Pulmonary tuberculosis risks and challenges

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Abstract. Pulmonary Tuberculosis (PTB) is an airborne bacterial infection that can be deadly if not treated. PTB is most common in developing countries, ecologically problematic, where it kills about 1 million people each year. Pulmonary tuberculosis is a dreaded disease that can have a devastating impact on its victims. Tuberculosis is a serious respiratory infection caused by the bacterium Mycobacterium tuberculosis. It commonly affects the lungs but can also affect other parts of the body, such as the kidney, spine and brain. This review article discusses the PTB risks and challenges worldwide. The global burden of TB remains high, with approximately one-third of the world's population being infected with the bacterium. Overall, more needs to be done to improve the management of TB worldwide in order to ensure that no person is left to suffer from the devastating effects of this disease.

1 Introduction

Pulmonary tuberculosis (PTB) is a serious lung infection caused by the bacterium Mycobacterium tuberculosis [1]. PTB is one of the leading causes of death globally, and it has been estimated that there were 1.4 million deaths due to PTB in 2017 [2]. In South Africa, the prevalence of TB is estimated to be between 98 and 144 cases per 100,000 populations each year, although it is estimated that there are around 7 million people living with active TB in the country [3]. However, there is growing evidence to suggest that the number of cases of TB in South Africa could be much higher than the reported figures [4]. Tuberculosis is contagious and is often spread through the air when someone coughs or sneezes. However, not everyone infected with tuberculosis will develop symptoms. Some infected people will never experience any signs or symptoms and remain carriers of the bacteria. If left untreated, the disease can spread from the lung to other parts of the body and cause serious complications such as death [5]. In India, an estimated 2 million people are affected by tuberculosis every year, with about 90% of these cases occurring in adults. While cure is possible, it usually takes many months of treatment with antibiotics to cure the disease (Table 1). The treatment for tuberculosis requires regular visits to the hospital where the affected person gets treatment in the form of intravenous drugs administered over a period of several months. Treatment for tuberculosis is expensive and requires a long
hospital stay. Many patients are unable to pay for their treatment and have to rely on government schemes to help them with the expenses involved. The treatment of pulmonary tuberculosis usually involves a period of isolation for the infected person to reduce the risk of spreading the disease to others [6]. This period of isolation is usually followed by a long period of medications and chest physiotherapy to clear the infection. Prevention of tuberculosis involves screening individuals who are at risk of developing the disease. People become infected with PTB when they inhale tiny droplets containing the bacteria that are coughed out by someone who has the infection [5]. This usually happens when a person is in close contact with someone who has TB, such as family members or close contacts of a person with TB [7]. PTB can progress to more serious complications if left untreated, including permanent lung damage, organ failure and death. Early detection and treatment are crucial in reducing the risks of developing severe symptoms and complications of PTB [8]. There are many strategies in place that aim to improve the prevention, diagnosis and management of this disease, these include the use of testing tools such as the Xpert MTB/RIF test and the implementation of widespread screening programmed to detect infected individuals so that they can be treated and prevent the spread of the disease [9]. The implementation of these strategies is essential in order to prevent the spread of PTB and to reduce the associated health burden of the disease [10]. However, there is an ongoing need to raise awareness of TB symptoms among the general population in order to encourage people to seek medical help if they suspect that they have the disease [7]. In addition, there is a need to ensure that adequate healthcare resources are available to diagnose and treat people with PTB [11].

<table>
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<tr>
<th>Table 1. Treatment choice for tuberculosis.</th>
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<tr>
<td><strong>Non-drug resistant</strong></td>
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<td>isoniazid (INH), rifampin (RIF), as a proxy for rifapentine, pyrazinamide (PZA), and fluoroquinolones</td>
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2 Types of TB

TB is a potentially fatal lung infection caused by the bacteria Mycobacterium tuberculosis (Fig.1). There are three types of TB: primary, which is most common; secondary, which develops after someone has contracted TB from another person or animal; and latent TB, which occurs when a person does not become sick with active TB despite having a high risk of developing the disease in the future [12]. The majority of cases in the United States are primary TB. Latent TB is more common in other countries. TB is curable in most people, but approximately 10% to 15% of people do not respond to treatment [13]. The likelihood of death from TB depends in part on the type of TB a person has. People with latent TB have a high risk of developing active TB, so it is very important to diagnose latent TB as early as possible [14]. Early detection increases the chances of curing the disease and preventing the spread of the disease to others. There are two types of TB: latent and active [15]. Latent TB means that the bacteria are inside the body but that they are not growing [14]. People with latent TB are usually healthy and have no symptoms. Active TB means that the bacteria are growing and causing disease in the body. Latent TB infection is most common and about 13 million people in the United States have latent TB infection. However, only about 10% of these people are actively infectious [16].
3 Prevalence of TB

