

Current Status on Training and Education on Public and Healthcare Workers towards Tuberculosis Elimination: Case in South Korea

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Abstract

Tuberculosis, despite global effort to eliminate tuberculosis, still remains as a high burden to global public health. For tuberculosis elimination to be achieved, trainings and educations play pivotal role, tuberculosis control and prevention in particular. Internationally, several organizations are in charge of tuberculosis training and education program design, especially in its preparation and dissemination. In case of Korea, TB prevalence remains high, 59.0 per 100,000 in 2019. To overcome TB, institutes from both governmental and public sectors are organizing and providing tuberculosis-related training and education programs however, only few investigations on tuberculosis training in Korea was carried out, indicating difficulty lies in understanding and analyzing current TB training and education landscape. Hence, in this study, we have reviewed each institute and their roles in terms TB training and educational aspects as well as current tuberculosis status and strategies employed in Korea. Also, there are limitation lies in tuberculosis training and education thus, the call for global cooperation is necessary to response regional consideration against tuberculosis.

Introduction

Tuberculosis (TB), an infectious disease caused by *Mycobacterium tuberculosis* (*M. tb*), is a serious public health burden in worldwide (1, 2). This is one of the leading causes of infection and death among curable infectious diseases; it is curable as antitubercular drugs are available and can be overcome by training and education (3, 4). Globally, although rate of prevalence have decreased in recent years, approximately 10.0 million are estimated to be suffering from TB infection with roughly 1.2 million of TB related deaths in 2020 according to the World Health Organization (WHO) (5). In case of Korea, referring Republic of Korea, 23,821 TB patients were newly notified in 2019 that is summed to 30,304 as total number of patients. This can also be presented as 46.4 and 59.0 per 100,000 for newly notified and total number of patients in 2019 respectively. As of 2018, 1,800 were reported as dead due to TB (6).

In 2000, the Millennium Development Goals (MDGs) was established to combat HIV/AIDS, TB, malaria and others by 2015 (7-9). In 2015, the United Nations Sustainable Development Goals (UN SDGs) superseded MDGs and aimed to eliminate HIV/AIDS, malaria, TB by 2030 with WHO End TB strategy (7, 10-12). Korea, with global trend toward TB elimination, had established comprehensive tuberculosis control plan since 2013. As of 2018, 2nd plan was implemented (13) .

The success in terms of TB treatment can be influenced by insufficient knowledge of the public and Healthcare Workers (HCWs) (4, 14). Given that the provision of training to physicians can increase productivity and effectivity in TB treatment (15). In many countries, in order to improve and implement TB control strategies, numbers of training courses have been coordinated and organized both at international and national level. TB training, in general, has been included as part of basic curriculum for degree programs related to medical profession. Although these are provided to physicians, nurses, laboratory technicians in most of developing countries or countries where TB prevails, quality of TB trainings varies (16, 17). In the context of training for TB control, key challenge lies in spread of TB

training while maintaining high-quality implementation (16). Currently numbers of organizations from government and public sectors such as Korea Disease Control and Prevention Agency (KDCA), Korea National Tuberculosis Association (KNTA), Korea Human Resource Development Institute for Health and Welfare (KOHl), Masan National Tuberculosis Hospital (MNTH) and Korea Nurses Association (KNA) have been organizing and/or providing TB training courses in Korea, where Korea refers to Republic of Korea.

Internationally, TB training and education and its evaluation have been widely investigated and these works are to be considered to contribute in terms of significant increase in TB treatment success rate (4, 18, 19). Further, the analysis on emerging issues regarding TB training during evaluation can contribute in developing and refining training programs in future (20). For TB training and education to be evaluated, identifying current status of TB training is essential hence there is a need to identify the current status of related trainings. Also, it is high-lightened that improving and maintaining technical and theoretical aspects in TB of HCWs is, undoubtedly, important strategy and failure to do so will consequently lead to poor treatment performance. However, only handful of studies have attempted to investigate on current status of TB training in Korea. So far, there are several institutes involving TB training and education yet these institutes were not been analyzed and compared in Korea. Thus, in this study, we have discussed TB education and trainings, which reflects current TB status in Korea, provided by government and public organizations in Korea

