68 shows the trend in estimated under-5 mortality in Kazakhstan between 2000 and 2015. As can be seen, in this period under-5 mortality declined by more than two thirds, reaching 14.1 deaths per 1000 live births in 2015.⁴¹ Such an impressive trend indirectly indicates an increase in access to and quality of health care in the general population.

Fig. 68 Trend in under-5 mortality rate per 1000 live births, Kazakhstan, 2000–2015



5 Key findings and conclusion

- *TB funding in Kazakhstan increased annually by about 20% over the years 2010–2013. Increased TB funding most probably contributed to driving the TB epidemic downwards.*
- *Although the total number of microscopy laboratories fell from 466 in 2010 to 332 in 2016, they still remain widely accessible to the population across the country. Introduction and roll-out of LPA from 2011 and GeneXpert MTB/RIF from 2013 helped to reduce delays in diagnosis and start of treatment, thereby reducing TB transmission in the population and in hospital settings. Improvements in diagnostic services are therefore likely to have played an important role in reducing the TB burden in Kazakhstan.*
- *The practice of active case finding in the civilian population and among contacts has not changed in recent years; the yield of TB cases from screening the general population, as well as contacts, remains quite low.*

⁴¹ UNICEF Data: under-five mortality (<https://data.unicef.org/topic/child-survival/under-five-mortality>).

- *The proportion of successfully treated patients improved among new and relapse cases (from 84% in 2012 to 91% in 2015) and among MDR-TB cases (from 72% in 2010 to 76% in 2014). Efficient treatment of TB patients is likely to be one of the key factors in reducing TB transmission and case fatality.*
- *There is some uncertainty over the number of notified RR/MDR-TB cases and the trend of drug-resistant TB, based on data provided by the NTP. Nevertheless, the CNR of MDR-TB fell from 45.1 per 100 000 population in 2011 to 32.9 in 2016.*
- *Since 2013 Kazakhstan has achieved universal MDR-TB treatment coverage, which contributes to the decline in the TB epidemic in the country.*
- *Prevalence of HIV among TB patients increased from 0.8% in 2008 to 5.4% in 2016. Data on HIV testing coverage is not complete because of undernotification in some parts of the population. Coverage of ART and CPT among TB/HIV-coinfected patients improved from 12% in 2008 to 83% in 2016. With the increase in ART coverage, the treatment success rate of TB/HIV-coinfected patients has improved notably in recent years.*
- *The absolute number and rate of notified TB cases in prisons fell by more than two thirds between 2010 and 2015.*
- *Prevalence of HIV among the general population has continued to rise by 10% annually in recent decades. Such a rapid increase in HIV prevalence would normally drive the TB epidemic upwards, but because the overall prevalence of HIV is low (0.2%), the effect of the HIV epidemic on TB is not yet significant. ART coverage among PLHIV, although it has increased in recent years, still remains alarmingly low (42%).*
- *Prevalence of diabetes in Kazakhstan, as in many European countries, is increasing, which might slow the decline in the TB epidemic.*
- *High rates of tobacco use (44% in males in 2015) may play a role in limiting the effectiveness of TB treatment and control efforts in Kazakhstan.*
- *GDP per capita increased exponentially after 2000 as a consequence of economic growth.*
- *Health care is still predominantly financed by OOP payments; there has been very little improvement in financial protection for health care costs.*
- *Under-5 mortality has fallen rapidly, indicating improvement in health systems.*

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