TB

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Description

Tuberculosis (TB) is a disease caused by bacteria called Mycobacterium **tuberculosis**. The bacteria usually attack the lungs, but they can also damage other parts of the body. TB spreads through the air when a person with TB of the lungs or throat coughs, sneezes, or talks.

When a person gets active **TB** disease, it means **TB** bacteria are multiplying and attacking the lung(s) or other parts of the body, such as the lymph nodes, bones, kidney, brain, spine and eve the skin. From the lungs, **TB** bacteria move through the blood or lymphatic system to different p of the body.

Stages of tuberculosis

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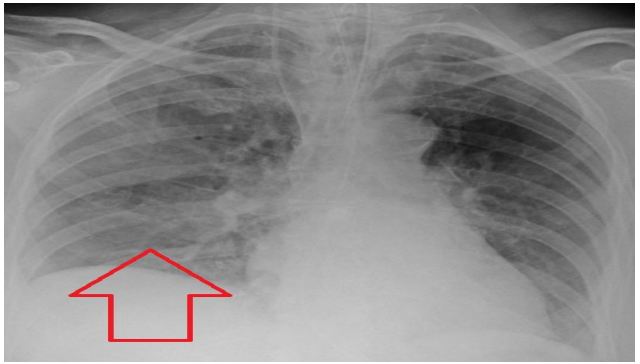
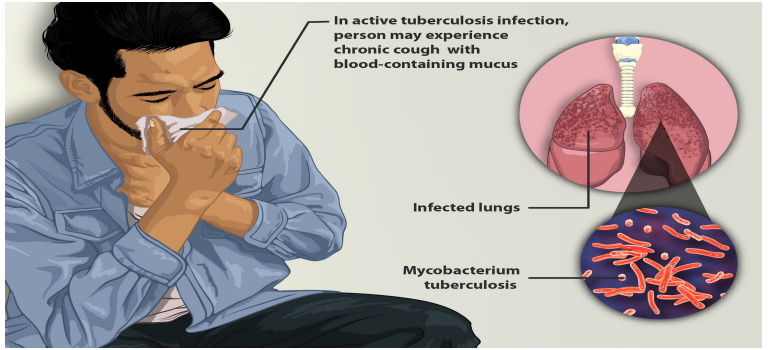
Exposure. This happens when a person has been in contact with, or exposed to, another person who has TB. The exposed person will have a negative skin test, a normal chest X-ray and no signs or symptoms of the disease.



Latent TB infection. This happens when a person has TB bacteria in their body, but no symptoms of the disease. The infected person's immune system walls off the TB organisms. And the TB stays inactive throughout life in most people who are infected. This person would have a positive skin or blood test for TB, but a normal chest X-ray. They would have no signs of active infection in other parts of the body.

TB disease. This person has signs and symptoms of an active TB infection. The person could have a positive or negative skin or blood test for TB. And a positive chest X-ray, biopsy, or other finding showing an active infection.

How is TB(Tuberculosis) CONTAINED



TB infection is often diagnosed with a skin or blood test. In the skin test (called a PPD), a small amount of testing material is injected into the top layer of the skin. If a certain size bump develops within 2 or 3 days, the test may be positive for TB infection. A blood test called quantiferon may also be used. Other tests that may be key for diagnosing TB include X-rays and sputum tests.

TB skin or blood tests are suggested for people:

- in high-risk categories
- Who live or work in close contact with people who are at high risk
- Who have never had a TB skin or blood test

