

Tuberculosis in the pediatric population: Manifestations and Management

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ABSTRACT:

Tuberculosis (TB) in children is a significant global health concern, particularly in regions with high TB prevalence. Due to their developing immune systems, children are more susceptible to TB and its severe forms, which can lead to high morbidity and mortality. This paper reviews the epidemiology, clinical manifestations, diagnostic challenges, and management strategies for pediatric TB. The global burden of TB among children is substantial, with millions affected annually. Factors such as malnutrition, HIV infection, and living in crowded conditions exacerbate the risk. High-burden regions include parts of Asia, Africa, and Latin America, where healthcare resources are often limited (World Health Organization, 2022). Clinically, TB in children can present with a wide range of symptoms, including persistent cough, fever, weight loss, and fatigue. Unlike adults, children are more likely to develop extrapulmonary TB, affecting organs such as the lymph nodes, bones, and central nervous system (Starke, 2021). Severe forms like miliary TB and TB meningitis are more common in young children and require prompt diagnosis and treatment. Diagnosing TB in children poses unique challenges due to the non-specific nature of symptoms and the limitations of diagnostic tests. The tuberculin skin test (TST) and interferon-gamma release assays (IGRAs) are standard but have limitations. Advances in diagnostic technologies, such as molecular tests like Xpert MTB/RIF, offer improved accuracy (Moore et al., 2024). Treatment involves a combination of first-line and second-line drugs, depending on drug susceptibility. The World Health Organization (WHO) recommends shorter regimens for non-severe drug-susceptible TB. Newer drugs like bedaquiline and delamanid are being used for multidrug-resistant TB in children (Nolt & Starke, 2021). Management challenges include ensuring adherence to treatment, particularly in resource-limited settings. Prevention strategies involve vaccination, prophylactic treatment, and infection control measures. The *Bacillus Calmette-Guérin* (BCG) vaccine remains crucial in high TB prevalence areas. This review highlights the importance of early detection, appropriate treatment, and comprehensive prevention strategies to improve outcomes for children affected by TB. Ongoing research and innovation are essential for developing new diagnostic tools, treatment options, and preventive measures to combat pediatric TB effectively.

Keywords: Tuberculosis, Pediatric; Pediatric; Population; Tuberculosis Diagnosis; Management;

INTRODUCTION:

According to WHO, 2021. tuberculosis is an infectious disease primarily affecting the lungs, although it can spread to other organs. it is caused by the bacterium mycobacterium tuberculosis. tuberculosis is transmitted through airborne particles when a person with active tuberculosis coughs, sneezes, or speaks. while many people infected with the bacteria do not develop symptoms (latent tuberculosis), about 10% can progress to active disease, especially if their immune system is weakened. symptoms of active tuberculosis typically include a persistent cough, chest pain, fever, night sweats, weight loss, and fatigue. left untreated,

tuberculosis can be fatal, especially in immunocompromised individuals, such as those with HIV/AIDS. tuberculosis is a major global health concern, particularly in developing countries, although it is treatable and preventable with proper medical care. the history of tuberculosis dates back thousands of years, with evidence found in ancient Egyptian mummies. in the 19th century, tuberculosis was known as "consumption" due to the severe weight loss it caused. the discovery of the mycobacterium tuberculosis by Robert Koch in 1882 marked a major milestone in understanding and combating the disease. treatment involves a course of antibiotics over a period of six months or longer, often using multiple drugs to

avoid early detection programs, are essential in controlling the spread of tuberculosis. despite progress, tuberculosis remains one of the leading causes of death from infectious diseases worldwide (Lange et al., 2022)

Pediatric tuberculosis cases are difficult to obtain for a multitude of reasons, including under-recognition, challenges in confirming the diagnosis, and under-reporting to national TB programs. The clinical and radiographic manifestations are less specific in children compared to adults, and are often confused with bacterial pneumonia. Microbiologic confirmation of disease is limited by the paucibacillary nature of TB in children; in general, TB cultures and newer rapid molecular tests are positive in the minority of children, generally <25–40% of children with TB disease (Thomas et al., 2017).

NEED FOR STUDY:

According to a conducted in study Botswana focused on pediatric TB cases over a period of 11 years. The researchers identified several factors contributing to poor treatment outcomes in children, such as co-infection with HIV, malnutrition, and delays in diagnosis. The findings highlighted the importance of early diagnosis, integrated care for children with TB and HIV, and nutritional support to improve treatment outcomes. The study calls for tailored strategies to address these challenges and reduce TB-related morbidity and mortality among children. (Mupere, E., et al. 2022).

Tuberculosis Infection in Children and Adolescents: Testing and Treatment report by the American Academy of Pediatrics provides a comprehensive review of the current methods for diagnosing and treating TB in children and adolescents. It discusses the limitations of traditional diagnostic tools like the tuberculin skin test (TST) and the need for more accurate methods such as interferon-gamma release assays (IGRAs). The report also emphasizes the importance of preventive therapy for children exposed to TB and suggests shorter, child-friendly treatment regimens. It highlights the need for ongoing research to improve diagnostic accuracy and develop new medications tailored for children (Starke, J.R., & Donald, P.R. (2021).

As per systematic review examines the guidelines from various countries and international organizations for managing TB in children. The review found significant variations in the recommendations, particularly regarding diagnostic methods, treatment regimens, and preventive measures. The authors call for a more standardized approach to ensure that children receive consistent and effective care regardless of where they live. The review also highlights areas where further research is needed to fill gaps in knowledge and improve clinical guidelines (Jenkins, H.E., et al. (2014).

