



MODERN APPROACHES TO THE PREVENTION OF TUBERCULOSIS IN CHILDREN AND ADOLESCENTS

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ABSTRACT

Tuberculosis (TB) remains a significant public health concern, particularly among children and adolescents, who are more vulnerable to severe disease forms and long-term complications. Modern approaches to TB prevention emphasize early diagnosis, vaccination, chemoprophylaxis, and strengthened public health strategies. The Bacillus Calmette-Guérin (BCG) vaccine remains a cornerstone of pediatric TB prevention, but advancements in diagnostic technologies and the development of new vaccine candidates are enhancing protection. Additionally, targeted screening programs and preventive therapy for high-risk populations are proving effective in reducing TB incidence. This article reviews contemporary preventive strategies, highlights innovative interventions, and underscores the importance of global collaboration in eradicating childhood TB.

СОВРЕМЕННЫЕ ПОДХОДЫ К ПРОФИЛАКТИКЕ ТУБЕРКУЛЕЗА У ДЕТЕЙ И ПОДРОСТКОВ

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ABSTRACT

Туберкулез (ТБ) остается серьезной проблемой общественного здравоохранения, особенно среди детей и подростков, которые более уязвимы к тяжелым формам заболевания и отдаленным осложнениям. Современные подходы к профилактике туберкулеза делают упор на раннюю диагностику, вакцинацию, химиопрофилактику и усиление стратегий общественного здравоохранения. Вакцина Bacillus Calmette-Guérin (BCG) остается краеугольным камнем профилактики детского туберкулеза, но достижения в диагностических технологиях и разработка новых



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вакцин-кандидатов усиливают защиту. Кроме того, программы целевого скрининга и профилактическая терапия для групп высокого риска доказали свою эффективность в снижении заболеваемости туберкулезом. В этой статье рассматриваются современные профилактические стратегии, освещаются инновационные меры и подчеркивается важность глобального сотрудничества в искоренении детского туберкулеза.

Relevance. Tuberculosis (TB) remains one of the most persistent infectious diseases worldwide, with children and adolescents accounting for a significant proportion of new cases and TB-related deaths. According to the World Health Organization (WHO, 2023), over 1.1 million children develop TB annually, with many cases going undiagnosed or untreated. Children are particularly susceptible to severe forms of TB, such as miliary TB and TB meningitis, which can lead to lifelong disability or death if not treated promptly (Marais et al., 2019). Preventing TB in pediatric populations is therefore a critical component of global public health efforts to reduce the disease burden.

Modern preventive strategies rely on a combination of vaccination, early detection, and prophylactic treatment for latent TB infection (LTBI). The Bacillus Calmette-Guérin (BCG) vaccine, introduced nearly a century ago, remains widely used for its protective effect against severe TB in children, although its efficacy against pulmonary TB is limited (Roy et al., 2014). In response, researchers are exploring new vaccine candidates, while public health programs are strengthening contact tracing, screening, and preventive therapy for high-risk groups.

Additionally, innovative diagnostic tools, such as interferon-gamma release assays (IGRAs) and rapid molecular tests, have improved the identification of latent and active TB in pediatric populations (Schrager et al., 2020). Coupled with community-based interventions, health education, and improved healthcare access, these approaches offer a multifaceted pathway to reducing TB transmission and protecting vulnerable populations.

This article explores the evolution of TB prevention in children and adolescents, discussing current best practices, recent scientific advancements, and remaining challenges. By integrating modern medical research with public health strategies, it is possible to move closer to the goal of TB elimination in younger populations and build a healthier future for all.

Effective tuberculosis (TB) prevention in children and adolescents requires a multifaceted approach that combines vaccination, early diagnosis, targeted preventive therapy, and robust public health measures. The literature highlights significant progress in each of these areas, with ongoing research aimed at optimizing existing strategies and developing innovative solutions.