Main Text

Status of tuberculosis in Korea

Korea had been suffered from TB that mortality rate of TB was estimated to 71.7 per 100,000 in 1942 and such mortality rate reached roughly 5-fold higher than that of 1942 in 1954, 350 per 100,000, when the Korean war was over (13, 21). In 1954, total prevalence of TB was estimated as 1.3 million over 20 million in Korea (21, 22). Since of 1962, Korea actively engaged in TB control program, resulted significant decreases in TB prevalence rate to 59.0 per 100,000 in 2019 (6, 23) (Figure 1). Despite significant declining of TB prevalence, Korea still shows the higher TB mortality rate than that of Organization for Economic Co-operation and Development (OECD), 4.0 versus 0.9 per 100,000 (6, 21).

Along with high prevalence of tuberculosis, Multi-Drug Resistant Tuberculosis (MDR-TB) rate of Korea of 4.1% is slightly higher than that of OECD average, 2.6% (21, 24). The MDR-TB, as its unique feature, requires second-line antitubercular drugs along with prolonged treatment. It is widely known that second-line drugs are relatively less effective to that of first-line drugs, MDR-TB treatment often involves side effects and medical complications hence is major public health concern (25, 26). With effort to eliminate MDR-TB, cases of MDR-TB are decreased from 975 in 2011 to 580 cases in 2019. Similarly, XDR-TB cases was decreased from 140 to 33 cases from 2011 to 2019 (Figure 1). However, proportion of MDR-TB among foreigners was increased to 20.5% from 4.5% when 2019 was compared to 2011, indicating an influx of tuberculosis cases from abroad (23).

Latent Tuberculosis Infection (LTBI) is a state of *M. tb* infection without any clinical manifestation and/or symptoms of active TB (27, 28). Roughly one-thirds of global populations are estimated to be infected with LTBI globally according to WHO (29). Each individual infected with LTBI often unaware of the condition and among these individuals, roughly 5 to 15% of LTBI cases progress to active TB (30). This LTBI emerges as one of the most important sources of TB (31). In case of Korea back in 1960, the LTBI rate was estimated to be 64.2% when tuberculin skin test carried out. Such LTBI rate estimate is decreasing rapidly as it can be seen through periodic analysis that in 2016, LTBI rate was estimated to be 33.2% that is similar to that of global average (23, 32, 33).

Strategies in Korea

TB still remains as a serious public health challenge in Korea (21). To overcome prevalent TB, Korea have employed several strategies and legislated laws to take action against TB for control and prevention purposes. Several acts such as the infectious disease control and prevention act in 1957 and the tuberculosis prevention act in 1968 were legislated to effectively control TB, specifying for the formulation and implementation of a comprehensive tuberculosis control plan for TB research, education, and training (20, 34).

One of the main strategies to TB elimination is Public-Private Mix (PPM) project, which was initiated in 2009 (35, 36). The objective of PPM project is to disseminate technical knowledge regarding TB to private hospitals by assigning trained TB management-specialized nurses for improvement in TB treatment success rate. As part of PPM project, registered nurses should be trained first in prior to be assigned as TB management-specialized nurses through TB management-specialized nurses training courses, provided by collaboration of KDCA, KNA and KNTA (36-38). Then these nurses are assigned in each hospital and are responsible for compliance management and TB prevention education provision (21, 35). As of 2019, 258 TB management-specialized nurses have been assigned in 150 private hospitals. These assignment of TB management-specialized nurses have increased national average of TB treatment success rate from 79.8% to 90.5% from 2012 to 2018 (39, 40).

Korea Disease Control and Prevention Agency

In 2003, the Korea Centers for Disease Control and Prevention (KCDC) was established to promote public hygiene and conduct prevention, investigation, quarantine, testing, and research on infectious diseases and chronic diseases (41, 42). In 2020, the KCDC was reformed and elevated to KDCA, which allows KDCA to stand as independent infectious disease control tower(43).

The one of the main roles of KDCA is TB control and prevention. The KDCA conducts activities related to TB control and prevention at national, provincial, and local levels such as TB surveillance, promoting TB training and prevention education. Hence, the KDCA closely engaged with city and provincial department of public hygiene to promote TB training to officers in public health centers (36).

