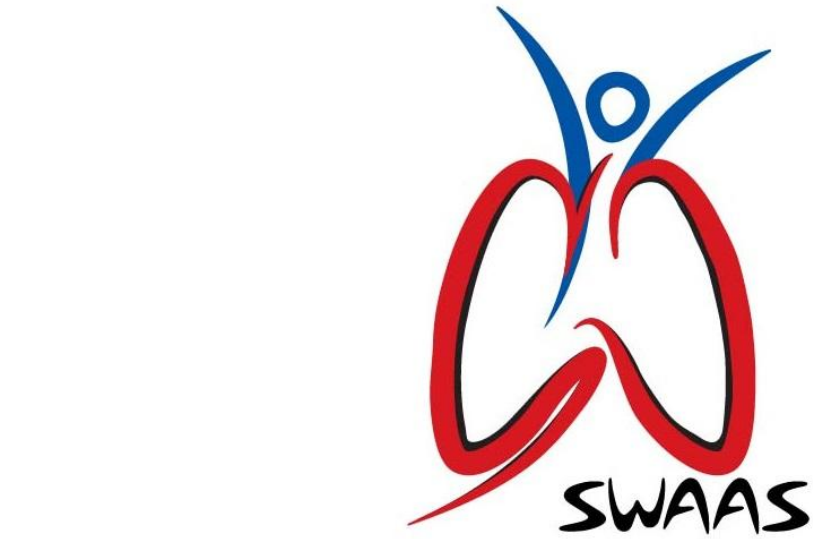

Kerala State COPD Control Program

Module for Staff Nurses

SWAAS

Kerala State Program for Prevention and Management of Obstructive Airway Diseases

Module for Staff Nurses

Developed by

State NCD Division, Directorate of Health Services, Government of Kerala

National Health Mission

State Health Systems Resource Center- Kerala

Academy of Pulmonary and Critical Care Medicine

The Preface

The Kerala state has launched a Public health programme for Prevention and management of COPD for the first time in India. This programme envisages its targets in par with the SDG, covering all the levels of health care.

As COPD is incurable, the SWAAS strategies are mainly focusing on the preventive aspects for which the strengthening of the primary care is given at most importance. Through this programme, the government is starting COPD clinics in all Primary Health centres in a phased manner.

This module prepared by the SWAAS Technical team with support of Association of Pulmonary and Critical care Medicine will guide the primary care physicians in understanding the disease and also operationalizing the programme in the way it is needed. I take this opportunity to acknowledge the SWAAS technical Team headed by Prof K. Anitha Kumari and Dr Sanjeev Nair for their tremendous effort in framing the SWAAS Programme and bringing out this module and also the SHSRC team headed by Dr. Shinu K.S for coordinating the activities with State NCD Division. I recommend this module cum TOG to all the primary care specialists who are taking care of Kerala's public health.

Dr R.L. SARITA
Director of Health Services

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Abbreviations

AFB- Acid Fast Bacillus

COPD- Chronic Obstructive Pulmonary Disease

CRD- Chronic Respiratory Diseases

CXR- Chest X ray

FEV1- Forced Expiratory Volume 1

FEV6- Forced Expiratory Volume in 6 seconds

FVC- Forced Vital Capacity

GBD- Global Burden of Diseases

GINA- Global Initiative for Asthma

GOLD- Global Initiative for Chronic Obstructive Lung Disease

ICU- Intensive Care Unit

INSEARCH- Indian Study on Epidemiology of Asthma, Respiratory Symptoms and Chronic Bronchitis.

mMRC – Modified Medical Research Council Scale

MO- Medical Officer

NCD- Non Communicable Disease

NIV- Non Invasive Ventilation

NPCDCS- National Programme For Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke

OAD- Obstructive Airway Disease

PAL- practical Approach to Lung Health

PEFR- Peak Expiratory Flow Rate

PHC- Primary Health Centre

SDG- Sustainable Development Goals

UN- United Nation

WHO- World Health Organization

Table of Contents

Introduction 6
Definitions and overview 7
Definitions 7
Epidemiology and risk factors 7
SWAAS - the Kerala COPD prevention and control program 10
When to suspect Obstructive Airway Diseases 134
Diagnosis of COPD and Asthma 14
Differentiating COPD and Asthma 166
How to perform Spirometry 167
Differential diagnosis 20
Management of COPD and Asthma 21
Pharmacological management 21
Pharmacological management of COPD 21
Pharmacological management of Asthma 23
Management of exacerbations of COPD and Asthma 23
Non pharmacological management of COPD and Asthma 24
Non pharmacological management of COPD 25
Non pharmacological management of Asthma 33
Managing comorbidities in COPD and Asthma 35
Managing co-morbidities in COPD 44
Managing co-morbidities in Asthma 39
Referral Criteria 41
Recording, reporting and logistics management 42
Communicating with patients and patient education 48
Annexure 1 Equipment and drugs required for the Kerala COPD prevention and control program 46
Annexure 2 Instructions on use of inhaler devices 49
Annexure 3 Commonly used Inhaler medications and doses 52
Annexure 4 Protocol for Pulmonary Rehabilitation 53
Annexure 5 RNTCP Algorithm for diagnosis of Pulmonary Tuberculosis 56

References……57

Introduction

Kerala state is moving towards achieving the Sustainable Development Goals (SDG), adopted by the United Nations General Assembly on 25th September 2015. Goal 3 of the SDG addresses *"Ensuring healthy lives and promoting well-being for all at all ages"*. The sub-goal 3.4 of the SDG has the target "By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing". [(1)]

Non communicable diseases (NCD) are chronic conditions of non-contagious origin having prolonged course and leading to functional impairment, disability or death. NCD constitute a set of diseases (cardiovascular diseases, cancers, chronic respiratory diseases, diabetes) responsible for substantial proportion of premature deaths, particularly in developing countries like India. The World Health Organization (WHO) attributed NCD as the cause of 60% of all deaths in India in 2010. In Kerala, the major NCD such as cardiovascular diseases, cancers, diabetes and chronic lung diseases are increasing. Chronic Respiratory Diseases were poorly addressed among the NCD in India, despite the fact that COPD is one of the leading causes of mortality in India Recently the National NCD program took a decision to include COPD as one of the prime NCDs to be addressed as part of the NCD control program.

