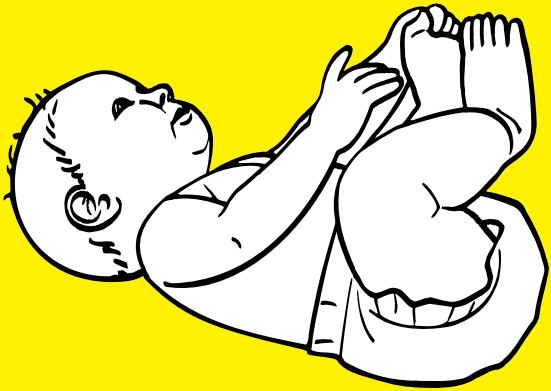
REPUBLIC OF KENYA

MINISTRY OF HEALTH

# NATIONAL GUIDELINES ON MANAGEMENT OF TUBERCULOSIS IN CHILDREN



NATIONAL TUBERCULOSIS, LEPROSY AND LUNG DISEASE PROGRAM

**Third Edition: August 2017**

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| | |
|---|---|
| **3TC** | Lamivudine |
| **ABC** | Abacavir |
| **AZT** | Zidovudine |
| **CHEW** | Community Health Extension Worker |
| **CHW** | Community Health Worker |
| **Cm** | Capreomycin |
| **CPT** | Cotrimoxazole Preventive Therapy |
| **Cs** | Cycloserine |
| **CSF** | Cerebrospinal Fluid |
| **EFV** | Efavirenz |
| **EPTB** | Extra Pulmonary TB |
| **ESR** | Erythrocyte Sedimentation Rate |
| **FNA** | Fine Needle Aspirate |
| **HAART** | Highly Active Antiretroviral Therapy |
| **IGRA** | Interferon-Gamma Release Assay |
| **INH** | Isoniazid |
| **IRIS** | Immune Reconstitution Syndrome |
| **Lfx** | Levofloxacin |
| **LPV/r** | Lopinavir/Ritonavir(Kaletra) |
| **MAM** | Moderate Acute Malnutrition |
| **MTB** | Multidrug Resistant TB |
| **MUAC** | Mid Upper Arm Circumference |
| **NaCl** | Sodium Chloride |
| **NVP** | Nevirapine |
| **PCP** | Pneumocystis Jirovenci Pneumonia |
| **Pto** | Prothionamide |
| **RIF** | Rifampicin |
| **RTV** | Ritonavir |
| **SAM** | Severe Acute Malnutrition |
| **TB** | Tuberculosis |
| **TBM** | TB Meningitis |
| **TST** | Tuberculin Skin Test |
| **TU** | Tuberculin Units |
| **W/H** | Weight for Height |
| **W/L** | Weight for Length |
| **WHO** | World Health Organization |
| **XDR-TB** | Extensively Resistant Tuberculosis |
| **Xpert MTB/RIF** | Gene Xpert Test |
| **ZN** | Ziehl Neelsen |

## FOREWORD

The National Tuberculosis, Leprosy and Lung Disease Program (NTLD-Program) is mandated to develop policies, build capacity and provide technical assistance in health to the devolved county system.

Treatment of tuberculosis has over the years focused more on adults leaving children with little attention as medical practitioners considered children to be of little epidemiologic significance. Available data indicates that about 9% of TB cases notified in Kenya are children below 15 years. This is thought to be an underestimate yet TB causes significant morbidity and mortality in children. Tuberculosis in children is also an important indicator of on-going TB transmission in the society.

Medication for treating TB in children has evolved over the years with the current regimen now containing Ethambutol that was not previously used in children. The actual formulations have been reviewed to cater for higher doses of Isoniazid and Rifampicin used in children below 25kg body weight. These newer formulations enable treatment with a regimen that has a pleasant taste and is simpler for the health care workers and the caregivers to administer. This enhances treatment adherence and leads to improved treatment outcomes for children with TB.

With the high burden of TB in the population, there is need to ensure contact tracing for all child contacts of bacteriologically diagnosed TB. Contacts found to have TB disease are treated. Those below the age of five years without the disease are initiated on Isoniazid prophylaxis to protect them from developing TB.

Children with TB and HIV co-infection require management for both conditions to reduce their morbidity and mortality rates. This should be carefully planned to minimize drug interactions, development of drug resistance and ensure good treatment outcomes.

This guideline seeks to provide guidance to the health care workers on the management of TB in children. It seeks to demystify TB diagnosis in children especially in the context of new diagnostic methods expected to revolutionize TB diagnosis and management. It also guides health care workers on the treatment of TB in children and the management of child TB contacts. This guideline will also act as a reference material for medical students, researchers and the entire community.

**Dr. Kioko Jackson K., OGW**
**DIRECTOR OF MEDICAL SERVICES**
**MINISTRY OF HEALTH**

## ACKNOWLEDGEMENT

The National Tuberculosis, Leprosy and Lung Disease Program is indebted to the Ministry of Health's leadership and health care workers in the implementation of TB control activities in the country and their support during the revision of this guideline.

The NTLD-Program specifically acknowledges the input received from the following technical and training institutes:
Ministry of Health
World Health Organization (WHO)
US Centers for Disease Control and Prevention (CDC)
United States Agency for International Development (USAID)
National Tuberculosis, Leprosy and Lung Disease Program (NTLD-Program)
National AIDS and STI Council (NASCOP)
University of Nairobi (UON)
Kenya Medical Research Institute (KEMRI)
Moi Teaching and Referral Hospital (MTRH)
International Center for AIDS Care and Treatment Program (ICAP)
Centre for Health Solutions - Kenya (CHS)

**Dr. Maureen Kamene**
**HEAD OF NATIONAL TUBERCULOSIS,**
**LEPROSY AND LUNG DISEASE PROGRAM**
**MINISTRY OF HEALTH**

# CHAPTER 1

## INTRODUCTION TO TUBERCULOSIS

### 1.1 Aetiology

TB is caused by the bacterium *Mycobacterium tuberculosis* (*M. tuberculosis*). *M. tuberculosis* and seven very closely related mycobacterial species (*M. bovis, M. africanum, M. microti, M. caprae, M. pinnipedii, M. canetti and M. mungi*) together comprise what is known as the M. tuberculosis complex. Most, but not all, of these species have been found to cause diseases in humans. *M. tuberculosis* organisms are also called tubercle bacilli.

In rare situations, Non-Tuberculous Mycobacteria (NTM) may cause a disease similar to typical TB.

### 1.2 Transmission

M. tuberculosis is transmitted through airborne infectious droplet nuclei which are generated when persons who have pulmonary or laryngeal TB disease cough, sneeze, shout, or sing. These tiny particles (1– 5 microns in diameter) can remain suspended in the air for several hours. M. tuberculosis is transmitted through the air, not by surface contact. Transmission occurs when a person inhales droplet nuclei containing M. tuberculosis, and the droplet nuclei traverse the mouth or nasal passages, upper respiratory tract, and bronchi to reach the alveoli of the lungs.

To be infected with the tubercle bacillus a person must be exposed to an infectious case of TB.

**Figure 1: Transmission of TB from an adult to a child**

**Risk factors of exposure to the TB bacillus**

a) Incidence of infectious TB in population/community
b) Average duration of infectiousness of cases
c) Number of cases/contact interactions over time
d) Population density
e) Family size
f) Poverty
g) Overcrowding

**Risk factors for transmission**

1. **Level of TB infection in a person:** A person with TB who expels more bacilli is more infectious than one who expels fewer bacilli. The level of infection is increased if the patient has a cough or pulmonary disease, poor cough etiquette, inappropriate treatment, cavitatory disease, culture or bacteriologically positive disease.
2. **Susceptibility of the exposed child with the contact:** This is dependent on the immune status of the exposed child. If the child contact has a weakened immune system, TB transmission is more likely. The very young have a higher risk of developing disease upon exposure.
3. **Environmental factors:** These are factors that may increase the concentration of the bacilli in the immediate environment of the child. They include the concentration of infectious droplet nuclei in the air, exposure in small-enclosed spaces, recirculation of air containing infectious droplet nuclei, improper specimen handling procedures that generate infectious droplet nuclei.
4. **Proximity, frequency and duration of exposure with the infectious person:** The longer the duration of contact, the more frequent the contact, the closer the contact, the higher the risk of transmission.

## 1.3 Pathogenesis of TB

Upon exposure to an infectious case, the child inhales droplet nuclei containing infectious bacilli and they reach the alveoli. They are ingested by alveolar macrophages which destroy them. A few bacilli may survive, multiply in the macrophages and are released when the macrophages die. This process induces an immune response.

The immune cells in the alveoli may form an immune capsule called a granuloma (Ghon focus) that keeps the bacilli contained and under control. It might also involve the draining lymph nodes. Both the granuloma and the draining lymph nodes are called Ghon complex (Primary complex). If this is present without signs and symptoms of disease, it is **latent TB infection.**

If the immune system cannot keep the bacilli under control, they multiply rapidly, affecting the lung parenchyma and the airways. They may spread through the lymphatics or the blood stream to the rest of the body. The child will then be symptomatic and said to be having TB disease **(primary TB disease).**

Without treatment, many children infected with M. tuberculosis will develop TB disease in the first or second year after infection. In others, the bacilli remain dormant for a long time and they may develop TB disease at some point in their lifetime. Progression of the latent infection to disease is **secondary TB disease.**

**Risk of latent TB infection progressing to TB disease**

Children with latent TB infection can progress to active TB disease. Risk factors for this progression include:

- HIV infection
- Age especially those under the age of two years
- Recent infection with M. tuberculosis (within the last two years)
- History of previously poorly treated TB
- Immunosuppressive therapy
- Other immune suppressive conditions e.g. diabetes, silicosis, malignancies

Progression of the primary complex may lead to enlargement of hilar and mediastinal nodes with resultant bronchial collapse. Progressive primary TB disease may develop when the primary focus cavitates and organisms spread through contiguous bronchi. Lympho-haematogenous dissemination, especially in children, may lead to milliary TB when caseous material reaches the bloodstream from a primary focus or a caseating metastatic focus in the wall of a pulmonary vein. TB meningitis may result from haematogenous dissemination.

Bacilli may remain dormant in the lungs for several months or years. A positive tuberculin skin test (TST) or Interferon Gamma Release Assay (IGRA) where available would be the only evidence of infection.

***TB in young children is often disseminated and rapidly progressive***

## 1.4 Definitions

**TB infection** is when a person carries the mycobacterium tuberculosis bacteria inside the body. Many people have TB infection and seem to be healthy. A positive TST indicates an infection - but a negative TST does not exclude the possibility of infection. TB infection is also called latent TB.

**TB disease** occurs in someone with TB infection when the bacteria inside the body start to multiply and become numerous enough to damage one or more organs of the body. This damage causes clinical symptoms and signs and is referred to as "Tuberculosis" or active disease.

**Index case (index patient):** The initially identified case of new or recurrent TB, in a person of any age, in a specific household or other comparable setting in which others may have been exposed. An index case is the case around which a contact investigation is centred (but is not necessarily the source case)

**Household contact:** A person who shared the same enclosed living space for one or more nights or for frequent or extended periods during the day with the index case during the 3 months before commencement of the current treatment episode

**Close contact:** A person who is not in the household but shared an enclosed space, such as a social gathering, workplace or facility, for extended time periods during the day with the index case during the 3 months before commencement of the current treatment episode (e.g. care taker, school staff)

**Children** refers to those between 0 to 14 years of age

**Infant** is a child of less than 1 year of age (0-12 month age group)

## 1.5 Classification of TB

**A presumptive TB case** is one who presents with symptoms or signs suggestive of TB (previously known as a TB suspect).

**Case definitions**

a) **A bacteriologically confirmed TB case:** one from whom a biological specimen is positive by smear microscopy, culture or WRD (WHO-approved rapid diagnostics such as Xpert MTB/RIF). All such cases should be notified regardless of whether TB treatment was started or not.

b) **A clinically diagnosed TB case:** A clinically diagnosed TB case is one who does not fulfil the criteria for bacteriological confirmation but has been diagnosed with active TB by a clinician or other medical practitioner who has decided to give the patient a full course of TB treatment. This definition includes cases diagnosed based on X-ray abnormalities or suggestive histology and extra pulmonary cases without laboratory confirmation. Clinically diagnosed cases subsequently found to be bacteriologically positive (before or after starting treatment) should be reclassified as bacteriologically confirmed.

Bacteriologically confirmed or clinically diagnosed cases of TB are also classified according to:

- Anatomical site of disease
- History of previous treatment
- Drug resistance
- HIV status

This is shown in **Table 1.**

## Table 1: Classification of TB

| **Classification based on anatomical sites** | |
|---|---|
| **Pulmonary TB (PTB)** | This is TB disease involving the lung parenchyma (segmentalor lobar consolidation, TB bronchopneumonia). Milliary TB is disseminated disease but classified as PTB because there are lesions in the lungs. |
| **Extra pulmonary TB (EPTB)** | This is TB disease present outside the lung parenchyma.<br>• Intra-thoracic (Inside the chest, but outside the lung tissue): pleural effusion, intra-thoracic lymphadenopathy, (mediastinal, paratracheal or hilar lymphadenopathy)<br>• Extra-thoracic (Outside the chest): Peripheral Lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges. |
| A patient with both pulmonary and extra pulmonary TB should be classified as a case of PTB. | |
| **Classification based on history of previous TB treatment (patient registration group)** | |
| **New patients** | Patient who has never been treated for TB or has taken anti-TB drugs for less than one month. |
| **Previously treated patients** | Patient who has received 1 month or more of anti-TB drugs in the past. They are further classified by the outcome of their most recent course of treatment as follows:<br>• **Relapse patients**: previously treated for TB, declared cured or treatment completed at the end of their most recent course of treatment and are now diagnosed with a recurrent episode of TB<br>• **Treatment after failure patients**: previously treated for TB and whose treatment failed during their most recent course of treatment<br>• **Treatment after loss to follow-up patients**: previously treated for TB, and declared lost to follow-up during their most recent course of treatment. (These were previously known as return after default patients) |
| **Patients with unknown previous TB treatment history** do not fit into any of the categories listed above | |
| **Classification of TB patients based on HIV status** | |
| **HIV-positive** | TB patient who has a positive result from HIV testing conducted at the time of TB diagnosis or other documented evidence of HIV diagnosis. |
| **HIV-negative** | TB patient who has a negative result from HIV testing conducted at the time of TB diagnosis. Any HIV-negative TB patient subsequently found to be HIV-positive should be reclassified accordingly. |
| **Unknown HIV status** | TB patient who has no HIV test result and no other documented evidence of HIV diagnosis. If the patient's HIV status is subsequently determined, he or she should be reclassified accordingly. |
| **Classification based on drug resistance according to Drug Susceptibility Testing** | |
| **Monoresistance** | Resistance to any **one** of the first-line anti-TB drugs. |
| **Polydrug resistance** | Resistance to more than one first-line anti-TB drug (**other than both Isoniazid and Rifampicin**). |
| **Multidrug resistance** | Resistance to **both Isoniazid and Rifampicin** ± any other first-line anti-TB drugs |
| **Extensive drug resistance** | Resistance to **any fluoroquinolone** (Levofloxacin, Moxifloxacin) and to **at least one of three second-line injectable drugs** (Capreomycin, Kanamycin and Amikacin), in addition to multidrug resistance |
| **Rifampicin resistance** | **Resistance to Rifampicin** detected using phenotypic or genotypic methods, with or without resistance to other anti-TB drugs. It includes any resistance to rifampicin, whether monoresistance, multidrug resistance, polydrug resistance or extensive drug resistance |

**Please note:**

1. All TB patients must be tested for HIV, and all efforts must be made to classify them either as HIV positive or HIV negative as this impacts management.
2. The above categories of classification based on drug resistance are not all mutually exclusive. When enumerating Rifampicin-resistant TB (RR-TB), for instance, multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) are also included.

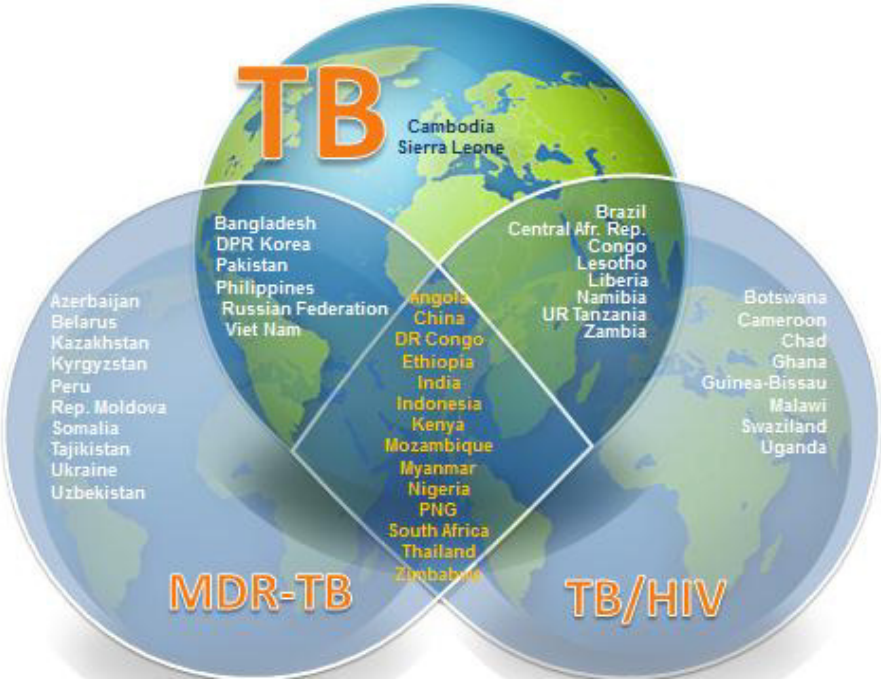
# CHAPTER 2

## Background

### 2.1 Epidemiology of TB in children

It is estimated that one third of the world's population is infected with Mycobacterium tuberculosis. In 2015, it is estimated that 10.4 million globally people fell ill with TB, of whom about 1.8 million died. Of the annual TB cases, about 10% occur in children (under 15 years of age). Kenya is among the 30 TB high burden countries in the world and is among the 14 with high burden for TB, TB/HIV and MDR-TB as seen in Figure 2. This list will be used by WHO between 2016 and 2020.

**Figure 2: The World's 30 High Burden Countries**



In 2015, Kenya reported a total of 81,518 cases of all forms of TB, of whom 8.5% were Children aged less than 15 years. This is a decline from 9.5% notified the previous year. In the last 5 years, Kenya has reported a decline in the number of reported TB cases at a rate of 1% annually possibly due to effective control interventions coupled with the declining HIV prevalence in the population.

## 2.2 Tuberculosis Control Strategies

**The End TB Strategy**

The previous STOP TB Strategy that ended in 2015 had various notable achievements. Among these was 37 million lives saved between the year 2000 and 2013 through effective TB diagnosis and treatment, a 45% decline in TB mortality rate and a 41% decline in TB prevalence rate since 1990. In addition, HIV related TB deaths reduced by 34% in the last decade with triple the number of DR TB cases diagnosed and a three-fold increase in treatment coverage since 2009. However, there were challenges: 3 million people with TB were missed by the health systems every year, TB/HIV interventions still needed further scaling up and a widening gap between people diagnosed with MDR-TB and those put on treatment were noted. This could compromise the gains made in MDR TB management.

In the interest of social justice and universal health coverage, everyone with TB should have access to tools and services for rapid diagnosis, treatment and care, which is the cornerstone of the end TB Strategy as outlined in Figure 3.

## Figure 3: The End TB Strategy

| | | | | |
|---|---|---|---|---|
| **VISION** | **A world free of tuberculosis – zero deaths, disease and suffering due to tuberculosis** | | | |
| **GOAL** | **End the global tuberculosis epidemic** | | | |
| **INDICATORS** | **MILESTONES** | | **TARGETS** | |
| | **2020** | **2025** | **SDG 2030*** | **END TB 2035** |
| Reduction in number of TB deaths compared with 2015 (%) | 35% | 75% | 90% | 95% |
| Reduction in TB incidence rate compared with 2015 (%) | 20% (<85/100 000) | 50% (<55/100 000) | 80% (<20/100 000) | 90% (<10/100 000) |
| TB-affected families facing catastrophic costs due to TB (%) | Zero | Zero | Zero | Zero |

**PRINCIPLES**

1. *Government stewardship and accountability, with monitoring and evaluation*
2. *Strong coalition with civil society organizations and communities*
3. *Protection and promotion of human rights, ethics and equity*
4. *Adaptation of the strategy and targets at country level, with global collaboration*

**PILLARS AND COMPONENTS**

1. **INTEGRATED, PATIENT-CENTRED CARE AND PREVENTION**
   - A. Early diagnosis of tuberculosis including universal drug-susceptibility testing, and systematic screening of contacts and high-risk groups
   - B. Treatment of all people with tuberculosis including drug-resistant tuberculosis, and patient support
   - C. Collaborative tuberculosis/HIV activities, and management of co-morbidities
   - D. Preventive treatment of persons at high risk, and vaccination against tuberculosis
2. **BOLD POLICIES AND SUPPORTIVE SYSTEMS**
   - A. Political commitment with adequate resources for tuberculosis care and prevention
   - B. Engagement of communities, civil society organizations, and public and private care providers
   - C. Universal health coverage policy, and regulatory frameworks for case notification, vital registration, quality and rational use of medicines, and infection control
   - D. Social protection, poverty alleviation and actions on other determinants of tuberculosis
3. **INTENSIFIED RESEARCH AND INNOVATION**
   - A. Discovery, development and rapid uptake of new tools, interventions and strategies
   - B. Research to optimize implementation and impact, and promote innovations

**Global priority indicators and targets for monitoring the implementation of the End TB Strategy**

The following indicators were outlined and all countries should aim to reach these targets by 2025.

- **Treatment coverage:** Number of people that developed TB, and were notified and treated, out of the total estimated number of incident cases in the same year (%): **≥ 90%**
- **TB treatment success rate**: Number of TB patients who were successfully treated out of all notified TB cases (%): **≥ 90%**
- **Preventive treatment coverage**: Number of people living with HIV and children who are contacts of cases who were started on preventive treatment (IPT) for latent TB infection, out of all those eligible (%): **≥ 90%**
- **TB affected households facing catastrophic costs:** Number of TB patients and their households that experienced catastrophic costs due to TB, out of all TB patients (%): **0%**
- **Uptake of new diagnostics and new drugs**: Number of TB patients who were diagnosed using WHO-recommended rapid tests, out of all TB patients (%): **≥ 90%** and number of TB patients who were treated with recommended regimens including new TB drugs: out of those eligible for treatment with such drugs (%): **≥ 90%**

## 2.3 Rationale for the Paediatric TB guideline

These guidelines have been developed to guide the health care workers on the management of children with TB and TB/HIV. They have been reviewed to incorporate revisions in the treatment regimens and availability of new formulations for the treatment of TB in children. Advances in diagnostic methods to include newer tests such as GeneXpert and the use of specimens other than sputum have also been included in this revised edition.
It is expected that these guidelines will go a long way in accelerating TB case detection among children, reduced mortality and improved treatment outcomes.

# CHAPTER 3

## Diagnosis of TB in Children

The diagnosis of TB in children relies on a good history, a careful physical examination as well as the relevant investigations. All efforts should be made to get a specimen for bacteriological confirmation of TB in children. I**n cases where it is not possible to obtain a specimen in a timely way, this should not be a barrier to making the diagnosis, a presumptive TB diagnosis may be used for treatment decisions.**

A trial treatment with anti-TB drugs is not recommended as a method of diagnosing TB in children. Most children with TB have Pulmonary TB. However, approximately 30 – 40% of children with TB have TB in organs outside of the chest – also called extra-pulmonary TB.

### 3.1 Diagnosis of pulmonary TB

**History**
The key elements of history are:

a) **History of contact with an adolescent or adult with confirmed or presumptive TB within the last two years**

**Close contact** is defined as a person who has confirmed or presumptive TB living in the same household or in frequent contact with the child (e.g. caretakers, school staff).

If no index case is identified, always ask about anyone in the household/ dormitory/classroom/school transport with chronic cough- if present request assessment of that person for possible TB.
Most children who develop TB, do so within two years of exposure.

b) **History of symptoms suggestive of TB**

The most common symptoms associated with TB include the following:

- Progressive and non-remitting cough
- Fever and/or night sweats
- Lethargy / reduced playfulness / less active
- Poor weight gain or weight loss (failure to thrive)

***The diagnosis of TB in children relies on a careful history and physical examination***

**Physical examination**

a) **General examination**

Examine the child and check for:

- Temperature > 37.5 (fever)
- Weight (to confirm poor weight gain, weight loss)
- Respiratory rate (fast breathing)

b) **Examination of the Respiratory System**

**In early stages of pulmonary TB, the respiratory** exam **may** show few abnormal signs. As the disease progresses respiratory signs become more obvious as follows:

- Cough
- Increased respiratory rate (fast breathing)
- Respiratory distress e.g. laboured breathing, chest in-drawing (this shows severe disease)
- Percussion note - dull when lobar consolidation is present (normal resonance in many children with PTB)
- Auscultation may be normal in early disease, and abnormal in more advanced disease (crackles, bronchial breathing)

***The classic symptoms of PTB are cough, fever, poor weight gain and lethargy/reduced playfulness***

In some cases, there may be **less typical clinical presentations of PTB,** especially in children under age 2 years, or who are severely immunosuppressed. In this case, the child may present with features of **acute severe pneumonia**.

Acute severe pneumonia presents with:

- Cough of acute onset (less than 7 days),
- Fast breathing / tachypnoea (age 2-12 months RR > 50/min, age 1 – 5 yr RR > 40/min)
- Signs of respiratory distress such as chest in-drawing, grunting, hypoxia (oxygen saturation < 92%).

In children under 2 years of age or severely immunosuppressed children (Severe malnutrition or HIV disease), TB may present as an acute pneumonia and the HCW should have a high index of suspicion from the first presentation.

## 3.2 Diagnosis of Extra Pulmonary Tuberculosis (EPTB)

**Approximately 30-40% of children with TB have TB in organs outside of the chest – also called extra-pulmonary TB.** Younger children and children with HIV disease are more likely to have EPTB than older children and adults.
EPTB disease is TB outside the lung parenchyma. It can be:

- **Intra-thoracic (inside the chest, but outside of the lung tissue)** – pleural effusion, intra-thoracic lymphadenopathy (mediastinal, para-tracheal or hilar lymphadenopathy)
- **Extra-thoracic (outside the chest)** – peripheral lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges.

The most common site for EPTB is in the lymph nodes (hilar or cervical), followed by TB meningitis. Frequently, a child will have a combination of both pulmonary and extra pulmonary TB, with infection starting in the lungs and disseminating to other parts of the body.

**History**
For children suspected to have EPTB, two elements of history are important:

- History contact with an adolescent or adult with confirmed or presumptive TB within the last two years
- History of symptoms suggestive of EPTB

Children with EPTB may have the classic symptoms suggestive of TB:

- Fever and / or night sweats
- Poor weight gain or weight loss
- Lethargy, less active, reduced play
- Cough

In addition, they have symptoms specific to the site of EPTB for example:

- Swollen neck lymph nodes, may be discharging caseous material
- Symptoms of meningitis – progressive unrelenting headache, irritability, confusion, focal neurologic weakness, convulsions, reduced consciousness
- Symptoms of hilar lymphadenopathy compressing the airways – Wheeze, rapid breathing and worsening breathlessness (may or may not have cough)

Table 2 shows some of the sites EPTB may affect and the presentation.

## Table 2: Types of EPTB and their presentation

| Site of EPTB | History | Clinical signs |
|---|---|---|
| Cervical Lymphadenitis | -Progressive swelling in neck<br>-Usually on one side, but may occur on both sides<br>-Several swellings that are not painful<br>+/- thick yellow discharge | -Enlarged cervical LN >2cm diameter<br>-Not hot or tender<br>+/- Discharging sinus (caseous discharge)<br>-Most common in neck area |
| Hilar lymphadenopathy | - May or may not have cough<br>- Noisy breathing (parent may describe as a wheeze)<br>- Fast breathing, progressive breathlessness | - Tachypnoea<br>-+/- respiratory distress<br>- Normal percussion note<br>- Breath sounds may be louder on one side of chest than the other<br>- Wheeze / rhonchi which are often asymmetric, low pitched, with poor response to bronchodilators |
| Pleural TB | - Chest pain on affected side<br>- Progressive breathlessness<br>- May or may not have cough | - Dullness on percussion<br>- Reduced breath sounds on affected side |
| TB meningitis | -Unremitting headache progressing to Irritability/abnormal behaviour<br>-Lethargic/reduced level of consciousness<br>+/- Convulsions | -Irritability/abnormal behaviour<br>-Lethargic/reduced level of consciousness, +/-Convulsions<br>-Neck stiffness<br>-Bulging fontanel<br>-Cranial nerve palsies |
| Milliary TB | -Non-specific<br>-Lethargic<br>+/- Cough | -Fever<br>-Wasting<br>+/- Respiratory signs<br>+/- Hepatosplenomegaly |
| Abdominal TB | -Painless abdominal swelling<br>+/-GIT disturbances | -Ascites<br>+/- Hepatosplenomegaly |
| Spinal TB | -Painless deformity of spine<br>-May have lower limb weakness/paralysis | -Gibbus deformity<br>-X-ray shows anterior vertebral collapse |
| Pericardial TB | -Cardiac failure: Cough, difficulty in breathing, swelling of legs and/or abdomen | - Crackles in lungs<br>-Apex beat difficult to palpate<br>-Muffled heart sounds |
| TB bone and joint (excluding spine) | -Painless swelling end of long bones with limitation of movement<br>-Painless unilateral joint swelling | -Effusion of large joints (usually knee or hip)<br>-Limitation of movement in long bones |

***The most common form of extra-pulmonary TB in children is lymphadenopathy. This can be cervical or hilar***

## 3.3 Investigations

After history and physical examination, investigate every child suspected to have TB. Investigations commonly used for diagnosis of TB are as shown in table 3. These are categorized as bacteriological investigations, radiologic investigations ad immunologic investigations.

### Table 3: Investigations for TB diagnosis

| **Bacteriological investigations*** | | |
|---|---|---|
| **Laboratory test** | **Target** | **Purpose** |
| MTB/Rif GeneXpert | • The first line test for all presumptive or suspected TB in Infants, children and adolescents<br>• Surveillance for Drug Resistant TB among children previously treated for TB, child contacts of DRTB patients, refugees, prisoners, children not improving on first line TB treatment | For diagnosis of TB<br><br>To determine rifampicin susceptibility<br><br>Done for child specimens of sputum, CSF, Gastric aspirate, Nasopharyngeal aspirates, Pleural fluid, Pericardial fluid, Ascitic fluid, FNA |
| Smear microscopy (Fluorescent and Light microscopy) | Infants, children and adolescents with presumptive Pulmonary TB | Only used in situations where Xpert is not accessible<br><br>Monitoring smear positive and/or gene Xpert positive TB patients on treatment at months 2, 5 and 6 |
| **Radiological investigations** | | |
| X-ray | Chest X-ray for all infants, children and adolescents with presumptive TB<br><br>X-rays of the affected bone, joint, spine as appropriate | Diagnosis of TB and EPTB in all children where x-ray services are available.<br><br>For children obtain Anteroposterior and lateral CXR views |
| Ultrasound | Abdominal ultrasound<br>Chest ultrasound | Diagnosis of abdominal TB<br>Detection of pleural effusion |
| CT Scan or MRI | Head CT, Chest CT as needed<br>MRI of the abdomen, head, chest or spine as needed | Evaluation of severe or complicated cases |
| **Immunologic Tests** | | |
| Tuberculin skin test | Children | Useful test to detect TB exposure in children and support presumptive clinical diagnosis in situations where there is no obvious close TB contact to the child |
| Interferon gamma reaction assay (IGRA) | Children | Similar role to TST but more expensive. |
| ***Whenever possible try to make a bacteriological diagnosis of TB in infants and older children by obtaining specimens and sending them for Gene Xpert (preferred first line test), AFB microscopy or TB culture.*** | | |

**This includes tests that detect the TB bacillus or its antigens*

Other tests may be used together with those above to further support a diagnosis of TB. These are shown in table 4.

**Table 4: Adjunct test for use in selected situations**

| Laboratory Test | Target | Purpose |
|---|---|---|
| Line Probe Assay (LPA) | Children who are:<br>• MTB positive rifampicin sensitive, and are at high risk for DRTB<br>• MTB positive rifampicin resistant, and are either high or low risk for DRTB | To determine if Isoniazid resistance is present |
| Culture and DST | Children who are:<br>• Eligible for LPA should also have a culture and DST requested<br>• Children with clinically suspected TB whose Xpert is negative<br>• Children who are on treatment for TB who are failing to respond to therapy | To diagnose TB<br>To determine the drug sensitivity pattern<br>To diagnose infections with non-tuberculous mycobacteria |
| Histology | All presumptive extra-pulmonary TB where FNA is indeterminant | Tissue diagnosis in suspected EPTB e.g. TB adenitis |

**Xpert MTB/Rif Assay**

This is a molecular test used to detect presence of *M. Tuberculosis* as well as Rifampicin resistance. It is more sensitive and specific than sputum microscopy in detecting TB.

**It is the preferred test of choice for TB diagnosis among children.**
**The use of Xpert for TB diagnosis in children is as shown in figure 4.**

## Figure 4:Xpert MTB/Rif algorithm

REPUBLIC OF KENYA

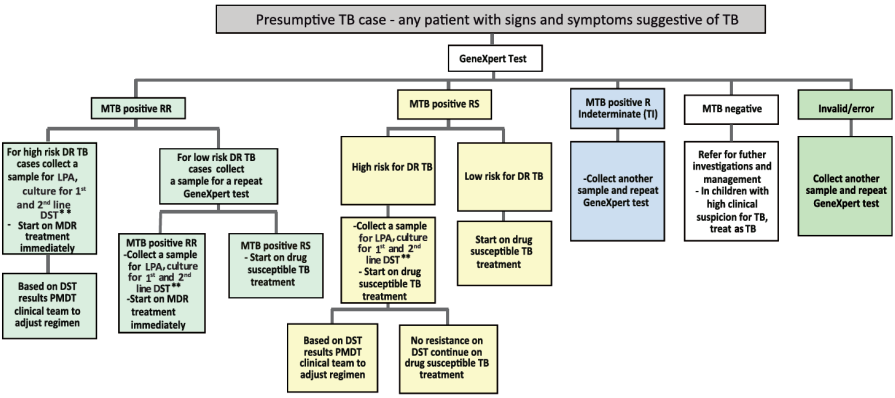
MINISTRY OF HEALTH

# MINISTRY OF HEALTH

## GENEXPERT ALGORITHM

**GeneXpert test is the preferred first test for TB diagnosis and identification of Rifampicin resistance in all presumptive TB cases***

**Patients diagnosed using GeneXpert should be followed up using smear microscopy**




| High risk for DR TB | Low risk for DR TB |
|---|---|
| • Previously treated TB patients: treatment failures, relapses, treatment after loss to follow up<br>• Drug Resistant TB patient contacts<br>• TB patients with a positive smear result at month 2 or month 5 of TB treatment<br>• Patient who develops TB symptoms while on IPT or has had previous IPT exposure<br>• Healthcare Workers with TB symptoms<br>• Prisoners with TB symptoms<br>• Refugees with TB symptoms | All presumptive TB cases who are not in the high risk group including:<br>• People Living with HIV with TB symptoms<br>• Children <15 years with TB symptoms<br>• All presumptive TB cases with a negative smear microscopy result |

*In situations where GeneXpert is not available, smear microscopy may be used for initial TB diagnosis and concurrently, a sample specimen sent for GeneXpert test

**KEY:**
**MTB RR**= Mycobacterium Tuberculosis positive, Rifampicin resistant
**MTB RS**= Mycobacterium Tuberculosis positive, Rifampicin sensitive
**TI**=Indeterminate GeneXpert results
**MDR** = Multi Drug Resistant Tuberculosis
**LPA**= Line probe assay
**DST**=Drug susceptibility testing
**PMDT**= Programmatic Management of Drug Resistant Tuberculosis
** LPA, Culture & 1st and 2nd line DST

**Samples for GeneXpert**
- Sputum
- CSF
- Gastric aspirate
- Nasopharyngeal aspirate
- Pleural fluid
- Pericardial fluid
- Ascitic fluid
- FNA
- Lymph node biopsy

**Drug Susceptible TB Treatment Regimen**

| TYPE OF TB | REGIMEN |
|---|---|
| Pulmonary TB | 2RHZE/4RH |
| Extra pulmonary (all other except bone TB and TB Meningitis) | |
| Extra pulmonary (Bone TB and TB Meningitis) | 2RHZE/10RH |

- Follow up smears should be done for all bacteriologically confirmed TB cases at end of month 2,5 and 6 of TB treatment using smear microscopy
- Follow up of RR TB and DR TB should be done as per PMDT guidelines

| POSITIVE SMEAR RESULT AT | ACTION |
|---|---|
| MONTH 2 | - Request for GeneXpert (refer to GeneXpert algorithm)<br>- Continue drug susceptible TB treatment<br>- Treat based on GeneXpert results<br>- If there is no rifampicin resistance, repeat GeneXpert test at month 3 and treat according to GeneXpert results |
| MONTH 5 | - Declare treatment failure<br>- Request for GeneXpert (refer to genexpert algorithm)<br>- Treat based on GeneXpert results |
| MONTH 6 | - Declare treatment failure<br>- Request for GeneXpert (refer to GeneXpert algorithm)<br>- Treat based on GeneXpert results<br>- Evaluate patient adherence to treatment and advice on next treatment options |

Once TB treatment is started it should be completed regardless of duration of treatment

**Specimen collection**

Bacteriological tests are conducted on a specimen collected from the child. The most common specimen used is sputum which can be obtained by asking the child to expectorate. Younger children however are not able to expectorate hence the HCW should use other means to obtain the specimen.

Other specimen that may be used include CSF, Gastric aspirates, Nasopharyngeal aspirates, Pleural fluid, Ascitic fluid, FNA and Lymph node biopsies.

To ensure a good yield from the bacteriologic tests, the specimen should be correctly collected and relayed to the lab in a timely manner.

The results should also be relayed to the requesting clinician in a timely manner.

**a) Procedure for expectoration**

**Background**

All sputum specimens produced by children should be sent for Xpert MTB/Rif and where available, mycobacterial culture. Where access to Xpert MTB/Rif is not possible, the specimen may be subjected to AFB microscopy.

