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TUBERCULOSIS MINISYMPOSIUM

Global resources in the fight against tuberculosis

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Abstract
Tuberculosis continues to be a significant cause of mortality and morbidity worldwide, particularly in developing countries. Diagnosis and treatment of paediatric patients presents a challenge that can only be improved by the joint efforts of the international community, working together in cooperation and partnership. This article reviews global resources available to doctors and healthcare professionals in the fight against TB, including international programmes, policies and healthcare pathways. Special attention is paid to the role of international paediatric radiology in improving diagnostics, including available educational resources and support on a global, regional, national and individual level.

Keywords Children · Global initiatives · Imaging · Tuberculosis

Tuberculosis (TB) continues to be a significant cause of morbidity and mortality in many countries worldwide. It is the second leading cause of deaths related to infectious pathology, affecting many countries, especially in the low-resource regions in Africa and Asia.

The World Health Organization (WHO) Global Tuberculosis Report showed an estimated 10.6 million people falling ill with TB in 2021, equivalent to 134 cases per 100,000 population. This is an increase of 4.5% from 10.1 million in 2020, reversing many years of slow decline [1], with the 2019 coronavirus disease (COVID-19) pandemic seen as a main contributory factor to the reversal of previous success in TB reporting and treatment.

Geographically, most TB cases in 2021 were in Southeast Asia (45%), Africa (23%) and Western Pacific (18%), with a lower number of cases in the Eastern Mediterranean (8.1%), the Americas (2.9%) and Europe (2.2%) (Fig. 1).

Globally, the annual number of deaths from TB has also increased over recent years to 1.6 million in 2021, from 1.5 million in 2020 and 1.4 million in 2019 [1].

Children and young adolescents aged under 15 years represent around 11% of all TB cases globally, with 1.1 million new TB infections every year in this age group (Fig. 2). Every day, over 600 children below the age of 15 years (over a quarter of million per year) die from this preventable and curable disease [2].

The situation is especially tragic in rural and underprivileged countries, without adequate (or frequently no) access to appropriate healthcare.

Worldwide, over 50% of children and adolescents with TB face significant barriers to accessing specialist care. In 2020, an estimated 63% of children younger than 15 years did not have access to diagnosis and treatment. This situation was even worse in the population below 5 years of age, with an estimated 72% missing out on adequate healthcare (WHO Global Report 2021) [3].

In 2017, only 23% of eligible children under 5 years old received preventive therapy [2].

Children are also left behind in funding efforts. While they represent around 10% of global TB patients, they account for just 3% of overall spending on research and development [2].

To address the current situation and the urgent challenges in prevention and treatment of TB, an international community came together to create a joint approach in the fight against this deadly disease. Professional governmental and non-governmental organisations are involved in the joint programmes, together with the medical societies and cross-speciality healthcare organisations, working in cooperation and in partnerships. The international work is led by the WHO and the United Nations International Children's Emergency Fund (UNICEF), with active participation from the medical, paediatric and radiological societies and many professional and academic institutions worldwide.

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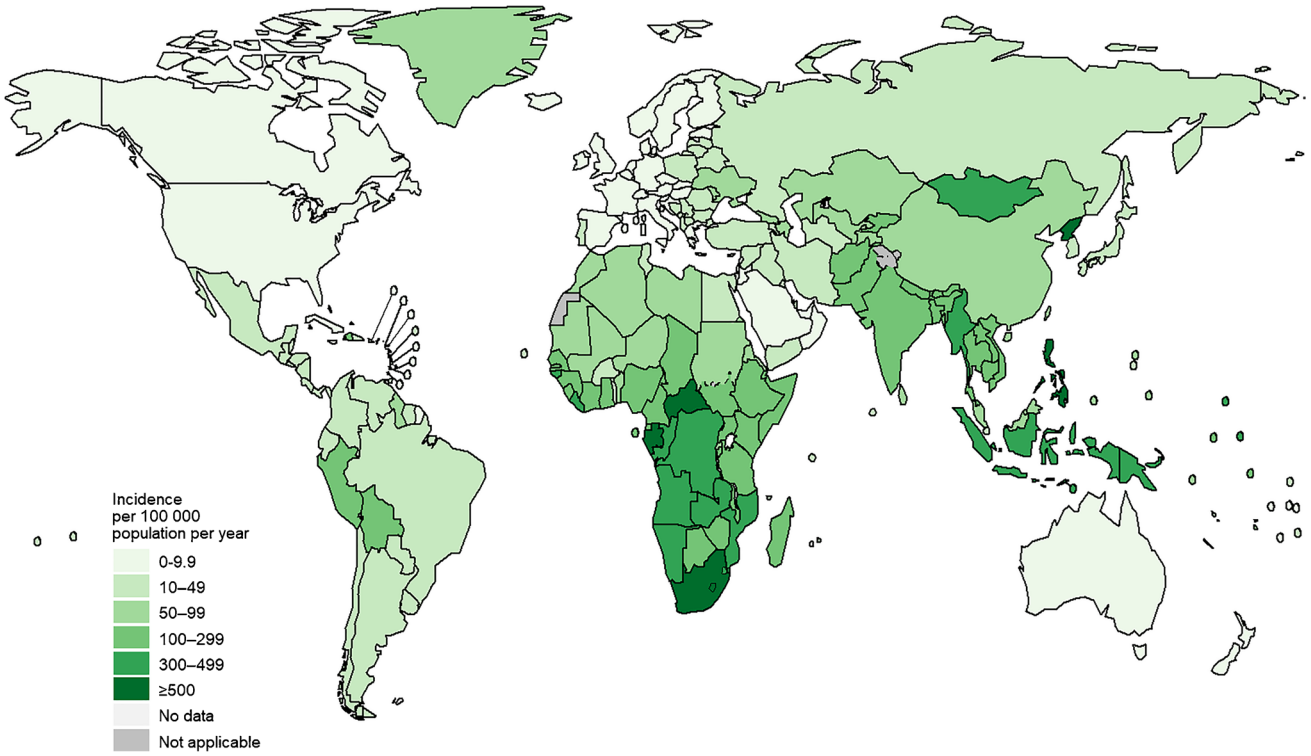