Prevalence of TB was 9.6 cases per 100,000 people in 2017 and is projected to increase to 11.4 by 2030 [17]. The highest rate of TB in the world is among adults aged 15-44 years, according to the WHO [18]. The World Health Organization estimates the annual global death toll due to TB to be more than 1 million, in 2020, 87% of new TB cases occurred in the 30 high TB burden countries [19]. Eight countries accounted for more than two thirds of the global total: India, Indonesia, China, the Philippines, Pakistan, Nigeria, Bangladesh and the Democratic Republic of the Congo [20]. Most cases of TB occur in developing countries, such as Africa and India, where access to health care is limited [21, 22]. Although death rates from TB have decreased over the past several decades, they remain high in some parts of the world, including the United States, India, China and South Africa [23, 24]. Approximately one third of all people who develop active TB will die from the disease [25]. The leading cause of TB deaths is the progression of the disease to the internal organs (known as multidrug-resistant tuberculosis or MDR-TB); the development of resistance to medications used to treat TB is known as drug resistance [26]. In 2016, there were approximately two million cases of drug-resistant TB around the world, including 200,000 cases in the United States [27]. Although the risk of acquiring TB is low in most developed countries, the risk of infection increases with age [28]. There is an estimated likelihood that one in twenty-five people will develop active TB during their lifetimes in the United States [29]. There are approximately 140 cases of tuberculosis per 100,000 people in South Africa every year, making it one of the highest rates in the world [30]. Despite this high rate of infection, many people living in South Africa do not know that they have TB and are therefore not receiving treatment [31].

4 Immigrants and PTB

Tuberculosis is a contagious disease that commonly affects the lungs but can also affect other parts of the body. If left untreated, it can spread throughout the body and cause death [32]. The risk of acquiring PTB depends largely on a person's country of birth, with foreign-born individuals from high-burden countries being at highest [33]. In the United States, it is estimated that approximately 10,000 people develop active TB each year [34]. About one-third of them are immigrants [35]. Immigrants are particularly vulnerable to TB because they are often unaware of their risk and do not seek prompt medical care when symptoms occur [36]. As a result, they often delay treatment and can unknowingly spread the disease to other members of their community [7].
In 1993, the number of Korean immigrants in the United States was 71,000, but in 2013 the number of Korean immigrants was over 600,000 [37]. The number of Chinese immigrants in the United States has grown similarly [38]. In 2015, there were over 13 million foreign born people living in the United States, many of these immigrants are originally from countries where TB is more prevalent [39].

There were 9,000 cases of TB diagnosed in the United States in 2018, according to the Centers for Disease Control and Prevention (CDC) [40]. Although TB was once one of the leading causes of death in the U.S., the disease has significantly declined over the last several decades. According to the National Center for Health Statistics, 7,174 Americans were diagnosed with TB disease in 2020 [41]. It is estimated that in 2020, over 450,000 people will develop active TB disease in the United States and approximately 25,000 people will die from the disease [16]. Many cases of TB are preventable, and a national strategy has been developed to prevent the spread of TB in the United States. In 2021, a total of 7,860 TB cases were provisionally reported to CDC’s National Tuberculosis Surveillance System (NTSS) by the 50 U.S. states and the District of Columbia (DC) [16]. Overall, reported cases of tuberculosis (cases per 100,000 individuals) increased by 9.4% during 2021 [42]. This increase was due to increases in reported cases among foreign-born populations aged ≥65 years [43]. The incidence of TB increased both among U.S.-born and non-U.S.-born populations aged 65 and older in 2021. There were significant increases in the proportion of confirmed new cases among immigrants from Mexico (+22.5%), the Philippines (+20.3%), India (+18.0%), China (+17.9%), Vietnam (+12.6%), Korea (+10.8%), and other countries of origin not listed separately in the annual report [44]. These increases occurred despite reductions in new reports among immigrants from many high-burden countries.

5 Male: Female ratio

The male: female ratio of incident TB cases ranged from 1.3 in the WHO Eastern Mediterranean Region to 11.1 in the Western Pacific Region [45]. The highest rates were reported in the WHO European Region at 5.3 cases per 100,000 population; the lowest rates were found in the Western Pacific Region at 2.0 cases per 100,000 populations [46]. Rates were highest among men overall and women in the Eastern Mediterranean Region.

6 Xpert MTB/RIF is a rapid molecular test that detects

DNA and rifampicin resistance gene sequences simultaneously from a single sputum sample in less than an hour. WHO has endorsed the use of Xpert MTB/RIF worldwide as a faster alternative to conventional testing for the diagnosis of MDR-TB and XDR-TB [7]. Although Xpert MTB/RIF has been introduced in several countries, the uptake of the test in low- and middle-income countries has been slow [9]. In 2019, only 18 out of 44 countries with a high burden of TB had Xpert MTB/RIF available for use in health centers, public health laboratories, or referral hospitals and an additional nine countries were introducing this test into routine services [47]. As rapid molecular diagnostic tests have higher sensitivity than traditional methods, they should be used as the initial diagnostic test for all people with symptoms of TB [48]. Molecular testing is also recommended in people with a known history of TB and in people with drug-resistant TB [49]. Conventional culture-based methods are still used in some situations such as for drug susceptibility testing and for children younger than two years [50]. Molecular methods to detect TB are available in 87 countries, and of these, 51 countries have devices approved by regulatory authorities, meaning that these assays can be used to diagnose patients with suspected TB in these
countries. Rapid molecular tests are also widely available in the middle-income countries with the highest burden of TB in Asia and Latin America, including China and India [51].

7 Conclusions

Tuberculosis is a serious and potentially deadly respiratory illness. It is estimated that 1 billion people worldwide are infected with TB, and that more than two million people die from the illness each year. As of 2020, 30 countries had achieved the WHO's 2020 target of eliminating TB as public health problems by the year 2030, and about 80 percent of people affected by TB live in these countries.

8 Recommendation

There is an ongoing need to raise awareness of TB symptoms among the general population in order to encourage people to seek medical help if they suspect that they have the disease. In addition, there is a need to ensure that adequate healthcare resources are available to diagnose and treat people with PTB.

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