Children who can produce a sputum specimen may be infectious, so, as with adults, they should be asked to expectorate outside in open, well ventilated places and not in enclosed spaces (such as toilets) unless there is a room specially equipped for this purpose.

For diagnosis, two specimens at least 4 hours apart are collected.

**Procedure**

1. Give the child confidence by explaining to him or her (and any family members) the reason for sputum collection.
2. Instruct the child to rinse his or her mouth with water before producing the specimen. This will help to remove food and any contaminating bacteria in the mouth.
3. Instruct the child to take two deep breaths, holding the breath for a

few seconds after each inhalation and then exhaling slowly. Ask him or her to breathe in a third time and then forcefully blow the air out. Ask him or her to breath in again and then cough. This should produce sputum from deep in the lungs. Ask the child to hold the sputum container close to the lips and to spit into it gently after a productive cough.

4. If the amount of sputum is insufficient, encourage the patient to cough again until a satisfactory specimen is obtained. Remember that many patients cannot produce sputum from deep in the respiratory track in only a few minutes. Give the child sufficient time to produce an expectoration, which he or she feels, is produced by a deep cough. If there is no expectoration, consider the container used and dispose of it in the appropriate manner.

**b) Procedure for Gastric aspiration**

**Background**

Gastric aspiration is a technique used to collect gastric contents to try to confirm the diagnosis of TB by Xpert MTB/Rif in children with presumptive PTB who cannot expectorate or sputum cannot be induced using hypertonic saline.

During sleep, the lung's mucociliary system beats mucus containing Mycobacterium TB up into the throat. The mucus is swallowed and remains in the stomach until the stomach empties. Therefore, the highest yield specimens are obtained first thing in the morning.

Performing the test properly usually requires two people (one doing the test and an assistant). Children not fasted for at least 4 hours (3 hours for infants) prior to the procedure and children with a low platelet count or bleeding tendency should not undergo the procedure.

The following equipment are needed:

- Gloves
- Nasogastric tube (usually 10 French or larger)
- 5, 10, 20 or 30 cc syringe, with appropriate connector for the nasogastric tube
- Litmus paper

- Specimen container
- Pen (to label specimens)
- Laboratory requisition forms
- Sterile water or normal saline (0.9% NaCl) Sodium bicarbonate solution
- (8%) Alcohol/chlorhexidine.

**Procedure**

The procedure can be carried out as:

- An inpatient: first thing in the morning when the child wakes up, at the child's bedside or in a procedure-room on the ward (if one is available), or as
- An outpatient. The child should have fasted for at least 4 hours (infants for 3 hours) before the procedure.

1. Find an assistant to help.
2. Prepare all equipment before starting the procedure.
3. Place a plain sheet (or a papoose board if available) on a couch.
4. Position the child on his or her back with the arms straight against the side.
5. Wrap the child with the sheet tucking the sheet under the child. The assistant should help to hold the child.
6. Measure the distance between the nose and stomach, to estimate distance that will be required to insert the tube into the stomach.
7. Attach a syringe to the nasogastric tube.
8. Gently insert the nasogastric tube through the nose and advance it into the stomach.
9. Withdraw (aspirate) gastric contents (2–5ml) using the syringe attached to the nasogastric tube and pour into a falcon tube. Add
10. To check that the position of the tube is correct, test the gastric contents with litmus paper: blue litmus turns red (in response to the acidic stomach contents). This can also be checked by pushing some air (e.g.3–5ml) from the syringe into the stomach and listening with a stethoscope over the stomach.
11. If no fluid is aspirated, insert 5–10ml sterile water or normal saline and attempt to aspirate again.
12. If still unsuccessful, attempt this again (even if the nasogastric tube is in an incorrect position and water or normal saline is inserted into the airways, the risk of adverse events is still small).

13. Do not repeat more than three times.
14. Withdraw the gastric contents (ideally at least 5–10ml).
15. Transfer gastric fluid from the syringe into a sterile sputum container.
16. Add an equal volume of sodium bicarbonate solution to the specimen (to neutralize the acidic gastric contents and so prevent destruction of tubercle bacilli).

**After the procedure**

Wipe the specimen container with alcohol/chlorhexidine to prevent cross-infection and label the container.

Fill out the laboratory requisition forms.

Transport the specimen (in a cool box) to the laboratory for processing as soon as possible (within 4 hours).

If it is likely to take more than 4 hours for the specimens to be transported, place them in the refrigerator (4–8°C) until transported.

Give the child his or her usual food.

**Safety**

Gastric aspiration is generally not an aerosol-generating procedure. As young children are also at low risk of transmitting infection, gastric aspiration can be considered a low risk procedure for TB transmission and can safely be performed at the child's bedside or in a routine procedure room.

**c) Procedure for Sputum Induction**

Note that, unlike gastric aspiration, sputum induction is an aerosol-generating procedure. Where possible, therefore, this procedure should be performed in an isolation room that has adequate infection control precautions (negative pressure, ultraviolet light (turned on when room is not in use) and an extractor fan).

Sputum induction is regarded as a low-risk procedure. Very few adverse events have been reported, and they include coughing spells, mild wheezing and nosebleeds. Recent studies have shown that this procedure can safely be

performed even in young infants, though staff will need to have specialized training and equipment to perform this procedure in such patients.

**General approach**

Examine children before the procedure to ensure they are well enough to undergo the procedure.

Children with the following characteristics should not undergo sputum induction.

- Inadequate fasting: if a child has not been fasting for at least 3 hours, postpone the procedure until the appropriate time
- Severe respiratory distress (including rapid breathing, wheezing, hypoxia)
- Children who are intubated
- Bleeding: low platelet count, bleeding tendency, severe nosebleeds (Symptomatic or platelet count<50/ml blood)
- Reduced level of consciousness
- History of significant asthma

**Procedure**

1. Administer a bronchodilator (e.g. salbutamol) to reduce the risk of wheezing
2. Administer nebulized hypertonic saline (3%NaCl) for 15 minutes or until 5 $cm^3$ of solution have been fully administered
3. Give chest physiotherapy is necessary; this is useful to mobilize secretions
4. For older children now able to expectorate, follow procedures as described in section A above to collect expectorated sputum
5. For children unable to expectorate (e.g. young children), carry out either:
    I. Suction of the nasal passages to remove nasal secretions; or
    II. Nasopharyngeal aspiration to collect a suitable specimen

Any equipment that will be reused will need to be disinfected and sterilized before use for a subsequent patient.

**Sputum smear examination**

**The test of choice for all child specimens is Xpert MTB/Rif**. In a few instances, access to Xpert MTB/Rif for TB diagnosis may not be possible. E.g. in facilities that do not have an Xpert MTB/Rif machine and are not linked to one where child samples can be referred. In such instances, TB diagnosis using sputum for ZN and FM microscopy may be done if available.

It involves collection of 2 sputum samples, a spot and a morning sample as shown in table 5.

## Table 5: Spot and morning sputum collection strategy

| Sample | When is it collected? | Where is it collected? |
|---|---|---|
| **Spot 1st sample** | On the spot when child presents to facility | In the health facility |
| **Morning 2nd sample** | Patient collects upon waking up the following morning | At home and brings to health facility (Or in hospital if patient is hospitalized) |

Instruct the patient and explain to them the procedure for expectoration as above.

Results should ideally be available **within 24 hours** after the sample is submitted.

ZN and FM microscopy is also used for following up patients who were bacteriologically confirmed at diagnosis even if they were diagnosed using Xpert MTB/Rif.

**Culture and Drug Susceptibility Testing (DST)**

Culture and sensitivity are used to confirm a diagnosis of TB and to evaluate if patient has any drug resistance.
Culture is indicated in:

- All high patients risk patients who turn positive on Xpert MTB/Rif
- All with Rifampicin resistance on Xpert MTB/Rif should have a culture and DST done.

Children are categorised as low and high risk for DRTB as follows:

| Low risk for DR TB | High risk for DR TB |
|---|---|
| • People Living with HIV with TB symptoms<br>• Children <15 years with TB symptoms<br>• All presumptive TB cases with a negative smear microscopy result | • Previously treated TB patients: treatment failures, relapses, treatment after loss to follow up<br>• Contacts of patients with Drug Resistant TB<br>• TB patients with a positive smear result at month 2 or month 5 of TB treatment<br>• Child who develops TB symptoms while on IPT or has had previous IPT exposure<br>• Prisoners with TB symptoms<br>• Refugees with TB symptoms |

**Chest Radiograph (Chest X-ray)**

The chest radiograph (chest x-ray) is an important investigation for diagnosis of TB in children. A clinical diagnosis of PTB may be made by combining suggestive history, physical examination findings and an abnormal CXR. Primary TB tends to be predominantly enclosed in hilar lymph nodes and therefore the bacilli are absent in sputum. In this case, the CXR provides important support for making a clinical diagnosis of PTB in children.

***For children with history and physical signs suggestive of TB it is important to do a chest x-ray. An abnormal CXR provides additional evidence to support the clinical diagnosis of PTB in children.***

The radiological features that may be suggestive of PTB include:

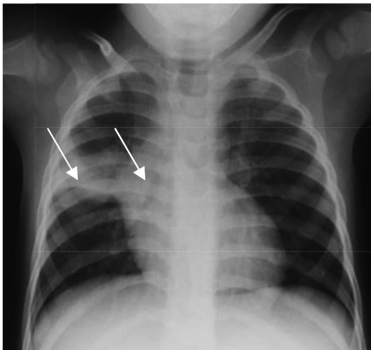
- Enlarged hilar or sub carinal lymph nodes (check for these on AP and lateral views of the chest x-ray)
- Lung opacification – especially if focal (segmental or lobar opacification common, but in infants may be patchy opacification in many lobes as seen in broncho-pneumonia)
- Diffuse micro nodular infiltrates throughout both lungs (milliary pattern)
- Older children and adolescents – upper lobe opacification with or without cavities.

Other radiological features may be suggestive of EPTB:

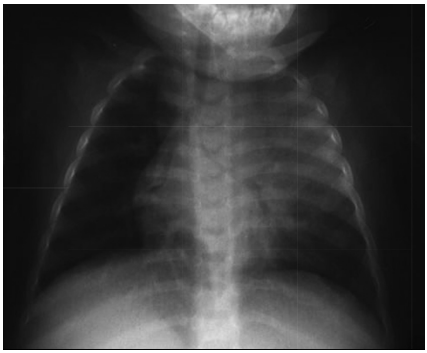
a) In the thoracic cavity, e.g. Pleural effusion (usually one-sided)
b) Other sites in the body e.g. Bone and joint disease, spinal TB

The images in figure 5 show some of the radiological changes that may occur with PTB.

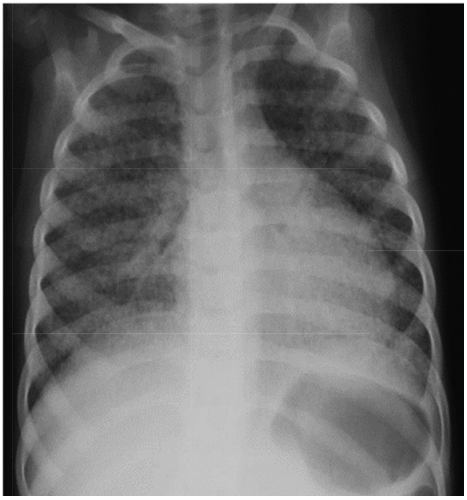
**Figure 5: Pictures suggestive of Pulmonary TB**



Right perihilar lymph node enlargement with opacity in the right mid-zone



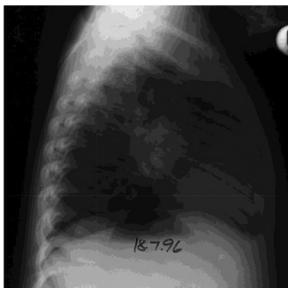
Left upper lobe opacification with narrowing and shift of left main bronchus



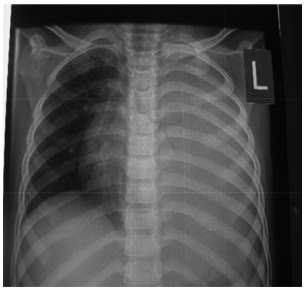
Milliary TB: Typical bilateral diffuse micro nodular pattern. Note differences to LIP X-ray above

Radiological features that may suggest extra pulmonary TB vary according to the affected site. Examples include those in figure 6.

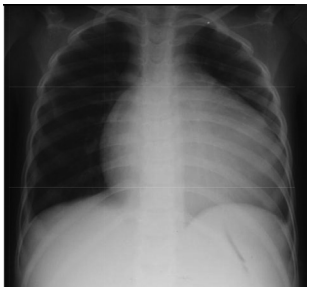
**Figure 6: X-rays suggestive of extrapulmonary TB**



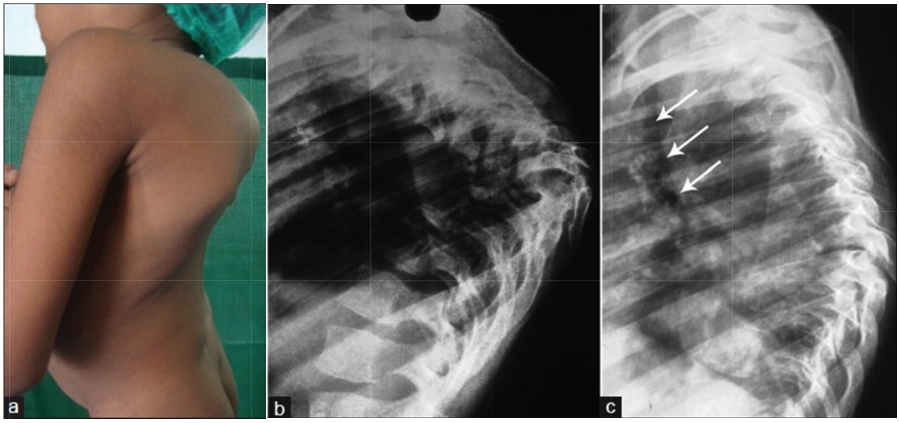
Lateral CXR showing enlarged hilar lymph nodes ("doughnut sign")




TB pleural effusion: large left-sided effusion. Pleural tap to differentiate from emphysema



Pericardial TB: enlarged cardiac shadow. Echocardiogram to differentiate from other causes of cardiac failure




Spinal TB: collapse of thoracic vertebra causing angulation in a 6-year old boy

**Tuberculin Skin Test (Mantoux test)**

A positive Mantoux test is evidence that one is infected with M. Tuberculosis, but doesn't necessarily indicate disease. Correct technique of administering, reading and interpretation of a Mantoux test is very important. (See Annex 1)

Mantoux is positive if induration is:

- ≥10mm in a well-nourished, HIV negative child
- ≥5mm in a malnourished, or HIV infected child

A negative Mantoux does not rule out TB (especially in the HIV positive or malnourished child)

**Interferon-Gamma Release Assays (**IGRAs)

Haematological tests that can aid in diagnosing *Mycobacterium tuberculosis* **infection** e.g. QuantiFERON TB Gold In-Tube test (QFT-GIT) and T-SPOT®.*TB* **test (T-Spot). It is an antibody-antigen test** like Mantoux that measures the presence of an immune response to TB bacilli. There is limited data on its use in:

- Children younger than 5 years of age
- Persons recently exposed to *M. tuberculosis*
- Immunosuppressed persons and
- Serial testing

**Other Tests for TB diagnosis**

- Radiologic tests include:
  - CT scan – In complicated intracranial TB (tuberculoma, hydrocephalus, comatose child)
  - Ultrasound – useful for abdominal TB and pleural effusion
- Laboratory tests: These are mainly used in research settings
  - Nucleic acid amplification tests
  - Gamma interferon assays
- Non specific tests like ESR and C- reactive protein tests suggest presence of inflammation if increased.
- Biochemical tests – Elevated protein and low glucose levels in cerebrospinal fluid (CSF), pleural aspirates or ascitic aspirates suggest an exudate.

**HIV test**

Making a diagnosis of HIV infection has obvious implications for the management of TB and HIV. All children with suspected TB should be tested for HIV. (Refer to chapter 4).

**Differential Diagnosis for Child with Chronic Cough/Respiratory Symptoms**
Other conditions to consider in a child with chronic cough /chronic respiratory symptoms who does not fulfil the classical clinical picture of PTB include those in table 6.

## Table 6: Differential diagnosis for child with chronic cough/ Respiratory symptoms

| Differential diagnosis | Clinical Presentation |
|---|---|
| Asthma | Recurrent wheeze/cough – responds to bronchodilators<br>Usually associated with other allergies such as eczema, rhinitis. |
| Upper airway conditions<br>Allergic rhinitis<br>Adenoid hypertrophy | Recurrent / persistent runny nose and /or nasal blockage and snoring<br>Seasonal pattern Triggers |
| Foreign Body Inhalation | Usually sudden onset in previously well child<br>May have history of choking<br>Persistent cough<br>One sided respiratory signs–inspiratory stridor, wheeze |
| Gastro-esophageal reflux disease | Recurrent cough/wheeze<br>Onset in early infancy<br>+/- Hoarse voice |
| Bronchiectasis | Severe persistent cough, much sputum ( often infected green or yellow in colour)<br>Finger clubbing<br>CXR shows reticular or honey-comb pattern |
| Congenital Heart Disease | Easily fatigability, breathlessness,<br>Onset early infancy |
| Acquired heart disease | Older children, palpitations, easy fatigability, dyspneaon exertion<br>+/- oedema |
| Congenital respiratory disorders | Onset early infancy<br>Commonly premature baby<br>Noisy breathing during inspiration not responding to bronchodilators |

The following is a summary of the algorithm for diagnosis of TB in children.

## ALGORITHM FOR DIAGNOSIS OF PULMONARY TB IN CHILDREN

| | | |
|---|---|---|
| **History of Presenting illness** | For all children presenting to a health facility ask for the following suggestive symptoms: **(Cough, fever, poor weight gain, lethargy or reduced playfulness)**<br>Suspect TB if child has two or more of these suggestive symptoms<br>Ask for history of contact with adult/adolescent with chronic cough or TB within the last 2 years | |
| **Physical Examination** | Examine the child and check for:<br>• Temparature >37.5 (fever)<br>• Weight (to confirm poor weight gain, weight loss) - check growth monitoring curve<br>• Respiratory rate (fast breathing)<br>• Respiratory system examination - any abnormal findings<br>Examine other systems for abormal signs suggestive of extra-pulmonary TB[#] | |
| **Investigations** | Obtain specimen* for Xpert MTB/RIF (and culture when indicated**)<br>Do a chest Xray (where available)<br>Do a Mantoux test*** (where available)<br>Do a HIV test<br>Do other tests to diagnose extra-pulmonary TB where suspected[#] | |
| **Diagnosis** | **Bacteriologically confirmed TB:**<br>Diagnose if specimen is positive for MTB | **Clinically diagnosed TB:**<br>*Child has **two or more** of the following suggestive symptoms:*<br>• Persistent cough, fever, poor weight gain, lethargy<br>PLUS **two or more** of the following:<br>• Positive contact, abnormal respiratory signs, abnormal CXR, positive Mantoux<br>Note: If the child has clinical signs suggestive of EPTB, refer to EPTB diagnostic table[#] |
| **Treatment** | **Treat for TB as follows:**<br>• All children with **bacteriologically confirmed TB**<br>• All children with a **clinical diagnosis of TB**<br>NB: In children who do not have an Xpert result, or their Xpert result is negative, **but** they have clinical signs and symptoms suggestive of TB they should be treated for TB<br>All forms of TB (Except TB meningitis, bone and joint TB): **Treat for 6 months (2 RHZE / 4 RH)**<br>TB meningitis, bone and joint TB: **Treat for 12 months (2 RHZE/ 10 RH)** | |

*Specimen may include: Expectorated sputum (child > 5 years), induced sputum, nasopharyngeal aspirate and gastric aspirate. **Attempt to obtain specimen in every child**

**Do a culture and DST for the following children:

1. Rifampicin resistance detected by the Xpert test
2. Refugees and children in contact with anyone who has Drug Resistant TB
3. Those not responding to TB treatment
4. Those with Indeterminate Xpert results

*** This may include IGRA in facilities where it is available

[#] Use IMCI guidelines to classify severity of disease

Refer to table 7 on diagnosis of Extra-pulmonary TB in the guideline

## Table 7:Diagnosis of Extra-pulmonary TB in children

| Site of EPTB | Typical clinical presentation | Investigations* | Action |
|---|---|---|---|
| Cervical Lymphadenitis (TB adenitis) | -Asymmetrical, matted, non-tender lymph node enlargement for more than one month<br>+/- discharging sinus<br>-Commonly in neck area | -Fine needle aspiration<br><br>±Mantoux test | Treat for TB for 6 months |
| Hilar lymphadenopathy | -May or may not have cough<br>-Noisy breathing<br>-Fast breathing, progressive breathlessness<br>-Asymmetrical wheeze not responsive to bronchodilators | -Chest X-ray<br><br>±Mantoux test | -Treat for TB for 6 months<br>-Include steroid therapy<br>-Admit if having features of respiratory distress |
| TB meningitis | -Headache<br>-Irritability/abnormal behaviour<br>-Lethargic/reduced level of consciousness, convulsions, neck stiffness, bulging fontanel, cranial nerve palsies | -Lumbar puncture to obtain CSF2<br>-Infants-cranial ultrasound<br>-Older child; do CT scan brain<br>±Mantoux test | -Treat for TB for 12 months<br>-Hospitalize for TB Treatment<br>-Include steroid therapy |
| Pleural TB | -Shortness of breadth<br>-Dullness on percussion and reduced breath sounds<br>+/-chest pain | -CXR<br>-Pleural tap1<br>±Mantoux test | -If pleural fluid is straw coloured, treat for TB for 6 months.<br>-Add steroid therapy<br>-If pleural tap reveals pus consider Empyema and refer |
| Abdominal TB | -Painless abdominal swelling with ascites | -Ascitic tap[1]<br>-Abdominal ultra-sound4<br>-±Mantoux test | -Treat for TB for 6 months |
| Spinal TB | -Painless deformity of spine<br>-May have lower limb weakness/ paralysis<br>-Gibbus | -AP and Lateral X-ray spine<br>-±Mantoux test | Treat for TB for 12 months<br>Physiotherapy and occupational therapy if indicated |
| Pericardial TB | -Cardiac failure<br>-Distant heart sounds<br>-Apex beat difficult to palpate | -CXR<br>-Echocardiogram<br>-±Mantoux test | Hospitalize for TB treatment<br>Treat for TB for 6 months<br>Add steroid therapy |
| TB bone and joint (excluding spine) | -Painless, non-tender swelling end of long bones with limitation of movement<br>-Painless, non-tender unilateral effusion of usually knee or hip | -X-ray of affected bone and/ or joint<br>-Joint tap<br>- Mantoux test | Treat for TB for 12 months |

[1]Typical findings: straw coloured fluid, exudates with high protein (forms a web on standing), white blood cells especially lymphocytes

[2]Require 2 - 5ml of CSF. Do not attempt if there are signs of raised intracranial pressure (projectile vomiting, focal neurological deficit, deteriorating mental status)

[3]Referral may be necessary for investigation procedure and laboratory support as well as clinical care. If referral is difficult or not readily available, start anti-TB treatment. The above table highlights the more common forms of EPTB; however, TB may infect other organs.

[4]Abdominal ultra-sound illustrates abdominal lymphadenopathy and shows complex ascites +/- septation

*For all paediatric specimens except blood, Xpert MTB/Rif is the test of choice.

## 3.4 Intracranial Tuberculosis

***In young children with signs and symptoms of meningitis, consider a diagnosis of TB Meningitis if there is history of contact with a TB patient***

Intracranial TB includes TB meningitis (TBM), tuberculomas and TB abscesses. TBM is more common in children than in adults, especially in the first 5 years of life. It is associated with high morbidity and mortality particularly if the diagnosis is delayed. Milliary or disseminated TB has a high risk (60–70%) of meningeal involvement. For this reason, all children with Milliary TB (or suspected of having Milliary TB) should have a lumbar puncture done to exclude TB meningitis.

30% of children with TBM are likely to die while over 50% of survivors develop neurological sequelae. Early diagnosis and prompt treatment are thus crucial to reduce the risk of a poor outcome.

Clinical presentation of TBM is usually insidious and one must have a high index of suspicion. Presenting symptoms include irritability, headache, anorexia, photophobia, vomiting, and neck stiffness. They may present on a background of longstanding fever and poor weight gain. In young children, symptoms may progress rapidly resulting in declining mental status, coma and death. Occasionally, these children may present with focal neurological signs e.g. nerve palsies and/or hemiplegia.

**Xpert MTB/RIF is the preferred diagnostic test for cerebrospinal fluid specimens from children suspected of having TB meningitis.** Caution must be employed when conducting a lumbar puncture. It must not be attempted when a child presents with signs of raised intracranial pressure (bulging anterior fontanel, deteriorating mental status, projectile vomiting, and focal neurological deficit) due to the risk of brainstem herniation and death. In children suspected to have raised intracranial pressure, a fundoscopy or imaging with CT scans may be necessary prior to attempting a lumbar puncture.

Early initiation of treatment in children with intracranial tuberculosis is essential. Children with TB meningitis should be hospitalized until the child

is clinically stable. Corticosteroids have been shown to improve survival and reduce morbidity in TB meningitis and are thus recommended in all cases of TBM.

Complications of intracranial TB include:

- Obstructive hydrocephalus
- Visual impairment
- Longstanding neurological impairment

In patients with evidence of obstructive hydrocephalus and neurological deterioration who are undergoing treatment for TBM, placement of a ventricular shunt should not be delayed. Prompt shunting improves outcome, particularly in patients presenting with minimal neurological deficit.

# CHAPTER 4

## Treatment of Tuberculosis

Treatment outcomes in all children are generally good provided treatment is started as soon as a diagnosis is made. However, response to treatment in HIV positive children may be slow. Children generally tolerate the anti-TB medicine better than adults and their dosages are calculated according to weight (not age). Weight is important for monitoring treatment response.

The goals of anti- TB treatment in children are to:

- Cure the child of TB
- Prevent death from TB
- Prevent complications arising from TB disease
- Prevent TB relapse/recurrence by eliminating the dormant bacilli
- Prevent the development of drug resistance by using a combination of drugs
- Reduce TB transmission to others

### 4.1 Standard Operating Procedures for initiating anti-TB Treatment

- Classify the case of child TB before starting treatment into pulmonary or extra-pulmonary. For extra-pulmonary forms, specify the site, noting that TB meningitis and TB bone / joint is treated for 12 months, but all other forms of TB are treated for 6 months
- Record the TB diagnostic category, treatment regimen and date anti-TB treatment was started on road-to-health book as well as on TB treatment card and facility TB register
- A caregiver should be identified as the DOT (Direct Observation Therapy) supporter for all ages including older children. Educate the DOT supporter on anti-TB regimen and adherence
- Take the child's weight at each visit and record
- Once treatment is started it must be completed; **"trial of TB treatment" should never be used as a diagnostic tool**

Treatment regimen for TB in children is shown in table 9.

## 4.2 Recommended Treatment Regimen

The drugs used for first line treatment of TB in children are:

- Rifampicin (R)
- Isoniazid (H) or (INH)
- Pyrazinamide (Z)
- Ethambutol (E)

Table 8 shows the recommended dosages.

### Table 8: Dosage of individual anti-TB drugs according to body weight

| Drug | Recommendations Average dose in mg/kg | Range in mg/kg | Maximum Dose |
|---|---|---|---|
| Isoniazid | 10 | 7–15 | 300mg |
| Rifampicin | 15 | 10–20 | 600mg |
| Pyrazinamide | 35 | 30–40 | 2.0g |
| Ethambutol | 20 | 15–25 | 1.0g |

The first 3 drugs have been combined into paediatric child-friendly fixed dose combinations (FDCs) which are dispersible in liquid, have a pleasant taste and are therefore easier for children to take. The improved paediatric TB FDCs provide the correct dosing ratio of Rifampicin: Isoniazid: Pyrazinamide as follows:

Rifampicin 75mg: isoniazid 50mg: pyrazinamide 150mg **(RHZ 75:50:150)** tablet

Rifampicin 75mg: isoniazid 50mg **(RH 75:50)** tablet

Ethambutol is available as a single drug paediatric tablet of 100mg **(E 100)**
Young age influences drug metabolism: a particular dose of a drug in mg/kg when given to a young child (under 5 years) may not reach the same level in the blood as when given to an older child or adult. Higher mg/kg dosages are therefore required in young children to achieve bactericidal levels.

Pharmacokinetic studies show that the revised dosages will result in

higher blood levels in young children, including those under 2 years of age. Systematic review of the evidence also shows that the revised dosages have an excellent safety profile and are not associated with an increased risk of toxicity (including no increased risk of drug induced hepatotoxicity due to isoniazid or pyrazinamide, or of optic neuritis due to ethambutol).

**How to administer TB Treatment in children**

Treatment is given in two phases as follows:

- **The Intensive phase** – this takes **two months**. During this period, 4 medicines are administered daily to rapidly kill the bacilli in the body (bactericidal).
- **The Continuation phase** –This varies depending on the type of TB being treated. In this phase, 2 drugs are given daily to kill dormant and slowly multiplying bacilli that may linger after the intensive phase. All forms of TB are treated for **four months** in the continuation phase except TB meningitis, TB of the spine, bone and joint that are treated for **ten months**.

This information is summarized in table 9.

## Table 9: WHO recommended TB treatment regimen

| TB disease category | Recommended regimen | |
|---|---|---|
| | Intensive phase | Continuation phase |
| All forms of TB (Except TB meningitis and TB of the bones and joints) | 2 months RHZE | 4 months RH |
| TB meningitis<br>TB of the bones and joints | 2 months RHZE | 10 months RH |
| Drug resistant TB | Refer to a DR TB specialist and inform CTLC | |

H=Isoniazid, R= Rifampicin, Z=Pyrazinamide, E= Ethambutol

For previously treated children who present with symptoms of TB within two years of completing anti-TB treatment, evaluate for drug resistant TB, progressive HIV disease or other chronic lung disease.

Make every effort to diagnose the child and manage as per the algorithm for TB diagnosis.

**DOSAGES FOR PAEDIATRIC TB TREATMENT (IMPROVED FORMULATIONS)**

- During the intensive phase give paediatric FDC of RHZ dispersible tablets plus E tablets.
- During the continuation phase give paediatric FDC of RH dispersible tablets.

The regimen is combined as shown in tables 10 to 12 below.

## Table 10: Dosages for a child weighing up to 3.9 kg

| Weight band (Kg) | Number of tablets | | | | |
|---|---|---|---|---|---|
| | Intensive Phase | | | Continuation Phase | |
| | RHZ (75/50/ 150mg) | E (100mg) | How to reconstitute the medicines | RH (75/ 50mg) | How to reconstitute the medicines |
| Less than 2 Kg | ¼ | ¼ | Dissolve **one (1)** tablet of RHZ in **20 ml** of safe drinking water.<br><br>Once fully dissolved, add the completely crushed **one (1)** tablet of Ethambutol and give **5ml (1/4)** of this solution measured with a syringe. | ¼ | Dissolve **one (1)** tablet of RH in **20 ml** of safe drinking water.<br><br>Once fully dissolved, give **5ml (1/4)** of this solution measured with a syringe. |
| 2 – 2.9 | ½ | ½ | Dissolve **one (1)** tablet of RHZ in **20ml** of safe drinking water.<br><br>Once fully dissolved, add the completely crushed **one (1)** tablet of Ethambutol and give **10ml (1/2)** of this solution measured with a syringe. | ½ | Dissolve **one (1)** tablet of RH in **20 ml** of safe drinking water.<br><br>Once fully dissolved, give **10ml (1/2)** of this solution measured with a syringe. |
| 3 – 3.9 | ¾ | ¾ | Dissolve **one (1)** tablet of RHZ in **20 ml** of safe drinking water.<br><br>Once fully dissolved, add the completely crushed **one (1)** tablet of Ethambutol and give **15ml (3/4)** of this solution measured with a syringe. | ¾ | Dissolve **one (1)** tablet of RH in **20 ml** of safe drinking water.<br><br>Once fully dissolved, give **15ml (3/4)** of this solution measured with a syringe. |

Ethambutol is not dispersible. Crush it completely before adding to the prepared solution of RHZ during the intensive phase.

**After giving the child their dose for that day, discard the rest of the solution. Prepare a fresh solution every day.**

## Table 11: Dosages for a child weighing 4-25 kg

| Weight band (Kg) | Number of tablets | | | | |
|---|---|---|---|---|---|
| | Intensive Phase | | | Continuation Phase | |
| | RHZ (75/50/150mg) | E (100mg) | How to reconstitute the medicines | RH (75/ 50mg) | How to reconstitute the medicines |
| 4 - 7.9 | 1 | 1 | Dissolve the tablet(s) of RHZ in **20 ml** of safe drinking water.<br><br>Once fully dissolved, add the completely crushed tablet(s) of Ethambutol and give **ALL** this solution to the child. | 1 | Dissolve the tablet(s) of RH in **20 ml** of safe drinking water.<br><br>Once fully dissolved give **ALL** this solution to the child. |
| 8 - 11.9 | 2 | 2 | | 2 | |
| 12 - 15.9 | 3 | 3 | | 3 | |
| 16 - 24.9 | 4 | 4 | | 4 | |
| 25 kg and above | Use adult dosages and preparations | | | | |

## Table 12: Dosages for a child weighing 25kgs and above (adult formulation dosage table)

| Weight band (Kg) | Number of tablets | |
|---|---|---|
| | Intensive Phase | Continuation Phase |
| | RHZE (150/75/400/275mg) | RH(150/75mg) |
| 25 – 39.9 | 2 | 2 |
| 40 – 54.9 | 3 | 3 |
| 55kg and above | 4 | 4 |

**Pyridoxine supplementation for children on TB treatment**

Isoniazid is associated with a potential adverse effect of peripheral neuropathy. Children who are malnourished or who have borderline to low levels of pyridoxine (vitamin B6) are most at risk of developing this adverse reaction to INH.

ALL children who are on an Isoniazid-containing treatment should be given pyridoxine ***throughout the period of treatment,*** to prevent / minimize the risk of Isoniazid toxicity.

The recommended doses of pyridoxine are given in table 13.

## Table 13: Pyridoxine (vitamin B6) dosing for children on TB treatment

| Weight band (Kgs) | Dose in mg | Number of 25mg tablets | Number of 50mg tablets |
|---|---|---|---|
| **Less than 5** | 6.25 mg | Half a tablet 3 TIMES PER WEEK | Not suitable for young infant |
| **5.0 – 7.9** | 12.5 mg | Half a tablet daily | Half of 50mg tablet 3 TIMES PER WEEK |
| **8.0 – 14.9** | 25 mg | One tablet daily | Half of 50mg tablet daily |
| **15 kg and above** | 50 mg | Two tablets daily | One 50mg tablet daily |

**Other important observations to note include:**

- Report all children receiving anti-TB treatment to the National TB Program
- Side effects may occur but are not common. The most important side effect is hepatotoxicity

**Use of Ethambutol in children**

The risk of toxicity is negligible when Ethambutol is used at recommended dosages of **20(15-25) mg/kg/day.**

Risk of toxicity is dose-related and related to duration of therapy. The main potential side effect is optic neuritis that can lead to blindness. However, the data on risk of toxicity in children has been extensively reviewed and there is now a lot of clinical experience of its use in young children.

## 4.3 Additional Management Decisions

### a) Hospitalization:

The following categories of children with TB should be treated as in-patients:

- Severe forms of PTB and EPTB (e.g. Spinal TB) for further investigation and initial management
- TB meningitis and other forms of intracranial TB
- Severe malnutrition for nutritional rehabilitation
- Signs of severe pneumonia(i.e. chest in-drawing)
- Other co-morbidities e.g. severe anaemia
- Social or logistic reasons to ensure adherence
- Severe adverse reactions such as hepatotoxicity

### b) Steroid therapy:

This should be given in the following situations:

- TB meningitis and other forms of intracranial TB
- PTB with respiratory distress
- PTB with airway obstruction by hilar lymph nodes
- Severe Milliary TB
- Pericardial effusion

Give prednisone at **2mg/kg** once daily for 4weeks, then taper down over 2 weeks **(1mg/kg for 7 days, then 0.5mg/kg for 7days).**

### c) For all HIV-infected children

Commence Cotrimoxazoleprophylaxis (**25 –30mg/kg** once daily as shown in table 26).

Commence antiretroviral therapy within 2– 8 weeks of starting anti-TB therapy as per the ART guidelines.

Conduct family-based care/screening for HIV.

**Referral of children with TB should be considered if:**

- Child has severe disease as per IMCI guidelines
- Diagnosis is uncertain
- Necessity for HIV-related care e.g.to commence ART
- Failure to respond to treatment despite good adherence

## 4.4 Follow-up of a Child on anti-TB Therapy

Children on treatment for TB are routinely followed up to assess for improvement and adherence to treatment. Some of the investigations are relevant as part of treatment follow up. The key features of follow up are specified in table 14.

**Table 14: Follow up of a child on TB treatment**

| Month | Baseline | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clinical review for both PTB and EPTB (symptom assessment, drug toxicity and adherence) | ✓ | Every week | | Every two weeks | | | | | | | | | |
| Weight (dose adjustment) | ✓ | Every week | | Every two weeks | | | | | | | | | |
| Height/Weight for Height Z-score/BMI for age | ✓ | | | | | | ✓ | | | | | | ✓ |
| Xpert MTBRIF (Done for diagnosis. May repeat at any other point if drug resistance is suspected) | ✓ | | | | | | | | | | | | |
| Smear for follow up in bacteriologically confirmed TB | | | ✓ | | | ✓ | ✓ | | | | | | |
| Culture and DST (if not improving/suspected resistance) | See algorithm | | | | | | | | | | | | |
| Viral load (for HIV infected) | ✓ | | | | | | ✓ | | | | | | ✓ |
| CXR | ✓ | Repeat if not responding to treatment at any point | | | | | | | | | | | |

Monitoring of a child with EPTB should be conducted based on the site of disease.

## 4.5 Poor Response to Treatment

Most children with TB will start to show signs of improvement within a month of anti-TB treatment. Weight gain is a sensitive indicator of good response to treatment. Children not responding to TB treatment after one month should be reassessed for causes of the poor response and possible drug resistance.