Kerala has been the first state in India to address Chronic Respiratory Diseases (CRD) as a public health program, when it pilot tested the PAL strategy. Building on the experience of the state in addressing CRD in the past, and considering the inherent strengths of the public health system in the state, Kerala state is now moving towards developing and implementing a Public Health program for CRDs, **which would primarily address COPD and Asthma.** It is expected that this program would result in significant reduction in mortality and morbidity from COPD and Asthma, and take the state forward in achieving the SDG targets.

Definitions and overview

Definitions

Chronic Obstructive Pulmonary Disease (COPD) -Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. [(2)]

Asthma – Asthma is a heterogeneous disease, usually characterized by chronic inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation. [(3)]

Epidemiology and risk factors

Epidemiology in India and Kerala

- Globally 12 out of 100 persons are COPD patients
- An estimated three million deaths annually due to COPD
- By 2030 there will be 4.5 million COPD related deaths annually.
- India the estimated the burden of COPD is 3.5% above the age of 35 yrs. as per INSEARCH study.
- The prevalence of Asthma in India was estimated to be 2.05% in the INSEARCH study.
- Trivandrum had a high prevalence of COPD i.e., 10%, which is much higher than the National average.
- The prevalence of self-reported asthma was 2.82% and that of chronic bronchitis was 6.19% in Kollam District.[(4)]

Risk factors

Modifiable risk factors	Non modifiable risk factors
➢ Smoking ➢ environmental tobacco smoke exposure ➢ Biomass fuel smoke exposure ➢ Occupational exposures	➢ Age ➢ Genetic factors ➢ Previous history of diseases like Asthma and TB

COPD risk will be more among

- smokers and ex-smokers
- More than 40-year age group
- Men than women

"Global Burden of Diseases" [5] (2016) estimated that COPD stands second in cause of mortality in India.

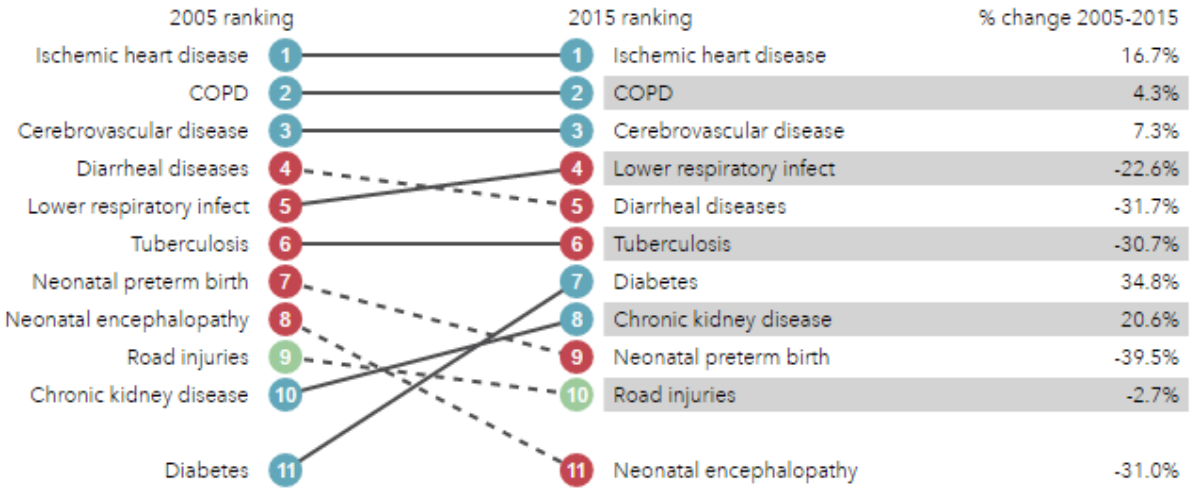


Figure. 1. **Global Burden of Disease (GBD) ranking for causes of mortality in India**

Assuming that the National estimates for Asthma and COPD reflect the situation in Kerala too, the number of COPD cases in Kerala is estimated to be 5, 30,000, and the number of Asthma patients among adults is estimated to be 480,000. Since the disease burden is huge it needs to be addressed with appropriate strategies.

The major issues in Kerala with respect to COPD include increasing prevalence due to an aging population and increasing cost of care leading to inadequate treatment and poor symptom control. Cases of COPD are often diagnosed at late stages of the diseases whereas if they had been diagnosed in the early stages, secondary prevention could have been more successful (e.g. Smoking cessation). The risk factors for COPD that need to be addressed include Age, smoking cessation, and indoor and outdoor air pollution.

It was earlier believed that COPD was a disease of male smokers. However the INSEARCH study showed that COPD was common even among females in India. There is 2.7% prevalence among women in India

as compared to 3.5% overall prevalence (4.2% in males). The major risk factor for females who are non smokers is indoor air pollution. In contrast, in western countries, COPD is mainly a disease of smokers. Most of the international treatment guidelines are formulated based on evidence from COPD patients who are smokers. The natural history, progression and response to treatment in patients who are non-smokers have not well been studied.

Current strategies for COPD in India and Kerala

There is no specific public health program for COPD in India or Kerala. COPD is covered under the National NCD program, however this program called the "National Program for Prevention and Control of Cancer, Diabetes, CVD and Stroke (NPCDCS)" only briefly addresses COPD without clear guidelines on how facilities for diagnosis and treatment can be organized. Recently COPD along with Chronic Kidney Disease (CKD) was included among the list of major NCDs in the NPCDCS, but detailed guidelines are yet to be formulated.

