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Review Article

Tuberculosis Control: Evidence and Suggestions for Population-Based Interventions Used in New Zealand

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ABSTRACT

Tuberculosis presents a major challenge to global public health. Although, the number of deaths caused by tuberculosis has reduced worldwide, most people are unaware of their latent infection. In recent years, New Zealand has achieved significant reduction in tuberculosis incidence. However, some improved measures are required to completely eradicate the disease from the country. The article enlightens the population-based approach followed to control the tuberculosis infection in New Zealand.

Key words: Latent infection, genotyping, outbreak, sensitivity, specificity.

INTRODUCTION

Tuberculosis is a notifiable disease, under the Tuberculosis Act 1948, in New Zealand. [(1)] The infectious form of the disease, compared to most other developed countries, has the higher incidence in New Zealand. [(1)] Though there is a significant decline in the rate of tuberculosis in New Zealand since 1980, the incidence rate has relatively become stable since 2007. [(2-4)] The article will describe the current population-based approaches used to manage tuberculosis in New Zealand, the evidence base for these approaches, and discuss their effectiveness and limitations. The article will also propose some recommendations to improve the tuberculosis management in New Zealand.

Vaccination

Strategy: Bacillus Calmette-Guérin (BCG) is the only available vaccine to prevent tuberculosis. The vaccine is recommended and provided free for children, under five years of age, at high risk of tuberculosis. [(5)]

Critical evaluation: According to World Health Organisation (WHO) the BCG vaccine does not prevent against primary or relapse infection of tuberculosis but can prevent children against the severe form of tuberculosis i.e. meningeal and miliary tuberculosis. [(6)]

Also, 1-2% of BCG vaccinations can cause subcutaneous abscess and lymphadenopathy which are not serious. Two in a million can have fatal infection following BCG vaccination. [(7)]

BCG can cause false negative results of tuberculin skin test (Mantoux) in children, and its' use is thus under controversy. Countries like U.K. had universal BCG program while USA advocates BCG vaccination among high risk in children. [(8)]

However, studies suggest that BCG vaccination to infants reduces the overall infant mortality rate. [(9)]

Immigrant screening and case detection

Strategy: Immigrants who wish to stay in New Zealand are screened for active tuberculosis. A chest X-ray is followed by medical history to identify the active disease. Screening for tuberculosis cannot be forced upon the people who hold

Australia or New Zealand passport, asylum seekers (unless the residence is asked), children below eleven years of age, and pregnant women (unless chest X-ray is requested by Immigration New Zealand).

However, quota refugees have screened for tuberculosis offshore and in New Zealand also. If found with infectious disease, arrival is delayed till treatment is complete. The treatment for latent tuberculosis infection (LTBI) is restricted to refugee children from high incidence countries and below 16 years of age. [(10)]

In New Zealand, a practitioner who identifies the new or relapse tuberculosis disease is bound to report to health officer. There is no compulsion for the practitioners, though they are requested, to notify the latent infection. [(10)] If the patient has pulmonary or laryngeal tuberculosis and does not adhere to the treatment, the medical officer can obtain three-month detention order to isolate and treat the disease. However, this does not apply to the cases with the latent tuberculosis infection who cannot be forced for the treatment. [(10)]

For the people who travel to high incidence country (and stay more than three months), Mantoux test for adults and BCG-vaccinated in previously not vaccinated below five years children is done. [(10)]

Critical evaluation: Study done by Nair et.al showed that detection of active tuberculosis by chest X-ray and clinical findings is high, but it does not detect the latent form of tuberculosis. [(11)] Thus the approach, up to an extent, does control the incoming of active disease from foreign countries and spread of active tuberculosis in existing New Zealanders.

A similar strategy is followed in the USA where the diagnosis of active tuberculosis, in immigrants above fifteen years of age, by medical history, followed by chest X-ray is done. Though the rate of tuberculosis in the USA is much less than New Zealand [(12)] the majority of tuberculosis cases in both the countries are foreign-born individuals. Studies have shown that the majority of tuberculosis cases in most of the low tuberculosis incidence countries occur as conversion of LTBI, acquired abroad, to an active form. [(13)]

Over two-third of tuberculosis cases in New Zealand are reported in foreign-born individuals. Studies have shown that immigration from high-incidence countries is the major factor responsible for the persistent rate of tuberculosis in New Zealand. [(14)] The main reason for this might be the inadequate approach to limit the immigration of people with LTBI in the country.

Recommendations: WHO considers management of latent tuberculosis infection in middle and high-income countries as a critical component of post-2015 end tuberculosis strategy to reduce tuberculosis incidence up to more than 90% till 2035 compared to 2015. [(15)] Therefore, evaluating the immigrants for latent tuberculosis infection and its' treatment must be made mandatory before coming to New Zealand. Also, even after arriving in New Zealand, if a person acquires any latent tuberculosis infection, its' treatment must be made compulsory for that person.