**TB treatment should however not be stopped.**

Potential causes of poor response to treatment include:

- Poor adherence; HIV infection
- Wrong diagnosis
- Other concurrent chronic lung diseases

- Under dosage of drugs
- Resistant form of TB
- Complications e.g. neurological complications, bronchiectasis

Consider treatment failure if child is receiving anti-TB treatment and:

- There is no symptom resolution or symptoms are getting worse. In this case, always confirm if adherence is good. If uncertain, a child can have health care worker DOT at the health facility
- There is continued weight loss
- If child was bacteriologically confirmed at diagnosis and remains smear positive at month 2 or 5

Refer children with suspected treatment failure for further assessment.

***Poor adherence is the most common cause of poor response to treatment. If uncertain a child can have a health care worker DOT at the health facility***

**Importance of Adherence to Treatment**

- Reduces disease transmission
- Reduce relapses
- Increase cure rate
- Reduce defaulter rate
- Reduces mortality
- Reduces the emergence of drug resistance (multi drug resistant strains)

**Ways to improve adherence**

- Explain and emphasize to care-giver and child why they must take the full course of treatment even if they are feeling better
- Note risk factors for poor adherence such as distance/transport; orphan (especially if mother has died) or primary care-giver unwell; adolescents
- Education and adherence support especially TB/HIV
- Explain that anti-TB drugs in children are well tolerated and safe

### 4.6 Treatment Interruptions

If a child interrupts anti-TB treatment for a period less than 2 consecutive months, continue with their TB treatment when they resume and extend treatment to cover the period missed.

If the child interrupts anti-TB therapy for a period longer than 2 months, conduct an Xpert test when they resume and start them on a treatment regimen based on Xpert MTB/Rif results.

### 4.7 Adverse drug reactions of anti TB drugs in children

Adverse events caused by anti-TB drugs are much less common in children than in adults.

The most important side effect is hepatitis, which may present with nausea and vomiting. Presence of abdominal pain, jaundice and a tender enlarged liver suggest severe hepatotoxicity.

INH may cause symptomatic pyridoxine deficiency; particularly in severely malnourished children and HIV infected children on highly active antiretroviral therapy (HAART). It manifests as tingling, numbness and weakness. A child may also present with reduced playfulness. Supplemental pyridoxine is recommended for **all children** on TB treatment or on Isoniazid.

Other side effects that may be experienced while the child is on TB treatment are as shown in table 15.

### Table 15: Other important adverse effects

| Drug | Adverse effects |
|---|---|
| Isoniazid | Peripheral neuropathy<br>Hepatitis |
| Rifampicin | Hepatitis<br>Red coloured body fluids<br>Drug interactions with ARVs, warfarin, insulin, oral contraceptives |
| Pyrazinamide | Hepatitis<br>Arthralgia |
| Ethambutol | Optic neuritis |

## 4.8 Managing Drug Toxicities

**Peripheral neuropathy**

- May be potentiated by other neurotoxic drugs (DDI, d4t), alcoholism, metabolic disease (diabetes), malnutrition and infections
- Rarely severe enough to require drug withdrawal
- Preventable with low dose supplemental pyridoxine (Table 13)
- Treated with high dose pyridoxine (25-50mg/day)
- Relief of symptoms can be done using Analgesics, Tricyclic antidepressants (amitriptyline, nortriptyline), Anticonvulsants (carbamazepine, phenytoin)

**Anti-TB drug induced hepatitis**

- Elevation of liver enzymes may occur in the first weeks of treatment. Serum liver enzyme levels do not need to be monitored routinely, as asymptomatic mild elevation of serum liver enzymes (less than five times the normal values) is not an indication to stop treatment
- All children with gastrointestinal symptoms (nausea and vomiting, liver tenderness, hepatomegaly or jaundice) should have their liver function assessed
- **Elevation of liver enzymes less than 5 times the normal without symptoms:** continue TB treatment but closely monitor the liver functions and consider senior review
- **Elevation of liver enzymes less than 5 times the normal with symptoms:** stop all anti-TBs and refer for further management
- **If the liver enzyme levels are elevated to more than 5 times the normal,** stop all ant-TBs and refer for further management. Consider in-patient management
- Patients should be screened for other causes of hepatitis (the hepatitis viruses-A, B, C), and no attempt should be made to reintroduce these drugs until liver functions have normalized. An expert with experience in managing drug-induced hepatotoxicity should be involved in the further management of such cases

**Ethambutol toxicity**

- This is rare if child is treated with Ethambutol doses that are within the recommended dose range of 15 to 25mg
- Early signs of Ethambutol toxicity can be tested in the older child through visual assessment

- Patients who develop Ethambutol toxicity should not be treated with Ethambutol again and should be advised never to take the drug again in their lifetime

## 4.9 Treatment outcomes for children on treatment for TB

**Treatment outcome definitions (excluding children treated for RR-TB and MDR-TB)**

The new treatment outcome definitions make a clear distinction between two types of patients:

i) Patients treated for drug-sensitive TB

ii) Patients treated for drug-resistant TB using second-line treatment (defined as combination chemotherapy for drug-resistant tuberculosis which includes drugs other than those in Group 1)

The two groups are mutually exclusive. Any patient found to have drug-resistant TB and placed on second line treatment is removed from the drug-sensitive TB outcome cohort and included only in the second-line TB treatment cohort analysis. This means that management of the standard TB register and of the second-line TB treatment register needs to be coordinated to ensure proper accounting of the outcomes of treatment.

**Treatment outcomes for drug sensitive TB patients**

All bacteriologically confirmed and clinically diagnosed TB cases who are sensitive to 1$^{st}$ line drugs should be assigned an outcome from the list in table 16.

## Table 16: Treatment Outcomes for Drug Sensitive TB Patients

| Outcome | Definition |
|---|---|
| **Cured** | A pulmonary TB patient with bacteriologically confirmed TB at the beginning of treatment who was smear or culture negative in the last month of treatment and on at least one previous occasion. |
| **Treatment completed** | A TB patient who completed treatment without evidence of failure BUT with no record to show that sputum smear or culture results in the last month of treatment and on at least one previous occasion were negative, either because tests were not done or because results are unavailable. |
| **Treatment success** | The sum of cured and treatment completed. This is calculated based on bacteriologically confirmed cases. |
| **Treatment failed** | A TB patient whose sputum smear or culture is positive at month 5 or later during treatment. |
| **Died** | A TB patient who dies for any reason before starting or during treatment. |
| **Lost to follow-up** | A TB patient who did not start treatment or whose treatment was interrupted for 2 consecutive months or more. |
| **Not evaluated** | A TB patient for whom no treatment outcome is assigned. This includes cases “transferred out” to another treatment unit as well as cases for whom the treatment outcome is unknown to the reporting unit. |

# CHAPTER 5

## Management of Tuberculosis in HIV infected children

Most paediatric HIV infection occurs prenatally through vertical transmission. HIV disease progresses rapidly in children with ~50% of them developing severe immune-suppression and dying before 2 years of age if they do not access anti-retroviral therapy. In this setting, when these children are infected with TB, TB progresses even more rapidly to severe disease with high mortality. These children are at high risk of TB infection as they live in households where a parent is also likely to have HIV disease and have a higher probability of developing active TB. Similarly, TB co-infection itself causes more rapid progression of HIV disease.

HIV influences TB in several ways:

- Rapid progression of new TB infection to TB disease
- Increased risk of disseminated and complicated TB disease
- Reactivation of latent TB infection (older children and adolescents)
- Poor response to TB treatment in the child with severe immune-suppression
- Increased risk of relapse or recurrence of TB after successful treatment
- Increased risk of death from TB HIV co-infection
- Increased risk of multiple co-infections in addition to TB, e.g. bacterial pneumonia, pneumocystic carinii pneumonia

HIV infected children may have multiple and concurrent opportunistic lung infections that clinically present like TB, thus making the diagnosis of TB in a HIV infected child more difficult. The ARVs and anti-TB drugs have potentially significant drug-drug interactions as well as overlapping toxicities that pose additional challenges in treating co-infections. Therefore, comprehensive approach to management of both TB and HIV is critical.

## 5.1 Diagnosis of TB in HIV

Approach to diagnosis of TB in HIV infected children is similar as for HIV uninfected children. History of contact with TB is extremely important in pointing to possibility of TB disease in a younger, HIV infected child.

The clinical presentation of TB is similar between those in early stages of HIV disease and those without HIV. However, those with advanced HIV disease may not have the typical TB clinical features, and chronic respiratory symptoms may be due to other causes. They may also present with extra pulmonary TB. **(See table 7).**

All healthcare settings should implement TB infection control guidelines to reduce the risk of transmission of TB between patients, visitors and staff.
Symptom-based TB screening using the Intensified Case Finding tool MUST be performed for all children living with HIV at every clinic visit to rule out active TB; patients who screen positive (presumptive TB cases) must be evaluated according to the algorithm for TB diagnosis. Patients who screen negative should be initiated on Isoniazid Preventive Therapy (IPT). The screening is done using a tool as shown in table 17 and 18.

### Table 17: Paediatric Intensified Case Finding Screening Tool

| Screening Questions | Y/N |
|---|---|
| 1. Cough of any duration (Y/N) | |
| 2. Fever (Y/N) | |
| 3. Failure to thrive or poor weight gain (Y/N) | |
| 4. Lethargy, less playful than usual (Y/N) | |
| 5. Contact with a TB case (Y/N) | |
| • If "Yes" to any of the above questions, suspect TB, examine the child and use the paediatric TB diagnostic algorithm to evaluate for active disease. Rule out underlying conditions, refer if necessary<br>• If "No" to all questions, initiate workup for IPT and repeat screening on subsequent visits | |

## Table 18: Adolescent and Adult Intensified Case Finding Screening Tool

| Screening Questions | Y/N |
|---|---|
| 1. Cough of any duration | |
| 2. Fever | |
| 3. Noticeable weight loss | |
| 4. Night sweats | |
| • If "Yes" to any question; take a detailed history, examine the patient and do sputum examination if coughing (sputum smear or GeneXpert). Exclude underlying illnesses<br>• If "No" to all questions, initiate workup for IPT and repeat screening on subsequent visits | |

**Xpert MTB/Rif test is the recommended 1st test for diagnosis of TB and Rifampicin resistance in all-presumptive TB cases.**

Together with TB symptoms, a positive Mantoux test is suggestive of TB disease. A positive Mantoux test without symptoms or features suggestive of TB should not be used to diagnose TB in children (see algorithm for TB diagnosis in children). Any child with a positive Xpert MTB/RIF test result should be started on anti TB treatment. A negative Xpert MTB/RIF test result however doesn't indicate the child has no TB; further clinical evaluation is needed to make a clinical diagnosis of TB in such children.

## 5.2 Diagnosis of HIV in TB

HIV testing should be voluntary and conducted ethically in an environment where the five Cs of Consent, Confidentiality, Counseling, Correct results and Connection (linkage) can be assured.

For all children and adolescents with TB, conduct HIV testing and counselling (with parental assent). Infants should be tested according to the available guidelines for HIV diagnosis in infants aged <18 months. A positive HIV antibody test in a child younger than 18 months of age confirms HIV exposure.

All HIV Exposed Infants (HEI) should be tested with DNA PCR within 6 weeks of age or 1st contact thereafter, and if negative then another DNA PCR at 6 months, and if negative then another DNA PCR at 12 months. **This replaces previous guidelines to perform antibody testing for infants at 9 months.**

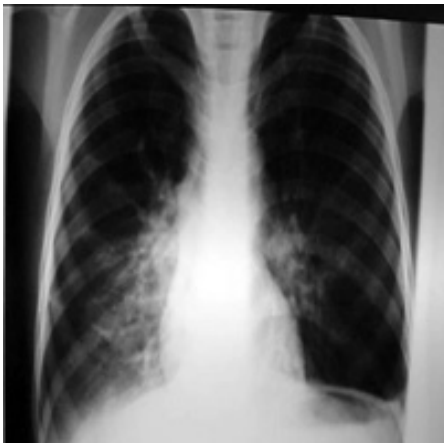
An antibody test should be performed for all HEI at 18 months, and 6 weeks after complete cessation of breastfeeding.
Adolescents aged 15 years and above and emancipated minors can provide self-consent. For younger adolescents, obtain their assent and parental/ caregiver consent.
Link all children and adolescents identified as HIV positive to treatment and prevention services.

## 5.3 Differential Diagnosis in a HIV infected Child with Chronic Respiratory Symptoms

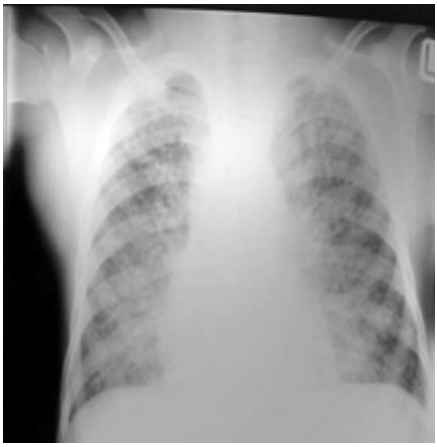
The diagnosis of PTB can be particularly challenging in a HIV-infected child because of clinical and radiological overlap with other HIV-related lung disease.
The respiratory system is a common site for many opportunistic infections in HIV infected children. Often there is co-infection as well, which further complicates the diagnosis, other possible causes of chronic lung disease in HIV infected children are shown in table 19.

### Table 19: Differential diagnosis of chronic respiratory symptoms in HIV infected children

| Differential Diagnosis | Clinical features |
|---|---|
| Tuberculosis | Persistent respiratory symptoms not responding to antibiotics.<br>Often poor nutritional status; positive TB contact especially in younger children<br>CXR: focalabnormalitiesandperihilaradenopathy |
| Recurrent pneumonia | Recurrent episodes of cough, fever and fast breathing that usually respond to antibiotics |
| Lymphoid Interstitial Pneumonitis | Slow onset cough associated with generalized symmetrical lymphadenopathy, finger clubbing, parotid enlargement, variable nutritional status, mild hypoxia,<br>CXR: diffuse reticulonodular pattern and bilateral perihilar adenopathy |
| Bronchiectasis | Cough, productive or purulent sputum, halitosis, finger clubbing, seen in older children.<br>CXR: honeycombing usually of lower lobes<br>Complicates recurrent bacterial pneumonia, LIP or TB |
| Pneumocystis Jerovecii Pneumonia | Common cause of acute severe pneumonia, severe hypoxia especially in infants. Unusual after 1 year<br>CXR: diffuse interstitial infiltration, hyperinflation |
| Mixed infection | Common problem: LIP, bacterial pneumonia, Consider TB when there is poor response to first-line empiric management |
| Kaposi's sarcoma | Uncommon<br>Characteristic lesions on skin or palate |



Bronchiectasis: focal opacification in right lower zone with thickening of bronchial walls and honeycomb appearance



Lymphoid interstitial pneumonitis: typical features are bilateral, diffuse reticulonodular infiltration with bilateral perihilar lymph node enlargement

## 5.4 Treatment of the TB/HIV co-infected child

As stated earlier, TB infection progresses rapidly to severe disease and death in children, and even more rapidly if they have HIV.

***Once a diagnosis of TB is made in a HIV infected child, TB treatment should be initiated as a matter of urgency, regardless of whether the child is on ART or not***

With the 2016 ART guidelines **all PLHIV now qualify for ART** irrespective of WHO Clinical Stage, CD4 count, age, gender, pregnancy status or co-infection status etc. Any child with active tuberculosis should begin TB treatment immediately; and begin ART as soon as the TB treatment is tolerated; i.e. no nausea or vomiting and no on-going or evolving adverse drug events, usually 2 to 8 weeks into TB therapy.

**Post-test counselling should, at a minimum, include three key messages that begin the ART treatment preparation process for all PLHIV:**

- Treatment (called antiretroviral therapy or ART) is available and is recommended for everyone with HIV
- Starting treatment as soon as possible (preferably within two weeks of testing positive for HIV) reduces the chance of your illness getting

worse or of passing HIV to others

- If you take your ART properly and do not miss pills you can expect to live a long and productive life

***Laboratory assessment is not a prerequisite to ART initiation. It should not cause undue delay in starting ART following treatment preparation and clinical evaluation by history and physical examination***

All patients enrolling into HIV care should have a complete medical history taken, a thorough physical examination and appropriate laboratory investigations. Important baseline investigations are shown in table 20. However, ART should not be delayed if a laboratory test is not available.

## Table 20: Baseline Laboratory Investigations for PLHIV

| | Test | Comments |
|---|---|---|
| **HIV Specific** | Confirm and document positive HIV test result | As per testing guidelines |
| | CD4 cell count | • Recommended<br>• If CD4≤100 cells/mm$^3$ then laboratory should perform a serum cryptococcal antigen (sCrAg) on the same sample to rule out cryptococcal meningitis before starting ART |
| | Viral load (HIV-1 RNA) | • Baseline viral load (VL) is only recommended (where available) for HEIs after 1st PCR test is positive. Specimen for baseline VL can be drawn before or at time of initiating ART; obtaining a VL should not delay ART initiation |
| | Serum Cryptococcal Antigen (sCrAg) | • Obtain serum CrAg in all adults with a CD4 count ≤100 cells/mm$^3$<br>• If positive, manage as per the cryptococcal meningitis screening algorithm (Refer to the Kenya ARV guidelines) |
| | Hb (preferably full blood count if available) | • Recommended<br>• If baseline Hb < 9.5 g/dL then AZT should be avoided |
| | Pregnancy status | • Pregnancy status should be determined for all women of reproductive age (based on history of last menstrual period, and if delayed then a urine pregnancy test should be performed) |
| | Urinalysis (for protein & glucose) | • Recommended |
| | Creatinine | • Recommended<br>• Calculate Creatinine Clearance (CrCl): if CrCL≤50 ml/min then TDF should be avoided |
| | RPR (syphilis serology) | • Recommended (for all PLHIV with a history of being sexually active) |
| | Glucose | • Recommended |
| | Plasma lipid profile | • Recommended |
| | HBsAg | • Recommended<br>• If negative, patients should be immunized for HBV as soon as they achieve confirmed viral suppression; if positive refer to ARV guideline for management of HIV/HBV co-infection |
| | HCV antibody | • Recommended for PWID or for patients with history of injection drug use |
| | ALT | • Not a recommended baseline investigation unless there is a specific clinical reason (e.g. patient with history of hepatitis, signs or symptoms of liver disease, or risk of liver disease - alcoholics, HBV/HCV infection, hepatotoxic drugs, etc.) |

Management of these children requires taking note of the following possible scenarios for each child as summarized in figure 7, to guide how and when to give both the anti-TB and the ART treatment.

**Scenario 1**

Children who are not yet on ART

- Start anti-TB immediately
- Initiate ART as soon as anti-TB medications are tolerated, preferably within 2 - 4 weeks

**Scenario 2**

Children who are already on ART but have received it for less than 6 months

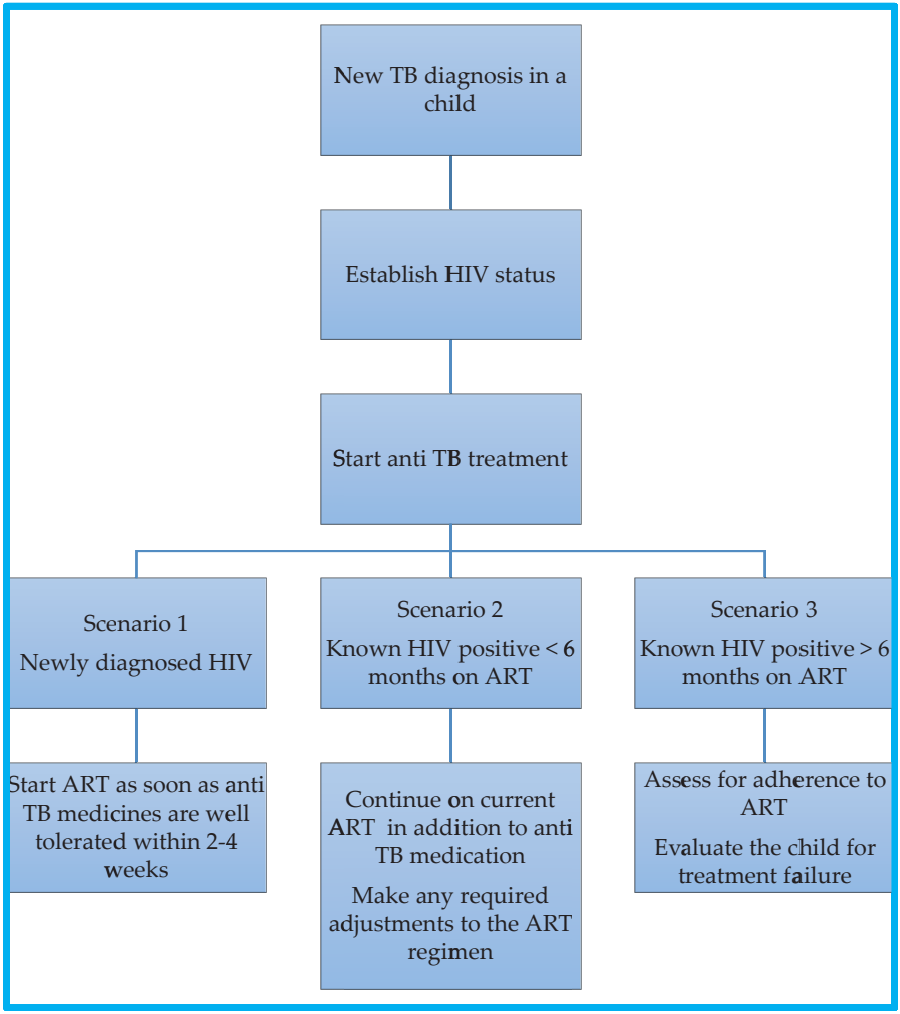
- Start anti-TB immediately
- Continue ART, making any required adjustments to the ART regimen based on predicted drug interactions

**Scenario 3**

Children who are already on ART but have received it for more than 6 months

- Start anti-TB immediately
- Evaluate for possible treatment failure making any required adjustments to the ART regimen. Continue ART, based on predicted drug interactions

**Figure 7: Management of HIV in a child with TB**




The principles of treatment of tuberculosis in HIV-infected children are similar to those in HIV-negative children, and the same regimens should be used as those used in HIV negative children. However, response to TB treatment may be slow in children living with HIV.

All children with TB/HIV should receive Cotrimoxazole prophylaxis as well as antiretroviral therapy. Nutritional support is often needed for children with TB/HIV.

The management of children with TB/HIV should be integrated so that all family members are counselled and tested for HIV, screened for TB and managed appropriately.

Healthcare settings present suitable conditions for transmission of TB; particularly among vulnerable individuals like PLHIV. All healthcare settings should develop and implement TB infection control guidelines to reduce the risk of transmission of TB between patients, visitors and staff.

## 5.5 Antiretroviral Therapy in HIV Infected Child with TB

Tuberculosis is an increasingly common opportunistic infection in HIV-infected children. HIV infection increases a child's risk of progressive primary tuberculosis and reactivation of latent TB in the older child.

Recent data suggest that early initiation of HAART early in TB treatment reduces TB morbidity and mortality, without excess adverse events.

Any child with active tuberculosis should begin TB treatment immediately; and begin ART as soon as the TB treatment is tolerated; i.e. no nausea or vomiting and no on-going or evolving adverse drug events, usually 2 to 4 weeks into TB therapy.

The TB/HIV co-infected child has not only diagnostic but also drug management challenges. The pill burden in TB/HIV co-infection is large. Intensive adherence support and monitoring should be offered. The risk of adverse drug reactions is increased during concomitant therapy. Perform a full clinical evaluation at every clinic visit and if there are symptoms suggestive of adverse drug reactions, particularly liver toxicity, refer the child.

There are significant drug-drug interactions between the ARVs and anti-TB medications, overlapping toxicities between these two classes of medications and a high pill burden. Rifampicin interacts with both PIs and Nevirapine, reducing their blood levels and hence their effectiveness. Therefore, when treating TB and giving concurrent ART, the ART regimen may require adjustment.

If significant problems are experienced such as severe drug intolerance or erratic adherence, continue the anti-TB and refer the child to a HIV clinical

management team/specialist.

Effective ART consists of a minimum of 3 agents from at least 2 different classes of ARVs. ART options with Rifampicin are limited and are based on the various scenarios as indicated.

- EFV based ART
- Super boosted LPV with ritonavir during TB treatment and revert to the normal LPV/r dosing after completion of TB treatment
- Triple nucleosides- Triple nucleoside ART has a likelihood of developing virologic treatment failure

Use of AZT+ABC+3TC may lead to accumulation of mutations. It should be used only when other options are not indicated or available or when preferred option is not tolerated and child needs to be put on ART due to severe immune suppression.

***Always weigh the child and adjust the TB and ARV dosing accordingly***
***Refer to national guidelines on Anti-retroviral therapy for Paediatric ARV dosing***
***Triple nucleoside ART should NOT be used in TB/HIV co-infected patients who have previously failed ART***

The preferred ART Regimens for children with TB/HIV Co-infection are as shown in table 21 and 22.

## Table 21: Preferred ART Regimens for TB/HIV Co-infection for Children Newly Initiating 1st Line ART

| Age | 1st Line if TB/HIV Co-infection |
|---|---|
| < 4 weeks | Start anti-TB treatment immediately<br>Start ART after 4 weeks of age, once tolerating anti-TB drugs (follow the regimen recommendations for children 4 weeks to < 3 years of age) |
| 4 weeks - < 3 years | • ABC + 3TC + LPV/r + RTV([1,2])<br>• If not able to tolerate super-boosted LPV/r+ RTV then use AZT + ABC + 3TC for duration of TB treatment<br>•After completion of TB treatment revert to the recommended 1st line regimen (ABC + 3TC + LPV/r) |
| 3-15 years (< 35 kg body weight) | ABC + 3TC + EFV |
| 3-15 years (≥ 35 kg body weight) | TDF + 3TC + EFV |
| >15 years | TDF + 3TC + EFV |
| PWID >15 years | TDF + 3TC + ATV/r (using Rifabutin-based anti-TB treatment) |
| [1] Use "super-boosted" LPV/r by adding additional Ritonavir suspension to manage the drug interaction between LPV/r and Rifampicin (see Table 25 for LPV/r dosing recommendations). As soon as TB treatment is completed the child should go back to standard LPV/r dosing. For children who cannot tolerate LPV/r + RTV (usually because of GI side-effects), the alternative regimen is AZT+ABC+3TC; **as soon as TB treatment is completed the child should go back to ABC+3TC+LPV/r, because of the increased risk of developing treatment failure while on a triple-NRTI regimen**<br>[2] EFV is no longer recommended for children < 3 years old because of highly variable EFV metabolism at that age | |

## Table 22: Preferred ART Regimens for TB/HIV Co-infection for Patients Currently on 1st Line ART [1, 2]

| Current Regimen[3] | Age | Recommended Substitution |
|---|---|---|
| **PI/r-based**<br>AZT + 3TC + LPV/r<br>ABC + 3TC + LPV/r<br>TDF + 3TC + LPV/r<br>ABC + 3TC + ATV/r<br>AZT + 3TC + ATV/r<br>TDF + 3TC + ATV/r | < 3 years old | • Super-boost LPV/r with additional RTV[4]<br>• If not able to tolerate super-boosted LPV/r + RTV then use AZT + ABC + 3TC for the duration of TB treatment[5]<br>**• After completion of TB treatment revert to the original regimen** |
| | 3 years – 15 years (weight < 35kg) | Switch to EFV. If EFV cannot be used, super- boost LPV/r with additional RTV to a ratio of 1:1 |
| | Child <15 years and ≥ 35 kg | Continue PI/r; use Rifabutin[6] for anti-TB treatment |
| | > 15 years (any weight) | Continue PI/r; use Rifabutin for anti-TB treatment |
| **EFV-based**<br>ABC + 3TC + EFV<br>TDF + 3TC + EFV<br>AZT + 3TC + EFV | Any age | Continue same regimen |
| **NVP-based**[7]<br>AZT + 3TC + NVP<br>ABC + 3TC + NVP<br>TDF + 3TC + NVP | < 3 years old | Switch to AZT + ABC + 3TC **(as soon as TB treatment is completed switch back or original regimen)** |
| ≥ 3 years old | | Switch to EFV |
| **RAL-based**<br>ABC + 3TC+RAL<br>AZT + 3TC+RAL<br>RAL + 3TC + DRV + RTV<br>AZT + RAL + 3TC + DRV + RTV<br>AZT + RAL + 3TC + DRV + RTV | All ages | Give double the standard dose of RAL |

[1] Always assess for HIV treatment failure in patients who develop TB after being on ART for _ 6 months
[2] For patients on 2nd line ART, subsequent regimens, or non-standard drugs such as RAL or DTG who require regimen change because of TB treatment, consult the Regional or National HIV Clinical TWG (ulizanascop@gmail.com)
[3] NRTIs in the patient's current regimen do not require any adjustments with anti-TB treatment
[4] Use "super-boosted" LPV/r by adding additional Ritonavir suspension to manage the drug interaction between LPV/r and Rifampicin (see Table 8.7 for dosing recommendations). **As soon as TB treatment is completed the child should go back to standard LPV/r dosing**
[5] For children who cannot tolerate LPV/r+ RTV (usually because of GI side-effects), the alternative regimen is AZT+ABC+3TC; **as soon as TB treatment is completed the child should go back to ABC+3TC+LPV/r, because of the increased risk of developing treatment failure while on a triple-NRTI regimen**
[6] Rifabutin 150 mg once daily in place of Rifampicin. When using Rifabutin, closely monitor for side effects e.g. neutropenia, neurotoxicity and uveitis
[7] **Guidelines recommend LPV/r for children < 3 years, however some children < 3 years maybe on NVP due to LPV/r toxicity**

Table 23 below gives the names and abbreviations of ARVs.

**Table 23: Abbreviations and Names of Antiretroviral Drugs**

| | | | | | |
|---|---|---|---|---|---|
| **3TC** | Lamivudine | **DRV** | Darunavir | **LPV/r** | Lopinavir/ Ritonavir |
| **ABC** | Abacavir | **DRV/r** | Darunavir/ Ritonavir | **NVP** | Nevirapine |
| **ATV** | Atazanavir | **DTG** | Dolutegravir | **RAL** | Raltegravir |
| **ATV/r** | Atazanavir/ Ritonavir | **EFV** | Efavirenz | **RTV** | Ritonavir |
| **AZT** | Zidovudine | **LPV** | Lopinavir | **TDF** | Tenofovir Disoproxil Fumarate |

**Rifabutin**

This is an anti-TB drug of the Rifamycins group. It is given at a dose of 150mg once daily throughout the TB treatment of the child. It is given to children above the weight of 35kg who are on a PI-based regimen who may suffer severe side effects from super-boosting the PI.

For children who are on an Efavirenz-based regimen, the dosing schedule to be used is as shown in table 24.

**Table 24: Efavirenz dosage in children**

| Weight (kg) | EFV dose (mg) Tablets | Quantities |
|---|---|---|
| 3.5 to 4.9 | 100 | **½ of 200mg single scored tablet** |
| 5 to 7.4 | 150 | 3 of 50mg capsules |
| 7.5 to 13.9 | 200 | 1 tablet of the 200mg tablet |
| 14 to 19.9 | 300 | ½ tablet of the 600 double scored |
| 20 to 24.9 | 300 | 1 ½ of the 200mg single scored |
| 25 to 40 | 400 | 2 tablets of the 200mg |
| Above 40 | 600 | I tablet of 600mg tablet |

For children on a PI-based regimen who require super-boosting of Ritonavir, the dosing used for Ritonavir is as shown in table 25.

## Table 25:Ritonavir Dosing for Super-Boosting LPV/r in Children Taking Rifampicin

| Weight Range (kg) | Lopinavir/ritonavir (LPV/r) | | Additional dosing of ritonavir for children taking rifampin |
|---|---|---|---|
| | **Twice Daily** | **Twice Daily** | **Twice Daily** |
| | **Lopinavir/ ritonavir 80/20mg/ml solution** | **Lopinavir/ ritonavir 200/50mg tablets** | **Ritonavir liquid (80mg/ml, in 90 ml bottle)** Ritonavir dose is adjusted to nearest mark for the ease of measurement |
| 3 - 5.9 | 1 ml | - | 1 ml |
| 6 - 9.9 | 1.5 ml | - | 1 ml |
| 10 - 14.9 | 2 ml | - | 1.5 ml |
| 14 - 19.9 | 2.5 ml | 1 tab twice daily | 2 ml |
| 20 - 24.9 | 3 ml | 1 tab twice daily | 2.5 ml |
| 25 - 34.9 | 4 ml | 2 tab in am & 1 tab in pm | 4 ml in am & 2 ml in pm |

## 5.6 Cotrimoxazole Preventive Therapy (CPT)

Cotrimoxazole has been shown to reduce mortality among children infected with HIV. All TB/HIV co-infected children should be offered CPT and it should be started as soon as possible. The duration of treatment is usually life-long with a once daily dosing.

The children should be monitored for side effects, which include skin rashes and gastrointestinal disturbances. Severe adverse reactions are uncommon and usually include extensive exfoliative rash, Steven Johnson syndrome or severe anemia / pancytopenia. CPT should be discontinued if a child develops severe adverse reactions. The recommended dosage of Cotrimoxazole for children is shown in table 26.

**Table 26: Recommended doses for Cotrimoxazole**

| Weight in Kg | Child Suspension (200mg/40mg per 5ml) | Child Tablet (100mg/20mg) | Single strengthadult tablet (400mg/80mg) | Double strengthadult tablet (800mg/160mg) |
|---|---|---|---|---|
| <5 | 2.5ml | One tablet | ¼ tablet | - |
| 5-15 | 5ml | Two tablets | ½ tablet | - |
| 15-30 | 10ml | Four tablets | One tablet | ½ tablet |
| >30 | - | - | Two tablets | One tablet |

- When Dapsone (as a substitute for CPT) is being used as PCP prophylaxis, it is only recommended for patients in WHO Stage 4 and/or absolute CD4 count < 200 cells/$mm^3$ (or CD4% < 25% for children ≤ 5 years old), and should be discontinued once a patient achieves a sustained CD4 count of > 200 cell/$mm^3$ (or > 25% for children ≤ 5 years old) for at least 6 months. It is given at **2mg / kg once daily (maximum dose 100mg).** It is supplied in 25mg and 50mg tablets.

## 5.7 Immune re-constitution inflammatory syndrome (IRIS)

IRIS is a paradoxical deterioration after initial improvement following ART treatment initiation. It is seen during the initial weeks of TB treatment with initial worsening of symptoms due to immune re-constitution. IRIS is commonly seen in the severely immuno-compromised TB/HIV co- infected child after initiating ARV treatment.

IRIS is managed by continuing anti-TB therapy and giving non-steroidal anti-inflammatory drugs until severe symptoms subside. Prednisone is given at **2mg/kg** once daily for 4 weeks, and then taper down over 2 weeks **(1mg/kg for 7days, then 0.5mg/kg for 7 days then stop).**

## 5.8 Prevention of TB in HIV

All HIV-infected children need to be screened for TB. All HIV infected children exposed to sputum smear positive TB case should be evaluated for TB and treated if diagnosed with TB disease. Those without TB disease should be offered Isoniazid preventive therapy at **10mg/kg/day** for 6 months.

All TB infected children should be offered counselling and testing for HIV infection. Known HIV infected children should minimize their exposure to other patients with chronic cough (e.g. separate waiting area, or fast track their consultation from the waiting area).

The specific needs of each family should be determined and a plan of action developed to ensure that the family receives comprehensive care using all available services.
Deliberate efforts should be made to expand the prevention of mother to child transmission. This is because minimizing HIV infection in children will reduce their risks of developing TB.

BCG vaccine is to be given to all new born babies except those with symptoms of severe HIV infection. It is also not given to children started on IPT before its administration. In these children complete the IPT course and wait 2 weeks after IPT completion to give BCG.
Always examine the placenta for tubercles because their presence may implicate vertical TB transmission.

## 5.9 IPT in HIV infected children

Children living with HIV who are more than 12 months of age, who are unlikely to have active TB on symptom-based screening and have no contact with a TB case should receive six months of IPT at **10 mg/kg/ day** (maximum 300 mg/ day*)* as part of a comprehensive package of HIV prevention and care services.

In children living with HIV who are less than 12 months of age, only those who have contact with a TB case, and who are evaluated for TB should receive six months of IPT if the evaluation shows no TB disease.
Refer to table 34 for the dosage of Isoniazid (IPT) and table 13 for the dosage of pyridoxine in children.

# CHAPTER 6

# TB in special circumstances

## 6.1 Management of a baby born to a Mother with PTB

Congenital TB is TB acquired in-utero through haematogenous spread via the umbilical vessels, or at the time of delivery through aspiration or ingestion of infected amniotic fluid or cervico-vaginal secretions. Congenital TB usually presents in the first 3 weeks of life and mortality is high.

Neonatal TB is TB acquired after birth through exposure to an infectious case of TB - usually the mother but sometimes another close contact. It is often difficult to distinguish between congenital and neonatal TB but management is the same for both. Transmission of TB within new born units, paediatric wards and maternity wards does occur in overcrowded health facilities, hence the need to implement infection prevention control measures (including the use of surgical masks) whenever one case of TB has been identified within this set up. This is to reduce transmission to new-borns who are extremely vulnerable to TB.

The TB-exposed neonate is highly vulnerable and may rapidly progress to symptomatic and severe TB disease. Symptoms and clinical signs of neonatal TB are usually nonspecific and examples are shown in table 28.

### Table 28: Signs and symptoms of neonatal TB

| Symptoms | Clinical signs |
|---|---|
| Lethargy | Respiratory distress |
| Fever | Non-resolving 'pneumonia' or respiratory infection |
| Poor feeding | Hepatosplenomegaly |
| Low birth weight | Lymphadenopathy |
| Poor weight gain | Abdominal distension |
| | Clinical picture of 'neonatal sepsis' |

The diagnosis of TB should be included in the differential diagnosis of a child with neonatal sepsis, poor response to antimicrobial therapy, congenital infections and atypical pneumonia. The most important clue to the diagnosis of neonatal TB is a maternal history of TB or any contact with a person with chronic cough.

Always examine the placenta for tubercles because their presence may implicate vertical TB transmission.

### 6.2 Management of the asymptomatic neonate exposed to maternal TB

If a neonate is born to a mother with TB, or is exposed to a close contact with TB, Isoniazid Preventive Therapy (IPT) should be given for 6 months once TB disease has been ruled out. 2 weeks after completion of IPT, give BCG. It is not necessary to separate the neonate from the mother. However, the mother should be educated on infection prevention control measures.