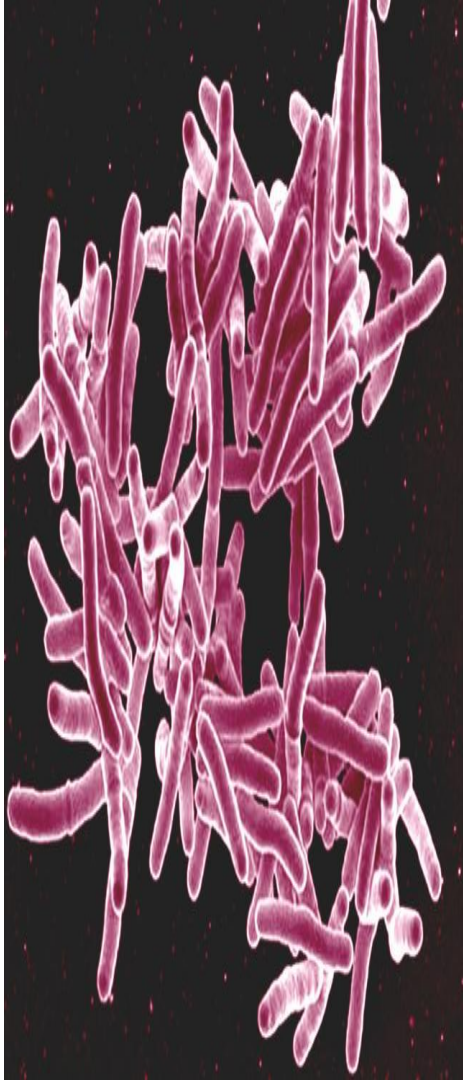
In children, the American Academy of Pediatrics recommends testing:

- If the child may have been exposed in the last 5 years
- If the child has an X-ray that looks like TB
- If the child has any TB symptoms
- If the child comes from a country where TB is common
- For children living with HIV
- For children receiving medicines that suppress the immune system
- For children who are in detention facilities
- For children who are exposed to high-risk people
- If the child's parent has come from a high-risk country
- If the child has traveled to high-risk areas
- If the child lives in a densely populated area

What causes TB?

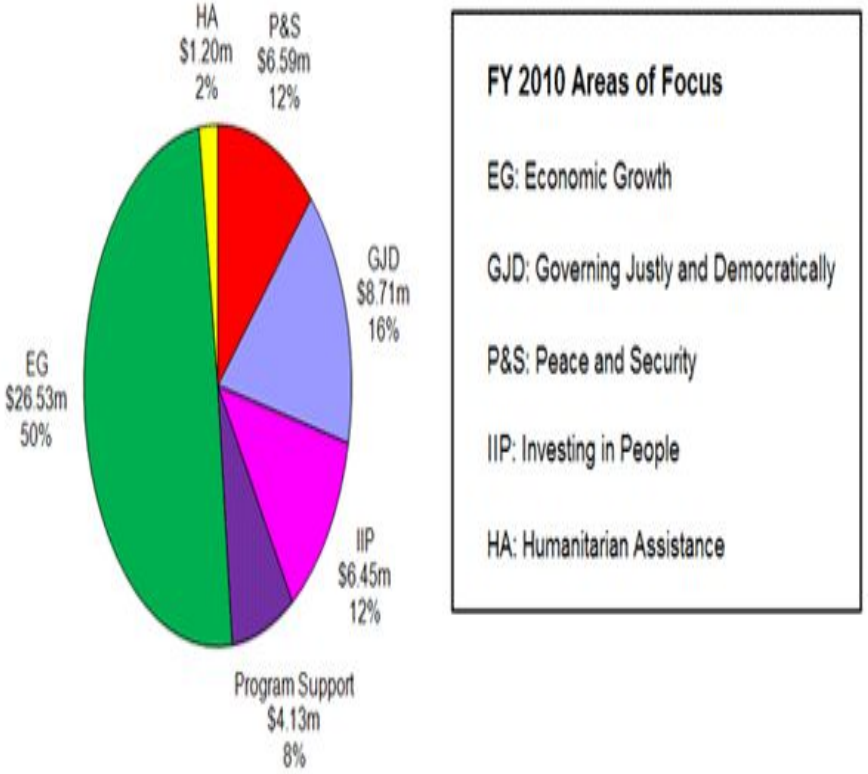
The main TB bacteria is Mycobacterium tuberculosis (M. tuberculosis). Many people infected with this bacteria never have active TB. They remain in the inactive (latent) TB stage. But some will develop active TB anytime from months to years or even decades after being exposed. The chance of developing active TB increases in babies and children and in older adults. It also increases in people with a weak immune system, especially those with HIV. Or in those getting medicines that suppress the immune system.