The KNTA is commissioned by KDCA or projects to conduct trainings on medical doctors and nurses, and related officers from public and private hospitals. The first TB trainings for Healthcare Workers were conducted in 1954; since 2000, the TB training and education programs broaden its coverage such as BCG vaccine, TB-vulnerable social groups, and LTBI (36, 44, 45). Other than the training mentioned above, other training consists of TB management exclusively for public health doctors, including conscripted medical doctors, military medical officers, and medical doctors from public health centers, hospitals, and correctional facilities. This training program handles policy related to national tuberculosis program, treatment and diagnosis for TB, resistant TB, and LTBI as well as TB epidemiological investigation (44). The Korea Institute of Tuberculosis, a sub-affiliate of KNTA, is in charge of conducting technical support and related training for TB medical technicians as commissioned by KDCA and Ministry of Health and Welfare (MoHW) since 1954 (44, 46).

Even before KDCA was elevated, the KCDC was in charge for production and dissemination of publications related to TB. Since 2011, the KDCA are publishing Korean Guidelines for TB and National TB Control Guideline periodically. The national tuberculosis control guideline comprises of international and national TB status, national tuberculosis program, TB notification process, treatment and management and its related epidemiology for TB, MDR-TB, and LTBI patients as well as TB diagnostics. This guideline conveys up-to-date information related to TB to maximize performance in TB control and prevention (36). Also, training and educational materials such as laboratory manuals and others have been published (Table 1).

Table 1. Publications related to TB by KDCA from 2011 to 2020

No.	Guidelines and Manuals	Co-publishing institute*	Year of publication
1	Korean Guidelines for Tuberculosis (1 st – 4 th Ed)	1	2011 – 2020
2	National Tuberculosis Control Guideline (1 st – 16 th Ed)	N/A	2003 – 2021
3	Tuberculosis “Close Contact Investigation on Crowded Facility” Major Casebook (1 st – 5 th Ed)	2	2014 – 2019
4	Tuberculosis Control Guide for Medical Institutes	N/A	2016
5	Manual of Laboratory Tests for Tuberculosis (1 st , 2 nd Ed)	4, 5	2013 – 2016
6	Tuberculin Skin Test Guidebook for examiners	3	2019
7	Family-contact Examination participating Medical Institutes. Training material for Physicians	6	2019
8	Basic Training for Tuberculosis management-specialized nurses	6	2019

*1. The Korean Academy of Tuberculosis and Respiratory diseases; 2. Ministry of Health and Welfare; 3. Korea Institute of Tuberculosis; 4. Korea National Institute of Health; 5. The Korean Society of Clinical Microbiology; 6. Korean National Tuberculosis Association

Korea Human Resource Development Institute of Health and Welfare

KOHI is an institution specialized in public health education and training to build and increase related officers’ specialties and capabilities to successfully convey public health practices. The KOHI initially initiated its role, public health education and training in particular, as public health education division of National health center in 1946 and through centuries and numbers of reorganizations, KOHI was established in 2007 as quasi-governmental institution. Since its establishments, numbers of education and training programs were organized and conducted where categories of programs vary from general capability building education to public health and public health industry training (47).

Since even before establishment of KOHI, Public health training department of Korea National Institute of Health, precursor of KOHI, carried out public health trainings as commissioned by MoHW (47). The KOHI is also known to provide TB-specialized trainings and other related programs periodically (Table 2). As time passes from 2018, the training programs became more specified.

As of 2020, there are 3 representative TB-centered training programs provided by KOHI and these are TB diagnosis and interpretation, TB control, and advance TB control. 1) The TB diagnosis and interpretation program is offered to officers from public health centers and Public Health and Environmental Research Institutes, governmental institutes for infectious disease analysis and research as well as environmental and public health promotion and investigation, to increase basic acid-fast bacilli smear staining

techniques as well as TB diagnosis techniques ; 2) In case of TB control program, this is prone to practical-oriented as these primarily focus on LTBI treatment principles, case study based on TB patient treatment, close contact investigation and epidemiology, and TB control status analysis. Also, this program recommends related programs such as advanced TB control program and getting to know tuberculosis series after completion as part of advanced TB control and treatment as well as continuing education; 3) For advanced TB control program, this program is intended for those who completed TB control program hence covers wider aspects of TB control such as establishment of TB prevention promotion strategies, figuring out of current status on local TB management as well as case study(47, 48). Upon completion of this program, the participants are expected to implement appropriate TB control and prevention strategies based on regional or local TB conditions. Also, understanding and designing TB-related promotional materials is one of the main capabilities that participants gain as go through the program (47).