One of the components of Stop TB Strategy, "Health System Strengthening" included the "Practical Approach to Lung Health"-which was meant to tackle obstructive airway diseases and pneumonias. This strategy was pilot tested for India in Kerala. The guidelines were developed and the pilot testing was done in Kollam district. A preliminary analysis showed that this pilot study resulted in reduced usage of antibiotics and steroid injections in the PHCs where this was implemented. However a detailed evaluation is needed to evaluate if cases of COPD and Asthma were diagnosed correctly, whether they were treated appropriately and whether all COPD and Asthma patients in these areas had access to care. Also the guidelines developed for the PAL strategy addresses COPD only at primary care level and only mention at certain points in diagnostic and treatment algorithms that patients should be referred to the next level hospital, however what needs to be done at the next level is not specified in the guideline.

Mortality reduction in COPD can occur only by properly formulating strategies for management of COPD and incorporating smoking cessation, oxygen therapy and non-invasive ventilation for COPD care. With this objective, Kerala state is for the first time in India, developing a public health program for COPD, also addressing Asthma, as both these diseases are diagnosed and treated in a similar manner and have considerable overlap.

SWAAS - the Kerala COPD prevention and control program

What does SWAAS aim for?

The aims of the Kerala COPD prevention and control program would be

- Identification of COPD in the early stages of the diseases
- Develop a structured program for COPD diagnosis and treatment, starting from the primary care level leading up to the tertiary care level, including the Medical Colleges
- Develop a system for generating information on disease burden of COPD, health seeking behaviour and health system needs which will aid in further planning and strategizing for COPD management in Kerala.
- Use the option of Pulmonary rehabilitation well, using available resources and by developing indigenously acceptable pulmonary rehabilitation techniques

Structure of the proposed Kerala COPD Prevention and Control Program

- The Kerala COPD prevention and control program would be implemented in a phased manner. The first phase include selection of PHCs which can be linked to Taluk hospital which can provide the specialist care which is the first referral unit for COPD. The program would be expanded to all the PHCs of Kerala.
- The first Phase of the Kerala COPD prevention and control program would be organized in two mutually supportive systems. The primary system would start at the level of COPD Clinics at selected PHCs. The selected PHCs in the first phase to be designated as COPD Clinics would be selected among-170 family health centers, only including those which come in a taluk where the taluk headquarters hospital has a pulmonologist in place, so that for these selected PHCs (COPD Clinics), there is a center available for referral for patients who require referral and higher level care.
- **At COPD Clinic (PHC Level),** the officer in charge will be MO of the PHC. This MO will be trained in diagnosis and management of COPD and Asthma. Basic equipments as in Annexure 1 would be made available. For cases of diagnostic delay or patients whose treatment requires care at a higher level as per treatment algorithm, patient would be referred to the next level, which would be the taluk level. The PHC field staff will also be trained to screen for symptoms of COPD to facilitate early diagnosis, as secondary prevention can bring down mortality. **Nurse(s) in the PHC**

would be trained as Asthma-COPD nurses, as one or two doctors can't do the entire COPD care at the PHC level. This person might perform nebulisation, inhaler training, counselling, smoking cessation clinics and mini-spirometry.

- **At taluk level**, the junior consultant / consultant (respiratory medicine), under Kerala Health Service Specialty cadre, would be designated as the MO-COPD. This would be the first level where specialist care will be provided. Patients who can't be managed at PHC level in terms of diagnostic uncertainty and inadequate response to treatment would be managed at this level. At this level, a dedicated set of nurses will be trained as Asthma-COPD nurses, as one specialist might not be able to manage the COPD patients round the clock. A dedicated person would be required for performing nebulisation, inhaler training, counselling and mini-spirometer.
- **At district level: -**Here there would be two places of care. The district hospital would have a junior consultant / consultant (respiratory medicine) would act as District level COPD consultant. This person would provide a higher-level facility for diagnosis and treatment, including a spirometer and ICU care with a ventilator in place. The other major person would be the junior consultant / consultant (Respiratory Medicine) at the District TB Center who would act as a District COPD Officer (DCO) and provide clinical care as well as take a public health role. He would also take up the responsibility of training, supervision and reporting. He would share resources with the District TB Officer (DTO) like vehicles for transportation, computer, data-entry operator and office space and staff. He would assist the DTO in supervision for TB too during his / her field visits and the DTO would be expected to support him / her by supervising for COPD during the DTO's field visits.
- The structure of this system would be as in figure 2.

- The second system of COPD care would be Model COPD Clinics. These would include four PHCs which will be linked to one government medical college each (the medical colleges with MD courses would be linked, i.e. Government Medical Colleges at Thiruvananthapuram, Kottayam, Thrissur and Kozhikode). These Model COPD clinics will provide COPD care as per the same guidelines but would have the next level of referral directly to Medical Colleges. The Medical Colleges, as per human resource availability, might provide OP services at these Model COPD Clinics on weekly or fortnightly basis. In addition to this, the colleges (Pulmonary Medicine and Community Medicine Departments) would provide technical support for community level COPD screening at Model COPD Clinic's area so as to generate data on COPD prevalence. The additional information generated would be on social

and environmental determinants; health seeking behavior and level of control and adherence to treatment of COPD. This would help in generating information for further health planning with respect to COPD. The three UHCs under the SHSRC will also act as model COPD clinics and will be linked to Medical College, Trivandrum.

- As part of SDG strategy to reduce mortality due to COPD, infrastructure in Medical Colleges for managing COPD will need to be strengthened. The main requirements would be provision of central oxygen to wards where COPD patients would be managed. Full-fledged Respiratory ICUs, which are already present in Medical Colleges (as it is part of MCI requirements) would be further strengthened by addition of more Non-invasive ventilations machines and beds, which would improve COPD care without the need for ventilating all patients. Full fledged pulmonary rehabilitation units would be set up for COPD care in Medical colleges, which would serve as model units for the peripheral level hospitals.
- In addition to these two systems, as per the SDG targets for NCD, the risk factor reduction strategies as part of the NCD strategies would benefit COPD control. Also treatment guidelines developed by the state level team would be available for all PHCs, including those not included in Phase I. In view of resource limitations (financial, infrastructure and human-resources), it might not be feasible to implement the Kerala COPD prevention and control program in all districts at the beginning, but in a phased manner all PHCs would be involved by 2018 end. At the end of one year (July 2018), the impact of the program would be evaluated for midway corrections and developing the best model for COPD care for Kerala.