The TB bacteria is spread through the air when an infected person coughs, sneezes, speaks, sings, or laughs. It’s very unlikely to be spread from personal items that a person with TB has touched. Good ventilation can limit the spread of TB to other people. But early diagnosis and treatment of the person with active TB is most important. It's also important to limit other people's exposure. This means using masks and respiratory isolation.



Who is at risk for TB(tuberculosis)

People who live or work with others who have TB
Those can’t access healthcare
Homeless people
People from countries where TB is more common
People in group settings, such as nursing homes
People who abuse alcohol
People who use injection drugs
People with a weak immune system, including those who have HIV
The very young and older adults
Healthcare workers who come in contact with high-risk population



How to treat TB?

Short-term hospital stay.

For latent TB. Often a 3- to 9-month course of 1 or 2 antibiotics will be given to kill off the TB organisms in the body. The most common antibiotics prescribed are isoniazid, rifapentine, and rifampin. Your healthcare provider can review the treatment options. They may recommend one as the best option for you, taking into account many factors.

For active TB. Your healthcare provider may prescribe 2 to 4 or more antibiotics in combination for 6 to 9 months or longer. Examples include: isoniazid, rifampin, pyrazinamide, and ethambutol. People often begin to improve within a few weeks of starting treatment. After several weeks of treatment with the correct medicines, the person is often no longer contagious. But medicine must be finished for the greatest chance of cure, as prescribed by a healthcare provider.

DATA AND STATISTICS

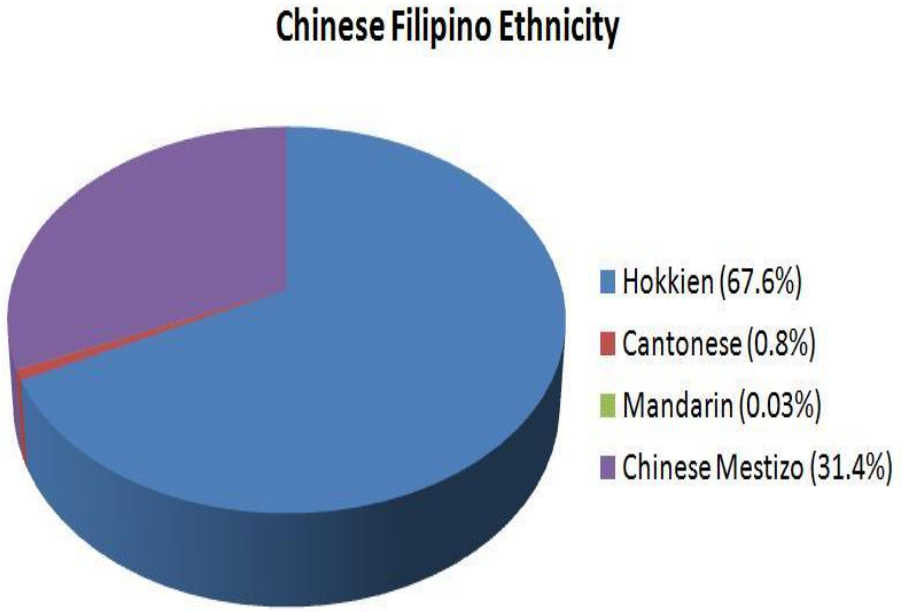
TB in the United States by the numbers:

8,920: number of provisionally reported TB cases in the United States in 2019 (a rate of 2.7 per 100,000 persons) . The complete 2019 TB surveillance data report will be available in late 2020.

