REPUBLIC OF KENYA

MINISTRY OF HEALTH

NATIONAL TUBERCULOSIS, LEPROSY AND LUNG DISEASE PROGRAM

INTEGRATED GUIDELINES ON THE MANAGEMENT OF CHRONIC RESPIRATORY DISEASES

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List of Abbreviations and Acronyms

6MWT: Six-Minute Walk Test

ABPA: Allergic Bronchopulmonary Aspergillosis

ARI: Acute Respiratory Infections

BAL: Bronchoalveolar Lavage

BMI: Body Mass Index

BNP: B-type Natriuretic Peptide

BPD: Bronchopulmonary Dysplasia

CCAM: Congenital Cystic Adenomatoid Malformation

CHP: Community Health Promoter

COPD: Chronic Obstructive Pulmonary Disease

CPAM: Congenital Pulmonary Airway Malformations

CRDs: Chronic Respiratory Diseases

CT: Computed Tomography

DALYs: Disability-Adjusted Life Years

DLCO: Diffusing Capacity of the Lungs for Carbon Monoxide

EMCA: Environmental Management and Coordination Act

FEV1: Forced Expiratory Volume in 1 second

FRC: Functional Residual Capacity

FVC: Forced Vital Capacity

GINA: Global Initiative for Asthma

HNAPs: Health National Adaptation Plan

HRCT: High-Resolution Computed Tomography

IAP: Indoor Air Pollution

ISAAC: International Study of Asthma and Allergic Disease in Childhood

MRI: Magnetic Resonance Imaging

MUAC: Mid-Upper Arm Circumference

NCDs: Non-Communicable Diseases

NCPAP: Nasal Continuous Positive Airway Pressure

NTM: Non-Tuberculous Mycobacteria

PCD: Primary Ciliary Dyskinesia

PEF: Peak Expiratory Flow

PEFR: Peak Expiratory Flow Rate

PET: Positron Emission Tomography

PFTs: Pulmonary Function Tests

PHC: Primary Health Care

PHQ-9: Patient Health Questionnaire-9

PR: Pulmonary Rehabilitation

PTLD: Post Tuberculosis Lung Disease

RSV: Respiratory Syncytial Virus

RV: Residual Volume

TB: Tuberculosis

TLC: Total Lung Capacity

UHC: Universal Health Coverage

VAS: Visual Analog Scale

WHOQOL: World Health Organization Quality of Life

FOREWORD

Chronic respiratory diseases (CRDs) such as asthma, chronic obstructive pulmonary disease (COPD), and post-tuberculosis lung disease (PTLD) continue to pose a significant and growing public health challenge in Kenya. Alongside other conditions including lung cancer, interstitial lung diseases, and occupational lung diseases, they contribute greatly to illness, disability, premature deaths, and health system costs. Despite this burden, CRDs have historically received less attention compared to communicable diseases. This has often led to delayed diagnosis, inconsistent management, and fragmented follow-up care, with devastating consequences for patients, families, and the economy.

The Ministry of Health recognizes the urgent need for a comprehensive, integrated, and standardized approach to lung health care. These National Integrated Guidelines on the Management of Chronic Respiratory Diseases are therefore a landmark effort to strengthen the prevention, diagnosis, treatment, and long-term management of priority lung conditions across all levels of the health system. The guidelines draw from international best practices—such as the Global Initiative for Asthma (GINA), the Global Initiative for Chronic Obstructive Lung Disease (GOLD), and World Health Organization (WHO) recommendations—while being carefully adapted to Kenya's health system context.

This document underscores the importance of prevention through tobacco control, pollution reduction, vaccination, and occupational health interventions; promotes early detection through tools such as spirometry and digital chest X-ray with artificial intelligence (AI); and provides evidence-based, stepwise management protocols for asthma, COPD, PTLD, and other CRDs. It further emphasizes the need for continuum of care, from community to tertiary referral hospitals, integration with existing TB, HIV, and non-communicable disease programs, and alignment with Kenya's Universal Health Coverage (UHC) agenda.

I urge all health workers, policymakers, trainers, and implementing partners to embrace these guidelines and ensure their effective implementation. By doing so, we will reduce the burden of chronic respiratory diseases, improve the quality of life for millions of Kenyans, and move closer to achieving our national and global health commitments.

The Ministry of Health extends gratitude to all stakeholders—national and county health teams, development partners, clinicians, researchers, and patient groups—whose dedication and expertise made this guideline possible. Their contribution reflects our collective commitment to equitable, evidence-based, and people-centered health care.

Together, let us act decisively to transform lung health services and safeguard the breathing health of our nation.

Dr. Patrick Amoth, EBS
Director General for Health
Ministry of Health, Kenya

ACKNOWLEDGEMENT

The development of the National Integrated Guidelines on the Management of Chronic Respiratory Diseases (CRDs) marks an important milestone in strengthening Kenya's response to the growing burden of lung health conditions. For many years, the National Tuberculosis Program has provided leadership in the fight against TB, but we have also witnessed first-hand the significant challenges faced by TB survivors who continue to live with post-TB lung disease (PTLD). Addressing PTLD alongside asthma, chronic obstructive pulmonary disease (COPD), lung cancer, occupational-related lung diseases, and other chronic respiratory conditions is therefore critical to ensuring holistic and sustainable lung health care in Kenya.

The National TB Program is proud to have played a key role in coordinating and supporting the development of this guideline. This collaborative effort brought together experts and stakeholders across government programs, academia, development partners, clinicians, county health teams, professional associations, and community health actors. Their tireless commitment, technical expertise, and passion for lung health have ensured that these guidelines are evidence-based, practical, and responsive to Kenya's health system needs.

We extend our heartfelt appreciation to the Ministry of Health leadership for providing strategic direction, to our county health management teams for their input, and to our frontline health workers for their dedication to patient care. Special recognition also goes to our development partners and technical agencies, whose financial and technical support made this process possible.

It is our hope that these guidelines will serve as a powerful tool to standardize care, promote integration of CRD management with TB and other national programs, and strengthen health worker capacity at all levels. By ensuring timely diagnosis, appropriate treatment, and long-term follow-up, we can reduce morbidity and mortality from chronic respiratory diseases, while improving quality of life for patients and families.

On behalf of the National TB Program, I reaffirm our commitment to championing the implementation of these guidelines. Together with our partners, we will continue to drive innovation, capacity building, and health system strengthening in order to safeguard the lung health of all Kenyans.

Dr. Immaculate Kathure, OGW

Head, Division of National Tuberculosis, Leprosy and Lung Disease Program (DNTLD-P)
Ministry of Health – Kenya

EXECUTIVE SUMMARY

Chronic respiratory diseases (CRDs) are a major and growing public health challenge in Kenya. Asthma, chronic obstructive pulmonary disease (COPD), and post-tuberculosis lung disease (PTLD) contribute substantially to morbidity, mortality, and health system costs. Together with lung cancer, occupational lung diseases, and interstitial lung diseases, they represent a significant burden requiring a coordinated, evidence-based response.

This National Integrated Lung Health Guideline provides standardized recommendations for the prevention, diagnosis, treatment, and long-term management of priority lung conditions across all levels of care. It draws from international best practices, including the Global Initiative for Asthma (GINA), Global Initiative for Chronic Obstructive Lung Disease (GOLD), and WHO guidance, and adapts them to the Kenyan health system context.

The guideline emphasizes:

- **Prevention and Health Promotion:** Tobacco control, air pollution reduction, occupational health, vaccination, and community awareness.
- **Early Detection and Diagnosis:** Use of digital chest X-ray with AI support, peak expiratory flow rate (PEFR), spirometry and other essential investigations.
- **Standardized Clinical Management:** Evidence-based stepwise treatment of asthma, classification-based management of COPD, and comprehensive care for PTLD.
- **Continuum of Care Across Levels:** From community screening and primary health centers to tertiary referral hospitals, with clear referral pathways.
- **Integration with Existing Programs:** Alignment with TB, HIV, NCDs, and UHC strategies.
- **Health System Strengthening:** Ensuring commodity security, training of health workers, integration into HMIS/DHIS2, and supportive supervision.

The intended outcomes of implementing this guideline are:

- Improved diagnostic accuracy and early initiation of care.
- Reduced morbidity, disability, and premature deaths from lung diseases.
- Strengthened integration of lung health into Kenya's primary health care and UHC agenda.
- Empowered patients through education, self-management, and rehabilitation.

This guideline will be operationalized through a companion **Pocket Book** for clinicians and a **Job Aid** for frontline workers. Together, these tools will ensure that all cadres of health workers have access to appropriate, practical, and harmonized information for lung health care delivery.

Purpose and Scope of the Guideline

Purpose

The purpose of this guideline is to provide standardized, evidence-based recommendations for the prevention, diagnosis, management, and long-term follow-up of priority lung diseases in Kenya. It is designed to strengthen health worker capacity, promote rational use of diagnostics and medicines, and support integration of lung health into existing national health programs.

Scope

This guideline covers the following areas:

- **Diseases included:** Asthma, COPD, PTLD, lung cancer, occupational lung diseases, interstitial lung diseases, cystic fibrosis, and pediatric chronic respiratory diseases.
- **Health system levels:** Community, primary health facilities, secondary (county) hospitals, and tertiary referral hospitals.
- **Cross-cutting elements:** Prevention and risk reduction, diagnostics, referral pathways, patient education, rehabilitation, palliative care, monitoring and evaluation, and integration with TB, HIV, and NCD programs.

Target users:

- Specialists (pulmonologists, physicians, pediatricians)
- Nurses and clinical officers at county, sub-county hospitals and primary care facilities
- Community health practitioners (CHPs) and volunteers
- Program managers, policymakers, and trainers

Introduction

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1.1 Background

Chronic Respiratory Diseases (CRDs) are a significant and growing public health problem in Kenya. Conditions such as asthma, chronic obstructive pulmonary disease (COPD), and post-tuberculosis lung disease (PTLD) contribute to a growing number of outpatient visits, hospital admissions, disability, and premature mortality. In addition, other respiratory conditions including lung cancer, occupational lung diseases, interstitial lung disease, cystic fibrosis, and pediatric chronic respiratory diseases are increasingly recognized as important contributors to morbidity.

The rising burden of lung disease in Kenya is driven by multiple risk factors. These include tobacco use, household and ambient air pollution, occupational exposures, indoor biomass fuel use, respiratory infections, and the growing number of TB survivors who are at risk of long-term lung complications (1–5). Social determinants such as poverty, overcrowding, malnutrition, and limited access to health services further compound the problem (6,7) .

Despite this burden, services for CRDs have historically received less attention compared to communicable diseases such as TB, malaria, and HIV. Diagnosis is often delayed, management is inconsistent, and follow-up care is fragmented. As a result, many patients experience poor health outcomes, avoidable disability, and reduced quality of life.

This guideline has been developed in recognition of the urgent need to strengthen lung health services in Kenya. It provides a framework for standardizing care, improving access to essential diagnostics and medicines, and building health worker capacity across all levels of the health system.

1.2 Rationale for the Guideline

The rationale for developing this guideline is based on:

- **High and rising disease burden:** Asthma, COPD, PTLD, and other lung diseases are major contributors to illness and premature death in Kenya.

- **Variability in care:** Current diagnosis and management practices are inconsistent across facilities and levels of care, resulting in inequities and poor outcomes.
- **Need for integration:** Lung health must be better integrated into existing TB, HIV, NCD, and UHC programs to ensure continuity of care.
- **Alignment with global best practice:** Standardization based on global evidence (GINA, GOLD, WHO) adapted to the Kenyan context is essential.
- **Capacity building:** Health workers require clear, practical, and harmonized tools to diagnose, manage, and monitor lung diseases effectively.

1.3 Purpose of the Guideline

The purpose of this guideline is to provide standardized, evidence-based recommendations for the prevention, diagnosis, management, and long-term follow-up of priority lung diseases in Kenya. It seeks to strengthen the capacity of health workers, promote rational use of medicines and diagnostics, and support integration of lung health into the national health system in line with Universal Health Coverage (UHC).

1.4 Scope of the Guideline

This guideline covers the following areas:

- **Diseases included:** Asthma, COPD, PTLD, lung cancer, occupational lung diseases, interstitial lung disease, cystic fibrosis, and pediatric chronic respiratory diseases.
- **Health system levels:** Community, primary health facilities, secondary (county) hospitals, and tertiary referral hospitals.
- **Cross-cutting elements:** Prevention and risk reduction, diagnostics, referral pathways, patient education, rehabilitation, palliative care, monitoring and evaluation, and integration with TB, HIV, and NCD programs.
- **Companion tools:** This guideline is supported by a **Pocket Book** for clinicians and a **Job Aid** for frontline health workers to facilitate implementation across all levels of care.

1.5 Target Audience

This guideline is intended for:

- **Specialist providers:** pulmonologists, physicians, pediatricians, thoracic surgeons, radiologists, rehabilitation specialists.
- **General clinicians:** medical officers, clinical officers, nurses, pharmacists, physiotherapists, and nutritionists working in county and sub-county hospitals.

- **Primary health care workers:** clinicians, nurses, and community health practitioners at dispensaries and health centers.
- **Community health workers:** community health practitioners (CHPs) and volunteers providing education, case finding, follow-up, and adherence support at the community level.
- **Health system managers and policymakers:** MoH officials, county health management teams, program managers, and implementing partners responsible for planning, resource allocation, monitoring, and supervision.
- **Training institutions:** medical and nursing schools, universities, and professional associations that will incorporate these guidelines into curricula and continuing professional development (CPD).

1.6 Burden of Lung Disease in Kenya and Globally

Respiratory diseases account for more than 10% of all disability-adjusted life years (DALYs) and make up five of the thirty most common causes of death worldwide (8,9). In Kenya, respiratory diseases account for at least 30% of outpatient morbidity and remain a major contributor to overall mortality (10,11).

The most frequently occurring respiratory diseases that result in substantial morbidity and mortality are pneumonia, acute respiratory infections (ARI), TB, Asthma, chronic obstructive pulmonary disease (COPD), and lung cancer (12). In Kenya COPD is more common among males, older persons and farmers (13).

A multi-country study of chronic respiratory diseases (CRDs) in Kenya, Ethiopia, and Sudan revealed that asthma was the most prevalent condition (36%), followed by chronic bronchitis (25%), COPD (8%), bronchiectasis (5%), and post-TB lung disease (4%) (14). The mean duration of hospital admission for COPD is three (3) days with exacerbations accounting for 49% of deaths peaking (41%) during cold seasons, 20% of these deaths resulting from cardiac complications (14). Spirometry results indicated that 35% of patients showed signs consistent with COPD, and 38% demonstrated respiratory restrictions (14) .

The study also highlighted a significant challenge in respiratory healthcare such as suboptimal diagnosis and management of asthma and COPD. Expanding access to diagnostic tools is therefore critical to improving care and outcomes.

1.7 Policy and Legal Framework

Kenya has a strong policy and legal environment that supports the prevention and control of lung diseases. Relevant instruments include:

- **The Constitution of Kenya (2010):** Right to a clean and healthy environment; right to the highest attainable standard of health; and right to access information (15).
- **The Health Act (2017):** Provides an overarching framework for health services (16).
- **The Tobacco Control Act (2007):** Provides measures for reducing tobacco use and protecting populations from second-hand smoke (17).

- **The Pharmacy and Poisons Act (Cap 244):** Regulates medicines and poisons, including those used in lung disease management (18).
- **The Environmental Management and Coordination Act (1999):** Provides for protection from environmental pollution (19).
- **The Occupational Safety and Health Act (2007):** Provides workplace protections against harmful exposures (20).
- **The Cancer Prevention and Control Act (2012):** Establishes measures for cancer prevention and care (21).
- **Kenya National Health Policy (2014):** Provides strategic direction for the health sector (22).
- **National Climate Change Action Plan (2022) and Health National Adaptation Plan (HNAPs):** Provide measures to address health risks related to climate variability and environmental change (23) .

These instruments provide an enabling framework for the implementation of this guideline, ensuring that prevention, early detection, and management of lung diseases are embedded in Kenya's broader health and development agenda.

Principles of Integrated Lung Health Care

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Effective prevention, diagnosis, and management of lung diseases require a foundation of core principles that apply across all conditions. These principles ensure that care is standardized, evidence-based, and accessible at every level of the health system. They emphasize prevention and risk reduction, early detection of disease, provision of an essential package of services appropriate to each level of care, patient education for self-management, and integration with broader health system priorities. The sections that follow outline these guiding principles, which form the basis for the management of specific lung diseases described in subsequent chapters.

2.1 Prevention and Risk Reduction for Chronic Respiratory Diseases

A wide range of factors contribute to the onset and progression of chronic respiratory diseases. Understanding and addressing these factors is critical for prevention.

2.1.1 Individual Factors

- **Age:** Asthma is more common in childhood; while COPD is more common among people aged above 40 years.
- **Sex:** Childhood asthma is more common in boys, whereas in adulthood, asthma is more common among women.
- **Weight:** Both underweight and overweight/obesity increase risk of poor lung function, asthma, sleep apnoea, and other CRDs.
- **History of infection/exposure:** Previous tuberculosis (PTB), close contact with a person with TB increases risk of long-term lung impairment.

- **Genetic predisposition**: Family history of asthma or COPD, as well as alpha-1 antitrypsin deficiency, increases susceptibility.
- **Perinatal factors:** Prematurity, congenital anomalies, and low birth weight affect lung development and increase long-term risk.
- **Recurrent respiratory infections:** Frequent infections in childhood, TB, or fungal lung disease can result in chronic impairment.
- **Poor nutrition**: Deficiencies in vitamins (A, C, D) and antioxidants can weaken immunity and lung function.

2.1.2 Lifestyle Factors

- **Tobacco use:** The leading cause of COPD and lung cancer and an exacerbating factor for asthma; tobacco use damages lung tissue and reduces lung function over time.
- **Secondhand smoke:** Exposure in households, public spaces, and through occupational risks such as tobacco curing associated with tobacco farming.
- **Smoking during pregnancy:** Can lead to impaired lung development in infants, increasing their risk of chronic respiratory diseases later in life.
- **Physical inactivity & obesity:** Leads to poor respiratory fitness, overweight, and obesity, which contribute to asthma and sleep apnoea.

2.1.3 Environmental Factors

- **Outdoor air pollution**: Exposure to outdoor pollutants (vehicle emissions, industrial fumes and waste burning).
- **Indoor household air pollution:** Use of biomass fuel, kerosene, coal, and exposure to household detergents, perfumes, and dust mites.
- **Allergens:** Pollen, pets (cats, dogs), cockroaches, and other triggers
- **Fungal exposure:** Molds including *Alternaria* and *Cladosporium*.
- **Strong odors:** Perfumes and cleaning agents can worsen symptoms.

2.1.4 Occupational Hazards

Long-term exposure to occupational dust, fumes, and chemicals is a major driver of CRDs.

- **Common exposures:** silica, asbestos, coal dust, gold dust, quarry dust, flour, cereal, and textile dusts.
- **High-risk occupations:** mining, construction, farming, textiles, welding, sand harvesting, painting, carpentry, roofing, and hairdressing.

- **Associated diseases:** These exposures are strongly linked with occupational lung diseases such as pneumoconiosis (including silicosis, asbestosis, and coal workers' pneumoconiosis), occupational asthma, hypersensitivity pneumonitis, and chronic bronchitis

2.2 Clinical Features of Chronic Respiratory Diseases

CRDs often present with overlapping features, which can complicate diagnosis. Health workers should maintain a high index of suspicion when evaluating patients with:

- Chronic cough (can be dry or productive)
- Difficulty in breathing
- Shortness of breath
- Wheezing
- Cyanosis
- Postural Dyspnea
- Sleep apnea syndrome
- Easy fatigability
- Finger clubbing
- Chest Pain
- Hemoptysis
- History of allergy/ atopy
- History of treatment for Pulmonary TB

2.3 Causes of Chronic Respiratory Diseases

CRDs may be caused by chronic exposures, infections, autoimmune disorders, malignancies, or systemic diseases.

Common causes of chronic cough include (Table 2-1):

- **Upper airway:** Tobacco smoke, household pollutants, irritants (e.g., perfumes, dust), allergic rhinitis, postnasal drip, viral or bacterial infections.
- **Lower respiratory tract:** Chronic exposure to smoke, fumes, dust; tuberculosis; pneumonia; asthma; COPD; hypersensitivity pneumonitis; bronchiectasis; sarcoidosis; interstitial lung disease; lung cancer; pneumoconiosis.
- **Other causes:** Left heart failure, gastroesophageal reflux disease (GERD), side effects of medicines such as ACE inhibitors (e.g., Enalapril), and foreign bodies.

Table 2.1 Causes of chronic cough

Upper airway:	**Lower respiratory tract causes:**

• Tobacco use and exposure to tobacco smoke
• Household pollutants
• Exposure to other mucosal irritants
• Upper airway cough syndrome (formerly postnasal drip)
• Chronic allergic rhinitis
• Infections – viral, bacterial etc
	• Chronic exposure to Irritants: Smoke; fumes; dust, perfumes
	• Infections-Tuberculosis, Pneumonia, Fasciolosis
	• Inflammatory-Asthma, Chronic Obstructive Pulmonary Disease (COPD), hypersensitivity pneumonitis, Bronchiectasis
	• ·Autoimmune Disorders: Sarcoidosis, Interstitial Lung diseases
	• ·Carcinomas: Lung cancer, metastases
	• Pneumoconiosis
	• Cardiac causes: Left heart failure
	• Foreign Body
	• Others cause outside the respiratory system:
	  • Gastroesophageal reflux (GERD)
	  • Side effects of certain medicines e.g. ACE inhibitors e.g. Enalapril

2.4 Programmatic Scope for Chronic Respiratory Diseases

CRDs contribute significantly to global and national morbidity and mortality. A comprehensive programmatic approach is essential for prevention, early detection, and effective management.

Key CRDs of public health importance include:

- Asthma
- Chronic Obstructive Pulmonary Disease (referring to Chronic bronchitis and emphysema)
- Tuberculosis
- Post Tuberculosis Lung Disease (PTLD): Lung scarring (fibrosis), lung abscess, spontaneous pneumothorax, bronchiectasis
- Cystic fibrosis (including congenital)
    - Occupation-related respiratory diseases such as asbestosis, silicosis, hypersensitivity pneumonitis, bronchiolitis obliterans, and coal workers' pneumoconiosis, linked to industries including leather, cement, textiles, and mining etc

- Chronic Pulmonary Aspergillosis - in the form of Aspergilloma
- Lung Cancer

2.5 Chronic Respiratory Diseases of Focus in This Guideline

This guideline will focus specifically on:

1. Asthma
2. Chronic obstructive pulmonary disease (COPD)
3. Tuberculosis (TB)
4. Post TB lung diseases (PTLD)
5. Lung cancer
6. Chronic lung diseases unique to pediatrics

2.6 Essential Package of Lung Health Services

The essential package of care varies by health system level, based on resources and capacity.

- **Level 1 (Community):** Screening, health education, tracing of treatment interrupters, home-based pulmonary rehabilitation, referral to higher levels.
- **Level 2 (Dispensaries/Health centres):** Screening, basic diagnosis, PEFR measurement, initial treatment, referral, health education, tobacco cessation.
- **Level 3 (Primary hospitals):** Diagnosis (including PEFR, basic X-ray with AI, diagnostic spirometry), treatment, facility-based pulmonary rehabilitation, follow-up, referral to higher levels, back-transfer of stable patients.
- **Level 4 (County hospitals):** Comprehensive diagnosis, spirometry, X-ray with AI support, TB diagnostic equipment, treatment, multidisciplinary lung health teams, pulmonary rehabilitation, mentorship for lower facilities.
- **Levels 5 & 6 (Tertiary/Referral hospitals):** Advanced diagnosis (CT, bronchoscopy, interventional radiology, blood gas analysis), specialist management, advanced laboratory tests, pulmonary rehabilitation, palliative care, training, and regional referral services.

Table 2.2 Essential Package of Lung Health Services by Facility Level

Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5&6**
Services	**Services**	**Services**	**Services**	**Services**
Screening	Screening	Screening	Screening	Screening
Referral to level 2&3	Diagnosis	Diagnosis	Diagnosis	Diagnosis

Home-based pulmonary rehabilitation	Peak expiratory flow rate	Peak expiratory flow rate	Peak expiratory flow rate	Peak expiratory flow rate
Follow-up	Treatment	Spirometry	Spirometry	Spirometry
Tracing of treatment interrupters	Referral to level 3	Treatment	Treatment	Treatment
Health Education	Back transfer to level 1 for follow up	Referral to level 4	Primary referral for level 2&3	Primary referral for level 4
Tobacco cessation	Facility based Pulmonary rehabilitation	Back transfer to lower level for follow up	Referral to level 5&6	Regional and international referrals for specialized services
	Follow-up	Facility based Pulmonary rehabilitation	Back transfer to lower level for follow up	Back transfer to lower level for follow up
	Health Education	Follow up	Facility based Pulmonary rehabilitation	Facility based Pulmonary rehabilitation
	Community Outreach	Health Education	Follow up	Follow up
	Tobacco Cessation	Community Outreach	Health Education	Health Education
		Tobacco Cessation	Lung Health Multi disciplinary team*	Training and mentorship
			Radiologist/Remote X-ray reading	Center for excellence for lung health
			Tobacco Cessation	Lung Health Multi disciplinary team*
				Advanced laboratory tests
				Radiologist
				Blood gas analysis
				Bronchoscopy & Pleural services
				Interventional Radiology

Tools, Equipment and Commodities	**Tools, Equipment and Commodities**	**Tools, Equipment and Commodities**	**Tools, Equipment and Commodities**	**Tools, Equipment and Commodities**
Smartphone recording and reporting on eCHIS	Nebulizer	Nebulizer	Nebulizer	Nebulizer
Oxygen concentrators/	Spacers	Spacers	Spacers	Spacers
portable oxygen cylinders	Inhalers (ICS, SABA, LABA, LAMA	Inhalers (ICS, SABA, LABA, LAMA	Inhalers (ICS, SABA, LABA, LAMA)	Inhalers (ICS, SABA, LABA, LAMA)
	Peak Flow Meter	Peak Flow Meter	Peak Flow Meter	Peak Flow Meter
	EMRs/IBU lite	Diagnostic Spirometer	EMRs/IBU lite	EMRs/IBU lite
	Basic Oxygen Equipment	EMRs/TIBU lite	X-Ray with AI	X-Ray with AI
	Screening and treatment algorithm	X-Ray with AI	TB Dx equipment	TB Dx equipment
	Sample referral network	Oxygen Equipment	Diagnostic Spirometer	Diagnostic Spirometer
		Screening and treatment algorithms	Incentive Spirometer	Incentive Spirometer
		Sample referral network	Oxygen Equipment	Oxygen Equipment
			Screening and treatment algorithms	Screening and treatment algorithms
			EMRs/TIBU lite	EMRs/TIBU lite
			Sample referral network	Sample referral network
				e-learning platform

To complement the package of care outlined above, an integrated service delivery pathway guides health workers in systematically evaluating patients with respiratory symptoms. The pathway links symptom screening with digital chest X-ray (DCXR) and AI, tuberculosis diagnostics, spirometry, and referral for chronic respiratory diseases and lung cancer, ensuring timely diagnosis, appropriate management, and continuity of care across all levels of the health system.

REPUBLIC OF KENYA

MINISTRY OF HEALTH

NATIONAL TUBERCULOSIS, LEPROSY AND LUNG DISEASE PROGRAM

LUNG HEALTH SCREENING AND DIAGNOSTIC AGORITHM

Does the client/patient have ANY of the following signs and symptoms?

1. Cough of any duration
2. Fever (body temp exceeding 37°C)
3. Drenching night sweats
4. Unexplained weight loss
5. In Children, Fatigue (lethargy), reduced playfulness, less active
6. BMI<18.5 or Z score < -2
7. In children, Poor weight gain, Z score <-2
8. Chest pain
9. Difficulty in breathing
10. History of contact with a person with TB or person with a chronic cough
11. Presence of social or occupational risk factors **(Box 1)**

YES

NO → Evaluate for other conditions and manage appropriately

Digital Chest X-Ray with AI ← Presence of any of the Risk Factors

Digital Chest X-Ray with AI → Normal / Abnormal

Normal → **Eligible for Spirometry**
- **Spirometer available, conduct spirometry test, and**
- **Spirometry NOT available – clinically evaluate for Chronic lung diseases**

For KVP (Box 2) and patients with high clinical/social/occupational risk factors

Normal → **Not Eligible for Spirometry** Re-evaluate and manage appropriately

Eligible for Spirometry → Diagnosis of Chronic Lung Disease

Eligible for Spirometry → If No Asthma, No COPD, No PTLD conditions or or Occupation-Related Chronic Lung Disease **(Evaluate and manage for other conditions)**

Abnormal → Abnormal suggestive of TB / Abnormal Others / Presence of Lung Nodules

Abnormal suggestive of TB → TB molecular Testing as per DSTB & DRTB guidelines

Presence of Lung Nodules → Refer for lung cancer evaluation as per the NCI guidelines

TB molecular Testing as per DSTB & DRTB guidelines → **MTB Detected** Manage as per DSTB & DRTB Guidelines / **MTB Not Detected**

MTB Detected Manage as per DSTB & DRTB Guidelines → Follow up for Post-TB Lung Disease (PTLD) as per the integrated management of chronic respiratory diseases guideline **(Do Spirometry after successful completion of treatment and follow the cascade)**

MTB Not Detected → Clinical Re-Evaluation **(Box 2)**

Clinical Re-Evaluation **(Box 2)** → **Clinical Diagnosis of TB or EPTB** If Smear microscopy is positive, investigate for NTM (specimen for culture)

Clinical Re-Evaluation **(Box 2)** → **Evaluate for Chronic Lung Diseases (Asthma, COPD, PTLD Conditions, Occupation-Related Chronic Lung Disease)**

Abnormal / Presence of Lung Nodules → **Evaluate for Chronic Lung Diseases (Asthma, COPD, PTLD Conditions, Occupation-Related Chronic Lung Disease)**

Evaluate for Chronic Lung Diseases (Asthma, COPD, PTLD Conditions, Occupation-Related Chronic Lung Disease) → **Six-Minute Walk Test (6-MWT)**

Six-Minute Walk Test (6-MWT) → **Abnormal:** <400 Metres / **Normal**: 400 – 700 Metres

Abnormal: <400 Metres → Peak Flow Meter **NOT** available / Peak Flow Meter (PEFR) Available

Peak Flow Meter (PEFR) Available → PEFR <80% / PEFR >80%

PEFR <80% → Spirometer **NOT** available / Spirometry where available

Spirometry where available → Abnormal (Obstructive, Restrictive & Mixed Features) / Normal

Peak Flow Meter **NOT** available → **Clinical Re-evaluation for Chronic Lung Diseases**

Clinical Re-evaluation for Chronic Lung Diseases → Chronic Obstructive Pulmonary Disease, Asthma, PTLD or Occupation-Related Chronic Lung Disease **(Manage as per the integrated management of chronic respiratory diseases guideline)**

Abnormal (Obstructive, Restrictive & Mixed Features) → Chronic Obstructive Pulmonary Disease, Asthma, PTLD or Occupation-Related Chronic Lung Disease **(Manage as per the integrated management of chronic respiratory diseases guideline)**

Normal → 1. Evaluate for other conditions 2. Evaluate for TB Preventive Therapy (TPT) eligibility

PEFR >80% → 1. Evaluate for other conditions 2. Evaluate for TB Preventive Therapy (TPT) eligibility

Box 1: Social/Occupational Risk
1. HCWS
2. Mine workers
3. Prisoners and wardens
4. Refugees, migrants, and displaced populations
5. Urban poor communities, homeless communities
6. Cement dust
7. Sawdust
8. Animal wastes
9. Coal dust
10. Asbestos fibers
11. Silica dust
12. Flour dust
13. Cotton dust
14. Farming
15. Chemicals
16. Mold

Box 2: Key and Vulnerable populations (KVPs)
1. Patients with Diabetes
2. Dialysis
3. Patients with cancer
4. Immunosuppressive conditions/therapy
5. Diabetic
6. Obesity
7. PLHIV
8. Hypertension
9. Mental Health
10. Malnourished (BMI <18 or z-score <-2 in children)

Box 3: Clinical Evaluation
1. Evaluate for other respiratory conditions, e.g., Asthma, COPD, Lung cancer, PTLD, bronchiectasis, or others
2. Review CXR. If not done, request for one
3. Additional imaging, e.g. CT scan, ultrasound, MRI
4. Re-evaluate and consider a clinical diagnosis of TB or EPTB
5. Consider a diagnosis of Non-Tuberculous Mycobacterium (NTMs), especially if a patient was smear positive. Collect and send a sample for Culture

CLINTON HEALTH ACCESS INITIATIVE

GSK

GF

Link: https://tinyurl.com/2675rnfd

2.7 Patient Education and Health Literacy

Patient education is critical to improve adherence, self-management, and quality of life. The key messages to patients that should be repeated at each contact include:

1. **Understanding the Condition:** Explain the nature, causes, symptoms, and progression of asthma, COPD, PTLD, and other CRDs.
2. **Medication Adherence:** Emphasize the importance of taking medications as prescribed. Explain the different types of medications (e.g., bronchodilators, corticosteroids, Antibiotics, Anti-TBs) and their proper use, including inhaler techniques.
3. **Smoking Cessation:** If the patient smokes, strongly encourage quitting. Provide resources, support, and referrals to smoking cessation programs or medications.
4. **Symptom Management**: Educate patients about recognizing and managing symptoms, such as shortness of breath, chronic cough, and increased mucus production. Encourage prompt reporting of any worsening symptoms to healthcare providers.
5. **Pulmonary Rehabilitation:** Discuss the benefits of pulmonary rehabilitation programs, which include exercise training, education, and support for managing the condition.
6. **Nutrition and Exercise:** Emphasize the importance of a balanced diet and regular exercise to maintain strength and improve overall well-being. Guide suitable exercise activities and breathing techniques.
7. **Vaccinations**: Ensure that patients are up-to-date on vaccinations, including annual influenza vaccines and pneumococcal vaccines.
8. **Breathing Techniques:** Teach effective breathing techniques, such as pursed-lip breathing and diaphragmatic breathing, to manage breathlessness.
9. **Oxygen Therapy:** If prescribed, explain the importance of using oxygen therapy as directed to improve oxygen levels and alleviate symptoms.
10. **Avoiding Environmental Triggers:** Discuss strategies to minimize exposure to environmental triggers such as air pollution, dust, and respiratory irritants.
11. **Lifestyle Modifications:** Encourage a healthy lifestyle, including maintaining a healthy weight and avoiding excessive alcohol intake
12. **Emergency Action Plan:** Develop and review an emergency action plan with the patient, including steps to take in case of worsening symptoms or exacerbations.
13. **Coping Strategies:** Acknowledge the emotional impact of living with a chronic condition and discuss coping strategies, including support groups and counseling.
14. **Regular Follow-up:** Stress the importance of regular follow-up appointments with healthcare providers to monitor the condition and adjust treatment plans as needed.