***Breastfeeding is not contraindicated for a child whose mother has TB***

Neonates born to mothers with MDR-TB or XDR-TB should however be referred for TB screening and management. **IPT should not be given.** Infection control measures such as the mother wearing a mask are required to reduce the likelihood of mother to child transmission of DR TB.

### 6.3 Management of the neonate with TB disease

If a neonate who is exposed to a mother or another contact with TB is found to have symptoms suggestive of TB, treatment with anti-TBs should be initiated even while awaiting bacteriological confirmation as TB progresses rapidly in neonates. Drug dosages must be tailor made based on the neonate's weight. **Refer to table 10 in chapter 4**. Breastfeeding is encouraged.

### 6.4 TB among children in congregate settings

Children may contract TB in congregate settings outside the household. These congregate settings include childcare (day care) centres, orphanages, prisons (juvenile prisons), (day and boarding) and refugee camps. This is due

to several factors including overcrowding, poor hand hygiene, poor cough etiquette, poor ventilation, and general poor TB infection control measures in place.

Once a child has been diagnosed with TB within the congregate set up, all efforts must be made to screen all contacts of the diagnosed child, while conducting reverse contact tracing to identify the index case. All presumptive TB cases must be evaluated according to the algorithm for TB diagnosis and those diagnosed with TB initiated on treatment. Where feasible, older children with bacteriologically confirmed TB within these congregate settings should be separated or isolated from others until they are considered at low risk for transmission (after sputum conversion).

Congregate settings are an important component of the country's TB surveillance activities and should be assessed for TB infection control. Such assessments should be followed by screening of all presumptive TB cases and development of infection prevention and control plans to support administrative, environmental and respiratory measures.

## 6.5 TB/DM co-morbidity

Changes in lifestyle and diet have contributed to an increased prevalence of diabetes in low and middle-income countries where the burden of TB is high. The growing burden of diabetes is contributing to sustained high levels of TB in the community, and the proportion of TB cases attributable to diabetes globally is likely to increase over time. This double burden of disease is a serious and growing challenge for health systems. Diabetes can worsen the clinical course of TB, and TB can worsen glycaemic control in people with diabetes. Children with both conditions require careful clinical management ensuring optimal care is provided for both diseases.

Symptoms of diabetes include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes and fatigue. These symptoms may occur suddenly or insidiously.

Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily administration of insulin. The cause of type 1 diabetes is not known and it is not preventable.

Type 2 diabetes (formerly called non-insulin-dependent or adult-onset) results from the body's ineffective use of insulin. Type 2 diabetes comprises 90% of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity. Symptoms may be like those of Type 1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have already arisen. Until recently, type 2 diabetes was seen only in adults but it is now also occurring in children.

All diabetic children should be screened for TB at every clinical visit and the results recorded in their diabetic care records. All diabetic children with TB should be started on anti TB treatment immediately and their glycaemic control monitored closely.

TB infection control should be ensured in areas where diabetes is managed. Administrative measures include early recognition, diagnosis and treatment of TB. During diabetes clinic visits, children with TB and diabetes can be seen on a different day or at a different time to reduce the risk of TB transmission to other children.

Each health-care facility should have an infection control plan, which includes administrative and environmental control measures to reduce transmission of TB within this setting. These measures should adhere to National Guidelines for TB infection Control.

All children with both TB and Diabetes should receive pyridoxine for the duration of TB treatment to reduce the risk of peripheral neuropathy. If the child is on DR TB treatment with aminoglycosides, there should be close monitoring of the renal functions. In renal impairment, the dose of anti-TBs should be adjusted downwards according to the creatinine clearance. Renal function test should be done monthly for DR TB/ Diabetes patients. Glycaemic control needs to be closely monitored in underweight co-morbid patients who would need an increased caloric intake and their dose of insulin adjusted accordingly. These patients are best managed by a team that includes the nutritionist.

## 6.6 TB among street families

In 2007, the Consortium of Street Children estimated that there were 250,000- 300,000 children living and working on the streets of Kenya with, more than 60,000 of them living in Nairobi. The population of street families in Kenya is quite fluid.

Street families have several factors that put them at a higher risk of contracting TB including;

- Malnutrition
- Sexual exploitation accompanied by a high risk of contracting STIs and HIV/AIDS
- Illicit drug use
- Smoking
- Poor hygienic and sanitary conditions
- Poor access to healthcare

Persons living on the streets experience longer delays in accessing comprehensive healthcare due to social exclusion and in most cases, will access healthcare quite late in the disease process. During this period, transmission may occur amongst groups of street families and the homeless. Poor compliance results in low effectiveness of anti-TBs and an increased risk of DR TB. Malnutrition contributes to higher TB mortality in this group.

Street children with TB require close follow up and attachment to social workers or children's' homes. It is preferable to give DOTs for those able to visit health facilities daily, while tailor made solutions for compliance must be discussed to ensure these children are able to take their drugs as required, particularly if their families move from place to place. Outreach missions are a resource in mobilizing street families for screening and providing health education to them.

# CHAPTER 7

## Drug Resistant TB

Drug resistant (DR) TB occurs when *Mycobacterium tuberculosis* bacilli are not killed or inhibited by Anti-tuberculosis drugs that they have been subjected to. This results in selection of acquired or naturally occurring resistant mutants.

- **Primary drug resistance** occurs when the patient is infected with a resistance strain of mycobacterium tuberculosis
- **Acquired or Secondary resistance** occurs when the patient is infected with a drug susceptible strain which becomes resistant over time. It is clinically manifested by disease progression despite treatment, failure to achieve sputum or cultures conversion

In children, it is mainly the result of transmission of DR TB bacilli from an infected source. It should be highly suspected in a child with history of exposure to a known DR TB case or to a person with a chronic cough.

Resistance to Rifampicin and/or Isoniazid is the most important, as these two drugs form the backbone of the current TB chemotherapy.

### 7.1 Classification of drug resistant TB

Drug resistance is classified as shown in table 29.

**Table 29: Classification of drug resistant TB**

| | |
|---|---|
| **Mono-resistant TB** | Resistance to **one** first line anti-TB medicine only |
| **Poly-resistant TB** | Resistance to more than one first line anti TB medicine other than both Rifampicin and Isoniazid |
| **Rifampicin Resistant (RR)** | Resistance to at least Rifampicin in absence of Isoniazid (INH) resistance |
| **Multi-drug resistant (MDR) TB** | Resistance to both Isoniazid and Rifampicin with or without other medicines (excluding injectables and quinolones) |
| **Pre–XDR TB** | Resistance to Isoniazid and Rifampicin and either a fluoroquinolone or second-line injectable agent but not both |
| **Extensive drug resistant (XDR) TB** | Resistance to Rifampicin, Isoniazid, an injectable and a quinolone |

**Presumptive drug resistant TB cases**:
These are patients without bacteriological confirmation but are highly suspected to have drug resistant TB. These include:

- Presumptive MDR TB,
- Presumptive XDR TB
- Presumptive Rifampicin resistant cases.

## 7.2 Diagnosis

Drug-resistant TB should be suspected when:

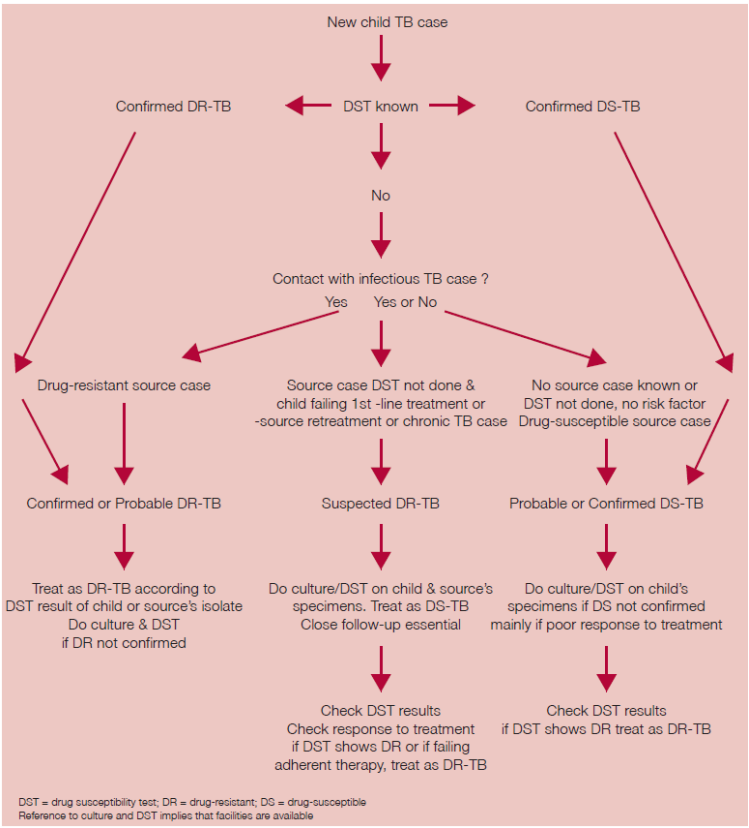
- There is contact with known DR-TB
- There is contact with suspected DR-TB, i.e. source case had treatment failure or was previously treated
- A child with TB is not responding to first-line therapy despite adherence
- A child previously treated for TB presents with recurrence of disease

When DR-TB is suspected, every effort should be made to confirm the diagnosis by obtaining specimens for culture and drug susceptibility testing (DST). Rapid DST of Isoniazid and Rifampicin or Rifampicin alone is recommended over conventional testing or no testing at the time of diagnosis. Children without bacteriological confirmation but are highly suspected to have drug resistant TB should be initiated on DR TB treatment.

For children who are confirmed contacts of an index case of DR TB, treat as per resistance pattern of the index case in absence of drug sensitivity testing confirmation. Adjust treatment regimen based on DST results.

The diagnosis of children suspected to have MDR TB is as summarized in the algorithm as shown in figure 8.

**Figure 8: Diagnostic algorithm for the diagnosis of DR-TB in children[a]**




[a]This is produced from Schaaf HS, Marais BJ. Management of multidrug-resistant tuberculosis in children: a survival guide for paediatricians. *Paediatric Respiratory Reviews*, 2011, 12:31-38 as presented in the Guidance for national tuberculosis programs on the management of tuberculosis in children (second edition)

## 7.3 Treatment of DR TB in children

The treatment varies with the resistance pattern as per the table below:

**Basic principles of treatment of DR TB:**

- Do not add a drug to a failing regimen
- While treating a child with presumptive DR TB, use the regimen of

the index case and adjust once the child's DST results are available

- Use at least four drugs to be effective
- Pyrazinamide is included as part of the MDR TB regimen
- Do patient baseline tests prior to treatment as per the PMDT guidelines. Delay in baseline test results should not delay treatment initiation.
- Get the caregiver to sign a commitment to adhere to treatment once they have been educated about DR TB
- Use daily directly observed therapy (DOT) only
- Counsel the child's caregiver at every visit to provide support, advice about adverse events and the importance of compliance and completion of treatment
- Dosing for treatment should be based on the child's weight. Adjust the dose whenever the child's weight changes

There are different patterns of drug resistant TB. These vary depending on the number of drugs a child is resistant to. Treatment also varies with the different resistance patterns to TB treatment as shown in the table 30.

**Table 30: Patterns of drug resistance and recommended treatment**

| | Pattern of drug resistance | Regimen | Duration of treatment |
|---|---|---|---|
| **Mono Resistant** | H (±S) | R/Z/E/LFX | 9 Months |
| **Poly Drug Resistant** | H, E, Z (±S) | 3Cm-Lfx-R-Z / 15 Lfx-R-Z** | 18 Months |
| | H and Z | 3Cm-Lfx-R-Z / 15 Lfx-R-Z** | 18 Months |
| | H and E | 3Cm-Lfx-R-Z/ 15 -Lfx-R--Z** | 18 months |
| **MDR TB** | **R & H (MDR TB)** | **8Cm-Pto-Lfx-Cs-Z / 12 Pto-Lfx-Cs-Z*** | **20 months** |
| **RR TB** | R | 8Cm-Pto-Lfx-Cs-Z / 12 Pto-Lfx-Cs-Z* | 20 months |
| | R and E (± S) | 8Cm-Pto-Lfx-Cs-Z/ 12 Pto-Lfx-Cs-Z* | 20months |
| | R and Z (± S) | 8Cm-Pto-Lfx-Cs-Z/ 12 Pto-Lfx-Cs-Z* | 20 months |

H-Isoniazid R-Rifampicin E-Ethambutol S-Streptomycin LFX-Levofloxacin
Cs-Cycloserine Pto-Prothionamide Cm-Capreomycin Z-Pyrazinamide

* A sample should be collected for culture and DST and the patient started on MDR regimen

**Consider a patient's previous TB drug history between the time of sample collection and results being received before starting the patient on the recommended regimen.
The dosage and mechanism of actions for the various medicines used for MDR TB treatment is as shown in table 31.

## Table 31: Second-line anti-TB drugs for treatment of MDR*-TB in children

| Medication | Dose | Maximum daily dose |
|---|---|---|
| Isoniazid(H) | 10mg/kg daily | 300mg |
| Rifampicin (R) | 15mg/kg daily | 600mg |
| Ethambutol (E) | 25mg/kg daily | 1200mg |
| Pyrazinamide (Z) | 30 -40 mg/kg daily | 1500mg |
| Streptomycin (S) | 20 - 40mg/kg daily | 1000mg |
| Kanamycin (K) | 15 -30mg/kg daily | 1000mg |
| Capreomycin (Km) | 15 -30mg/kg daily | 1000mg |
| Ofloxacin (Ofx) | 15 - 20mg/kg daily | 800mg |
| Levofloxacin (Lfx) | 15 - 25mg/kg daily | 1000mg |
| Moxifloxacin (Mfx) | 7.5 -106mg/kg daily | 400mg |
| Ethionamide (Eto) | 15 – 20 mg/kg daily | 1000mg |
| Cycloserine (Cs) | 10 – 20mg/kg daily | 1000mg |
| Terizidone(Trd) | 10 – 20mg/kg daily | 1000mg |
| Para – aminosalisylic acid (PAS) | 150mg/kg daily | 8g(PASER) |

*** MDR: multidrug resistant**
Although Fluoroquinolone are not approved for use in children in most countries, the benefit of treating children with MDR-TB with a Fluoroquinolone may outweigh the risk in many instances.

## 7.4 Extensive Drug resistant TB (XDR TB)
Treatment regimen is tailored depending on resistance pattern. All children with suspected or confirmed XDR TB should be referred to a specialist/clinical committee for further evaluation and management.

## 7.5 Follow up for DR TB treatment

- All attempts should be made to get mycobacterial culture and DST during treatment for any child who did not have bacteriologically confirmed DR TB disease at diagnosis
- Clinical, radiological and bacteriological mycobacterial culture for any child who had bacteriologically confirmed disease at diagnosis is essential
- Patient on treatment should be monitored monthly using clinical and laboratory evaluation as per the guide in table 32.

### Table 32: Patient monitoring schedule for patients with MDR TB

| Month | Baseline | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 15 | 18 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clinical review | X | Every 2 weeks | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Audiometry | X | X | X | X | X | X | X | X | X | | | | | | | |
| Weight | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Height | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Smear | X | X | X | X | X | X | X | X | X | X | X | X | X | Monthly till treatment completion | | |
| Culture | X | X | X | X | X | X | X | X | X | X | X | X | X | Monthly till treatment completion | | |
| DST | X | | | | | | SLD DST | | | | | | | | | |
| LFTs (AST, ALT, Bilirubin) | X | X | X | X | | | X | | | X | | | X | X | X | |
| Creatinine, Potassium | X | X | X | X | X | X | X | X | X | | | | | | | |
| Full hemogram | X | | | X | | | X | | | | | | X | | X | |
| CD4 | X | | | | | | | | | | | | | | | |
| Viral Load | | | | | | | X | | | | | | X | | X | |
| CXR | X | | | | | | X | | | | | | X | | X | |
| TSH | X | | X | | | | X | | | | | | X | | X | |
| Pregnancy test | X | | | | | | | | | | | | | | | |

**Note**

- Second line DST should be done at the beginning of treatment and carried out if a culture negative patient turns positive
- Liver function and kidney function tests may be done at any time as clinically

indicated

- Patient's height should be taken at baseline in adults and monthly in children. BMI/ Z-score should be calculated monthly
- The patient's HIV test should be done at baseline and repeated as per the guideline
- Hemogram (HB) in a patient on Zidovudine (AZT) should be carried out at baseline, 4, 8 and 12 months

## 7.6 Side effects for second-line treatment and management

With correct dosing, few long-term side effects are seen even with the more toxic second line drugs in children, including Ethionamide and Fluoroquinolone. Some of the common side effects and their likely causative agents is as shown in table 33.

## Table 33: Common side effects of second-line medicines, their likely causing agents, and suggested management strategies

| Classification group | Name of Drug | Side-effects | |
|---|---|---|---|
| | | Common | Uncommon |
| **Group 1:** First-line oral anti-TB agents | Isoniazid (H) | Hepatitis, Cutaneous hypersensitivity, Peripheral neuropathy | Giddiness, Convulsion, Optic neuritis, Mental symptoms, Haemolytic anaemia, Aplastic anaemia, Lupoid reactions, Arthralgia, Gynaecomastia |
| | Rifampicin (R) | Hepatitis, Cutaneous hypersensitivity, Gastrointestinal reactions, Thrombocytopenic, purpura, Febrile reactions, "Flu syndrome" | Shortness of breath, Shock, Haemolytic anaemia, Acute renal failure |
| | Ethambutol (E) | Retrobulbar neuritis, Arthralgia | Cutaneous reaction, Peripheral neuropathy |
| | Pyrazinamide (Z) | Hepatitis, Nausea, Vomiting, Arthralgia, | Sideroblastic anaemia |
| **Group 2:** Injectable anti-TB agents | Streptomycin (S) | Cutaneous hypersensitivity, Giddiness, Numbness, Tinnitus, Vertigo, Ataxia, Deafness | Renal damage, Aplastic anaemia |
| | Kanamycin (Km) | Ototoxicity: hearing damage, vestibular, disturbance, Nephrotoxicity: deranged renal function test | Clinical renal failure |
| | Amikacin (Am) | Ototoxicity: hearing damage, vestibular, disturbance, Nephrotoxicity: deranged renal function test | Clinical renal failure |
| | Capreomycin (Cm) | Ototoxicity: hearing damage, vestibular, disturbance, Nephrotoxicity: deranged renal function test | Clinical renal failure |
| **Group 3:** Fluo-roquinolones | Ofloxacin (Ofx) | Gastrointestinal reactions, Insomnia | Anxiety, Dizziness, Headache, Tremor, Convulsion |
| | Levofloxacin (Lfx) | Gastrointestinal reactions, Insomnia | Anxiety, Dizziness, Headache, Tremor, Convulsion |
| | Moxifloxacin (Mfx) | Gastrointestinal reactions, Insomnia | Dizziness, Restlessness, Diarrhoea |
| **Group 4:** Oral Bacteriostatic 2nd line anti-TB agents | Ethionamide (Eto) | Gastrointestinal reactions | Hepatitis, Cutaneous reactions, Peripheral neuropathy |
| | Prothionamide (Pto) | Gastrointestinal reactions | Hepatitis, Cutaneous reactions, Peripheral neuropathy |
| | Cycloserine (Cs) | Dizziness, Headache, Depression, Memory loss | Psychosis, Convulsion |
| | P-aminosalicylic acid (PAS) | Gastrointestinal reactions | Hepatitis, Drug fever, Hypothyroidism, Haematological |
| | Terizidone | Dizziness, Headache, Depression, Memory loss | Psychosis, Convulsion |

# CHAPTER 8

# Prevention of TB

## 8.1 Infection prevention and control

Tuberculosis infection prevention and control (IPC) refers to a combination of measures aimed at minimizing the risk of TB transmission within populations. It complements core interventions in TB and HIV control. It is important because of:

- Association of TB with HIV
- Emergence of drug resistant TB (DR-TB)
- Increased risk of transmission among contacts of TB patients, health care facilities and congregate settings

Patients can infect other patients, workers, or visitors. Likewise, workers can infect patients, other staff or visitors and visitors can infect patients, workers and other visitors.

**IPC measures**

**There are three levels of IPC measures:**

1. Administrative control measures
2. Environmental control measures
3. Personal protective equipment

### 1. Administrative control measures

These are defined as the managerial or work practices that reduce the risk of TB transmission by preventing the generation of droplet nuclei and limiting exposure to droplet nuclei.

Administrative support for TB infection control involves:

- **Administrative commitment** to implementation of TB infection control is necessary within facilities to ensure success of TB prevention efforts
- **An Infection Prevention and Control Committee:** It should be formed to coordinate activities amongst different facility services

There are three key components of administrative controls. These are:

**1. TB Infection Prevention and Control assessment.**

This entails:

- Review of the statistical TB reports
- Evaluation of existing TB IPC activities
- Identification and prioritization of the most-at-risk settings within the facility
- Identification of categories of HCWs that need to be included in a TB screening program
- Identification of mechanisms for prompt recognition and reporting of presumptive TB episodes and TB transmission

**2. Patient management**

The following are the key strategies of patient management to prevent TB transmission:

- Screening of clients for cough as they enter the facility
- Education of clients on cough hygiene
- Provision of masks/tissues to coughing clients as they enter the facility
- Separation of clients who cough from those who don't
- Reduction of waiting times for clients who cough
- Early referral and investigation of clients who are coughing for TB
- Provision of a safe environment for collection of sputum
- Reducing exposure in the laboratory
- Isolation
- Surveillance for TB disease/infection among HCW

**3. Development of an infection control plan**

Development of an IPC plan will be based on the following:

- Risk assessment results
- TB surveillance data
- Epidemiological data

The IPC plan should be monitored monthly and evaluated every year. The plan should include:

- Description of the incidence or TB and TB/HIV in the facility
- Assessment of HCW training needs and training plan
- Administrative policies regarding triage and screening, referral and diagnosis, separation and isolation

- Using and maintaining environmental controls
- Policy on the training and use of respiratory protection
- Area-specific infection control recommendations
- Description of roles and responsibilities for implementation and monitoring the infection control plan
- Time-line and budget (e.g., material and personnel costs)

**2. Environmental control measures**

These are measures that are used to **reduce the concentration of droplet nuclei in the air**. Such measures include maximizing natural ventilation and controlling the direction of airflow.

There are two types of environmental controls:

1. **Natural ventilation**

Simple natural ventilation may be optimized by maximizing the size of the opening of windows and doors and locating them on opposing walls. *Where possible, the use of natural ventilation should be maximized before considering other ventilation systems.*

2. **Mechanical ventilation**

Well-designed, maintained and operated fans (mixed-mode ventilation) can help to obtain adequate dilution when natural ventilation alone cannot provide sufficient ventilation rates.

**Personal protective equipment**

This refers to items specifically used to protect the health care provider, the patient and the community from exposure to bodily discharges or from droplet or airborne organisms. Personal protective equipment includes gloves, aprons, gowns, caps, surgical masks, respirators and protective eye gear.

**N95 for health care workers**

- N95 are a special type of respirators that provide 94-95% filtration efficiency against 0.3-0.4 micrometre particles
- They should be closely fitted to the face to prevent leakage around the edges. If the respirator is not worn correctly, infectious droplet nuclei can easily enter a person's airways, potentially resulting in infection. The N95 masks can be re-used repeatedly for several weeks if they are properly stored before disposal
- Respirator should be stored in a clean dry location devoid of humidity, dirt and filter damage
- Plastic bags should never be used since they retain humidity

**Protection in high risk areas**

- Respirators should be worn by all personnel entering high risk areas such as bronchoscopy rooms, sputum induction rooms, MDR-TB isolation wards, people handling specimens in the laboratory, MDR-TB Clinic
- The use of powered air- purifying respirator (PAPR) is also recommended where high risk procedures are performed, for they are cost-effective and are re-usable and does not require fit testing

**Note:**

It is important to remember that a surgical mask worn by HCWs may not adequately protect them from inhalation of air contaminated with M. tuberculosis. Respirators are the preferred device to reduce the concentration of M. tuberculosis bacilli inhaled.

**Multi-Drug Resistant and Extensively Drug Resistant TB**

The health care workers working with DR TB patients should take necessary preventive precautions. These include:

1. Educating the community about TB infection prevention and control
2. Sensitizing MDR-TB care providers at community level on risk of transmission and providing them with basic protective equipment
3. Providing MDR-TB patients with basic personal protective equipment (surgical mask) for use in the home setting where there are vulnerable groups like children under five years of age, the elderly and chronic ill people

## 8.2 Screening for Child Contacts of known TB Cases

Young children living in close contact with an index case of smear positive pulmonary TB are at a high risk of TB infection and disease.

The risk of infection is greatest if:

- The contact is close and prolonged
- The child is malnourished children
- The child is under 5 years
- The child is HIV infected

Disease usually develops within 2 years of infection. In infants, the time lag can be as short as a few weeks.

Isoniazid Preventive Therapy (IPT) for young children (aged less than 5 years) exposed to TB who have not yet developed disease will greatly reduce the likelihood of developing TB during childhood.

***Contact screening refers to the evaluation for TB of all children who are close contacts of bacteriologically confirmed PTB cases***
***Reverse contact screening refers to the evaluation of all possible source cases of a child diagnosed with TB disease***

The main purpose of child contact screening is to:
1. Identify symptomatic children (i.e. children of any age with undiagnosed TB disease) and treat them for TB.

2. Provide Isoniazid Preventive Therapy (IPT) for the high-risk children who have no signs or symptoms of TB disease.

**Process of contact investigation (CI)**
When CI is initiated the index case should be interviewed as soon as possible after the diagnosis (generally within one week) to elicit the names of household members and other close contacts.

The focus should be on household members, where the yield is potentially highest, but work place and social contacts should not be ignored.

If the human resources are available, the person conducting the CI should visit the home of the index patient to ensure that all contacts are interviewed and referred for evaluation when indicated. This is usually done by the community volunteer or at times the health care worker. The visit will give a more accurate view of the actual circumstances of the exposure and provide an opportunity for identification of needed social support, and for education regarding tuberculosis and infection control measures that may be taken.

If a child presents with active tuberculosis, it is important to conduct what is often referred to as “reverse contact tracing.” Most sick children contracted tuberculosis from an adult with the disease with whom they have had close contact. With reverse contact tracing, attempts are made to identify the adult who is the source of the infection.

Data on CI should be collected in the recommended contact tracing tools availed by the TB program.

Contact screening is done using a symptom screen using the set of questions as listed in the ICF tool. These include:

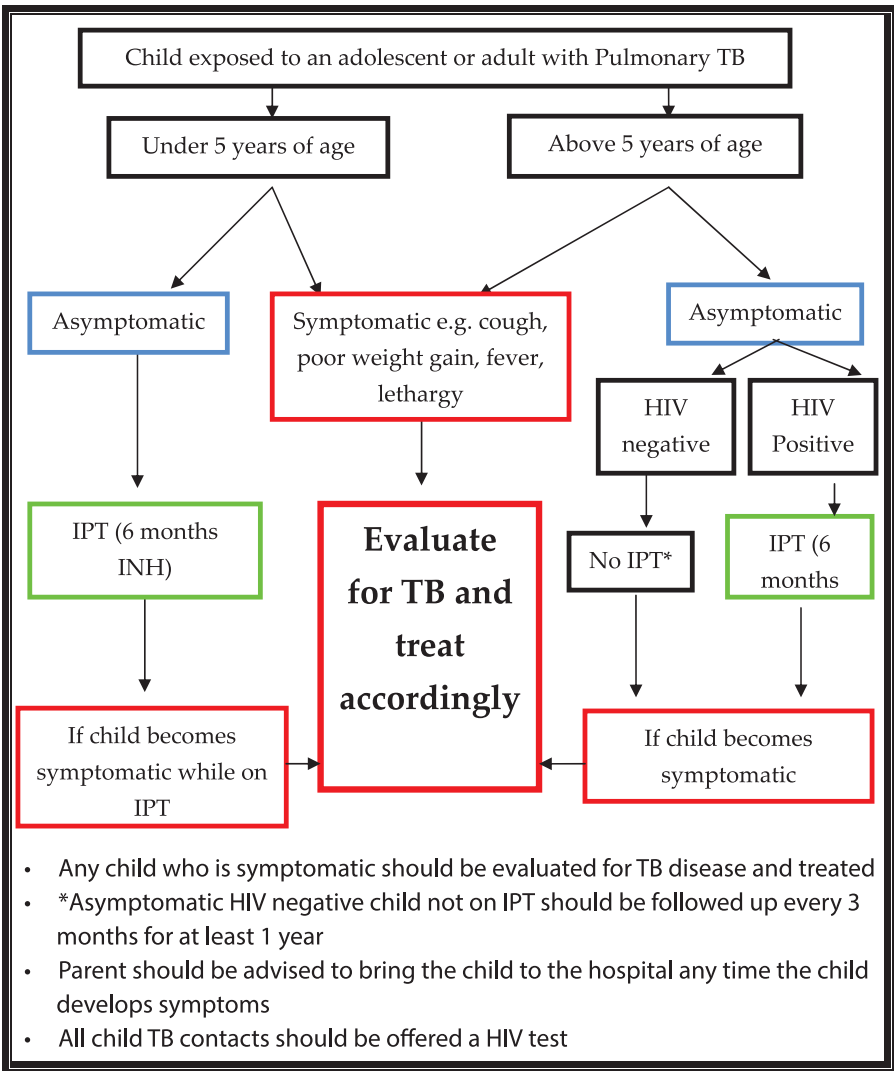
1. Cough
2. Fever
3. Loss of weight/poor weight gain
4. Lethargy/malaise/reduced play
5. Extra pulmonary signs and symptoms e.g. enlarged cervical LN

A child or contact that has any of the signs and symptoms of TB should be referred to the nearest health facility to have a full evaluation for TB.

Contacts found to have TB disease are initiated on the full course of treatment while those without TB are counselled to identify signs and symptoms and advised when to return. Contacts aged less than 5 years they are initiated on IPT once TB disease has been ruled out.

Management of child contacts is summarized in the algorithm in figure 9.

**Figure 9: Management of a Child who has been exposed to an adolescent or adult with Pulmonary TB**




## 8.3 IPT in HIV infected children

Isoniazid is used for prevention of TB. It is given at a dose of **10mg/kg** for over 6 months in children. Before giving IPT, TB disease should be ruled out. All

children on IPT should receive pyridoxine at recommended dose as in table 13.

Children eligible for IPT include:

- Children living with HIV who are more than 12 months of age, who are unlikely to have active TB on symptom-based screening and have no contact with a TB case should receive six months of IPT at **10 mg/ kg/ day** (maximum 300 mg/day*)*
- In children living with HIV who are less than 12 months of age, only those who have contact with a TB case, and who are evaluated for TB should receive six months of IPT if the evaluation shows no TB disease.
- All children under 5 years of age who have been exposed to a case of infectious TB irrespective of their HIV status should be put on IPT if TB disease has been ruled out.

## Table 34: Dose of Isoniazid (INH) for Isoniazid Preventive Therapy (IPT) in children

| Weight (kg) | Daily Dose in mg | Number of 100 mg, INH tablets |
|---|---|---|
| 2 – 3.4 | 25 | 1/4 |
| 5.1 – 9.9 | 100 | 1 |
| 10-14.9 | 150 | 1½ |
| 15-19.9 | 200 | 2 |
| 20-29.9 | 300 | 3* |

*For children more than 20 kg, one can use 1 adult tablet of INH (300mg) once daily.

**All children on IPT should also receive pyridoxine.**

## 8.4 BCG Vaccination in Children

BCG is a live attenuated vaccine derived from *M bovis*. It offers protection against the more severe types of TB such as Milliary TB and TB meningitis, which are common in young children.

A child who has not had routine neonatal BCG immunization and has symptoms of advanced HIV disease (WHO Stage 3 or 4) should not be given BCG because of the risk of disseminated BCG disease.

In children with suspected TB infection or disease, the BCG vaccination should be deferred till 2 weeks after completion of IPT/TB treatment because the anti-TB medicines will denature the vaccine.

**Disseminated BCG disease**
A small number of children (1–2%) may develop complications following BCG vaccination. These commonly include:

- Local abscesses at the injection site
- Secondary bacterial infections
- Suppurative adenitis in the regional axillary lymph node
- Local keloid formation.
- Disseminated BCG disease. If axillary node enlargement is on the same side as BCG in a HIV- positive infant, consider BCG disease and refer.

Most reactions will resolve spontaneously over a few months and do not require specific treatment. Children who develop disseminated BCG disease should be investigated for immunodeficiency and treated for TB using the first-line regimen: 2RHZE then 4RH. The child should always be reviewed by a specialist.

# CHAPTER 9

## Roles and Responsibility

TB is a curable and preventable disease. Therefore, various individuals in the community and health facilities have a responsibility to prevent transmission and promote treatment adherence among patients, families and the community at large. Health education is equally important for creating awareness about TB, changing attitudes and behaviour and reducing stigma and discrimination.

These roles are defined from the lowest level of the patient and community units to the highest level of care. These levels of health care are:

**Level I-** Community units (this includes patient, family, Community Health Volunteer (CHV), Community Health Extension Worker (CHEW) and community)
**Level II-** Dispensary
**Level III-** Health centre
**Level IV-** Primary referral unit
**Level V-** Secondary referral unit
**Level VI-** Tertiary referral unit
**The patient, family, CHV, CHEW and community**

**The patient**
Every patient has a right to access health care; where health care shall include promotive, preventive, curative, reproductive, rehabilitative and palliative care. These responsibilities are borne by the children themselves (older children) or by the parents or caregivers (younger children). They include:

- To inform other family members and people in close contact with to undergo TB screening
- To take care of his/her health by adopting a healthy lifestyle. The TB patient should spend more time in an open space to reduce indoor transmission
- For children, protection, care and healthy lifestyle of the minor shall be the responsibility of their parent or guardian
- To adopt a positive attitude towards their health and life that helps them to overcome stigma and discrimination. This will help them to take part in peer/support groups and help others to complete

treatment

- To respect the rights of others and not to endanger their life and health by completing treatment and observing cough etiquette and hygiene
- To give health care providers relevant, accurate information to facilitate diagnosis, treatment, rehabilitation and/or counselling while being truthful and honest on past health care. In young children, parents and caregivers usually do this. It is important for the health care worker to ask for history of contact with adult/adolescent with chronic cough or TB within the last 2 year
- To take care of the health records in his or her possession and produce them when required by the health care provider. This is necessary to support history taking in TB
- To keep scheduled clinic appointments
- To follow instructions, adhere to and not abuse or misuse prescribed medication or treatment and/or rehabilitation requirements. TB medication requires consistency as non- adherence will lead to unfavourable treatment outcomes
- To seek treatment at the earliest opportunity
- To express any health concerns to the HCW
- To be treated with respect and their health information treated with confidentiality

## 9.1 Family/ Household members

- Parents/care givers should ensure that all new born babies are given BCG and other primary vaccines
- Children, parents, and other family members should seek information about TB and the importance of completing treatment
- To support and observe the child during treatment according to the instruction provided by the health care worker
- Lactating mothers with children suffering from TB should practice exclusive breast feeding for the first 6 months
- Provide the child with a healthy diet
- Provide a TB free environment by ensuring good ventilation and observe cough hygiene and etiquette
- TB patients who develop complications should be referred to an expert for evaluation and treatment

## 9.2 The community:

- Ensure individuals with suggestive symptoms of TB are screened and those on treatment supported to adhere to treatment
- Mobilize patients lost to follow up to resume their TB treatment
- Create awareness on TB to reduce stigma and discrimination
- Ensuring adequate ventilation and minimizing crowding in congregate settings like schools, prisons, children homes etc.

## 9.3 Community Health Volunteers (CHVs)/ Community Health Extension Worker (CHEW)

CHVs are major players in the implementation of primary healthcare since 1980s. They play a major role in mobilizing communities to take care of their health and provide basic health care at community level. CHEWs play a role in training CHVs and provide a linkage between the community and the health system. Their role in TB control includes to:

- Educate communities that every new born child should receive all the primary vaccines including BCG
- Create awareness on TB to reduce stigma and discrimination
- Perform TB symptom screening in the community and refer symptomatic persons to the nearest health facility
- DOT support for patients on TB treatment
- Identify all TB patients who are lost to follow up and refer them back for TB treatment
- Participate in patient support groups to offer counselling and psycho social support
- Maintain a household register used to determine overall health status in the community

**Health facilities**

Diagnosis and treatment of TB is done in health facilities, which offer different kinds of services depending on its Tier and the resources available. The facilities are classified into the following levels:

**Level II-** Dispensary
**Level III-** Health centre
**Level IV-** Primary referral unit (Sub-county hospital)
**Level V-** Secondary referral unit (County referral hospital)
**Level VI-** Tertiary referral unit (National referral hospital)

The roles of the various levels of health facilities are as shown in table 35.

## Table 35: Roles of the different health facilities

| Level | Level 2 and 3: Dispensary and Health centre | Level 4 and 5: Sub County and County Referral Hospitals | Level *6:* National Referral Hospitals |
|---|---|---|---|
| **Role** | Lower level of health service delivery | Referral facilities for patients from the Dispensary/Health centre levels | This is the highest level of referral for specialized care |
| **Diagnosis** | -History of presenting illness<br>-Physical Examination<br>-Investigations<br>• Gene Xpert is the recommended test therefore refer specimen to a gene Xpert site<br>• Where referral is not possible Sputum microscopy can be done<br>• For diagnosis of EPTB, children should be referred to a higher level | • -History of presenting illness<br>• -Physical Examination<br>• -Investigations<br>• Gene Xpert is done, where it is not available refer specimen to a gene Xpert site<br>• Where referral is not possible Sputum microscopy can be done<br>• Diagnosis of EPTB through X-ray, Mantoux, FNA and any other recommended tests<br>• Nasal pharyngeal aspiration is done | -History of presenting illness<br>-Physical Examination<br>-Investigations<br>• Gene Xpert is done<br>• Diagnosis of EPTB through X-ray, Mantoux, FNA and any other recommended tests<br>• Nasal pharyngeal aspiration is done |
| **Treatment** | • Children diagnosed with TB are initiated on treatment according to the regimen and dosage recommendations<br>• Documentation: recording, reporting and notification of cases<br>• Follow up of children on treatment<br>• Pharmacovigilance | • Children diagnosed with TB are initiated on treatment according to the regimen and dosage recommendations<br>• Documentation: recording, reporting and notification of cases<br>• Follow up of children on treatment<br>• Pharmacovigilance<br>• Management of complicated cases who require admission or individualized regimen e.g. DRTB<br>• Decentralization of diagnosed cases to other facilities | • Children diagnosed with TB are initiated on treatment according to the regimen and dosage recommendations<br>• Documentation: recording, reporting and notification of cases<br>• Follow up of children on treatment<br>• Pharmacovigilance<br>• Specialized patient management for complicated cases or provision of individualized regimen e.g. DRTB.<br>• Decentralization of diagnosed cases to other facilities |
| **Prevention** | • Health education<br>• Triaging<br>• IPC Plans<br>• IPT | • Health education<br>• Triaging<br>• IPC Plans<br>• IPT<br>• Isolation facilities for cases who require admission | • Health education<br>• Triaging<br>• IPC Plans<br>• IPT<br>• Isolation facilities for cases who require admission |
| **Support** | • Linking patients to other services<br>• Identification of contacts<br>• Linkage with community<br>• Ensuring adequacy of resources for patients e.g. medicines, Human resource<br>• Referral of complicated cases to a higher level | • Linking patients to other services<br>• Identification of contacts<br>• Linkage with community<br>• Ensuring adequacy of re-sources for the Sub County/ County e.g. medicines, Human resource | • Linking patients to other services<br>• Identification of contacts<br>• Linkage with community<br>• Ensuring adequacy of re-sources for the Sub County/ County e.g. medicines, Human resource |

# CHAPTER 10

# Monitoring and Evaluation for childhood TB

***Tuberculosis is a Notifiable Disease under the Laws of Kenya (Public Health Act CAP 242: PART III)***
***TB treatment in Kenya is free***

A **notifiable disease** is any disease that is required by law to be reported to government authorities. This facilitates close monitoring of the disease and timely action to control it.

