



MINISTRY OF HEALTH

Integrated Lung Health JOB AID



**NATIONAL TUBERCULOSIS, LEPROSY
AND LUNG DISEASE PROGRAM**

FOREWORD

It is with great pride and commitment that I present this Integrated Lung Health Job Aid, developed under the leadership of the National Tuberculosis, Leprosy and Lung Disease Program (NTLD-P). Tuberculosis and chronic lung diseases continue to pose a significant burden on the health and well-being of our people, accounting for substantial morbidity, mortality, and social disruption across the country. These conditions not only affect individual patients but also undermine families, communities, and our national development agenda.

This job aid provides a comprehensive, stepwise approach to the prevention, screening, diagnosis, treatment, and long-term management of TB and other chronic lung diseases. It builds on existing national guidelines while integrating innovations such as digital chest X-ray with artificial intelligence, structured lung function testing, and multidisciplinary care models. By aligning services across all levels of the health system, this tool ensures that patients can access timely, effective, and quality care regardless of where they seek services.

I commend the dedication of healthcare workers who are at the frontline of TB and lung health care, often working under challenging circumstances. This job aid is designed to empower them with practical guidance, strengthen clinical decision-making, and enhance patient outcomes. Furthermore, it reflects our collective responsibility to expand access to equitable, people-centered lung health services in line with our universal health coverage goals.

On behalf of the Ministry of Health and the NTLD-P, I extend my sincere appreciation to all stakeholders, partners, and experts who contributed to the development of this vital resource. Together, we reaffirm our commitment to ending TB, improving lung health, and safeguarding the future of our nation.



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

Ministry of Health, Kenya

Package of care for lung health

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 rehabilita- tion	Back transfer to lower level for follow -up	Back transfer to lower level for follow -up
	Health Education	Follow up	Facility based Pulmonary rehabilita- tion	Facility based Pulmonary rehabilita- tion
	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/ portable oxygen cylinders	Spacers	Spacers	Spacers	Spacers
	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

*Lung Health Multi disciplinary team: Clinical Officer/Medical Officer, Nurse, Radiologist, Radiographer, Psychosocial Support Specialist, Physiotherapist, Pharmacist.

Lung Function Assessment Based on Facility Capability

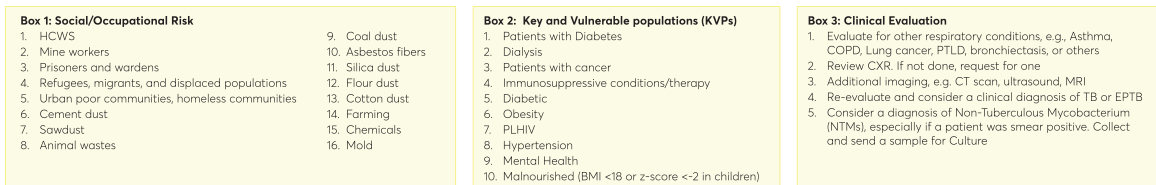
Assessment Component	Facilities with DCXR+AI, Spirometer + Peak Flow Meter	Facilities with Peak Flow Meter Only	Facilities without Spirometer and Peak Flow Meter
Symptom screening	✓	✓	✓
Risk factor assessment	✓	✓	✓
Physical examination	✓	✓	✓
Chest X-Ray	✓	Refer out	Refer out
Pulse oximetry	✓	✓	✓
6-Minute Walk Test	✓	✓	✓
Sit-to-Stand Test	✓	✗	✗
Peak Expiratory Flow Rate	✓	✓	Refer out
Spirometry (pre- and post-bronchodilator)	✓	Refer out	Refer out
Specialized Imaging CT scan, MRI where available	✓	✓	✓
Diagnostics molecular tests	✓	✓	✓
Blood Gas analysis (using handheld device/lab)	✓	✗	✗
Bronchoscopy/Pleural Services/ Interventional Radiology	✓ (if available)	✗	✗
Linkage to care	✓	✓	✓

Symptom Screening and Risk Assessment

Symptom screening	Screen for risk factors
<i>Start by screening every patient for respiratory symptoms.</i> <i>Use the symptom checklist below to identify possible respiratory illness. Ask about and observe for the following symptoms:</i> • Cough of any duration (can be dry or productive) • Fever (body temp exceeding 38°C) • Drenching night sweats • Loss of appetite • Unexplained weight loss • Chest pain • Difficulty in breathing, • Shortness of breath • Wheeze, Rhonchi • Hemoptysis • Weight loss, fatigue • Cyanosis • Postural Dyspnea • Sleep apnea syndrome • Easy fatigability • Finger clubbing • History of allergy/ atopy	<i>Explore individual, lifestyle, environmental, and occupational risk factors. Document risk factors to support clinical decision-making and patient education.</i> Individual factors • Age: Asthma (common in children), COPD (common in adults >40 years) • Sex: Childhood asthma → males; adult asthma/COPD → females • Weight: Underweight, overweight and obesity increase risk • History: PTB, Contact with a person with TB or a person with a chronic cough • Other conditions: HIV, Diabetes, other cancers, renal failure, • Genetics: Family history of asthma/COPD; Alpha-1 antitrypsin deficiency • Perinatal history: Prematurity, congenital issues, low birth weight • Recurrent respiratory infections: Including TB and fungal disease • Poor nutrition: Low vitamins A, C, D; weakens immunity and lung function Lifestyle Factors • Tobacco use: Primary cause of COPD and lung cancer • Second-hand smoke: Including tobacco curing (e.g., tobacco farming) • Smoking during pregnancy: Impairs infant lung development • Physical inactivity: Leads to poor respiratory fitness and obesity Environmental Factors • Outdoor air pollution: Vehicle exhaust, industrial fumes • Indoor air pollution: Biomass fuel, kerosene, detergents, dust mites • Allergens: Pollen, pets (cats, dogs), cockroaches • Fungal exposure: Mold, Alternaria, Cladosporium • Strong odors: Perfumes, cleaning agents Occupational Hazards • Long-term exposure to dust, fumes, or chemicals including: ◦ Silica, asbestos, coal, gold, quarry, flour, cereal and textile dusts • Common in mining, construction, farming, textile industries, welders, sand harvesters, painters, roofing. carpenters, hair stylists

Combine symptom screening and risk factor assessment to determine the need for further evaluation or management.

Not all health facilities are equipped with chest X-ray (CXR) services, and fewer have access to digital chest X-ray (DCXR) with artificial intelligence (AI) interpretation.



Digital Chest X-Ray (DCXR) with AI for Lung Health Screening: Interpretation Guide

Purpose: Guide clinical decision-making using AI-generated chest X-ray scores from CAD4TB and Qure.ai (qXR).

Note: AI supports—but does not replace—clinical judgment. Always correlate with symptoms, risk factors, and clinical findings.

STEP 1: CONFIRM AI TOOL USED

- **CAD4TB:** TB score (0–100), heatmap
- **Qure.ai (qXR):** TB probability (0–1), heatmap + abnormality categories

STEP 2: INTERPRET RESULTS

CAD4TB		
Score	TB Risk	Action
0–29	Very Low	Routine care
30–50	Low	Clinical correlation
51–69	Moderate	Confirmatory testing using mWRD
≥70	High	Confirmatory testing using mWRD

See image on next page of the heatmap.

Qure.ai (qXR)

Score (qXR):

- < 0.3 = Low risk → Routine care if asymptomatic
- 0.3–0.6 = Moderate → Correlate, Confirmatory testing using mWRD
- > 0.6 = High → Confirmatory testing using mWRD

Category	Meaning	Action
Normal	No abnormalities	Routine care if asymptomatic
Abnormal – Suggestive of TB	TB-like features (e.g., cavities)	Confirmatory testing workup
Abnormal – Other	Non-TB findings (e.g., fibrosis)	Evaluate with Lung function tests i.e peak flow, spirometry
Abnormal – Lung Nodules	Pulmonary nodules	Refer for CT and specialist assessment
51–69	Moderate	Confirmatory testing using mWRD
≥70	High	Confirmatory testing using mWRD

STEP 3: CLINICAL JUDGMENT STILL MATTERS

- Always assess symptoms (cough, fever, weight loss, etc.)
- Consider risk factors (HIV, diabetes, TB contact)
- Use AI scores alongside clinical evaluation