15. **Support System**: Encourage patients to build a support system that may include family, friends, and healthcare professionals

NB: A patient with severe symptoms referred for review will require continuity of PR as long as the symptoms persist

2.8 Cross-Cutting Care Considerations

- **Life course approach:** Chronic care requires continuity from childhood through adulthood.
- **Integration with other programs:** Linkages with TB, HIV, and NCD programs for efficiency.
- **Comorbidities:** Screening and management of diabetes, hypertension, cardiovascular disease, and mental health conditions.
- **Rehabilitation:** Pulmonary rehabilitation is essential for patients with COPD, PTLD, and severe asthma.
- **Equity and access:** Special attention to vulnerable groups including rural populations, informal settlement residents, and people with disabilities.
- **Palliative care:** Should be available for advanced lung disease.

Diagnostic Principles And Lung Function Assessment Tests

3

Early and accurate diagnosis is essential for effective management of CRDs. Historically, diagnosis has relied heavily on symptoms, but integration of objective tools such as spirometry, peak expiratory flow rate (PEFR), digital chest X-ray (DCXR) with AI, and pulse oximetry is necessary to improve accuracy.

This chapter outlines the key diagnostic principles and tools available for lung health in Kenya, including their role, application at different levels of care, and interpretation. A particular emphasis is placed on **lung function assessment tests**, which have not been standard practice but are now recognized as critical for improving diagnosis and management of asthma, COPD, and post-TB lung disease.

3.1 General Principles of Diagnosis in Lung Health

Diagnosis of CRDs requires a combination of history, risk factor assessment, symptom recognition, and use of diagnostic tools.

- **Holistic assessment:** No single tool is sufficient; diagnosis is strengthened when history, examination, and investigations are combined.
- **Syndromic approach:** Chronic cough, wheeze, and breathlessness are the most common presentations and should trigger structured evaluation.
- **Differential diagnosis:** Distinguish CRDs (asthma, COPD, PTLD) from tuberculosis and other conditions such as cardiac disease or gastroesophageal reflux.
- **Limitation of symptom-only diagnosis:** Reliance solely on symptoms risks misdiagnosis and delayed treatment; objective testing improves accuracy.

3.2 Symptom Screening and Clinical Evaluation

- **Screening and initial clinical evaluation** are essential first steps in diagnosing CRDs. Health workers should:

- **Review symptoms** (chronic cough, wheeze, breathlessness, chest pain, sputum production, exercise intolerance), and
- **Screen for risk factors** (smoking, occupational exposures, biomass fuel use, and history of TB e.t.c), as outlined in Chapter 2.
- Following this, a **focused physical examination** should be performed, looking for:
    - Wheeze, crackles, or reduced breath sounds on auscultation
    - Cyanosis
    - Finger clubbing
    - Chest deformities or hyperinflation
    - Use of accessory muscles of breathing
    - Signs of respiratory failure or cor pulmonale in advanced disease
- Checklists should be used at community and primary care levels to standardize screening, while physical examination findings guide decisions on referral and further diagnostic testing.

3.3 Lung Function Assessment Tests

Lung function tests (LFTs) are used to assess respiratory health by measuring airflow, lung volume, and gas exchange. They help diagnose, monitor, and guide treatment decisions for conditions such as asthma, COPD, post-TB lung disease, and restrictive lung disease.

3.3.1 Spirometry

Spirometry is the gold standard for lung function assessment. This test measures how much air a person can breathe in and out of the lungs, as well as how easily and quickly the air can be expelled. It helps diagnose and monitor respiratory conditions such as:

a) **Obstructive lung diseases** (airflow is blocked) such as Asthma, Chronic obstructive pulmonary disease (COPD), Bronchiectasis

b) **Restrictive lung diseases** (lungs cannot fully expand) such as pulmonary fibrosis and interstitial lung disease

Spirometry is important for:

- Early detection of lung diseases before symptoms become severe.
- Tracking disease progression and response to treatment.
- Supporting HCWs in adjusting medications based on lung function.
- Assessing whether patients have adequate lung capacity to undergo surgery.
- Detecting work-related lung diseases, especially in industries with dust or chemical exposure.

During the test, the patient breathes into a spirometer, which records the following:

- Forced Vital Capacity (FVC): The total amount of air exhaled after taking a deep breath.
- Forced Expiratory Volume in 1 second (FEV1): The amount of air forcefully exhaled in the first second.
- Residual Volume (RV): The amount of air remaining in the lungs after full exhalation, which prevents lung collapse.
- Total Lung Capacity (TLC): The maximum amount of air the lungs can hold, including tidal volume, inspiratory reserve volume, expiratory reserve volume, and residual volume.
- Functional Residual Capacity (FRC): The volume of air remaining in the lungs at the end of normal expiration.

Table 3.1: Normal values of pulmonary function test

Pulmonary function test	***Normal value (95 percent confidence interval)***
FEV_1	80% to 120%
FVC	80% to 120%
Absolute FEV_1 /FVC ratio	Within 5% of the predicted ratio
TLC	80% to 120%
FRC	75% to 120%
RV	75% to 120%

Adapted from AAFP, 2020: https://www.aafp.org/pubs/afp/issues/2020/0315/p362.html

Algorithm for interpreting spirometry

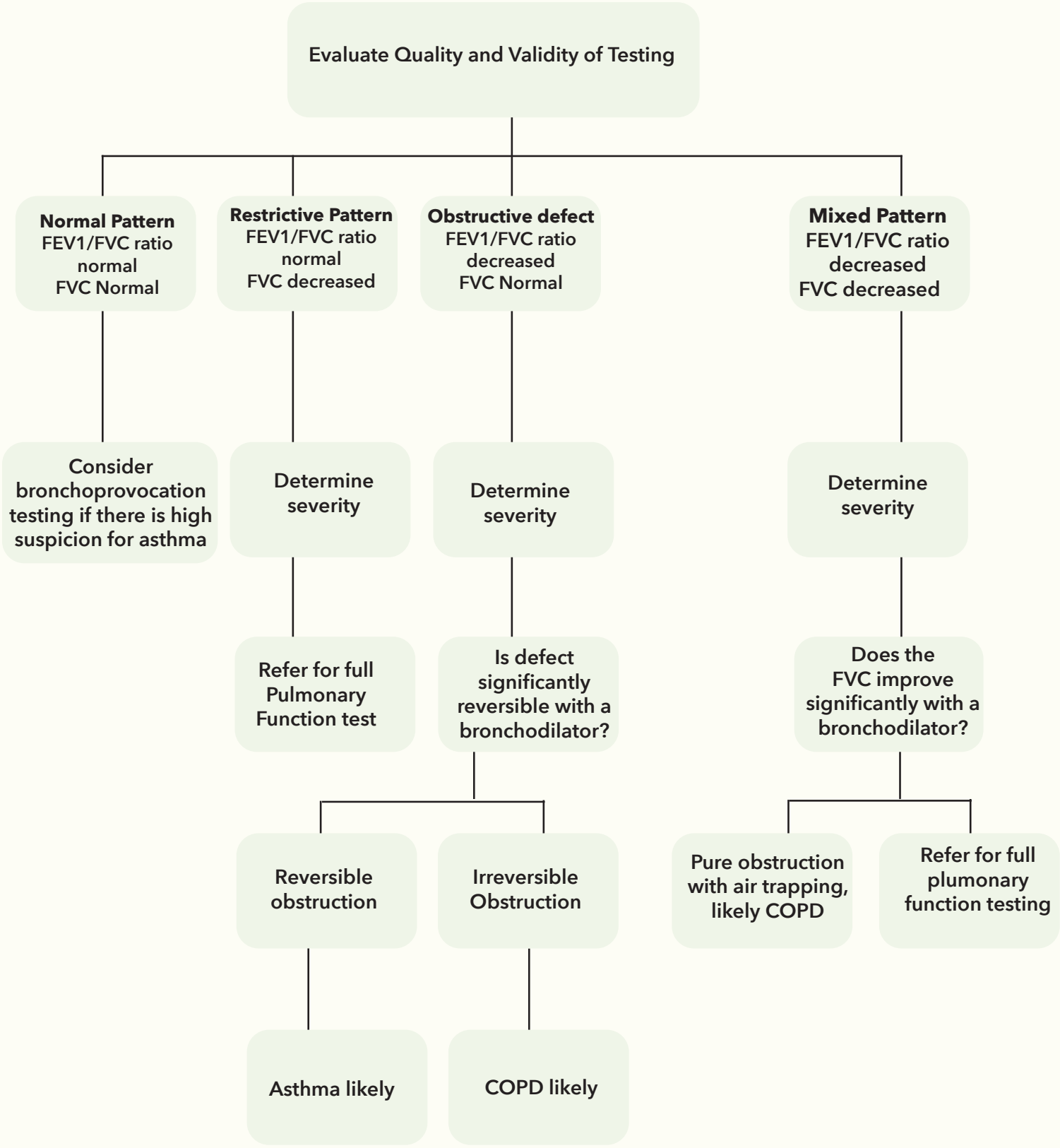


Figure 3.1: Algorithm for interpreting spirometry

Spirograms and Flow Volume Curves

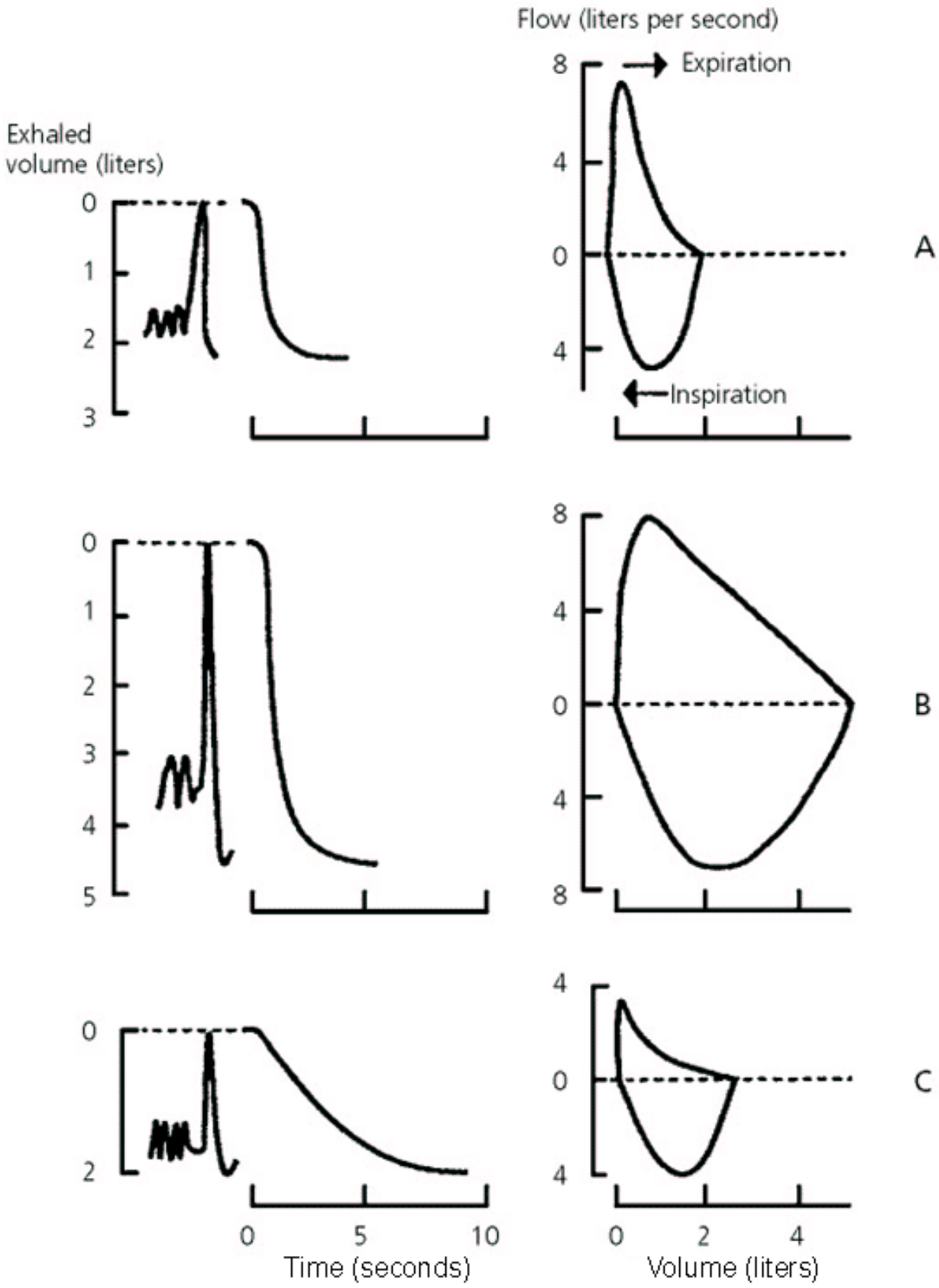


Figure 3.2: Spirograms and Flow Volume Curves

(A) Restrictive ventilatory defect. (B) Normal spirogram. (C) Obstructive ventilatory defect.

Table 3.2: Common Spirometry Patterns and Their Clinical Significance

Normal Spirometry: Indicates no significant lung obstruction or restriction.

Obstructive Pattern: A reduced FEV1/FVC ratio indicates airway obstruction, typically in conditions like COPD or Asthma.

Restrictive Pattern: A reduced FVC with a standard or increased FEV1/FVC ratio suggests a restrictive lung disease with limited lung expansion.

Mixed Pattern: FEV1/FVC ratio<0.7and reduced FVC suggests a combined obstructive and restrictive pattern

Contraindications of spirometry:

- Recent surgery (abdominal, chest, eye, brain, ear)
- Myocardial infarction within the past month
- Recent or current pneumothorax
- Confusion or inability to follow instructions
- Dementia
- Inability to seal mouthpiece
- Acute illness affecting test performance (e.g. vomiting, nausea, vertigo)
- Chest or abdominal pain
- Oral or facial pain aggravated by mouthpiece
- Severe incontinence triggered by coughing

NB: Active TB patients should not undergo spirometry testing until completion of treatment regardless of smear results.

3.3.2 Peak Flowmetry

Peak Flowmetry, or Peak Expiratory Flow Rate (PEFR) measurement, is a simple, non-invasive test used to assess lung function. It measures the maximum speed at which a person can forcibly exhale after taking a deep breath. The test is performed using a small handheld device called a peak flow meter.

Uses of Peak Flowmetry in Lung Health

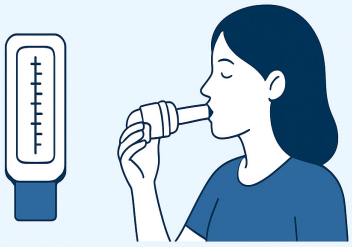
1. Screening for Lung Function Impairment
    - PEFR can be used as a simple screening tool in primary care and occupational settings to identify individuals with possible airflow limitations.
    - Abnormal results should prompt further evaluation with spirometry where available.

2. Monitoring Asthma
    - A decline in PEFR indicates worsening airway obstruction.
    - Regular monitoring helps patients and providers detect early signs of asthma exacerbations and adjust treatment accordingly.
3. Assessment and Monitoring of COPD
    - Helps track disease progression and evaluate treatment response.
    - Not a primary diagnostic tool (spirometry is preferred), but persistently low PEFR may suggest chronic airflow limitation.
4. Assessing Lung Function in Occupational Health
    - Peak flowmetry is useful in occupational health settings to monitor workers exposed to lung irritants (e.g., dust, fumes, and chemicals)
    - Helps detect early impairment in high-risk jobs (e.g., miners, textile workers, farmers).
5. Identifying Exercise-Induced Bronchoconstriction (EIB)
    - Some people experience airway narrowing during or after physical activity. Measuring PEF before and after exercise can help diagnose exercise-induced bronchoconstriction
6. Detecting Respiratory Infections and Acute Exacerbations
    - Conditions like bronchitis, pneumonia, or respiratory viral infections can temporarily reduce peak expiratory flow
    - Patients with chronic lung conditions use peak flow monitoring to recognize worsening symptoms due to infections
7. Assessing Treatment Effectiveness
    - For patients using bronchodilators or inhaled corticosteroids, peak flowmetry helps determine whether medications are effectively improving lung function
    - If PEFR values remain low despite treatment, this may prompt a healthcare provider to adjust the therapy

PEAK FLOWMETRY

(PEAK EXPIRATORY FLOW RATE)

is a simple, non-invasive test used to assess lung function



It measures the maximum speed at which a person can forcibly exhale after taking a deep breath.

The test is performed using a small handheld device called a peak flow meter.

How to Use a Peak Flow Meter

1. Stand or sit upright (proper posture improves accuracy).
2. Reset the device to zero before use.
3. Inhale deeply to fill the lungs.
4. Seal lips around the mouthpiece.
5. Blow out hard and fast in a single breath.
6. Repeat three times and record the highest reading.
7. Compare with the patient's personal best or expected values.

Interpreting Peak Flow Readings

- Green Zone (80-100% of personal best) ⟶ Normal, well-controlled lung function.
- Yellow Zone (50-79%) ⟶ Caution, possible airway narrowing—adjust medication or seek advice.
- Red Zone (<50%) ⟶ Emergency, severe airflow obstruction—seek medical help immediately.

Limitations of Peak Flowmetry

- Less sensitive than spirometry for diagnosis.
- Dependent on patient effort and correct technique.
- Affected by patient compliance and consistency in measurement.

3.4 Other Diagnostic Tools

While lung function tests are central to diagnosis, other tools complement assessment:

- **Pulse oximetry:** Provides rapid assessment of oxygen saturation; essential for triage and monitoring.
- **Chest imaging:**
  - Chest X-ray for common CRD features.
  - Digital chest X-ray (DCXR) with AI for integrated screening and TB rule-out.
  - CT scans for complex or advanced cases.
- Laboratory investigations:
  - TB tests (GeneXpert/MTB-RIF, culture, AFB microscopy).

- Arterial blood gases (for advanced COPD and critical care).
- Complete Blood Count with eosinophils, allergy testing, biomarkers where available.

Diagnostic tools are essential to move beyond symptom-based management of lung diseases. Strengthening access to and use of spirometry, PEFR, DCXR, and oximetry will transform lung health care in Kenya. The following chapters provide disease-specific guidance on how to apply these diagnostic principles in practice.

Asthma

4

4.1 Background

The Global Initiative for Asthma (GINA) defines asthma as a heterogeneous disease usually characterized by chronic airway inflammation (24). . It is identified by a history of variable respiratory symptoms—wheeze, shortness of breath, chest tightness, and cough—that vary in intensity and over time, together with reversible expiratory airflow limitation.

The chronic airway inflammation is associated with airway hyperresponsiveness (AHR) which leads to recurrent episodes of the symptoms. These episodes are usually associated with widespread but variable airway obstruction within the lung that is often reversible either spontaneously or with treatment. The clinical presentation varies in severity and frequency among individuals. People with asthma often have periods of worsening symptoms called exacerbations (also called "attacks" or "flare-ups") that can be fatal.

Globally, an estimated 339 million people suffer from asthma with an associated mortality of 383,000 annually (25). According to the International Study of Asthma and Allergic Disease in Childhood (ISAAC), Kenya has an estimated prevalence of asthma in 10% of the population, which is approximately 4 million people (26). The prevalence of wheeze in the past 12 months among 13- 14-year-olds was 18% and 13.8 % in Nairobi and Eldoret, respectively, in the year 2000, up from 17.1% and 10.4 % in 1995. The prevalence of asthma in older children between the ages of 12-14 years may be increasing

Asthma is one of the leading chronic diseases in children and adults in Kenya, frequently underdiagnosed and undertreated. Poor asthma control contributes to school and work absenteeism, reduced quality of life, and preventable hospitalizations.

The key components of asthma include:

- Presence of airway inflammation
- Airway hyperresponsiveness, where the airways narrow excessively in response to stimuli
- Recurrent episodes of wheezing, breathlessness, chest tightness, and coughing

- Reversible airway obstruction, demonstrable by changes in lung function (Forced Expiratory Volume in 1 second and Peak Expiratory Flow) in response to a bronchodilator such as salbutamol.

4.2 Risk Factors for Asthma

Asthma arises from an interaction of genetic, environmental, and host factors.

Modifiable Risk Factors

- Allergen exposure (pollen, house dust mites, dander, cockroach, mold)
- Tobacco smoke (active and passive)
- Air pollution (indoor - biomass fuel exposure (firewood, charcoal, kerosene) and outdoor)
- Occupational exposures (chemicals, dust, vapors)
- Respiratory infections- Chronic rhinitis and sinusitis, & GERD
- Obesity
- Exercise-induced asthma
- Psychological stress, anxiety, depression
- Hormonal therapy-related changes
- Drugs, e.g., beta-blockers, aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDs).

Non-Modifiable Risk Factors

- Family history of asthma or allergies
- Atopy (genetic tendency to develop allergic diseases)
- Gender (boys in childhood, women in adulthood)
- Severe early-life viral infections (e.g., RSV)
- Puberty and natural hormonal changes

4.3 Clinical Presentation of Asthma

Asthma is characterized by a history of fluctuating respiratory symptoms—wheezing, shortness of breath, chest tightness, and cough—that vary in intensity and frequency. Symptoms are often worse at night or in the early morning and may be triggered by viral infections, exercise, allergen exposure, weather changes, fumes, or strong odors.

Table 4.1 Typical and atypical presentation of asthma

Typical presentation	Atypical presentation
▪ Frequent episodes of wheezing, shortness of breath, cough, and/or chest tightness that vary in duration and severity ▪ Symptoms vary over time and in intensity ▪ Symptoms occur mainly at night and wake up the patient, usually in the early hours of the morning ▪ Symptoms are triggered by viral infections (colds), exercise, allergen exposure, changes in weather, and irritants such as exhaust fumes, smoke, or strong smells ▪ Reversible symptoms; spontaneously or after bronchodilator use ▪ Persistent breathlessness can occur in the most severe form of asthma, due to progression from reversible to irreversible airflow limitation ▪ Severe progression is rare and linked to irreversible airway remodeling ▪ Several risk and trigger factors are usually present	▪ Mainly in children ▪ Recurrent attacks of cough, particularly in the evening and/or at night, which do not respond to symptomatic treatment ▪ Chest tightness with wheezing that occurs only after exercise ▪ Clinical pattern similar to an acute respiratory infection but frequently recurs during a short period

4.4 Diagnosis of Asthma

4.4.1 Clinical Diagnosis

Clinical history remains the most important component of diagnosing asthma. A detailed history should ascertain:

- Recurrent or episodic wheeze, cough, chest tightness, or shortness of breath
- Symptoms that are particularly troublesome at night or early morning
- Symptoms triggered by dust, cold exposure, strong smells, exercise, or emotions
- Consistent response to asthma-specific treatment
- Personal and family history of atopy (allergic conjunctivitis, allergic rhinitis, eczema, food allergy, or asthma)

4.4.2 Objective Tests

Lung function tests should be obtained where available:

- Spirometry is the gold standard for diagnosis, demonstrating variable airflow limitation
- Peak expiratory flow (PEF) is a useful alternative in primary care settings where there's no spirometer.

Conducting and Interpreting Spirometry (Spirometry Algorithm)

Figure 4.1 Conducting and Interpreting Spirometry (Spirometry Algorithm)

Results Interpretation:

- **Normal Spirometry:** Indicates no significant lung obstruction or restriction
- **Is there airflow limitation** - FEV1/FVC less than 85% or diurnal variation in PEF? FEV1/ FVC < 85% in children and 75% in adults is indicative of obstructive airway disease. A reduced FEV1/FVC ratio indicates airway obstruction, typically in conditions like COPD or asthma.
- **Is there a bronchodilator response** - FEV1 or PEF improvement by greater than 12.5% (or 200mls), or 20% respectably, 30 minutes after inhalation of a short-acting bronchodilator?

- **PEF variability:** Wide swings in PEF between morning/evening or on/off work days
- **Bronchoprovocation:** Does the FEV1 drop below 20% with only small doses of inhaled bronchoconstrictors such as Methacholine, Histamine or with exercise?
- **Mixed Pattern:** FEV1/FVC ratio < 0.7 with reduced FVC suggest a combined obstructive and restrictive pattern.

4.4.3 Diagnostic Algorithms

Asthma diagnostic algorithm for children less ≤ 5 years

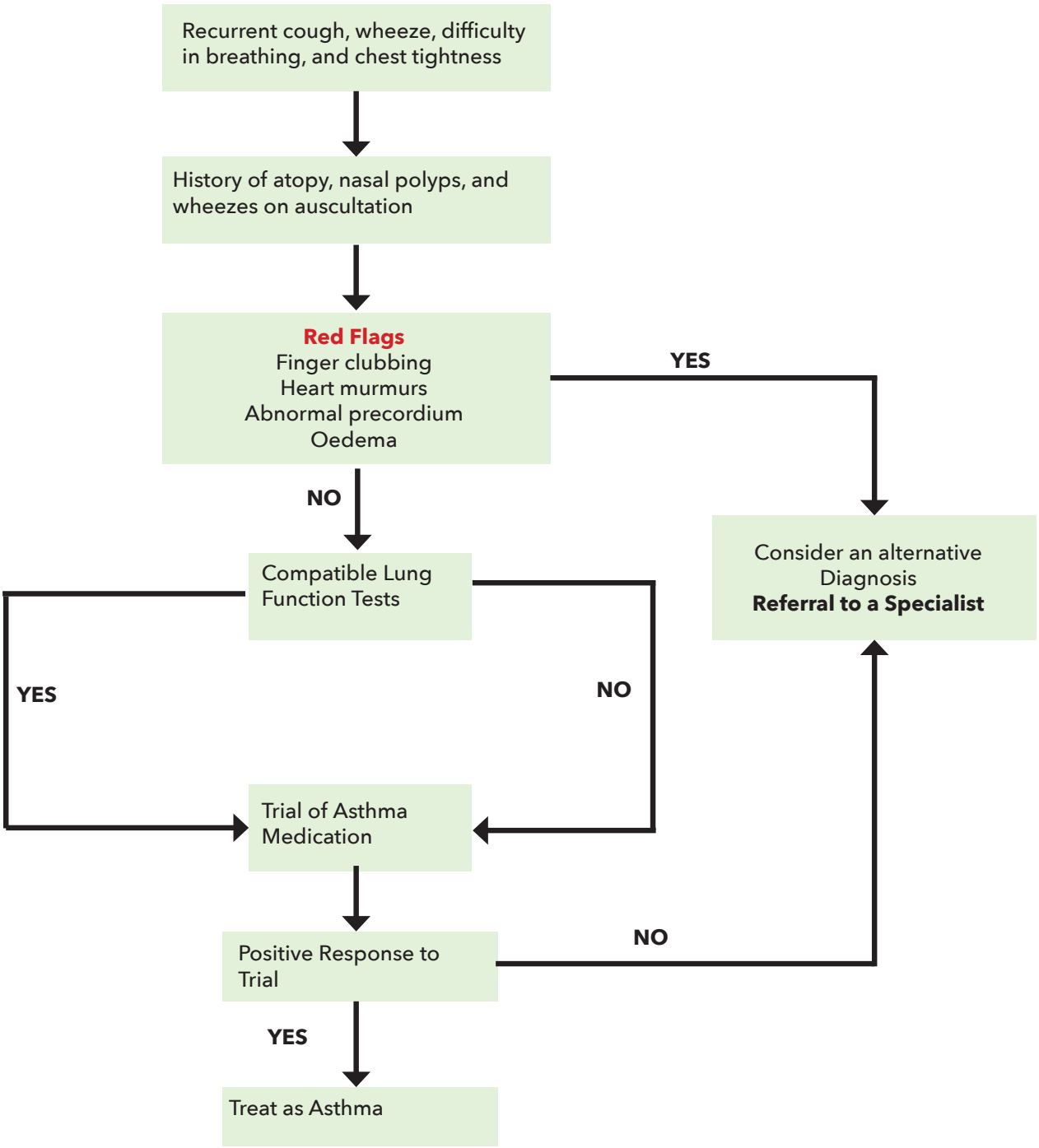
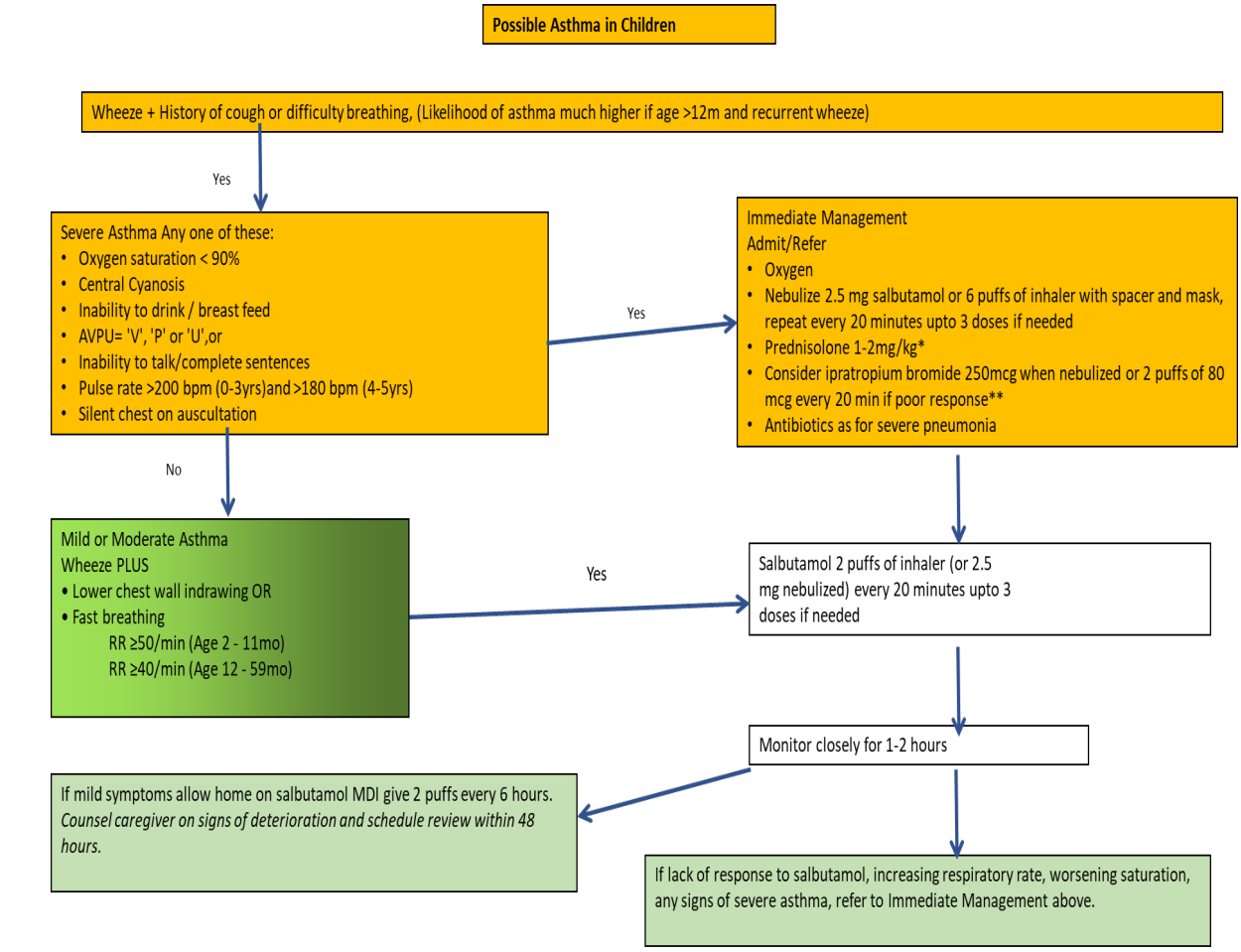


Figure 4.2: Asthma diagnostic algorithm for children less ≤ 5 years



Recurrence of asthma symptoms
- Consider Inhaled corticosteroid (ICS) therapy or adjust the doses if already on ICS. (Look out for other comorbidities)
- Demonstrate MDI and spacer use to the caregiver before discharge from the health facility.
- Preferably use spacer with face masks for <3 years and for 4 - 5 years use facemask or mouthpiece.
- Advise on regular follow up

*Prednisolone administered for 3-5 days. Max dose of 20mg/day for < 2 years and 30mg/day for 2-5 years.
** Repeat every 20 minutes for one hour if needed.