TB is handled in other programs as well such as nosocomial infection control for medical doctors and infectious disease risk response program. These programs covers TB infection control in practice and TB containing sputum packaging while getting to know TB programs are introductory TB series that is generally intended for public hence consist of brief introduction, treatment, and prevention of TB and LTBI (47, 49).

Table 2. TB prevention education program provided by KOHI in 2020

No.	Participants*	Training program	Description	Hours
1	Medical doctors	Nosocomial infection control for medical doctors	<ul style="list-style-type: none"> - National nosocomial infection surveillance system - National policy related to nosocomial infection - Infection control practice such as TB and Carbapenem-Resistant Enterobacteriaceae - Infection control statistics and analysis 	16
2	Public officers ^{1,2}	Tuberculosis diagnosis and interpretation	<ul style="list-style-type: none"> - <i>M. tuberculosis</i> characteristics and genotyping - TB diagnosis and treatment - TB-related biosafety 	21
3	Public officers ^{3,4}	Tuberculosis control	<ul style="list-style-type: none"> - National policy related to TB control and prevention - LTBI diagnosis and treatment management - TB prevention promotion - TB epidemiological investigation on crowded facilities 	21
4	Public officers ^{1,5,6}	Infectious disease risk response simulation	<ul style="list-style-type: none"> - Sputum collection and clinical TB sample packaging 	3
5	Public	Getting to know tuberculosis series	<ul style="list-style-type: none"> - Introduction to TB and LTBI -TB prevention, control, treatment and management of antitubercular drug side effects - TB notification and case study 	3
6	Tuberculosis control program participants	Advanced tuberculosis control	<ul style="list-style-type: none"> - Utilization of public media for TB prevention - Analysis on TB status in local governments - Designing and analysis on promotion for TB prevention 	12

*1. Public Health Centers, 2. Public Health and Environmental Research Institutes, 3. MoHW, 4. Local Governments, 5. KDCA, 6. National Quarantine Stations

Masan National Tuberculosis Hospital

The MNTH was initiated on March of 1941 as a sanatorium with mission to treat and care TB-suffered veterans. Since May, 2002, it was renamed as MNTH and has become representative TB-specialized hospital in Korea.

The MNTH was an affiliated institution under MoHW and since of September of 2020 when KCDC was elevated to KDCA and turned to be independent from MoHW, the MNTH transferred and changed its affiliation from MoHW to KDCA. The MNTH conducts multiple roles other than TB treatment such as leading National Tuberculosis Program, performing TB research, and TB prevention education and training. The MNTH is a medical institute specialized in MDR-TB treatment (50).

The MNTH promotes public health through TB treatment and research thus advancing TB control and prevention capability (51). As of 2020, there are 2 TB medical specialist (TB-Spc) training institutes, the Seobuk hospital and the MNTH, remained(52) in Korea. Since the MNTH was designated as TB-Spc training institute by MoHW in 1993, institute trained total number of 14 TB-Spc since year of 1993 (50, 51). Other than TB-Spc training, the MNTH is actively educating HCWs and students for TB control and prevention on monthly basis starting from year of 2016. So far, total number of 67,426 people were educated over 272 education sessions as of 2019, indicating significant contribution to TB control and prevention through education (51).

Discussion

Due active TB control and prevention activities conducted by the Korean government in terms of implementing TB related acts to eliminate TB, consequently, significantly improved TB status was observed recently(13, 21). Despite such, several TB statistics have shown that TB still remains as serious public health burden and Korea still has high TB incidence and mortality rate as compared to OECD average(5). Along with TB diagnosis and treatment, TB-related training and education unarguably function as pivotal role to tackle TB. Hence, the Korean government has exerted effort in TB-related training and education programs(13). For instance, KOHI, a quasi-governmental institute funded by MoHW, is a representative example of institute designing and coordinating TB training and education programs. Such effort made is undoubtedly significant and Korea as a country with proven history of TB control and prevention, it is thus noble responsibility of Korea to take in charge of and lead global TB elimination, especially supporting on Middle-and-Low-Income Countries (LMICs).