60: jurisdictions (states, cities, and US territories) in the United States that report TB data to the CDC

Up to 13 million: estimated number of people in the United States living with latent TB infection

Reaching the goal of TB elimination in the United States requires maintaining and strengthening current TB control priorities while increasing efforts to identify and treat latent TB infection among high-risk populations.



Tuberculosis is a major public health problem in the **Philippines**. In 2010, **TB** was the 6th leading cause of mortality with a rate of 26.3 deaths for every 100,000 population and accounts for 5.1% of total deaths. This is slightly lower than the five-year average of 28.6 deaths per 100,000 population.

TB is more prevalent among males compared to females and among the 25-55 year old age group. It is also higher among the malnourished and diabetics. The 1997 survey showed that prevalence of TB among the urban poor in Metro Manila is twice that of the general population.

The first national Drug Resistance Survey was done in 2003-2004 and revealed the following prevalence of drug resistance: 4% among the new cases, 21% among the re-treatment cases, and 5.7% combined. The second National Drug Resistance Survey was done in 2011-2012 and showed a decrease in the prevalence of drug resistance among new cases from 4% to 2%. However, there was no change in the prevalence of drug resistance re-treatment cases which remained at 21%.

Prevalence of culture-positive TB	6.6/1,000	3.1/1,000	2.0/1,000
Prevalence of sputum smear-positive TB	4.2%	4.2%	6.3%

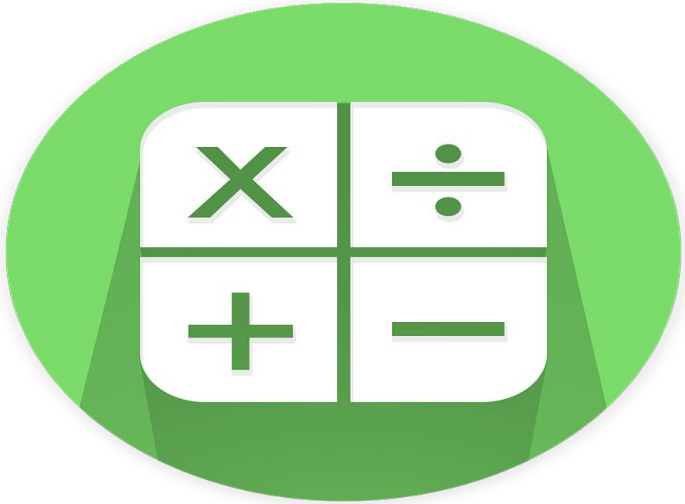
Mathematical model of TB with variability

This work extends a mathematical model for the transmission dynamics of tuberculosis that examined the impact of certain factors on tuberculosis case detection (Okuonghae and Omosigho, 2011). The extended model now classifies the latently infected individuals by their level of tuberculosis awareness (as was done for the susceptible sub-population) and further expands the number of key factors that can positively affect the tuberculosis case detection rate.

$$\int_{-\infty}^{\infty} \sqrt{\frac{\sqrt{x^n}+1}{\alpha+\beta^{\gamma}}}\, dx$$

we assumed that susceptible individuals are divided into two groups depending on their level of awareness of the disease (and any treatment policy): the high risk (low level of awareness) group, S_1, and the "educated," low risk (high level of awareness) group, S_2. The S_1 class is "educated" at the per capita rate α_1 and thereafter move into the S_2 class. Tuberculosis infection can invade the S_1 and S_2 classes, depending on the "efficacy" of the education programme. The programme is assumed to reduce the likelihood of infection by a factor of σ ($0 \leq \sigma \leq 1$). The case $\sigma = 0$ signifies a completely effective education program, while $\sigma = 1$ models the situation where the program is totally ineffective.