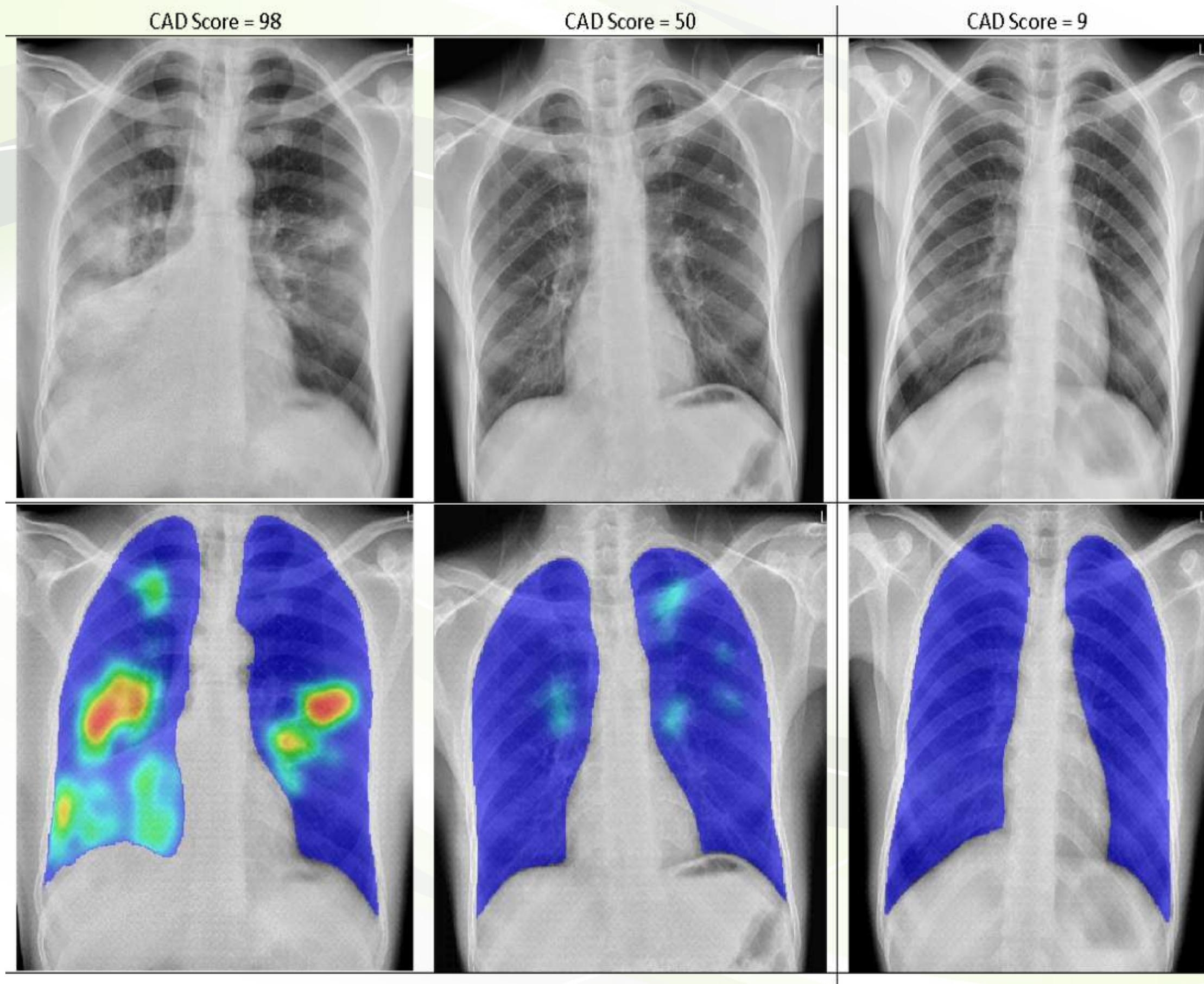
STEP 4: DOCUMENT & COMMUNICATE

- Record software tool used, score and output
- Record Clinical Action taken
- Inform patient clearly and arrange referral if needed

PITFALLS TO AVOID

- Do not treat CAD score as a probability
- Do not ignore symptoms in low-score patients
- Ensure good X-ray quality to avoid false outputs
- Do not delay action based solely on score

CAD4TB Output Score and Heatmap



Physical Examination: Pulse Oximetry



A pulse oximeter is a small, non-invasive medical device used to measure the oxygen saturation (SpO₂) level of the blood and pulse rate.

It helps assess how well oxygen is being delivered to parts of the body furthest from the heart, like the fingers and toes.

Frequency: On every visit

Steps to Use a Pulse Oximeter:

1. Prepare the Patient by ensuring the hand is clean, warm, and relaxed. **Remove nail polish, artificial nails, or anything that can interfere with the reading.**
2. Power On the Device.
3. Insert the patient's index or middle finger into the clip-like sensor with the nail facing upward.
4. Keep the hand still while the device reads the SpO₂ and pulse rate for 2 minutes.
5. Read and Record Results by noting the:
 - Oxygen saturation (%)
 - Pulse rate (bpm)
6. Remove the finger and turn off the device.
7. Clean the device using an alcohol swab if it's to be used on another person.

Some devices display a waveform or bar graph indicating signal strength.

Factors That May Affect Accuracy:

- Poor circulation (cold hands)
- Movement or tremors
- Nail polish or artificial nails
- Low battery or dirty sensor
- Darker complexion.
- Severe anemia or carbon monoxide poisoning (may show false normal)

Key Clinical Cut-offs:

- < 94%: May indicate early hypoxia in acute illness (e.g., COVID-19, pneumonia).
- < 90%: General clinical cut-off for hypoxemia needing urgent attention.
- < 88%: Often used to determine need for long-term oxygen therapy in chronic lung diseases (e.g., COPD).
- < 85%: Indicates severe oxygen desaturation, emergency action needed. (Except known COPD patients)

Note:

- Always interpret SpO₂ in context: Patient's condition, altitude, presence of CO poisoning, or anemia can affect accuracy.
- Confirm low readings with arterial blood gas (ABG) in critical situations.

Reminder for Chronic Respiratory Patients:

- For patients with known chronic respiratory conditions (e.g., asthma, COPD, PTLT), encourage them to avoid applying nail polish on the index or middle finger prior to routine check-ups, as it may interfere with accurate pulse oximeter readings.

Physical Assessment: Six Minute Walk Test (6MWT)

The 6MWT measures the distance a person can walk on a flat, hard surface in six minutes. It evaluates functional exercise capacity and is commonly used for patients with heart failure, pulmonary disease, and other conditions affecting exercise tolerance.

Pre-Test Requirements

Equipment needed is:

- Stopwatch or timer
- Pre-measured walkway, i.e., track/corridor
- Data Recording Sheet
- At least one chair, positioned at the end of the track/corridor
- Pulse oximeter
- Blood pressure machine
- Emergency equipment nearby

Environmental setup:

- Walkway: point-to-point straight/continuous corridor/track
- The walkway should be flat, with minimal blind turns or obstacles
- Mark the start and finish line clearly on the track/corridor
- Ensure good lighting and ventilation
- Remove obstacles from the pathway
- Position chair(s) at both ends for rest

Patient preparation:

- Review medical history and account for any exercise precautions/contraindication.
- Comfortable walking shoes and clothing
- Avoid vigorous exercise 2 hours before the test
- A light meal is permitted 2 hours before
- Continue usual medications unless contraindicated
- The patient should use usual walking aids if needed

Contraindications

Absolute contraindications:

- Unstable angina or MI within the past month
- Resting heart rate >120 bpm after 10 minutes of rest
- Systolic BP >180 mmHg or diastolic BP >100 mmHg
- Acute illness or fever
- Resting SpO₂ < 85% on room air or on prescribed level of supplemental O₂
- Physical disability prevents safe performance

Relative contraindications

- Resting heart rate 50-120 bpm
- Recent cardiac event (within 3 months)
- Uncontrolled hypertension
- Patient is unable to understand instructions

Pre-test measurements - Record baseline values:

- Heart rate: ____ bpm
- Blood pressure: ____ / mmHg
- Oxygen saturation: ____ %
- Dyspnea level (Modified Borg Scale 0-10): ____
- Fatigue level (Modified Borg Scale 0-10): ____

Modified Borg Scale (0-10)

Patient Instructions for Borg Scale

‘On this scale, 0 means no shortness of breath at all, and 10 means the worst shortness of breath you have ever experienced. Please tell me the number that best describes your breathing right now.’

Refer to the scale on the next page for scoring/interpretation.

Physical Assessment: Six Minute Walk Test (6MWT)

Use this scale to assess dyspnea (shortness of breath) and fatigue levels:

Rating	Intensity	Description
0	Nothing at all	No breathlessness/fatigue
0.5	Very, very slight	Just noticeable
1	Very slight	Light breathlessness/fatigue
2	Slight	Mild breathlessness/fatigue
3	Moderate	Noticeable but not severe
4	Somewhat severe	Getting uncomfortable
5	Severe	Strong breathlessness/fatigue
6		Between severe and very severe
7	Very severe	Very strong breathlessness/fatigue
8		Between very severe and maximal
9		Very, very severe (almost maximal)
10	Maximal	Highest level ever experienced

6-MWT Instructions

Before the Test

- The pulse oximeter is to be attached to the patient, so it is ready to be checked throughout the test without interfering with walking pace.
- Describe the walking track to the patient

Give the following instructions to the patient (Read Aloud)

‘The purpose of this test is to see how far you can walk in 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, which means you will be exerting yourself. You are permitted to slow down, stop, and rest as needed. You may lean against the wall while resting but resume walking as soon as you are able.’

‘You will be walking back and forth between the marked lines. I will keep track of the time and let you know when you have completed 6 minutes.’

‘Are there any questions before we begin?’

During the test:

- Start timer when patient begins walking
- Walk behind the patient
- Do not talk to patient except for standardized encouragement
- Count laps completed
- Record any stops or rests taken during the test
- Monitor for signs of distress

Standardized encouragement phrases

After 1 minute: ‘You are doing well. You have 5 minutes to go.’ **After 2 minutes:** ‘Keep up the good work. You have 4 minutes to go.’ **After 3 minutes:** ‘You are doing well. You are halfway done.’ **After 4 minutes:** ‘Keep up the good work. You have only 2 minutes left.’ **After 5 minutes:** ‘You are doing well. You have only 1 minute to go.’ **15 seconds before the end:** ‘In a moment, I’m going to tell you to stop. When I do, just stop right where you are, and I will come to you.’ **At 6 minutes:** ‘Stop!’

6MWT 1					Date:	Time
Supplemental Oxygen					Mobility Aid	
Time (Mins)	BP	SpO ₂	HR	Distance Walked	Rests/ Comments	
1						
2						
3						
4						
5						
6						

Post-test measurements/ Immediately after stopping, record:

Record baseline values:

- Distance walked: _____ meters
- Heart rate: _____ bpm
- Blood pressure: _____ / mmHg
- Oxygen saturation: _____ %
- Dyspnea level (Modified Borg Scale 0-10): _____
- Fatigue level (Modified Borg Scale 0-10): _____

Recovery Monitoring:

Monitor the patient for 5-10 minutes or until values return to baseline.