The TB-related training and education programs provided by KOHI are highly helpful as numbers of health care workers and public officers benefit every year. Yet, the programs impose limitations in that

only a few programs provide practical TB diagnosis training for medical technologists. Also, there is a gap between the training program and actual routine hospital work as training needs to be related to the hospital setting. There are no published, systematic evaluation of programs provided by KOHI, which creates difficulty in analyzing the quality and quantity of the programs as well as its effectiveness.

When designing and providing the TB training and educations, quality must be taken into considerations. The high-quality training has strong relationship with quality of treatment and care provided to patients. The quality of tuberculosis treatment is often assessed by what health care was provided to patients and the way was it completed (53). Hence, it is top priority to provide HCWs for high quality TB training programs containing different TB training curricula, especially in high TB burden countries. To maintain TB training program maintained as high-quality, quality assurance for TB training program is inevitable. As part of quality assurance, it is highly essential to conduct survey for participants feedback, performance test, pre-test, and post-test to evaluate quality of the program. Also, consultation and cooperation with international organizations such as WHO, the International Union Against Tuberculosis and Lung Disease (IUATLD), and related institutes are recommended (17).

The MNTH is national TB-specialized medical institute leading TB treatment, education, and research in Korea. The contributions attained by the MNTH over past 80 years has sufficiently proved for domestic achievements in TB treatment, education, and research. Also, these demonstrated that the MNTH can be improved further and has potential to stand frontline and lead TB control and prevention program towards TB elimination (50, 51). An instance of this was when MNTH designed and developed an advanced TB program specialized for TB treatment, nursing, control and prevention, as well as diagnosis. As stated above, there are certain shortcomings present even for TB training and education programs but there is high demand for practical TB related training, which can be directly translate training to be implemented to actual work.

Along with global trend against TB, the need for global cooperation and collaboration is intensified as time passes. For instance, the Koninklijke Nederlandse Centrale Vereniging Tuberculosis Foundation (KNCV) and IUATLD are internationally known for providing TB training programs with mission to achieve TB elimination through correcting irrelevant contents and ineffective or impractical methodologies related to TB as these can negatively influence on time and other resources; impact gets worsen especially in LMICs(16, 54-56). However, for course design, regional features should also be taken into consideration. The MNTH could satisfy the current demand to fill the gap of TB training and has competitive expertise to collaborate with international organizations to design appropriate regional-specific TB training programs.

Conclusion

Korea, since 1962, has been actively engaged in TB control and prevention programs. To overcome prevalent TB, the Korean government has implemented several TB control and prevention strategies, one of which is the provision of TB-related training and education. As TB training and education significantly influence TB control, they are considered an essential element. Several institutes

designing and conducting TB training and education are as follows: KDCA, KNTA, KOHI, MNTH, KNA and other programs not mentioned in this paper. The trend of TB programs became diversified since 20th century, shifting from general TB training to ones on BCG vaccine, MDR-TB, LTBI, TB epidemiological investigation, and other TB related topics. However, despite recent improvements in TB training and education, limitations still exists and training programs can be developed further. Also, the call for global cooperation is highly demanded to support countries, especially low- and middle-income countries. Finally, due to the COVID-19 pandemic, most of TB trainings and educations were shifted to distance-learning programs. However, to train TB professionals in terms of clinical applicability, both theoretical knowledge and practical training needs to be carried out concurrently. With such perspectives, MNTH, as a leading national TB-specialized medical institute, has sufficient capability to satisfy the global needs and challenge the current limitations in TB training and education programs.

Abbreviations

IUATLD: International Union Against Tuberculosis and Lung Disease

KCDC: Korea Centers for Disease Control and Prevention

KDCA: Korea Disease Control and Prevention Agency

KNA: Korea Nurses Association

KNCV: Koninklijke Nederlandse Centrale Vereniging

KNTA: Korea National Tuberculosis Association

KOHI: Korea Human Resource Development Institute for Health and Welfare

LMICs: middle-and low-income countries

LTBI: Latent Tuberculosis Infection

M. tb: *Mycobacterium tuberculosis*

MDGs: Millennium Development Goals

MDR-TB: Multi-Drug Resistant Tuberculosis

MNTH: Masan National Tuberculosis Hospital

MoHW: Ministry of Health and Welfare

OECD: Organization for Economic Co-operation and Development

PPM: Public-Private Mix

TB-Spc: TB medical specialist

TB: Tuberculosis

UN SDGs: United Nations Sustainable Development Goals

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Conflict of Interest

The authors declare that they have no competing interests.