Continuation

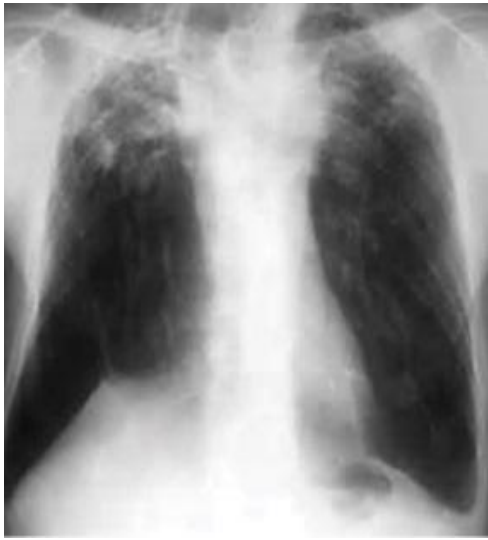


It was further assumed that the "vaccine" (education program) produces temporary immunity at the per capita rate θ. The case $\theta = \infty$ corresponds to the case where there is absolutely no immunity while $\theta = 0$ corresponds to life-long immunity. Hence, θ measures the rate at which those in the S_2 class return to the S_1 class due to forgetfulness caused by lack of continuous exposure to the enlightenment program while the disease persists in the community. We assumed β to be the disease transmission rate.

We also assumed that the variables E, I, J, and T represented the "primary" latent, infectious, identified infectious (for treatment under DOTS) and the effectively treated individuals, respectively (by "primary" latency, we are referring to susceptible individuals who are infected for the first time as well as treated individuals who now get reinfected after recovering from a previous infection). In addition to these groups, a separate class ($R(t)$) was added to account for individuals who become latent due to failed treatment or self cure (we refer to this situation as "secondary" latency).

The parameter η was used as a modification parameter ($0 \leq \eta \leq 1$) to account for the relative infectiousness of infectious individuals in the J class. We also assumed that ϵ is the reduced likelihood of reinfection of effectively treated individuals, where $0 \leq \epsilon \leq 1$. Also, we took $0 < p < 1$ as the fraction of individuals with new infections who develop TB fast per unit of time, with Λ being the rate of recruitment of uninfected newborns and immigrants into the low risk susceptible class. For simplifications, we assumed that all entrants into the population move into the S_1 group. We also assumed that μ is the natural death rate while d is the tuberculosis-induced death rate.

CONTINUATION



To account for exogenous reinfection of latently infected individuals, we assumed that β^* be the transmission rate amongst this group in infected persons. We also assumed that *k* is the rate of progression of infected individuals in the latent stage to active tuberculosis.

Individuals with active TB can be identified using chronic cough lasting more than 2 weeks as a marker, at the rate α_2, and are referred to a TB treatment program under DOTS for effective treatment (in Okuonghae and Omosigho, 2011, α_2 was known as the cough identification rate). However, a fraction of these identified cases will eventually get into the treatment program when we consider the cost factor. Hence, a cost improvement factor ($\nu : 0 < \nu \leq 1$) will affect the actual number of identified cases that commences treatment. The cost factor considers the effect the actual cost of medical tests and treatment will have on the care -Givers when presenting the infectious individual for treatment.

If $\nu = 0$, then the cost of medical tests and treatment is prohibitively high and $\nu\alpha_2 = 0$ implies that the TB case will not get into a TB treatment program due to the financial cost on the care givers or family members. However, if $\nu = 1$, it means that the cost of medical tests and treatment is totally free and $\nu\alpha_2 I$ will be the total number of identified cases that are tested and treated for tuberculosis under DOTS

.CONTINUATION

We assumed that r_2 is the treatment rate for the identified infectious individuals under the DOTS scheme while the fraction of the detected cases who were successfully treated under the DOTS was n, with $m = 1 - n$ being the fraction of those whose treatment were unsuccessful and, thereafter, moved to the "secondary" latency group.Tuberculosis cases that are not detected either die at the rate d, or self-cure and revert to the "secondary" latent state (in R) at the rate r_1.

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The mathematical model was then given by the following system of non-linear ordinary differential equations (Okuonghae and Omosigho, 2011):

Info source

The frontiers in microbiology

And medlineplus.gov