Distance Calculation: Total distance = (Number of laps × Measured track length) + Additional partial distance

Example:

If your measured track length is 25 meters, and the patient did 6 complete laps plus an extra 10 meters: **Total distance = (6 × 25) + 10 = 160 meters**

Normal Values Reference

Healthy adults: 400-700 meters

Heart failure patients: Often <300 meters, COPD patients: Variable, typically reduced

Physical Assessment: 1 Minute sit to stand test



The 1-minute sit-to-stand test assesses lower limb strength and endurance, functional capacity, and exercise tolerance in patients with chronic respiratory disease.

Note: This test can be used to monitor progress in pulmonary rehabilitation or identify reduced functional capacity in routine care.

STEP 1: Prepare the patient

- Confirm patient is clinically stable (no acute illness or exacerbation).
- Explain the procedure and obtain verbal consent.
- Confirm the patient:
 - Is aged 14 years and above
 - Can stand independently and perform sit-to-stand without support

STEP 2: Equipment & Setup

- Use a standard armless chair (height ~46 cm) placed against a wall for stability.
- Ensure a timer or stopwatch is available.
- Optional:
 - Pulse oximeter to monitor oxygen saturation and heart rate.
 - Borg Scale can be used pre- and post-test to assess dyspnea and exertion.

STEP 3: Baseline Measures/ Record:

- Heart rate: _____ bpm
- Blood pressure: _____ / mmHg
- Oxygen saturation: _____ %
- Dyspnea level (Modified Borg Scale 0-10): _____
- Fatigue level (Modified Borg Scale 0-10): _____

STEP 4: Instructions To Patient (Read Aloud)

'When I say 'Go,' stand up and sit down as many times as you can in one minute. Keep your arms crossed over your chest. You may rest if needed, but resume as soon as you're able. Are you ready? Go.'

STEP 5: Conduct The Test

- Start the timer for 60 seconds
- Count only **full stands** (knees fully extended + full seated return)
- Do not encourage the test
- Monitor patient closely for signs of distress (stop if needed)

STEP 6: Post-Test Measures- Immediately Record:

- Number of full repetitions
- SpO₂ and heart rate
- Borg score for dyspnea and leg fatigue
- Recovery time (time to return to baseline SpO₂ or resting state)

STEP 7: Interpret Results

Age Group	Expected Norm (Median Repetitions)
20-39 years	40-43
40-59 years	35-39
60-79 years	28-33
80+ years	20-25

Interpretation Flags:

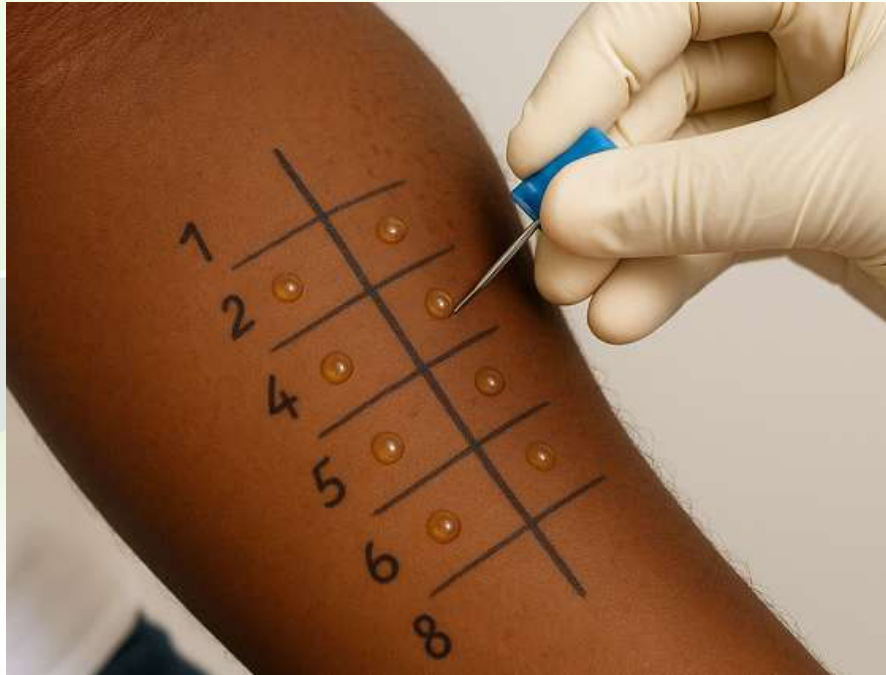
- Fewer than 19 reps (in adults <65 yrs) suggests poor functional status
- Desaturation >4% or SpO₂ <88% warrants further investigation

STEP 8: Document & Action

- Record in patient file:
 - Test date, score, pre/post SpO₂, Borg scale
 - Any symptoms or reason for stopping
- Consider:
 - Referral for pulmonary rehabilitation
 - Further diagnostic testing if significant desaturation or low performance
 - Education on physical activity

Alternative for Bedridden Patients: If unable to perform sit-to-stand, modify by assessing the ability to rise and lie down from bed repeatedly.

Skin Prick Test (SPT)



The skin prick test is a quick and safe diagnostic test used to identify allergic reactions to specific substances (allergens).

It helps diagnose allergies such as:

- Allergic rhinitis
- Asthma
- Eczema
- Food allergies
- Insect venom allergies

How It Works:

A small amount of allergen is applied to the skin, usually on the forearm or back. The skin is then lightly pricked to allow the allergen to enter just beneath the surface.

- If allergic, a small red bump (wheal), similar to a mosquito bite, appears within 15–20 minutes.

Contraindications: Not recommended if:

- o Severe eczema or skin conditions prevent clear testing
- o History of severe anaphylaxis
- o The patient cannot discontinue antihistamines

Procedure:

1. Preparation:

- Performed in a clinical setting.
- Stop antihistamines 3–7 days before, as advised, to prevent interference.
- The skin (usually the forearm or back) is cleaned with alcohol and marked with a grid to identify each allergen.

2. Allergen Application:

- A drop of each test allergen is placed on the skin at the marked sites.

3. Pricking the Skin:

- A sterile needle or lancet is used to prick the skin through each allergen drop, allowing the allergen to penetrate the skin's surface
- The prick is shallow — not deep enough to cause bleeding.

4. Observation Period:

- Wait for 15–20 minutes.
- The healthcare provider checks for raised, red, itchy wheals at the test sites.

5. Result Interpretation:

- A wheal larger than the control (usually saline for negative, histamine for positive) indicates a positive reaction.
- Results are documented and used to guide allergy management.

Advantages:

- Quick (results in 20 minutes)
- Minimally invasive
- Tests multiple allergens at once
- Low cost

Risks

- Mild local itching or swelling
- Rare risk of severe allergic reaction (anaphylaxis) — emergency measures should be available

Peak Flow Meter

This is a handheld device that measures Peak Expiratory Flow Rate (PEFR) — The maximum speed at which a person can forcefully exhale after a full inhalation.

It is used to:

- Detect airflow limitation in suspected chronic respiratory diseases (CRDs)
- Identify patients requiring further evaluation (e.g., spirometry, specialist referral)
- Assess bronchodilator reversibility, primarily to support an asthma diagnosis
- Monitor disease progression or treatment response during routine or follow-up care

Procedure:

1. Pre-Test Preparation

- Explain the procedure and obtain verbal consent.
- Ensure the patient:
 - o Has avoided bronchodilators:
 - SABA (e.g., salbutamol): avoid for at least 6 hours
 - LABA: avoid for 12–24 hours
 - o Is seated or standing upright.
 - o Is not acutely unwell or having a respiratory infection.

2. Baseline PEFR Measurement

- Use a calibrated peak flow meter.
- Instruct the patient to:
 - o Take a deep breath
 - o Seal lips tightly around the mouthpiece
 - o Blow out as hard and fast as possible
- Repeat 3 times (allow rest between attempts).
- Record the highest of the 3 readings as the baseline PEFR.

3. Estimate Predicted PEFR

Use the reference chart provided on the next page to determine the predicted PEFR based on age and height.

Then calculate:

$$\text{PEFR (\% of Predicted)} = \frac{\text{Baseline PEFR (highest of 3 attempts)} \times 100}{\text{Predicted PEFR from the chart}}$$

See Next Page for PEFR Prediction Chart (based on age and height)

Estimate Predicted

PEFR Result (% of Predicted)	Interpretation	Action Needed
≥80%	Normal	No immediate action
60–80%	Mild/moderate obstruction	Evaluate further, check SpO ₂
<60%	Significant obstruction	Reversibility test or spirometry

4. Administer Bronchodilator

- Give **400 micrograms of salbutamol (4 puffs)** via a spacer, or as per local protocol.
- Ensure correct inhaler technique:
 - o Shake the inhaler, insert it into the spacer.
 - o One puff at a time, with slow, deep inhalation.
- Wait for **15–20 minutes**.

5. Post-Bronchodilator PEFR Measurement

- Repeat the peak flow measurement:
 - o Make three attempts again and record the **highest** reading.