Level	**Institution**	**Person responsible**	**Support**
Primary care	PHC (COPD Clinics)	MO – PHC	NCD Nurse / COPD Nurse
Taluk level	Taluk Hospital (Taluk COPD clinic)	MO-COPD (Respiratory Specialist)	MOTC Physician THQH NCD Nurse / COPD Nurse

District Level	District Hospital (District COPD Clinic) District TB Center (District COPD Center)	District COPD Officer (Respiratory Specialist)	DMO(H) DTO NCD Nurse / COPD Nurse
Sub-state level	Medical Colleges (Government and Private)	Professor (Pulmonary Medicine)	
State Level	State COPD Center (@Chest Disease hospital, Pulayanarkotta)	State COPD Officer	Director of Health Services Additional DHS (Medical) **State COPD Technical team** (Professor and HOD, Pulmonary Medicine, Medical College, Trivandrum; Nodal Officer NCD, DHS; other members nominated by the Health Secretary)

Figure 2. **Basic structure of the Kerala COPD prevention and control program**

When to suspect Obstructive Airway Diseases

COPD should always be suspected in any patient who has dyspnoea, chronic cough or sputum production. An added requirement to consider COPD is a history of exposure to risk factors for the disease and particular care should be taken to take a detailed history on exposure to cigarette smoke, domestic biomass fuel smoke and occupational dust / smoke exposure. Spirometry is needed to diagnose COPD. In spirometry, the presence of a post-bronchodilator FEV1/FVC of less than 70% is considered as persistent airflow limitation and is needed to make the diagnosis of COPD.

Asthma is suspected when the patient has one of the following symptoms present which include wheeze, shortness of breath, cough and chest tightness. These symptoms are generally worse at night or in the early morning and the symptoms vary over time and in intensity. A typical history is the increase in symptoms when exposed to “triggers” which include viral infections, exercise, allergen

exposure (like pollen / dust / strong smells), changes in weather, laughter and irritants like smoke or fumes.

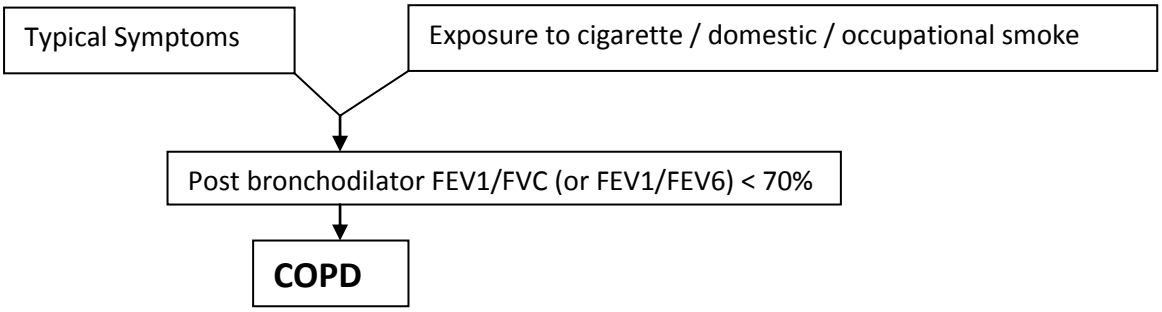
Diagnosis of COPD and Asthma

Diagnosis of COPD

At the PHC level, patients will be evaluated for COPD if the following symptoms are present

- Shortness of breath, predominantly exertional breathlessness.
- Chronic cough
- Sputum production

Patients will be diagnosed as COPD if the following are present



All such patients will also undergo sputum examination for AFB if not done so in the last three months as per the current RNTCP diagnostic algorithm. (Annexure 5)

The main disease to be differentiated from would be Asthma. This would be done as per a tool using clinical history and spirometry / mini-spirometry.

Patients coming with acute exacerbation of breathlessness would be provided appropriate care as per guidelines including nebulized drugs / increased dose of drugs through spacer, antibiotics / oral corticosteroids / oxygen whenever indicated. Patients who do not respond adequately to the treatment offered at the PHC and in whom complications like pneumothorax and cor pulmonale are suspected would be referred to the next level of care, where in addition to specialist care and medications, they would also be offered non-invasive ventilation whenever indicated. Patients needing further specialist care would be referred to the tertiary care hospitals where in addition to the therapy already offered might be offered ventilatory care, if indicated. In such patients, who are too sick for assessment, the diagnosis of COPD / Asthma would be made only after the control of the exacerbation and when the

patient is stable. If they are detected to have any of non-communicable diseases including hypertension, coronary artery disease, depression, osteoporosis, etc. they would be linked to the NCD program.

Field level screening would be done by field workers to identify patients with symptoms of COPD, and such patients would be offered smoking cessation advice by the field worker, who would be also offered consultation at the PHC for further evaluation to confirm the clinical diagnosis. Field workers would also follow up such persons on subsequent visits to strengthen the smoking cessation advice.

Diagnosis of Asthma

At the PHC level, patients will be evaluated for Asthma if the symptoms like **wheeze, shortness of breath, cough, and chest tightness** are present.

In asthma, these symptoms are episodic and generally more severe in the early morning or night. Also, a history of specific precipitating factor might be obtained like increased symptoms when exposed to allergens, cold, smoke / irritants / strong smells, emotional factors and exercise. Often a history of co-existing atopy / allergic rhinitis in the past (or currently) can also be elicited and sometimes a family history of asthma / allergic rhinitis / atopy.