Figure 4.3: Asthma diagnostic algorithm for children less ≤ 5 years - Type the texts in powerpoint

Asthma diagnostic algorithm for children above 5 years and Adults

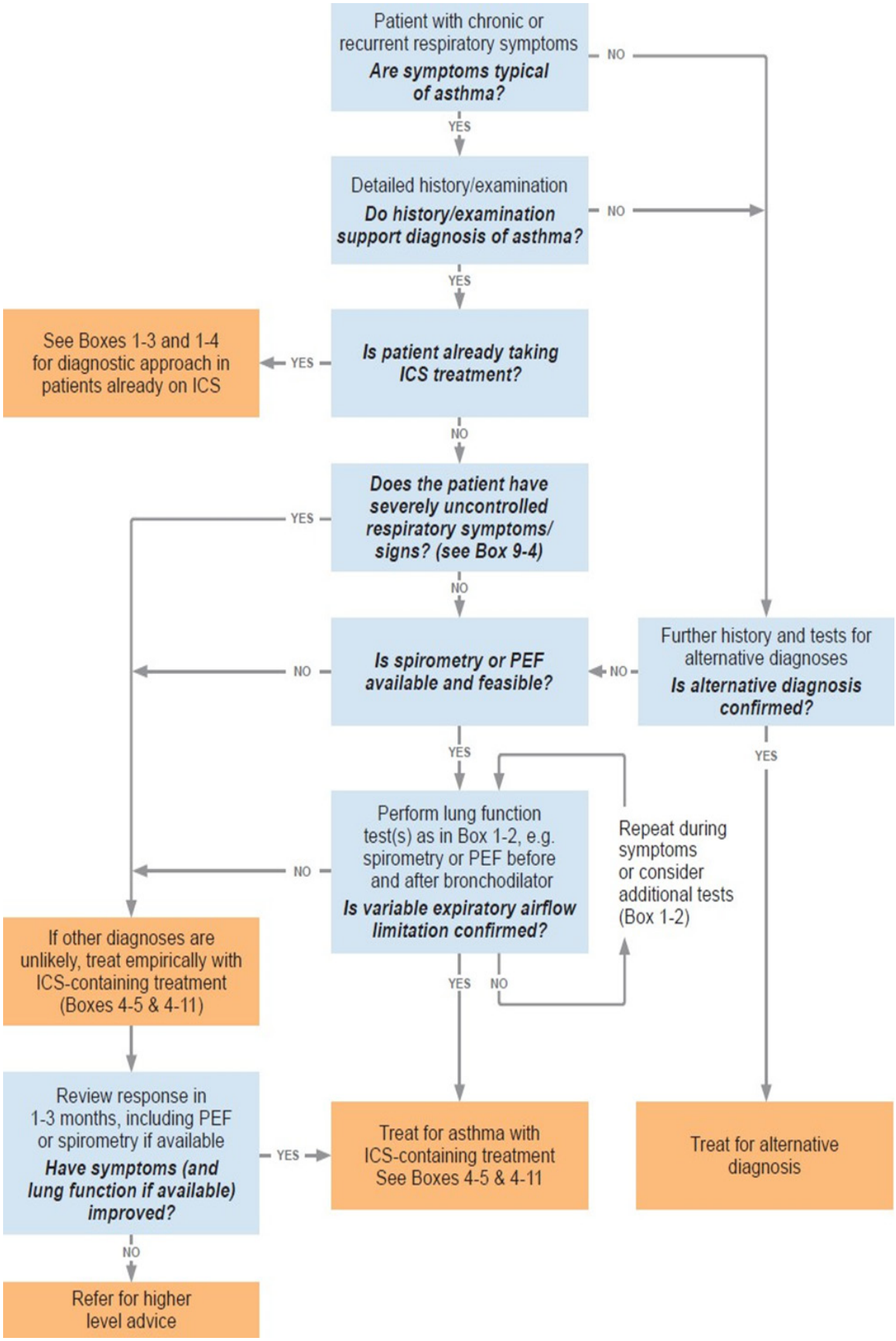


Figure 4.4: Diagnostic flow-chart for asthma in clinical practice >6 years (including Adults)

4.4.4 Likelihood of Asthma in Children

The likelihood of asthma in children is determined by weighing features that increase or decrease diagnostic probability.

4.4.4.1 Factors influencing likelihood of asthma in children

Table 4.2: Factors influencing likelihood of asthma in children

Factors that Increase the Likelihood of Asthma in Children	Factors that Decrease the Likelihood of Asthma
Frequent episodes of wheeze, cough, chest tightness or heaviness, breathlessness particularly experienced at night and/ or early morning, or triggered by exercise or during playtime, common irritants like dust and perfumes, emotions like laughter or symptoms that also occur in the absence of a 'common cold'	Symptoms with 'colds' only with no other interval symptoms
Personal history of atopy/allergy conditions like eczema, allergic rhinitis or conjunctivitis, history of reactions to animal proteins like milk, meat, or eggs. Family history of atopy or Asthma in siblings, parents, or close relatives	Isolated cough especially when 'moist'
History of improvement in symptoms or lung function in response to asthma-specific therapy.	No response to a trial of asthma therapy.
Alternative diagnosis ruled out	Clinical features pointing to an alternative diagnosis e.g., failure to thrive, malnutrition, finger clubbing, sternal anomalies, edema, heart murmurs

4.4.5 Differential diagnosis of Asthma;

a) Differential diagnosis for asthma Table 4-3, below:

Table 4.3: Common differential diagnoses for asthma by age group

Non-Asthma cause of cough and or wheeze in children	Non-Asthma causes of cough and or wheeze in adults
• Chronic rhinosinusitis • Recurrent viral respiratory tract infection • Foreign body aspirations • Gastro esophageal reflux • Tuberculosis • Congenital heart disease • Cystic Fibrosis • Bronchopulmonary dysplasia • Congenital malformation with narrowing of the airway • Primary ciliary dyskinesia syndrome • Immune deficiency • Bronchiectasis	• Tuberculous • Chronic bronchitis and COPD • Bronchiectasis • Heart disease • Airway obstruction e.g. lung cancer, tracheal stenosis etc.

Approaches to Identifying and evaluating Asthma Differentials (Table 4-4), below:

Table 4.4: Approaches to Identifying and Evaluating Asthma Differentials

Diagnosis	Evaluation
Upper Airway Disease Adeno-tonsillar hypertrophy Rhinosinusitis Postnasal Drip	Clinical ENT Examination Sinus X-ray CT Paranasal Sinuses ENT Specialist Referral
Congenital Structural Bronchial Disease Tracheo- bronchomalacia Cartilage Rings Cysts Webs	Bronchoscopy CT Scan Chest

Diagnosis	Evaluation
Bronchial/ Tracheal Obstruction Vascular Rings/ Slings Enlarged Cardiac Chamber Lymph Node Enlargement from TB or Lymphoma	CXR CT Scan Chest Echocardiogram Mediastinoscopy
Endobronchial Disease Foreign Body /Tumor	Chest X-ray Bronchoscopy
Esophageal / Swallowing Problems Reflux Uncoordinated Swallowing Laryngeal Cleft Tracheo-esophageal Fistula	Upper GI Studies/Barium Swallow Upper Endoscopy PH Probe Milk Scan
Pulmonary Suppuration Cystic Fibrosis Primary Ciliary Dyskinesia Severe Immunodeficiency Syndromes Agammaglobulinemia	Sweat/Genetic testing Lung/Sinus Biopsy/Molecular Genetic Testing Complete Blood Count Immunoglobulin Levels Complement Levels
Miscellaneous Post Viral Wheeze Acute Bronchiolitis. Laryngo-Tracheobronchitis	Characteristic Viral Syndrome Antigen Tests for RSV Viral Cultures PCR CXR
Chronic obstructive pulmonary disease	Spirometry
Congestive heart failure	Echocardiogram Serum BNP

Diagnosis	Evaluation
Pulmonary embolism	Chest X-ray Lower limb doppler ultrasound CT pulmonary angiogram Echocardiogram Perfusion/ventilation scans
Tumors	Digital x-ray with AI Contrast enhanced CT scan chest
Pulmonary eosinophilia	Sputum eosinophilia Elevated eosinophil counts in full haemogram.
ACE inhibitor-induced cough	Medication review and discontinuation of ACE inhibitors
Vocal cord dysfunction	Bronchoscopy
Laryngeal dysfunction	Laryngoscopy

Table 4.5: differential diagnosis categorization by age

Age	If the symptoms or signs below are present, consider…	Condition
6–11 Years	Sneezing, itching, blocked nose, throat-clearing	Chronic upper airway cough syndrome
	Sudden onset of symptoms, unilateral wheeze	Inhaled foreign body
	Recurrent infections, productive cough	Bronchiectasis
		Congenital immunodeficiency
	Recurrent infections, productive cough, sinusitis	Primary ciliary dyskinesia Congenital immunodeficiency
	Cardiac murmurs	Congenital heart disease
	Pre-term delivery, symptoms since birth	Bronchopulmonary dysplasia
	Excessive cough and mucus production, gastrointestinal symptoms	Cystic fibrosis

12–39 Years	Sneezing, itching, blocked nose, throat-clearing	Chronic upper airway cough syndrome
	Dyspnea, inspiratory wheezing (stridor)	Inducible laryngeal obstruction
	Dizziness, paresthesia, sighing	Hyperventilation, dysfunctional breathing
	Productive cough, recurrent infections	Bronchiectasis
	Excessive cough and mucus production	Cystic fibrosis
	Cardiac murmurs	Heart disease
	Shortness of breath, family history of early emphysema	Alpha1-antitrypsin deficiency
	Sudden onset of symptoms	Inhaled foreign body
40+ Years	Dyspnea, inspiratory wheezing (stridor)	Inducible laryngeal obstruction
	Dizziness, paresthesia, sighing	Hyperventilation, dysfunctional breathing
	Cough, sputum, dyspnea on exertion, smoking or noxious exposure	COPD*
	Productive cough, recurrent infections	Bronchiectasis
	Dyspnea with exertion, nocturnal symptoms, ankle edema	Cardiac failure
	Treatment with angiotensin-converting enzyme (ACE) inhibitor	Medication-related cough
	Dyspnea with exertion, non-productive cough, finger clubbing	Parenchymal lung disease
	Sudden onset of dyspnea, chest pain	Pulmonary embolism
	Dyspnea, unresponsive to bronchodilators	Central airway obstruction
All ages	Chronic cough, hemoptysis, dyspnea; and/or fatigue, fever, (night) sweats, anorexia, weight loss; sometimes unilateral wheeze	Tuberculosis
	Prolonged paroxysms of coughing, sometimes stridor	Pertussis

Upon diagnosis, management is determined by the severity and frequency of the disease. The classification of Asthma is therefore classified as follows: intermittent, mild persistent, moderate persistent and severe persistent asthma.

Table 4.6: Classification of Asthma Severity

Classification	Daytime Symptoms	Nocturnal Symptoms	Lung Function (PEF or FEV1)	Variability
Intermittent	≤ 1 time per week; asymptomatic and normal PEF between attacks	≤ 2 times per month	> 80% predicted	< 20%
Mild Persistent	> 1 time per week but < 1 time per day	> 2 times per month	> 80% predicted	20–30%
Moderate Persistent	Daily symptoms; attacks affect activity	> 1 time per week	60–80% predicted	> 30%
Severe Persistent	Continuous symptoms; severely limited physical activity	Frequent	< 60% predicted	> 30%

4.5 Management of asthma

4.5.1 Goals of Management

To achieve asthma control and to return patients to productive lives. The aim is to :

- Achieve and maintain control of symptoms
- Prevent asthma exacerbations
- Maintain near-normal lung function
- Maintain normal level of activity, including exercise
- Avoid adverse effects of asthma medications
- Prevent development of irreversible airflow limitation/ progression to COPD
- Maintain normal growth velocity in children.
- Prevent long-term asthma-related mortality.
- No requirement for maintenance oral corticosteroids (OCS)
- No sleep disturbance due to asthma

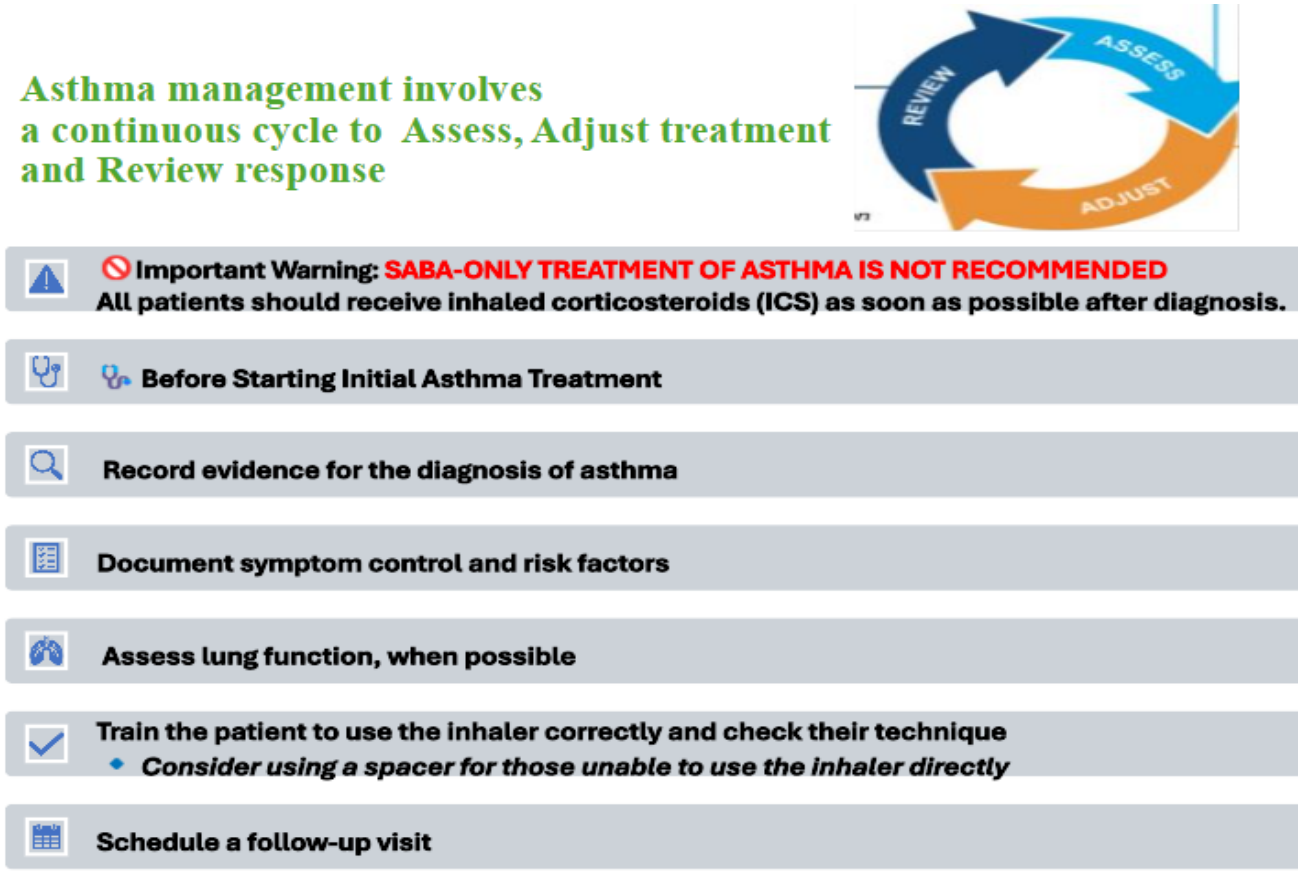


Figure 4.5: Important warning in asthma management

4.5.2 Pharmacological Management

4.5.2.1 Classification of Asthma Medications

Asthma medication can be classified into two broad groups:

Table 4.7: Classification of asthma medication

Relievers	They reverse broncho-constriction and relieve its symptoms. They include rapid and short acting, rapid and long-acting bronchodilators. Short acting bronchodilators: Salbutamol
Controllers	They are taken daily to keep asthma under control through their anti – inflammatory effects: Beclomethasone inhaler Budesonide inhaler
	Long Acting 2 Agonists (LABA) have anti-inflammatory effects, are used in combination with inhaled corticosteroids for the long-term control of asthma, they also inhibit mast cell mediator release, plasma exudation and reduce sensory nerve activation.

4.5.2.2 Treatment by Age Group

Asthma Treatment For Adults And Adolescents 12+ Years

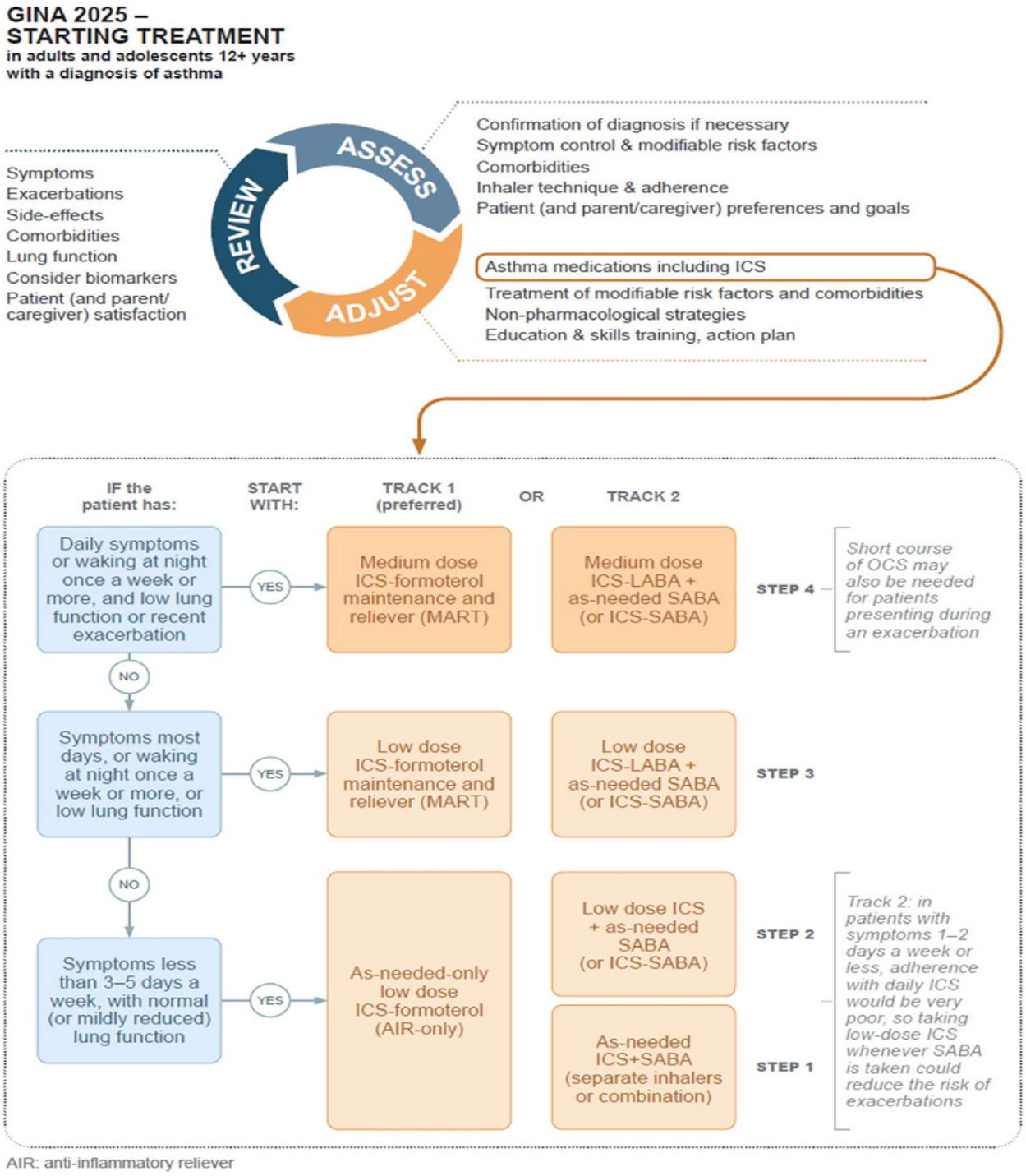


Figure 4.6: Flowchart for selecting initial treatment in adults and adolescents with a diagnosis of asthma

Source; GINA guideline 2025

Source; GINA guidelines 2025

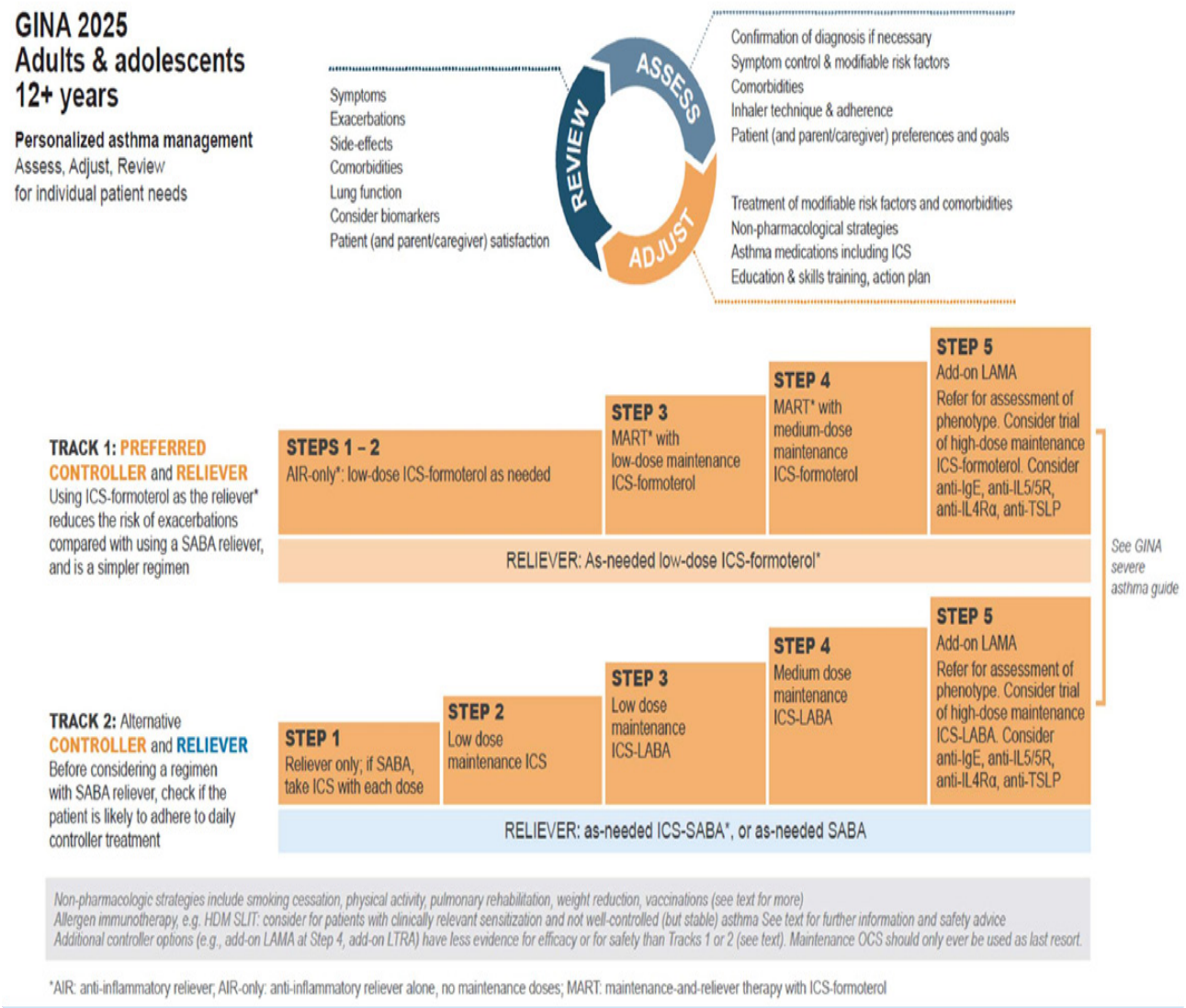


Figure 4.7: Personalized management for adults and adolescents to control symptoms and minimize future risk

Asthma Treatment For Children 6-11 Years

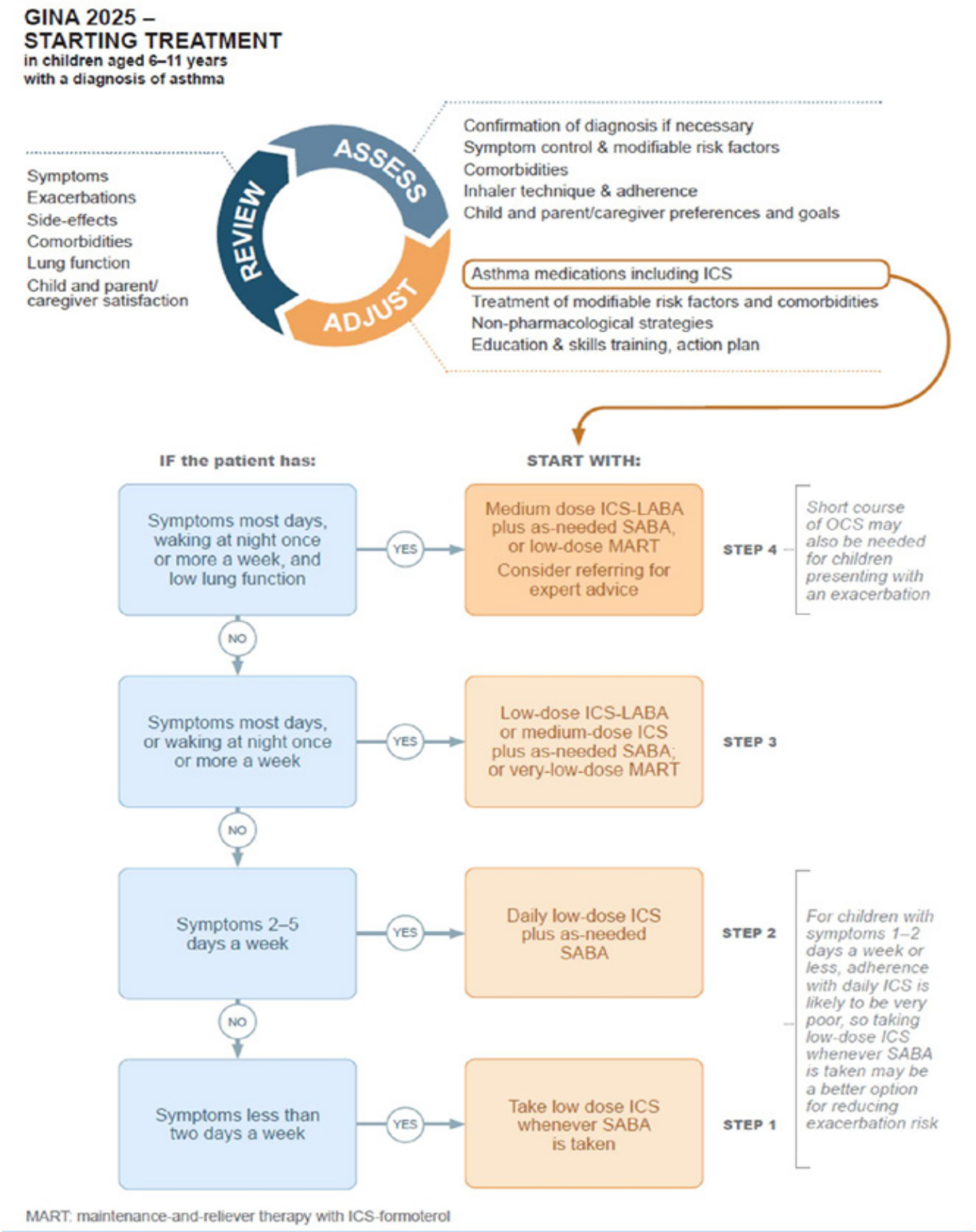


Figure 4.8: Initial treatment: children 6–11 years with a diagnosis of asthma

Source; GINA guide 2025.

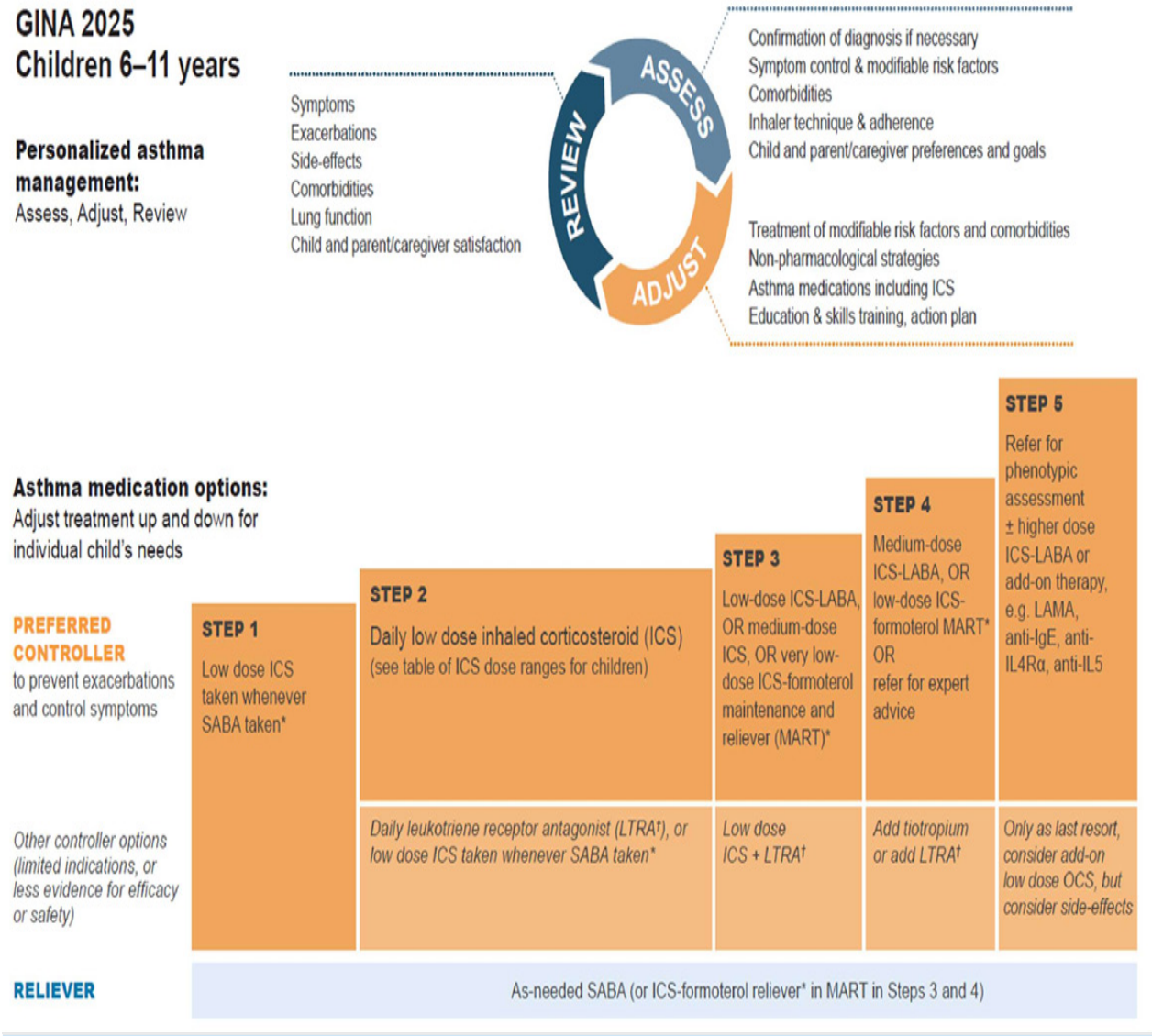


Figure 4.9: Personalized management for children 6–11 years to control symptoms and minimize future risk

Source; GINA guide 2025.

Table 4.8: Medications and treatment regimens for adults, adolescents, and children 6–11 years Asthma Medicines in the Kenya Essential Medicines List of 2023

Medicine	Formulation	Dosage	Frequency
Budesonide	Inhalation (aerosol)	100 micrograms/dose (200 dose)	4
		200 micrograms/dose (200 dose)	
	Metered dose inhaler	100 micrograms + 6mg/ metered dose	
Budesonide + Formoterol	Dry powder inhaler	80 micrograms + 4.5mcg/ metered dose (120 dose)	
		160 micrograms + 4.5mcg/ metered dose (120 dose)	

Epinephrine (adrenaline)	Injection	1mg/mL amp	2
Ipratropium bromide	Inhalation (aerosol)	20 micrograms/metered dose (200 dose)	3
	Nebuliser solution	500 micrograms/2mL unit dose vial (isotonic)	
Montelukast	Tablet (chewable)	5mg (as sodium salt)	4
	Tablet	10mg (as sodium salt)	
Salbutamol	Nebuliser solution	5mg/mL (as sulphate)	2
Salbutamol + Beclomethasone	Inhalation (aerosol)	100 microgram + 50 microgram	
Salbutamol + Ipratropium	Nebuliser solution	Salbutamol 2.5mg (as sulphate) + Ipratropium 500 microgram (as bromide) in 2.5mL Amp	3

Asthma Treatment for Children Aged 0 - 5 Years

For children aged 5 years and younger with mild persistent asthma -eg, symptoms occurring more than 2 days per week with a history of severe wheezing episodes, GINA recommends controller treatment with daily low-dose ICS with as-needed SABA as reliever. For children who have symptoms for 2 days per week or less and no history of severe wheezing (step 1), there is insufficient evidence for daily controller treatment in this group, and current recommendations for this group are to use SABA as needed.