6. Calculate Reversibility

$$\text{PEFR Improvement (\%)} = \frac{\text{Post-bronchodilator PEFR} - \text{Baseline PEFR}}{\text{Baseline PEFR}} \times 100$$

7. Interpret Results and Determine Follow-Up:

- **Positive response (suggestive of asthma): PEFR increase of ≥20% AND ≥60 L/min**
- **Negative response:**
If no significant change but symptoms persist, consider:
 - o Spirometry with reversibility
 - o Serial peak flow monitoring (clinic or home)
 - o Referral for methacholine or exercise challenge (specialist)

8. Document Findings

- Date and time of test
- PEFR (L/min): Predicted: _____ Baseline: _____ Post-bronchodilator (if done): _____
- % improvement
- Bronchodilator used and dose
- Interpretation and next steps

Predicted Peak Expiratory Flow Rate (PEFR) Values

Predicted PEFR values for Adult Male aged 18-80 years

PEFR in L/min (Male)= -1 .807 [Age (in years)]+ 3.206* [Height (in cm)] (r²=0.892)*

Height	Age (in Yrs.)																															
(incm)	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00
141	420	418	416	414	412	410	409	407	405	403	401	400	398	396	394	392	391	389	387	385	383	382	380	378	376	374	373	371	369	367	365	364
142	423	421	419	417	415	414	412	410	408	406	405	403	401	399	397	396	394	392	390	388	387	385	383	381	379	378	376	374	372	370	369	367
143	426	424	422	421	419	417	415	413	411	410	408	406	404	402	401	399	397	395	393	392	390	388	386	384	383	381	379	377	375	374	372	370
144	429	427	426	424	422	420	418	416	415	413	411	409	407	406	404	402	400	398	397	395	393	391	389	388	386	384	382	380	379	377	375	373
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150	448	447	445	443	441	439	438	436	434	432	430	428	427	425	423	421	419	418	416	414	412	410	409	407	405	403	401	400	398	396	394	392
151	452	450	448	446	444	443	441	439	437	435	434	432	430	428	426	424	423	421	419	417	415	414	412	410	408	406	405	403	401	399	397	396
152	455	453	451	449	448	446	444	442	440	439	437	435	433	431	429	428	426	424	422	420	419	417	415	413	411	410	408	406	404	402	401	399
153	458	456	454	453	451	449	447	445	444	442	440	438	436	435	433	431	429	427	425	424	422	420	418	416	415	413	411	409	407	406	404	402
154	461	459	458	456	454	452	450	449	447	445	443	441	440	438	436	434	432	430	429	427	425	423	421	420	418	416	414	412	411	409	407	405
155	464	463	461	459	457	455	454	452	450	448	446	445	443	441	439	437	435	434	432	430	428	426	425	423	421	419	417	416	414	412	410	408
156	468	466	464	462	460	459	457	455	453	451	450	448	446	444	442	441	439	437	435	433	431	430	428	426	424	422	421	419	417	415	413	412
157	471	469	467	465	464	462	460	458	456	455	453	451	449	447	446	444	442	440	438	436	435	433	431	429	427	426	424	422	420	418	417	415
158	474	472	470	469	467	465	463	461	460	458	456	454	452	451	449	447	445	443	441	440	438	436	434	432	431	429	427	425	423	422	420	418
159	477	475	474	472	470	468	466	465	463	461	459	457	456	454	452	450	448	447	445	443	441	439	437	436	434	432	430	428	427	425	423	421
160	480	479	477	475	473	471	470	468	466	464	462	461	459	457	455	453	452	450	448	446	444	442	441	439	437	435	433	432	430	428	426	424
161	484	482	480	478	476	475	473	471	469	467	466	464	462	460	458	457	455	453	451	449	448	446	444	442	440	438	437	435	433	431	429	428
162	487	485	483	481	480	478	476	474	472	471	469	467	465	463	462	460	458	456	454	453	451	449	447	445	443	442	440	438	436	434	433	431
163	490	488	486	485	483	481	479	477	476	474	472	470	468	467	465	463	461	459	458	456	454	452	450	448	447	445	443	441	439	438	436	434
164	493	491	490	488	486	484	482	481	479	477	475	473	472	470	468	466	464	463	461	459	457	455	454	452	450	448	446	444	443	441	439	437
165	496	495	493	491	489	487	486	484	482	480	478	477	475	473	471	469	468	466	464	462	460	459	457	455	453	451	449	448	446	444	442	440
166	500	498	496	494	492	491	489	487	485	483	482	480	478	476	474	473	471	469	467	465	464	462	460	458	456	454	453	451	449	447	445	444
167	503	501	499	497	496	494	492	490	488	487	485	483	481	479	478	476	474	472	470	469	467	465	463	461	460	458	456	454	452	450	449	447
168	506	504	502	501	499	497	495	493	492	490	488	486	484	483	481	479	477	475	474	472	470	468	466	465	463	461	459	457	455	454	452	450
169	509	507	506	504	502	500	498	497	495	493	491	489	488	486	484	482	480	479	477	475	473	471	470	468	466	464	462	460	459	457	455	453
170	512	511	509	507	505	503	502	500	498	496	494	493	491	489	487	485	484	482	480	478	476	475	473	471	469	467	466	464	462	460	458	456
171	516	514	512	510	508	507	505	503	501	499	498	496	494	492	490	489	487	485	483	481	480	478	476	474	472	471	469	467				

Predicted PEFR values for Adult Male aged 18-80 years

$$PEFR \text{ in L/min (Male)} = -1.807 * [\text{Age (in years)}] + 3.206 * [\text{Height (in cm)}] \quad (r^2=0.892)$$

Height (incm)	Age (in Yrs.)																													
	50.00	51.00	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00	60.00	61.00	62.00	63.00	64.00	65.00	66.00	67.00	68.00	69.00	70.00	71.00	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00
141	362	360	358	356	354	353	351	349	347	345	344	342	340	338	336	335	333	331	329	327	326	324	322	320	318	317	315	313	311	309
142	365	363	361	359	358	356	354	352	350	349	347	345	343	341	340	338	336	334	332	331	329	327	325	323	322	320	318	316	314	312
143	368	366	364	363	361	359	357	355	354	352	350	348	346	345	343	341	339	337	336	334	332	330	328	327	325	323	321	319	318	316
144	371	370	368	366	364	362	360	359	357	355	353	351	350	348	346	344	342	341	339	337	335	333	332	330	328	326	324	323	321	319
145	375	373	371	369	367	365	364	362	360	358	356	355	353	351	349	347	346	344	342	340	338	337	335	333	331	329	328	326	324	322
146	378	376	374	372	370	369	367	365	363	361	360	358	356	354	352	351	349	347	345	343	342	340	338	336	334	333	331	329	327	325
147	381	379	377	376	374	372	370	368	366	365	363	361	359	357	356	354	352	350	348	347	345	343	341	339	338	336	334	332	330	329
148	384	382	381	379	377	375	373	371	370	368	366	364	362	361	359	357	355	353	352	350	348	346	344	343	341	339	337	335	334	332
149	387	386	384	382	380	378	377	375	373	371	369	367	366	364	362	360	358	357	355	353	351	349	348	346	344	342	340	339	337	335
150	391	389	387	385	383	382	380	378	376	374	372	371	369	367	365	363	362	360	358	356	354	353	351	349	347	345	344	342	340	338
151	394	392	390	388	387	385	383	381	379	377	376	374	372	370	368	367	365	363	361	359	358	356	354	352	350	349	347	345	343	341
152	397	395	393	392	390	388	386	384	383	381	379	377	375	373	372	370	368	366	364	363	361	359	357	355	354	352	350	348	346	345
153	400	398	397	395	393	391	389	388	386	384	382	380	378	377	375	373	371	369	368	366	364	362	360	359	357	355	353	351	350	348
154	403	402	400	398	396	394	393	391	389	387	385	383	382	380	378	376	374	373	371	369	367	365	364	362	360	358	356	355	353	351
155	407	405	403	401	399	398	396	394	392	390	389	387	385	383	381	379	378	376	374	372	370	369	367	365	363	361	360	358	356	354
156	410	408	406	404	403	401	399	397	395	394	392	390	388	386	384	383	381	379	377	375	374	372	370	368	366	365	363	361	359	357
157	413	411	409	408	406	404	402	400	399	397	395	393	391	390	388	386	384	382	380	379	377	375	373	371	370	368	366	364	362	361
158	416	414	413	411	409	407	405	404	402	400	398	396	395	393	391	389	387	385	384	382	380	378	376	375	373	371	369	367	366	364
159	419	418	416	414	412	410	409	407	405	403	401	400	398	396	394	392	390	389	387	385	383	381	380	378	376	374	372	371	369	367
160	423	421	419	417	415	414	412	410	408	406	405	403	401	399	397	396	394	392	390	388	386	385	383	381	379	377	376	374	372	370
161	426	424	422	420	419	417	415	413	411	410	408	406	404	402	401	399	397	395	393	391	390	388	386	384	382	381	379	377	375	373
162	429	427	425	424	422	420	418	416	415	413	411	409	407	406	404	402	400	398	396	395	393	391	389	387	386	384	382	380	378	377
163	432	430	429	427	425	423	421	420	418	416	414	412	411	409	407	405	403	402	400	398	396	394	392	391	389	387	385	383	382	380
164	435	434	432	430	428	426	425	423	421	419	417	416	414	412	410	408	407	405	403	401	399	397	396	394	392	390	388	387	385	383
165	439	437	435	433	431	430	428	426	424	422	421	419	417	415	413	412	410	408	406	404	403	401	399	397	395	393	392	390	388	386
166	442	440	438	436	435	433	431	429	427	426	424	422	420	418	417	415	413	411	409	408	406	404	402	400	398	397	395	393	391	389
167	445	443	441	440	438	436	434	432	431	429	427	425	423	422	420	418	416	414	413	411	409	407	405	403	402	400	398	396	394	393
168	448	446	445	443	441	439	437	436	434	432	430	428	427	425	423	421	419	418	416	414	412	410	409	407	405	403	401	399	398	396
169	451	450	448	446	444	442	441	439	437	435	433	432	430	428	426	424	423	421	419	417	415	414	412	410	408	406	404	403	401	399
170	455	453	451	449	447	446	444	442	440	438	437	435	433	431	429	428	426	424	422	420	419	417	415	413	411	409	408	406	404	402
171	458	456	454	452	451	449	447	445	443	442	440	438	436	434	433	431	429	427	425	424	422	420	418	416	415	413	411	409	407	405
172	461	459	457	456	454	452	450	448	447	445	443	441	439	438	436	434	432	430	429	427	425	423	421	420	418	416	414	412	410	409
173	464	462	461	459	457	455	453	452	450	448	446	444	443	441	439	437	435	434	432	430	428	426	425	423	421	419	417	415	414	412
174	467	466	464	462	460																									