A study done by Nicastro et. al showed that immigrant child with tuberculosis, particularly from the high-incidence country, increases the risk of developing drug-resistant tuberculosis. [(16)] It has been considered that children below twelve years are rarely infectious. [(10)] However, a case study was done by Cardona et.al has shown that a diseased child can spread tuberculosis to many others in the school. [(17)]

Therefore, an immigrant child must be screened for tuberculosis before coming to New Zealand. The similar measure is followed in the US were tuberculosis diagnostic test in immigration children is mandatory. [(18)]

CDC recommends IGRA test over tuberculin skin test (TST) to identify tuberculosis in adults [(19)] and study done by Campbell et.al has shown that long-term development of an active form of tuberculosis was more in IGRA-positive

individuals than TST-positive individuals. [(20)] Hence, evaluating the tuberculosis status in the adults, who return from the high-incidence country, by using IGRA rather than using TST can be a better strategy.

Contact tracing and management

The investigation of diseased, clinically diagnosed, and contacts must start without waiting for the laboratory results. [(1)] The immediate neighbors and members sharing the accommodation are considered close/high-risk contacts. Workplace, if not overcrowded and ventilated, and other public places are put at low risk. [(10)] The patient is also interviewed for any contact history.

If there is no evidence of recent transmission of infection in the high-risk group, the contact tracing is stopped. If not, the low-risk groups are investigated. [(10)] The factors which increase the risk of diseases, like old/young age or immunosuppression, must be considered while contact tracing and screening for these contacts, as a precautionary measure, can be done. [(10)]

The baseline test for identification of contact cases is Mantoux test in children and interferon gamma release assay (IGRA) testing in adults. The positive test is followed by further investigations while a negative test is followed by repeat test after eight weeks of exposure. If a child, below five years, has repeat Mantoux test negative then only BCG vaccination with no further action is required.

Patients who spend more than eight hours in the same room with the pulmonary case and have a cough are treated as the high-risk contacts. In hospitals, the medical officer of health must maintain an overview of the investigation, if any case of pulmonary disease is present in the hospital, of the staff and the patients. [(10)]

In the case of schools if a teacher has smear positive disease, the pupil in his/her class till before three months are screened and if a pupil shows a positive test, rest of his/her class/year is screened. However, to search for the source case, all the staff can be screened. [(10)]

Critical evaluation: CDC agrees that tuberculosis can pass to anyone, either close or low-risk contact, depending upon their immune system. The onset of disease may take weeks or years. The amount of infected droplets inhaled by an individual decides the onset of infection. The closer and the longer a healthy individual will live with the diseased person, the more risk he/she will have to develop tuberculosis. [(21)] So, the contact investigation does not identify all the infected cases, but it does help to identify the infection in the high-risk population.

However, as per World Health Organisation (WHO), the contact tracing of tuberculosis needs a rapid response. If delayed, identification of index case becomes difficult. Also, the contact tracing requires resources and is difficult when the incidence cases in an outbreak increase. The tests require time and efforts. [(22)]

However, all the available tests for screening of tuberculosis, according to CDC, lack sensitivity and specificity. Also, these tests cannot ascertain that the contact was recently or remotely infected. [(23)] Thus contact tracing might not reveal an infected person or differentiate between recent and remotely infected person.

Recommendation: A case study in Portugal has shown that changing the contact tracing strategy from targeting close contacts i.e. home and people told to be at risk in diseased person's interview to active visit of a health care worker to diagnose the case both at home and at workplace identified more risk-contacts and prevented more tuberculosis cases. [(24)] Thus, including workplace in close contact group for contact tracing will prevent more cases of tuberculosis.

A case in New South Wales, Australia has shown that a tuberculosis infection in a school can go undiagnosed for months. The initial case of one teacher and one student was followed by infection of a child at low risk. The case suggests that

contact screening in schools must be done for entire school rather than confining it to individual classes/year. [(25)]

Surveillance

DNA fingerprinting of the active disease registered with healthcare service is always reviewed at district and national level so that further action, if needed, can be taken on identified disease clusters. [(10)] However, the typing results need time, and epidemiological investigation should not wait for typing results to become available.

As per CDC, genotyping is the only way for precise identification of the epidemic strain of tuberculosis. Two people having the same genotyping can be identified as, if sharing same epidemiological links, transmission from same infection chain. Hence, registering genotype data will help in the early control of an outbreak. The genotyping also identifies the drug resistant strain and helps to analyse the type of drug becoming less effective in the treatment. Further, the genotyping differentiates the strain responsible for the new and relapse cases of tuberculosis. [(26)]

WHO recommendation

Tuberculosis, in New Zealand, is associated with low socio-economic status. Most of the cases of tuberculosis occur in urban parts of Auckland. [(18)] The people with crowded housing and poor status are at more risk of developing the disease. WHO recommends for mandatory tuberculosis screening in shelters for further prevention of the disease. [(27)]

CONCLUSION

A combination approach is needed to eliminate tuberculosis from New Zealand. The incidence rate of tuberculosis, for past several years, is not declining in New Zealand. The main reason is immigration of people, from high-incidence country, with latent tuberculosis infection. This shows that the disease needs to be targeted globally to reduce its' incidence in New Zealand. Latent tuberculosis treatment should be made compulsory to eliminate the disease from the country. Contact tracing must be expanded and immigrant screening for both forms of tuberculosis, latent and active, should be made compulsory. However, if any case of latent tuberculosis gets notified in the country, it must complete the full treatment for LTBI.

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