Fig. 1 Estimated tuberculosis incidence rates in 2021 (WHO Global TB Report 2022) [1]

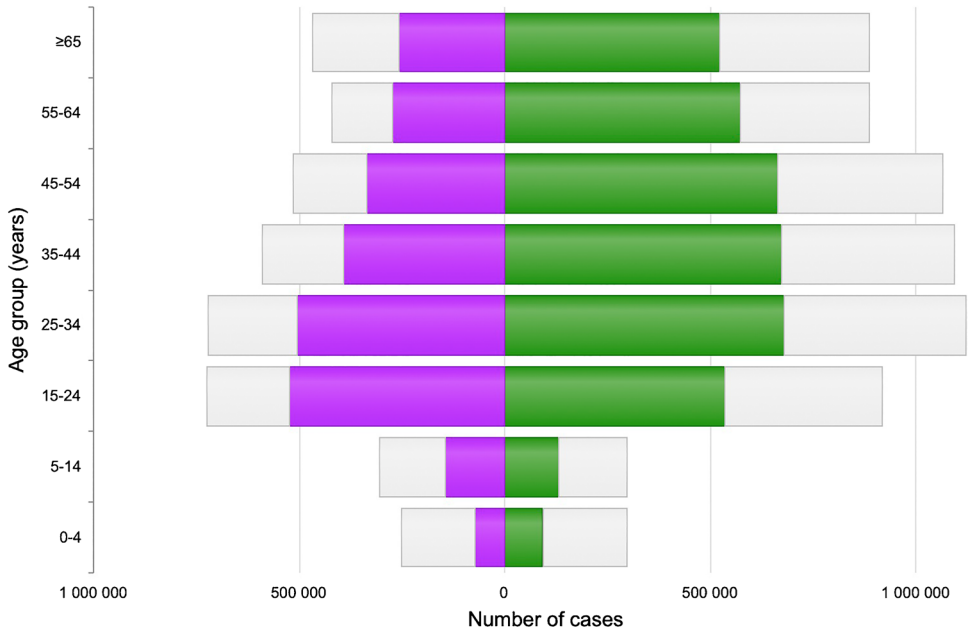

Fig. 2 Global estimates of tuberculosis incidence numbers and case notifications by age and sex in 2021 (female in purple, male in green). WHO Global TB Report 2022 [1]

World Health Organization

In 1993, the WHO declared TB a global emergency, due to significant increases in morbidity and mortality on an international scale. The WHO Global Tuberculosis Programme was created, which works towards the goal of a world free of TB, with zero deaths, disease and suffering from the disease. The team's mission is to lead and guide the global effort to end the TB epidemic through universal access to people-centred prevention and care, multisectoral action and innovation [4].

Since 1997, the WHO has published an annual global TB report, providing a comprehensive and up-to-date assessment of the TB epidemic at global, regional and national level [1].

To address the most urgent issues, the WHO invites multiple groups of healthcare professionals to work together, to carry out research and produce guidelines and recommendations related to diagnosis and treatment of this deadly infection.