Spirometry is indicated in patients who are suspected to have Asthma. Patients may have a reduced FEV1/FVC (or FEV1/FEV6), particularly when symptomatic. The other findings that might aid in the diagnosis on spirometry include

- Post bronchodilator reversibility (increase in FEV1 >12% AND >200ml)
- Excessive diurnal variability when twice-daily Peak Expiratory flow rate (PEFR) measurements are made with a peak flow meter for one to two weeks
- Significant increase in FEV1 or PEFR after 4 weeks of controller treatment[6]

However, spirometry might be normal in Asthma patients when they are well controlled, hence in many cases diagnosis might be made by MO on the basis of clinical features and a significant response to the treatment offered.

Differentiating COPD and Asthma

COPD and Asthma are similar diseases; however, the risk factors are different, the treatment is different and the prognosis of the patient is different. Hence it is essential to differentiate between these two common diseases. The following table (Table. 1) can be used to differentiate between Asthma and COPD. Presence of three or more of the clinical features in either half of the table is associated with a diagnosis of either Asthma or COPD. However, in about 15% of patients, three or more clinical features on both halves of the table might be present. In such patients a diagnosis of Asthma and COPD overlap syndrome is made (ACOS). Spirometry is useful in differentiating between the two conditions. Presence of a post-bronchodilator FEV1/ FVC (or FEV1/FEV6) of less than 70% suggests a diagnosis of COPD whereas a post bronchodilator reversibility suggests a diagnosis of asthma.

Table 1. Differentiating COPD and Asthma

Asthma	COPD
Age of onset before 20 yrs.	Age of onset after 40 yrs.
Symptoms vary over time	Symptoms are persistent
Worse during night or early morning	Mainly exertional dyspnea
Triggering factors like exposure to dust, allergens, emotions, laughter, drugs and exercise	Associated with chronic cough and sputum, no triggers
Past history of Asthma, allergic rhinitis or atopy	No associations
Family history of Asthma, allergic rhinitis or atopy	Exposure to cigarette smoke / occupational exposure / Household biomass fuel smoke
Good response to treatment	Limited relief to treatment
Normal chest X ray	Hyperinflation or normal

How to perform Spirometry

Spirometry is an essential tool in the evaluation of COPD and Asthma. However, this test is effort dependent and needs proper instructions to the patients. The results can be interpreted if the patient takes effort properly. The method of performing spirometry is as follows

Things to be done before performing spirometry:

- the calibration of the equipment
- Recording of patient's age name, age, sex, race, their height and weight without shoes.

If the patient is unable to stand to have their height measured, arm span can be used as an estimate.

The activities which are to be avoided before performing spirometry are

- eating a large meal within 2 hours
- vigorous exercise within 30 minutes,
- smoking within 1 hour and
- drinking alcohol within 4 hours
- for reversibility testing, patient should not take short acting bronchodilators within 6 hours, long acting bronchodilators within 24 hours

Contraindications for spirometry

If any of the following have occurred recently, then it may be better to wait until the patient has fully recovered before carrying out spirometry.

- Haemoptysis of unknown origin
- Pneumothorax
- Unstable cardiovascular status, recent myocardial infarction or pulmonary embolism
- Thoracic, abdominal or cerebral aneurysms
- Recent eye surgery
- Acute disorders affecting test performance, such as nausea or vomiting
- Recent thoracic or abdominal surgical procedures

The method of performing spirometry is as follows

Patient positioning: Make the patient sit in upright position with feet flat on the ground and also to loosen the tight-fitting clothes if any. Then the patient is asked to completely empty their lungs and then to take in a quick full inspiration, followed by a full expiration into the hand held device through a disposable mouth piece. Enough encouragement should be given so that good results will be obtained

Reversibility testing

All PFTs should be ideally followed by reversibility testing. Reversibility is a criterion to diagnose asthma and overlap syndromes and COPD severity is graded according to the post-bronchodilator. Spirometry is performed, after which a bronchodilator is given that can either be a short-acting β-agonist or other agents, such as anticholinergics. For the former, 4×100 µg salbutamol are recommended *via* a spacer device and 15 min is given before retesting, and for the latter, 4×40 µg ipratropium bromide is recommended, leaving 30 min before retesting. There should be at least a 12% change and a 200-mL in FEV1 improvement from baseline and for the PFT to be reversible.

Minispirometer or COPD-6

A simple, fast and accurate battery-operated handheld device which gives FEV1, FEV6, ratio and % predicted, obstructive index, COPD classification and lung age. The technique and the interpretation of the results are similar to usual spirometer. At a primary care level, the mini-spirometer can be used as a simple and effective diagnostic tool.

Differential diagnosis

The presence of the following symptoms in a patient suspected to have COPD should lead to a search for other diagnosis:

- History of haemoptysis (consider Malignancy / TB)
- Presence of clubbing (consider Malignancy /ILD)
- Presence of crepitations on auscultation (Consider Heart disease / Bronchiectasis/ILD)
- Chest pain (Consider cardiac diseases / pneumonia / pneumothorax / pleural effusion / TB)
- Oedema (Consider cardiac diseases)

The presence of the following symptoms in a patient suspected to have Asthma should lead to a search for other diagnosis:

- Isolated cough with no other respiratory symptoms
- Chronic production of sputum (consider Chronic bronchitis / bronchiectasis / TB)
- Shortness of breath associated with dizziness, light-headedness or peripheral tingling (Consider hyperventilation associated with psychiatric disorders)
- Chest pain (Consider cardiac diseases / pneumonia / pneumothorax / pleural effusion / TB)
- Exercise-induced dyspnoea with noisy inspiration (stridor)

Differential Diagnosis

COPD	**Asthma**
• Asthma • Tuberculosis • Lung cancer • Congestive cardiac failure • Bronchiectasis • Obstructive bronchiolitis • Interstitial Lung Disease	• COPD • Tuberculosis • Congestive cardiac failure • Bronchiectasis • Vocal cord dysfunction • Psychosomatic illness • Acute bronchitis • Foreign body aspiration • Upper airway / Endobronchial obstruction

Management of COPD and Asthma

Patients generally present to the PHC with acute exacerbation of breathlessness and they would be provided appropriate care as per guidelines including nebulized drugs / increased dose of drugs through spacer, antibiotics / oral corticosteroids / oxygen whenever indicated. The management of exacerbations of COPD and Asthma is described in a later section.