Key Points:

- Inhaled corticosteroids are the cornerstone of managing asthma to achieve control.
- Oral short-acting bronchodilators, cough mixtures, and mucolytics are not recommended for the management of asthma.
- A spacer device can be used in any age group, including adults for those not able to use pressurized metered dose inhalers (pMDIs) directly. They should be prescribed in all children below 12 years, with a facemask for children under 5 years.

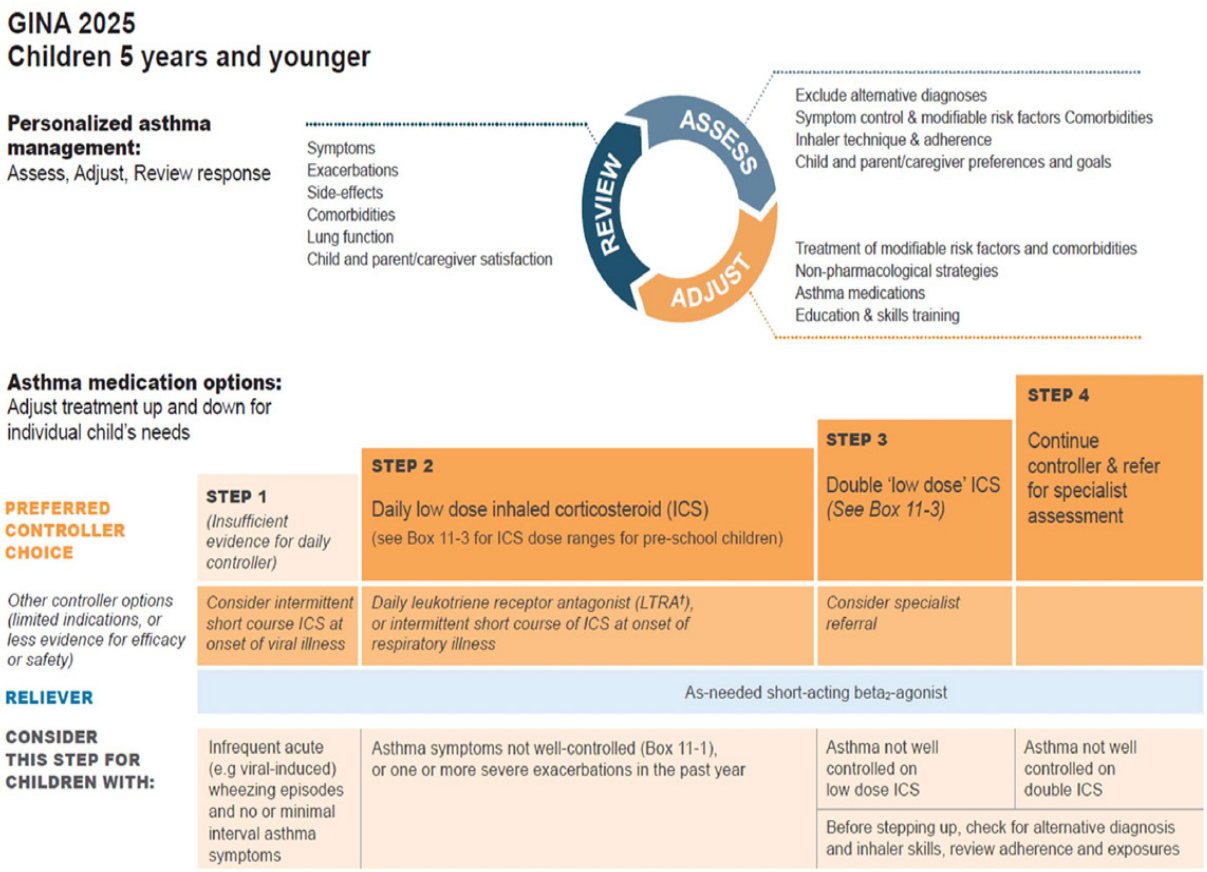


Figure 4.10: Personalized management of asthma in children 5 years and younger

Source; GINA guide 2025.

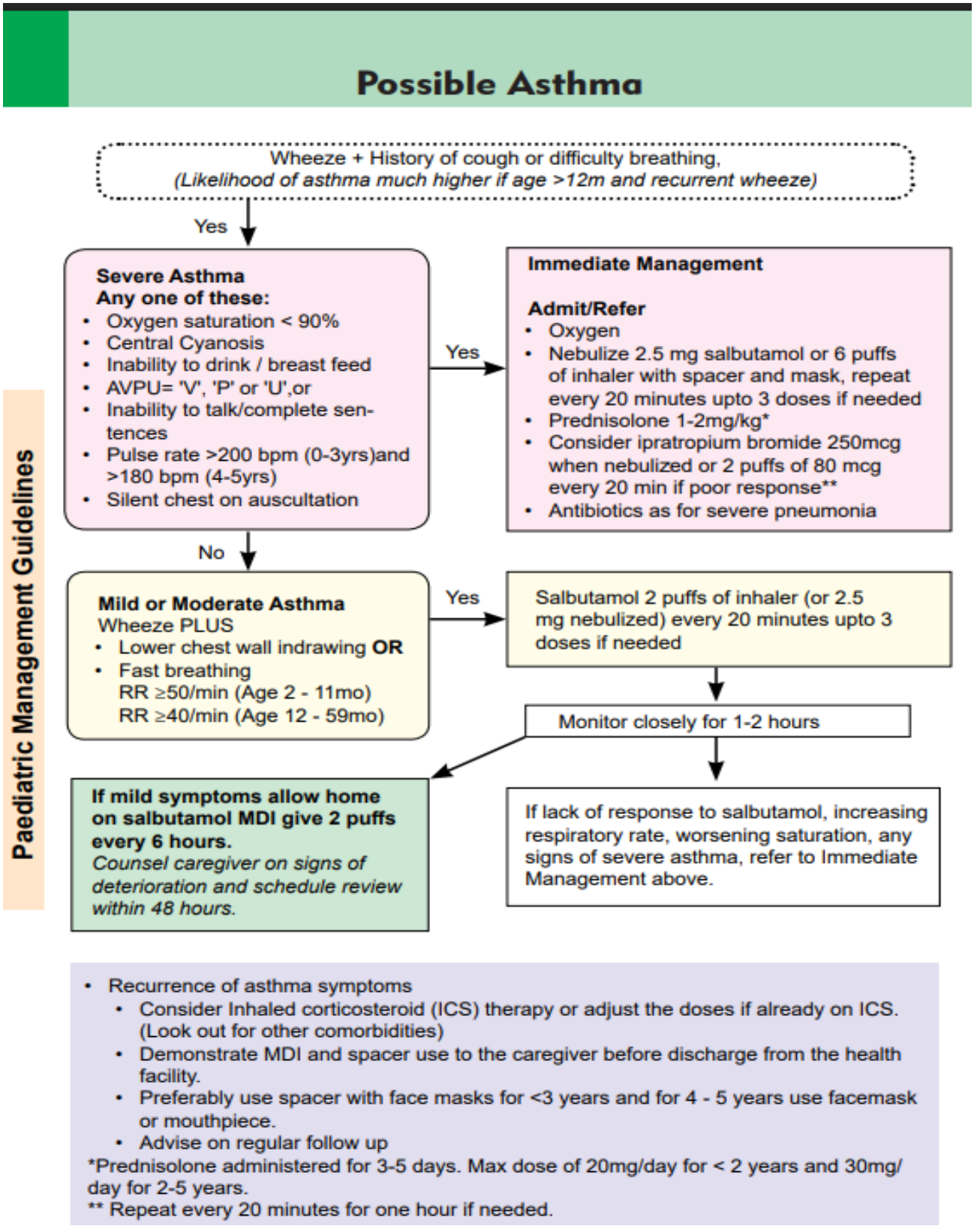


Figure 4.11: Management of Asthma in children 0-5 years

Source; Basic paediatric protocols, 2022

4.5.2.3 Management of worsening asthma and exacerbations in children 5 years and younger

Early symptoms of an exacerbation may include any of the following:

- Onset of symptoms of respiratory tract infection
- An acute or sub-acute increase in wheeze and shortness of breath
- An increase in coughing, especially while the child is asleep
- Lethargy or reduced exercise tolerance
- Impairment of daily activities, including feeding
- A poor response to reliever medication.

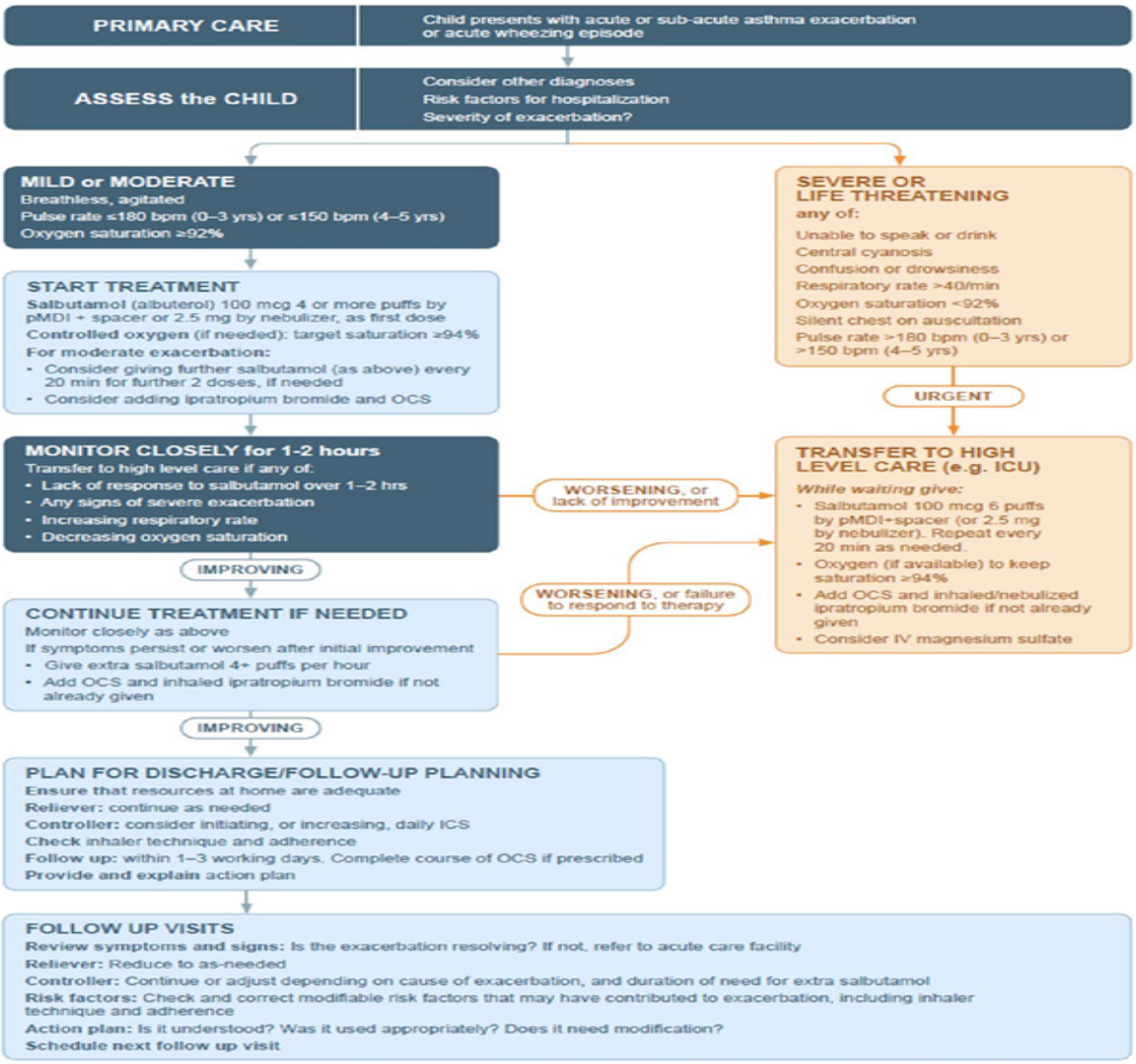


Figure 4.12: Management of acute asthma or wheezing in children 5 years and younger

Source; GINA guide 2025.

4.5.3 Acute Asthma Management

Acute asthma is classified as:

- Mild asthma attack,
- Moderate asthma attack and
- Severe asthma attack.

Table 4.9: Management of mild to moderate asthma

Mild to Moderate Asthma
Does the patient have any of the following of symptoms? • Talks in phrases • Prefers sitting to lying • Not agitated • Respiratory rate increased • Accessory muscles not used • Pulse rate 100 – 120 bpm • Oxygen saturation on air 90-95% • PEF >50% predicted or best
Treatment • Assess for signs of imminent respiratory arrest • If no signs of imminent respiratory arrest, assess for signs of clinical distress • If the patient is not in imminent respiratory arrest, treat in the emergency room • SABA 4-10 puffs pMDI + spacer, repeat every 20 minutes for 1 hour • Use prednisolone: Adults- 1mg/kg maximum 50mg, Children: 1-2mg/kg maximum 40mg • Control oxygen (if available), target saturation 93%-95% (children 94%-98% children) • Assess response at 1 hour, if improving assess for discharge (symptoms improved, not needing SABA, PEF >60-80% personal best or predicted, oxygen saturation >94%) • At discharge: reliever as needed rather than routinely, controller- stat or step up, check inhaler technique and adherence, continue with prednisolone for 5-7days (3-5 days) for children

Table 4.10: Management of severe asthma

Severe Asthma
• Does the patient have any of the symptoms? • Talks in words, • Sits hunched forward, • Agitated, • Respiratory rate >30 p/m • Accessory muscles in use • Pulse rate >120bpm • Oxygen saturation on air <90% • PEF <50% predicted or best • Life-threatening asthma: Drowsy, confused, silent chest
Treatment • Treat urgently • Transfer to acute care facility where available, and if not stabilize and refer • While waiting for transfer to acute care facility: give SABA by nebulizer, oxygen therapy, systemic corticosteroid, immediately give inhaled SABA, inhaled Ipratropium bromide • In acute care facility, IV magnesium sulfate, may be considered if the patient is not responding to the initial treatment

Table 4.11: Follow-up for asthma

Follow up of Asthma
Reliever: as needed rather than routinely Controller: continue higher dose for short term (1-2 weeks) or long term (3 months) depending on background exacerbation Correct modifiable risk factors, including inhaler technique and adherence If worsening condition worsens, manage as per the severe asthma

4.5.4 Management of chronic asthma

Asthma is a chronic illness, and therefore, the clinical team and patients need to develop a long-term plan for patient management. The Patient–Health Provider Partnership includes:

1. Personalized Education: Ensure the following is included in the patient education-

    a) Basic information about the Disease

    b) Medication, including Relievers and Preventers

    c) Potential side effects of medicines

    d) Training on the medicine inhaler technique

    e) Recognition of worsening asthma and actions to be taken

2. Self-monitoring of asthma control

    a) Regular review to assess control and adjust treatment as may be necessary

    b) Identification and avoidance of symptom trigger factors (indoor and outdoor pollutants)

3. A written asthma management plan

4. Regular assessment of patients for their symptom control.

Assessment of asthma symptom control shall be as shown in Table 310 below:

Table 4.12: Assessment of asthma symptom control

In the past 4 weeks, has the patient had;	Yes	No
Daytime symptoms of asthma (cough, wheeze, shortness of breath more than twice/week etc)?		
Any night waking due to asthma?		
Reliever needed more than twice/week?		
Any activity limitation due to asthma?		
Score: Well-controlled, None of these, Partially- controlled - 1-2 of these, Uncontrolled - 3-4 of these		

Note: For programmatic monitoring:

- Controlled asthma is when a patient has not presented with any of the above symptoms for a specified period - Monthly, quarterly, annually

- Uncontrolled asthma is when a patient has presented to a facility with any of the above symptoms for a specified period - Monthly, quarterly, annually

Poor responders shall be managed as outlined below;

- The first step is to exclude alternative diagnose

- The second is to consider and exclude comorbidities
- The third Assess adherence to medication
- The fourth step involves identifying the pattern of inflammation and response to treatment. Innovative biological therapies can be used.

Medication for chronic care

Long Acting $_2$ Agonists (LABA) have anti-inflammatory effects and are used in combination with inhaled corticosteroids (ICS) for the long-term control of asthma. They also inhibit mast cell mediator release, plasma exudation and reduce sensory nerve activation. Anti- inflammatory therapy (ICS) forms the backbone of asthma control.

All asthma patients should be on inhaled corticosteroids. Bronchodilators should not be used without combining with ICS, since asthma is an inflammatory disease. Frequent use of SABA can lead to excess deaths due to side effects and failure to address the inflammatory aspect

Table 4.13: Other medications used in asthma management

Medication category	Comments
Anticholinergics	• They are used for the treatment, especially in the acute care setting. Ipratropium bromide is usually combined with a short acting B2 agonist
Leukotriene Modifiers	• They are used as add on therapy in patients who fail to achieve control. • Used with low dose inhaled corticosteroids or as alternatives to low dose inhaled corticosteroids and in aspirin induced asthma (AIA). • It is useful in the presence of allergic rhinitis and asthma to relieve both nasal and chest symptoms
Systemic Corticosteroids	• They are recommended for patients with moderate to severe acute exacerbations of asthma. In some patients with steroid dependent asthma the lowest possible dose of should be used
The cromones, Anti IGE	• Refer to the National asthma Guidelines

4.5.5 Stepping Down Treatment

Once asthma is well controlled with stable lung function for ≥ 3 months:

- Consider stepping down ICS dose by 25–50% every 3 months, under clinical supervision.
- Do not completely stop ICS in adults or adolescents unless temporarily required to confirm diagnosis.
- Patients on biologics should not discontinue lCS-formoterol MART even if stable.

4.6 Non-pharmacological management

- Avoidance of occupational or domestic exposures to allergens or irritants
- Cessation of smoking, environmental tobacco exposure (ETS) and vaping
- Physical activity
- Pulmonary rehabilitation programs
- Avoidance of medications that may make asthma worse
- Assess and manage comorbidities

Chronic Obstructive Pulmonary Disease (COPD)

5

Chronic Obstructive Pulmonary Disease (COPD) is a progressive, long-term lung disease that makes breathing difficult and worsens over time. It is irreversible and is characterized by persistent airflow limitation associated with chronic airway inflammation.

COPD describes a group of conditions; the most common are chronic bronchitis and emphysema. Patients can sometimes have both emphysema and bronchitis, while others can have both asthma and COPD.

The leading causes of COPD include tobacco use and exposure to tobacco smoke and emissions, long-term exposure to irritants, dust or fumes, and biofuels. In Kenya and similar LMIC settings, biomass fuels and post-tuberculosis lung disease (PTLD) are significant contributors.

Although less common, genetic predisposition (e.g., alpha-1 antitrypsin deficiency) can cause COPD. Respiratory infections do not cause COPD but can exacerbate the condition; vaccination is therefore essential in COPD care.

5.1 Risk Factors

1. **Age:** >40 years
2. **Sex:** Female > Male (partly due to higher biomass exposure)
3. **Environmental factors:**
    - Tobacco smoking
    - Exposure to second hand tobacco smoke and emissions
    - Indoor air pollution - biofuels and coal
    - Outdoor air pollution
    - Occupation exposure
    - Organic and inorganic dust
    - Chemical agents and fumes

4. **Genetic factors:** Severe hereditary deficiency of alpha-1 antitrypsin (AATD), the gene encoding matrix metalloproteinase-12 (MMP-12), and glutathione S-transferase have also been related to decline in lung function or risk of COPD

5. **Lung development:** Any factor that affects lung growth during gestation and childhood (low birth weight, respiratory infections, etc.) has the potential to increase an individual's risk of developing COPD

6. **Lower socio-**economic status is associated with an increased risk of developing COPD.

7. **Asthma and airway hyper-reactivity** - Asthma may be a risk factor for the development of airflow limitation and COPD

8. **Infections**- A history of severe childhood respiratory infection has been associated with reduced lung function and increased respiratory symptoms in adulthood

9. **Post-Tuberculosis lung damage**

5.2 Clinical Indicators of COPD:

Consider COPD if any of these clinical indicators are present: (These indicators are not diagnostic themselves, but the presence of multiple key indicators increases the probability of the presence of COPD; in any case,)

Table 5.1: COPD Clinical Indicators

Clinical Indicator	Description
MMRC Dyspnea Scale	Grade 0: Breathless with strenuous exercise. Grade 1: Short of breath when hurrying on level ground or walking up a slight hill. Grade 2: Walks slower than people of the same age on level ground because of breathlessness or has to stop for breath when walking at own pace on level ground. Grade 3: Stops for breath after walking about 100 meters or after a few minutes on level ground. Grade 4: Too breathless to leave the house or breathless when dressing or undressing
Chronic cough	May be intermittent and may be productive or non-productive • In Chronic Bronchitis their sputum production • In Emphysema may or may not present with sputum
Recurrent wheeze	Repeated episodes of high-pitched whistling sounds during breathing, usually on exhalation. Often associated with airway narrowing or obstruction.
Recurrent Lower respiratory tract infections (LRTIs)	Multiple episodes of infections affecting the bronchi and lungs (e.g., bronchitis, pneumonia) over a defined period.

Clinical Indicator	Description
History of risk factor	• Tobacco smoke (including popular local preparations) • Smoke from home cooking and heating fuels • Occupational dusts, vapors, fumes, gases and other chemicals • Host factors e.g. genetic factors, developmental abnormalities, low birthweight, prematurity, childhood respiratory infections etc.) • Age of 40 years and above
Gradual onset of symptoms	Symptoms like cough and breathlessness develop slowly over time, often initially overlooked
Age of 40 years and above	COPD is more common in individuals aged 40 and above, especially with a history of exposure to risk factors like smoking or biomass fuel.
Chest tightness	A common symptom due to airway narrowing and inflammation, often associated with breathing difficulty.
Patient with above symptoms and previously treated for Tuberculosis (post TB lung Disease)	Previous TB can cause lung scarring and airflow limitation, increasing the risk of COPD-like symptoms.
Family history of COPD	Genetic predisposition can contribute to the development of COPD, especially with shared environmental exposures.
Fatigue	Chronic breathlessness and low oxygen levels can lead to persistent tiredness and reduced activity tolerance.
Weight Loss	Advanced COPD may lead to muscle wasting and weight loss due to increased energy expenditure and poor appetite.

5.3 Findings on Physical Examination

Findings are not diagnostic but may include

1. Tachypnoea
2. Use of accessory muscles to breathe
3. Barrel chest due to hyperinflation
4. On auscultation:

- Coarse crackles due to lung collapse and mucus
- Asterixis due to flapping arms

5. Cyanosis, pursed-lip breathing
6. Signs of right heart strain (advanced disease)

5.4 Diagnosis of COPD

Suspect COPD in patients with relevant clinical history and risk factors. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommends spirometry as the gold standard for diagnosis and monitoring.

1. A post-bronchodilator FEV1/FVC ratio <0.70 confirms the presence of persistent airflow limitation consistent with COPD.
2. Access to spirometry is essential for accurate diagnosis, management, and follow-up of COPD patients.
3. Where spirometry is not available, refer patients with a high index of suspicion to facilities with spirometry capacity.

5.4.1 Clinical Indicators for Considering a Diagnosis of COPD

COPD is a progressive lung disease that makes breathing difficult and includes chronic bronchitis and emphysema. Consider COPD in patients presenting with the following indicators, and confirm the diagnosis with spirometry:

- Persistent cough, often productive
- Progressive breathlessness
- Recurrent lower respiratory tract infections
- History of exposure to risk factors (smoking, biomass fuels, occupational exposures)
- Onset after the age of 40 years

Referral Red Flags

Refer patients for further assessment if:

- Symptoms begin before the age of 40 years
- There is rapid progression of disease
- Exacerbations are frequent despite appropriate treatment

Table 5.2: Role of Spirometry in Management of COPD

Role of Spirometry in COPD	Description
Diagnosis	Confirms persistent airflow limitation
Assessment of severity of airflow (for prognosis)	Determines degree of obstruction for prognosis
Follow-up assessment:	Informs therapeutic decisions • Pharmacological in selected circumstances (e.g., discrepancy between spirometry and level of symptoms) • Consider alternative diagnoses when symptoms are disproportionate to the degree of airflow obstruction • Non-pharmacological (e.g., interventional procedure) • Identification of rapid decline

5.4.2 Severity of COPD

Classification of the severity of COPD is based on bronchodilator *FEV1* (in patients with *FEV1/FVC* less than 70%).

Table 5.3: GOLD Classification of COPD

Gold 1	Mild FEV 1≥80% Predicted
Gold 2	Moderate 50%≤ FEV1< 80% Predicted
Gold 3	Severe 30% ≤ FEV1<50% Predicted
Gold 4	FEV< 30% Predicted

5.4.3 Additional Testing:

1. Pulse Oximetry
2. Stratification through GOLD groups
3. Full hemogram: anaemia, polycythaemia (due to chronic hypoxia)
4. Chest X-ray: although not diagnostic, findings will include an increase in the anterior-posterior ratio; an increase in intercostal spaces
5. Genetic testing: not routine. Useful in people over 45 years or in rapidly progressing cases, should be tested for Alpha 1 antitrypsin

5.5 Differential Diagnosis

Table 5.4: Differential Diagnosis of COPD

Condition	Suggestive Features
COPD	Symptoms are slowly progressive, history of tobacco smoking or other risk factors. Onset after 40 years of age.
Asthma	Variable airflow obstruction, Symptoms vary widely from day to day, Symptoms are worse at night/early morning, Allergy/rhinitis and/or eczema also present, often occurs in children, family history of asthma. Onset before 20 years of age
Congestive Heart Failure	CXR shows dilated heart and pulmonary oedema, pulmonary function tests indicative of volume restriction, NOT airflow obstruction.
Bronchiectasis	Large volumes of purulent sputum, commonly associated with bacterial infection, CXR/HRCT shows bronchial dilation
Tuberculosis	Onset at all ages, CXR shows lung infiltrate, and microbiological confirmation
Obliterative bronchiolitis	Can occur in children, seen after lung or bone marrow transplantation, HRCT on expiration shows hypodense areas
Diffuse pan-bronchiolitis	Predominantly seen in patients of Asian descent, most patients are male and nonsmokers, almost all have chronic sinusitis, CXR and HRCT show diffuse small centrilobular opacities and hyperinflations

NOTE: *These features tend to be characteristic of the respective diseases, but are not mandatory. For example, a person who has never smoked may develop COPD (especially in LMICs where other risk factors may outweigh cigarette smoking in significance).*

5.5.1 Distinguishing asthma and COPD

Although challenging, especially in adulthood, it is important to distinguish Asthma and COPD to make the right diagnosis and decide on appropriate initial treatment, follow-up, and referral. The diagram (Figure 5.1) illustrates the main differences between the two.

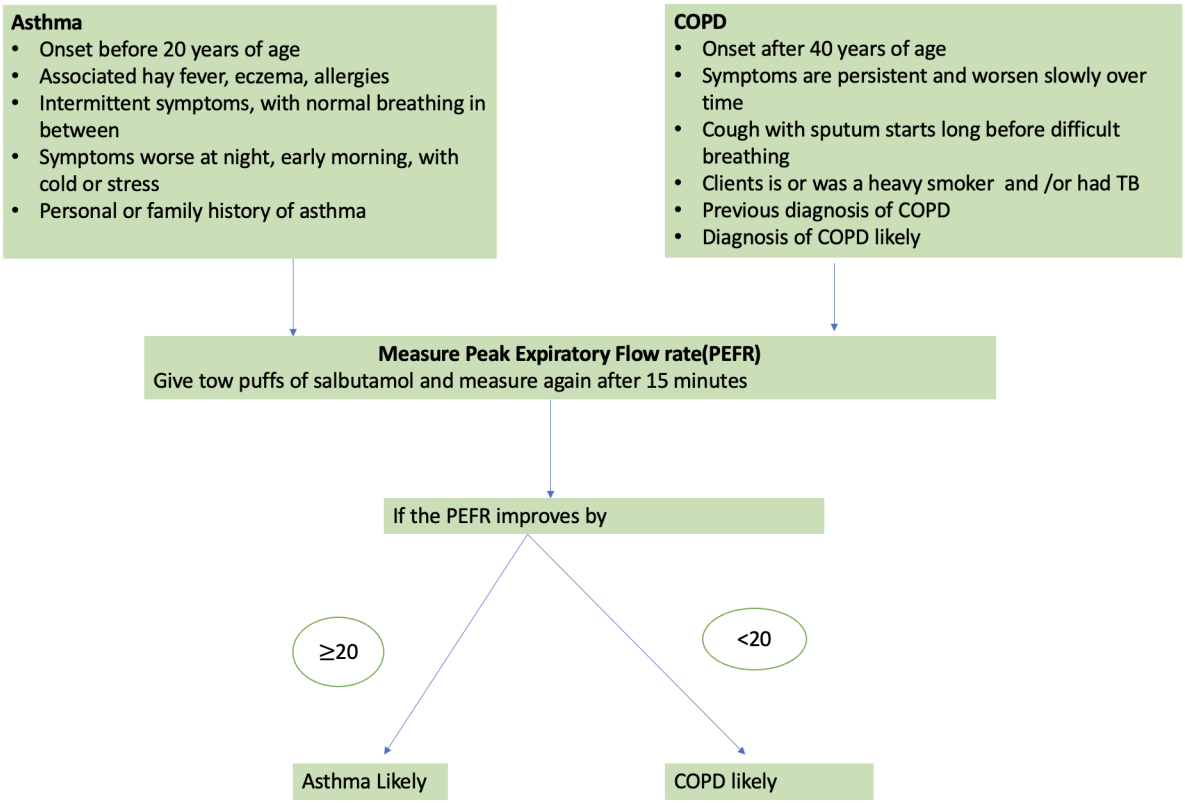


Figure 5.1: Differences between Asthma and COPD

5.5.2 Differentiating Bronchitis and Emphysema:

Bronchitis and Emphysema usually overlap, and there are key findings that can help differentiate them, Table 15:

Table 5.5: Differences between Bronchitis and Emphysema

Bronchitis	Emphysema
• Productive Cough • Dyspnea • Cyanosis • Obesity	• Pursed lips breathing (attempt to prevent bronchial collapse, hence improving ventilation) • Thin frame

5.6 Routine and General Management of COPD

The goals of COPD management are to slow disease progression, relieve symptoms, prevent exacerbations, and improve quality of life. Management should be tailored to disease severity and reviewed regularly at every patient visit.

5.6.1 Routine COPD Care

- COPD care aims to **stop further deterioration of lung function** and to recognize and treat acute exacerbations early.
- Patients should be **reviewed regularly**, with assessment of symptoms, lung function, and treatment adherence.
- At each visit, provide the following:
    - **Smoking cessation support** – the mainstay of care. Smoking cessation drastically reduces disease progression, and patients are more likely to quit if advised by a health professional.
    - **Assess disease severity** and adjust treatment accordingly.
    - **Check inhaler use and adherence** – ensure correct inhaler or spacer technique and reinforce patient education.