In June 2021, the WHO introduced a TB knowledge sharing platform, with easy and free access to all the WHO guidelines on TB, including corresponding handbooks and training material (https://tbksp.org/en).

The platform also includes multiple e-learning courses, with training material on rapid diagnostics for TB detection (https://tbksp.org/en/node/1722) and guidelines on 'Chest radiography in TB detection'.

World Tuberculosis Day

World Tuberculosis Day takes place in March each year, to raise general awareness and to advocate for efforts to eliminate TB. March 24th marks the day in 1882 when Dr Robert Koch discovered the bacterium that causes TB, which enabled development of a diagnostic pathway and curative treatment of this terrible disease.

World TB Day is an excellent opportunity to focus on people and societies affected by the disease. It is also an opportunity to discuss international efforts and coordinate actions on prevention and treatment.

Each year, World TB Day has a different theme, designed to focus international attention on the most relevant and urgent requirements in the global fight. In 2022, the theme 'Invest to end TB. Save lives' highlighted the urgent need for financial investments and commitments by global, international and national leaders to end TB. The chosen topic was an important reminder that outlined the significant delays in the progress of the 'End TB' programme, which was relegated in response to the COVID-19 pandemic. In 2020, the number of deaths related to TB increased for the first time in over a decade.

To encourage perseverance and highlight new developments in research and treatment, 2023 World TB Day concentrated on further actions and joint programmes, with a theme 'Yes, we can end TB'. It aimed to inspire hope and encourage multisectoral collaboration to combat the TB epidemic, by increased investments, adoption of innovations, faster uptake of new WHO recommendations and accelerated international actions.

World Health Organization guidelines on tuberculosis in children

In 2022, the WHO World TB programme paid special attention to the youngest members of the global population with a special 2022 theme, 'Ending TB in children and adolescents'.

World TB Day was dedicated to children and marked by the publication of new WHO guidelines for the management of TB in the paediatric population [5].

The consolidated WHO guidelines cover recommendations on all aspects of TB care including screening, prevention, diagnostic approach, treatment pathways and various models of care to optimise TB service delivery. The paediatric guidelines are important and timely, as recent WHO/UNICEF data [6] showed a significant gap in the reporting of TB between the adult and paediatric populations. In children below 5 years of age, nearly 70% of TB cases were missed (under-diagnosed or under-reported), in comparison to 35% of the general population (Fig. 3).

The 'WHO consolidated guidelines on tuberculosis' [7] and 'WHO operational handbook on tuberculosis' [8] in children and adolescents are available to read and download for free from the WHO website. They provide well-researched

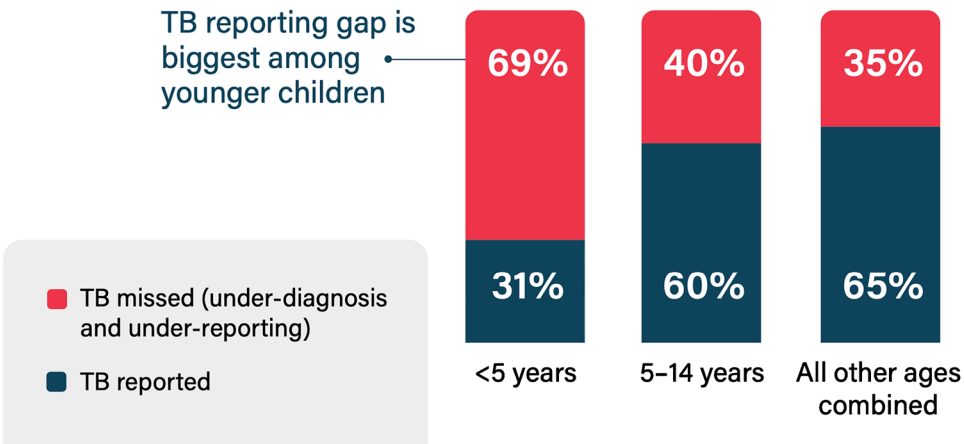

Fig. 3 Case detection gap—missed tuberculosis cases in different age groups. Roadmap towards ending TB in children and adolescents, 2nd edition, UNICEF [6]

and up-to-date information on all aspects of TB infection in children and young adults and are of practical help to all healthcare professionals working with this difficult disease.

The publication of the paediatric guidelines has been highlighted and promoted by on-line educational events, organised by a collaboration between the WHO, the World Federation of Pediatric Imaging (WFPI) and the International Society of Radiology (ISR) [9].