Once the exacerbation is controlled as the patient is stable, the diagnosis of COPD or Asthma would be established as per the diagnostic tests described in the previous chapter. Once the diagnosis is established, the pharmacologic treatment would be initiated after assessing the severity of disease in COPD or level of control in Asthma.

Pharmacologic management of COPD

The major steps required for severity assessment in COPD are assessment of symptoms based on modified Medical Research Council scale for the assessment of dyspnea (mMRC scale) and pulmonary function based on GOLD COPD staging. mMRC is assessed as per Table 2 and GOLD state is assesses as per Table 3. (GOLD COPD State is applicable only in patients who have a post bronchodilator FEV1 / FVC (or FEV1 / FEV6) less than 70%.

Table 2: mMRC dyspnea scale

Grade	Description of Breathlessness
Grade 0	Breathlessness only with strenuous exercise
Grade 1	Shortness of breath when hurrying on level ground or walking up a slight hill
Grade 2	Breathlessness when walking with people of the same age or having to stop for breath when walking at own pace on level ground
Grade 3	Stopping for breath after walking about 100 yards or after a few minutes on level ground
Grade 4	Too breathless to leave the house or breathlessness when dressing

Table 3. Classification of airflow limitation severity - GOLD COPD stage

GOLD Stage	Severity of airflow limitation	Post bronchodilator FEV1 (percentage of predicted)
GOLD 1	Mild	More than or equal to 80% of predicted
GOLD 2	Moderate	Between 50% and 80% of predicted
GOLD 3	Severe	Between 30% and 50% of predicted
GOLD 4	Very severe	Less than 30% of predicted

After assessment, pharmacotherapy will be as follows

mMRC grade	GOLD COPD stage	Treatment
0 – 1	1 or 2	As required bronchodilators (either inhaled salbutamol or oral salbutamol / theophylline)
0 – 1	3 or 4	Inhaled tiotropium

≥ 2	1 or 2	Inhaled tiotropium
≥ 2	3 or 4	Inhaled tiotropium and inhaled budesonide-formoterol

Inhaled drugs will be provided using pressurized metered dose inhaler (pMDI) with a spacer device.

Dosage of drugs is given in annexure 3.

Pharmacological management of Asthma

Management of Asthma is done on a step wise manner, either stepping up or stepping down based on level of control. Level of control is assessed by the following features

- Presence of day time symptoms more than twice a week
- Waking up at night due to asthma symptoms
- Using reliever medications more than two times a week
- Any activity limitation due to Asthma
- Poor lung function – FEV1 / FVC (or FEV1/FEV6) less than 70% or FEV1less than 60% of predicted

Presence of none of the above indicates good control. Presence of any one or two of the above indicates partial control. Presence of three or more of the above features indicated uncontrolled asthma.

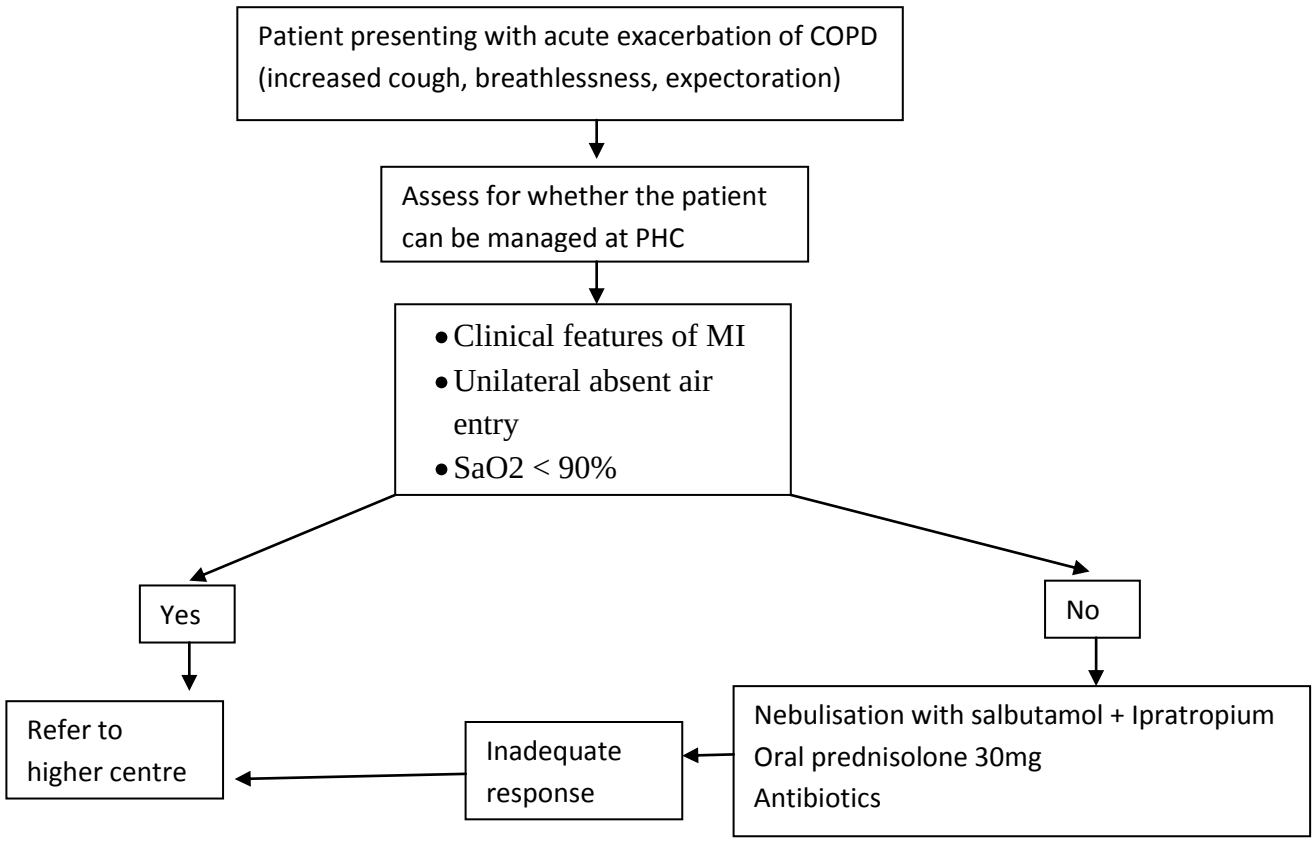
All patients with symptom frequency, after control of exacerbation, of at least once a month would be started on pharmacotherapy with inhaled budesonide-formoterol.