A study published by Boston University discusses the global health challenge posed by TB, emphasizing the need for better diagnostic tools, treatment strategies, and understanding of latent TB infection. It highlights the importance of identifying high-risk individuals and developing evidence-based treatment protocols.

According to **WHO,2021**. report discusses the essential role of TB research and innovation in achieving global TB targets. It highlights the need for technological breakthroughs, such as effective vaccines, rapid diagnostic tests, and shorter, safer treatment regimens

Studying pediatric TB is crucial for developing better diagnostic tools, preventive measures, and treatment strategies to reduce the burden of this disease on children and their families (Moore BK et al.,2024).

CLINICAL MANIFESTATIONS:

The clinical manifestations of TB in children vary widely, often making diagnosis challenging.

1. **Pulmonary TB:** The most common form, characterized by a persistent Persistent non-remitting **cough** most common symptom, occurring in roughly 95% of patients, Night sweats reported in approximately 45% of patients. Weight loss: Seen in around 55% of cases and night sweats ([Davies et al. 2014](#)). In children, pulmonary TB may also present as wheezing or difficulty breathing tuberculosis (TB) symptoms often develop gradually and can last from weeks to months. However, they can present more acutely in young children or individuals with weakened immune systems (Marais et al., 2004).
2. **Extrapulmonary TB:** Children are more likely than adults to develop extrapulmonary TB, which can affect lymph nodes (scrofula), bones and joints (skeletal TB), the central nervous system (TB meningitis), and the abdominal cavity (Barss L. et al. 2022) (Adams, L. V. et al. 2023).
3. **Miliary TB:** This severe form occurs when TB bacteria spread through the bloodstream to multiple organs. Symptoms include high fever, severe fatigue, and a widespread rash. Miliary TB is more common in infants and young children (Donald et al., 2007). Miliary TB accounts for 1–2% of all cases of TB. It is more commonly seen in infants and children under 5 years of age and in immunocompromised hosts, including patients with rheumatological conditions

receiving tumour necrosis factor- α agents (Sharma SK. et al. 2016).

4. **Latent TB Infection (LTBI):** Many children infected with TB bacteria remain asymptomatic but can develop active TB later. LTBI is identified through positive tuberculin skin tests (TST) or interferon-gamma release assays (IGRAs) (Starke, 2014).

MANAGEMENT OF PEDIATRIC TB:

1. Clinical Diagnosis:

Diagnosing tuberculosis (TB) in children involves a comprehensive approach due to the diverse clinical presentations and difficulties in obtaining diagnostic samples.

Clinical Assessment: Detailed medical history and physical examination, focusing on symptoms, risk factors, and contact with known TB cases (Graham et al., 2015).

Tuberculin Skin Test (TST): A common screening tool where a purified protein derivative (PPD) is injected into the skin and measuring the reaction 48-72 hours later to detect TB infection. However, TST can give false positives in children vaccinated with *Bacille Calmette-Guérin* (BCG) (Lewinsohn et al., 2017).

Interferon-Gamma Release Assays (IGRAs): Blood tests that measure the immune response to TB antigens. IGRAs are more specific than TST and not influenced by BCG vaccination (Pai et al., 2014).

Radiographic Examination: Chest X-rays are used to detect lung abnormalities indicative of TB. CT scans may be employed for detailed imaging (WHO, 2014).

Microbiological Tests: Sputum smear microscopy, culture, and nucleic acid amplification tests (NAATs) to detect TB bacteria. In children, samples may be obtained through induced sputum, gastric lavage, or bronchoalveolar lavage (Lawn & Zumla, 2011).

2. Treatment of Pediatric Tuberculosis:

The treatment of TB in children involves a combination of antibiotics over an extended period. The standard regimen includes:

- A. **First-Line Anti-TB Drugs:** Isoniazid, rifampicin, pyrazinamide, and ethambutol for a 2-month intensive phase, followed by isoniazid and rifampicin for a 4-month continuation phase (WHO, 2010).
- B. **Drug-Resistant TB:** Treatment is more complex and may involve second-line drugs such as fluoroquinolones, aminoglycosides, and newer agents like bedaquiline and delamanid (Dheda et al., 2017).
- C. **Management of LTBI:** Children with LTBI may receive isoniazid or rifapentine to prevent progression to active TB (Sterling et al., 2011).

1. **Prevention:** Preventive strategies are crucial in reducing the incidence of TB among children:
 - **BCG Vaccination:** Administered at birth in countries with high TB prevalence, BCG vaccine provides partial protection against severe forms of TB in children (Trunz et al., 2006).
 - **Contact Tracing and Prophylaxis:** Identifying and treating TB in contacts of TB patients, particularly in households, to prevent transmission (Fox et al., 2013).
 - **Nutritional Support:** Ensuring adequate nutrition to support the immune system and overall health of children at risk of TB (Bhargava et al., 2013).
 - **Public Health Interventions:** Strengthening TB control programs, improving access to healthcare, and raising awareness about TB prevention and treatment (Lönnroth et al., 2010).

CONCLUSION:

Tuberculosis in children presents unique challenges in terms of diagnosis, treatment, and prevention. Continued research and tailored public health strategies are essential to address these challenges and reduce the burden of TB in the pediatric population. By focusing on these aspects, we can work towards a future where TB is no longer a threat to our youngest and most vulnerable population.

CONFLICTS OF INTEREST: The authors declare no conflict of interest.

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