## 10.1 Monitoring

Monitoring is the routine tracking of key elements of program performance through careful record keeping and regular reporting. Monitoring is used to assess whether activities are carried out as planned. It focuses on the activities implemented and results achieved. It provides continuous information on the progress being made to achieve goals and alerts staff and managers to problems, providing an opportunity for these to be resolved early. Effective monitoring relies on accurate records being maintained for all children.

**Recording**
This is the practice of capturing data on patients' management over time and across clinical sites. This will help track patient progress and identify issues with treatment early for necessary interventions. All children diagnosed with TB should then be recorded in the TB register.
After recording the child's information, the cases should then be notified to the Ministry of Health. This information will be useful to the TB program in ensuring successful planning and implementation of Paediatric TB activities.

**Reporting**
This is the aggregation and relay of the recorded information to the next management level. This should be done monthly, quarterly and annually. Reports should be accurate, regular and timely. This enables countrywide monitoring of TB activities and evidence-based decision making.

**Importance of Recording and Reporting**

Recording and reporting are important for:

- Monitoring and evaluation of implementation of activities at different levels
- Monitor children's response to treatment (clinical and physical)
- Assess program performance
- Program planning
- Aiding staff to provide adequate services to the individual child
- Ensuring patient quality and continuum of care
- Sharing of information with patient and transfer of information between health facilities
- Accountability for administered medicines

Clinical monitoring, done at every visit, will include assessing and recording the following:

- Weight; Weigh the child monthly and adjusting dosage appropriately.
- Monitor Height/length; Weight for Height/ z-score and MUAC
- Response to treatment. If there is poor response to TB treatment, re-evaluate the child for possible drug resistance and rule out other differential diagnoses
- Dosages and regimen used follow the recommended dosages as per the weight bands
- Drug adherence and drug toxicity or side effects

## 10.2 Evaluation

Evaluation is an episodic, in-depth analysis of program performance. It assesses progress towards operational targets and epidemiological objectives. Evaluation is done to quantify the impact of the interventions that have been implemented. Regular evaluation is necessary for efficient management of the paediatric TB. Evaluation gives the health care worker an opportunity to use the data for decision making to improve quality of care.

In TB management, this is done periodically every 3 months for case notification and 12 months after the treatment completion. It measures:

- Number of children notified with TB (Case finding reports)
- Treatment outcomes for the children e.g. cured, failure, Treatment completed etc.
- Nutritional status- (Proportion of children with Z-scores/BMIs

and those under Nutritional Support)
- TB-HIV co-infection rate among the children
- Number of health care workers trained on Paediatric TB
- The quantities of paediatric TB medicines used

## 10.3 Quality records and reports

TB patient management data informs the kind of interventions a patient receives. It is also useful in making evidence-based decisions. Therefore, all efforts should be made to ensure the data and reports generated from it are of good quality.

**Dimensions of Data Quality**
Data quality comprises of various dimensions as shown in table 36.

## Table 36: Dimensions of data quality

| Dimension of Data Quality | Definition | Consequences of Poor Quality Data |
|---|---|---|
| Accuracy | Data measures what they are intended to measure | • Misrepresentation of the health situation in the country<br>• Conclusive decisions cannot be drawn leading to Program failure<br>• Patient mis-management leading to DR-TB development and complications<br>• Inaccurate resource allocation e.g. financial, human resource, medicines, infrastructure<br>• Medico-legal implications |
| Validity | The extent to which a measurement is well-founded and corresponds accurately to the real world | |
| Consistency | Repeatability and replicability | |
| Completeness | Data that has sufficient details i.e. an information system represents the complete list of measurable indicators | |
| Timeliness | Data is available within the stipulated period | |
| Integrity | No deliberate bias or manipulation of data for political or personal reasons | |

### *10.4 Recording and reporting tools*

Tools that are used for recording and reporting information on TB management of patients are shown in table 37.

## Table 37: TB Recording and reporting tools

| Facility level tools | Summary registers and Forms | Monthly and quarterly Reports |
|---|---|---|
| Sputum/ Xpert MTB/RIF request form | Tuberculosis (TB-4) Facility Register | Quarterly report on TB case finding |
| Patient Record Card (TB &HIV) | MOH 711A, MOH 731 | AFB work load report |
| Patient Appointment Card (TB & HIV) | Other HIV data summary forms | Cohort report |
| Treatment Unit Register (TB &HIV) | IPT register | EQA report |
| Culture and DST request form | DR-TB Register | MOH 711A, MOH 731 |
| AFB register | | |
| IPT appointment card | | |
| Support supervision tool | | |
| TB Presumptive Register | | |
| ICF/IPT Cards - Paeds | | |
| DR-TB Patient Log Book | | |
| DR-TB Patient Appointment Card | | |
| Community Monthly Reporting Tool | | |

# CHAPTER 11

## Child nutrition and TB

Malnutrition is an important public health issue particularly for children under five years of age who have a significantly higher risk of mortality and morbidity than well-nourished children. In Kenya, the infant and the under-five mortality rates are 77 and 115 per 1000 live births respectively. The national figure for acute malnutrition of children under five years old is estimated at 6%.

Malnutrition is defined as "a state when the body does not have enough of the required nutrients (under-nutrition) nor does it have excess of the required nutrients (over-nutrition). There are two categories of malnutrition: Acute Malnutrition and Chronic Malnutrition.

Children can have a combination of both acute and chronic. Acute malnutrition is categorized into Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM), determined by the patient's degree of wasting. All cases of bi-lateral oedema are categorized as SAM.

Chronic malnutrition is determined by a patient's degree of stunting, i.e. when a child has not reached his or her expected height for a given age. To treat a patient with chronic malnutrition requires a long-term focus that considers household food insecurity in the long run; home care practices (feeding and hygiene practices); and issues related to public health.

SAM is further classified into two categories: Marasmus and Kwashiorkor. Patients may present with a combination of SAM known as Marasmic-Kwashiorkor. Patients diagnosed with Marasmic-Kwashiorkor are extremely malnourished and at a great risk of death.

Admission criteria for acute malnutrition are determined by a child's weight and height, by calculating weight-for-height as "z-score" (using WHO Child Growth Standard, 2006), and presence of oedema. All patients with bi-lateral oedema are considered to have severe acute malnutrition. See table 38 for anthropometric criteria.

One of the key indicators for clinical monitoring in children being treated for TB is improvement in nutrition status. There are several ways to monitor the nutrition status of undergoing TB treatment. All children should have a baseline weight, height and MUAC. The MUAC will be an indicator of acute malnutrition and if recent will call for the appropriate interventions. The weight is then assessed at every visit and appropriate drug adjustments made in case of weight gain.

For children 0-59 months of age their age, weight and height/ length is taken and Z–Scores documented as per the reference charts. For children 5-19 years their age, weight and height are used to assess the BMI for age.

## 11.1 Nutritional Assessment, Counseling and Support (NACS) process

All children diagnosed with TB should receive a nutritional assessment, counselling, and support, tailored to the individual needs of the patients, including:

- Nutrition assessment and diagnosis
  - Anthropometric
  - Biochemical investigations
  - Physical and clinical examination
  - Dietary (24 hr recall for food type/frequency and household food security)
  - Environmental and psychosocial
  - Functional (ability to care for self, bedridden, etc.)

- Counseling& education
  - Benefits of maintaining good nutritional status to a TB patient
  - On infant and child nutrition (ICN)
  - Identifying locally available foods they can access given their own context, food safety and food preparation
  - Helping the client to plan meals and snacks with a variety of foods to meet their energy, high protein and nutrient needs and treatment plans
  - Identifying any constraints the client may face and find ways to minimize them
  - Helping the client to understand the potential side effects and food interactions of the medicines they are taking, and help the client

identify ways to manage these side effects
  - Exploring with the client the cause(s) of poor appetite and appropriate responses (type of food, disease, pain, depression, anxiety, or side effects of medications)
  - Counseling on high levels of sanitation and food hygiene

- Support
  - Nutrition care plan
  - Therapeutic and supplementary foods (food by prescription, therapeutic feeds, fortified blended flour)
  - Complementary foods for children ≥6 months
  - Micronutrient supplements
  - Point-of-use water purification to prevent water-borne disease
  - Food security and linkage to community

Upon assessment, anthropometric criteria are used to classify the nutrition status of the child as shown in table 38.

**Table 38: Anthropometric criteria to identify severe, moderate and at risk categories of acute malnutrition for children and adolescents***

| Indicator | Severe Acute Malnutrition (SAM) | Moderate Acute Malnutrition (MAM) | At Risk of Acute Malnutrition |
|---|---|---|---|
| Infants less than 6 months | | | |
| W/L | W/L < - 3 Z-Score | Static weight or losing weight at home | Static weight or losing weight at home Z-Score |
| Oedema | Oedema Present | Oedema Absent | Oedema Absent |
| Other signs | Too weak to suckle or feed | Poor feeding | Poor feeding |
| Children 6 months to 10 years | | | |
| W/H Z-Scores | < -3 Z-Score | Between -3 to < -2 ZScore | Between -2 to <-1 Z-Score |
| MUAC (6 - 59 months only) | <11.5cm | 11.5 to 12.4cm | 12.5-13.4cm |
| Oedema | Oedema Present | Oedema Absent | Oedema Absent |
| Adolescent (10 years to 18 years) | | | |
| MUAC | < 16cm | N/A | N/A |
| Oedema | Oedema Present | Oedema Absent | Oedema Absent |

*Anthropometric criteria based on WHO Child Growth Standards (2006)
Mid-Upper Arm Circumference (MUAC) is often the screening tool used to determine malnutrition for children in the community under five years old. A very low MUAC (<11.5cm for children under five years) is considered a high mortality risk and is criteria for admission with severe acute malnutrition. Table 39 outlines for MUAC criteria for children under-five years.

**Table 39: MUAC criteria to identify malnutrition of children less than 5 years in the community**

| Severely Malnourished | Moderately Malnourished | At Risk of malnutrition |
|---|---|---|
| Less than 11.5cm | 11.5cm to 12.4cm | 12.5cm to 13.4cm |

## 11.2 Classifying nutrition status using weight for age

In selected situations one may not be able to get an accurate height. This may happen in:

- Children who are -very sick, disabled, have neurologic abnormalities, very irritable
- Instances where the instruments to measure height are not available

In such circumstances one may use weight for age assessment in children up to 14 years. Use the weight for age WHO charts to assess the nutrition status of the child.

To determine the nutrition intervention to be given to the child, the triage criteria is as shown in table 40.

## Table 40: Triage to determine treatment of malnutrition

| | |
|---|---|
| **ASK:** | 1. Has there been any weight loss in previous month?<br>2. Does the patient have an appetite?<br>3. Does the patient have any medical condition that will impair nutritional status?<br>4. Is the breast-feeding child suckling well? |
| **LOOK AND FEEL FOR:** | Visible signs of wasting |
| **CHECK:** | MUAC<br>Weight<br>Height/length<br>Bilateral-oedema |
| **DETERMINE:** | Level of malnutrition using W/H reference charts (or W/A) |
| **LOOK AT SHAPE OF GROWTH CURVE:** | 1. Has the child lost weight?<br>2. Is the growth curve flattening? |

## 11.3 Nutrition care process

Once nutrition assessment has been done and a diagnosis made, the child then needs to have interventions to address their specific nutrition needs. These interventions include nutrition counselling, food supplementation and food by prescription as summarized in table 41.

## Table 41: Steps in the nutrition care process

| Nutrition care process | Classification of under nutrition | |
|---|---|---|
| | **Severe** | **Moderate / mild** |
| Nutrition Assessment | 1. Look for signs of severe wasting<br>- loss of muscle mass<br>- severe visible wasting<br>2.Check for presence of bilateral pitting edema – any grade<br>3. Measure the MUAC<br>4. Take weight<br>5. Check for medical complications<br>6. Conduct appetite test | 1. Take weight<br>2. Measure the MUAC<br>3. Assess dietary intake<br>4. Check for medical complications<br>5. Assess the social economic status<br>6. Check for bilateral pitting oedema<br>7. Check for clinical signs of malnutrition |
| Nutrition Diagnosis | -Signs of severe visible wasting<br>-Bilateral pitting Oedema (+, ++, +++) | |
| Nutrition intervention | - Nutrition and infant feeding counselling<br>- Provide 200 Kcal/Kg/day RUTF 279gms per day of RUTF i.e., (21 sachets per wk)<br>-200- 300 grams per day FBF every 2 weeks or monthly<br>- One bottle (150 ml) of SWS*per month<br>- Inpatient stabilization care to treat underlying illnesses | - Nutrition and infant feeding counselling<br>- Provide 200- 300 grams per day of FBF (for mild malnutrition)<br>--Provide 200 Kcal/Kg/day RUTF 279gms per day of RUTF i.e., (21 sachets per wk for moderate malnutrition)<br>- One bottle (150 ml) SWS* per month<br>- Routine basic treatment e.g. Vitamin A, deworming, iron folic supplementation. |
| Nutrition monitoring and evaluation | -Check weight weekly<br>-Conduct appetite test weekly<br>-Carry out other nutrition assessments<br>-Give education and counselling as required.<br>-Little or no edema for 10 days and passed appetite test-continue on FBF | -Check weight monthly and height every three months<br>-Carry out nutrition assessment monthly<br>-Give education and counselling as required |

# CHAPTER 12

# Managing Anti-TB Medicines

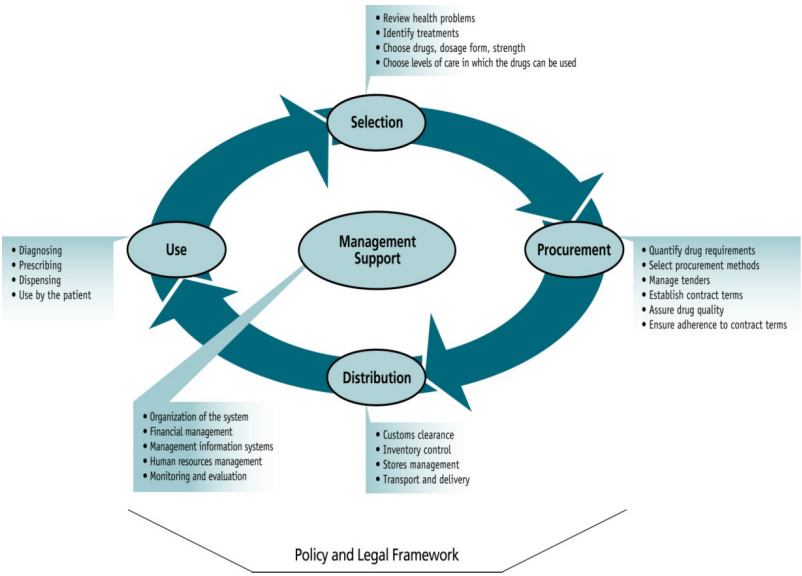
## 12.1 Pharmaceutical management

Pharmaceutical management is a set of practices aimed at ensuring the timely availability and appropriate use of safe, effective, quality medicines and related products and services in any health-care setting.

**The Pharmaceutical Management Cycle**

The Pharmaceutical Management Cycle is a systematic approach to ensure that medicines at all levels of health care delivery are consistently available and appropriately used. It emphasizes the connections between four drug management activities - selection, procurement, distribution and use as shown in figure 10.

**Figure 10: The pharmaceutical management cycle**




*The cycle was developed by the Management Sciences for Health' Centre for Pharmaceutical Management in collaboration with the World Health Organization's Action Program on Essential Drugs.*

## 12. 2 Quantification of anti-tuberculosis medicines

Quantification is the process of estimating the quantities of anti-tuberculosis medicines needed for a specific period to ensure an uninterrupted supply. Quantification is an important step in procurement and ordering for re-supply. Good quantification ensures the appropriate allocation of funds to enable purchase of the right medicine in the right quantity at the right time.

**The rationale for quantification of anti-tuberculosis medicines**

- To ensure that there are sufficient quantities to meet clients' / patients' needs and avoid shortages/stock-outs.
- To avoid surpluses that may lead to over-stocking, expiries and/or wastage of commodities.
- To make informed procurement adjustments when faced with budgetary constraints.

**Quantification methods**

This guideline focuses attention on the two most commonly used methods—consumption and morbidity. The method used depends on the type of data available. The main methods of quantification include:

a) **Consumption method**

The consumption based method uses historical data on the actual medicines dispensed to patients to calculate the quantity of medicines that will be needed in the future. When using the consumption method for quantification, out of stock periods must be adjusted in the calculation.

b) **Morbidity method**

The morbidity-based method uses data about diseases and the frequency of their occurrence in the population (incidence or prevalence) or the frequency of their presentation for treatment. It forecasts the quantity of drugs needed for the treatment of specific diseases, based on projections of the incidence of those diseases.

12.3 Good inventory management

An inventory management system is a cycle of activities comprising ordering, receiving, storage and issuing of anti-tuberculosis medicines.

a) **Ordering**

The facility orders supplies monthly from the district store using a standard order form (FCDRR). The district orders supplies monthly from KEMSA stores using an electronic district aggregation tool, which also serves as a report.

b) **Receiving**

The facility receives supplies; counter checks against the standard order form and delivery note, and record's the transaction on a stock card.

c) **Storage**

Anti-tuberculosis commodities should be stored in optimal conditions to ensure their safety and efficacy in accordance with the principles of good storage practices:

- Good arrangement
- Quality maintenance
- Assured security
- Good inventory control and stock rotation
- Good record keeping

Disposal of unusable stock should be carried out according to the guidelines for disposal of pharmaceuticals. Some commodities like PAS require cold storage and maintenance of the cold chain is important to maintain their efficacy.

d) **Issuing**

The facility issues supplies to various points of use, using an issue/requisition voucher (S11/S12) and records the issue on the bin card.

**Types of inventory records**

Various forms are used for requisitioning and issuing medicines, financial accounting, and preparing consumption and stock balance reports as shown in table 42.

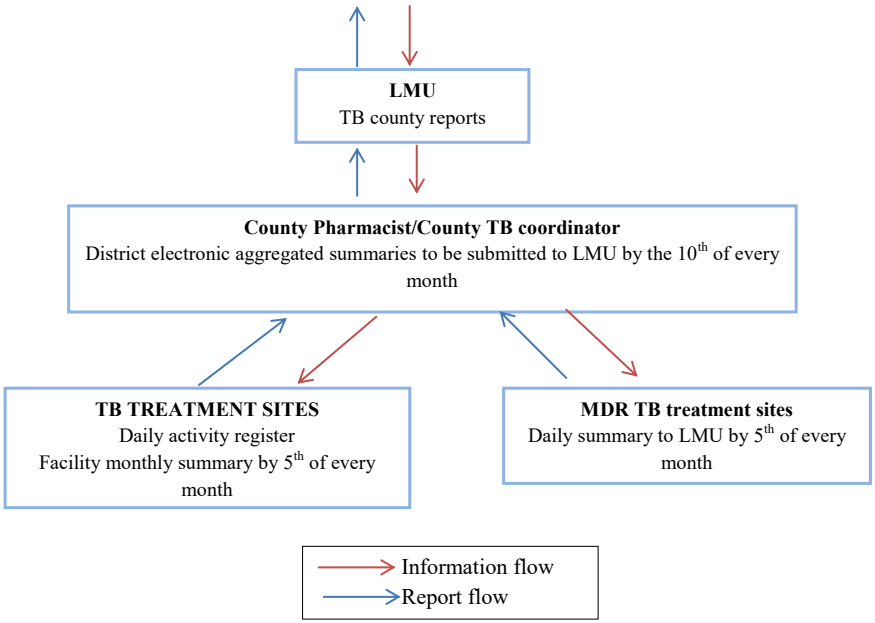
## Table 42: Types of inventory records

| Record type | Source document | Information |
|---|---|---|
| Stock keeping records | Bin cards, stock ledger card | Stock at hand<br>Receipts, losses and adjustments |
| Transaction records | Issue and receipt voucher – (S12, S11), KEMSA delivery notes, Standard order form | Orders, issues and receipts |
| Consumption records | Daily activity Register, Health facility monthly summary, District aggregation tool, tally/tick sheet | Consumption data<br>Stock out days<br>Patient numbers |

TB commodities are issued from a central store (KEMSA) and utilised at the facility level. This process involves quantification and ordering by the facilities from their county stores. The stores in turn quantify their needs and

order from the national store. The national store also communicates to the counties on the stock status, ordering rates and commodity reports. The flow of information and data between the facilities, county stores and the national store is as shown in figure 11.

**Figure 11: Flow of logistic Management Information**




**Definitions of Key Inventory Management Terms**

- **Average monthly consumption**: this refers to the average quantity of commodities consumed per month.
- **Months of stock:** the quantity on hand expressed as the number of months that quantity should last calculated based on the commodity's average monthly consumption.
- **Lead time:** the time interval between when a new stock is ordered and when it is received and available for use.
- **Review period**: The routine interval of time between assessments of stock levels to determine if an order should be placed. It is also known as order interval or re supply interval.

- **Maximum stock level:** the amount of stock above which a facility should not exceed under normal circumstances
- **Minimum stock level:** the amount of stock below which a facility should not fall under normal circumstances
- **Shelf life**: the length of time a product may be stored without compromising its usability, safety, purity or potency
- **Pipeline:** the entire chain of storage facilities and transportation links through which supplies are moved from manufacturers to clients
- **Stock out:** Non-availability of any ACT for 2 consecutive days in a month.

**M & E Indicators**

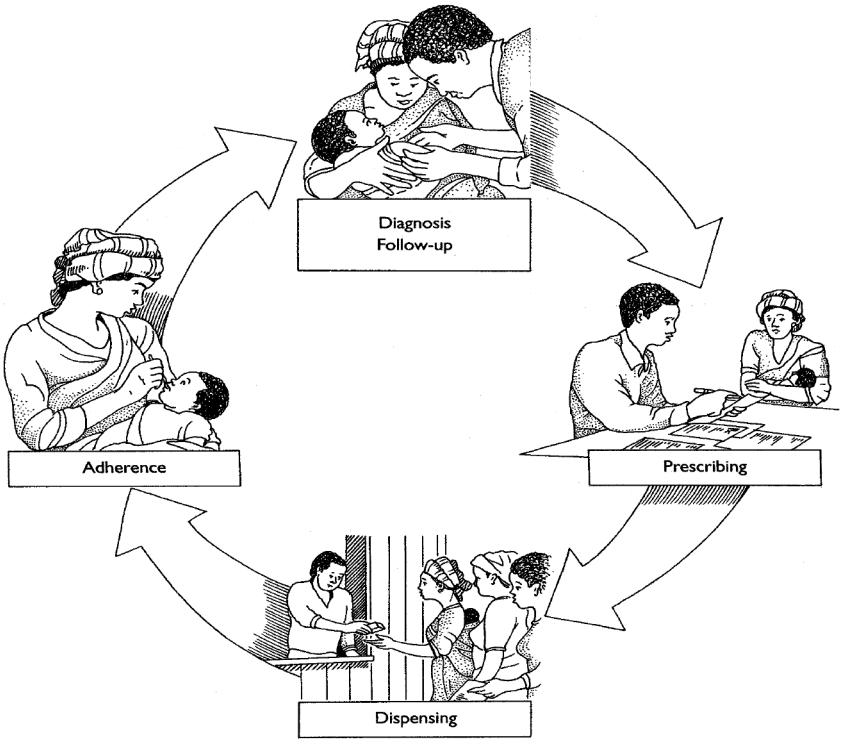
- National reporting rate
- Proportion of health facilities having a total stock out of Tb patient packs

## 12.4 Rational use of anti-tuberculosis medicines

**Definition of Rational Drug Use (RDU)**

The rational use of medicines requires that patients receive medicines appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period, and at the lowest cost to them and the community (World Health Organization, 1988). This calls for rational use of medicines in the entire medicine use cycle whose steps are outlined in figure 12.

**Figure 12: The medicine use cycle**




**Importance of RDU**

- Irrational medicine use can destroy the benefits of a good pharmaceutical management system and reduce the therapeutic useful life of an effective medicine.
- Resources spent on procurement are lost if the correct drugs are not prescribed and dispensed to the correct patient.

**Factors affecting rational use of medicines**

- **Diagnosis** - correct diagnosis based on parasitologically confirmed diagnosis
- **Prescribing**– prescribing /administering the recommended medicine based on the correct diagnosis
- **Dispensing** - correct dispensing (quantity, packaging and labelling) of the prescribed medicine.

- **Patient compliance**- patients' adherence to health worker and label instructions.

**Minimum dispensing information**

a) Instructions on how to take the drug with DOT
b) Instructions on how long to take the medicine
c) Report any suspected ADR
d) Clear label with appropriate patient and medicine information

## 12.5 Pharmacovigilance

**Definitions of key terms**

**Pharmacovigilance:** WHO defines pharmacovigilance as the science of collecting, monitoring, researching, assessing and evaluating information from healthcare providers and patients on the adverse effects of medicines, biological products, herbals and traditional medicines, with the view to identifying new information about hazards, and preventing harm to patients.

**An ADR** is a response to a drug which is noxious and unintended, and which occurs at doses normally used in humans for the prophylaxis, diagnosis or therapy of disease, or for the modification of physiological function.

**Adverse event:** Any untoward medical occurrence that may present during treatment with a pharmaceutical product but which does not necessarily have a causal relationship with this treatment.
**Side effect:** Any unintended effect of a pharmaceutical product occurring at doses normally used in humans, which is related to the pharmacological properties of the drug.

**Counterfeits:** WHO defines a counterfeit pharmaceutical product as a product that is deliberately and fraudulently mislabelled with respect to identity and / or source.

**Ultimate goals of Pharmacovigilance are:**

- The rational and safe use of medicines
- The assessment and communication of the risks and benefits of drugs on the market
- Educating and informing patients

**Adverse experiences with medication**
Report ALL suspected adverse experiences with medications, especially those where the patient outcome is:

- Death
- Life-threatening (real risk of dying)
- Hospitalization (initial or prolonged)
- Disability (significant, persistent or permanent)
- Congenital anomaly
- Required intervention to prevent permanent impairment or damage

**Report and adverse experience even if:**

- You are not certain if the drug caused the reaction
- You do not have all the details

**Tools and information flow**
Reporting of ADRs is done using:

- Yellow form (PV 1) - form to capture all suspected adverse drug reactions
- White card (PV 4) - Alert card for life threatening drug reactions
- Pink form (PV 6) - form for reporting poor quality medicinal products

The pharmacovigilance tools for recording patient side effects are placed in the clinicians' rooms where patients are seen. Once a patient reports a side effect, this form is filled in duplicate. A copy is kept in the patient's file for reference in future and the other copy submitted to pharmacy for onward reporting to the Pharmacy and poisons board**.**
Feedback to all levels of the system is the responsibility of the Pharmacy and Poisons Board. This could take the form of:

- Recall – a withdrawal of affected product batches from the market
- Labelling change – inclusion of new information
- Reschedule – change of the regulatory class e.g. POM to OTC
- Withdrawal – removal of product from the market
- Policy change – e.g. change of use of SP from uncomplicated malaria to use in IPT prophylaxis

## Annex 1: Tuberculin Skin Test

A Tuberculin skin Test (TST) or Mantoux test is the intradermal injection of a combination of mycobacterial antigens which elicit an immune response

(delayed-type hypersensitivity), represented by in duration, which can be measured in millimetres. The TST using the Mantoux method is the standard method of identifying people infected with M. tuberculosis. Multiple puncture tests should not be used to determine whether a person is infected, as these tests are unreliable (because the amount of tuberculin injected intradermally cannot be precisely controlled).

Details of how to administer, read and interpret a TST are given below, using 5 tuberculin units (TU) of tuberculin PPD-S. An alternative to 5 TU of tuberculin PPD-S is 2 TU of tuberculin PPD RT23.

**Preparation**
When preparing to administer the Mantoux tuberculin skin test, make sure that the area for administering the test has a firm, well-lit surface, and that equipment and supplies are ready.

Supplies should include a vial of tuberculin, a single-dose disposable tuberculin syringe, one-quarter to one-half inch, 27-gauge needle with a short bevel, a ruler with millimetre (mm) measurements, 2x2 gauze pads or cotton balls, alcohol swabs, a puncture-resistant sharps disposal container, record-keeping forms for the patient and provider, and a pen.

To avoid reducing the potency of the tuberculin, store it inside a refrigerator so that it remains between 35 and 46 degrees Fahrenheit or between 2 and 8 degrees Centigrade.

Also store and transport the tuberculin in the dark as much as possible and avoid exposure to light.

Discuss with the patient why the skin test is given, what is involved in the procedure, and when the patient should return for the test to be read. If a patient can't return within the 72-hour period, do not administer the test. Instead, schedule another time that allows the patient to come for both the test and the return appointment.

It's also important to encourage the patient to ask questions and talk about any anxieties he or she may have about the test. That way you can answer any questions and ease any fears the patient may have. After providing patient education, you should wash your hands, using an appropriate hand-washing

technique, before administering the test or any other procedure involving patient contact.

**Administration**

1. **Locate and clean injection site 5–10cm(2–4inches) below elbow joint**

Place the forearm palm-side up on a firm, well-lit surface.
Select an area free of any barriers to placing and reading the skin test such as muscle margins, heavy hair, veins, sores, or scars.

Clean the area with an alcohol swab by circling from the centre of the site outward. Allow the site to dry completely before the injection. Because some of the tuberculin solution can adhere to the inside of the plastic syringe, the skin test should be given as soon as possible after the syringe is filled.

2. **Prepare syringe**

Look at the vial label to make sure the vial contains tuberculin PPD-S (5 TU per 0.1 ml) and expiration date.

When you open a new vial, write the date and your initials on the label to indicate when the vial was opened and who opened it.
Fill the syringe with 0.1 ml tuberculin.

3. **Inject tuberculin (see Figure 3)**

The Mantoux tuberculin skin test is an intradermal injection.
With the needle bevel against the patient's skin, insert it slowly at a 5 - 15 degree angle. The 5- 15 degree angle is very important because this layer of skin is very thin.

For an intradermal injection, the needle bevel is advanced through the epidermis, the superficial layer of skin, approximately 3 mm so that the entire bevel is covered and lies just under the skin. The injection will produce inadequate results if the needle angle is too deep or too shallow.
When the needle is inserted at the correct angle you can see the bevel of the needle just below the skin surface. Next, release the stretched skin and hold the syringe in place on the forearm.

Now, slowly inject the tuberculin solution. You should feel firm resistance

as the tuberculin enters the skin. A tense, pale wheal that's 6 to 10 mm in diameter appears over the needle bevel. Remove the needle without pressing or massaging the area.

Discard the used syringe immediately in the designated puncture-resistant container.

**4. Check injection site**

After injection, a flat intradermal wheal of 8–10 mm diameter should appear. If not, repeat the injection at a site at least 5 cm (2 inches) away from the original site.

In case a drop of blood appears at the injection site, lightly blot the blood away with a gauze pad or cotton ball.

Do not cover the site with an adhesive bandage because the adhesive could cause irritation and interfere with the test.

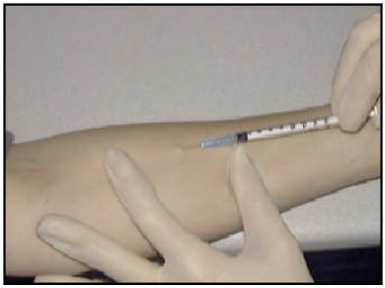
Immediately and thoroughly wash your hands.

**5. Record information**

Write the date and the time the test was administered, the name and manufacturer of the injected solution, the lot number, the tuberculin dose administered, the expiration date, the forearm or alternative site in which the injection was given, the site location if you repeat the test, the name of the person who administered the test, and the reason for giving the skin test.
**Remind the patient to return.**

Explain how to care for the injection site after the test. Tell the patient to avoid scratching the site, keep the site clean and dry, and avoid putting creams, lotions, or adhesive bandages on it. Also mention that getting the site wet with water is not harmful, but the site should not be wiped or scrubbed.
Return the tuberculin vial to the refrigerator, or other cooling container.

**Figure 13: Administration of the tuberculin skin test**



**Reading**

The results should be read 72 hours after administration. A patient who does not return within 72 hours will probably need to be rescheduled for another TST.

Have a small, plastic, flexible ruler marked in millimetres to measure the test, a pen to mark the edges of the induration, and an alcohol pad to clean off the pen marks. You'll need the patient's record or other appropriate forms for documenting the measurement results.

1. **Inspect site**

Visually inspect injection site under good light and on a firm surface.
Use fingertips to find the margins of in duration, which is a hard, dense, raised formation. This is the area that is measured. Sometimes the site has erythema, a reddening of the skin that can also have swelling. The erythema should NOT be measured.

Mark induration.

2. **Measure diameter of induration using a clear flexible ruler**

The diameter of the induration is measured across the forearm; from the thumb side of the arm to the little finger side of the arm or vice versa.

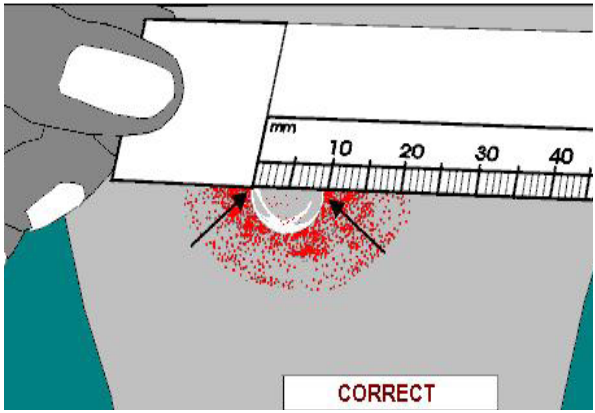
Place "0" of ruler line on the inside-left edge of the induration.

Read ruler line on the inside-right edge of the induration (use lower measurement if between two gradations on mm scale).

### 3. Record diameter of induration

Do not record as “positive” or “negative”. Only record the measurement in millimetres. If no induration, record as 0 mm.

**Figure 14: Reading the tuberculin skin test**




**Interpretation**

TST interpretation depends on two factors:

- Diameter of the induration.
- Person’s risk of being infected with TB and risk of progression to disease if infected.

Mantoux is positive if induration is:

- 10mm in a well-nourished, HIV negative child
- 5mm in a malnourished, or HIV infected child

A negative Mantoux does not rule out TB infection or disease (especially in the HIV positive or malnourished child).

## Annex 2: Steps for Patient Management to prevent transmission of TB in Community and health care settings

| Step | Action | Description |
|---|---|---|
| 1. | Screen | -Begins with early identification and detection of patients with suspected or confirmed TB disease<br><br>-Achieved by assigning a staff member in a health facility and trained community health workers to screen patients for cough and take immediate action<br><br>-Patients with cough or who report being under investigation or treatment for TB*, should not be allowed to wait in the line with other patients<br><br>-The patients under investigation and on TB treatment should be weighed in the treatment room and not referred to the MCH/FP (well baby clinic) where mothers and infant are waiting<br><br>-Likewise, patients with cough should immediately be referred to a health facility<br><br>-Carry out active contact tracing of bacteriologically confirmed PTB including MDR and XDR TB<br><br>-Actively track those lost to follow up and bring them back to treatment |
| 2. | Educate | -Educate the above-mentioned persons identified through screening on cough etiquette and respiratory hygiene<br><br>-Instruct them to cover their noses and mouths when coughing or sneezing<br><br>-When possible provide facemasks, handkerchiefs or tissues for covering their mouths |
| 3. | Triage | Patients in special groups (known HIV positive, the very young and old) should be given preference in care. Triaging symptomatic patients to the front of the line for the services should be done. In an integrated service delivery setting known HIV patients should be separated from smear positive TB patients. Known HIV positive clients in the community should frequently be monitored for TB and referred promptly. |
| 4. | Investigate for TB or<br><br>Refer | -TB diagnostic tests should be done on site or, if not available onsite, the facility should have an established link with aTB diagnostic and treatment site to which symptomatic patients can be referred. |
| 5. | Treatment | -Appropriate TB treatment should be initiated in accordance with National TB guidelines at the earliest time possible. Directly observed therapy (DOT) to ensure adherence to treatment. Follow-up and monitor patients in accordance with National TB guidelines.<br><br>-Conduct additional diagnostic procedures to ensure the appropriate treatment is given (both for TB treatments well as potential interactions with other medications such as ARVs). Document completion of treatment. |
| 6. | Discharge<br><br>Plan | -For inpatient and outpatient settings, coordinate a discharge plan with the patient (including a patient who is a HCW with TB disease) and the TB-control program of the local, district or provincial health facilities. If applicable, co-management of patients with HIV or other diseases should be coordinated with the applicable sub-county or County health facilities. For MDR-TB, identify trained HCW in referral sites who will be able to manage the patient according to the national multi-drug-resistant TB guidelines. |

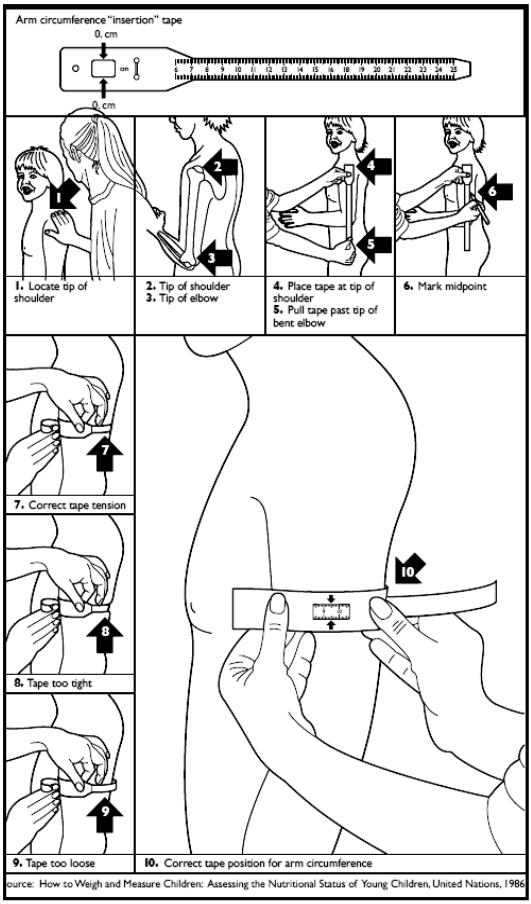
## Annex 3: Taking Anthropometric Measurements

### Taking a Child's Middle Upper Arm Circumference (MUAC)

MUAC is an alternative way to measure "thinness" (alternative to weight-for-height). It is especially used for children six months old to five years old.