Initial dose will be two puffs twice a day. Patient will be reassessed after one month; if the Asthma is well controlled inhaler will be stepped down to one puff twice daily. If the patient is only having partial control / uncontrolled, then the dose of two puffs twice daily will be continued. Further stepping down will be attempted at the end of three months.

Management of exacerbations of COPD and Asthma

Exacerbations of COPD and Asthma are associated with significant mortality and need to be managed promptly and adequately for reduction of mortality. Exacerbation is defined as an increase in symptoms of the disease which require a change in medications.

Algorithm for managing exacerbations of COPD



Treatment of Asthma exacerbations

Exacerbation of Asthma would be managed with **Oral Prednisolone, nebulized salbutamol and Oxygen.** Patients with inadequate response with this would be nebulized with salbutamol + Ipratropium and Oxygen at ½ hour intervals for two more cycles. If patients are not responding adequately, they would be referred to higher center. At any point, if patient has low saturation (<90%), silent chest and altered sensorium, patient would be immediately referred to higher center.

Nursing management of Asthma and COPD

- Obtain history about previous attacks.
- Place the patient ‘s with asthma in high Fowlers position
- Evaluate wheezes for location, duration and phase of respiration when they occur.
- Monitor pulse oximetry
- Identifies medications the patient is currently taking
- Administer medications as prescribed and monitors the response of patient to those medication.

- Administer fluids if the patient is dehydrated
- Assess frequently the vital sign as clients condition dictates.
- Provide reassurance to relieve anxiety.

Emergency Interventions

- Alert the physician immediately.
- Observe the patient closely for respiratory arrest. Monitor his respiratory rate continuously and other vital signs every 5 minutes. Never leave the patient alone.
- Make sure the patient receives oxygen and bronchodilator and nebulizer therapies as ordered.
- Have emergency equipment brought to the bedside and prepare to assist with intubation and mechanical ventilation if respiratory arrest occurs.
- Administer drugs a s per guidelines.
- Prepare to transfer the patient to higher centre if conditions worsen.

Inhalers

Metered Dose Inhaler

It is a metered dose inhaler is a small device that delivers a measured amount of medication to the lungs. We get this medication with each spray (puff) when we breathe in.

About Spacers

Spacers are long tubes that slow the delivery of medication from pressurized MDIs.

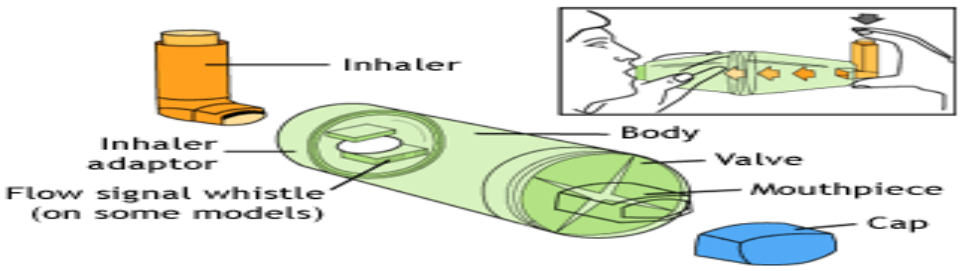


Fig 3: **Parts of spacer**[7]

Spacers should always be used with MDIs which deliver inhaled corticosteroids. Spacers can make it easier for medication to reach the lungs and less medication gets deposited in the mouth and throat where it can lead to irritation and mild infections.

How to use spacer

1. Shake the inhaler well before use (3-4 shakes)
2. Remove the cap from your inhaler, and from your spacer, if it has one
3. Put the inhaler into the spacer
4. Breathe out, away from the spacer
5. Bring the spacer to your mouth, put the mouthpiece between your teeth and close your lips around it
6. Press the top of your inhaler once
7. Breathe in very slowly until you have taken a full breath. If you hear a whistle sound, you are breathing in too fast. Slowly breathe in.
8. Hold your breath for about ten seconds, and then breathe out.

Cleaning Your Spacer

To clean your spacer, follow the instructions that come with it. In most cases, they will advise you to:

1. Take the spacer apart.
2. Gently move the parts back and forth in warm water using a mild soap. Never use high-pressure or boiling hot water, rubbing alcohol or disinfectant.
3. Rinse the parts well in clean water.
4. Do not dry inside of the spacer with a towel as it will cause static. Instead, let the parts air dry (for example, leave them out overnight).
5. Put the spacer back together.