With developing technology and 'virtual cooperation', social media has become an important platform for communication and raising awareness of TB-related issues. For World TB Day in 2022, the WHO launched a special 'Invest to End TB Challenge', where participants were invited to share their experiences and stories by submitting 15-s videos on TikTok, Instagram or Facebook. There are multiple other programmes and initiatives available through social media, bringing together various groups, communities and individuals involved in the fight against TB, with #tuberculosis and #EndTB being popular on social media.

The United Nations International Children's Emergency Fund

UNICEF was established in 1946 after World War II, to protect and help children whose lives and futures were at risk. Since then, its work continues to protect children's rights to survive, thrive and reach their full potential.

Over recent years, UNICEF has been actively involved in the fight against TB in children and adolescents, working closely with the WHO and other international organisations.

In 2013, UNICEF launched the first ever programme 'Roadmap for Childhood TB: Towards Zero Deaths', outlining measures to prevent and treat TB in children and adolescents. This helped to attract global attention and interest, placing the childhood TB epidemic in the international spotlight and raising awareness of this significant problem.

The launch of their second roadmap in 2018, combined with the UN General Assembly meeting on TB, presented an opportunity for all stakeholders to join efforts to address the burden of TB among children and adults and to consolidate commitments and resources [6]. A new action plan was published by UNICEF in 2018 [6], including both updated and new recommendations, with a clear call for global partnerships, priority actions and investments.

The 2018 Roadmap is intended to be adapted by all countries and to be used by global, regional and national policy-makers, national TB, maternal and child health, human immunodeficiency virus and other primary healthcare programmes that formulate strategies and plans for health services.

The Roadmap highlights key actions to end TB in children and adolescents, with high-level leadership and accountability, functional partnerships, increased funding, advocacy, integrated family- and community-centred strategies with improved monitoring and more research (Fig. 4).

International Union Against Tuberculosis and Lung Disease

'The Union' is another global organisation, joining individuals and institutions from around the world in the fight against TB [10]. It was established in 1920, as an International Union Against Tuberculosis and Lung Disease, committed to creating a healthier world, free of TB and lung disease. The Union provides educational support to develop clinical expertise, management skills and support in research and advocacy. It has several regional offices and networks through all continents, providing conferences, courses and educational events. It cooperates and works closely with the WHO and other international organisations, complementing their efforts.

The International Journal of Tuberculosis and Lung Disease is the official publication of The Union, one of the leading peer-reviewed journals dedicated to lung health worldwide. It has more than 21,000 subscribers in 189 countries.

In March 2022, as part of World TB Day, The Union published a guide to the interpretation of chest radiographs (CXRs)—'Diagnostic CXR Atlas for tuberculosis in children: A Guide to Chest X-ray Interpretation' [11]. This was the second edition of a widely used atlas, first published in 2003, to help non-specialist healthcare workers to interpret CXRs performed for the investigation of TB. The publication was especially important in countries and regions where radiographs are read by non-medical healthcare professionals, due to a shortage of trained radiologists and paediatricians.

In October 2022, the 'Diagnostic CXR Atlas for Tuberculosis in Children Image Library' was launched, freely available on The Union website [12]. This on-line library has been developed to provide additional training material to build capacity and required skills for frontline health professionals working in resource-limited settings. It provides a systematic approach to reading CXRs and discusses the most common findings and pattern characteristics for TB infection in young patients (Fig. 5).

To help in the practical implementation of the TB programme at regional and national levels, The Union created the Child and Adolescent Tuberculosis Centre of Excellence in sub-Saharan Africa. This is a virtual network of professionals and organisations, providing a community of learning and support. With its office in Uganda, the network currently covers 9 countries, including Eswatini, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Uganda, Zambia, Eswatini and Zimbabwe.

Fig. 4 Roadmap towards ending TB in children and adolescents, UNICEF [6]

World Federation of Pediatric Imaging

The WFPI provides an international platform for paediatric radiology organisations to address the challenges in global paediatric imaging, training, education and delivery of services. It unites all international and national societies of paediatric radiology behind common goals and programmes, including the fight against TB.

The WFPI Childhood TB Group aims to improve the diagnosis of TB using radiology investigations in screening programmes for early detection of this curable disease. Members of the WFPI TB Group produce lectures and educational videos, available for free in the TB Corner of the WFPI website [13].

The educational material not only includes theoretical knowledge, but also provides practical help and an approach to various investigations, a guide on how to read paediatric frontal and lateral CXRs and how to perform an ultrasound scan of the chest for evaluation of mediastinal lymphadenopathy [14]. It covers not only pulmonary TB, but also TB meningitis and hepatic, gastrointestinal and genitourinary TB infections, with special attention paid to differential diagnosis, unusual patterns of clinical presentation and future developments in imaging.