***Figure 1.1: How to Measure MUAC***

- Ask the mother to remove any clothing covering the child's left arm.
- Calculate the midpoint of the child's left upper arm: first locate the tip of the child's shoulder (arrows 1 and 2 in diagram below) with your finger tips.
- Bend the child's elbow to make the right angle (arrow 3).
- Place the tape at zero, which is indicated by two arrows, on the tip of the shoulder (arrow 4) and pull the tape straight down past the tip of the elbow (arrow 5).
- Read the number at the tip of the elbow to the nearest centimetre. Divide this number by two to estimate the midpoint. As an alternative, bend the tape up to the middle length to estimate the midpoint. A piece of string can also be used for this purpose; it is more convenient and avoids damage to the tape.
- Mark the midpoint with a pen on the arm (arrow 6).
- Straighten the child's arm and wrap the tape around the arm at the midpoint. Make sure the numbers are right side up. Make sure the tape is flat around the skin (arrow 7).
- Inspect the tension of the tape on the child's arm. Make sure the tape has the proper tension (arrow 7) and is not too tight or too loose (arrows 8 and 9). Repeat any step as necessary
- When the tape is in the correct position on the arm with correct tension, read and call out the measurement to the nearest 0.1cm (arrow 10).
- Immediately record the measurement.



## Taking a Child's Weight

Children are weighed with a 25 kg hanging sprint scale, graduated to 0.100 kg. Do not forget to re-adjust the scale to zero before each weighing.

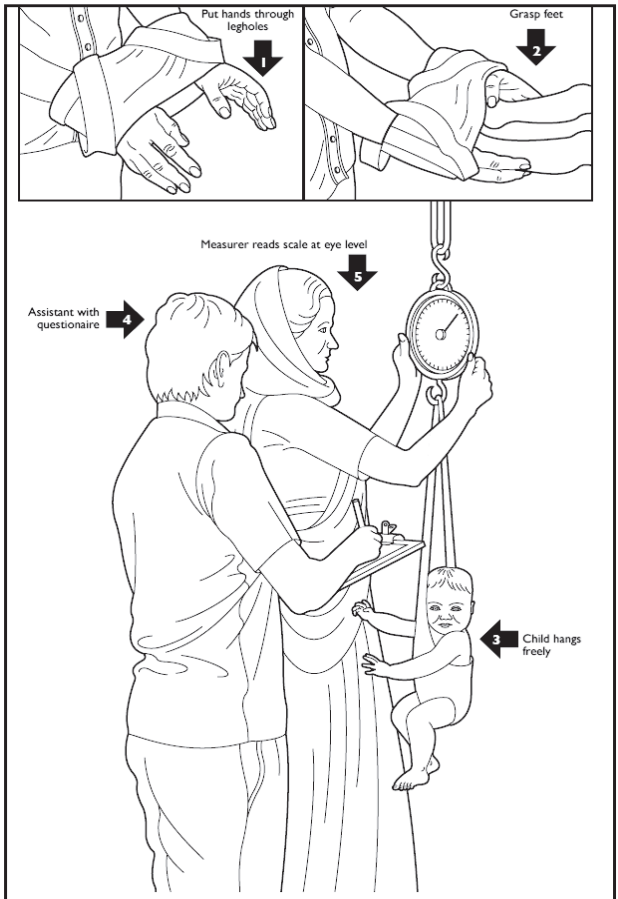
A plastic wash basin should be supported by four ropes that attach (are knotted) underneath the basin. The basin is close to the ground in case the child falls out and to make the child feel secure during weighing. If the basin is soiled, first clean it with disinfectant. The basin is more comfortable and familiar for the child, can be used for ill children, and is easily cleaned. In the absence of a basin, weighing pants can be used although are sometimes inappropriate for very sick children. When the pant is soiled, it can be cleaned and disinfected to reduce the risk to pass an infection to the next patient.

When the child is steady in the basin or pant, record the measurement to the nearest 100 grams, recording with the frame of the scale at eye level. The scales must be checked for accuracy by using a known weight on a regular basis, i.e. weekly.

***Figure 1.2: Taking a child's weight***

Instructions on Taking the Weight

1. Before weighing the child, take all his/her clothes off
2. Zero the weighing scale (i.e. make sure the arrow is on 0)
3. Ensure that the weighing scale is at eye level
4. Place the child in the weighing pans
5. Make sure the child is not holding onto anything
6. Read the child's weight. The arrow must be steady.
7. Record the weight in kg to the nearest 100g e.g. 6.6 kg
8. Do not hold the scale when reading the weight




Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

***Figure 1.3: Taking a child's length***

For children less than 87 cm the measuring board is placed on the ground.

1. The child is placed lying down along the middle of the board.
2. The assistant holds the sides of the child's head and positions the head until it firmly touches the fixed headboard with the hair compressed.
3. The measurer places her hands on the child's legs, gently stretches the child and then keeps one hand on the thighs to prevent flexion.
4. While positioning the child's legs, the sliding foot-plate is pushed firmly against the bottom of the child's feet.
5. To read the height measurement, the foot-plate must be perpendicular to the axis of the board and vertical.
6. The height is read to the nearest 0.1cm

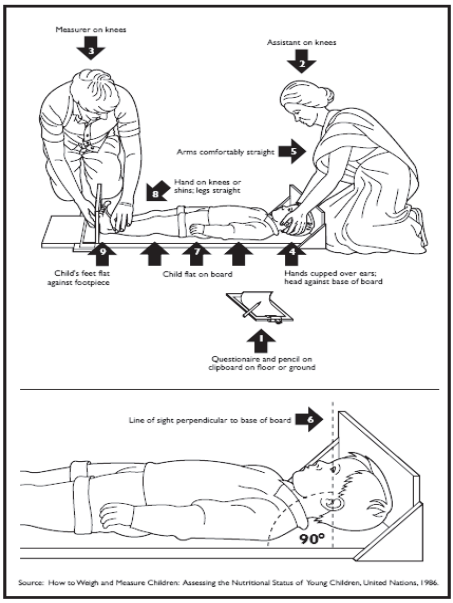
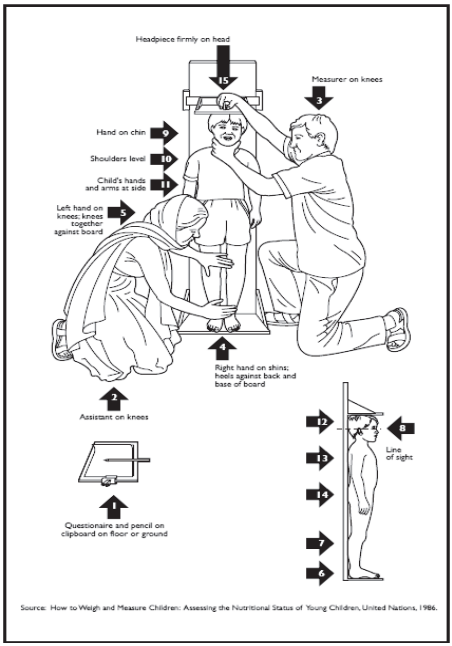



***Figure 1.4: Taking a child's height***

For children taller than 87 cm the measuring board is fixed upright on level ground.

1. The child stands, upright against the middle of the measuring board.
2. The child's head, shoulders, buttocks, knees, and heels are held against the board by the assistant.
3. The measurer positions the head and the cursor.
4. The height is read to the nearest 0.1 cm
5. Measurement is recorded immediately



## Annex 4: Growth monitoring charts

For children 0-59 months of age, age, weight and height/ length is taken and Z –Scores documented as per the reference charts. For children 5-17 years old, age, weight and height are used to assess the BMI for age.

**Instructions for using the Z-score chart**

**Always ensure the child is less than 5 years when using these charts.**

**Step 1: Measurement**
First determine the age of the child in “years” and “months”.
For infants and children less than 2 years or if under 87cm, measure the length in “cm” while lying down (supine.) Children over 2 years or above 87cm, measure height in “cm” while standing. Measure the weight in “kg” and record in the patient record card.

**Step 2: Read the chart**
Confirm if the child’s age corresponds to the chart for 0-2 years or 2-5 years and identify the correct chart.
Identify the length/height column on the chart.

- **a)** Find where the measured length/height of the child is on the chart and place your finger on this cell.
- **b)** Move along the row where height was identified and identify the cell with weight that is equal to or less than the actual recorded weight of the child.

**Step 3: Classification**
Classify and report the child’s weight for height Z score corresponding to the identified weight from the SD rows at the top of the chart.

**Step 4: Intervention**
All children with a Z-score of -2SD and below are eligible for Food by Prescription.

**Weight-for-length BOYS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 45.0 | 1.9 | 2.0 | 2.2 | 2.4 | 2.7 | 3.0 | 3.3 |
| 45.5 | 1.9 | 2.1 | 2.3 | 2.5 | 2.8 | 3.1 | 3.4 |
| 46.0 | 2.0 | 2.2 | 2.4 | 2.6 | 2.9 | 3.1 | 3.5 |
| 46.5 | 2.1 | 2.3 | 2.5 | 2.7 | 3.0 | 3.2 | 3.6 |
| 47.0 | 2.1 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.7 |
| 47.5 | 2.2 | 2.4 | 2.6 | 2.9 | 3.1 | 3.4 | 3.8 |
| 48.0 | 2.3 | 2.5 | 2.7 | 2.9 | 3.2 | 3.6 | 3.9 |
| 48.5 | 2.3 | 2.6 | 2.8 | 3.0 | 3.3 | 3.7 | 4.0 |
| 49.0 | 2.4 | 2.6 | 2.9 | 3.1 | 3.4 | 3.8 | 4.2 |
| 49.5 | 2.5 | 2.7 | 3.0 | 3.2 | 3.5 | 3.9 | 4.3 |
| 50.0 | 2.6 | 2.8 | 3.0 | 3.3 | 3.6 | 4.0 | 4.4 |
| 50.5 | 2.7 | 2.9 | 3.1 | 3.4 | 3.8 | 4.1 | 4.5 |
| 51.0 | 2.7 | 3.0 | 3.2 | 3.5 | 3.9 | 4.2 | 4.7 |
| 51.5 | 2.8 | 3.1 | 3.3 | 3.6 | 4.0 | 4.4 | 4.8 |
| 52.0 | 2.9 | 3.2 | 3.5 | 3.8 | 4.1 | 4.5 | 5.0 |
| 52.5 | 3.0 | 3.3 | 3.6 | 3.9 | 4.2 | 4.6 | 5.1 |
| 53.0 | 3.1 | 3.4 | 3.7 | 4.0 | 4.4 | 4.8 | 5.3 |
| 53.5 | 3.2 | 3.5 | 3.8 | 4.1 | 4.5 | 4.9 | 5.4 |
| 54.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.7 | 5.1 | 5.6 |
| 54.5 | 3.4 | 3.7 | 4.0 | 4.4 | 4.8 | 5.3 | 5.8 |
| 55.0 | 3.6 | 3.8 | 4.2 | 4.5 | 5.0 | 5.4 | 6.0 |
| 55.5 | 3.7 | 4.0 | 4.3 | 4.7 | 5.1 | 5.6 | 6.1 |
| 56.0 | 3.8 | 4.1 | 4.4 | 4.8 | 5.3 | 5.8 | 6.3 |
| 56.5 | 3.9 | 4.2 | 4.6 | 5.0 | 5.4 | 5.9 | 6.5 |
| 57.0 | 4.0 | 4.3 | 4.7 | 5.1 | 5.6 | 6.1 | 6.7 |
| 57.5 | 4.1 | 4.5 | 4.9 | 5.3 | 5.7 | 6.3 | 6.9 |
| 58.0 | 4.3 | 4.6 | 5.0 | 5.4 | 5.9 | 6.4 | 7.1 |
| 58.5 | 4.4 | 4.7 | 5.1 | 5.6 | 6.1 | 6.6 | 7.2 |
| 59.0 | 4.5 | 4.8 | 5.3 | 5.7 | 6.2 | 6.8 | 7.4 |
| 59.5 | 4.6 | 5.0 | 5.4 | 5.9 | 6.4 | 7.0 | 7.6 |
| 60.0 | 4.7 | 5.1 | 5.5 | 6.0 | 6.5 | 7.1 | 7.8 |
| 60.5 | 4.8 | 5.2 | 5.6 | 6.1 | 6.7 | 7.3 | 8.0 |
| 61.0 | 4.9 | 5.3 | 5.8 | 6.3 | 6.8 | 7.4 | 8.1 |
| 61.5 | 5.0 | 5.4 | 5.9 | 6.4 | 7.0 | 7.6 | 8.3 |
| 62.0 | 5.1 | 5.6 | 6.0 | 6.5 | 7.1 | 7.7 | 8.5 |
| 62.5 | 5.2 | 5.7 | 6.1 | 6.7 | 7.2 | 7.9 | 8.6 |
| 63.0 | 5.3 | 5.8 | 6.2 | 6.8 | 7.4 | 8.0 | 8.8 |
| 63.5 | 5.4 | 5.9 | 6.4 | 6.9 | 7.5 | 8.2 | 8.9 |
| 64.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.6 | 8.3 | 9.1 |
| 64.5 | 5.6 | 6.1 | 6.6 | 7.1 | 7.8 | 8.5 | 9.3 |
| 65.0 | 5.7 | 6.2 | 6.7 | 7.3 | 7.9 | 8.6 | 9.4 |
| 65.5 | 5.8 | 6.3 | 6.8 | 7.4 | 8.0 | 8.7 | 9.6 |
| 66.0 | 5.9 | 6.4 | 6.9 | 7.5 | 8.2 | 8.9 | 9.7 |
| 66.5 | 6.0 | 6.5 | 7.0 | 7.6 | 8.3 | 9.0 | 9.9 |
| 67.0 | 6.1 | 6.6 | 7.1 | 7.7 | 8.4 | 9.2 | 10.0 |
| 67.5 | 6.2 | 6.7 | 7.2 | 7.9 | 8.5 | 9.3 | 10.2 |
| 68.0 | 6.3 | 6.8 | 7.3 | 8.0 | 8.7 | 9.4 | 10.3 |
| 68.5 | 6.4 | 6.9 | 7.5 | 8.1 | 8.8 | 9.6 | 10.5 |
| 69.0 | 6.5 | 7.0 | 7.6 | 8.2 | 8.9 | 9.7 | 10.6 |
| 69.5 | 6.6 | 7.1 | 7.7 | 8.3 | 9.0 | 9.8 | 10.8 |
| 70.0 | 6.6 | 7.2 | 7.8 | 8.4 | 9.2 | 10.0 | 10.9 |
| 70.5 | 6.7 | 7.3 | 7.9 | 8.5 | 9.3 | 10.1 | 11.1 |
| 71.0 | 6.8 | 7.4 | 8.0 | 8.6 | 9.4 | 10.2 | 11.2 |
| 71.5 | 6.9 | 7.5 | 8.1 | 8.8 | 9.5 | 10.4 | 11.3 |
| 72.0 | 7.0 | 7.6 | 8.2 | 8.9 | 9.6 | 10.5 | 11.5 |
| 72.5 | 7.1 | 7.6 | 8.3 | 9.0 | 9.8 | 10.6 | 11.6 |
| 73.0 | 7.2 | 7.7 | 8.4 | 9.1 | 9.9 | 10.8 | 11.8 |
| 73.5 | 7.2 | 7.8 | 8.5 | 9.2 | 10.0 | 10.9 | 11.9 |
| 74.0 | 7.3 | 7.9 | 8.6 | 9.3 | 10.1 | 11.0 | 12.1 |
| 74.5 | 7.4 | 8.0 | 8.7 | 9.4 | 10.2 | 11.2 | 12.2 |
| 75.0 | 7.5 | 8.1 | 8.8 | 9.5 | 10.3 | 11.3 | 12.3 |

**Weight-for-length BOYS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 75.5 | 7.6 | 8.2 | 8.8 | 9.6 | 10.4 | 11.4 | 12.5 |
| 76.0 | 7.6 | 8.3 | 8.9 | 9.7 | 10.6 | 11.5 | 12.6 |
| 76.5 | 7.7 | 8.3 | 9.0 | 9.8 | 10.7 | 11.6 | 12.7 |
| 77.0 | 7.8 | 8.4 | 9.1 | 9.9 | 10.8 | 11.7 | 12.8 |
| 77.5 | 7.9 | 8.5 | 9.2 | 10.0 | 10.9 | 11.9 | 13.0 |
| 78.0 | 7.9 | 8.6 | 9.3 | 10.1 | 11.0 | 12.0 | 13.1 |
| 78.5 | 8.0 | 8.7 | 9.4 | 10.2 | 11.1 | 12.1 | 13.2 |
| 79.0 | 8.1 | 8.7 | 9.5 | 10.3 | 11.2 | 12.2 | 13.3 |
| 79.5 | 8.2 | 8.8 | 9.5 | 10.4 | 11.3 | 12.3 | 13.4 |
| 80.0 | 8.2 | 8.9 | 9.6 | 10.4 | 11.4 | 12.4 | 13.6 |
| 80.5 | 8.3 | 9.0 | 9.7 | 10.5 | 11.5 | 12.5 | 13.7 |
| 81.0 | 8.4 | 9.1 | 9.8 | 10.6 | 11.6 | 12.6 | 13.8 |
| 81.5 | 8.5 | 9.1 | 9.9 | 10.7 | 11.7 | 12.7 | 13.9 |
| 82.0 | 8.5 | 9.2 | 10.0 | 10.8 | 11.8 | 12.8 | 14.0 |
| 82.5 | 8.6 | 9.3 | 10.1 | 10.9 | 11.9 | 13.0 | 14.2 |
| 83.0 | 8.7 | 9.4 | 10.2 | 11.0 | 12.0 | 13.1 | 14.3 |
| 83.5 | 8.8 | 9.5 | 10.3 | 11.2 | 12.1 | 13.2 | 14.4 |
| 84.0 | 8.9 | 9.6 | 10.4 | 11.3 | 12.2 | 13.3 | 14.6 |
| 84.5 | 9.0 | 9.7 | 10.5 | 11.4 | 12.4 | 13.5 | 14.7 |
| 85.0 | 9.1 | 9.8 | 10.6 | 11.5 | 12.5 | 13.6 | 14.9 |
| 85.5 | 9.2 | 9.9 | 10.7 | 11.6 | 12.6 | 13.7 | 15.0 |
| 86.0 | 9.3 | 10.0 | 10.8 | 11.7 | 12.8 | 13.9 | 15.2 |
| 86.5 | 9.4 | 10.1 | 11.0 | 11.9 | 12.9 | 14.0 | 15.3 |
| 87.0 | 9.5 | 10.2 | 11.1 | 12.0 | 13.0 | 14.2 | 15.5 |
| 87.5 | 9.6 | 10.4 | 11.2 | 12.1 | 13.2 | 14.3 | 15.6 |
| 88.0 | 9.7 | 10.5 | 11.3 | 12.2 | 13.3 | 14.5 | 15.8 |
| 88.5 | 9.8 | 10.6 | 11.4 | 12.4 | 13.4 | 14.6 | 15.9 |
| 89.0 | 9.9 | 10.7 | 11.5 | 12.5 | 13.5 | 14.7 | 16.1 |
| 89.5 | 10.0 | 10.8 | 11.6 | 12.6 | 13.7 | 14.9 | 16.2 |
| 90.0 | 10.1 | 10.9 | 11.8 | 12.7 | 13.8 | 15.0 | 16.4 |
| 90.5 | 10.2 | 11.0 | 11.9 | 12.8 | 13.9 | 15.1 | 16.5 |
| 91.0 | 10.3 | 11.1 | 12.0 | 13.0 | 14.1 | 15.3 | 16.7 |
| 91.5 | 10.4 | 11.2 | 12.1 | 13.1 | 14.2 | 15.4 | 16.8 |
| 92.0 | 10.5 | 11.3 | 12.2 | 13.2 | 14.3 | 15.6 | 17.0 |
| 92.5 | 10.6 | 11.4 | 12.3 | 13.3 | 14.4 | 15.7 | 17.1 |
| 93.0 | 10.7 | 11.5 | 12.4 | 13.4 | 14.6 | 15.8 | 17.3 |
| 93.5 | 10.7 | 11.6 | 12.5 | 13.5 | 14.7 | 16.0 | 17.4 |
| 94.0 | 10.8 | 11.7 | 12.6 | 13.7 | 14.8 | 16.1 | 17.6 |
| 94.5 | 10.9 | 11.8 | 12.7 | 13.8 | 14.9 | 16.3 | 17.7 |
| 95.0 | 11.0 | 11.9 | 12.8 | 13.9 | 15.1 | 16.4 | 17.9 |
| 95.5 | 11.1 | 12.0 | 12.9 | 14.0 | 15.2 | 16.5 | 18.0 |
| 96.0 | 11.2 | 12.1 | 13.1 | 14.1 | 15.3 | 16.7 | 18.2 |
| 96.5 | 11.3 | 12.2 | 13.2 | 14.3 | 15.5 | 16.8 | 18.4 |
| 97.0 | 11.4 | 12.3 | 13.3 | 14.4 | 15.6 | 17.0 | 18.5 |
| 97.5 | 11.5 | 12.4 | 13.4 | 14.5 | 15.7 | 17.1 | 18.7 |
| 98.0 | 11.6 | 12.5 | 13.5 | 14.6 | 15.9 | 17.3 | 18.9 |
| 98.5 | 11.7 | 12.6 | 13.6 | 14.8 | 16.0 | 17.5 | 19.1 |
| 99.0 | 11.8 | 12.7 | 13.7 | 14.9 | 16.2 | 17.6 | 19.2 |
| 99.5 | 11.9 | 12.8 | 13.9 | 15.0 | 16.3 | 17.8 | 19.4 |
| 100.0 | 12.0 | 12.9 | 14.0 | 15.2 | 16.5 | 18.0 | 19.6 |
| 100.5 | 12.1 | 13.0 | 14.1 | 15.3 | 16.6 | 18.1 | 19.8 |
| 101.0 | 12.2 | 13.2 | 14.2 | 15.4 | 16.8 | 18.3 | 20.0 |
| 101.5 | 12.3 | 13.3 | 14.4 | 15.6 | 16.9 | 18.5 | 20.2 |
| 102.0 | 12.4 | 13.4 | 14.5 | 15.7 | 17.1 | 18.7 | 20.4 |
| 102.5 | 12.5 | 13.5 | 14.6 | 15.9 | 17.3 | 18.8 | 20.6 |
| 103.0 | 12.6 | 13.6 | 14.8 | 16.0 | 17.4 | 19.0 | 20.8 |
| 103.5 | 12.7 | 13.7 | 14.9 | 16.2 | 17.6 | 19.2 | 21.0 |
| 104.0 | 12.8 | 13.9 | 15.0 | 16.3 | 17.8 | 19.4 | 21.2 |
| 104.5 | 12.9 | 14.0 | 15.2 | 16.5 | 17.9 | 19.6 | 21.5 |
| 105.0 | 13.0 | 14.1 | 15.3 | 16.6 | 18.1 | 19.8 | 21.7 |
| 105.5 | 13.2 | 14.2 | 15.4 | 16.8 | 18.3 | 20.0 | 21.9 |
| 106.0 | 13.3 | 14.4 | 15.6 | 16.9 | 18.5 | 20.2 | 22.1 |

**Weight-for-length BOYS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 106.5 | 13.4 | 14.5 | 15.7 | 17.1 | 18.6 | 20.4 | 22.4 |
| 107.0 | 13.5 | 14.6 | 15.9 | 17.3 | 18.8 | 20.6 | 22.6 |
| 107.5 | 13.6 | 14.7 | 16.0 | 17.4 | 19.0 | 20.8 | 22.8 |
| 108.0 | 13.7 | 14.9 | 16.2 | 17.6 | 19.2 | 21.0 | 23.1 |
| 108.5 | 13.8 | 15.0 | 16.3 | 17.8 | 19.4 | 21.2 | 23.3 |
| 109.0 | 14.0 | 15.1 | 16.5 | 17.9 | 19.6 | 21.4 | 23.6 |
| 109.5 | 14.1 | 15.3 | 16.6 | 18.1 | 19.8 | 21.7 | 23.8 |
| 110.0 | 14.2 | 15.4 | 16.8 | 18.3 | 20.0 | 21.9 | 24.1 |

**WHO Child Growth Standards**

**Weight-for-height BOYS**
**2 to 5 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 65.0 | 5.9 | 6.3 | 6.9 | 7.4 | 8.1 | 8.8 | 9.6 |
| 65.5 | 6.0 | 6.4 | 7.0 | 7.6 | 8.2 | 8.9 | 9.8 |
| 66.0 | 6.1 | 6.5 | 7.1 | 7.7 | 8.3 | 9.1 | 9.9 |
| 66.5 | 6.1 | 6.6 | 7.2 | 7.8 | 8.5 | 9.2 | 10.1 |
| 67.0 | 6.2 | 6.7 | 7.3 | 7.9 | 8.6 | 9.4 | 10.2 |
| 67.5 | 6.3 | 6.8 | 7.4 | 8.0 | 8.7 | 9.5 | 10.4 |
| 68.0 | 6.4 | 6.9 | 7.5 | 8.1 | 8.8 | 9.6 | 10.5 |
| 68.5 | 6.5 | 7.0 | 7.6 | 8.2 | 9.0 | 9.8 | 10.7 |
| 69.0 | 6.6 | 7.1 | 7.7 | 8.4 | 9.1 | 9.9 | 10.8 |
| 69.5 | 6.7 | 7.2 | 7.8 | 8.5 | 9.2 | 10.0 | 11.0 |
| 70.0 | 6.8 | 7.3 | 7.9 | 8.6 | 9.3 | 10.2 | 11.1 |
| 70.5 | 6.9 | 7.4 | 8.0 | 8.7 | 9.5 | 10.3 | 11.3 |
| 71.0 | 6.9 | 7.5 | 8.1 | 8.8 | 9.6 | 10.4 | 11.4 |
| 71.5 | 7.0 | 7.6 | 8.2 | 8.9 | 9.7 | 10.6 | 11.6 |
| 72.0 | 7.1 | 7.7 | 8.3 | 9.0 | 9.8 | 10.7 | 11.7 |
| 72.5 | 7.2 | 7.8 | 8.4 | 9.1 | 9.9 | 10.8 | 11.8 |
| 73.0 | 7.3 | 7.9 | 8.5 | 9.2 | 10.0 | 11.0 | 12.0 |
| 73.5 | 7.4 | 7.9 | 8.6 | 9.3 | 10.2 | 11.1 | 12.1 |
| 74.0 | 7.4 | 8.0 | 8.7 | 9.4 | 10.3 | 11.2 | 12.2 |
| 74.5 | 7.5 | 8.1 | 8.8 | 9.5 | 10.4 | 11.3 | 12.4 |
| 75.0 | 7.6 | 8.2 | 8.9 | 9.6 | 10.5 | 11.4 | 12.5 |
| 75.5 | 7.7 | 8.3 | 9.0 | 9.7 | 10.6 | 11.6 | 12.6 |
| 76.0 | 7.7 | 8.4 | 9.1 | 9.8 | 10.7 | 11.7 | 12.8 |
| 76.5 | 7.8 | 8.5 | 9.2 | 9.9 | 10.8 | 11.8 | 12.9 |
| 77.0 | 7.9 | 8.5 | 9.2 | 10.0 | 10.9 | 11.9 | 13.0 |
| 77.5 | 8.0 | 8.6 | 9.3 | 10.1 | 11.0 | 12.0 | 13.1 |
| 78.0 | 8.0 | 8.7 | 9.4 | 10.2 | 11.1 | 12.1 | 13.3 |
| 78.5 | 8.1 | 8.8 | 9.5 | 10.3 | 11.2 | 12.2 | 13.4 |
| 79.0 | 8.2 | 8.8 | 9.6 | 10.4 | 11.3 | 12.3 | 13.5 |
| 79.5 | 8.3 | 8.9 | 9.7 | 10.5 | 11.4 | 12.4 | 13.6 |
| 80.0 | 8.3 | 9.0 | 9.7 | 10.6 | 11.5 | 12.6 | 13.7 |
| 80.5 | 8.4 | 9.1 | 9.8 | 10.7 | 11.6 | 12.7 | 13.8 |
| 81.0 | 8.5 | 9.2 | 9.9 | 10.8 | 11.7 | 12.8 | 14.0 |
| 81.5 | 8.6 | 9.3 | 10.0 | 10.9 | 11.8 | 12.9 | 14.1 |
| 82.0 | 8.7 | 9.3 | 10.1 | 11.0 | 11.9 | 13.0 | 14.2 |
| 82.5 | 8.7 | 9.4 | 10.2 | 11.1 | 12.1 | 13.1 | 14.4 |
| 83.0 | 8.8 | 9.5 | 10.3 | 11.2 | 12.2 | 13.3 | 14.5 |
| 83.5 | 8.9 | 9.6 | 10.4 | 11.3 | 12.3 | 13.4 | 14.6 |
| 84.0 | 9.0 | 9.7 | 10.5 | 11.4 | 12.4 | 13.5 | 14.8 |
| 84.5 | 9.1 | 9.9 | 10.7 | 11.5 | 12.5 | 13.7 | 14.9 |
| 85.0 | 9.2 | 10.0 | 10.8 | 11.7 | 12.7 | 13.8 | 15.1 |
| 85.5 | 9.3 | 10.1 | 10.9 | 11.8 | 12.8 | 13.9 | 15.2 |
| 86.0 | 9.4 | 10.2 | 11.0 | 11.9 | 12.9 | 14.1 | 15.4 |
| 86.5 | 9.5 | 10.3 | 11.1 | 12.0 | 13.1 | 14.2 | 15.5 |
| 87.0 | 9.6 | 10.4 | 11.2 | 12.2 | 13.2 | 14.4 | 15.7 |
| 87.5 | 9.7 | 10.5 | 11.3 | 12.3 | 13.3 | 14.5 | 15.8 |
| 88.0 | 9.8 | 10.6 | 11.5 | 12.4 | 13.5 | 14.7 | 16.0 |
| 88.5 | 9.9 | 10.7 | 11.6 | 12.5 | 13.6 | 14.8 | 16.1 |
| 89.0 | 10.0 | 10.8 | 11.7 | 12.6 | 13.7 | 14.9 | 16.3 |
| 89.5 | 10.1 | 10.9 | 11.8 | 12.8 | 13.9 | 15.1 | 16.4 |
| 90.0 | 10.2 | 11.0 | 11.9 | 12.9 | 14.0 | 15.2 | 16.6 |
| 90.5 | 10.3 | 11.1 | 12.0 | 13.0 | 14.1 | 15.3 | 16.7 |
| 91.0 | 10.4 | 11.2 | 12.1 | 13.1 | 14.2 | 15.5 | 16.9 |
| 91.5 | 10.5 | 11.3 | 12.2 | 13.2 | 14.4 | 15.6 | 17.0 |
| 92.0 | 10.6 | 11.4 | 12.3 | 13.4 | 14.5 | 15.8 | 17.2 |
| 92.5 | 10.7 | 11.5 | 12.4 | 13.5 | 14.6 | 15.9 | 17.3 |
| 93.0 | 10.8 | 11.6 | 12.6 | 13.6 | 14.7 | 16.0 | 17.5 |
| 93.5 | 10.9 | 11.7 | 12.7 | 13.7 | 14.9 | 16.2 | 17.6 |
| 94.0 | 11.0 | 11.8 | 12.8 | 13.8 | 15.0 | 16.3 | 17.8 |
| 94.5 | 11.1 | 11.9 | 12.9 | 13.9 | 15.1 | 16.5 | 17.9 |
| 95.0 | 11.1 | 12.0 | 13.0 | 14.1 | 15.3 | 16.6 | 18.1 |

**Weight-for-height BOYS**
**2 to 5 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 95.5 | 11.2 | 12.1 | 13.1 | 14.2 | 15.4 | 16.7 | 18.3 |
| 96.0 | 11.3 | 12.2 | 13.2 | 14.3 | 15.5 | 16.9 | 18.4 |
| 96.5 | 11.4 | 12.3 | 13.3 | 14.4 | 15.7 | 17.0 | 18.6 |
| 97.0 | 11.5 | 12.4 | 13.4 | 14.6 | 15.8 | 17.2 | 18.8 |
| 97.5 | 11.6 | 12.5 | 13.6 | 14.7 | 15.9 | 17.4 | 18.9 |
| 98.0 | 11.7 | 12.6 | 13.7 | 14.8 | 16.1 | 17.5 | 19.1 |
| 98.5 | 11.8 | 12.8 | 13.8 | 14.9 | 16.2 | 17.7 | 19.3 |
| 99.0 | 11.9 | 12.9 | 13.9 | 15.1 | 16.4 | 17.9 | 19.5 |
| 99.5 | 12.0 | 13.0 | 14.0 | 15.2 | 16.5 | 18.0 | 19.7 |
| 100.0 | 12.1 | 13.1 | 14.2 | 15.4 | 16.7 | 18.2 | 19.9 |
| 100.5 | 12.2 | 13.2 | 14.3 | 15.5 | 16.9 | 18.4 | 20.1 |
| 101.0 | 12.3 | 13.3 | 14.4 | 15.6 | 17.0 | 18.5 | 20.3 |
| 101.5 | 12.4 | 13.4 | 14.5 | 15.8 | 17.2 | 18.7 | 20.5 |
| 102.0 | 12.5 | 13.6 | 14.7 | 15.9 | 17.3 | 18.9 | 20.7 |
| 102.5 | 12.6 | 13.7 | 14.8 | 16.1 | 17.5 | 19.1 | 20.9 |
| 103.0 | 12.8 | 13.8 | 14.9 | 16.2 | 17.7 | 19.3 | 21.1 |
| 103.5 | 12.9 | 13.9 | 15.1 | 16.4 | 17.8 | 19.5 | 21.3 |
| 104.0 | 13.0 | 14.0 | 15.2 | 16.5 | 18.0 | 19.7 | 21.6 |
| 104.5 | 13.1 | 14.2 | 15.4 | 16.7 | 18.2 | 19.9 | 21.8 |
| 105.0 | 13.2 | 14.3 | 15.5 | 16.8 | 18.4 | 20.1 | 22.0 |
| 105.5 | 13.3 | 14.4 | 15.6 | 17.0 | 18.5 | 20.3 | 22.2 |
| 106.0 | 13.4 | 14.5 | 15.8 | 17.2 | 18.7 | 20.5 | 22.5 |
| 106.5 | 13.5 | 14.7 | 15.9 | 17.3 | 18.9 | 20.7 | 22.7 |
| 107.0 | 13.7 | 14.8 | 16.1 | 17.5 | 19.1 | 20.9 | 22.9 |
| 107.5 | 13.8 | 14.9 | 16.2 | 17.7 | 19.3 | 21.1 | 23.2 |
| 108.0 | 13.9 | 15.1 | 16.4 | 17.8 | 19.5 | 21.3 | 23.4 |
| 108.5 | 14.0 | 15.2 | 16.5 | 18.0 | 19.7 | 21.5 | 23.7 |
| 109.0 | 14.1 | 15.3 | 16.7 | 18.2 | 19.8 | 21.8 | 23.9 |
| 109.5 | 14.3 | 15.5 | 16.8 | 18.3 | 20.0 | 22.0 | 24.2 |
| 110.0 | 14.4 | 15.6 | 17.0 | 18.5 | 20.2 | 22.2 | 24.4 |
| 110.5 | 14.5 | 15.8 | 17.1 | 18.7 | 20.4 | 22.4 | 24.7 |
| 111.0 | 14.6 | 15.9 | 17.3 | 18.9 | 20.7 | 22.7 | 25.0 |
| 111.5 | 14.8 | 16.0 | 17.5 | 19.1 | 20.9 | 22.9 | 25.2 |
| 112.0 | 14.9 | 16.2 | 17.6 | 19.2 | 21.1 | 23.1 | 25.5 |
| 112.5 | 15.0 | 16.3 | 17.8 | 19.4 | 21.3 | 23.4 | 25.8 |
| 113.0 | 15.2 | 16.5 | 18.0 | 19.6 | 21.5 | 23.6 | 26.0 |
| 113.5 | 15.3 | 16.6 | 18.1 | 19.8 | 21.7 | 23.9 | 26.3 |
| 114.0 | 15.4 | 16.8 | 18.3 | 20.0 | 21.9 | 24.1 | 26.6 |
| 114.5 | 15.6 | 16.9 | 18.5 | 20.2 | 22.1 | 24.4 | 26.9 |
| 115.0 | 15.7 | 17.1 | 18.6 | 20.4 | 22.4 | 24.6 | 27.2 |
| 115.5 | 15.8 | 17.2 | 18.8 | 20.6 | 22.6 | 24.9 | 27.5 |
| 116.0 | 16.0 | 17.4 | 19.0 | 20.8 | 22.8 | 25.1 | 27.8 |
| 116.5 | 16.1 | 17.5 | 19.2 | 21.0 | 23.0 | 25.4 | 28.0 |
| 117.0 | 16.2 | 17.7 | 19.3 | 21.2 | 23.3 | 25.6 | 28.3 |
| 117.5 | 16.4 | 17.9 | 19.5 | 21.4 | 23.5 | 25.9 | 28.6 |
| 118.0 | 16.5 | 18.0 | 19.7 | 21.6 | 23.7 | 26.1 | 28.9 |
| 118.5 | 16.7 | 18.2 | 19.9 | 21.8 | 23.9 | 26.4 | 29.2 |
| 119.0 | 16.8 | 18.3 | 20.0 | 22.0 | 24.1 | 26.6 | 29.5 |
| 119.5 | 16.9 | 18.5 | 20.2 | 22.2 | 24.4 | 26.9 | 29.8 |
| 120.0 | 17.1 | 18.6 | 20.4 | 22.4 | 24.6 | 27.2 | 30.1 |