Predicted PEFr values for Adult Female aged 18-80 years
PEFR in L/min (Female) = -1.454* [Age (in years)]+ 2.368* [Height (in cm)] (r²=0.882)

Height (incm)	Age (in Yrs.)																															
	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00
141	308	306	305	303	302	300	299	298	296	295	293	292	290	289	287	286	284	283	282	280	279	277	276	274	273	271	270	268	267	266	264	263
142	310	309	307	306	304	303	301	300	298	297	296	294	293	291	290	288	287	285	284	282	281	280	278	277	275	274	272	271	269	268	266	265
143	312	311	310	308	307	305	304	302	301	299	298	296	295	294	292	291	289	288	286	285	283	282	280	279	278	276	275	273	272	270	269	267
144	315	313	312	310	309	308	306	305	303	302	300	299	297	296	294	293	292	290	289	287	286	284	283	281	280	278	277	276	274	273	271	270
145	317	316	314	313	311	310	308	307	306	304	303	301	300	298	297	295	294	292	291	290	288	287	285	284	282	281	279	278	276	275	274	272
146	320	318	317	315	314	312	311	309	308	306	305	304	302	301	299	298	296	295	293	292	290	289	288	286	285	283	282	280	279	277	276	274
147	322	320	319	318	316	315	313	312	310	309	307	306	304	303	302	300	299	297	296	294	293	291	290	288	287	286	284	283	281	280	278	277
148	324	323	321	320	318	317	316	314	313	311	310	308	307	305	304	302	301	300	298	297	295	294	292	291	289	288	286	285	284	282	281	279
149	327	325	324	322	321	319	318	316	315	314	312	311	309	308	306	305	303	302	300	299	298	296	295	293	292	290	289	287	286	284	283	282
150	329	328	326	325	323	322	320	319	317	316	314	313	312	310	309	307	306	304	303	301	300	298	297	296	294	293	291	290	288	287	285	284
151	331	330	328	327	326	324	323	321	320	318	317	315	314	312	311	310	308	307	305	304	302	301	299	298	297	295	294	292	291	289	288	286
152	334	332	331	329	328	326	325	324	322	321	319	318	316	315	313	312	311	309	308	306	305	303	302	300	299	297	296	295	293	292	290	289
153	336	335	333	332	330	329	327	326	325	323	322	320	319	317	316	314	313	311	310	309	307	306	304	303	301	300	298	297	295	294	293	291
154	339	337	336	334	333	331	330	328	327	325	324	323	321	320	318	317	315	314	312	311	309	308	307	305	304	302	301	299	298	296	295	293
155	341	339	338	337	335	334	332	331	329	328	326	325	323	322	321	319	318	316	315	313	312	310	309	307	306	305	303	302	300	299	297	296
156	343	342	340	339	337	336	335	333	332	330	329	327	326	324	323	321	320	319	317	316	314	313	311	310	308	307	305	304	303	301	300	298
157	346	344	343	341	340	338	337	335	334	333	331	330	328	327	325	324	322	321	319	318	317	315	314	312	311	309	308	306	305	303	302	301
158	348	347	345	344	342	341	339	338	336	335	333	332	331	329	328	326	325	323	322	320	319	317	316	315	313	312	310	309	307	306	304	303
159	350	349	347	346	345	343	342	340	339	337	336	334	333	331	330	329	327	326	324	323	321	320	318	317	315	314	313	311	310	308	307	305
160	353	351	350	348	347	345	344	343	341	340	338	337	335	334	332	331	329	328	327	325	324	322	321	319	318	316	315	313	312	311	309	308
161	355	354	352	351	349	348	346	345	343	342	341	339	338	336	335	333	332	330	329	327	326	325	323	322	320	319	317	316	314	313	311	310
162	357	356	355	353	352	350	349	347	346	344	343	341	340	339	337	336	334	333	331	330	328	327	325	324	323	321	320	318	317	315	314	312
163	360	358	357	355	354	353	351	350	348	347	345	344	342	341	339	338	337	335	334	332	331	329	328	326	325	323	322	321	319	318	316	315
164	362	361	359	358	356	355	353	352	351	349	348	346	345	343	342	340	339	337	336	335	333	332	330	329	327	326	324	323	321	320	319	317
165	365	363	362	360	359	357	356	354	353	351	350	349	347	346	344	343	341	340	338	337	335	334	333	331	330	328	327	325	324	322	321	319
166	367	365	364	363	361	360	358	357	355	354	352	351	349	348	347	345	344	342	341	339	338	336	335	333	332	331	329	328	326	325	323	322
167	369	368	366	365	363	362	361	359	358	356	355	353	352	350	349	347	346	345	343	342	340	339	337	336	334	333	331	330	329	327	326	324
168	372	370	369	367	366	364	363	361	360	359	357	356	354	353	351	350	348	347	345	344	343	341	340	338	337	335	334	332	331	329	328	327
169	374	373	371	370	368	367	365	364	362	361	359	358	357	355	354	352	351	349	348	346	345	343	342	341	339	338	336	335	333	332	330	329
170	376	375	373	372	371	369	368	366	365	363	362	360	359	357	356	355	353	352	350	349	347	346	344	343	341	340	339	337	336	334	333	331
171	379	377	376	374	373	371	370	369	367	366	364	363																				

Predicted PEFR values for Adult Male Aged 18-80 years

$$PEFR \text{ in L/min (Female)} = -1.454 * [\text{Age (in years)}] + 2.368 * [\text{Height (in cm)}] \quad (r^2=0.882)$$

Height (incm)	Age (in Yrs.)																														
	50.00	51.00	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00	60.00	61.00	62.00	63.00	64.00	65.00	66.00	67.00	68.00	69.00	70.00	71.00	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00	80.00
141	261	260	258	257	255	254	252	251	250	248	247	245	244	242	241	239	238	236	235	234	232	231	229	228	226	225	223	222	220	219	218
142	264	262	261	259	258	256	255	253	252	250	249	248	246	245	243	242	240	239	237	236	234	233	232	230	229	227	226	224	223	221	220
143	266	264	263	262	260	259	257	256	254	253	251	250	248	247	246	244	243	241	240	238	237	235	234	232	231	230	228	227	225	224	222
144	268	267	265	264	262	261	260	258	257	255	254	252	251	249	248	246	245	244	242	241	239	238	236	235	233	232	230	229	228	226	225
145	271	269	268	266	265	263	262	260	259	258	256	255	253	252	250	249	247	246	244	243	242	240	239	237	236	234	233	231	230	228	227
146	273	272	270	269	267	266	264	263	261	260	258	257	256	254	253	251	250	248	247	245	244	242	241	240	238	237	235	234	232	231	229
147	275	274	272	271	270	268	267	265	264	262	261	259	258	256	255	254	252	251	249	248	246	245	243	242	241	239	238	236	235	233	232
148	278	276	275	273	272	270	269	268	266	265	263	262	260	259	257	256	255	253	252	250	249	247	246	244	243	241	240	239	237	236	234
149	280	279	277	276	274	273	271	270	269	267	266	264	263	261	260	258	257	255	254	253	251	250	248	247	245	244	242	241	239	238	237
150	283	281	280	278	277	275	274	272	271	269	268	267	265	264	262	261	259	258	256	255	253	252	251	249	248	246	245	243	242	240	239
151	285	283	282	281	279	278	276	275	273	272	270	269	267	266	265	263	262	260	259	257	256	254	253	251	250	249	247	246	244	243	241
152	287	286	284	283	281	280	279	277	276	274	273	271	270	268	267	265	264	263	261	260	258	257	255	254	252	251	249	248	247	245	244
153	290	288	287	285	284	282	281	279	278	277	275	274	272	271	269	268	266	265	263	262	261	259	258	256	255	253	252	250	249	247	246
154	292	291	289	288	286	285	283	282	280	279	277	276	275	273	272	270	269	267	266	264	263	261	260	259	257	256	254	253	251	250	248
155	294	293	291	290	289	287	286	284	283	281	280	278	277	275	274	273	271	270	268	267	265	264	262	261	259	258	257	255	254	252	251
156	297	295	294	292	291	289	288	287	285	284	282	281	279	278	276	275	273	272	271	269	268	266	265	263	262	260	259	257	256	255	253
157	299	298	296	295	293	292	290	289	287	286	285	283	282	280	279	277	276	274	273	271	270	269	267	266	264	263	261	260	258	257	255
158	301	300	299	297	296	294	293	291	290	288	287	285	284	283	281	280	278	277	275	274	272	271	269	268	267	265	264	262	261	259	258
159	304	302	301	299	298	297	295	294	292	291	289	288	286	285	283	282	281	279	278	276	275	273	272	270	269	267	266	265	263	262	260
160	306	305	303	302	300	299	297	296	295	293	292	290	289	287	286	284	283	281	280	279	277	276	274	273	271	270	268	267	265	264	263
161	309	307	306	304	303	301	300	298	297	295	294	293	291	290	288	287	285	284	282	281	279	278	277	275	274	272	271	269	268	266	265
162	311	309	308	307	305	304	302	301	299	298	296	295	293	292	291	289	288	286	285	283	282	280	279	277	276	275	273	272	270	269	267
163	313	312	310	309	307	306	305	303	302	300	299	297	296	294	293	291	290	289	287	286	284	283	281	280	278	277	275	274	273	271	270
164	316	314	313	311	310	308	307	305	304	303	301	300	298	297	295	294	292	291	289	288	287	285	284	282	281	279	278	276	275	273	272
165	318	317	315	314	312	311	309	308	306	305	303	302	301	299	298	296	295	293	292	290	289	287	286	285	283	282	280	279	277	276	274
166	320	319	317	316	315	313	312	310	309	307	306	304	303	301	300	299	297	296	294	293	291	290	288	287	285	284	283	281	280	278	277
167	323	321	320	318	317	315	314	313	311	310	308	307	305	304	302	301	299	298	297	295	294	292	291	289	288	286	285	283	282	281	279
168	325	324	322	321	319	318	316	315	313	312	311	309	308	306	305	303	302	300	299	297	296	295	293	292	290	289	287	286	284	283	282
169	327	326	325	323	322	320	319	317	316	314	313	311	310	309	307	306	304	303	301	300	298	297	296	294	293	291	290	288	287	285	284
170	330	328	327	325	324	323	321	320	318	317	315	314	312	311	310	308	307	305	304	302	301	299	298	296	295	294	292	291	289	288	286
171	332	331	329	328	326	325	324	322	321	319	318	316	315	313	312	310	309	308	306	305	303	302	300	299	297	296	294	293	292	290	289
172	335	333	332	330	329	327	326	324	323	322	320	319	317	316	314	313	311	310													

Spirometry

Spirometry is a simple, non-invasive diagnostic test that measures how much air a person can inhale and exhale, and how quickly they can do so. It provides key insights into **lung volume** and **airflow**, helping assess how well the lungs are functioning.