5.6.2 General Management Strategies

General management of COPD involves eliminating or reducing risk factors, addressing comorbidities, and providing supportive care:

- Tobacco cessation: This has the greatest impact in reducing the disease progression. This can be done through: Patient counseling and advice to quit; Nicotine replacement therapy; Institutionalization of smoking prevention and tobacco control strategies (Refer to National Tobacco Control policies), Table 16, below:

Table 5.6: Strategies for tobacco cessation- 5As and 5Rs approach

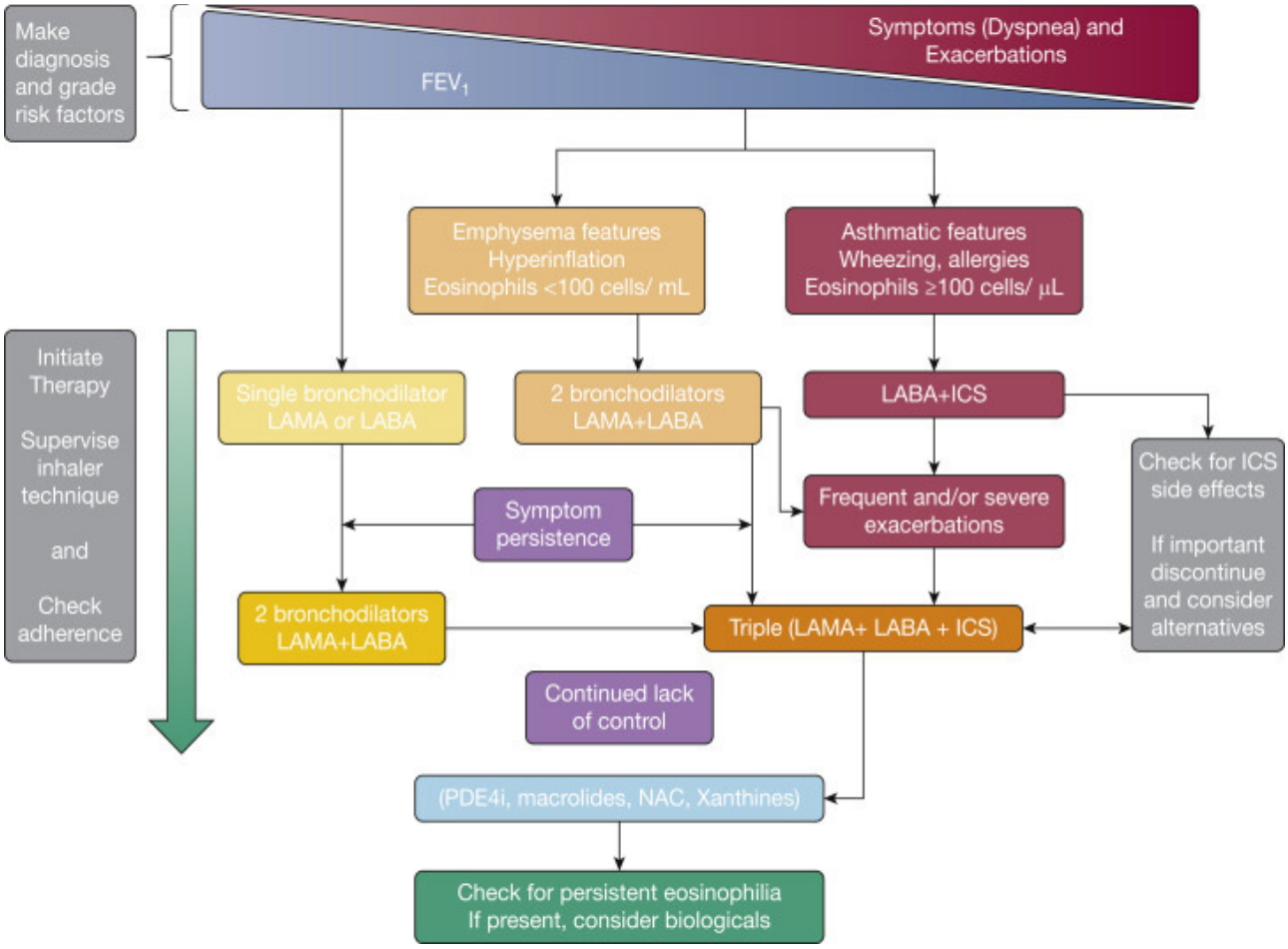
5As - Intended to help Quitting	5Rs - Intended to motivate to Quit
Ask all patients and clients about their history of tobacco use, exposure to SHS, and growing.	Relevance- Why quitting is personally necessary
Advise - discuss risks and advise to all patients on the harms of tobacco and action to take, and resources: quit, avoid exposure, and alternative livelihood.	Risk- Explain negative consequences of tobacco use, exposure to SHSH, and farming
Assess- Willingness to quit	Roadblocks- Patient-led Identification of barriers to quitting
Assist- to quit and plan	Rewards- Discuss socio-economic, environmental and health immediate, short- and long-term benefits of quitting for self and others
Arrange- Follow up or referral for specialized/ comprehensive care/ alternative livelihoods	Repetition - Repeat at every visit to assess readiness and progress as necessary

- Reduction of harmful exposures
- Mitigation of occupational exposure - To anticipate, recognize, and control hazards in the workplace; To promote the health and well-being of workers; To protect workers from injuries, illnesses, and accidents; To develop and maintain sustainable work environments
- Reduction of exposure to indoor pollutants, e.g., bio-fuels, indoor chemicals, e.g, detergents, aerosols, in poorly ventilated houses
- Pulmonary rehabilitation - includes aerobic and strength training to improve exercise tolerance and quality of life.
    - Encourage regular physical exercise - based on tolerance at the health facility, Household, and community level
- Education of the patient and families - provide ongoing counseling on disease, treatment, lifestyle modifications, and self-management.
- Vaccination - administer influenza (yearly), pneumococcal (every 5 years), and COVID-19 vaccines.
- Pharmacotherapy – aimed at reducing symptoms, frequency, and severity of exacerbations and improving health status. They include:
    - Inhaled bronchodilators Long-acting beta agonist.
    - Inhaled corticosteroids - for selected patients with severe disease and frequent exacerbations.
    - Long-acting muscarinic agents
        - NB: Combined inhaled corticosteroid/ bronchodilator therapy is more effective than individual components. Antibiotics are not recommended except for the treatment of suspected bacterial infections.
- Mucolytic agents for patients with viscous sputum
- Oxygen therapy - long-term administration of oxygen for > 15 hours per day has been shown to increase survival in patients with severe COPD
- Palliative care/ hospice care is important for patients with advanced COPD, which is marked with deteriorating health status, increasing symptoms, frequent acute exacerbations with frequent hospitalizations, and associated comorbidities, e.g., cardiovascular diseases, malignancies, and progressive respiratory failure
- Smoking Cessation as necessary (Nicotine Replacement Therapies (NRTs), Varenicline or Bupropion)

5.6.3 Other Management Considerations

- Non-tuberculous mycobacterial (NTM) lung disease in COPD may be exacerbated with inhaled steroids use!
- Investigations: Mycobacterial sputum culture before administering inhaled steroids (and antibiotics) should be conducted where available.

- Treatment: SABA is now recommended for only children < 13y



Key:

- LAMA - Long-Acting Muscarinic Antagonist,
- LABA - Long-Acting Beta Antagonist,
- ICS - Inhaled Corticosteroids,
- PDE4i- Phosphodiesterase 4 inhibitors, NAC - N-Acetylcysteine

Figure 5.2: Guide for the management of COPD based on the severity of the disease

5.6.4 Pharmacological Treatment of COPD

1. Short-Acting Beta-Agonists (SABA) – Rescue Inhalers
    - Salbutamol
        - Adults: 100–200 mcg (1–2 puffs) inhaled every 4–6 hours as needed
        - Nebulizer: 2.5 mg every 4–6 hours as needed
2. Short-Acting Muscarinic Antagonists (SAMA) – Rescue Inhalers
    - Ipratropium Bromide
        - MDI (Inhaler): 20–40 mcg (1–2 puffs) every 6–8 hours

        - Nebulizer: 500 mcg every 6–8 hours
3. Long-Acting Beta-Agonists (LABA) – Maintenance Therapy
    - Formoterol
        - 12–24 mcg inhaled every 12 hours
4. Long-Acting Muscarinic Antagonists (LAMA) – Maintenance Therapy
    - Tiotropium
        - Handihaler (DPI): 18 mcg inhaled once daily
        - Respimat (Soft Mist Inhaler): 2.5 mcg, 2 puffs once daily
5. Combination Therapy (LABA + LAMA or ICS + LABA + LAMA)
    - Budesonide + Formoterol (ICS + LABA)
        - 160/4.5 mcg inhaled twice daily
6. Inhaled Corticosteroids (ICS) – For Severe COPD with Frequent Exacerbations
    - Budesonide: 160–320 mcg inhaled twice daily
    - Fluticasone: 100–250 mcg inhaled twice daily.
7. Mucolytics – For Chronic Sputum Production
    - N-Acetylcysteine (NAC)
        - 600 mg orally once or twice daily
8. Additional COPD Management:
    - Oxygen Therapy: For chronic hypoxia (SpO_2 <88%)
    - Antibiotics (Azithromycin, Amoxicillin-Clavulanate): For bacterial exacerbations
    - Smoking Cessation (Nicotine Replacement, Varenicline, Bupropion)

5.7 Complications of COPD

1. Exacerbation: infections, pulmonary embolism, heart failure, arrhythmias, myocardial infarction
2. Pulmonary hypertension: occurs in response to hypoxemia and may lead to right-sided heart failure (Cor pulmonale)
3. Pneumothorax: May result from rupture of bullae

5.7.1 Exacerbations

An acute exacerbation of COPD is defined as a sudden worsening of respiratory symptoms (such as breathlessness, cough, or sputum production) beyond normal day-to-day variation, requiring a change in treatment. Exacerbations accelerate lung function decline, increase the risk of hospitalization, and contribute to mortality.

5.7.2 Management of Acute Exacerbations

- Short-acting bronchodilators
    - Administer a short-acting beta-agonist (SABA) (e.g., salbutamol), alone or in combination with a short-acting muscarinic antagonist (SAMA) (e.g., ipratropium bromide), via inhaler or nebulizer.
- Supplemental oxygen
    - Titrate to maintain oxygen saturation between 88–92%.
- Systemic corticosteroids
    - Prednisone 40 mg orally once daily for 7 days, or hydrocortisone intravenously if unable to tolerate oral.
- Antibiotics
    - Indicated when there is evidence of bacterial infection (increased sputum purulence/volume, fever).
    - First-line: **Doxycycline 100 mg every 12 hours for 10 days** or **Amoxicillin 500 mg every 8 hours for 10 days**.
- Inhaled corticosteroids
    - High-dose inhaled corticosteroids may be considered in patients with severe COPD and ≥2 infective exacerbations per year.
- Vaccination
    - Administer influenza vaccine annually and pneumococcal vaccine every 5 years.
- Ventilatory support
    - Consider non-invasive or invasive ventilation in cases of acute or impending respiratory failure.

5.7.3 Assessment During Exacerbation

During an exacerbation, assess:

- Severity of airflow limitation
- Impact on the patient's overall health status
- Risk of future exacerbations (the best predictor is ≥2 exacerbations in the previous year)
- Risk of mortality

5.7.4 Post-Exacerbation Care

- Review patients every 3–6 months if stable.
- Identify and manage complications (e.g., fluid retention, heart failure) – consider a low-dose diuretic when indicated.
- Encourage daily physical activity (walking, household chores, gardening, stair climbing).
- Reinforce inhaler technique, adherence, and lifestyle modifications.

5.8 Follow-up care

- Use of CT scan in stable COPD
- Define the stable and unstable COPD, Table 17, below:

Table 5.7: Comparison of Stable and Unstable COPD

Feature	Stable COPD	Unstable COPD (Exacerbation)
Definition	A phase where symptoms are relatively controlled and consistent.	A sudden worsening of respiratory symptoms beyond normal day-to-day variations.
Symptoms	Chronic cough, sputum production, and breathlessness persist but are manageable.	Increased breathlessness, cough, sputum volume, or change in sputum colour.
Triggers	Usually none or minimal environmental triggers.	Often triggered by infections, pollutants, or allergens.
Treatment Approach	Maintenance therapy (e.g., bronchodilators, inhaled corticosteroids, lifestyle).	May require short-term intensification: antibiotics, steroids, hospitalization.
Functional Status	Relatively stable lung function and activity level.	Marked decline in lung function and activity; may need oxygen or ventilation support.
Healthcare Utilization	Routine outpatient follow-ups.	Increased emergency visits, possible hospital admissions.
Prognostic Impact	Slower progression of disease.	Accelerates lung function decline; worsens prognosis.

Table 5.8: Follow-up care in the Management of COPD

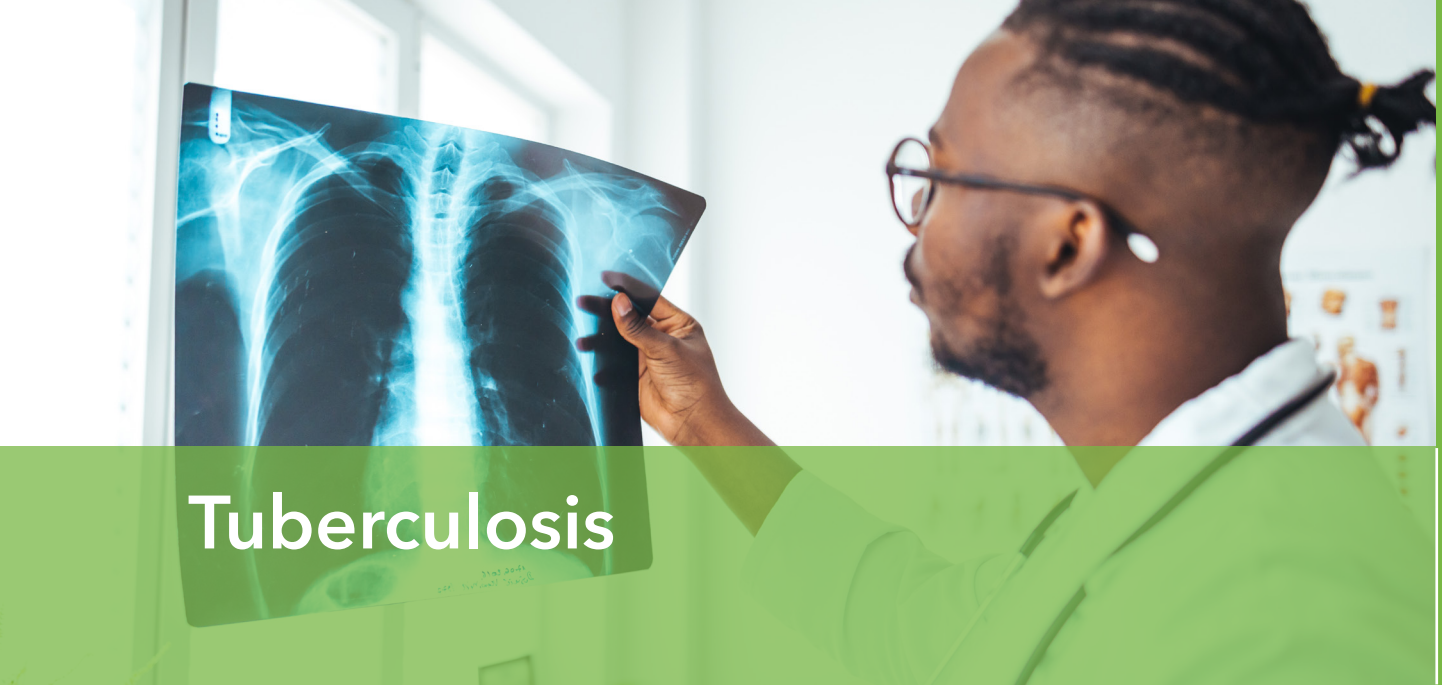
Differential Diagnosis	• Frequent exacerbations with excessive cough with sputum production, raising concern for bronchiectasis or atypical infection • Symptoms out of proportion to disease severity based on lung function testing
Lung Volume Reduction	• Endobronchial valve therapy may be a therapeutic option for patients if they demonstrate post-bronchodilator FEV1 between 15% to 45% and evidence of hyperinflation • Lung volume reduction surgery may be a therapeutic option for patients with hyperinflation, severe upper lobe predominant emphysema, and low exercise capacity after pulmonary rehabilitation
Lung Cancer Screening	• An annual low-dose CT scan is recommended for lung cancer screening in patients with COPD due to smoking, according to recommendations for the general population

Summary: Management of COPD

Table 5.9: Summary management of COPD

Does the patient have 2 or more of the following symptoms?
• Dyspnea that is progressive, persistent, and worsens with exercise • Chronic cough which may be intermittent and productive or not productive • Chronic sputum production • Wheezing • History of exposure to risk factors: age of 40 years and above, tobacco smoking, smoke from home cooking and heating biofuels, occupational dust and chemicals • Previous history of treatment for TB • Family history of COPD
Diagnosis
• Spirometry is the Gold standard for clinical diagnosis and monitoring of COPD • Post bronchodilator FEV1/FVC less than 70%

Treatment
• Smoking cessation- patient counseling occupational exposure, nicotine replacement therapy • Reduction of exposure to indoor pollutants • Physical exercise • Pharmacotherapy- Inhaled bronchodilators, Inhaled corticosteroids, Combined inhaled corticosteroid/ bronchodilator therapy is more effective than individual components, Mucolytic agents for patients with viscous sputum, Oxygen therapy - Long-term administration of oxygen for > 15 hours per day • Palliative care/ hospice care is important for patients with advanced COPD
Follow up
• o Smoking cessation - is the mainstay of care • o Check adherence to treatment and inhaler/spacer technique.



Tuberculosis

6

Tuberculosis (TB) is an airborne chronic infectious disease caused by *Mycobacterium tuberculosis*. It usually infects the lungs, but it can infect any part of the body, including the kidneys, spine, and brain. TB does not affect the nails, hair, and teeth. The treatment pathway for TB involves multiple stages, each critical for ensuring effective management and cure of the disease

The screening, diagnosis, and case management are as per the referenced algorithms.

1. Simplified algorithm for diagnosis of pulmonary TB in children below 15 years
2. Simplified algorithm for diagnosis of extrapulmonary TB in children below 15 years
3. Simplified algorithm for diagnosis of pulmonary TB in adults

6.1 Pre-Treatment Stage

This stage involves the processes leading up to the initiation of TB treatment. It involves screening and diagnosis. Symptom assessment involves evaluation of symptoms like a persistent cough, fever, night sweats, and weight loss. Consider further evaluation for PLHIV and key & vulnerable populations (KVPs) as per the TB guidelines.

6.1.1 Patient Education and Counseling

Educate the patient on TB, its transmission, and the importance of adherence to treatment.

6.1.2 Diagnostic Tests

1. Sputum Smear Microscopy: Detects the presence of Mycobacterium tuberculosis in sputum.
2. Chest X-ray: Helps identify lung damage caused by TB.
3. Tuberculin Skin Test (TST): Measures immune response to TB antigens.

4. Interferon-Gamma Release Assays (IGRAs): Blood tests that detect TB infection.
5. Molecular Tests: GeneXpert MTB/RIF test for detecting TB and rifampicin resistance.
6. Culture Test: The gold standard for TB diagnosis and drug susceptibility testing (DST). DST determines the sensitivity of TB bacteria to first-line and second-line anti-TB drugs, essential for detecting drug-resistant TB.

6.2 Treatment Stage

Tuberculosis treatment involves a combination of antibiotics taken over a period to ensure complete eradication of the bacteria.

1. Initial Phase (Intensive Phase)
    - Duration: Typically, the first 2 months. (60 days)
    - Medications: A combination of four first-line anti-TB drugs: Isoniazid (INH), Rifampicin (RIF), Pyrazinamide (PZA), and Ethambutol (EMB).
    - Purpose: To rapidly reduce the bacterial load and prevent the emergence of drug resistance.
2. Continuation Phase
    - Duration: Generally, 4 to 6 months after the initial phase.
    - Medications: Typically involves Isoniazid and Rifampicin.
    - Purpose: To eliminate any remaining bacteria and prevent relapse.
3. Monitoring and Follow-up
    - Directly Observed Treatment, Short-course (DOTS): A healthcare worker observes the patient taking their medication to ensure adherence.
    - Regular Sputum Tests and Chest X-rays: To monitor treatment progress and bacterial clearance.
    - Management of Side Effects: Addressing adverse reactions to medications, which can include liver toxicity, vision changes, or skin rashes.
4. Treatment of Drug-Resistant TB (DR-TB)
    - Second-line Drugs: For cases resistant to first-line drugs, a longer and more complex regimen involving second-line drugs is used.
    - Duration: Can range from 9 to 24 months or longer, depending on the severity and drug resistance pattern.

6.3 Post-Treatment Stage

This stage focuses on ensuring the patient is fully cured, post-TB lung complications are managed, and preventing recurrence of the infection.

1. Final Assessment
    - Clinical Evaluation: Assessment of the patient's clinical status and confirmation of the completion of treatment.
    - Sputum Tests and Chest X-ray: Final tests to confirm the absence of TB bacteria.
2. Post-Treatment Monitoring
    - Follow-up Visits: Regular check-ups, typically at 6- and 12-month post-treatment, to monitor for signs of relapse.
    - Health Education: Continued education on preventing reinfection and recognizing symptoms of recurrence.

6.4 Management of Post-TB Complications

1. Residual Lung Damage: Some patients may experience chronic lung issues or scarring, which interferes with the normal function of the lungs like breathing in and out without difficulties.
2. Rehabilitation: Includes Pulmonary rehabilitation or other interventions to improve lung function.

Successful TB treatment requires a comprehensive approach, involving medical, psychological, and social support to ensure patients not only recover from the disease but also reintegrate into their communities effectively.

Post-Tuberculosis Lung Disease (PTLD)

7

7.1 Background and Epidemiology

Following an episode of lung infection or injury, one of the long-term complications that can occur is post-infectious chronic lung disease. This refers to long-term lung problems that develop after either severe viral or bacterial infection including TB. In children severe viral bronchiolitis is also important cause of damaged lungs and presents as obliterative bronchiolitis. In this section we shall focus on post TB lung disease which is the commonest form of post infectious chronic lung disease.

Pulmonary rehabilitations plays an important role in the management of post infectious chronic lung conditions

Despite successful treatment of TB, residual lung damage can lead to various complications, impacting lung function and overall health. PTLD represents a significant health burden globally, particularly in regions with a high prevalence of TB. There is increasing evidence of long-term respiratory complications following TB in a proportion of these patients, affecting their quality of life. The World Health Organization (WHO) estimates that one out of four people infected with TB also develops TB-associated disabilities due to impairments worsened by, or developed due to, the TB disease and/or the treatment.

For several decades, TB programs have focused on microbial elimination without considering the quality of life and well-being of individuals affected by TB. It is now recognized that PTLD, including recurrent TB, impairment, and social costs after microbiological cure of TB, continues to affect individuals despite completion of treatment. Increasing evidence suggests that post TB lung disease (PTLD) causes significant morbidity and mortality.

7.2 Case definition for PTLD

Any person with history of Chronic respiratory symptoms and evidence of chronic respiratory impairment within two years after successful treatment for pulmonary tuberculosis in whom active TB is excluded, and no other cause of chronic lung disease

is identified

The long-term effects and the severity of PTLD may further be worsened by comorbidities such as diabetes, Mental Health conditions, compounded by severe forms of peripheral neuropathies.

7.3 Clinical Presentation of PTLD

Clinical presentation of PTLD is varied and is dependent on the clinical pattern. A sizeable proportion of people considered cured (or with TB treatment completed) report:

- Persistence of cough, chest pains, wheezing, weakness, fatigue
- Dyspnea on exertion on performing activities of daily living, which affects their quality of life (QoL) and increases the risk of death despite successful completion of PTB treatment.
- People with significant post-TB lung disease might present with features of right heart failure, e.g., leg swelling, dyspnea on exertion, abdominal swelling, etc.
- Social and economic effects of PTLD may lead to patients presenting with mental health impairments and substance abuse

Table 7.1: Clinical Patterns of Post-TB Lung Disease Based on the Affected Anatomical Region

Compartment	Clinical Pattern	Examination findings
Airways	Tuberculosis-associated obstructive lung disease	Airway obstruction (FEV_1/FVC ratio < 0.7 or <LLN) though primarily related small airway disease
	Airway dilatation	CT definition - evidence of airway dilatation; more than the diameter of the adjacent vessel, or non-tapering. OR CXR definition-evidence of ring and tramlines
	Airway constriction	FVC is reduced (less than 80%) FEV1/FVC is increased (0.70)

Compartment	Clinical Pattern	Examination findings
Parenchyma	Cavitations	CXR /CT - gas-filled space either within an area of pulmonary consolidations, or surrounded by a thin wall
	Parenchymal destruction	CT-Extensive destruction of lung tissue, with a gas- filled space occupying the volume of ≥1 lobe
	Fibrotic changes	Areas of parenchymal scarring, with associated volume loss
	Aspergillus-related lung disease	Evidence of aspergilloma on imaging or chronic pulmonary aspergillosis on imaging and blood testing
Pleural	Chronic pleural disease	Evidence of pleural thickening on CXR or CT imaging
Pulmonary vasculature	Pulmonary hypertension	Elevated pulmonary arterial pressures as estimated using doppler echocardiography or measured at right heart catheterization
Other	Other	Other pathologies not meeting the criteria above.

Largely adapted from the 1st symposium on post-TB lung disease in July 2019

7.4 Approach to Early Detection

7.4.1 Assessment for Lung Damage

Assessment of patients for PTLD should begin with a baseline assessment at the initiation of PTB treatment followed by regular assessment during and after successful completion of PTB treatment.

Table 7.2: Baseline and Schedule of assessment

Start of TB treatment	During TB Treatment	End of Treatment Review
• Record all presenting symptoms and signs • Take a CXR • Record all diagnostic tests used to confirm TB	• During scheduled visits, monitor symptoms, signs, and laboratory findings	• Chest X-ray at the end of treatment • Thorough clinical examination • Patient counseling on post-TB lung disease symptoms

Other key considerations: Mycobacterial Culture to identify non-tuberculous mycobacterial (NTM) lung diseases

Culture & Sensitivity for early recognition and eradication of Pseudomonas colonization (within 6 months of treatment) with IV and inhaled antibiotics.

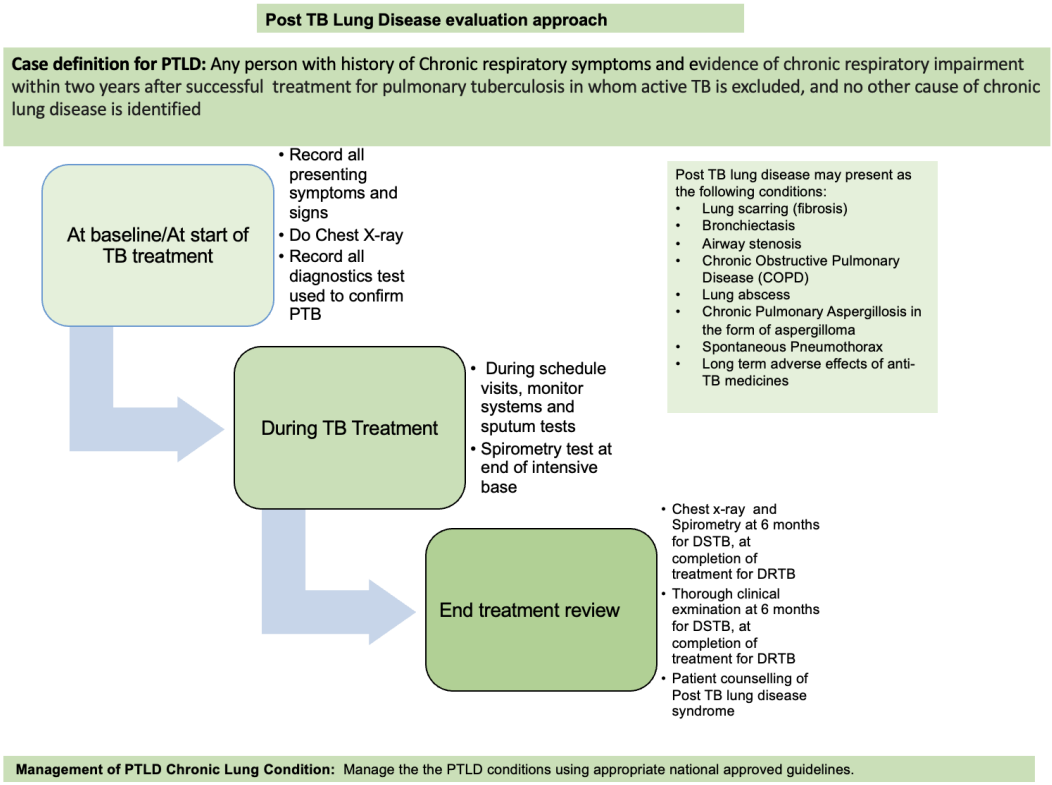


Figure 7.1: Post-TB Lung Disease Evaluation Approach

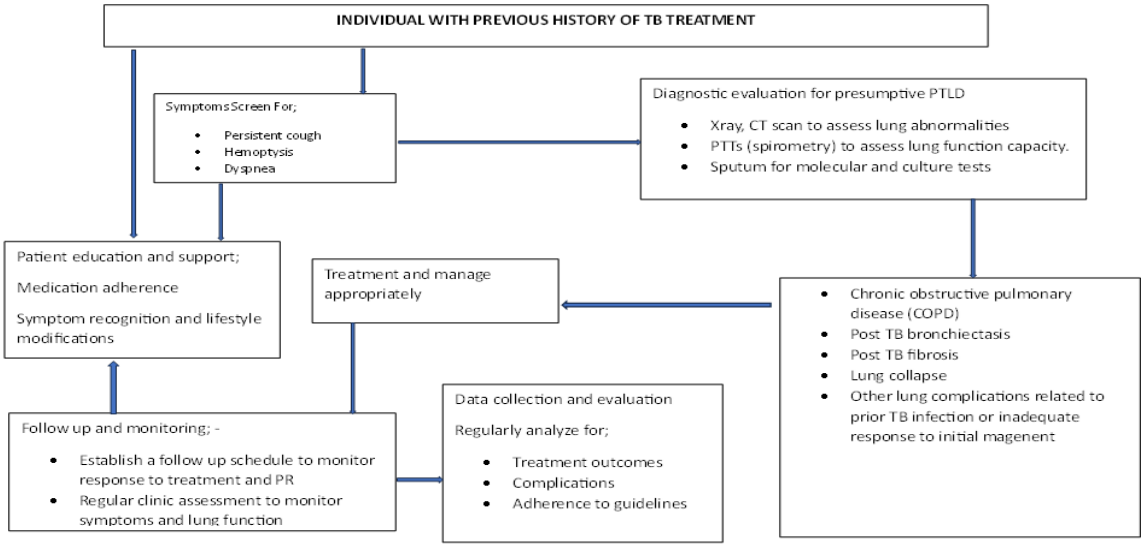


Figure 7.2: Algorithm for PTLD/ CRDs

7.4.2 Assessment of PTLD in children and adolescents

In young children, the life-time impact of PTLD could be even worse than in adults, because lungs continue to develop until early adulthood, with the first years of life being most critical in lung development.

There is evidence that lower respiratory tract infections in the early years reduce lung function later in life. PTB occurring in a young child or adolescent could therefore have a substantial impact on long-term lung health outcomes.

It is also likely that the long-term effects of PTB in children and adolescents depend on the type (parenchymal vs. nodal airway disease or other), the severity and the age of TB onset, which is relevant to age-related lung development.

At the end of treatment, all children with more severe forms of PTB or children who remain symptomatic at the end of their treatment need to be assessed for PTLD.

Medical treatment and long-term follow-up of children and adolescents who have PTLD should be guided by symptoms, the spectrum of respiratory disease and additional

investigations.

Note: TBM sequelae in children and adolescents; more common in < 5 years old.

7.5 Post TB Treatment Assessment

Every patient completing TB treatment should be clinically evaluated for presumptive PTLD. The assessment should be conducted as soon as possible at the end of treatment at the TB clinic and on appointment at month 6, 12, 18 and 24. The following set of basic examinations is critical upon clinical suspicion of either the presence of, or risk factors for, PTLD:

Assess such patients for:

- obstruction
- restriction
- desaturations and/or low oxygen levels
- reduced exercise tolerance
- related impairment in quality of life

Table 7.3: Post-TB Treatment Assessment

Assessment	
Clinical Assessment	Clinical history, symptom assessment, and clinical examination
Imaging	CXR, or (CT where available)
Functional evaluation	• Spirometry, including pre- and post-bronchodilator test • Pulse oximetry (SpO2 =peripheral Capillary oxygen saturation) • 6MWT • Five repetitions sit-to-stand test • Borg Scale
Subjective evaluation	• QoL (quality of life). questionnaire • CAGE • Frequent symptom score • PHQ-9 (Mental Health assessment)

Table 7.4: Possible outcomes of the Symptoms and CXR assessment and action

S/n	Symptomatic and Chest x-ray assessment outcomes and action
1	No symptoms. Normal CXR or minor residual x-ray changes, normal exercise capacity (6MWT), and normal spirometry. • Discharge from clinic, schedule follow up and advise to return if symptoms develop
2	No symptoms but significant residual changes on the CXR with a normal exercise capacity and a normal spirometry • If minor findings, e.g., calcification, fibrosis, pleural thickening, schedule follow-up and advise to return if symptoms develop
3	No symptoms but with significant residual changes on the CXR, an abnormal exercise capacity and or abnormal spirometry • If major findings e.g., pleural effusion, pneumothorax, lung mass, cardiac abnormalities- Refer to physician/surgeon as appropriate for management-High Resolution CT scan is required • Assess for PR eligibility and Start PR
4	Respiratory symptoms with a normal chest x-ray/minor residual X-ray changes and a normal exercise capacity and or normal Spirometry • Assess for PR eligibility and Start PR • Schedule a follow-up and advise to return if symptoms develop

5	Respiratory symptoms with significant residual changes on the CXR, but normal exercise capacity and or abnormal spirometry • Refer to a physician/surgeon as appropriate for management. A high-resolution CT scan is required • Assess for PR eligibility and start PR Self-exercise • Keep a follow-up schedule
6	Respiratory symptoms with significant residual changes on the CXR, abnormal exercise capacity, and or abnormal spirometry • Assess for PR eligibility and start the pulmonary rehabilitation (PR) Program • Sputum Culture to rule out a new TB episode • Refer to a physician/surgeon as appropriate for management. A high-resolution CT scan is required • The management is dependent on the diagnosis.
7	Presence of other forms of post-TB disability • Manage accordingly, schedule follow-up.