**WHO Child Growth Standards**

**Weight-for-length GIRLS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 45.0 | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 | 3.0 | 3.3 |
| 45.5 | 2.0 | 2.1 | 2.3 | 2.5 | 2.8 | 3.1 | 3.4 |
| 46.0 | 2.0 | 2.2 | 2.4 | 2.6 | 2.9 | 3.2 | 3.5 |
| 46.5 | 2.1 | 2.3 | 2.5 | 2.7 | 3.0 | 3.3 | 3.6 |
| 47.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.1 | 3.4 | 3.7 |
| 47.5 | 2.2 | 2.4 | 2.6 | 2.9 | 3.2 | 3.5 | 3.8 |
| 48.0 | 2.3 | 2.5 | 2.7 | 3.0 | 3.3 | 3.6 | 4.0 |
| 48.5 | 2.4 | 2.6 | 2.8 | 3.1 | 3.4 | 3.7 | 4.1 |
| 49.0 | 2.4 | 2.6 | 2.9 | 3.2 | 3.5 | 3.8 | 4.2 |
| 49.5 | 2.5 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | 4.3 |
| 50.0 | 2.6 | 2.8 | 3.1 | 3.4 | 3.7 | 4.0 | 4.5 |
| 50.5 | 2.7 | 2.9 | 3.2 | 3.5 | 3.8 | 4.2 | 4.6 |
| 51.0 | 2.8 | 3.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.8 |
| 51.5 | 2.8 | 3.1 | 3.4 | 3.7 | 4.0 | 4.4 | 4.9 |
| 52.0 | 2.9 | 3.2 | 3.5 | 3.8 | 4.2 | 4.6 | 5.1 |
| 52.5 | 3.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.7 | 5.2 |
| 53.0 | 3.1 | 3.4 | 3.7 | 4.0 | 4.4 | 4.9 | 5.4 |
| 53.5 | 3.2 | 3.5 | 3.8 | 4.2 | 4.6 | 5.0 | 5.5 |
| 54.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.7 | 5.2 | 5.7 |
| 54.5 | 3.4 | 3.7 | 4.0 | 4.4 | 4.8 | 5.3 | 5.9 |
| 55.0 | 3.5 | 3.8 | 4.2 | 4.5 | 5.0 | 5.5 | 6.1 |
| 55.5 | 3.6 | 3.9 | 4.3 | 4.7 | 5.1 | 5.7 | 6.3 |
| 56.0 | 3.7 | 4.0 | 4.4 | 4.8 | 5.3 | 5.8 | 6.4 |
| 56.5 | 3.8 | 4.1 | 4.5 | 5.0 | 5.4 | 6.0 | 6.6 |
| 57.0 | 3.9 | 4.3 | 4.6 | 5.1 | 5.6 | 6.1 | 6.8 |
| 57.5 | 4.0 | 4.4 | 4.8 | 5.2 | 5.7 | 6.3 | 7.0 |
| 58.0 | 4.1 | 4.5 | 4.9 | 5.4 | 5.9 | 6.5 | 7.1 |
| 58.5 | 4.2 | 4.6 | 5.0 | 5.5 | 6.0 | 6.6 | 7.3 |
| 59.0 | 4.3 | 4.7 | 5.1 | 5.6 | 6.2 | 6.8 | 7.5 |
| 59.5 | 4.4 | 4.8 | 5.3 | 5.7 | 6.3 | 6.9 | 7.7 |
| 60.0 | 4.5 | 4.9 | 5.4 | 5.9 | 6.4 | 7.1 | 7.8 |
| 60.5 | 4.6 | 5.0 | 5.5 | 6.0 | 6.6 | 7.3 | 8.0 |
| 61.0 | 4.7 | 5.1 | 5.6 | 6.1 | 6.7 | 7.4 | 8.2 |
| 61.5 | 4.8 | 5.2 | 5.7 | 6.3 | 6.9 | 7.6 | 8.4 |
| 62.0 | 4.9 | 5.3 | 5.8 | 6.4 | 7.0 | 7.7 | 8.5 |
| 62.5 | 5.0 | 5.4 | 5.9 | 6.5 | 7.1 | 7.8 | 8.7 |
| 63.0 | 5.1 | 5.5 | 6.0 | 6.6 | 7.3 | 8.0 | 8.8 |
| 63.5 | 5.2 | 5.6 | 6.2 | 6.7 | 7.4 | 8.1 | 9.0 |
| 64.0 | 5.3 | 5.7 | 6.3 | 6.9 | 7.5 | 8.3 | 9.1 |
| 64.5 | 5.4 | 5.8 | 6.4 | 7.0 | 7.6 | 8.4 | 9.3 |
| 65.0 | 5.5 | 5.9 | 6.5 | 7.1 | 7.8 | 8.6 | 9.5 |
| 65.5 | 5.5 | 6.0 | 6.6 | 7.2 | 7.9 | 8.7 | 9.6 |
| 66.0 | 5.6 | 6.1 | 6.7 | 7.3 | 8.0 | 8.8 | 9.8 |
| 66.5 | 5.7 | 6.2 | 6.8 | 7.4 | 8.1 | 9.0 | 9.9 |
| 67.0 | 5.8 | 6.3 | 6.9 | 7.5 | 8.3 | 9.1 | 10.0 |
| 67.5 | 5.9 | 6.4 | 7.0 | 7.6 | 8.4 | 9.2 | 10.2 |
| 68.0 | 6.0 | 6.5 | 7.1 | 7.7 | 8.5 | 9.4 | 10.3 |
| 68.5 | 6.1 | 6.6 | 7.2 | 7.9 | 8.6 | 9.5 | 10.5 |
| 69.0 | 6.1 | 6.7 | 7.3 | 8.0 | 8.7 | 9.6 | 10.6 |
| 69.5 | 6.2 | 6.8 | 7.4 | 8.1 | 8.8 | 9.7 | 10.7 |
| 70.0 | 6.3 | 6.9 | 7.5 | 8.2 | 9.0 | 9.9 | 10.9 |
| 70.5 | 6.4 | 6.9 | 7.6 | 8.3 | 9.1 | 10.0 | 11.0 |
| 71.0 | 6.5 | 7.0 | 7.7 | 8.4 | 9.2 | 10.1 | 11.1 |
| 71.5 | 6.5 | 7.1 | 7.7 | 8.5 | 9.3 | 10.2 | 11.3 |
| 72.0 | 6.6 | 7.2 | 7.8 | 8.6 | 9.4 | 10.3 | 11.4 |
| 72.5 | 6.7 | 7.3 | 7.9 | 8.7 | 9.5 | 10.5 | 11.5 |
| 73.0 | 6.8 | 7.4 | 8.0 | 8.8 | 9.6 | 10.6 | 11.7 |
| 73.5 | 6.9 | 7.4 | 8.1 | 8.9 | 9.7 | 10.7 | 11.8 |
| 74.0 | 6.9 | 7.5 | 8.2 | 9.0 | 9.8 | 10.8 | 11.9 |
| 74.5 | 7.0 | 7.6 | 8.3 | 9.1 | 9.9 | 10.9 | 12.0 |
| 75.0 | 7.1 | 7.7 | 8.4 | 9.1 | 10.0 | 11.0 | 12.2 |

**Weight-for-length GIRLS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 75.5 | 7.1 | 7.8 | 8.5 | 9.2 | 10.1 | 11.1 | 12.3 |
| 76.0 | 7.2 | 7.8 | 8.5 | 9.3 | 10.2 | 11.2 | 12.4 |
| 76.5 | 7.3 | 7.9 | 8.6 | 9.4 | 10.3 | 11.4 | 12.5 |
| 77.0 | 7.4 | 8.0 | 8.7 | 9.5 | 10.4 | 11.5 | 12.6 |
| 77.5 | 7.4 | 8.1 | 8.8 | 9.6 | 10.5 | 11.6 | 12.8 |
| 78.0 | 7.5 | 8.2 | 8.9 | 9.7 | 10.6 | 11.7 | 12.9 |
| 78.5 | 7.6 | 8.2 | 9.0 | 9.8 | 10.7 | 11.8 | 13.0 |
| 79.0 | 7.7 | 8.3 | 9.1 | 9.9 | 10.8 | 11.9 | 13.1 |
| 79.5 | 7.7 | 8.4 | 9.1 | 10.0 | 10.9 | 12.0 | 13.3 |
| 80.0 | 7.8 | 8.5 | 9.2 | 10.1 | 11.0 | 12.1 | 13.4 |
| 80.5 | 7.9 | 8.6 | 9.3 | 10.2 | 11.2 | 12.3 | 13.5 |
| 81.0 | 8.0 | 8.7 | 9.4 | 10.3 | 11.3 | 12.4 | 13.7 |
| 81.5 | 8.1 | 8.8 | 9.5 | 10.4 | 11.4 | 12.5 | 13.8 |
| 82.0 | 8.1 | 8.8 | 9.6 | 10.5 | 11.5 | 12.6 | 13.9 |
| 82.5 | 8.2 | 8.9 | 9.7 | 10.6 | 11.6 | 12.8 | 14.1 |
| 83.0 | 8.3 | 9.0 | 9.8 | 10.7 | 11.8 | 12.9 | 14.2 |
| 83.5 | 8.4 | 9.1 | 9.9 | 10.9 | 11.9 | 13.1 | 14.4 |
| 84.0 | 8.5 | 9.2 | 10.1 | 11.0 | 12.0 | 13.2 | 14.5 |
| 84.5 | 8.6 | 9.3 | 10.2 | 11.1 | 12.1 | 13.3 | 14.7 |
| 85.0 | 8.7 | 9.4 | 10.3 | 11.2 | 12.3 | 13.5 | 14.9 |
| 85.5 | 8.8 | 9.5 | 10.4 | 11.3 | 12.4 | 13.6 | 15.0 |
| 86.0 | 8.9 | 9.7 | 10.5 | 11.5 | 12.6 | 13.8 | 15.2 |
| 86.5 | 9.0 | 9.8 | 10.6 | 11.6 | 12.7 | 13.9 | 15.4 |
| 87.0 | 9.1 | 9.9 | 10.7 | 11.7 | 12.8 | 14.1 | 15.5 |
| 87.5 | 9.2 | 10.0 | 10.9 | 11.8 | 13.0 | 14.2 | 15.7 |
| 88.0 | 9.3 | 10.1 | 11.0 | 12.0 | 13.1 | 14.4 | 15.9 |
| 88.5 | 9.4 | 10.2 | 11.1 | 12.1 | 13.2 | 14.5 | 16.0 |
| 89.0 | 9.5 | 10.3 | 11.2 | 12.2 | 13.4 | 14.7 | 16.2 |
| 89.5 | 9.6 | 10.4 | 11.3 | 12.3 | 13.5 | 14.8 | 16.4 |
| 90.0 | 9.7 | 10.5 | 11.4 | 12.5 | 13.7 | 15.0 | 16.5 |
| 90.5 | 9.8 | 10.6 | 11.5 | 12.6 | 13.8 | 15.1 | 16.7 |
| 91.0 | 9.9 | 10.7 | 11.7 | 12.7 | 13.9 | 15.3 | 16.9 |
| 91.5 | 10.0 | 10.8 | 11.8 | 12.8 | 14.1 | 15.5 | 17.0 |
| 92.0 | 10.1 | 10.9 | 11.9 | 13.0 | 14.2 | 15.6 | 17.2 |
| 92.5 | 10.1 | 11.0 | 12.0 | 13.1 | 14.3 | 15.8 | 17.4 |
| 93.0 | 10.2 | 11.1 | 12.1 | 13.2 | 14.5 | 15.9 | 17.5 |
| 93.5 | 10.3 | 11.2 | 12.2 | 13.3 | 14.6 | 16.1 | 17.7 |
| 94.0 | 10.4 | 11.3 | 12.3 | 13.5 | 14.7 | 16.2 | 17.9 |
| 94.5 | 10.5 | 11.4 | 12.4 | 13.6 | 14.9 | 16.4 | 18.0 |
| 95.0 | 10.6 | 11.5 | 12.6 | 13.7 | 15.0 | 16.5 | 18.2 |
| 95.5 | 10.7 | 11.6 | 12.7 | 13.8 | 15.2 | 16.7 | 18.4 |
| 96.0 | 10.8 | 11.7 | 12.8 | 14.0 | 15.3 | 16.8 | 18.6 |
| 96.5 | 10.9 | 11.8 | 12.9 | 14.1 | 15.4 | 17.0 | 18.7 |
| 97.0 | 11.0 | 12.0 | 13.0 | 14.2 | 15.6 | 17.1 | 18.9 |
| 97.5 | 11.1 | 12.1 | 13.1 | 14.4 | 15.7 | 17.3 | 19.1 |
| 98.0 | 11.2 | 12.2 | 13.3 | 14.5 | 15.9 | 17.5 | 19.3 |
| 98.5 | 11.3 | 12.3 | 13.4 | 14.6 | 16.0 | 17.6 | 19.5 |
| 99.0 | 11.4 | 12.4 | 13.5 | 14.8 | 16.2 | 17.8 | 19.6 |
| 99.5 | 11.5 | 12.5 | 13.6 | 14.9 | 16.3 | 18.0 | 19.8 |
| 100.0 | 11.6 | 12.6 | 13.7 | 15.0 | 16.5 | 18.1 | 20.0 |
| 100.5 | 11.7 | 12.7 | 13.9 | 15.2 | 16.6 | 18.3 | 20.2 |
| 101.0 | 11.8 | 12.8 | 14.0 | 15.3 | 16.8 | 18.5 | 20.4 |
| 101.5 | 11.9 | 13.0 | 14.1 | 15.5 | 17.0 | 18.7 | 20.6 |
| 102.0 | 12.0 | 13.1 | 14.3 | 15.6 | 17.1 | 18.9 | 20.8 |
| 102.5 | 12.1 | 13.2 | 14.4 | 15.8 | 17.3 | 19.0 | 21.0 |
| 103.0 | 12.3 | 13.3 | 14.5 | 15.9 | 17.5 | 19.2 | 21.3 |
| 103.5 | 12.4 | 13.5 | 14.7 | 16.1 | 17.6 | 19.4 | 21.5 |
| 104.0 | 12.5 | 13.6 | 14.8 | 16.2 | 17.8 | 19.6 | 21.7 |
| 104.5 | 12.6 | 13.7 | 15.0 | 16.4 | 18.0 | 19.8 | 21.9 |
| 105.0 | 12.7 | 13.8 | 15.1 | 16.5 | 18.2 | 20.0 | 22.2 |
| 105.5 | 12.8 | 14.0 | 15.3 | 16.7 | 18.4 | 20.2 | 22.4 |
| 106.0 | 13.0 | 14.1 | 15.4 | 16.9 | 18.5 | 20.5 | 22.6 |

**Weight-for-length GIRLS**
**Birth to 2 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 106.5 | 13.1 | 14.3 | 15.6 | 17.1 | 18.7 | 20.7 | 22.9 |
| 107.0 | 13.2 | 14.4 | 15.7 | 17.2 | 18.9 | 20.9 | 23.1 |
| 107.5 | 13.3 | 14.5 | 15.9 | 17.4 | 19.1 | 21.1 | 23.4 |
| 108.0 | 13.5 | 14.7 | 16.0 | 17.6 | 19.3 | 21.3 | 23.6 |
| 108.5 | 13.6 | 14.8 | 16.2 | 17.8 | 19.5 | 21.6 | 23.9 |
| 109.0 | 13.7 | 15.0 | 16.4 | 18.0 | 19.7 | 21.8 | 24.2 |
| 109.5 | 13.9 | 15.1 | 16.5 | 18.1 | 20.0 | 22.0 | 24.4 |
| 110.0 | 14.0 | 15.3 | 16.7 | 18.3 | 20.2 | 22.3 | 24.7 |

**WHO Child Growth Standards**

**Weight-for-height GIRLS**
**2 to 5 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 65.0 | 5.6 | 6.1 | 6.6 | 7.2 | 7.9 | 8.7 | 9.7 |
| 65.5 | 5.7 | 6.2 | 6.7 | 7.4 | 8.1 | 8.9 | 9.8 |
| 66.0 | 5.8 | 6.3 | 6.8 | 7.5 | 8.2 | 9.0 | 10.0 |
| 66.5 | 5.8 | 6.4 | 6.9 | 7.6 | 8.3 | 9.1 | 10.1 |
| 67.0 | 5.9 | 6.4 | 7.0 | 7.7 | 8.4 | 9.3 | 10.2 |
| 67.5 | 6.0 | 6.5 | 7.1 | 7.8 | 8.5 | 9.4 | 10.4 |
| 68.0 | 6.1 | 6.6 | 7.2 | 7.9 | 8.7 | 9.5 | 10.5 |
| 68.5 | 6.2 | 6.7 | 7.3 | 8.0 | 8.8 | 9.7 | 10.7 |
| 69.0 | 6.3 | 6.8 | 7.4 | 8.1 | 8.9 | 9.8 | 10.8 |
| 69.5 | 6.3 | 6.9 | 7.5 | 8.2 | 9.0 | 9.9 | 10.9 |
| 70.0 | 6.4 | 7.0 | 7.6 | 8.3 | 9.1 | 10.0 | 11.1 |
| 70.5 | 6.5 | 7.1 | 7.7 | 8.4 | 9.2 | 10.1 | 11.2 |
| 71.0 | 6.6 | 7.1 | 7.8 | 8.5 | 9.3 | 10.3 | 11.3 |
| 71.5 | 6.7 | 7.2 | 7.9 | 8.6 | 9.4 | 10.4 | 11.5 |
| 72.0 | 6.7 | 7.3 | 8.0 | 8.7 | 9.5 | 10.5 | 11.6 |
| 72.5 | 6.8 | 7.4 | 8.1 | 8.8 | 9.7 | 10.6 | 11.7 |
| 73.0 | 6.9 | 7.5 | 8.1 | 8.9 | 9.8 | 10.7 | 11.8 |
| 73.5 | 7.0 | 7.6 | 8.2 | 9.0 | 9.9 | 10.8 | 12.0 |
| 74.0 | 7.0 | 7.6 | 8.3 | 9.1 | 10.0 | 11.0 | 12.1 |
| 74.5 | 7.1 | 7.7 | 8.4 | 9.2 | 10.1 | 11.1 | 12.2 |
| 75.0 | 7.2 | 7.8 | 8.5 | 9.3 | 10.2 | 11.2 | 12.3 |
| 75.5 | 7.2 | 7.9 | 8.6 | 9.4 | 10.3 | 11.3 | 12.5 |
| 76.0 | 7.3 | 8.0 | 8.7 | 9.5 | 10.4 | 11.4 | 12.6 |
| 76.5 | 7.4 | 8.0 | 8.7 | 9.6 | 10.5 | 11.5 | 12.7 |
| 77.0 | 7.5 | 8.1 | 8.8 | 9.6 | 10.6 | 11.6 | 12.8 |
| 77.5 | 7.5 | 8.2 | 8.9 | 9.7 | 10.7 | 11.7 | 12.9 |
| 78.0 | 7.6 | 8.3 | 9.0 | 9.8 | 10.8 | 11.8 | 13.1 |
| 78.5 | 7.7 | 8.4 | 9.1 | 9.9 | 10.9 | 12.0 | 13.2 |
| 79.0 | 7.8 | 8.4 | 9.2 | 10.0 | 11.0 | 12.1 | 13.3 |
| 79.5 | 7.8 | 8.5 | 9.3 | 10.1 | 11.1 | 12.2 | 13.4 |
| 80.0 | 7.9 | 8.6 | 9.4 | 10.2 | 11.2 | 12.3 | 13.6 |
| 80.5 | 8.0 | 8.7 | 9.5 | 10.3 | 11.3 | 12.4 | 13.7 |
| 81.0 | 8.1 | 8.8 | 9.6 | 10.4 | 11.4 | 12.6 | 13.9 |
| 81.5 | 8.2 | 8.9 | 9.7 | 10.6 | 11.6 | 12.7 | 14.0 |
| 82.0 | 8.3 | 9.0 | 9.8 | 10.7 | 11.7 | 12.8 | 14.1 |
| 82.5 | 8.4 | 9.1 | 9.9 | 10.8 | 11.8 | 13.0 | 14.3 |
| 83.0 | 8.5 | 9.2 | 10.0 | 10.9 | 11.9 | 13.1 | 14.5 |
| 83.5 | 8.5 | 9.3 | 10.1 | 11.0 | 12.1 | 13.3 | 14.6 |
| 84.0 | 8.6 | 9.4 | 10.2 | 11.1 | 12.2 | 13.4 | 14.8 |
| 84.5 | 8.7 | 9.5 | 10.3 | 11.3 | 12.3 | 13.5 | 14.9 |
| 85.0 | 8.8 | 9.6 | 10.4 | 11.4 | 12.5 | 13.7 | 15.1 |
| 85.5 | 8.9 | 9.7 | 10.6 | 11.5 | 12.6 | 13.8 | 15.3 |
| 86.0 | 9.0 | 9.8 | 10.7 | 11.6 | 12.7 | 14.0 | 15.4 |
| 86.5 | 9.1 | 9.9 | 10.8 | 11.8 | 12.9 | 14.2 | 15.6 |
| 87.0 | 9.2 | 10.0 | 10.9 | 11.9 | 13.0 | 14.3 | 15.8 |
| 87.5 | 9.3 | 10.1 | 11.0 | 12.0 | 13.2 | 14.5 | 15.9 |
| 88.0 | 9.4 | 10.2 | 11.1 | 12.1 | 13.3 | 14.6 | 16.1 |
| 88.5 | 9.5 | 10.3 | 11.2 | 12.3 | 13.4 | 14.8 | 16.3 |
| 89.0 | 9.6 | 10.4 | 11.4 | 12.4 | 13.6 | 14.9 | 16.4 |
| 89.5 | 9.7 | 10.5 | 11.5 | 12.5 | 13.7 | 15.1 | 16.6 |
| 90.0 | 9.8 | 10.6 | 11.6 | 12.6 | 13.8 | 15.2 | 16.8 |
| 90.5 | 9.9 | 10.7 | 11.7 | 12.8 | 14.0 | 15.4 | 16.9 |
| 91.0 | 10.0 | 10.9 | 11.8 | 12.9 | 14.1 | 15.5 | 17.1 |
| 91.5 | 10.1 | 11.0 | 11.9 | 13.0 | 14.3 | 15.7 | 17.3 |
| 92.0 | 10.2 | 11.1 | 12.0 | 13.1 | 14.4 | 15.8 | 17.4 |
| 92.5 | 10.3 | 11.2 | 12.1 | 13.3 | 14.5 | 16.0 | 17.6 |
| 93.0 | 10.4 | 11.3 | 12.3 | 13.4 | 14.7 | 16.1 | 17.8 |
| 93.5 | 10.5 | 11.4 | 12.4 | 13.5 | 14.8 | 16.3 | 17.9 |
| 94.0 | 10.6 | 11.5 | 12.5 | 13.6 | 14.9 | 16.4 | 18.1 |
| 94.5 | 10.7 | 11.6 | 12.6 | 13.8 | 15.1 | 16.6 | 18.3 |
| 95.0 | 10.8 | 11.7 | 12.7 | 13.9 | 15.2 | 16.7 | 18.5 |

**Weight-for-height GIRLS**
**2 to 5 years (z-scores)**

World Health Organization

| cm | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|
| 95.5 | 10.8 | 11.8 | 12.8 | 14.0 | 15.4 | 16.9 | 18.6 |
| 96.0 | 10.9 | 11.9 | 12.9 | 14.1 | 15.5 | 17.0 | 18.8 |
| 96.5 | 11.0 | 12.0 | 13.1 | 14.3 | 15.6 | 17.2 | 19.0 |
| 97.0 | 11.1 | 12.1 | 13.2 | 14.4 | 15.8 | 17.4 | 19.2 |
| 97.5 | 11.2 | 12.2 | 13.3 | 14.5 | 15.9 | 17.5 | 19.3 |
| 98.0 | 11.3 | 12.3 | 13.4 | 14.7 | 16.1 | 17.7 | 19.5 |
| 98.5 | 11.4 | 12.4 | 13.5 | 14.8 | 16.2 | 17.9 | 19.7 |
| 99.0 | 11.5 | 12.5 | 13.7 | 14.9 | 16.4 | 18.0 | 19.9 |
| 99.5 | 11.6 | 12.7 | 13.8 | 15.1 | 16.5 | 18.2 | 20.1 |
| 100.0 | 11.7 | 12.8 | 13.9 | 15.2 | 16.7 | 18.4 | 20.3 |
| 100.5 | 11.9 | 12.9 | 14.1 | 15.4 | 16.9 | 18.6 | 20.5 |
| 101.0 | 12.0 | 13.0 | 14.2 | 15.5 | 17.0 | 18.7 | 20.7 |
| 101.5 | 12.1 | 13.1 | 14.3 | 15.7 | 17.2 | 18.9 | 20.9 |
| 102.0 | 12.2 | 13.3 | 14.5 | 15.8 | 17.4 | 19.1 | 21.1 |
| 102.5 | 12.3 | 13.4 | 14.6 | 16.0 | 17.5 | 19.3 | 21.4 |
| 103.0 | 12.4 | 13.5 | 14.7 | 16.1 | 17.7 | 19.5 | 21.6 |
| 103.5 | 12.5 | 13.6 | 14.9 | 16.3 | 17.9 | 19.7 | 21.8 |
| 104.0 | 12.6 | 13.8 | 15.0 | 16.4 | 18.1 | 19.9 | 22.0 |
| 104.5 | 12.8 | 13.9 | 15.2 | 16.6 | 18.2 | 20.1 | 22.3 |
| 105.0 | 12.9 | 14.0 | 15.3 | 16.8 | 18.4 | 20.3 | 22.5 |
| 105.5 | 13.0 | 14.2 | 15.5 | 16.9 | 18.6 | 20.5 | 22.7 |
| 106.0 | 13.1 | 14.3 | 15.6 | 17.1 | 18.8 | 20.8 | 23.0 |
| 106.5 | 13.3 | 14.5 | 15.8 | 17.3 | 19.0 | 21.0 | 23.2 |
| 107.0 | 13.4 | 14.6 | 15.9 | 17.5 | 19.2 | 21.2 | 23.5 |
| 107.5 | 13.5 | 14.7 | 16.1 | 17.7 | 19.4 | 21.4 | 23.7 |
| 108.0 | 13.7 | 14.9 | 16.3 | 17.8 | 19.6 | 21.7 | 24.0 |
| 108.5 | 13.8 | 15.0 | 16.4 | 18.0 | 19.8 | 21.9 | 24.3 |
| 109.0 | 13.9 | 15.2 | 16.6 | 18.2 | 20.0 | 22.1 | 24.5 |
| 109.5 | 14.1 | 15.4 | 16.8 | 18.4 | 20.3 | 22.4 | 24.8 |
| 110.0 | 14.2 | 15.5 | 17.0 | 18.6 | 20.5 | 22.6 | 25.1 |
| 110.5 | 14.4 | 15.7 | 17.1 | 18.8 | 20.7 | 22.9 | 25.4 |
| 111.0 | 14.5 | 15.8 | 17.3 | 19.0 | 20.9 | 23.1 | 25.7 |
| 111.5 | 14.7 | 16.0 | 17.5 | 19.2 | 21.2 | 23.4 | 26.0 |
| 112.0 | 14.8 | 16.2 | 17.7 | 19.4 | 21.4 | 23.6 | 26.2 |
| 112.5 | 15.0 | 16.3 | 17.9 | 19.6 | 21.6 | 23.9 | 26.5 |
| 113.0 | 15.1 | 16.5 | 18.0 | 19.8 | 21.8 | 24.2 | 26.8 |
| 113.5 | 15.3 | 16.7 | 18.2 | 20.0 | 22.1 | 24.4 | 27.1 |
| 114.0 | 15.4 | 16.8 | 18.4 | 20.2 | 22.3 | 24.7 | 27.4 |
| 114.5 | 15.6 | 17.0 | 18.6 | 20.5 | 22.6 | 25.0 | 27.8 |
| 115.0 | 15.7 | 17.2 | 18.8 | 20.7 | 22.8 | 25.2 | 28.1 |
| 115.5 | 15.9 | 17.3 | 19.0 | 20.9 | 23.0 | 25.5 | 28.4 |
| 116.0 | 16.0 | 17.5 | 19.2 | 21.1 | 23.3 | 25.8 | 28.7 |
| 116.5 | 16.2 | 17.7 | 19.4 | 21.3 | 23.5 | 26.1 | 29.0 |
| 117.0 | 16.3 | 17.8 | 19.6 | 21.5 | 23.8 | 26.3 | 29.3 |
| 117.5 | 16.5 | 18.0 | 19.8 | 21.7 | 24.0 | 26.6 | 29.6 |
| 118.0 | 16.6 | 18.2 | 19.9 | 22.0 | 24.2 | 26.9 | 29.9 |
| 118.5 | 16.8 | 18.4 | 20.1 | 22.2 | 24.5 | 27.2 | 30.3 |
| 119.0 | 16.9 | 18.5 | 20.3 | 22.4 | 24.7 | 27.4 | 30.6 |
| 119.5 | 17.1 | 18.7 | 20.5 | 22.6 | 25.0 | 27.7 | 30.9 |
| 120.0 | 17.3 | 18.9 | 20.7 | 22.8 | 25.2 | 28.0 | 31.2 |

**WHO Child Growth Standards**

**Instructions for using the BMI for age chart**

**Always ensure the child is 5-17 years when using these charts.**

**Step 1: Measurement**

1. Confirm the age and gender of the child.
2. Take the child's height in "cm" and weight in "kg" and record.
3. Convert the child's height to 'meters'.
4. Calculate the child's BMI thus: weight (kg) / height (meters) $^2$

**Step 2: Reading the BMI for age**

1. Confirm the chart is correct for the gender of the child.
2. On the BMI for age chart, check the column marked "Year. Month" and identify the age of the child.
3. Along this row, choose the cell that is nearest to the actual BMI you have calculated.
4. This corresponds to the child's BMI for age score.

**Step 3: Classification**

Classify and report the child's BMI for age corresponding to the identified BMI from the SD rows at the top of the chart.

**Step 4: Intervention**

All children with a BMI for age of -2SD and below are eligible for Food by Prescription.

**BMI-for-age GIRLS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 5: 1 | 61 | 11.8 | 12.7 | 13.9 | 15.2 | 16.9 | 18.9 | 21.3 |
| 5: 2 | 62 | 11.8 | 12.7 | 13.9 | 15.2 | 16.9 | 18.9 | 21.4 |
| 5: 3 | 63 | 11.8 | 12.7 | 13.9 | 15.2 | 16.9 | 18.9 | 21.5 |
| 5: 4 | 64 | 11.8 | 12.7 | 13.9 | 15.2 | 16.9 | 18.9 | 21.5 |
| 5: 5 | 65 | 11.7 | 12.7 | 13.9 | 15.2 | 16.9 | 19.0 | 21.6 |
| 5: 6 | 66 | 11.7 | 12.7 | 13.9 | 15.2 | 16.9 | 19.0 | 21.7 |
| 5: 7 | 67 | 11.7 | 12.7 | 13.9 | 15.2 | 16.9 | 19.0 | 21.7 |
| 5: 8 | 68 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.1 | 21.8 |
| 5: 9 | 69 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.1 | 21.9 |
| 5: 10 | 70 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.1 | 22.0 |
| 5: 11 | 71 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.2 | 22.1 |
| 6: 0 | 72 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.2 | 22.1 |
| 6: 1 | 73 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.3 | 22.2 |
| 6: 2 | 74 | 11.7 | 12.7 | 13.9 | 15.3 | 17.0 | 19.3 | 22.3 |
| 6: 3 | 75 | 11.7 | 12.7 | 13.9 | 15.3 | 17.1 | 19.3 | 22.4 |
| 6: 4 | 76 | 11.7 | 12.7 | 13.9 | 15.3 | 17.1 | 19.4 | 22.5 |
| 6: 5 | 77 | 11.7 | 12.7 | 13.9 | 15.3 | 17.1 | 19.4 | 22.6 |
| 6: 6 | 78 | 11.7 | 12.7 | 13.9 | 15.3 | 17.1 | 19.5 | 22.7 |
| 6: 7 | 79 | 11.7 | 12.7 | 13.9 | 15.3 | 17.2 | 19.5 | 22.8 |
| 6: 8 | 80 | 11.7 | 12.7 | 13.9 | 15.3 | 17.2 | 19.6 | 22.9 |
| 6: 9 | 81 | 11.7 | 12.7 | 13.9 | 15.4 | 17.2 | 19.6 | 23.0 |
| 6: 10 | 82 | 11.7 | 12.7 | 13.9 | 15.4 | 17.2 | 19.7 | 23.1 |
| 6: 11 | 83 | 11.7 | 12.7 | 13.9 | 15.4 | 17.3 | 19.7 | 23.2 |
| 7: 0 | 84 | 11.8 | 12.7 | 13.9 | 15.4 | 17.3 | 19.8 | 23.3 |
| 7: 1 | 85 | 11.8 | 12.7 | 13.9 | 15.4 | 17.3 | 19.8 | 23.4 |
| 7: 2 | 86 | 11.8 | 12.8 | 14.0 | 15.4 | 17.4 | 19.9 | 23.5 |
| 7: 3 | 87 | 11.8 | 12.8 | 14.0 | 15.5 | 17.4 | 20.0 | 23.6 |
| 7: 4 | 88 | 11.8 | 12.8 | 14.0 | 15.5 | 17.4 | 20.0 | 23.7 |
| 7: 5 | 89 | 11.8 | 12.8 | 14.0 | 15.5 | 17.5 | 20.1 | 23.9 |
| 7: 6 | 90 | 11.8 | 12.8 | 14.0 | 15.5 | 17.5 | 20.1 | 24.0 |
| 7: 7 | 91 | 11.8 | 12.8 | 14.0 | 15.5 | 17.5 | 20.2 | 24.1 |
| 7: 8 | 92 | 11.8 | 12.8 | 14.0 | 15.6 | 17.6 | 20.3 | 24.2 |
| 7: 9 | 93 | 11.8 | 12.8 | 14.1 | 15.6 | 17.6 | 20.3 | 24.4 |
| 7: 10 | 94 | 11.9 | 12.9 | 14.1 | 15.6 | 17.6 | 20.4 | 24.5 |
| 7: 11 | 95 | 11.9 | 12.9 | 14.1 | 15.7 | 17.7 | 20.5 | 24.6 |
| 8: 0 | 96 | 11.9 | 12.9 | 14.1 | 15.7 | 17.7 | 20.6 | 24.8 |
| 8: 1 | 97 | 11.9 | 12.9 | 14.1 | 15.7 | 17.8 | 20.6 | 24.9 |
| 8: 2 | 98 | 11.9 | 12.9 | 14.2 | 15.7 | 17.8 | 20.7 | 25.1 |
| 8: 3 | 99 | 11.9 | 12.9 | 14.2 | 15.8 | 17.9 | 20.8 | 25.2 |
| 8: 4 | 100 | 11.9 | 13.0 | 14.2 | 15.8 | 17.9 | 20.9 | 25.3 |
| 8: 5 | 101 | 12.0 | 13.0 | 14.2 | 15.8 | 18.0 | 20.9 | 25.5 |
| 8: 6 | 102 | 12.0 | 13.0 | 14.3 | 15.9 | 18.0 | 21.0 | 25.6 |
| 8: 7 | 103 | 12.0 | 13.0 | 14.3 | 15.9 | 18.1 | 21.1 | 25.8 |
| 8: 8 | 104 | 12.0 | 13.0 | 14.3 | 15.9 | 18.1 | 21.2 | 25.9 |
| 8: 9 | 105 | 12.0 | 13.1 | 14.3 | 16.0 | 18.2 | 21.3 | 26.1 |
| 8: 10 | 106 | 12.1 | 13.1 | 14.4 | 16.0 | 18.2 | 21.3 | 26.2 |
| 8: 11 | 107 | 12.1 | 13.1 | 14.4 | 16.1 | 18.3 | 21.4 | 26.4 |
| 9: 0 | 108 | 12.1 | 13.1 | 14.4 | 16.1 | 18.3 | 21.5 | 26.5 |
| 9: 1 | 109 | 12.1 | 13.2 | 14.5 | 16.1 | 18.4 | 21.6 | 26.7 |
| 9: 2 | 110 | 12.1 | 13.2 | 14.5 | 16.2 | 18.4 | 21.7 | 26.8 |
| 9: 3 | 111 | 12.2 | 13.2 | 14.5 | 16.2 | 18.5 | 21.8 | 27.0 |
| 9: 4 | 112 | 12.2 | 13.2 | 14.6 | 16.3 | 18.6 | 21.9 | 27.2 |
| 9: 5 | 113 | 12.2 | 13.3 | 14.6 | 16.3 | 18.6 | 21.9 | 27.3 |
| 9: 6 | 114 | 12.2 | 13.3 | 14.6 | 16.3 | 18.7 | 22.0 | 27.5 |
| 9: 7 | 115 | 12.3 | 13.3 | 14.7 | 16.4 | 18.7 | 22.1 | 27.6 |
| 9: 8 | 116 | 12.3 | 13.4 | 14.7 | 16.4 | 18.8 | 22.2 | 27.8 |
| 9: 9 | 117 | 12.3 | 13.4 | 14.7 | 16.5 | 18.8 | 22.3 | 27.9 |
| 9: 10 | 118 | 12.3 | 13.4 | 14.8 | 16.5 | 18.9 | 22.4 | 28.1 |
| 9: 11 | 119 | 12.4 | 13.4 | 14.8 | 16.6 | 19.0 | 22.5 | 28.2 |
| 10: 0 | 120 | 12.4 | 13.5 | 14.8 | 16.6 | 19.0 | 22.6 | 28.4 |