What Does It Measure?

- **Forced Vital Capacity (FVC):** Total volume of air exhaled after a full inhalation
- **Forced Expiratory Volume in 1 Second (FEV₁):** Volume exhaled in the first second of a forced breath
- **FEV₁/FVC ratio:** Indicates the presence and severity of airflow obstruction

Spirometry is used to:

- **Diagnose chronic lung diseases**, including:
 - o Asthma
 - o Chronic Obstructive Pulmonary Disease (COPD)
 - o Post-TB lung disease
 - o Pulmonary fibrosis
 - o Cystic fibrosis
- **Assess the severity and progression** of respiratory conditions
- **Detect early changes** in lung function before symptoms appear
- **Guide treatment decisions**, including the use of inhaled medications
- **Monitor response to therapy** and adjust management plans
- **Evaluate lung function before surgery** or occupational exposure

1. Indications

- Unexplained chronic cough, wheeze, or dyspnea
- Suspected asthma or COPD
- Differentiating asthma (reversible) from COPD (non-reversible or partially reversible)
- Assessing response to bronchodilators
- Baseline for chronic respiratory disease management

2. Contraindications

Absolute:

- Recent myocardial infarction (within 1 week)
- Unstable angina
- Recent eye surgery (e.g., cataract)
- Thoracic, abdominal, or cerebral aneurysms
- Pneumothorax

Relative:

- Recent surgery (chest, abdomen, brain)
- Hemoptysis of unknown origin
- Uncontrolled hypertension
- Acute severe respiratory distress
- Inability to follow instructions (cognitive or developmental limitations)

3. Required Equipment

- Calibrate the **spirometer if required, based on the model**
- Disposable mouthpieces
- **Bronchodilator** (e.g., Salbutamol 400 mcg via spacer or nebulizer)
- Nose clip (optional)
- Alcohol wipes for cleaning
- Spirometry recording register or software

Spirometry Procedure

Summary Flowchart:

Prepare → Baseline Spirometry → Bronchodilator → Wait 15–20 mins → Post-BD Spirometry → Compare & Interpret → Action → Document

1. Pre-Test Preparation

- Explain the procedure to reduce anxiety.
- Instruct patient to:
 - Avoid SABA (6 hrs) or LABA (12–24 hrs) before the test.
 - Wear loose, comfortable clothing.
- Record baseline data:
 - Name, age, sex, height, weight, ethnicity.
 - Medical history and medication use.
- Position:
 - The patient should be seated upright with feet flat on the floor.

2. Baseline Spirometry Procedure

- Confirm patient ID and demographic details.
- Actively and guide the patient through the test to ensure they perform with maximum effort.
- Ensure:
 - Upright posture, head slightly elevated.
 - Patient understands the sequence: full inhale → seal lips → forceful ex-hale → full inhale again.
- Attach a clean mouthpiece.
- Instruct the patient to:
 - Take a deep breath until your lungs are full.
 - Seal lips tightly around the mouthpiece.
 - Blow out as hard and fast as possible until empty.
 - Inhale again with full effort if required.
- Repeat for at least three acceptable efforts (max eight if needed for adults).
- Verify acceptability and reproducibility efforts (per ATS/ERS)
- Perform more maneuvers as necessary

Record baseline values:

- **FVC** – Forced Vital Capacity
- **FEV₁** – Forced Expiratory Volume in 1 second
- **FEV₁/FVC ratio**
- **PEF** – Peak Expiratory Flow

3. Administer Bronchodilator

- Administer 400 mcg salbutamol (4 puffs via spacer) or 2.5 mg via nebulizer.
- Wait 15–20 minutes for the full effect.

4. Post-Bronchodilator Spirometry

- Repeat the same spirometry steps with at least 3 acceptable efforts.
- Actively and guide the patient through the test to ensure they perform with maximum effort.
- Record post-bronchodilator values:
 - FVC, FEV₁, FEV₁/FVC ratio

5. Interpretation and Follow-Up

Positive Bronchodilator Response:

- Increase in FEV₁ or FVC $\geq 12\%$ and ≥ 200 mL from baseline
- Always interpret with clinical context in mind and link to appropriate management.

Result	Interpretation
↑ FEV ₁ $\geq 12\%$ & ≥ 200 mL	Significant reversibility → suggestive of asthma
No significant change	Suggests fixed obstruction → e.g., COPD

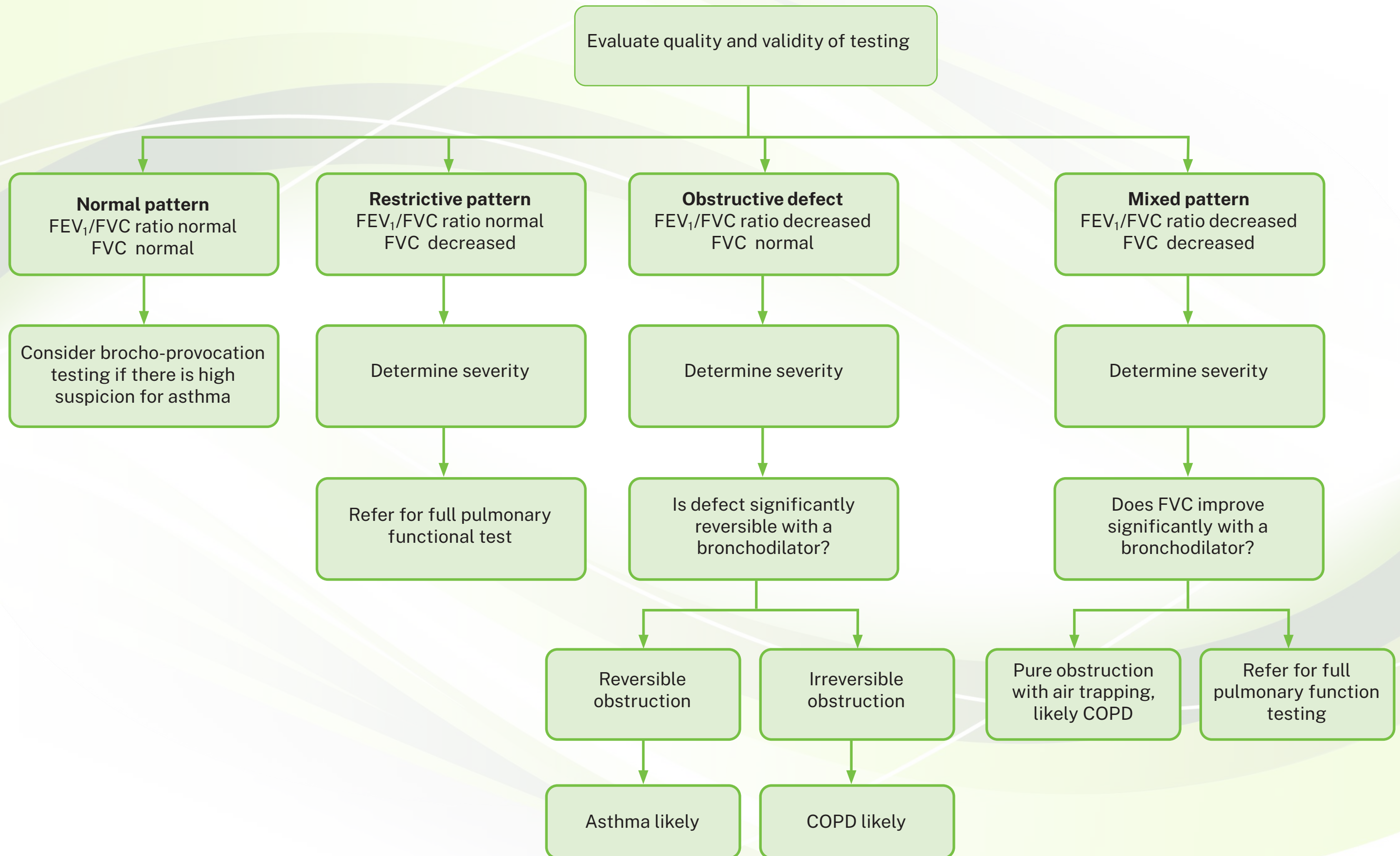
6. Documentation

- Patient demographics and clinical indication
- Baseline and post-bronchodilator spirometry values
- % improvement in FEV₁/FVC
- Interpretation summary
- Any testing issues (e.g., coughing, early stopping)
- Clinical recommendations

7. Quality Assurance Tips

- Ensure daily calibration of the spirometer.
- Coach the patient throughout the test for maximal effort.