Recommended assessments to be conducted at various facility levels at the end of TB treatment and at follow-up visits, Table 22, below:

Table 7.5: Recommended assessments to be conducted at various facility levels at the end of TB treatment and at follow-up visits

Parameter	Measurement Tool	Level of health facility				
Clinical history and examination	Symptoms: cough, dyspnea, sputum, hemoptysis, wheezing, chest pain, weight loss, fatigue	√	√	√	√	√
	Environmental exposures: smoking, biogas fuel, alcohol	√	√	√	√	√
	Comorbidities: cardiovascular diseases, HIV	√	√	√	√	√
	Physical examination: respiratory rate, heart rate, BMI	√	√	√	√	√

Parameter	Measurement Tool	Level of health facility				
Pulmonary function testing	Spirometry, including pre- and post-bronchodilator test		√	√	√	√
	Six-minute Walk test/ Five repetition sit-to-stand test	√	√	√	√	√
	Plethysmography (measures how much air you can hold in the lungs)					√
	Diffusing capacity of the lungs for carbon monoxide (DLCO); assesses the lungs' ability to transfer gas from inspired air to the bloodstream.					√
Blood gas analysis	Pulse oximetry (To measure the oxygen level (oxygen saturation) of the blood) ideal blood oxygen level is between 95% and 99%. Ideal heart rate is between 50 and 90 beats per minute (bpm).	√	√	√	√	√
Cardiopulmonary evaluation	Cardiopulmonary exercise testing					√
Subjective evaluation	Symptom score and quality of life instrument	√	√	√	√	√

7.5.1 Specific considerations for children

- Evaluation at the end of treatment should follow the same recommendations proposed for adults, except for chest CT scan, which is not recommended because of radiation exposure
- PFT should be considered in all 4 to 6-year-old children with severe lung impairment
- Exercise capacity can be assessed using 6MWT
- Quality of life questionnaires such as the EQ-5D-Y and the Toddler and Infant (TANDI) instrument can be used (appendix)

7.6 Management of Post TB associated Lung conditions:

Based on the anatomical region affected, post-TB lung disease may present as the following conditions:

- Lung scarring (fibrosis)
- TB-associated Bronchiectasis

- Lung abscess
- Chronic Pulmonary Aspergillosis in the form of aspergilloma
- Spontaneous Pneumothorax
- Airway stenosis
- Chronic Obstructive Pulmonary Disease (COPD)

Further, the long-term adverse effects of anti-TB medicines may contribute to the presentation of PTLD.

7.6.1 Lung Scarring (Fibrosis)

Definition: This is the thickening, scarring or stiffness of lung tissue negatively impacting ventilation capacity which can eventually limit delivery of oxygen to the blood. There is usually associated volume loss which develops as a consequence of lung healing from TB. The stiffness causes difficulty in lung expansion leading to shortness of breath.

Clinical presentation

Symptoms: The symptoms depend on the extent of fibrosis. Patients may be asymptomatic or experience dry cough and in severe cases shortness of breath that worsens on exertion.

Clinical examination: physical examination may reveal normal or abnormal chest symmetry and movements, chest is dull on percussion, reduction in breath sounds and inspiratory crackles.

Radiological appearance: Commonly occurs at the apices and upper lobes, with fibro nodular opacities and associated loss of lung volume. Elevation of the adjoining fissure or hilum may be associated.

Management:

For symptomatic patients and those with physical or lung function impairment, the key management is pulmonary rehabilitation

In people with evidence of hypoxemia (low SPo2 <88%) long-term oxygen therapy is required

Patients with evidence of right heart failure should be referred to heart specialist where available or may be treated with diuretics awaiting specialist review

Any patients with symptomatic, hypoxic or evidence of heart failure should be referred for specialized care.

Patients on follow up must be assessed for new episodes TB Infection.

7.6.2 TB associated bronchiectasis

Definition: This is a chronic lung disease often secondary to an infectious process that results in the abnormal and permanent distortion and widening of airways leading to build-up of excess mucus. The pathogenesis of bronchiectasis include; chronic bronchial

infection, altered ability to move bronchial mucus (altered muco-ciliary function) leading to mucus stagnation or pooling and long-term colonization by bacteria, airway obstruction and per bronchial fibrosis (the vicious vortex)

Clinical Presentation

Patients typically present with chronic or recurrent respiratory symptoms, often months or years after TB treatment. The symptoms may range from:

- Chronic Productive Cough with mucopurulent or purulent sputum.
- Recurrent Respiratory Infections, Frequent lower respiratory tract infections or exacerbations. May present with fever, increased cough, and sputum
- Hemoptysis ranging from streaks to massive bleeding.
- Breathlessness / Dyspnea -Progressive over time
- Wheezing especially if there is airway hyperreactivity
- Chest Pain usually pleuritic if infection is present
- Clubbing especially in advanced or long-standing disease
- Constitutional Symptoms (if active infection or exacerbation), Fatigue, Low-grade fever, Weight loss

Physical Examination Findings

- Coarse crackles over affected lung areas (especially upper lobes post-TB)
- Wheezes or rhonchi
- Signs of volume loss (tracheal deviation, chest wall asymmetry)
- Digital clubbing in some cases

Diagnosis: -The diagnosis of post TB bronchiectasis involves the following:

A compatible history of TB treatment with chronic respiratory symptoms (eg, recurrent or persistent cough with copious sputum production)

On physical examination the patient may or may not have finger clubbing, chest movements and symmetry may be normal but on auscultation inspiratory coarse crackles and sometimes expiratory rhonchi.

Investigations

1. Differential blood count
    - Serum immunoglobulins (total IgG, IgA and IgM)
2. Testing for allergic bronchopulmonary aspergillosis (ABPA)

3. Sputum culture for bacterial infection
4. Mycobacterial culture for NTM.
    - Additional tests may be appropriate in response to specific clinical features, or in patients with severe or rapidly progressive disease.

Imaging: Imaging plays a pivotal role in the diagnosis of bronchiectasis.

High-resolution computed tomography (HRCT) (Where Available) is the cornerstone in the radiological diagnosis of clinically suspected bronchiectasis and the most sensitive and specific non-invasive method for diagnosing bronchiectasis. In post TB bronchiectasis, the disease is almost universally associated with elements of lung fibrosis.

The CXR: The CXR is less sensitive for diagnosis of bronchiectasis, however, it's useful for diagnosis in gross disease. The affected individuals are often normal or show nonspecific findings. The key changes to look for include parallel line opacities (tram track appearance), tubular opacities (mucus plugging and ring opacities (dilated end on bronchi). Others are lobar atelectasis and compensatory hyperinflation.

Recommended tests:

Lab test such below may be done to rule out using the recommended microbiological tests

Colonization with Pseudomonas aeruginosa carries a poor prognosis, and therefore where available sputum culture should be done as a surveillance 6 monthly as a surveillance

Occasionally non-tuberculous mycobacteria may infect the bronchiectasis cavities and therefore microbiological assessment should be done.

Additional tests may be appropriate to exclude fungal disease or to exclude other causes of bronchiectasis based on the specific clinical features. Management Treatment is mainly aimed at reducing exacerbations. These are associated with increased airways, systemic inflammation and progressive lung damage. In addition, more severe and more frequent exacerbations are associated with worse quality of life, daily symptoms, lung function decline, and mortality. The cycle below shows the different cycles that a patient goes through.

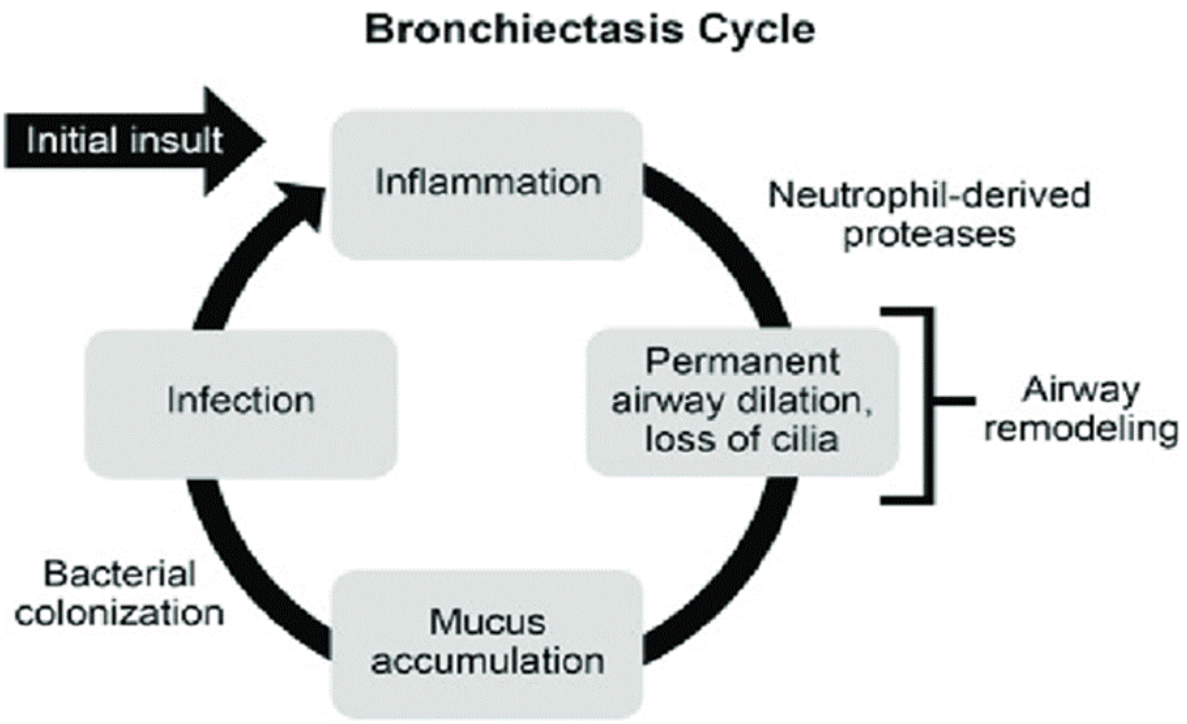


Figure 7.3: Vicious cycle concept of bronchiectasis

Long term management

Chest physiotherapy: This includes postural drainage and other maneuvers aimed at improving drainage of respiratory secretions.

Low dose azithromycin (250mgs once daily for 6 months) Once daily for 6months) is indicated for people who have frequent exacerbations (3 episodes annually) and it's used primarily in this setting for its anti-inflammatory effects. Long term use of low dose azithromycin however may be associated with increased risk of macrolide resistance.

Some of these patients may need to be on inhaled bronchodilators and steroids if they have features of obstructive ventilatory defects on lung function testing or symptoms compatible with airway obstruction.

Management of exacerbations:

Antibiotics: Infective exacerbations will require antibiotics. Broad-spectrum antibiotics such as amoxicillin-clavulanic derivatives, metronidazole or clindamycin for anaerobic infection.

Antipseudomonal antibiotic like ciprofloxacin, 3rd generation cephalosporin (e.g., ceftazidime) should be used when colonization with Pseudomonas is suspected.

Management of bronchiectasis related hemoptysis

Recurrent hemoptysis is common in patients with bronchiectasis. If a patient presents with severe or life threatening hemoptysis, they should be admitted immediately and/or referred for specialized care, with immediate interventions

such as inserting IV line, grouping and cross-matching, administration of thrombotic agents e.g. tranexamic acid and bronchoscopy(where available)

Those with recurrent hemoptysis should be offered definitive treatment such as surgery to remove the diseased lung/segment/lobe or bronchial artery embolization
NB: Once a diagnosis is made, REFER to a chest physician for further specialized care

7.6.3 Lung abscess

Definition: A lung abscess is a bacterial infection that occurs in the lung tissue. The infection causes tissue death, and pus collects in that space. A lung abscess can be challenging to treat, and it can be life threatening. Often seen in a patient with extensive damage to the lungs after tuberculosis.

Clinical presentation:

Symptoms: The most noticeable symptom of a lung abscess is a productive cough. The contents that are coughed up may be bloody or pus-like, with a foul odour, fever of 38 degrees Celsius or higher, chest pain, shortness of breath, sweating or night sweats, weight loss, fatigue.

Clinical examination: Dullness on percussion and decreased or absent breath sounds with an intermittent pleural friction rub (grating or rubbing sound) on auscultation, crackles may present.

Diagnosis: Rule out TB and other infections by conducting sputum or pus analysis, CXR and/or CT.

Full blood count and/or a blood culture will support establishing the causative agent.

Management of abscess

- Antibiotic treatment is given. The choice of antibiotic is aided by the results of a pus culture-sensitivity test.
- Surgical intervention may also be necessary.

NB: Once a diagnosis is made, REFER to a chest physician for further specialized care

7.6.4 Chronic Pulmonary Aspergillosis in the form of aspergilloma

Definition: This results from colonization of tuberculous cavities or bronchiectasis lesions with the fungus Aspergillus.

This may be recognized as: saprophytic infestation of airways, cavities and necrotic tissue

Symptoms and signs:

- Normal initially
- A cough that often brings up blood (hemoptysis)
- Wheezing
- Shortness of breath
- Unintentional weight loss
- Fatigue

Three distinctive patterns of aspergillus-related lung disease are recognized:

- Saprophytic infestation of airways, cavities and necrotic tissue
- Allergic disease including extrinsic allergic alveolitis, asthma, allergic broncho-pulmonary aspergillosis, broncho centric granulomatosis and
- Chronic eosinophilic pneumonia.

Classification of Aspergillus infection

The condition manifests depending on the underlying lung pathology and host immune status into the following 5 types. Aspergillus can cause a variety of clinical syndromes; variable host–pathogen interactions result in a spectrum of Aspergillus-related diseases, from hypersensitivity responses leading to allergic bronchopulmonary aspergillosis (ABPA) through to invasive diseases associated with severely immunocompromised states.

1. **Invasive pulmonary aspergillosis (IPA)**

Invasive pulmonary aspergillosis (IPA) most commonly occurs in severely immunocompromised patients and is characterized histopathologically by the invasion of lung tissue with hyphae.

2. **Chronic pulmonary aspergillosis**

Chronic pulmonary aspergillosis (CPA) includes aspergilloma, chronic cavitary pulmonary aspergillosis (CCPA), chronic fibrosing pulmonary aspergillosis (CFPA) and Aspergillus nodules. CPA is a chronic, progressive lung infection and the different manifestations of the disease are identified by characteristic radiographic findings

3. **Allergic bronchopulmonary aspergillosis**

Allergic bronchopulmonary aspergillosis (ABPA) is a complex hypersensitivity response to inhaled Aspergillus. This disease occurs almost exclusively in patients with asthma or

cystic fibrosis. It is estimated that the prevalence of ABPA among patients with asthma is 1–2.5% and should be suspected in patients with poorly controlled or corticosteroid-dependent asthma.

4. Aspergillus bronchitis

This is a chronic, superficial infection of the lower airways (trachea and bronchi), without lung parenchymal invasion or allergic airway response, which typically occurs in patients who are not significantly immunocompromised. Although the pathophysiology is not completely understood, it is likely to involve anatomical alterations leading to ineffective airway clearance, together with subtle immune defects.

5. Aspergillus rhinosinusitis

Similar to pulmonary disease, Aspergillus rhinosinusitis has both non-invasive and invasive manifestations. Non-invasive forms of Aspergillus rhinosinusitis include fungal balls and allergic fungal rhinosinusitis, both of which typically present with chronic rhinosinusitis symptoms. Nasal polyps are commonly associated with Aspergillus sensitization (raised Aspergillus IgE) and can lead to nasal obstruction and local infection. Fungal balls usually affect only one sinus cavity.

Clinical presentation:

Signs and Symptoms: These vary depending on the severity and type of illness one develops. Three distinct types are known with specific signs and symptoms.

Table 7.6: Signs and Symptoms of Aspergillosis

Type of illness	Signs / symptoms	Predisposing condition
Allergic reaction (allergic bronchopulmonary aspergillosis)	• Fever • A cough that may bring up blood or plugs of mucus • Worsening asthma	Develops in asthma or cystic fibrosis
Aspergilloma	• Normal initially • A cough that often brings up blood (haemoptysis) • Wheezing • Shortness of breath • Unintentional weight loss • Fatigue	Emphysema, tuberculosis or advanced sarcoidosis,

Type of illness	Signs / symptoms	Predisposing condition
Invasive aspergillosis (Most severe form and fatal)	Signs and symptoms depend on which organs are affected, Generally: • Fever and chills • A cough that brings up blood (haemoptysis) • Shortness of breath • Chest or) joint pain • Headaches or eye symptoms • Skin lesions	In people whose immune systems are weakened as a result of cancer chemotherapy, bone marrow transplantation or a disease of the immune system to the brain, heart, kidneys or skin

Table 7.7: Diagnosis of Aspergillosis

Diagnostic spectrum		
Allergic Bronchopulmonary Aspergillosis (ABPA)	Invasive aspergillosis (Chronic necrotizing Aspergillus pneumonia)	Aspergilloma
Laboratory testing		
Major: • Blood: CBC for Eosinophilia. • Skin test - positive result for A. fumigatus • Marked elevation of the serum immunoglobulin E (IgE) level to greater than 1000 IU/dL • Aspergillus Precipitin test: positive results for Aspergillus precipitins (primarily immunoglobulin G flgG], but also • Immunoglobulin A flgA] and immunoglobulin M flgM])	Demonstration of the organism in sputum	
Minor criteria – • Positive Aspergillus radioallergosorbent assay test results Sputum culture for Aspergillus in sputum and Culture / sensitivity		
Imaging		

Chest radiography	Chest radiography	Chest radiography
• Fleeting pulmonary infiltrates Mucoid impaction	• Variable features with variable, solitary or multiple nodules	• A mass in a pre existing cavity, • Usually in an upper lobe • manifested by a crescent of air partially outlining a solid mass. • Movement of mass with position
Central bronchiectasis	- Cavitary lesions	
• Lobulated infiltrate, which has been likened to a cluster of grapes or a hand in a mitten HRCT • Mucus filled bronchi Areas of atelectasis	• Alveolar infiltrates that are localized or bilateral • Diffuse infiltrates as disease progresses HRCT Characteristic halo sign (i.e., an area of ground-glass infiltrate surrounding nodular densities) • Later disease may show a crescent of air surrounding nodules, indicative of cavitation. • Because Aspergillus is angioinvasive, infiltrates may be wedge-shaped, Pleural-based, and cavitary, which is consistent with pulmonary infarction	HRCT • Better definition of the mass within a cavity • May demonstrate multiple aspergillomas in areas of extensive cavitary disease (supine and prone CTs to be considered)

High levels of specific immunoglobulin G against Aspergillus in blood (Confirmatory test)

Management

- The only effective treatment is surgical removal of the aspergilloma.
    - In addition to surgical removal: Oral itraconazole 200mg BD for 6 to 12 months may provide partial or complete resolution of aspergillomas in 60% of patients.
    - Other antifungal medicine can be used for invasive pulmonary aspergillosis e.g., Amphotericin B and voriconazole.

7.6.5 Spontaneous pneumothorax

Definition: It is the presence of air in the pleural cavity resulting in impairment of oxygenation and ventilation. It is a medical emergency and results from rupture of a TB cavity adjacent to the pleura. It may be associated with formation of pus in the pleural space (empyema) leading to a pyo-pneumothorax.

Clinical presentation

Symptoms: History of TB treatment, Acute onset shortness of breath, Chest pain.

Diagnosis: Pneumothorax is generally diagnosed using a chest X-ray. In some cases, a computerized tomography (CT) scan may be needed to provide more-detailed images.

Management:

The patient should be admitted to hospital for appropriate management. Underwater seal drainage, Oxygen therapy when needed.

NB: Once a diagnosis is made, REFER to a chest physician for further specialized care

A summarized version of Post TB Lung Diseases is shown in Table 68.

Table 7.8: Post-TB Lung Disease Conditions and Management

Condition	Investigation	Management
Lung Fibrosis	**physical examination** - normal or abnormal chest symmetry, movements, impaired chest percussion note, reduction in breath sounds, and inspiratory crackles. **Radiological appearance:** Commonly occurs at the apices and upper lobes, with fibronodular opacities and associated loss of lung volume. Elevation of the adjoining fissure or hilum may be associated.	Symptomatic patients or those with physical or lung function impairment =administer Pulmonary Rehabilitation Hypoxemic patients (low SPo2 <88%) = Long-term O2 therapy is required Patients with evidence of Rt. heart failure, refer to heart specialist, treated with diuretics, awaiting specialist review. Patients with symptomatic, hypoxic or evidence of heart failure should be referred for specialized care.
Bronchiectasis	**Compatible** h/o chronic respiratory symptoms (e.g., recurrent or persistent cough with copious sputum production **Physical examination.** the patient may or may not have finger clubbing, chest movements, and symmetry may be normal, but on auscultation, inspiratory coarse crackles and sometimes expiratory rhonchi. Tests recommended for etiological testing in adults: Differential blood count, Serum immunoglobulins (total IgG, IgA and IgM), Testing for allergic bronchopulmonary aspergillosis (ABPA), Sputum culture for bacterial infection and Mycobacterial culture for NTM **Radiology is key;** **High-resolution computed tomography** (HRCT) is the cornerstone in the radiological diagnosis of clinically suspected bronchiectasis and the most sensitive and specific non-invasive method for diagnosing bronchiectasis. In post TB bronchiectasis, the disease is almost universally associated with elements of lung fibrosis. **CXR**: is less sensitive for the diagnosis of bronchiectasis; however, it's useful for diagnosis in gross disease	Treatment is mainly aimed at reducing exacerbations. These are associated with increased airways, systemic inflammation, and progressive lung damage; - Chest physiotherapy Antibiotics Inhaled bronchodilators Low-dose medications, e.g., azithromycin for prolonged treatment In case of recurrent severe hemoptysis, admission for specialized care
Lung Abscess	Rule out TB and other infections by conducting sputum or pus analysis, CXR, and/or CT.	Antibiotic treatment is given. The choice of antibiotic is aided by the results of a pus culture-sensitivity test. Surgical intervention may also be necessary.

Condition	Investigation	Management
Spontaneous Pneumothorax	Pneumothorax is generally diagnosed using a chest X-ray. In some cases, a CT scan may be needed to provide more detailed images	The patient should be admitted to hospital for appropriate management. Underwater seal drainage
Aspergillosis; -Allergic Invasive Aspergilloma	Laboratory testing: Blood: CBC for Eosinophilia, -Skin test, positive result for A. fumigatus Marked elevation of the serum immunoglobulin E (IgE) level to greater than 1000 IU/dL Aspergillus Precipitin test: positive results for Aspergillus precipitins (primarily immunoglobulin G fIgG], but also immunoglobulin A fIgA] and immunoglobulin M fIgM]). Imaging	Surgical removal of the aspergilloma- the most effective Additionally, Oral itraconazole may provide partial or complete resolution of aspergillomas in 60% of patients. Antifungal medicine can be used for invasive pulmonary aspergillosis e.g. Amphotericin B and voriconazole.

7.7 Other Post TB Infection Sequelae

7.7.1 Post-TB Neurological Disability

Extrapulmonary TB can cause varying forms of impairment and contribute to disability depending on the location and extent of the disease.

Spinal TB is an extrapulmonary form of TB, which can result in damage to the bone, disc, joints, and neural structures.

TB meningitis can cause long-term impairments to brain functioning; this condition occurs more often in children and can cause serious cognitive and behavioral impairment, with consequences that can span the life course (affecting school performance or work).

Neurological consequences from TB meningitis include seizures, hearing and vision loss, neuromotor disability, paralysis, cognitive and behavioral impairments and hydrocephalus.

Adverse reactions to some anti-TB drugs, particularly the currently recommended medicines for drug-resistant TB (DR-TB), may result in visual, renal and neurological impairments, among other organs and systems affected.

Management

The goal of treatment is to achieve the best possible functional performance, with social reintegration, good mental health and optimal long-term quality of life.

Early involvement of physiotherapists and occupational therapists in the care of affected individuals is essential to achieve optimal long-term motor outcomes.

Pharmacotherapy for neurological sequelae of tuberculous meningitis is highly recommended

7.7.2 Post TB Cardiovascular and Pericardial Disease

Tuberculous pericarditis is the most common cardiac presentation of TB.

It usually presents with non-specific respiratory or constitutional symptoms, including cough, dyspnea, chest pain, night sweats, fatigue, and weight loss, which may result in a delayed or missed diagnosis. Heart failure signs may also be present. At post TB treatment, constrictive pericarditis is the most serious complication that may occur. This may require surgical intervention.

TB patients have elevated cardiovascular diseases **(CVD)** risk when they have CVD risk factors, including smoking, diabetes mellitus, hypertension, and dyslipidemia. Additionally, TB/HIV co-infected have higher risk.

7.7.3 Post TB Economic, Social, and Psychological Wellness

Economic consequences for individuals include the direct costs of healthcare services and indirect costs associated with travel costs to access care, and time away from productive work with subsequent income loss.

Mental disorders, such as anxiety and depression, are highly prevalent in people with TB and are sometimes associated with the stress of the illness and adverse effects of some medicines, among other factors.

TB co-morbidities such as some mental disorders and TB syndemics (e.g. HIV, diabetes, smoking or undernourishment) are likely to be significant contributors to TB-associated impairments and disability.

Stigma and discrimination pose additional challenges to individuals with TB-associated disabilities. They may negatively affect an individual's mental health as well as represent a barrier to participation in social and economic activities, because of social exclusion.

Lung Cancer

8

Cancer of the lungs is an important differential diagnosis in patients with chronic respiratory symptoms. Cancers in the lungs can either be primary or secondary. The most common primary lung cancer is the non-small cell type (NSCLC), accounting for 80% of all cases.

The objective of screening is to identify patients with features of lung cancer and to refer them for further confirmation of the diagnosis.

Predisposing factors include:

- Smoking - both active and passive is responsible for up to 80 – 90% of cases
- Asbestos exposure
- Occupational health hazards, e.g., mining
- Family history of lung cancer
- Chronic lung diseases
- Prior history of lung cancer

8.1 Clinical Presentation

Lung cancer does not usually cause symptoms in its early stages. Most patients will present with clinical signs on the first visit, but a minority (20%) may be diagnosed incidentally.

Symptoms may be directly related to local effects (tumour itself or pressure effects) of the cancer, or endocrine or metastatic effects.

8.1.1 Clinical symptoms of lung cancer

Clinical symptoms of lung cancer	
Chronic cough with or without haemoptysis	Shortness of breath
Changes in a smoker's cough	Hoarseness of voice
Chest pain	Unexplained weight loss
Wheezing	Fatigue
	Dysphagia

Figure 8.1: Clinical symptoms of lung cancer

8.2 Lung Cancer Screening Algorithm

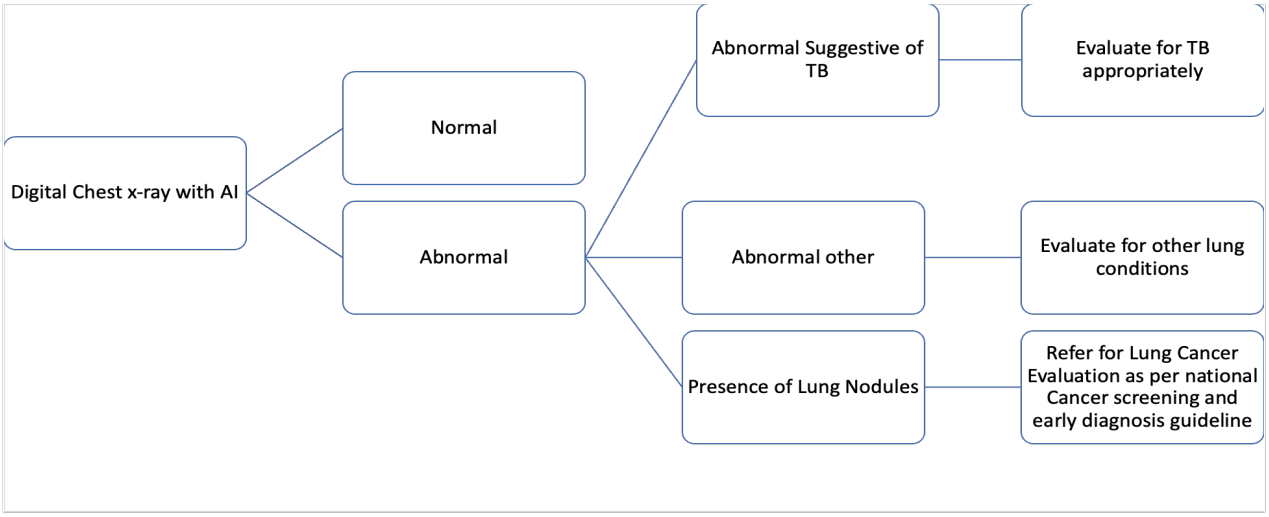


Figure 8.2: Lung cancer screening algorithm

8.3 Radiology diagnosis

The initial step involves conducting a chest X-ray, after which patients with lung nodules will be referred for additional evaluation.

- Chest radiography - This is the initial imaging evaluation. Suggestive features may include a pulmonary nodule, atypical region of consolidation with an alveolar pattern, cavitating lung mass, pleural effusion and pleural nodules, and enlarged lymph nodes. Most will show features of mass or enlarged lymph nodes. Others include multiple nodes with cavitation due to necrosis of centrally located malignant tissue, mediastinal mass, features of consolidation
- CT scan - This provides more definitive radiological criteria for a neoplastic lung lesion as well as staging of disease
- Others: MRI, Positron Emission Tomography (PET)

8.4 Histological diagnosis

- Biopsy (obtained through bronchoscopy, mediastinoscopy, open biopsy, etc)
- Fine Needle Aspirate cytology
- Sputum or thoracocentesis specimens can also be obtained for cytology

8.5 Lung Cancer Management

Early detection is key in cancer management and reduction in mortality. Management aims to cure patients in the early stages, reduce disease progression, relieve symptoms, and provide palliative care for advanced disease. The management of lung cancer is multidisciplinary. For a detailed management plan for Lung cancer refer to the National Guidelines for Cancer Management in Kenya.

Other Chronic Lung Diseases

9

9.1 Occupational-Related Lung Diseases

Table 9.1: Management of the common occupation-related Chronic Lung Diseases

Disease	Common Occupation/ Exposure	Investigations	Management
Asbestosis	Construction, shipbuilding, and insulation work	Chest X-ray (pleural plaques), HRCT, PFTs, occupational history	Remove from exposure, supportive care, smoking cessation, and monitor for malignancies (mesothelioma).
Silicosis	Mining, sandblasting, and stone cutting	Chest X-ray (nodular opacities), HRCT, PFTs, sputum tests for TB	Exposure cessation, supportive care, TB screening/treatment, and monitoring for progressive massive fibrosis.
Hypersensitivity Pneumonitis	Farming (moldy hay), textile workers, and animal handling	HRCT (ground-glass opacities), BAL, specific IgG testing, lung biopsy (if needed)	Antigen avoidance, corticosteroids for acute/ subacute forms, and supportive therapy.
Bronchiolitis Obliterans	Flavouring factories (diacetyl), chemical exposure	HRCT (mosaic attenuation), PFTs (obstructive pattern), lung biopsy (occasionally)	Exposure cessation, immunosuppressants (e.g., corticosteroids), bronchodilators, and supportive care.
Coal Workers' Pneumoconiosis	Coal mining	Chest X-ray (small rounded opacities), HRCT, PFTs	Exposure cessation, smoking cessation, monitor for progressive disease, and supportive care.

9.2 Interstitial Lung Diseases

Interstitial Lung diseases (ILDs), also referred to as diffuse parenchymal lung diseases, are group of over 100 chronic conditions that generally present with the symptom of breathlessness. They lead to lung tissue damage from varying degrees of inflammation and ultimately fibrosis or tissue scarring with loss of lung tissue elasticity. The lung loses its ability to supply oxygen to the bloodstream, and as the scarring progresses, one loses the ability to breathe.