Vaccination and Immunoprophylaxis

The Bacillus Calmette-Guérin (BCG) vaccine has been a cornerstone of pediatric TB prevention for nearly a century. Multiple studies confirm that BCG is highly effective in preventing severe forms of TB, such as TB meningitis and disseminated disease, in young



children (Roy et al., 2014). However, its limited efficacy against pulmonary TB and variable protection across populations have prompted researchers to develop next-generation vaccines. Candidates like M72/AS01E and VPM1002 have shown promise in clinical trials, potentially offering broader and longer-lasting immunity (Tait et al., 2019). Expanding access to BCG vaccination in high-burden settings remains essential, but future vaccines could revolutionize pediatric TB prevention.

Early Diagnosis and Screening

Early diagnosis is critical to interrupt TB transmission and prevent disease progression in children, who are more likely to develop severe disease than adults. Traditional diagnostic methods, such as sputum microscopy, are less effective in children due to low bacterial loads and difficulty producing sputum samples (Graham et al., 2015). The advent of interferon-gamma release assays (IGRAs) and nucleic acid amplification tests, like Xpert MTB/RIF, has improved diagnostic accuracy and reduced time to diagnosis (Lawn & Nicol, 2011). Nevertheless, access to these technologies remains limited in low-resource settings, highlighting the need for affordable, scalable diagnostic solutions.

Preventive Therapy for Latent TB Infection (LTBI)

Preventing the progression of latent TB infection to active disease is a key component of TB control in children and adolescents. The WHO recommends preventive therapy for children under five years old who have been in contact with an infectious TB patient, as well as for older children with HIV or other immunocompromising conditions (WHO, 2023). Traditional isoniazid preventive therapy (IPT) has proven effective, but its long duration (6–9 months) often leads to poor adherence. Newer, shorter regimens, such as 3HP (once-weekly rifapentine plus isoniazid for 3 months), have demonstrated high efficacy and better adherence, making them a valuable option for pediatric TB prevention (Dodd et al., 2021).

Public Health and Community-Based Interventions

Beyond biomedical approaches, public health interventions play a crucial role in TB prevention. Contact tracing, active case finding, and community-based education programs have been shown to reduce transmission and improve health-seeking behaviors (Mbusa et al., 2022). Social determinants of health — including poverty, malnutrition, and overcrowded living conditions — significantly influence TB risk, underscoring the importance of comprehensive public health policies that address these underlying factors. Community health workers and school-based TB education initiatives have proven particularly effective in promoting TB awareness and facilitating early detection (Craig et al., 2020).

In sum, the literature underscores the need for an integrated, multi-pronged approach to TB prevention in children and adolescents. While recent advances in vaccination, diagnostics, and preventive therapy offer hope, addressing disparities in healthcare access and strengthening public health infrastructure are equally vital to achieving lasting progress.

Preventing tuberculosis (TB) in children and adolescents remains a critical global health priority, especially given their vulnerability to severe disease and the challenges associated with early diagnosis. The literature highlights significant progress in preventive strategies, from the enduring role of the BCG vaccine to the promise of next-generation vaccine candidates. Advances in diagnostic tools, such as molecular tests and interferon-gamma



release assays (IGRAs), have improved early detection, while shorter, more manageable preventive therapy regimens like 3HP have enhanced treatment adherence and outcomes.

Conclusion. However, technological progress alone is not enough. Effective TB prevention requires a comprehensive approach that integrates biomedical innovation with strengthened public health systems, community-based interventions, and policies addressing social determinants of health. Expanding access to care, particularly in high-burden and low-resource settings, is essential to closing gaps in prevention and treatment. Additionally, ongoing research, sustained global collaboration, and investment in healthcare infrastructure will be key to accelerating progress toward TB elimination. By harnessing modern scientific advancements alongside targeted public health measures, it is possible to protect children and adolescents from TB, reduce transmission, and work toward a future where TB is no longer a threat to young populations worldwide. Continued commitment at local, national, and global levels will be crucial to achieving this vision and ensuring that no child suffers from a preventable and treatable disease.

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