**BMI-for-age GIRLS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 10: 1 | 121 | 12.4 | 13.5 | 14.9 | 16.7 | 19.1 | 22.7 | 28.5 |
| 10: 2 | 122 | 12.4 | 13.5 | 14.9 | 16.7 | 19.2 | 22.8 | 28.7 |
| 10: 3 | 123 | 12.5 | 13.6 | 15.0 | 16.8 | 19.2 | 22.8 | 28.8 |
| 10: 4 | 124 | 12.5 | 13.6 | 15.0 | 16.8 | 19.3 | 22.9 | 29.0 |
| 10: 5 | 125 | 12.5 | 13.6 | 15.0 | 16.9 | 19.4 | 23.0 | 29.1 |
| 10: 6 | 126 | 12.5 | 13.7 | 15.1 | 16.9 | 19.4 | 23.1 | 29.3 |
| 10: 7 | 127 | 12.6 | 13.7 | 15.1 | 17.0 | 19.5 | 23.2 | 29.4 |
| 10: 8 | 128 | 12.6 | 13.7 | 15.2 | 17.0 | 19.6 | 23.3 | 29.6 |
| 10: 9 | 129 | 12.6 | 13.8 | 15.2 | 17.1 | 19.6 | 23.4 | 29.7 |
| 10: 10 | 130 | 12.7 | 13.8 | 15.3 | 17.1 | 19.7 | 23.5 | 29.9 |
| 10: 11 | 131 | 12.7 | 13.8 | 15.3 | 17.2 | 19.8 | 23.6 | 30.0 |
| 11: 0 | 132 | 12.7 | 13.9 | 15.3 | 17.2 | 19.9 | 23.7 | 30.2 |
| 11: 1 | 133 | 12.8 | 13.9 | 15.4 | 17.3 | 19.9 | 23.8 | 30.3 |
| 11: 2 | 134 | 12.8 | 14.0 | 15.4 | 17.4 | 20.0 | 23.9 | 30.5 |
| 11: 3 | 135 | 12.8 | 14.0 | 15.5 | 17.4 | 20.1 | 24.0 | 30.6 |
| 11: 4 | 136 | 12.9 | 14.0 | 15.5 | 17.5 | 20.2 | 24.1 | 30.8 |
| 11: 5 | 137 | 12.9 | 14.1 | 15.6 | 17.5 | 20.2 | 24.2 | 30.9 |
| 11: 6 | 138 | 12.9 | 14.1 | 15.6 | 17.6 | 20.3 | 24.3 | 31.1 |
| 11: 7 | 139 | 13.0 | 14.2 | 15.7 | 17.7 | 20.4 | 24.4 | 31.2 |
| 11: 8 | 140 | 13.0 | 14.2 | 15.7 | 17.7 | 20.5 | 24.5 | 31.4 |
| 11: 9 | 141 | 13.0 | 14.3 | 15.8 | 17.8 | 20.6 | 24.7 | 31.5 |
| 11: 10 | 142 | 13.1 | 14.3 | 15.8 | 17.9 | 20.6 | 24.8 | 31.6 |
| 11: 11 | 143 | 13.1 | 14.3 | 15.9 | 17.9 | 20.7 | 24.9 | 31.8 |
| 12: 0 | 144 | 13.2 | 14.4 | 16.0 | 18.0 | 20.8 | 25.0 | 31.9 |
| 12: 1 | 145 | 13.2 | 14.4 | 16.0 | 18.1 | 20.9 | 25.1 | 32.0 |
| 12: 2 | 146 | 13.2 | 14.5 | 16.1 | 18.1 | 21.0 | 25.2 | 32.2 |
| 12: 3 | 147 | 13.3 | 14.5 | 16.1 | 18.2 | 21.1 | 25.3 | 32.3 |
| 12: 4 | 148 | 13.3 | 14.6 | 16.2 | 18.3 | 21.1 | 25.4 | 32.4 |
| 12: 5 | 149 | 13.3 | 14.6 | 16.2 | 18.3 | 21.2 | 25.5 | 32.6 |
| 12: 6 | 150 | 13.4 | 14.7 | 16.3 | 18.4 | 21.3 | 25.6 | 32.7 |
| 12: 7 | 151 | 13.4 | 14.7 | 16.3 | 18.5 | 21.4 | 25.7 | 32.8 |
| 12: 8 | 152 | 13.5 | 14.8 | 16.4 | 18.5 | 21.5 | 25.8 | 33.0 |
| 12: 9 | 153 | 13.5 | 14.8 | 16.4 | 18.6 | 21.6 | 25.9 | 33.1 |
| 12: 10 | 154 | 13.5 | 14.8 | 16.5 | 18.7 | 21.6 | 26.0 | 33.2 |
| 12: 11 | 155 | 13.6 | 14.9 | 16.6 | 18.7 | 21.7 | 26.1 | 33.3 |
| 13: 0 | 156 | 13.6 | 14.9 | 16.6 | 18.8 | 21.8 | 26.2 | 33.4 |
| 13: 1 | 157 | 13.6 | 15.0 | 16.7 | 18.9 | 21.9 | 26.3 | 33.6 |
| 13: 2 | 158 | 13.7 | 15.0 | 16.7 | 18.9 | 22.0 | 26.4 | 33.7 |
| 13: 3 | 159 | 13.7 | 15.1 | 16.8 | 19.0 | 22.0 | 26.5 | 33.8 |
| 13: 4 | 160 | 13.8 | 15.1 | 16.8 | 19.1 | 22.1 | 26.6 | 33.9 |
| 13: 5 | 161 | 13.8 | 15.2 | 16.9 | 19.1 | 22.2 | 26.7 | 34.0 |
| 13: 6 | 162 | 13.8 | 15.2 | 16.9 | 19.2 | 22.3 | 26.8 | 34.1 |
| 13: 7 | 163 | 13.9 | 15.2 | 17.0 | 19.3 | 22.4 | 26.9 | 34.2 |
| 13: 8 | 164 | 13.9 | 15.3 | 17.0 | 19.3 | 22.4 | 27.0 | 34.3 |
| 13: 9 | 165 | 13.9 | 15.3 | 17.1 | 19.4 | 22.5 | 27.1 | 34.4 |
| 13: 10 | 166 | 14.0 | 15.4 | 17.1 | 19.4 | 22.6 | 27.1 | 34.5 |
| 13: 11 | 167 | 14.0 | 15.4 | 17.2 | 19.5 | 22.7 | 27.2 | 34.6 |
| 14: 0 | 168 | 14.0 | 15.4 | 17.2 | 19.6 | 22.7 | 27.3 | 34.7 |
| 14: 1 | 169 | 14.1 | 15.5 | 17.3 | 19.6 | 22.8 | 27.4 | 34.7 |
| 14: 2 | 170 | 14.1 | 15.5 | 17.3 | 19.7 | 22.9 | 27.5 | 34.8 |
| 14: 3 | 171 | 14.1 | 15.6 | 17.4 | 19.7 | 22.9 | 27.6 | 34.9 |
| 14: 4 | 172 | 14.1 | 15.6 | 17.4 | 19.8 | 23.0 | 27.7 | 35.0 |
| 14: 5 | 173 | 14.2 | 15.6 | 17.5 | 19.9 | 23.1 | 27.7 | 35.1 |
| 14: 6 | 174 | 14.2 | 15.7 | 17.5 | 19.9 | 23.1 | 27.8 | 35.1 |
| 14: 7 | 175 | 14.2 | 15.7 | 17.6 | 20.0 | 23.2 | 27.9 | 35.2 |
| 14: 8 | 176 | 14.3 | 15.7 | 17.6 | 20.0 | 23.3 | 28.0 | 35.3 |
| 14: 9 | 177 | 14.3 | 15.8 | 17.6 | 20.1 | 23.3 | 28.0 | 35.4 |
| 14: 10 | 178 | 14.3 | 15.8 | 17.7 | 20.1 | 23.4 | 28.1 | 35.4 |
| 14: 11 | 179 | 14.3 | 15.8 | 17.7 | 20.2 | 23.5 | 28.2 | 35.5 |
| 15: 0 | 180 | 14.4 | 15.9 | 17.8 | 20.2 | 23.5 | 28.2 | 35.5 |

**BMI-for-age GIRLS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 15: 1 | 181 | 14.4 | 15.9 | 17.8 | 20.3 | 23.6 | 28.3 | 35.6 |
| 15: 2 | 182 | 14.4 | 15.9 | 17.8 | 20.3 | 23.6 | 28.4 | 35.7 |
| 15: 3 | 183 | 14.4 | 16.0 | 17.9 | 20.4 | 23.7 | 28.4 | 35.7 |
| 15: 4 | 184 | 14.5 | 16.0 | 17.9 | 20.4 | 23.7 | 28.5 | 35.8 |
| 15: 5 | 185 | 14.5 | 16.0 | 17.9 | 20.4 | 23.8 | 28.5 | 35.8 |
| 15: 6 | 186 | 14.5 | 16.0 | 18.0 | 20.5 | 23.8 | 28.6 | 35.8 |
| 15: 7 | 187 | 14.5 | 16.1 | 18.0 | 20.5 | 23.9 | 28.6 | 35.9 |
| 15: 8 | 188 | 14.5 | 16.1 | 18.0 | 20.6 | 23.9 | 28.7 | 35.9 |
| 15: 9 | 189 | 14.5 | 16.1 | 18.1 | 20.6 | 24.0 | 28.7 | 36.0 |
| 15: 10 | 190 | 14.6 | 16.1 | 18.1 | 20.6 | 24.0 | 28.8 | 36.0 |
| 15: 11 | 191 | 14.6 | 16.2 | 18.1 | 20.7 | 24.1 | 28.8 | 36.0 |
| 16: 0 | 192 | 14.6 | 16.2 | 18.2 | 20.7 | 24.1 | 28.9 | 36.1 |
| 16: 1 | 193 | 14.6 | 16.2 | 18.2 | 20.7 | 24.1 | 28.9 | 36.1 |
| 16: 2 | 194 | 14.6 | 16.2 | 18.2 | 20.8 | 24.2 | 29.0 | 36.1 |
| 16: 3 | 195 | 14.6 | 16.2 | 18.2 | 20.8 | 24.2 | 29.0 | 36.1 |
| 16: 4 | 196 | 14.6 | 16.2 | 18.3 | 20.8 | 24.3 | 29.0 | 36.2 |
| 16: 5 | 197 | 14.6 | 16.3 | 18.3 | 20.9 | 24.3 | 29.1 | 36.2 |
| 16: 6 | 198 | 14.7 | 16.3 | 18.3 | 20.9 | 24.3 | 29.1 | 36.2 |
| 16: 7 | 199 | 14.7 | 16.3 | 18.3 | 20.9 | 24.4 | 29.1 | 36.2 |
| 16: 8 | 200 | 14.7 | 16.3 | 18.3 | 20.9 | 24.4 | 29.2 | 36.2 |
| 16: 9 | 201 | 14.7 | 16.3 | 18.4 | 21.0 | 24.4 | 29.2 | 36.3 |
| 16: 10 | 202 | 14.7 | 16.3 | 18.4 | 21.0 | 24.4 | 29.2 | 36.3 |
| 16: 11 | 203 | 14.7 | 16.3 | 18.4 | 21.0 | 24.5 | 29.3 | 36.3 |
| 17: 0 | 204 | 14.7 | 16.4 | 18.4 | 21.0 | 24.5 | 29.3 | 36.3 |
| 17: 1 | 205 | 14.7 | 16.4 | 18.4 | 21.1 | 24.5 | 29.3 | 36.3 |
| 17: 2 | 206 | 14.7 | 16.4 | 18.4 | 21.1 | 24.6 | 29.3 | 36.3 |
| 17: 3 | 207 | 14.7 | 16.4 | 18.5 | 21.1 | 24.6 | 29.4 | 36.3 |
| 17: 4 | 208 | 14.7 | 16.4 | 18.5 | 21.1 | 24.6 | 29.4 | 36.3 |
| 17: 5 | 209 | 14.7 | 16.4 | 18.5 | 21.1 | 24.6 | 29.4 | 36.3 |
| 17: 6 | 210 | 14.7 | 16.4 | 18.5 | 21.2 | 24.6 | 29.4 | 36.3 |
| 17: 7 | 211 | 14.7 | 16.4 | 18.5 | 21.2 | 24.7 | 29.4 | 36.3 |
| 17: 8 | 212 | 14.7 | 16.4 | 18.5 | 21.2 | 24.7 | 29.5 | 36.3 |
| 17: 9 | 213 | 14.7 | 16.4 | 18.5 | 21.2 | 24.7 | 29.5 | 36.3 |
| 17: 10 | 214 | 14.7 | 16.4 | 18.5 | 21.2 | 24.7 | 29.5 | 36.3 |
| 17: 11 | 215 | 14.7 | 16.4 | 18.6 | 21.2 | 24.8 | 29.5 | 36.3 |
| 18: 0 | 216 | 14.7 | 16.4 | 18.6 | 21.3 | 24.8 | 29.5 | 36.3 |
| 18: 1 | 217 | 14.7 | 16.5 | 18.6 | 21.3 | 24.8 | 29.5 | 36.3 |
| 18: 2 | 218 | 14.7 | 16.5 | 18.6 | 21.3 | 24.8 | 29.6 | 36.3 |
| 18: 3 | 219 | 14.7 | 16.5 | 18.6 | 21.3 | 24.8 | 29.6 | 36.3 |
| 18: 4 | 220 | 14.7 | 16.5 | 18.6 | 21.3 | 24.8 | 29.6 | 36.3 |
| 18: 5 | 221 | 14.7 | 16.5 | 18.6 | 21.3 | 24.9 | 29.6 | 36.2 |
| 18: 6 | 222 | 14.7 | 16.5 | 18.6 | 21.3 | 24.9 | 29.6 | 36.2 |
| 18: 7 | 223 | 14.7 | 16.5 | 18.6 | 21.4 | 24.9 | 29.6 | 36.2 |
| 18: 8 | 224 | 14.7 | 16.5 | 18.6 | 21.4 | 24.9 | 29.6 | 36.2 |
| 18: 9 | 225 | 14.7 | 16.5 | 18.7 | 21.4 | 24.9 | 29.6 | 36.2 |
| 18: 10 | 226 | 14.7 | 16.5 | 18.7 | 21.4 | 24.9 | 29.6 | 36.2 |
| 18: 11 | 227 | 14.7 | 16.5 | 18.7 | 21.4 | 25.0 | 29.7 | 36.2 |
| 19: 0 | 228 | 14.7 | 16.5 | 18.7 | 21.4 | 25.0 | 29.7 | 36.2 |

2007 WHO Reference

**BMI-for-age BOYS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 5: 1 | 61 | 12.1 | 13.0 | 14.1 | 15.3 | 16.6 | 18.3 | 20.2 |
| 5: 2 | 62 | 12.1 | 13.0 | 14.1 | 15.3 | 16.6 | 18.3 | 20.2 |
| 5: 3 | 63 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.3 | 20.2 |
| 5: 4 | 64 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.3 | 20.3 |
| 5: 5 | 65 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.3 | 20.3 |
| 5: 6 | 66 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.4 | 20.4 |
| 5: 7 | 67 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.4 | 20.4 |
| 5: 8 | 68 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.4 | 20.5 |
| 5: 9 | 69 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.4 | 20.5 |
| 5: 10 | 70 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.5 | 20.6 |
| 5: 11 | 71 | 12.1 | 13.0 | 14.1 | 15.3 | 16.7 | 18.5 | 20.6 |
| 6: 0 | 72 | 12.1 | 13.0 | 14.1 | 15.3 | 16.8 | 18.5 | 20.7 |
| 6: 1 | 73 | 12.1 | 13.0 | 14.1 | 15.3 | 16.8 | 18.6 | 20.8 |
| 6: 2 | 74 | 12.2 | 13.1 | 14.1 | 15.3 | 16.8 | 18.6 | 20.8 |
| 6: 3 | 75 | 12.2 | 13.1 | 14.1 | 15.3 | 16.8 | 18.6 | 20.9 |
| 6: 4 | 76 | 12.2 | 13.1 | 14.1 | 15.4 | 16.8 | 18.7 | 21.0 |
| 6: 5 | 77 | 12.2 | 13.1 | 14.1 | 15.4 | 16.9 | 18.7 | 21.0 |
| 6: 6 | 78 | 12.2 | 13.1 | 14.1 | 15.4 | 16.9 | 18.7 | 21.1 |
| 6: 7 | 79 | 12.2 | 13.1 | 14.1 | 15.4 | 16.9 | 18.8 | 21.2 |
| 6: 8 | 80 | 12.2 | 13.1 | 14.2 | 15.4 | 16.9 | 18.8 | 21.3 |
| 6: 9 | 81 | 12.2 | 13.1 | 14.2 | 15.4 | 17.0 | 18.9 | 21.3 |
| 6: 10 | 82 | 12.2 | 13.1 | 14.2 | 15.4 | 17.0 | 18.9 | 21.4 |
| 6: 11 | 83 | 12.2 | 13.1 | 14.2 | 15.5 | 17.0 | 19.0 | 21.5 |
| 7: 0 | 84 | 12.3 | 13.1 | 14.2 | 15.5 | 17.0 | 19.0 | 21.6 |
| 7: 1 | 85 | 12.3 | 13.2 | 14.2 | 15.5 | 17.1 | 19.1 | 21.7 |
| 7: 2 | 86 | 12.3 | 13.2 | 14.2 | 15.5 | 17.1 | 19.1 | 21.8 |
| 7: 3 | 87 | 12.3 | 13.2 | 14.3 | 15.5 | 17.1 | 19.2 | 21.9 |
| 7: 4 | 88 | 12.3 | 13.2 | 14.3 | 15.6 | 17.2 | 19.2 | 22.0 |
| 7: 5 | 89 | 12.3 | 13.2 | 14.3 | 15.6 | 17.2 | 19.3 | 22.0 |
| 7: 6 | 90 | 12.3 | 13.2 | 14.3 | 15.6 | 17.2 | 19.3 | 22.1 |
| 7: 7 | 91 | 12.3 | 13.2 | 14.3 | 15.6 | 17.3 | 19.4 | 22.2 |
| 7: 8 | 92 | 12.3 | 13.2 | 14.3 | 15.6 | 17.3 | 19.4 | 22.4 |
| 7: 9 | 93 | 12.4 | 13.3 | 14.3 | 15.7 | 17.3 | 19.5 | 22.5 |
| 7: 10 | 94 | 12.4 | 13.3 | 14.4 | 15.7 | 17.4 | 19.6 | 22.6 |
| 7: 11 | 95 | 12.4 | 13.3 | 14.4 | 15.7 | 17.4 | 19.6 | 22.7 |
| 8: 0 | 96 | 12.4 | 13.3 | 14.4 | 15.7 | 17.4 | 19.7 | 22.8 |
| 8: 1 | 97 | 12.4 | 13.3 | 14.4 | 15.8 | 17.5 | 19.7 | 22.9 |
| 8: 2 | 98 | 12.4 | 13.3 | 14.4 | 15.8 | 17.5 | 19.8 | 23.0 |
| 8: 3 | 99 | 12.4 | 13.3 | 14.4 | 15.8 | 17.5 | 19.9 | 23.1 |
| 8: 4 | 100 | 12.4 | 13.4 | 14.5 | 15.8 | 17.6 | 19.9 | 23.3 |
| 8: 5 | 101 | 12.5 | 13.4 | 14.5 | 15.9 | 17.6 | 20.0 | 23.4 |
| 8: 6 | 102 | 12.5 | 13.4 | 14.5 | 15.9 | 17.7 | 20.1 | 23.5 |
| 8: 7 | 103 | 12.5 | 13.4 | 14.5 | 15.9 | 17.7 | 20.1 | 23.6 |
| 8: 8 | 104 | 12.5 | 13.4 | 14.5 | 15.9 | 17.7 | 20.2 | 23.8 |
| 8: 9 | 105 | 12.5 | 13.4 | 14.6 | 16.0 | 17.8 | 20.3 | 23.9 |
| 8: 10 | 106 | 12.5 | 13.5 | 14.6 | 16.0 | 17.8 | 20.3 | 24.0 |
| 8: 11 | 107 | 12.5 | 13.5 | 14.6 | 16.0 | 17.9 | 20.4 | 24.2 |
| 9: 0 | 108 | 12.6 | 13.5 | 14.6 | 16.0 | 17.9 | 20.5 | 24.3 |
| 9: 1 | 109 | 12.6 | 13.5 | 14.6 | 16.1 | 18.0 | 20.5 | 24.4 |
| 9: 2 | 110 | 12.6 | 13.5 | 14.7 | 16.1 | 18.0 | 20.6 | 24.6 |
| 9: 3 | 111 | 12.6 | 13.5 | 14.7 | 16.1 | 18.0 | 20.7 | 24.7 |
| 9: 4 | 112 | 12.6 | 13.6 | 14.7 | 16.2 | 18.1 | 20.8 | 24.9 |
| 9: 5 | 113 | 12.6 | 13.6 | 14.7 | 16.2 | 18.1 | 20.8 | 25.0 |
| 9: 6 | 114 | 12.7 | 13.6 | 14.8 | 16.2 | 18.2 | 20.9 | 25.1 |
| 9: 7 | 115 | 12.7 | 13.6 | 14.8 | 16.3 | 18.2 | 21.0 | 25.3 |
| 9: 8 | 116 | 12.7 | 13.6 | 14.8 | 16.3 | 18.3 | 21.1 | 25.5 |
| 9: 9 | 117 | 12.7 | 13.7 | 14.8 | 16.3 | 18.3 | 21.2 | 25.6 |
| 9: 10 | 118 | 12.7 | 13.7 | 14.9 | 16.4 | 18.4 | 21.2 | 25.8 |
| 9: 11 | 119 | 12.8 | 13.7 | 14.9 | 16.4 | 18.4 | 21.3 | 25.9 |
| 10: 0 | 120 | 12.8 | 13.7 | 14.9 | 16.4 | 18.5 | 21.4 | 26.1 |

**BMI-for-age BOYS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 10: 1 | 121 | 12.8 | 13.8 | 15.0 | 16.5 | 18.5 | 21.5 | 26.2 |
| 10: 2 | 122 | 12.8 | 13.8 | 15.0 | 16.5 | 18.6 | 21.6 | 26.4 |
| 10: 3 | 123 | 12.8 | 13.8 | 15.0 | 16.6 | 18.6 | 21.7 | 26.6 |
| 10: 4 | 124 | 12.9 | 13.8 | 15.0 | 16.6 | 18.7 | 21.7 | 26.7 |
| 10: 5 | 125 | 12.9 | 13.9 | 15.1 | 16.6 | 18.8 | 21.8 | 26.9 |
| 10: 6 | 126 | 12.9 | 13.9 | 15.1 | 16.7 | 18.8 | 21.9 | 27.0 |
| 10: 7 | 127 | 12.9 | 13.9 | 15.1 | 16.7 | 18.9 | 22.0 | 27.2 |
| 10: 8 | 128 | 13.0 | 13.9 | 15.2 | 16.8 | 18.9 | 22.1 | 27.4 |
| 10: 9 | 129 | 13.0 | 14.0 | 15.2 | 16.8 | 19.0 | 22.2 | 27.5 |
| 10: 10 | 130 | 13.0 | 14.0 | 15.2 | 16.9 | 19.0 | 22.3 | 27.7 |
| 10: 11 | 131 | 13.0 | 14.0 | 15.3 | 16.9 | 19.1 | 22.4 | 27.9 |
| 11: 0 | 132 | 13.1 | 14.1 | 15.3 | 16.9 | 19.2 | 22.5 | 28.0 |
| 11: 1 | 133 | 13.1 | 14.1 | 15.3 | 17.0 | 19.2 | 22.5 | 28.2 |
| 11: 2 | 134 | 13.1 | 14.1 | 15.4 | 17.0 | 19.3 | 22.6 | 28.4 |
| 11: 3 | 135 | 13.1 | 14.1 | 15.4 | 17.1 | 19.3 | 22.7 | 28.5 |
| 11: 4 | 136 | 13.2 | 14.2 | 15.5 | 17.1 | 19.4 | 22.8 | 28.7 |
| 11: 5 | 137 | 13.2 | 14.2 | 15.5 | 17.2 | 19.5 | 22.9 | 28.8 |
| 11: 6 | 138 | 13.2 | 14.2 | 15.5 | 17.2 | 19.5 | 23.0 | 29.0 |
| 11: 7 | 139 | 13.2 | 14.3 | 15.6 | 17.3 | 19.6 | 23.1 | 29.2 |
| 11: 8 | 140 | 13.3 | 14.3 | 15.6 | 17.3 | 19.7 | 23.2 | 29.3 |
| 11: 9 | 141 | 13.3 | 14.3 | 15.7 | 17.4 | 19.7 | 23.3 | 29.5 |
| 11: 10 | 142 | 13.3 | 14.4 | 15.7 | 17.4 | 19.8 | 23.4 | 29.6 |
| 11: 11 | 143 | 13.4 | 14.4 | 15.7 | 17.5 | 19.9 | 23.5 | 29.8 |
| 12: 0 | 144 | 13.4 | 14.5 | 15.8 | 17.5 | 19.9 | 23.6 | 30.0 |
| 12: 1 | 145 | 13.4 | 14.5 | 15.8 | 17.6 | 20.0 | 23.7 | 30.1 |
| 12: 2 | 146 | 13.5 | 14.5 | 15.9 | 17.6 | 20.1 | 23.8 | 30.3 |
| 12: 3 | 147 | 13.5 | 14.6 | 15.9 | 17.7 | 20.2 | 23.9 | 30.4 |
| 12: 4 | 148 | 13.5 | 14.6 | 16.0 | 17.8 | 20.2 | 24.0 | 30.6 |
| 12: 5 | 149 | 13.6 | 14.6 | 16.0 | 17.8 | 20.3 | 24.1 | 30.7 |
| 12: 6 | 150 | 13.6 | 14.7 | 16.1 | 17.9 | 20.4 | 24.2 | 30.9 |
| 12: 7 | 151 | 13.6 | 14.7 | 16.1 | 17.9 | 20.4 | 24.3 | 31.0 |
| 12: 8 | 152 | 13.7 | 14.8 | 16.2 | 18.0 | 20.5 | 24.4 | 31.1 |
| 12: 9 | 153 | 13.7 | 14.8 | 16.2 | 18.0 | 20.6 | 24.5 | 31.3 |
| 12: 10 | 154 | 13.7 | 14.8 | 16.3 | 18.1 | 20.7 | 24.6 | 31.4 |
| 12: 11 | 155 | 13.8 | 14.9 | 16.3 | 18.2 | 20.8 | 24.7 | 31.6 |
| 13: 0 | 156 | 13.8 | 14.9 | 16.4 | 18.2 | 20.8 | 24.8 | 31.7 |
| 13: 1 | 157 | 13.8 | 15.0 | 16.4 | 18.3 | 20.9 | 24.9 | 31.8 |
| 13: 2 | 158 | 13.9 | 15.0 | 16.5 | 18.4 | 21.0 | 25.0 | 31.9 |
| 13: 3 | 159 | 13.9 | 15.1 | 16.5 | 18.4 | 21.1 | 25.1 | 32.1 |
| 13: 4 | 160 | 14.0 | 15.1 | 16.6 | 18.5 | 21.1 | 25.2 | 32.2 |
| 13: 5 | 161 | 14.0 | 15.2 | 16.6 | 18.6 | 21.2 | 25.2 | 32.3 |
| 13: 6 | 162 | 14.0 | 15.2 | 16.7 | 18.6 | 21.3 | 25.3 | 32.4 |
| 13: 7 | 163 | 14.1 | 15.2 | 16.7 | 18.7 | 21.4 | 25.4 | 32.6 |
| 13: 8 | 164 | 14.1 | 15.3 | 16.8 | 18.7 | 21.5 | 25.5 | 32.7 |
| 13: 9 | 165 | 14.1 | 15.3 | 16.8 | 18.8 | 21.5 | 25.6 | 32.8 |
| 13: 10 | 166 | 14.2 | 15.4 | 16.9 | 18.9 | 21.6 | 25.7 | 32.9 |
| 13: 11 | 167 | 14.2 | 15.4 | 17.0 | 18.9 | 21.7 | 25.8 | 33.0 |
| 14: 0 | 168 | 14.3 | 15.5 | 17.0 | 19.0 | 21.8 | 25.9 | 33.1 |
| 14: 1 | 169 | 14.3 | 15.5 | 17.1 | 19.1 | 21.8 | 26.0 | 33.2 |
| 14: 2 | 170 | 14.3 | 15.6 | 17.1 | 19.1 | 21.9 | 26.1 | 33.3 |
| 14: 3 | 171 | 14.4 | 15.6 | 17.2 | 19.2 | 22.0 | 26.2 | 33.4 |
| 14: 4 | 172 | 14.4 | 15.7 | 17.2 | 19.3 | 22.1 | 26.3 | 33.5 |
| 14: 5 | 173 | 14.5 | 15.7 | 17.3 | 19.3 | 22.2 | 26.4 | 33.5 |
| 14: 6 | 174 | 14.5 | 15.7 | 17.3 | 19.4 | 22.2 | 26.5 | 33.6 |
| 14: 7 | 175 | 14.5 | 15.8 | 17.4 | 19.5 | 22.3 | 26.5 | 33.7 |
| 14: 8 | 176 | 14.6 | 15.8 | 17.4 | 19.5 | 22.4 | 26.6 | 33.8 |
| 14: 9 | 177 | 14.6 | 15.9 | 17.5 | 19.6 | 22.5 | 26.7 | 33.9 |
| 14: 10 | 178 | 14.6 | 15.9 | 17.5 | 19.6 | 22.5 | 26.8 | 33.9 |
| 14: 11 | 179 | 14.7 | 16.0 | 17.6 | 19.7 | 22.6 | 26.9 | 34.0 |
| 15: 0 | 180 | 14.7 | 16.0 | 17.6 | 19.8 | 22.7 | 27.0 | 34.1 |

**BMI-for-age BOYS**
**5 to 19 years (z-scores)**

World Health Organization

| Year: Month | Months | -3 SD | -2 SD | -1 SD | Median | 1 SD | 2 SD | 3 SD |
|---|---|---|---|---|---|---|---|---|
| 15: 1 | 181 | 14.7 | 16.1 | 17.7 | 19.8 | 22.8 | 27.1 | 34.1 |
| 15: 2 | 182 | 14.8 | 16.1 | 17.8 | 19.9 | 22.8 | 27.1 | 34.2 |
| 15: 3 | 183 | 14.8 | 16.1 | 17.8 | 20.0 | 22.9 | 27.2 | 34.3 |
| 15: 4 | 184 | 14.8 | 16.2 | 17.9 | 20.0 | 23.0 | 27.3 | 34.3 |
| 15: 5 | 185 | 14.9 | 16.2 | 17.9 | 20.1 | 23.0 | 27.4 | 34.4 |
| 15: 6 | 186 | 14.9 | 16.3 | 18.0 | 20.1 | 23.1 | 27.4 | 34.5 |
| 15: 7 | 187 | 15.0 | 16.3 | 18.0 | 20.2 | 23.2 | 27.5 | 34.5 |
| 15: 8 | 188 | 15.0 | 16.3 | 18.1 | 20.3 | 23.3 | 27.6 | 34.6 |
| 15: 9 | 189 | 15.0 | 16.4 | 18.1 | 20.3 | 23.3 | 27.7 | 34.6 |
| 15: 10 | 190 | 15.0 | 16.4 | 18.2 | 20.4 | 23.4 | 27.7 | 34.7 |
| 15: 11 | 191 | 15.1 | 16.5 | 18.2 | 20.4 | 23.5 | 27.8 | 34.7 |
| 16: 0 | 192 | 15.1 | 16.5 | 18.2 | 20.5 | 23.5 | 27.9 | 34.8 |
| 16: 1 | 193 | 15.1 | 16.5 | 18.3 | 20.6 | 23.6 | 27.9 | 34.8 |
| 16: 2 | 194 | 15.2 | 16.6 | 18.3 | 20.6 | 23.7 | 28.0 | 34.8 |
| 16: 3 | 195 | 15.2 | 16.6 | 18.4 | 20.7 | 23.7 | 28.1 | 34.9 |
| 16: 4 | 196 | 15.2 | 16.7 | 18.4 | 20.7 | 23.8 | 28.1 | 34.9 |
| 16: 5 | 197 | 15.3 | 16.7 | 18.5 | 20.8 | 23.8 | 28.2 | 35.0 |
| 16: 6 | 198 | 15.3 | 16.7 | 18.5 | 20.8 | 23.9 | 28.3 | 35.0 |
| 16: 7 | 199 | 15.3 | 16.8 | 18.6 | 20.9 | 24.0 | 28.3 | 35.0 |
| 16: 8 | 200 | 15.3 | 16.8 | 18.6 | 20.9 | 24.0 | 28.4 | 35.1 |
| 16: 9 | 201 | 15.4 | 16.8 | 18.7 | 21.0 | 24.1 | 28.5 | 35.1 |
| 16: 10 | 202 | 15.4 | 16.9 | 18.7 | 21.0 | 24.2 | 28.5 | 35.1 |
| 16: 11 | 203 | 15.4 | 16.9 | 18.7 | 21.1 | 24.2 | 28.6 | 35.2 |
| 17: 0 | 204 | 15.4 | 16.9 | 18.8 | 21.1 | 24.3 | 28.6 | 35.2 |
| 17: 1 | 205 | 15.5 | 17.0 | 18.8 | 21.2 | 24.3 | 28.7 | 35.2 |
| 17: 2 | 206 | 15.5 | 17.0 | 18.9 | 21.2 | 24.4 | 28.7 | 35.2 |
| 17: 3 | 207 | 15.5 | 17.0 | 18.9 | 21.3 | 24.4 | 28.8 | 35.3 |
| 17: 4 | 208 | 15.5 | 17.1 | 18.9 | 21.3 | 24.5 | 28.9 | 35.3 |
| 17: 5 | 209 | 15.6 | 17.1 | 19.0 | 21.4 | 24.5 | 28.9 | 35.3 |
| 17: 6 | 210 | 15.6 | 17.1 | 19.0 | 21.4 | 24.6 | 29.0 | 35.3 |
| 17: 7 | 211 | 15.6 | 17.1 | 19.1 | 21.5 | 24.7 | 29.0 | 35.4 |
| 17: 8 | 212 | 15.6 | 17.2 | 19.1 | 21.5 | 24.7 | 29.1 | 35.4 |
| 17: 9 | 213 | 15.6 | 17.2 | 19.1 | 21.6 | 24.8 | 29.1 | 35.4 |
| 17: 10 | 214 | 15.7 | 17.2 | 19.2 | 21.6 | 24.8 | 29.2 | 35.4 |
| 17: 11 | 215 | 15.7 | 17.3 | 19.2 | 21.7 | 24.9 | 29.2 | 35.4 |
| 18: 0 | 216 | 15.7 | 17.3 | 19.2 | 21.7 | 24.9 | 29.2 | 35.4 |
| 18: 1 | 217 | 15.7 | 17.3 | 19.3 | 21.8 | 25.0 | 29.3 | 35.4 |
| 18: 2 | 218 | 15.7 | 17.3 | 19.3 | 21.8 | 25.0 | 29.3 | 35.5 |
| 18: 3 | 219 | 15.7 | 17.4 | 19.3 | 21.8 | 25.1 | 29.4 | 35.5 |
| 18: 4 | 220 | 15.8 | 17.4 | 19.4 | 21.9 | 25.1 | 29.4 | 35.5 |
| 18: 5 | 221 | 15.8 | 17.4 | 19.4 | 21.9 | 25.1 | 29.5 | 35.5 |
| 18: 6 | 222 | 15.8 | 17.4 | 19.4 | 22.0 | 25.2 | 29.5 | 35.5 |
| 18: 7 | 223 | 15.8 | 17.5 | 19.5 | 22.0 | 25.2 | 29.5 | 35.5 |
| 18: 8 | 224 | 15.8 | 17.5 | 19.5 | 22.0 | 25.3 | 29.6 | 35.5 |
| 18: 9 | 225 | 15.8 | 17.5 | 19.5 | 22.1 | 25.3 | 29.6 | 35.5 |
| 18: 10 | 226 | 15.8 | 17.5 | 19.6 | 22.1 | 25.4 | 29.6 | 35.5 |
| 18: 11 | 227 | 15.8 | 17.5 | 19.6 | 22.2 | 25.4 | 29.7 | 35.5 |
| 19: 0 | 228 | 15.9 | 17.6 | 19.6 | 22.2 | 25.4 | 29.7 | 35.5 |

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## List of contributors

The TB Program acknowledges the input received from the following officers who worked tirelessly during the development of this guideline.

| | |
|---|---|
| Dr Joseph Sitienei | Division of Communicable Disease Prevention and Control |
| Dr Joel Kangangi | World Health Organization |
| Dr Enos Masini | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Agnes Langat | Center for Disease Control and Prevention |
| Dr Herman Weyenga | Center for Disease Control and Prevention |
| Dr Kamene Kimenye | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Richard Muthoka | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Immaculate Kathure | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Shobha Vakil | National AIDS & STI Control Program |
| Prof. Elizabeth Obimbo | The University of Nairobi |
| Dr Diana Marangu | The University of Nairobi |
| Dr Evans Amukoye | Kenya Medical Research Institute |
| Dr Lorraine Mugambi -Nyaboga | Tuberculosis Accelerated Response & Care |
| Dr Maureen Syowai | International Center for AIDS Care & Treatment Programs |
| Rose Wambu | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Teresiah Njoroge | Centre for Health Solutions - Kenya (CHS) |
| Wesley Tomno | National Tuberculosis, Leprosy and Lung Disease Program |

| | |
|---|---|
| Sammy Arithi | Kenya Association for the Prevention of TB and Lung Diseases |
| Dorothy Mibei | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Evelyn Kimani | County Government of Kiambu |
| John Martin Omondi | County Government of Kisii |
| Dr Kiogora Gatimbu | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Christine Wambugu | National Tuberculosis, Leprosy and Lung Disease Program |
| Jeremiah Okari | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Muthoni Karanja | National AIDS & STI Control Program |
| Dr Jacquie Oliwa | Kenya Medical Research Institute - Welcome Trust |
| Rose Muthee | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Brenda Mungai | Tuberculosis Accelerated Response & Care |
| Dorothy Njagi | Tuberculosis Accelerated Response & Care |
| Dr Laura Angwenyi | National AIDS & STI Control Program |
| Samuel Misoi | National Tuberculosis, Leprosy and Lung Disease Program |
| James Sekento | National Tuberculosis, Leprosy and Lung Disease Program |
| Dr Elizabeth Onyango | National Tuberculosis, Leprosy and Lung Diseases Program |