Algorithm for interpreting spirometry



Management Steps of an Acute Asthma Attack

A severe asthma attack is a life-threatening exacerbation of asthma with worsening airflow obstruction, poor response to usual relievers, and high risk of respiratory failure or death.

Signs & Symptoms

- Inability to complete full sentences
- Respiratory rate >30/min
- Use of accessory muscles
- Chest tightness or silent chest
- Severe wheezing (or absence due to poor air entry)
- Peak Expiratory Flow (PEF) <50% predicted or personal best

Red Flags

- Cyanosis
- Altered mental status or drowsiness
- Oxygen saturation < 92% on room air
- Bradycardia or hypotension
- Exhaustion or confusion
- Silent chest (no air entry)

Step	Action
1. Oxygen	Administer high-flow oxygen to maintain SpO ₂ ≥94%
2. Bronchodilator (Nebulized or Inhaler with Spacer)	- Salbutamol 5 mg via nebulizer every 20 minutes for 1 hour (3 doses) OR 4–8 puffs of salbutamol via MDI + spacer every 20 min for 1 hour
3. Add Ipratropium Bromide	0.5 mg every 20 minutes (for the first hour) if severe
4. Steroids	Give immediately: – Oral prednisolone 40–50 mg (if able to swallow) – OR IV hydrocortisone 100 mg if unable to take orally

Reassessment (After First Hour)

- Improving? → Continue bronchodilators PRN, taper frequency
- Not improving/worsening?
 - o Repeat nebulization
 - o Consider IV magnesium sulfate 1.2–2 g over 20 minutes
 - o Prepare for referral or ICU admission

Criteria for Urgent Referral or Admission

Refer urgently if any of the following are present:

- No improvement after initial therapy
- Life-threatening features (altered consciousness, silent chest, cyanosis)
- Frequent attacks or recent hospitalization
- SpO₂ persistently <92%
- Co-morbidities (e.g., cardiac disease)

Monitoring and Documentation

- Monitor: RR, HR, SpO₂, BP, PEF, and level of consciousness every 15–30 minutes
- Document: Medication doses, response to treatment, vital signs, time of reassessment

Key Patient Education Before Discharge

- Trigger avoidance (dust, mold, smoke, cold, exercise, infections, laughing)
- Proper inhaler technique (review and demonstrate)
- Prescribe and explain the use of ICS inhalers and the action plan
- Follow-up appointment within 1 week

Nebulization Procedure

Procedure:

STEP 1: Prepare Equipment and Environment

- Wash your hands thoroughly and wear gloves and a mask.
- Ensure the room is well-ventilated or has an extractor fan.
- Gather equipment:
 - o Nebulizer machine (compressor or oxygen-driven)
 - o Nebulizer cup and mouthpiece/mask
 - o Prescribed medication (e.g., salbutamol, ipratropium bromide)
 - o Normal saline (0.9%) if dilution needed
 - o Oxygen source (if required)

STEP 2: Prepare Medication

- Check the prescription and expiry dates.
- Add the prescribed dose of medication into the nebulizer cup.
- If needed, dilute with normal saline (up to 4–5 mL total).
- Securely close the nebulizer cup.

STEP 3: Administer Nebulization

- Connect the nebulizer cup to the mouthpiece or mask.
- Position the patient upright and seated comfortably.
- Instruct the patient to:
 - o Use a mouthpiece if possible (preferred) or a face mask if unable.
 - o Breathe normally through the mouth; occasional deep breaths help.
- Turn on the nebulizer machine:
 - o Check for mist production.
 - o Nebulization takes 5–10 minutes.

STEP 4: Monitor During Procedure

- Observe for:
 - o Increased respiratory distress
 - o Side effects (e.g., tremors, palpitations, dizziness)
 - o Change in oxygen saturation or consciousness
- If any adverse effects occur, stop treatment and reassess.

STEP 5: Post-Procedure

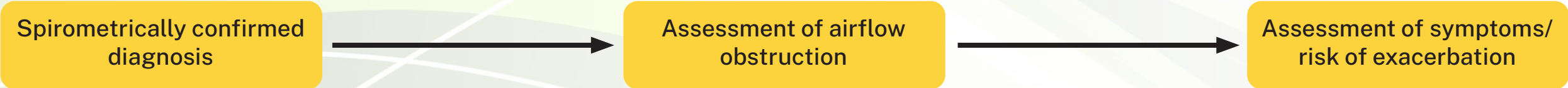
- Turn off the machine and remove the mask/mouthpiece.
- Wash and disinfect nebulizer parts as per protocol.
- Wash hands after removing gloves.
- Document:
 - o Medication, dose, time, and patient's response
 - o Any adverse reactions

Key Reminders

- Use oxygen-driven nebulizers in emergency/acute settings if possible.
- Nebulization is **not recommended** in infectious respiratory cases (e.g., TB, COVID-19) unless airborne precautions are in place.
- Clean nebulizer parts daily and after each use to avoid contamination.

COPD GOLD ABE Assessment TOOL

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



Post-Bronchodilator FEV1/FVC < 0.7	Grade	Severity	FEV1 (% Predicted)
	Gold 1	Mild	≥ 80
	Gold 2	Moderate	50 -79
	Gold 3	Severe	30 - 49
	Gold 4	Very Severe	< 30

		Exacerbation History (Per Year)	
		0–1 moderate exacerbation (not leading to hospitalization)	≥2 moderate exacerbations or ≥1 hospitalization
Symptoms	Low Symptoms (mMRC 0–1 or CAT <10)	Group A	Group E
	High Symptoms (mMRC ≥2 or CAT ≥10)	Group B	Group E

Comparison Table – Asthma vs COPD

Feature	Asthma	COPD
Onset	Early in life (childhood)	Mid-life or later
Symptoms	Variable, episodic	Progressive, persistent
Reversibility	Yes (with bronchodilator)	Limited/irreversible
Triggers	Allergens, cold, exercise, laughing,	Smoking, biomass, pollutants
Spirometry	FEV ₁ ↑ ≥12% and ≥200 mL	FEV ₁ ↑, minimal reversibility
Smoking history	Not always	Common
Biomass	Not always	Common
Exacerbation	Responds well to steroids	Frequent, slower recovery

Post TB Lung Disease

Post-Tuberculosis Lung Disease (PTLD) refers to persistent respiratory abnormalities and structural lung damage occurring after successful completion of TB treatment.

Purpose of Job Aid

To guide radiologists, clinicians, and radiographers in appropriate, standardized use of Chest CT scans for detecting Post-TB Lung Disease (PTLD) and related complications.

When to Perform Chest CT for PTLD

- Persistent respiratory symptoms post-TB: Chronic cough, breathlessness, chest pain
- Abnormal chest X-ray after TB treatment: Cavities, fibrosis, volume loss
- Suspected complications: Aspergilloma, bronchiectasis, lung destruction
- Pre-surgical planning: Decortication, Lobectomy, pneumonectomy
- Differential diagnosis: Suspected malignancy or reactivation

What to Look for in PTLD on CT

Abnormality	Description
Fibrosis	Reticular opacities, architectural distortion
Bronchiectasis	Dilated bronchi with thickened walls
Cavities	Thick- or thin-walled, may contain fluid or fungus ball
Aspergilloma	Mobile mass within a cavity, air crescent sign
Volume loss/Rib Crowding	Shift of mediastinum, elevated diaphragm
Emphysema/Bullae	Localized destruction of lung tissue
Pleural thickening/calcification	Common in old TB
Mediastinal lymph nodes	May indicate reactivation or other pathology

Image Review & Reporting

The structured format of review includes lungs, airways, pleura, mediastinum. It is compared with prior imaging if available.

Findings are documented clearly using terms like “post-TB bronchiectasis”, “residual fibrosis”, “aspergilloma suspected”

Where necessary it may include advise on follow-up and recommendation for referral to pulmonologist or TB specialist for chronic care.

Precautions

- Avoid unnecessary radiation, especially in repeat imaging.
- Always rule out active TB before labeling findings as PTLD.
- MRI may be indicated for spinal or CNS TB sequelae, not lung parenchyma.

Complementary Tools

- Spirometry/PFTs – assess functional impact
- Pulse oximetry – monitor oxygen saturation
- Sputum AFB/GeneXpert – exclude active TB

Metered Dose Inhaler (MDI)

How do I use a Metered Dose Inhaler (MDI)?

A metered dose inhaler, often called a puffer, is the most common type of inhaler. It can be used with a spacer.

Here are some tips that are helpful with all types of inhalers:

- Make sure your inhaler is not past its expiry date.
- Make sure your inhaler is not empty.
- Learn how to clean and care for your inhaler — and your spacer, if you use one.
- Lift your chin slightly while using your inhaler, as this helps the medicine reach your lungs.
- Wipe the mouthpiece of your inhaler with a dry cloth or tissue after every use

How to use an MDI:

1. Remove the cap.
2. Hold the inhaler upright and shake it before use.
3. Breathe out fully.
4. Hold the mouthpiece between your teeth and close your lips around it.
5. Breathe in deeply as you press the canister down to deliver the dose.
6. Hold your breath for 5 to 10 seconds, then breathe out.
7. If you need to take another dose, repeat from step 2.
8. Replace the cap.

How do I use inhaler in a spacer?

Some inhalers can be used together with a spacer. A spacer is a plastic chamber with an opening at one end, where the inhaler is attached, and a mouthpiece at the other end for you to breathe through. A spacer helps more of the medicine to reach your lungs, instead of it settling in your mouth or throat.

1. Put the spacer together (if necessary) by following the instructions supplied.
2. Remove the inhaler's protective cap.
3. Shake the inhaler well.
4. Insert the inhaler firmly into the end of the spacer, while keeping the inhaler upright.
5. Place the mouthpiece between your teeth and close your lips to form a seal.
6. Breathe out gently into the spacer.
7. Keep the spacer horizontal while you press the inhaler once to release a dose into the spacer. Do not remove the inhaler.
8. Breathe in slowly and deeply and hold your breath for about 5 seconds or as long as comfortable. Or breathe in and out normally for 3 or 4 breaths.
9. Remove the spacer from your mouth and breathe out gently.
10. Remove the inhaler from the spacer.
11. If more than one dose is needed, repeat all steps starting at step 3.
12. Replace inhaler cap.