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Author Contributions

T.K. and S.P contributed in conceptualization. T.K. conducted literature review. T.K and S.R prepared the manuscript. S.R was in charged for supervision and correspondence. Subsequently, all authors read and approved the final manuscript.

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Figures

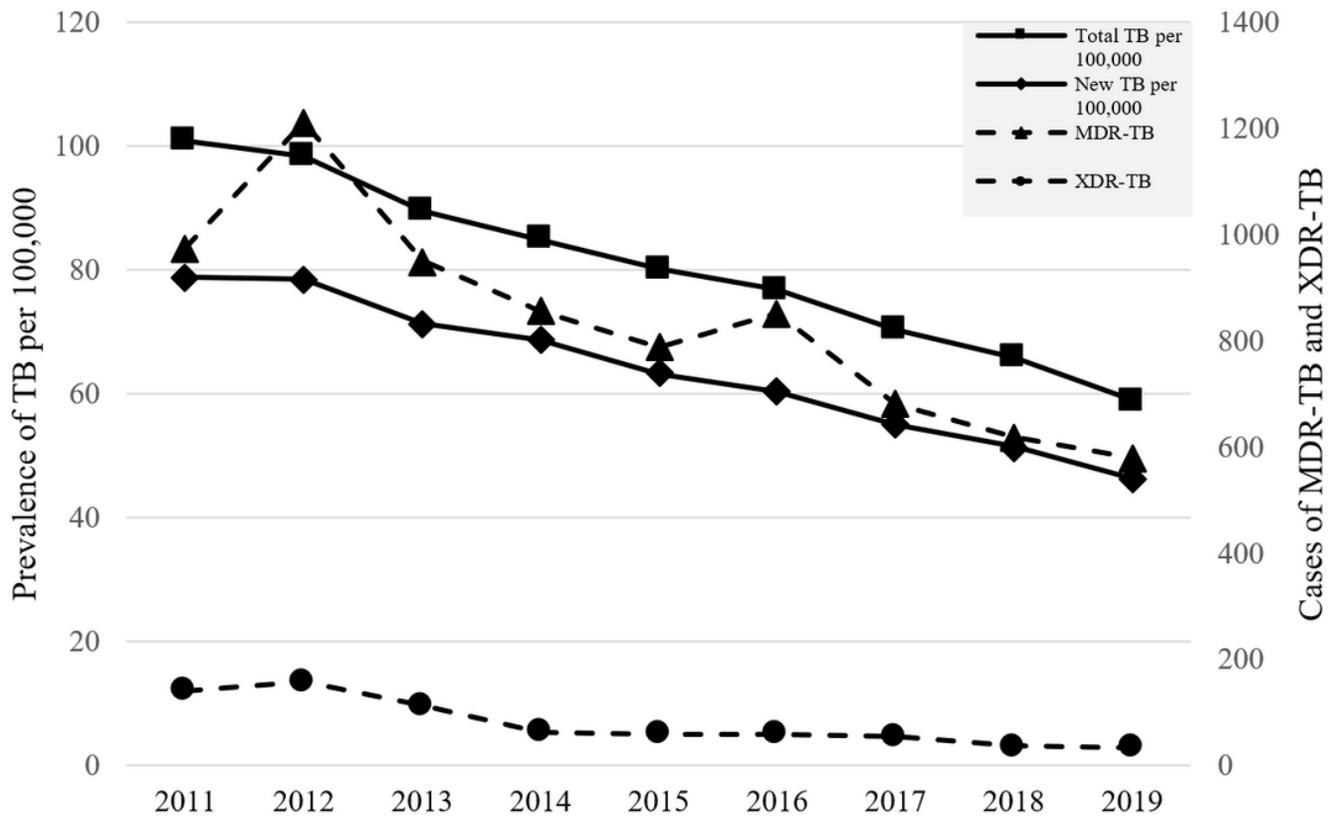


Figure 1

Notified TB cases in Korea from 2011 to 2019; square represents total TB cases per 100,000; diamond represents new TB cases per 100,000; triangle represents MDR-TB cases; circle represents XDR-TB cases