ILDs can coexist with other lung diseases. These are the main types of ILDs;

- DPLD: Diffuse parenchymal lung disease
- IIP: idiopathic interstitial pneumonia
- LAM: Lymphangioleiomyomatosis
- PLCH: pulmonary Langerhans cell histiocytosis/histiocytosis X

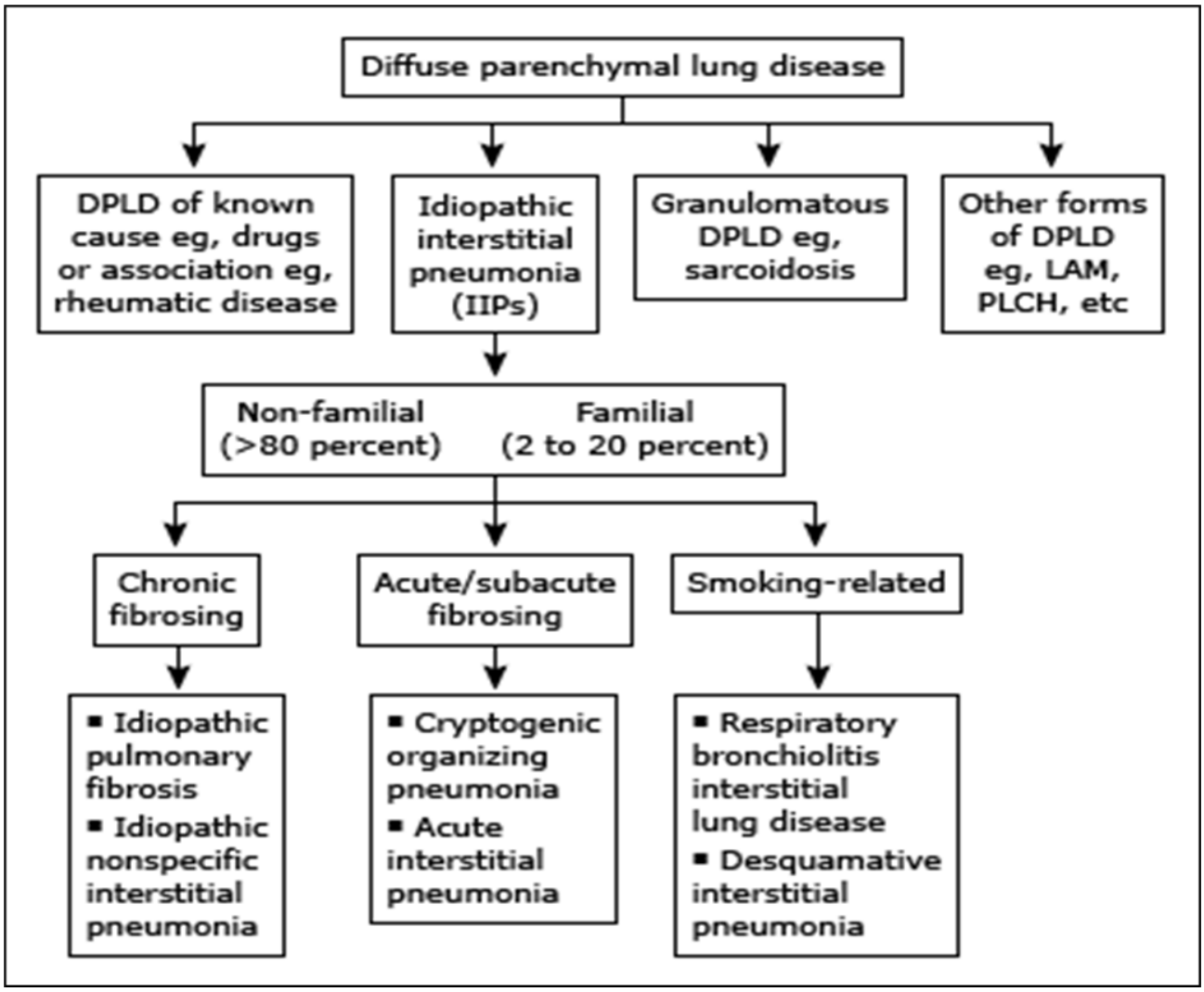


Figure 9.1: Types of ILDs

9.2.1 Causes of ILDs

Causes are divided into known (35%) and unknown (65%):

1. Known causes:
    a) Environmental factors – environmental and occupational agent exposure
    b) e.g., asbestos, beryllium, silica, bird allergens (hypersensitivity pneumonitis or extrinsic allergic alveolitis), radiation therapy
    c) Autoimmunity – rheumatic diseases with lung involvement e.g. dermatomyositis, rheumatoid arthritis, systemic lupus erythematosus, systemic sclerosis [scleroderma], mixed connective tissue disease
    d) Drug reactions – nitrofurantoin, amiodarone
    e) Infections – fungal (coccidioidomycosis, cryptococcosis, PCP), viral pneumonias, atypical bacterial pneumonias
2. Unknown (idiopathic) causes, these include.
    a) Sarcoidosis
    b) Cryptogenic organizing pneumonia
    c) Acute and chronic eosinophilic pneumonia
    d) Idiopathic interstitial pneumonias:
        i. Idiopathic pulmonary fibrosis (usual interstitial pneumonia)
        ii. Desquamative interstitial pneumonia
        iii. Respiratory bronchiolitis-interstitial lung disease
        iv. Acute interstitial pneumonia
        v. Nonspecific interstitial pneumonia

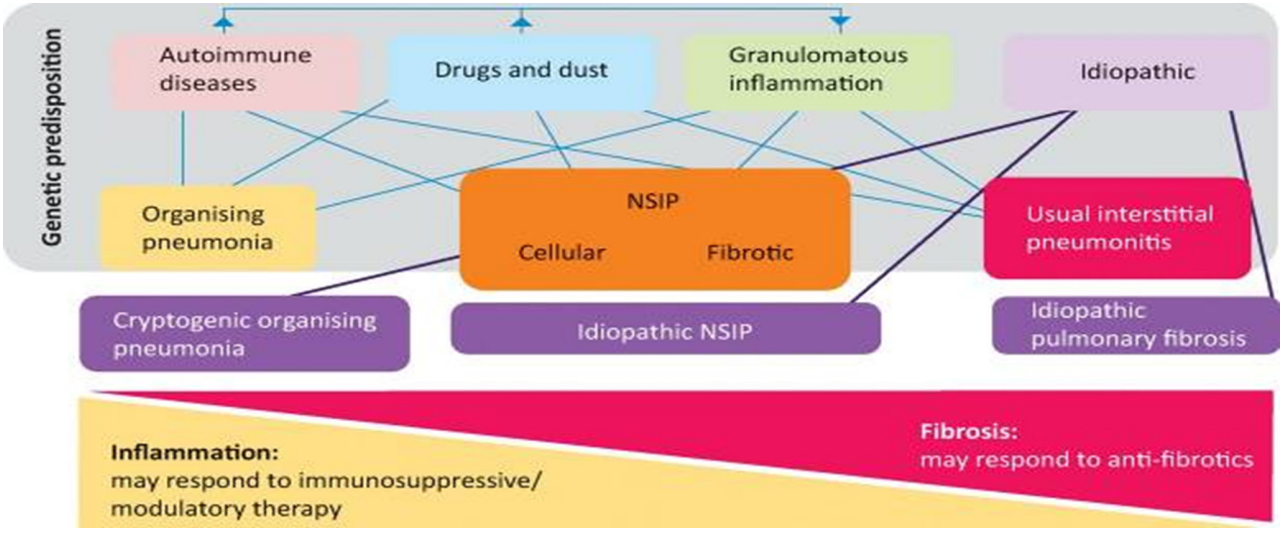


Figure 9.2: Causes of ILDs

9.2.2 Clinical Presentation of ILDs

The symptoms of ILDs appear gradually and they may not be apparent until the disease is fully established. They vary from moderate to severe and may include the

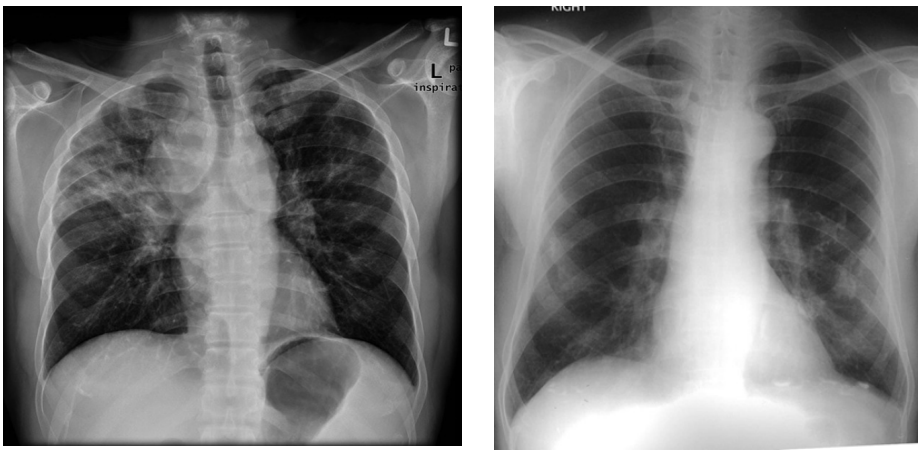
following.

- Shortness of breath especially on exertion
- Chronic dry or hacking cough
- Weight loss
- Finger and toe clubbing
- Unusual tiredness that persists for long
- Cyanosis in severe cases
- Characteristic inspiratory 'velcro' crackles of the lung bases on auscultation due to fibrosis

9.2.3 Diagnostic tests

1. Routine tests:
   - Haemogram – anemia, polycythemia, leukocytosis, or eosinophilia
   - Calcium – hypercalcemia in sarcoidosis
   - Pulse oximetry and ABGs
   - Urinalysis, RFTs, LFTs and creatine kinase for polymyositis
2. Chest X Ray and High-resolution CT scan for signs of scarring/fibrosis interstitial lung markings, loss of lung volume
3. Lung function tests – assess for lung restriction
4. Specific blood test depending on suspected cause e.g. autoimmune antibodies screen for connective tissue disease
5. Lung biopsy – bronchoscopy

The Chest X-Ray presentation of sarcoidosis and asbestosis is as shown below;



Sarcoidosis Asbestosis

Figure 9.3: Chest X-Ray presentation of sarcoidosis and asbestosis

9.2.4 Management of ILDs

- The fibrosis underlying ILD cannot be reversed, so treatment is aimed at slowing progression or improving symptoms.
- Work with a specialist in MDT setting and treat underlying disorder eg, connective tissue disease, infections, etc.
- Drugs such as corticosteroids (prednisone) are used to slow or stabilize progression in the inflammatory phase. Anti-fibrotic agents (pirfenidone and nintedanib) slow the decline in forced vital capacity (FVC) but do not slow progression.
- Pulmonary rehabilitation improves QOL and daily functioning
- Lung transplant therapy only that improves 5-year survival and QOL in idiopathic pulmonary fibrosis

9.3 Cystic Fibrosis of the Lung

Cystic fibrosis (CF) is a genetic disorder that primarily affects the lungs and digestive system. It is caused by mutations in the CFTR gene (Cystic Fibrosis Transmembrane Conductance Regulator), which leads to defective chloride ion transport across epithelial cells. This results in thick, sticky mucus buildup in various organs, especially the lungs.

It is less common in African than in European populations; the true prevalence in Kenya is unknown due to underreporting and lack of widespread genetic testing. Some studies in Africa suggest Cystic Fibrosis (CF) may be more prevalent than previously thought, especially in cases of unexplained chronic lung disease in children.

Children with CF in Kenya may present with Chronic cough and recurrent chest infections, Failure to thrive despite adequate feeding, Nasal polyps and sinusitis, Salty skin, Digital clubbing, Pancreatic insufficiency leading to steatorrhea (greasy stools). The condition is Often misdiagnosed as: Asthma, Bronchiectasis of unknown cause, post-TB lung disease, HIV-related pulmonary disease.

If suspected, refer to a specialist for diagnosis and management.

Chronic Lung Diseases Unique To Pediatrics

10

10.1 Post-bronchiolitis obliterative bronchiolitis

Also known as Post-infectious bronchiolitis obliterans (PIBO) typically follows a severe lower respiratory tract infection—often adenovirus, RSV, influenza, parainfluenza, measles, or Mycoplasma pneumoniae. Symptoms evolve over weeks to months, with persistent dry cough, progressive exertional dyspnea, wheezing, and possible exercise intolerance. These young children often show fixed obstructive deficits that do not improve with bronchodilators.

10.1.1 Diagnostic Work-Up

- Clinical history – chronic respiratory symptoms after severe infection, unresponsive to asthma therapy.
- High-Resolution Chest CT (HRCT) – shows air trapping/mosaic attenuation, bronchiectasis, airway wall thickening. Mild to moderate fibrosis or "unpaired" vessels may be seen.
- Pulmonary Function Tests (PFTs)
- In older children: fixed obstructive pattern (low FEV-FVC, minimal bronchodilator response), hyperinflation, normal DLCO early on.
- Bronchoscopy with BAL and ruling out infection – mandatory before initiating anti-inflammatory treatment.
    - Lung biopsy (surgical transthoracic biopsy) may be needed if imaging or functional testing is inconclusive and histologic confirmation is essential.

10.1.2 Management Protocols (Empiric & Supportive)

10.1.2.1 Supportive Measures

- Supplemental oxygen for hypoxemia; some children may need home oxygen therapy.
- Nutritional support, maximize growth, and avoid smoke exposure.
- Infection prophylaxis: routine influenza and pneumococcal vaccination recommended.

- Airway clearance strategies (e.g., hypertonic saline, physiotherapy) if bronchiectasis or significant secretions are present.
- Bronchodilators only if there is documented bronchial reversibility; response often limited.

10.1.2.2 Anti-inflammatory / Disease-Modifying Therapy

- Systemic corticosteroids remain the mainstay, especially early in disease.
- Some centers use intravenous methylprednisolone pulse therapy (monthly cycles): associated with fewer exacerbations, improved oxygen saturation, reduced hospitalization, and often tapering off oral steroids entirely.
- Daily oral prednisolone may be used but carries higher risk of long-term adverse effects.
- Macrolide therapy (commonly azithromycin) for its immunomodulatory and anti-inflammatory effects.
- Combination (FAM) regimens: Fluticasone (inhaled corticosteroid) + Azithromycin + Montelukast have been used empirically in some centers.

10.1.2.3 Practical Clinical Approach

- In any child with ongoing respiratory symptoms ≥6 weeks following a severe viral or atypical pneumonia, consider PIBO.
- Order an HRCT with expiratory views to assess for air trapping, mosaic pattern, bronchiectasis.
- If imaging and PFTs support the diagnosis, perform bronchoscopy with bronchoalveolar lavage to exclude ongoing infection before starting anti-inflammatory treatment.
- Begin corticosteroid therapy (e.g. IV methylprednisolone cycles), especially early in the disease.
- Add azithromycin ± montelukast + inhaled steroids (FAM protocol)
- Provide comprehensive supportive care including oxygen, nutrition, prevention of infections, and pulmonary rehabilitation.
- Monitor progress with serial PFTs, imaging as appropriate, and clinical assessments; taper steroids when possible.
- In advanced or declining cases, consider referral for lung transplant evaluation.

10.2 Congenital disorders of the Lungs

10.2.1 Bronchopulmonary Dysplasia (BPD)

Bronchopulmonary dysplasia (BPD) is a chronic lung disease of prematurity, marked by structural lung immaturity and injury from oxygen therapy or mechanical ventilation in very preterm infants. In BPD the lungs and the airways (bronchi) are damaged, causing tissue destruction (dysplasia) in the tiny air sacs of the lung (alveoli). Genetic susceptibility and growth restriction also play a role. It remains the most common chronic lung disease in neonates.

- The common risk factors of BPD are:
- Babies born more than 10 weeks before their due dates
- Weigh less than 2 pounds, or about 1,000 grams, at birth
- Have breathing problems at birth
- Have an infection during or shortly after birth

Some of these infants also may need long-term breathing support from nasal continuous positive airway pressure (NCPAP) machines or ventilators.

10.2.1.1 Pathophysiology of bronco pulmonary dysplasia

Many babies who develop BPD are born with serious respiratory distress syndrome (RDS). RDS is a breathing disorder that mostly affects premature newborns. These infants' lungs aren't fully developed and/or aren't able to make enough surfactant.

Surfactant is a liquid that coats the inside of the lungs. It helps keep them open so an infant can breathe in air once he or she is born.

Without surfactant, the lungs collapse, and the infant has to work hard to breathe. He or she might not be able to breathe in enough oxygen to support the body's organs. The lack of oxygen may damage the infant's brain and other organs if proper treatment isn't given.

Babies who have RDS are treated with surfactant replacement therapy. They also may get oxygen therapy. Shortly after birth, some babies who have RDS also are put on machines to help them breathe, such as NCPAP or ventilators.

Most babies who have RDS start to get better within 2 to 4 weeks of their births. However, some babies get worse and need more oxygen and/or breathing support from nasal continuous positive airway pressure (NCPAP) or a ventilator.

If premature infants still require oxygen therapy by the time they reach their original due dates, they're diagnosed with BPD.

10.2.1.2 Prognosis

Advances in care for premature infants now make it possible for more of these babies to survive. However, these premature infants are at high risk for BPD. This is due to delayed lung and surfactant development and a higher risk of excess fluid in the lungs.

Most babies who have BPD get better in time. However, they may need to continue treatment for months or even years. They may continue to have lung problems throughout childhood and even

into adulthood. There's some concern about whether people who had BPD as babies can ever develop normal lung function.

As children who have BPD grow, their parents can help reduce the risk of BPD complications. Parents can encourage healthy eating habits and good nutrition. They also can avoid cigarette smoke and other lung irritants.

10.2.1.3 Management principles

- Supportive care is cornerstone: optimize growth and nutrition, restrict fluids, manage using diuretics if needed
- Respiratory support: minimize invasive ventilation; favor CPAP or non-invasive support, titrating oxygen carefully to avoid hyperoxia and hypocarbia
- Medications:
    - Use vitamin A supplementation in very low birth weight infants to reduce BPD risk
    - Systemic corticosteroids: early (<7 days) use reduces BPD risk but increases neurodevelopmental risks; late (>7 days) may benefit ventilator-dependent infants but balance risk/benefit carefully
- Bronchodilators and inhaled steroids: considered in select cases.
- Prevent complications: respiratory syncytial virus (RSV) prophylaxis during RSV season; monitor for pulmonary hypertension via echocardiography and manage per pediatric guidelines
- Home oxygen therapy if hypoxemia persists; regular follow-up with pediatric pulmonology for early childhood up to 5 years or longer depending on clinical course.

10.2.2 Other rare congenital disorders

10.2.2.1 Wilson–Mikity Syndrome

A rare form of chronic lung disease in premature infants that develops without prior ventilation but clinically overlaps with BPD. Presents in the first days to weeks of life with respiratory distress and emphysema-like damage.

10.2.2.2 Childhood Interstitial Lung Disease (chILD)

Encompasses a group of rare, diffuse lung disorders in infants and children. In the very young (under 2 years), common subtypes include:

- Alveolar Capillary Dysplasia (ACD): nearly always fatal—caused by FOXF1 gene mutations; manifests within 24–48 hours after birth.

- Genetic surfactant disorders: mutations in surfactant protein genes impair lung function.
- Neuroendocrine cell hyperplasia of infancy (NEHI)
- Pulmonary interstitial glycogenosis

10.2.2.3 Structural Congenital Lung Malformations

Congenital pulmonary airway malformations (CPAM, previously CCAM), congenital lobar emphysema, pulmonary sequestrations, and bronchogenic cysts. These arise due to abnormal in utero development and may cause recurrent infections, respiratory distress, bronchiectasis, or chronic symptoms later in life.

10.2.2.4 Primary Ciliary Dyskinesia (PCD) / Kartagener Syndrome

Genetic defect in motile cilia causes impaired mucociliary clearance, leading to recurrent infections and progressive bronchiectasis beginning early in life. Associated with chronic cough and sinusitis and occasionally situs inversus in Kartagener variant. Diagnosis often delayed.

10.2.2.5 Williams–Campbell Syndrome

Extremely rare congenital bronchiectasis caused by deficient cartilage in subsegmental bronchi, leading to airway collapse, chronic cough, and recurrent infection.

Pulmonary Rehabilitation

11

11.1 Introduction

Pulmonary Rehabilitation (PR) is a strategy that aims at improving functional outcomes in patients with chronic respiratory diseases.

It entails a multidisciplinary team of clinicians, physiotherapists, nurses, cardiopulmonary therapists, nutritionists, psychologists, counsellors, pharmacists, occupational therapists etc. depending on the setting.

The primary goal is to enable patients to achieve and maintain their maximum level of independence and functioning.

Pulmonary rehabilitation can either be facility based or community based.

11.2 The goals of pulmonary rehabilitation

The primary goals of pulmonary rehabilitation are to:

1. Improve symptoms
2. Restore functional capabilities
3. Enhance overall quality of life

11.3 Importance of early detection

- Prevention of complications- early detection can help prevent or minimize complications associated with PTLD. Prompt treatment can reduce the risk of developing severe symptoms such as respiratory problems, e.g., fibrosis and bronchiectasis.
- Effective management- allows for timely initiation of treatment and Mx strategies. This helps in ensuring the effectiveness of treatment and slows down the progression of the disease.
- Quality of life – Early detection and intervention can lead to better outcomes and

an improved QOL for PTLD individuals

- Reduced transmission – Early detection and management of PTLD can also reduce the risk of transmission of TB to others.
- Cost effectiveness – Early detection and management of PTLD can be more cost-effective in the long run. By addressing the condition early, the healthcare costs associated with the condition are reduced.

Overall, early detection of PTLD is crucial for better outcomes, improved quality of life, and effective management of the condition.

11.4 Indications for pulmonary rehabilitation.

1. Impaired pulmonary function showing airflow obstruction or restriction (or mixed abnormalities/patterns and bronchodilator response and/or impaired DLCO
2. Abnormal blood gas: Pao2 < 80 mmHg and/or Paco2 > 45 mmHg and/or nocturnal and exercise-induced desaturation
3. Impaired exercise capacity
4. Persistent respiratory symptoms (dyspnea, cough, sputum, wheezing, chest pain, and fatigue)
5. Ineffective cough and/or difficulty to clear bronchial secretions
6. At least one hospitalization or two exacerbations within the last 12 months
7. Presence of comorbid conditions, including COPD, asthma, bronchiectasis, pulmonary fibrosis, pulmonary hypertension, and/or need for surgery.
8. Impaired quality of life

11.5 Contraindications of pulmonary rehabilitation; -

1. Active TB
2. Severe cardiac disease, Hepatic dysfunction, Renal failure
3. Severe Cognitive Impairment
4. Psychiatric disease that interferes with memory
5. Substance abuse without the desire to cease use
6. Severe musculoskeletal or neuromuscular disorders that limit the ability to perform exercises safely and effectively

11.6 The core components of a PR program

The core components of pulmonary rehabilitation are described in Table 101 below:

Table 11.1: Components of a Pulmonary Rehabilitation Program

Component	Indication	Intervention
Aerobic exercise; **Endurance training**	Impaired exercise capacity limited by dyspnea and /or other respiratory symptoms. Restrictions on activities of daily living	Choose the suitable technique for the subject among those available based on aerobic capacity which is patient centered e.g. free walking, cycling on a static bike, step-ups, marching on the spot, play activities for children.
Airway clearance technique	Excessive mucus production, impaired mucus clearance	Choose the suitable technique for the subject among those available based on respiratory capacity, mucus rheology, which is patient-centered, e.g., postural drainage, ACBT, forced expiratory technique
Inspiratory muscle training.	Decreased muscle breathing strength, dyspnoea	Choose the suitable technique for the subject among those available based on respiratory capacity, which is patient-centered. Breathing exercises – diaphragmatic breathing, pursed lip breathing
Nutritional Support	Malnutrition BMI < 16Kg/m2. Focus on patients with TB/HIV co-infection, MDR TB, Pregnant or lactating mothers	Nutritional assessment, Tailored treatment: foods and medical supplements, need for financial incentive, and transport access should be evaluated
Psychological support	Social isolation, depression, and/ or anxiety. Impaired health status and /or quality of life despite optimal pharmacological treatment. Low adherence to medical treatment	Psychological assessment, psychological support, and consider a self-help group

11.7 Basic Pulmonary Rehabilitation Model

The pulmonary rehabilitation follows a model based on exercise type, modality of care, and its frequency, duration, and intensity as per the table below:

Table 11.2 Pulmonary Rehabilitation Care Model

EXERCISE TYPE	MODALITY	FREQUENCY, DURATION & INTENSITY
Airway clearance techniques	Breathing exercises	Daily, 5 Mins
Warm up	Global ROM exercises: breathing control	Daily, 5 minutes. 4 exercises; -1 set of 8 to 15 repetitions
Aerobic training	Walking, cycling, stepping	Daily, 30 minutes continuous or 3 bouts of 10 minutes, 4-5 times in the modified Borg scale
Resistance training	Free weights (major muscle groups of upper & lower limbs	Daily, 15 minutes. 4 exercises; 2 sets of 10-12 repetitions, 4-6 in the modified Borg scale
Balance training	Upright positions; adjustment of COG in static & dynamic posture; dual cognitive & motor task	Daily,5-10 minutes- progression with eyes closed
Cool-down	Breathing control, stretching exercises	5 minutes 4 exercises; 2-4 repetitions, maintain 20 secs each

11.8 Pulmonary Rehabilitation in Healthcare Facilities

Pulmonary Rehabilitation (PR) is a multidisciplinary program of care that is a patient-centered approach. It is a core component in the management of Chronic Respiratory Diseases (CRDs) to improve respiratory symptoms, health status, exercise capacity, fatigue, and social functioning of the affected patients.

It forms a comprehensive package of interventions that includes airway clearance, exercise, education, nutrition, self-management activities, and psychosocial support.

The setup may be varied to include:

1. Outpatient setting
2. Alternative or extended care facility
3. Patient's Home
4. Community Unit

11.8.1 Composition of PR Multidisciplinary Team

The team is composed of clinicians, physiotherapists, nurses, nutritionists, psychologists,

counsellors, cardiopulmonary rehabilitation therapists, occupational therapists, and pharmacists, depending on the various facilities set up.

Their role is to assess, offer intervention, and monitor the rehabilitation outcome of an individualized patient plan.

11.8.2 Evaluation for Pulmonary Rehabilitation (PR)

All Patients with clinical and radiological signs and symptoms consistent with TB treatment sequelae or with chronic respiratory diseases should be evaluated for eligibility for pulmonary rehabilitation based on the algorithm below.

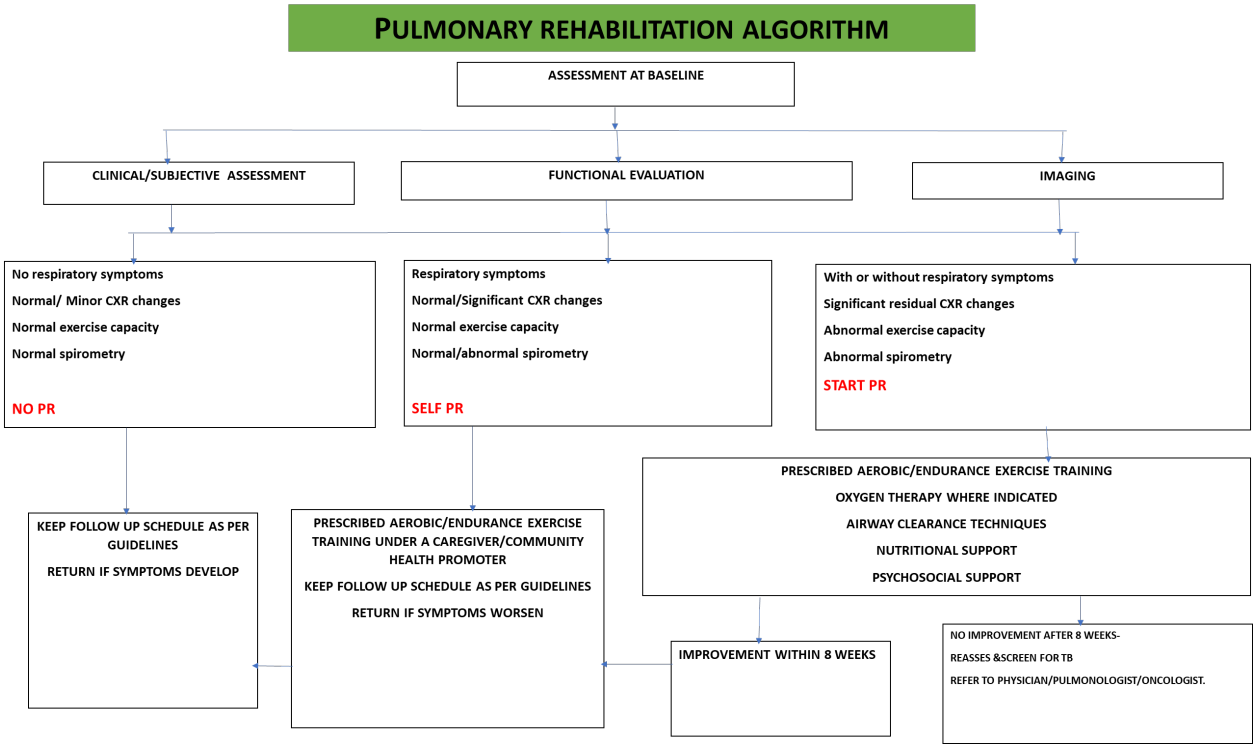


Figure *11.1:* **Pulmonary Rehabilitation Algorithm**

Table 11.3: Evaluation of Pulmonary Rehabilitation

Assessment	Outcome
Clinical history and physical examination	Detailed Patient History and Medical Background
Diagnostic test	Reported respiratory symptoms (dyspnea, cough, sputum, wheeze, chest pain, fatigue TB screening, sputum for culture, and CXR
Spirometry with plethysmography, if available Diffusing capacity for carbon monoxide (DLCO)	Impaired pulmonary function showing airflow obstruction or restriction, or mixed abnormalities and bronchodilator response and/or impaired diffusing capacity for carbon monoxide

Assessment	Outcome
Blood gas analysis and/or Pulse oximetry	Abnormal blood gas PaO2 ,80 mmHg/10.6 kPa and/ or PaCO2 .45 mmHg/6.0 kPa and/ or nocturnal and exercise-induced desaturation
Lung function tests (reduction of vital capacity,1.5 L and/or reduction of peak cough flow,160–200 L/min and/or or reduction of maximal inspiratory pressure and/or reduction of maximal expiratory pressure)	Ineffective cough and/or difficult to clear bronchial secretions
St George's Respiratory Questionnaire (SGRQ).25 WHOQOL (World Health Organization Quality of Life) Score of <60 (subjects aged 60)	Impaired quality of life Impaired quality of life
Six-minute walking test and/or Five-repetition sit-to-stand test MMRC Scale	Impaired exercise capacity Intensity of dyspnea
MMT, ROM	Reduced muscle strength and reduced flexibility
Body Mass Index, TANDI, MUAC	Malnourished patients.
PHQ-9	Anxiety, stress, depression

11.8.3 Program Duration

Start PR after the intensive phase of treatment whether the patient has respiratory symptoms or not, significant CXR changes, abnormal exercise capacity and abnormal spirometry.

The pulmonary rehabilitation sessions should occur 2 to 3 times per week. Each session should last between 60 to 90 minutes, consisting of a combination of exercise, education, and psychosocial support. Regular monitoring and reassessment are essential to ensure that the rehabilitation process is appropriate for the patient's progress.

The rehabilitation program typically lasts 8 to 12 weeks, adjusted based on the patient's needs and progress.

A patient with severe symptoms will require continuity of PR as long as the symptoms persist.

11.8.4 Program Structure

1. Phase 1 (Initial Assessment and Orientation):
    - Introduction to the program goals, objectives, and procedures.
    - Personalized treatment plan creation based on assessment data.
2. Phase 2 (Exercise Training and Education):
    - **Exercise Protocol**: Aerobic, resistance, and flexibility exercises (e.g., walking, cycling, strength training).
    - **Supervision**: Exercise sessions should be supervised by a physiotherapist/ cardiorespiratory rehabilitation therapist.
    - **Education Sessions**:
        - Breathing techniques (e.g., pursed-lip breathing).
        - Energy conservation.
        - Medications and inhaler techniques.
        - Nutrition and weight management.
        - Stress management and coping techniques.
3. Phase 3 (Maintenance/Long-term Follow-up):
        - Transition to independence or community-based programs.
        - Long-term follow-up (e.g., monthly check-ins for the first 6 months).

11.8.5 Methods of Treatment Delivery

For a successful pulmonary rehabilitation programme, the clients require a patient-centered approach in:

1. Physiotherapy
2. Nutritional support
3. Psychosocial support
4. Socio economic support
5. Effective monitoring structures/follow-up

11.8.5.1 Physiotherapy Interventions

1. Chest physiotherapy

    Airway clearance technique. This is achieved by performing:

    i. Postural drainage, Percussions, Vibration/shaking, Manual hyperinflation, Active cycle of breathing technique, Autogenic drainage (huffing technique), Positive expiratory pressure, and high frequency chest compression

ii. Exercises for airway clearance may be administered depending on the assessment outcome.

iii. Inspiratory Muscle Training – this is done by performing breathing exercises:

a. Diaphragmatic breathing

b. Pursed lip breathing.

2. Exercise prescription and delivery

A reduction in exercise tolerance is one of the main complaints of people with chronic lung disease. A PR program must include, at minimum:

1. Aerobic/ Endurance training
2. Strength training
3. Flexibility and stretching exercises
4. Postural Correction

Exercise prescription is based on 5 principles: **type, duration, frequency, intensity, and volume**. Each measure has guidelines for what parameters denote vigorous, moderate, and low intensity exercise.

11.8.5.2 Nutritional Support

It helps improve respiratory function, physical fitness, and overall quality of life for individuals with chronic respiratory diseases. Key aspects include:

- **Nutritional Assessment:** Conducting a comprehensive nutritional assessment to identify deficiencies and tailor interventions accordingly.
- **Protein Intake:** Ensuring adequate protein intake to maintain and rebuild muscle mass, including respiratory muscles like the diaphragm.
- **Energy Provision:** Providing sufficient energy through carbohydrates to support physical activity and exercise training.
- **Immune Support:** Enhancing immune function with adequate intake of vitamins A, C, D, and E, as well as minerals like zinc and selenium, to reduce the risk of infections and exacerbations.
- **Hydration:** Ensuring proper hydration to maintain mucus clearance and overall respiratory health.
- **Nutritional Counseling:** Educating patients and their families about proper nutrition and dietary choices to support long-term health and prevent complications.