Smoking Cessation: Procedure and Pharmacotherapy

Stopping smoking is a clinical and behavioral intervention that requires structured support, counseling, and pharmacotherapy.

This is an outline of the procedure and essential commodities used to help a person quit smoking.

Smoking Cessation Procedure (Step-by-Step)–5As

Action	Description
Ask	Systematically ask all patients about tobacco use at every visit.
Advise	Strongly advise all tobacco users to quit in a clear, personalized, and supportive manner.
Assess	Assess willingness to make a quit attempt (within 30 days).
Assist	Help the patient develop a quit plan, provide counseling, and prescribe cessation medications. • Set a quit date (within 1–2 weeks). • Remove tobacco products from home, car, workplace. • Identify triggers (e.g., stress, alcohol, social situations). • Teach coping strategies: deep breathing, distraction, oral substitutes (e.g., gum, water). • Encourage social support from friends/family or support groups.
Arrange	Schedule follow-up contacts to monitor progress and provide ongoing support.

Pharmacotherapy

Category	Commodity	Details
Nicotine Replacement Therapy (NRT)	Nicotine gum (2mg, 4mg)	Chewed intermittently; higher dose for heavy smokers
	Nicotine patch (7mg, 14mg, 21mg)	Worn daily, provides steady nicotine
	Nicotine lozenges	Dissolves in mouth slowly, helps with cravings
	Nicotine nasal spray	Rapid relief; prescription only in some countries
	Nicotine inhaler	Simulates hand-to-mouth behavior
Non-Nicotine Medications	Bupropion SR (Zyban)	150 mg once or twice daily; start 1 week before quit date
	Varenicline (Champix)	Reduces cravings and withdrawal; start 1–2 weeks before quit date

Follow-up and Monitoring

Timeframe	Actions
1 week after quit date	Reassess symptoms, withdrawal, reinforce motivation
1 month	Monitor progress, re-prescribe or adjust medications
3 months	Long-term planning, relapse prevention
6–12 months	Celebrate milestones, provide booster counseling if needed

Signs of Nicotine Withdrawal to Manage

- Irritability, restlessness
- Anxiety, depression
- Increased appetite
- Sleep disturbances
- Difficulty concentrating
- Cravings

Pulmonary Rehabilitation (PR)

Pulmonary rehabilitation is a comprehensive program designed to improve the physical and emotional well-being of patients with chronic respiratory conditions through exercise training, education, and behavioral modification. This is an intervention to reduce the work of breathing. It is meant to improve the patient's breathing functionality and the quality of life.

Target Population

Condition	Eligibility Criteria
Chronic Obstructive Pulmonary Disease (COPD)	- Persistent symptoms (e.g., dyspnea)
Post-TB Lung Disease (PTLD)	- History of exacerbations
	- Reduced exercise tolerance
	- Residual respiratory symptoms
	- Evidence of lung damage (e.g., fibrosis, bronchiectasis)
	- Reduced functional status
Asthma (chronic severe or uncontrolled)	- Poor symptom control
	- Reduced physical activity or frequent exacerbations
Bronchiectasis / ILD	- Persistent cough, sputum, breathlessness
	- Functional limitation
Pre/post-lung surgery or long COVID	- Functional impairment due to reduced lung function

Contraindications (relative):

- Acute exacerbation or unstable cardiac disease
- Severe cognitive or psychiatric illness
- Musculoskeletal limitations (evaluate individually)

Refer to physiotherapy department for pulmonary rehabilitation.

Mental Health Assessment: Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 is a validated, 9-item questionnaire used to: **Screen** for depression, **Measure symptom severity**, **Monitor response to treatment**. It is used in **primary care, mental health**, and **community settings**.

Instructions for Administration:

Setting Up

- Ensure a private, quiet space
- Introduce the tool with simple language:

‘This questionnaire helps us understand how you’ve been feeling over the past two weeks. It asks about common symptoms of depression. Please answer honestly—there are no right or wrong answers.’

Patient Instructions:

Over the last 2 weeks, how often have you been bothered by the following problems?

Question	Not at all	Several days	More than half the days	Nearly every day	Score
1. Little interest or pleasure in doing things	0	1	2	3	
2. Feeling down, depressed, or hopeless	0	1	2	3	
3. Trouble falling or staying asleep, or sleeping too much.	0	1	2	3	
4. Feeling tired or having little energy	0	1	2	3	
5. Poor appetite or overeating	0	1	2	3	
6. Feeling bad about yourself or that you are a failure or have let yourself or your family down.	0	1	2	3	
7. Trouble concentrating on things, such as reading the newspaper or watching television.	0	1	2	3	
8. Moving or speaking so slowly that other people could have noticed. Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3	
9. Thoughts that you would be better off dead, or of hurting yourself in some way.	0	1	2	3	---
Score totals					

Total Score: ____/27



Scoring Interpretation and Clinical Action

Score Range	Severity	Recommended Action
0-4	Minimal/None	Monitor; may not require treatment
5-9	Mild	Watchful waiting; consider counseling
10-14	Moderate	Active treatment recommended
15-19	Moderately Severe	Active treatment with therapy ± medication
20-27	Severe	Immediate treatment; consider intensive care

Critical Safety Alert

Question 9: Suicide Risk Assessment

‘Thoughts that you would be better off dead, or of hurting yourself.’

ANY score >0 on Question 9 requires IMMEDIATE action:

Q9 Score	Response	Required Action
1	Several days	Immediate risk assessment
2	More than half the days	Urgent clinical evaluation
3	Nearly every day	Emergency intervention protocols

Do not delay action on any non-zero score for Question 9. Proceed with immediate evaluation, regardless of total score.

Remember: Question 9 always takes priority regardless of total score

Step-by-Step Scoring & Response

Step 1: Confirm All Items Answered

- Ask the patient to complete any skipped questions

Step 2: Add Scores

- Sum responses from Questions 1–9. Record total out of 27

Step 3: Determine Severity

- Use the scoring table to categorize depression severity
- Consider clinical history and context

Step 4: Safety Check

- Always check Q9 first. If Q9 > 0: Pause and conduct suicide risk assessment

Step 5: Plan Clinical Response

- Match response to severity
- Document findings and planned actions
- Schedule appropriate follow-up

When to Reassess	Purpose
Baseline	Establish starting PHQ-9 score
2 weeks	First follow-up assessment
Monthly (during treatment)	Monitor improvement or resistance
Quarterly (maintenance)	Ensure continued remission/Maintenance phase

Clinically Significant Change

Improvement: Decrease of ≥5 points
Remission: Score <5 (ideally <2)
Treatment resistance: <25% reduction after 6-8 weeks

Documentation Summary

PHQ-9 Date: _____ Total Score: _____/27
Severity Level: _____ Question 9 score: _____
Safety Assessment: ☐ Completed ☐ N/A
Clinical Action: _____
Follow-up: _____

Common Scoring Errors to Avoid

- ✗ Don't ignore Question 9 even if total score is low
- ✗ Don't average scores - always sum for total
- ✗ Don't skip items - ensure all 9 questions completed
- ✗ Don't delay action on positive suicide screening
- ✗ Don't use outdated cutoff scores from older literature

ASTHMA CONTROL TEST (ACT) SCORE

The Asthma Control Test (ACT) is a validated, patient-reported outcome tool used to assess asthma control over the past 4 weeks.

Test Details

- **5 questions** each scored on a 5-point scale
- **Total score range:** 5-25 points
- **Higher scores = Better asthma control**

Key Clinical Points

- **Cutoff Score:** <20 indicates need for treatment optimization
- **Minimal Important Difference:** 3-point change is clinically significant
- **Frequency:** Can be administered at each visit to track progress
- **Correlation:** Scores correlate with physician assessment and lung function

When to Use ACT

- Initial asthma assessment
- Routine follow-up visits
- Treatment adjustment decisions
- Patient self-monitoring
- Clinical trial endpoints

ACT Questions and Scoring

Question	Response Options and Corresponding Points
1. In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?	All of the time = 1 Most of the time = 2 Some of the time = 3 A little of the time = 4 None of the time = 5
2. During the past 4 weeks, how often have you had shortness of breath?	More than once a day = 1 Once a day = 2 3 to 6 times a week = 3 Once or twice a week = 4 Not at all = 5

Question	Response Options and Corresponding Points
3. During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?	4 or more nights a week = 1 2 or 3 nights a week = 2 Once a week = 3 Once or twice = 4 Not at all = 5
4. During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?	3 or more times per day = 1 1 or 2 times per day = 2 2 or 3 times per week = 3 Once a week or less = 4 Not at all = 5
5. How would you rate your asthma control during the past 4 weeks?	Not controlled at all = 1 Poorly controlled = 2 Somewhat controlled = 3 Well controlled = 4 Completely controlled = 5

Clinical Actions by Score Range

Score Range	Control Level	Recommended Action
25	Complete control	Maintain current therapy
20-24	Well controlled	Continue current plan, monitor
16-19	Not well controlled	Review and adjust treatment
5-15	Very poorly controlled	Urgent intervention needed

Limitations

- Self-reported symptoms only
- Does not replace clinical judgment
- May not capture all aspects of asthma control
- Consider alongside spirometry and clinical assessment



NATIONAL TUBERCULOSIS, LEPROSY AND LUNG DISEASE PROGRAM

Supported by **GSK** and **Gates Foundation** through **Clinton Health Access Initiative**



National Tuberculosis, Leprosy and Lung Disease Program

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