Members of the TB Group collate and review existing TB literature and web-based TB learning material, as guidance to paediatric radiologists and other healthcare professionals, providing reliable and up-to-date information, with easy and free access to everyone. It is continuously reviewed and updated, to ensure compliance with current guidelines, modern radiology techniques and newly emerging investigations [15].

To further enhance knowledge and raise awareness among radiologists, a Tuberculosis Mini-Symposium was organised in cooperation with the Pediatric Radiology Journal in 2017. Several papers were published including ‘Revisiting and redefining the standards in tuberculosis imaging’ [16] and ‘Standardized radiographic interpretation of thoracic tuberculosis in children’ [17], among others. There were several articles written by leading experts in paediatric TB radiology, all of which are easily available and free of charge to everyone.

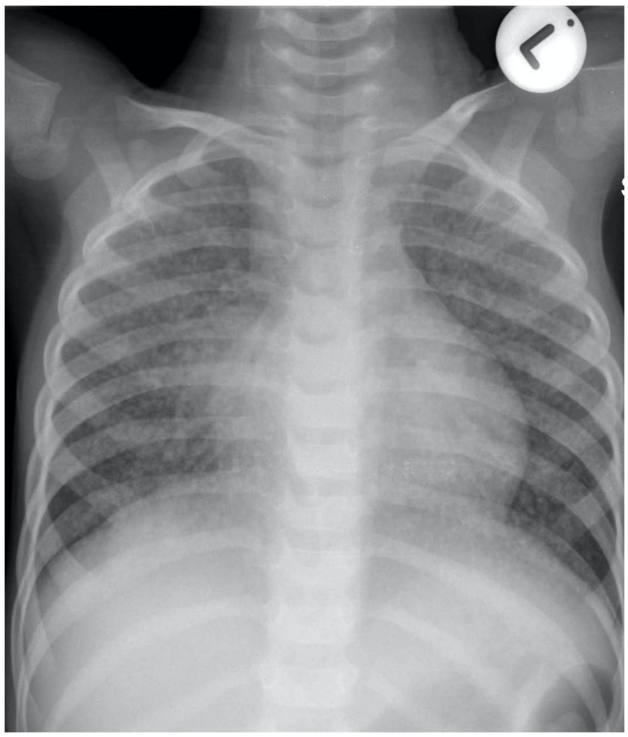

Fig. 5 Anteroposterior chest radiograph of a 5-year-old boy showing the characteristic pattern of tuberculosis in children, with miliary nodules scattered throughout both lungs

Lectures and presentations on imaging in TB have also been included in the scientific sessions organised by the WFPI at various international paediatric radiology conferences and meetings (International Paediatric Radiology Congress in 2021 in Rome, upcoming meeting of the European Society of Paediatric Radiology in 2023 in Serbia and others).

Over recent years, several webinars have been run, to reach a wider audience and help to improve the diagnosis of childhood TB across the globe. These sessions covered a detailed approach to diagnosis of TB in children and young adults, discussing the most common clinical presentations, challenging clinical dilemmas and new techniques in investigations of TB, including use of magnetic resonance imaging for the assessment of pulmonary and abdominal disease [15, 18].

In addition to the educational events and on-line training, WFPI members offer active and continuous support to various TB projects and programmes in Africa, Asia and Latin America through the TB 'hotline'. The TB hotline is a network of experts from many countries worldwide, ready to provide second opinions, guidance and targeted education and training [13].

The WFPI is an active member of the wider TB network which includes the ISR TB Steering Group, Stanford University Hospital, Médecins sans Frontiers, Stop TB Strategy Unit at WHO, Imaging the World and European Paediatric Tuberculosis Network.

The World Federation of Paediatric Imaging works together with the ISR's International Commission on Radiology Education (ICRE) and the ISR TB Steering Group, who developed an open access, on-line education module 'Imaging of Tuberculosis' available through the ISR website [19].

Conclusion

Tuberculosis is a preventable and curable disease, which continues to impact the lives and development of millions of children and adolescents worldwide. Recent increases in the morbidity and mortality rates are alarming and require urgent action from the international community. Tuberculosis is not only causing a high number of deaths, but also having a devastating impact on social and economic aspects of many societies and broader economies. The international community must work together and join efforts to achieve the universal goal of, 'A world free of TB, with zero deaths, disease and suffering due to disease'.

Tuberculosis will only be defeated by a global alliance, a United World to achieve the 'End of TB' and save millions of lives.

Data availability All data included in the article is freely available on the WHO and UNICEF websites.

Declarations

Conflicts of interest None

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