- **Tailored Interventions:** Developing individualized nutrition care plans based on the patient's specific needs, goals, and preferences.
- **Psychosocial Support:** Psychosocial support addresses the emotional and social challenges that often accompany chronic respiratory diseases. The support significantly reduces anxiety, depression, and stress levels, while improving the overall quality of life for patients. Key aspects include:
- **Emotional Support:** Providing counseling and support to help patients cope with anxiety, depression, and stress related to their condition. This can include individual therapy, group therapy, and support groups.
- **Education and Awareness:** Educating patients and their families about the psychological aspects of chronic respiratory diseases and the importance of mental health in overall well-being.
- **Cognitive Behavioral Therapy (CBT):** Utilizing CBT techniques to help patients manage negative thoughts and behaviors, improve coping strategies, and enhance their quality of life.
- **Social Support:** Encouraging social interactions and building a support network to reduce feelings of isolation and loneliness. This can include family involvement, peer support, and community resources.
- **Behavioral Interventions:** Implementing behavioral interventions to promote healthy lifestyle changes, such as smoking cessation, weight management, and adherence to treatment plans.
- **Holistic Approach:** Adopting a holistic approach that considers the patient's physical, emotional, and social needs, ensuring comprehensive care and support.

11.8.6 Criteria for discharging a patient for the Pulmonary Rehabilitation program

The patient will be ready for discharge if the following parameters are met: -

1. The desired goals have been satisfactorily achieved.
2. The patient is in stable Medical Condition
3. The patient has attained functional Independence
4. Patient/family Education on Self-Management is accomplished
5. Patient has gained improved Exercise Tolerance
6. Patient adheres to a customized home exercise plan
7. Psychosocial Readiness
8. Nutritional and Lifestyle Modifications have been achieved
9. A Follow-up Plan has been made.

11.8.7 Patient Education and counseling for CRD patients

Every patient who participates in a PR program should undergo counseling and health education.

1. Basic principles of the disease (epidemiology, clinical aspects, transmission, diagnosis, and treatment)
2. Common symptoms that they might experience after an acute disease
3. How to monitor and manage their symptoms at home, and when they should visit a health care facility/call a doctor
4. Risks of reinfection and how they can manage this risk.
5. Family members of patients should also be encouraged to participate.
6. Self-Management Techniques include:
    - Inhaler use education.
    - Recognizing early signs of exacerbations and when to seek medical help.
    - Lifestyle changes (e.g., smoking cessation, weight management).
    - Follow-up plan

11.9 Pulmonary Rehabilitation for Community Health Promoters

Primary health care (PHC) is "essential health care made accessible, acceptable and affordable through full participation of individuals, families and communities. The community health strategy 2020- 2025, anchored on PHC, is aimed at providing a framework for all stakeholders to implement Community Health Services in a standardized manner. Addressing post-TB lung diseases in a community setting is crucial because it:

- Promotes long-term Health
- Prevents further Illness
- Ensures cost-effective Economic Impact
- Ensures holistic care, including Mental Health Considerations, within the community
- Promotes education and Awareness in the community
- Ensure better resource Allocation
- Strengthens Health Systems, especially on UHC

11.9.1 Assessment for pulmonary rehabilitation

A community health promoter plays a crucial role in the management of PTLD through the following steps:

- Take note of any history of TB treatment or any other chest complication treated earlier
- Explore if there is exposure to TB: Any known contacts with TB patients.
- Assess for shortness of breath and respiratory rate
- Assess for chest pain
- Find out if there is a chronic cough lasting more than 3 weeks, either with or without blood.
- Take a history of recurrent respiratory infections.
- Check for the posture of the chest- stooping and barrel chest
- Check vital signs, temperature, pulse rate and respiratory rate
- Find out if there is fatigue in adults
- Explore if there is reduced physical activity in children
- Educate and refer for physical examination, screening, and diagnostic tools in the nearest health facility

11.9.2 Exclusion criteria for Pulmonary Rehabilitation by CHPs

In the presence of the following observations, refer the patient to the nearest health facility:

- Shortness of breath and respiratory rate is way out of normal (>12 and <25/ min)
- Severe cough, either with or without blood.
- Posture of the patient- stooping and guarding chest movements due to pain – VAS above 5
- Vital signs, temperature- above 37 degrees C, pulse rate – above 120 per minute.
- 6 minute walk test (MWT)- if 70 M and below.

11.9.3 Planning for rehabilitation

- If all the vital signs are out of the normal, the patient is coughing blood, has severe shortness of breath, and is fatigued, please refer to the nearest facility soonest possible
- If the vital signs are within the normal range, enroll the patient in either an individualized or a group exercise program
- If the patient has been referred to CHP from a health facility, please check the referral note with instructions provided, check the vital signs, and enroll for the community Pulmonary rehabilitation program
- Refer to the annex on administering pulmonary rehabilitation.

NB: Contact the Pulmonary Rehabilitation team at your link facility in case of uncertainty.

11.9.4 Methods of Treatment Delivery

For a successful pulmonary rehabilitation programme, the clients require a patient-centered approach in:

- Physiotherapy
- Nutritional support
- Psychosocial support
- Socio economic support
- Effective monitoring structures/ follow up

11.9.4.1 Nutritional support

Pulmonary TB is one key condition with nutritional implications. Others include COPD, Asthma, Pneumonia, and bronchitis, among others.

Poor nutritional status in TB and other lung diseases reduces exercise capacity. The presence of malnutrition and weight loss is associated with poor treatment outcomes.

It is therefore important to encourage eating well well-balanced diet, depending on what's available locally. For severely malnourished cases, contact the link facility nutritionist to advice on the food supplements to use

11.9.4.2 Psychosocial Support:

This is meant to address mental health and social challenges post-treatment.

- Stigma Reduction: Counsel to reduce stigma and discrimination associated with
- Adherence to Treatment and Pulmonary rehabilitation: Advice on this because its critical to preventing drug resistance, ensuring a cure, and improving function.
- Public Health Measures: Ensure contact tracing, testing, and preventive treatment for those exposed to TB
- Screening for common mental health conditions like anxiety and depression is key.
- The signs to look for are lack of concentration, isolation, withdrawal, unkempt, low self-esteem, restlessness etc.
- Form support groups which can help them address social stigma and promote social inclusion, share experiences, challenges etc. and how best to handle them. The CHPS can do counselling and refer those who may need psychiatric services

- Regular Check-ups: Scheduled appointments for comprehensive evaluations by CHP is important to monitor the improvement or deterioration of function. Use 6MWT.

11.9.5 Criteria for discharging a patient from the Pulmonary Rehabilitation program

This shall be as per the healthcare facility-based pulmonary rehabilitation program.

11.10 Pulmonary rehabilitation outcome measures.

Pulmonary rehabilitation outcomes are assessed through various measures to determine the effectiveness of the program. Detailed outcomes typically include:

- Improvement in Exercise Capacity; - Six-Minute Walk Test (6MWT): Measures the distance a patient can walk in six minutes. An increase in distance indicates improved endurance and functional status. In healthy subjects, the 6-min walk distance (6MWD) ranges from 400 to 700 m, the main predictor variables being gender, age and height.
- Reduction in Symptoms: Difficulty in breathing: Assessed using scales like the Borg/Modified Medical Research Council (MMRC) Dyspnoea Scale. Decreased scores indicate reduced breathlessness.
- Reduction in Healthcare Utilization: Hospital Admissions: Fewer hospitalizations due to exacerbations or respiratory-related issues.
- Emergency Department Visits: Decreased visits for acute respiratory problems.
- Smoking and substance abuse Cessation: Increased rates of quitting smoking among participants who smoke.
- Adherence to Treatment: Improved adherence to prescribed medications and inhaler techniques.
- Better compliance with home exercise programs and lifestyle modifications.
- Nutritional Status: Body Mass Index; Changes indicating improved or maintained weight.
- Nutritional Intake: Enhanced dietary habits as assessed by a dietitian.

These outcomes are typically evaluated at the start and end of the pulmonary rehabilitation program, and sometimes at follow-up intervals to assess long-term benefits.

11.10.1 Expected outcomes

1. Improvement of respiratory symptoms, e.g., dyspnea
2. Improvement of exercise tolerance
3. Improvement of quality of life
4. Reduction in health care utilization

NB: A patient with severe symptoms referred for review will require continuity of PR as long as the symptoms persist

Table 11.4: Evaluation of Pulmonary Rehabilitation Effectiveness

Outcome	Type of measure
Exercise capacity	6MWT Maximal oxygen consumption (VO2max, where available) Incremental shuttle walk test (ISTW) 5 repetitions of to sit-to-stand test(5STS)
Gas transfer	Pulse oximetry (SpO2, % desaturation) PaO2, PaCO2, DLCO, KCO (*where available)*
Health-related quality of life	SGRQ WHOQOL-BREF Pediatric: EQ-5D-Y and TANDI
Self-reported symptoms	History and physical examination
Acute infectious exacerbations (e.g., in bronchiectasis) requiring antibiotic and/or steroid treatment	Number of episodes

11.11 Key highlights of the Pulmonary Rehabilitation Program

Table 11.5: Key highlights of the pulmonary rehabilitation program

Assessment	· Key components include: · Detailed Patient History and Medical Background to exclude previous TB episodes
Symptom Assessment	· Dyspnoea, fatigue, cough, and sputum · Functional Capacity and Exercise Testing – 6MWT, 5 reps Sit Stand, Borg RPE
Pulmonary function testing	· Spirometry, Pulse oximetry, DLCO (Diffusing Capacity of the Lung for Carbon Monoxide)
Oxygenation and Respiratory Parameters	· Resting oxygen saturation, oxygen requirements during activity

Nutritional Assessment	· Body Mass Index, TANDI, MUAC
Psychosocial Evaluation	· PHQ9
Quality of Life Assessment	· St. George's Respiratory Questionnaire
Muscle Strength and Flexibility	· MMT, ROM
Programme Duration	· Start PR after the intensive phase of treatment, whether the patient has respiratory symptoms or not, significant CXR changes, abnormal exercise capacity, or abnormal spirometry. · The program typically lasts 8 to 12 weeks, adjusted based on the patient's needs and progress.
Frequency of Rehab Sessions	· Conduct 2 to 3 times per week, lasting between 60 to 90 minutes to consist of a combination of exercise, education, and psychosocial support. · Regularly monitor to ensure that the rehabilitation process is appropriate for the patient's progress.
Chest Physiotherapy (Chest PT) techniques include	· Airway clearance · Inspiratory muscle training
Exercise activities should include	· Aerobic Exercises · Inspiratory Muscle Training · Strength Training · Flexibility and stretching
Patient Education entails	· Understanding the disease process and self-management strategies. · Proper use of inhalers and other medications. · Lifestyle modifications such as smoking cessation, diet, and sleep hygiene. · Techniques to reduce shortness of breath during daily activities. · Recognizing signs of exacerbation and when to seek medical help.
Nutritional Support interventions	· Enhances optimal nutrition · Adequate protein intake · Energy Provision · Immune Support
Psychosocial Support	· Cognitive-behavioural therapy (CBT) · Group therapy or peer support · Stress management techniques

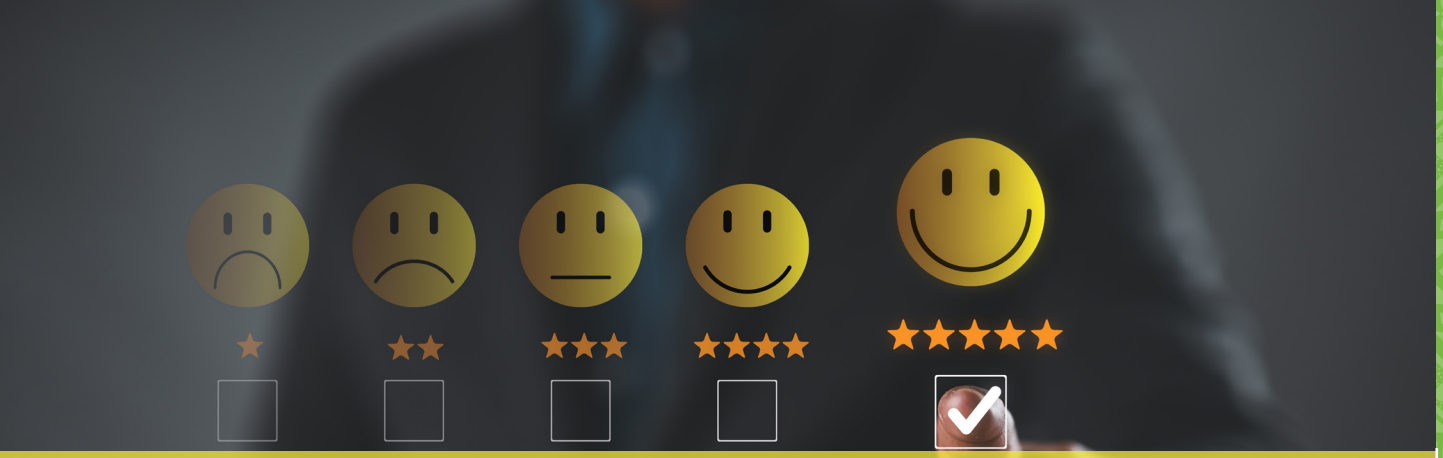
Medication, Oxygen Therapy, and Assisted Ventilation	· Review and optimize the patient's medication regimen, including bronchodilators, corticosteroids, and other respiratory drugs. · Long-term oxygen therapy (LTOT) where indicated. · Non-invasive ventilation (NIV) or mechanical ventilation to aid breathing during exercise, where indicated
Discharge	· Initiated when the patient reaches specific goals, such as improved exercise tolerance, better control of symptoms, and overall functional improvement. · Discharge planning includes: · Home exercise program · Continue follow-up appointments as per guidelines. · Education on self-PR and symptom monitoring. · Data Management · Baseline assessments · Progress data during the rehabilitation sessions · Final assessment and discharge summary
Quality Assurance	· Regular reviews of the clinical outcomes · Patient satisfaction surveys. · Staff training and development · Continuous improvement processes for the rehabilitation protocols and techniques

11.12 Follow-Up

These follow-ups typically include assessments of exercise tolerance, respiratory function, nutritional status, and psychological well-being. They also provide an opportunity to adjust the rehabilitation plan as needed and offer additional support and education.

- Initial Follow-Up: 1-2 weeks after completing the rehabilitation program to assess immediate progress and address any concerns.
- Monthly Follow-Ups: For the first 3-6 months to monitor adherence to the program, adjust exercise routines, and provide ongoing support.
- Quarterly Follow-Ups: After the initial 6 months, follow-ups can be scheduled every 3 months to evaluate long-term progress, manage any new symptoms, and reinforce education and behavior changes.
- Annual Follow-Ups: Once the patient is stable and maintaining their rehabilitation gains, annual follow-ups can help ensure continued success and address any emerging issues.

NB: For PTLD Keep follow up schedule for TB as per guidelines and return if symptoms worsen



Monitoring And Evaluation

12

12.1 Introduction

The National Strategic Plan (NSP) 2023/24-2027/28 lays out the strategic and technical direction for the elimination of TB, leprosy and reduction of the burden of lung disease. It presents the full aspiration of the country, including outcome and impact targets that align with international goals, with proposed of activities needed to reach these goals. The targets for ending TB by 2035 are based on the End TB strategy that builds on 3 pillars; integrated, patient-centered care and prevention, bold policies and supportive systems and intensified research and innovation. Whereas the strategic plan does not explicitly give details on lung health, this guideline acknowledges that TB and PTLD are part of lung health.

As outlined in the NSP, lung health services in the country faced multiple challenges, including the absence of a dedicated training curriculum and inadequate provider knowledge and skills across all levels. There was limited integration between lung health services and TB clinics, and a lack of recording and reporting tools that hindered data collection on post-TB lung health. Additionally, essential medications and consumables were often in short supply or not listed in the essential drug list, particularly in public facilities. Poor mapping and weak collaboration further limited effective service delivery.

12.2 Monitoring and evaluation framework

The Lung Health M&E framework is anchored in the national TB, Leprosy and Lung disease monitoring plan embedded in the NSP. This particular guideline acknowledges that the indicators and targets prescribed are largely covering TB, HIV and leprosy with none on lung death.

A structured Monitoring and Evaluation (M&E) framework aids to track progress, measure outcomes, and ensure the effective management of lung health conditions. This M&E framework is designed to facilitate real-time data collection, reporting, and performance analysis using key data entry tools and established indicators. The framework aligns with national health reporting standards and integrates multiple data sources, including electronic medical records (EMRs) and manual data collection tools, to improve the quality of surveillance, treatment outcomes, and patient management. The M&E framework looks at the key inputs, processes, outputs, outcome, and expected impact of the lung diseases in line with NSP; and identifying a set of relevant indicators and their corresponding targets that will be used to measure progress and performance.

The M&E framework on lung health is structured to:

- Track the burden of lung diseases through real-time surveillance and trend analysis.
- Monitor patient outcomes by following individuals diagnosed with asthma,

COPD, PTLD, and other chronic lung diseases.

- Evaluate the effectiveness of interventions such as spirometry, pulmonary rehabilitation, and tobacco cessation programs.
- Strengthen data-driven decision-making by integrating multiple health information systems (TIBU, Afya KE, other EMRs).
- Ensure high-quality data collection and reporting through standardized data entry tools.

12.3 Key Monitoring and Evaluation Indicators

This framework is designed to measure the following lung health indicators, categorized by periodicity and data source:

Table 12.1: Lung health indicators

Indicator	Periodicity	Data Source / Entry Tool	Responsible Persons
Prevalence of Chronic Lung Diseases per 100,000	Yearly	Modelling, Surveys	DNTLD-P
Chronic Lung Disease Hospitalization Rates per 100,000	Yearly	Surveys, Modelling	DNTLD-P
Death Rates due to Chronic Lung Disease per 100,000	Yearly	Surveys, Modelling	DNTLD-P
Interim Outcome of PTLD Patients at Year 1	Yearly	TBD	DNTLD-P
Number of PTLD Cases in Care	Quarterly	Lung Health Register, TIBU PMS, Other EMRs	DNTLD-P
Number of Patients with Asthma in Care	Quarterly	Lung Health Register, TIBU PMS, Afya KE	DNTLD-P
Number of Patients with COPD in Care	Quarterly	Lung Health Register, TIBU PMS, Other EMRs	DNTLD-P
Total Number of Patients Screened for Respiratory Symptoms	Monthly	ACF Departmental Summary Forms, Lung Health Register	DNTLD-P
Number of Patients with Respiratory Symptoms	Monthly	ACF Departmental Summary Forms	DNTLD-P
Number of Patients Screened for Lung Conditions Using Chest X-ray	Monthly	TIBU PMS, X-ray Register, Other EMRs	DNTLD-P
Number and Proportion with Abnormal CXR Suggestive of TB	Monthly	TIBU PMS, X-ray Register, Presumptive Summary (EMR)	DNTLD-P
Number and Proportion with Abnormal CXR Suggestive of Other Conditions	Monthly	TIBU PMS, X-ray Register, Other EMRs	DNTLD-P
Number of CXR with Lung Nodules	Monthly	TIBU PMS, X-ray Register	DNTLD-P

Indicator	Periodicity	Data Source / Entry Tool	Responsible Persons
Number of Patients Referred for Lung Cancer Evaluation	Monthly	TIBU PMS, Other EMRs	DNTLD-P
Number and Proportion of Patients Offered Spirometry	Monthly	Lung Health Register, TIBU PMS, Afya KE	DNTLD-P
Proportion of Bacteriologically Confirmed TB Cases	Monthly	TB5 Record Card, TIBU PMS, TB4	DNTLD-P
Proportion of Clinically Diagnosed TB Cases	Monthly	TB5 Record Card, TIBU PMS, TB4	DNTLD-P
Number of TB Cases Notified	Monthly	TB5 Record Card, TIBU PMS, TB4	DNTLD-P
Number of New Asthma Cases	Monthly	Asthma Register, Other EMRs	DNTLD-P
Number of New COPD Cases	Monthly	Lung Health Register, Other EMRs	DNTLD-P
Proportion of TB Patients Screened for PTLD	Monthly	TBD	DNTLD-P
Number of New PTLD Cases	Monthly	TBD	DNTLD-P
Number of Patients Diagnosed with Other Lung Diseases	Monthly	Lung Health Register, Other EMRs	DNTLD-P
Number of Patients on Pulmonary Rehabilitation (Community/ Facility)	Monthly	TIBU PMS, Other EMRs	DNTLD-P

NOTE: Each of these indicators will be monitored through a combination of electronic and paper-based data collection tools, including the TIBU system and KHIS, ensuring consistency in reporting and analysis.

12.4 Routine data collection

Data collection methods are essential for gathering accurate and reliable information to measure the indicators in the Monitoring and Evaluation (M&E) framework. Establishment of a reliable recording and reporting system is an essential part of the successful program implementation. Recording and reporting of TB data is vital for monitoring and evaluation for the lung health programme, which forms the general health information system, and aims to:

- Ensure a continuum of care, information-sharing with patients, and transfer of information between health facilities.
- Enable managers at different levels to monitor performance in a standardized and internationally comparable way, and
- Provide the basis for programmatic and policy development.

12.5 Recording and Reporting tools

In conformity with WHO recommendations, there are several recording and reporting tools in respect to the various thematic areas. Data for lung health indicators will be collected through the following standardized tools:

- Presumptive Register - Lists presumptive TB patients requiring further investigations, other lung health conditions should also be ruled out.
- X-ray register - Lists Patients Screened for Lung Conditions Using Chest X-ray; Abnormal CXR Suggestive of TB, Abnormal CXR Suggestive of Other Conditions, and Lung Nodules.
- Integrated Lung Health Register – Captures both baseline and follow up information; patient demographics, screening data, diagnostic results, treatment and follow-up status
- TB5 Record Card – A standardized TB surveillance tool that records case notification and treatment monitoring, supporting the tracking of post-TB lung disease (PTLD) cases. This tool is only limited to previous TB patients and tracks the development of post-TB complications; current complains, diagnostic tests, 6-minute walk test, differential diagnosis.
- TIBU PMS/ TIBU Lite – The centralized national TB surveillance system, which will now integrate lung health tracking. TIBU has been expanded to incorporate the integrated lung health register. This integrated register captures both baseline and follow-up data for patients diagnosed with lung health conditions.
- Afya KE – An electronic medical records (EMR) system used in health facilities for general patient management, including lung health cases.
- Other EMRs – Various facility-based electronic medical records integrated with the national system for broader patient data capture.

Each of these tools will facilitate data flow from health facilities to the national level, ensuring real-time monitoring of lung health trends. Table 112 provide the purpose of the tool, the point of use and the person responsible for filling the register.

Table *12.2:* **TB tools utilization**

No	Name of Tool	Purpose	Site of Use	Filled By
1.	Presumptive register	List patients on presumptive TB patients requiring further investigations	OPD	Clinician
2.	X-ray register	List Patients Screened for Lung Conditions Using Chest X-ray, Abnormal CXR Suggestive of TB, Abnormal CXR Suggestive of Other Conditions, and Lung Nodules.	Imaging department	Radiographer
3.	Integrated Lung health register	List patients with respiratory symptoms, COPD (New and those in care), patients diagnosed with other lung diseases, and patients offered spirometry	OPD	Clinician
4.	TB Record Card (TB5)	Clinical follow-up of TB patients including quality care through clinically evaluations and further investigations. This includes notified categorized into bacteriologically confirmed and clinically diagnosed; Number of patients screened for PTLD and new PTLD cases.	TB clinic	Clinician

12.6 Data flow

The reporting system will follow a hierarchical structure, ensuring timely data transmission from health facilities to decision-makers at the national level.

1. Health Facility Level
    - Data captured via Integrated Lung Health Register and TB5 Record Card,
    - Entered into TIBU Lite, Afya KE, or other EMRs.
    - Monthly verification of case-based data by Sub-County TB Coordinators.
    - Sub-County Level
    - Data aggregated from all facilities using TIBU Lite or other EMRs.
    - Validation and submission to County TB Coordinators.
    - Quarterly reports generated for trend analysis.
2. County Level
    - Review and approval of lung health reports.
    - Integration of data into county health dashboards.
    - Data forwarded to the National TB Program.
3. National Level
    - Data analyzed using TIBU PMS dashboards.
    - Annual reports generated for program evaluation.
    - Decision-making based on real-time indicator tracking

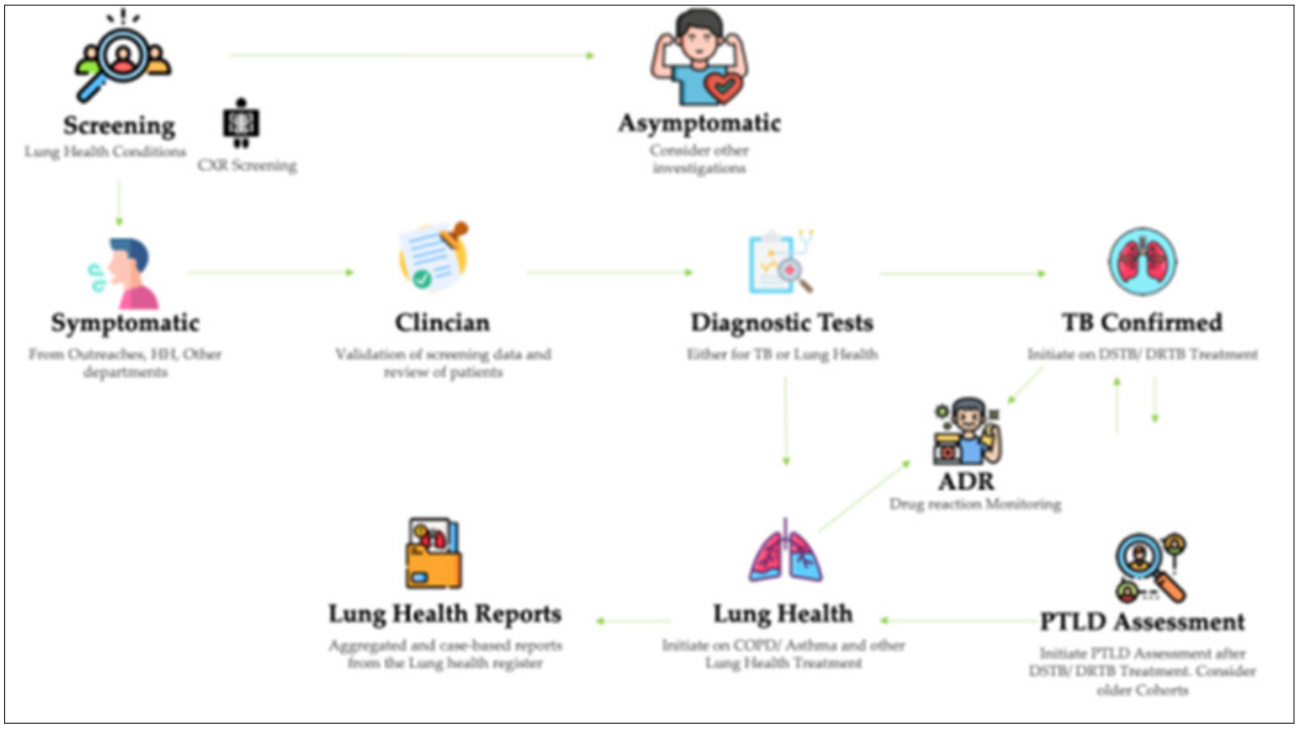


Figure *12.1:* **Lung health data flow**

12.7 Data Quality Assurance Mechanisms

To ensure accurate and reliable data collection, the following measures will be implemented:

- Standardized Recording and Reporting Tools – Ensure uniformity across facilities in capturing patient details and clinical outcomes.
- Automated Data Validation in TIBU Lite and EMRs – Include real-time validation rules to minimize errors in reporting.
- Routine Data Audits – Sub-County and County TB Coordinators to conduct quarterly data audits.
- Training and Capacity Building – Strengthen data management skills among healthcare providers and data clerks.
- Data Verification at Multiple Levels – Cross-checking of manual and electronic records to enhance accuracy.

12.8 Data Utilization and Decision-Making

The data collected will be used to:

- Guide Policy Development – Inform national strategies on lung health and post-TB care.
- Strengthen Case Management – Enhance early detection and treatment for lung conditions.
- Evaluate Program Performance – Assess the effectiveness of interventions such as pulmonary rehabilitation.
- Support Funding Decisions – Ensure resource allocation aligns with priority lung health challenges.

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ANNEXES

Annex 1: Administering pulmonary rehabilitation in the community

- Collaboratively build Participant numbers, then class size and number
- Publicize through community-based organizations in the community, including a church community, etc.
- Promote your group to family, friends, co-workers, and neighbors.
- Try posting fliers or using signs at your local community center, health club, or place of worship, and market to local businesses.
- It is preferable to conduct the PR classes in group sessions.
- In the case of an individual, you can supervise the program at home.
- Join and actively engage in Facebook groups related to fitness, or even just community groups aimed at your target demographic.
- Liaise with lead Pulmonary Rehabilitation in your unit health facility to build an online presence, perhaps through blogs, websites and/or social media
- Build a positive atmosphere- good music, allow participants to choose between two favorite playlists or a new hit song. Depending with availability you can use this methodology
- Make encouragement part of the social norm:
- By using partner exercises
- Making it perfectly clear that even though everyone is there for their own reasons, they are all there to get fit and should work together hard as a team
- Celebrate successes. When your team meets its goals, celebrate. This can be as simple as grabbing a cup of coffee/tea/soda/water after an exercise session.

Annex 2: Monitoring and evaluation Matric

Indicator	Indicator definition	Frequency	Source of data	Targets						Responsible person
				Baseline	**Y 1**	**Y2**	**Y3**	**Y4**	**Y5**	
				2024	**2025**	**2026**	**2027**	**2028**	**2029**	
Lung Health										
Objective 1: To determine the burden of chronic lung conditions in Kenya among them COPD and Asthma and post-TB lung disease (sequelae)										
• Prevalence of Chronic Lung Diseases per 100,000	Rate per 100,000	Yearly	Modelling	TBD						Program manager
• Chronic Lung Disease hospitalization rates per 100,000	Rate per 100000	Yearly	Surveys/ Modelling	TBD						Program manager
• Death rates due to Chronic Lung Disease per 100,000	Rate per 100,000	Yearly	Surveys/ Modelling	TBD						Program manager
• Interim outcome of PTLD patients at the end of Year 1	**Numerator**: Percentage of PTLD patients with improved lung conditions **Denominator:** number of PTLD patients who started rehabilitation	Quarterly	TBD	TBD						Program manager

Indicator	Indicator definition	Frequency	Source of data	Targets						Responsible person
• Number of PTLD Cases in Care	Number	Monthly	Lung Health Register, TIBU PMS, Other EMRs							Program manager
• Number of Patients with Asthma in Care	Number	Monthly	Lung Health Register, TIBU PMS, Afya KE							Program manager
• Number of Patients with COPD in Care	Number	Monthly	Lung Health Register, TIBU PMS, Other EMRs							Program manager
• Number of Patients Screened for Respiratory Symptoms	Number	Monthly	ACF Departmental Summary Forms, Lung Health Register							Program manager
• Number of Patients with Respiratory Symptoms	Number	Monthly	ACF Departmental Summary Forms							Program manager
• Number of Patients Screened for Lung Conditions Using Chest X-ray	Number	Monthly	TIBU PMS, X-ray Register, Other EMRs							Program manager
Proportion with Abnormal CXR Suggestive of TB (%)	Numerator=Number screened using CXR suggestive of TB X100 Denominator=Total number screened for TB using CXR	Monthly	TIBU PMS, X-ray Register, Presumptive Summary (EMR)							Program manager

Indicator	Indicator definition	Frequency	Source of data	Targets						Responsible person
Proportion with Abnormal CXR Suggestive of Other Conditions (100%)	Numerator: Number screened with CXR suggestive of other conditions X100 Denominator: Total screened with CXR	Monthly	TIBU PMS, X-ray Register, Other EMRs							Program manager
• Number of CXR with Lung Nodules	Number	Monthly	TIBU PMS, X-ray Register							Program manager
• Number of Patients Referred for Lung Cancer Evaluation	Number	Monthly	TIBU PMS, Other EMRs							Program manager
• Number and Proportion of Patients Offered Spirometry	Number	Monthly	Lung Health Register, TIBU PMS, Afya KE							Program manager
• Proportion of Bacteriologically Confirmed TB Cases	Numerator: Number of TB cases bacteriologically confirmed Denominator: Number of TB cases(All forms) notified	Monthly	TB5 Record Card, TIBU PMS, TB4							Program manager
• Proportion of Clinically Diagnosed TB Cases		Monthly	TB5 Record Card, TIBU PMS, TB4							Program manager

Indicator	Indicator definition	Frequency	Source of data	Targets						Responsible person
• Number of TB Cases Notified	Number	Monthly	TB5 Record Card, TIBU PMS, TB4							Program manager
• Number of New Asthma Cases	Number	Monthly	Asthma Register, Other EMRs							Program manager
• Number of New COPD Cases	Number	Monthly	Lung Health Register, Other EMRs							Program manager
• Proportion of TB Patients Screened for PTLD	**Numerator**: Number of pulmonary TB cases completing TB treatment **Denominator**: Total number of Pulmonary cases notified	Monthly	TBD							Program manager
• Number of New PTLD Cases	Number	Monthly	TBD							Program manager
• Number of Patients Diagnosed with Other Lung Diseases	Number	Monthly	Lung Health Register, Other EMRs							Program manager
• Number of Patients on Pulmonary Rehabilitation (Community/ Facility)	Number	Monthly	TIBU PMS, Other EMRs							Program manager

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