Important Reminders about Spacers

Always follow the instructions that come with your spacer. As well:

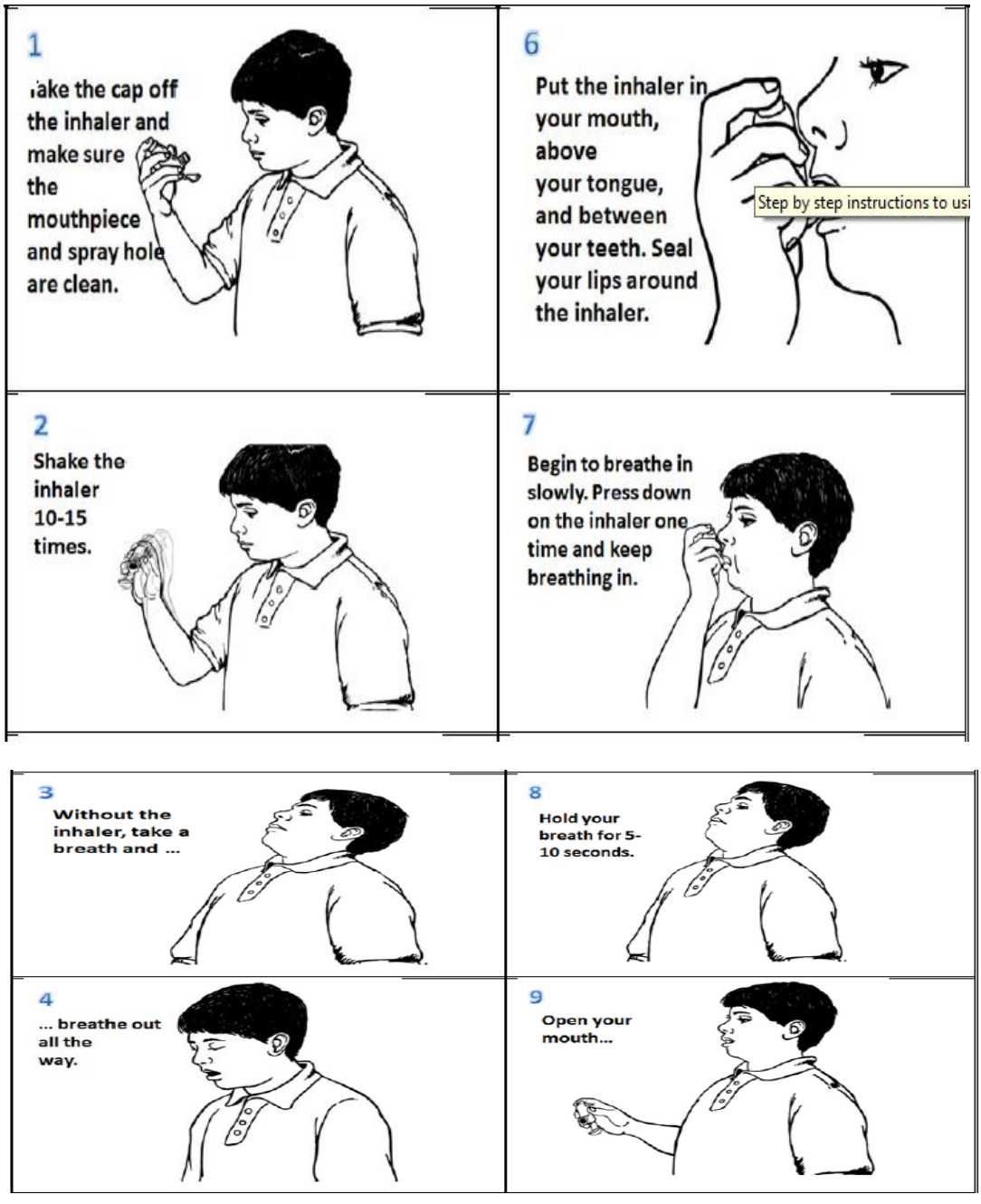
- Only use your spacer with a pressurized inhaler, not with a dry-powder inhaler.
- Spray only one puff into a spacer at a time.
- Use your spacer as soon as you've sprayed a puff into it.
- Never let anyone else use your spacer.
- Keep your spacer away from heat sources.
- If your spacer has a valve that is damaged, or if any other part of the spacer is damaged, do not use it. The spacer will have to be replaced.
- Some spacers have a whistle. Your technique is fine if you do not hear the whistle. However, if you hear the whistle, this means you should slow your breath down.

Dry Powder Inhaler

A dry powder inhaler is similar to Metered Dose Inhaler but it releases a puff of dry powder instead of a liquid mist. We should not use DPI with a spacer. Instead close the mouth tightly around the mouthpiece

of the DPI inhaler and inhale rapidly and steadily. It is important to remove the device from the mouth before exhale, so that humid air does not get into the device and make the powder clump.

How to Use Inhaler?



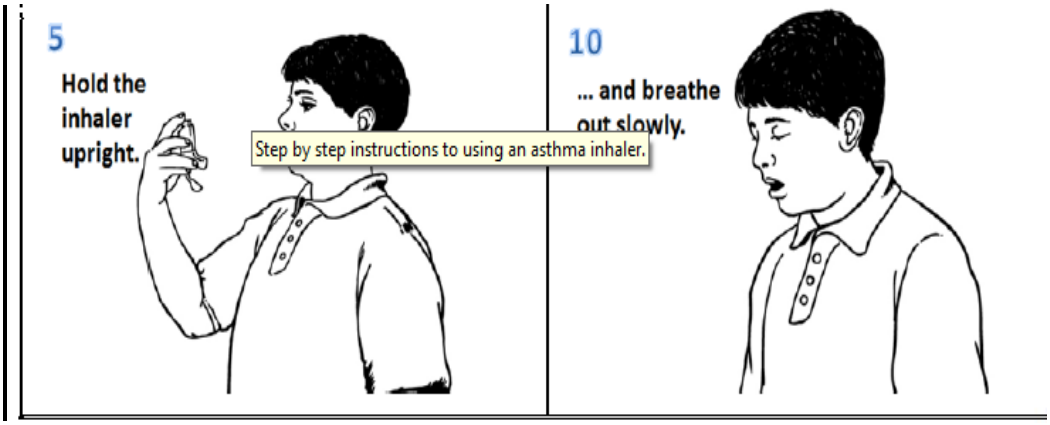


Fig 4: **Inhaler techniques**[8]

Soft Mist Inhaler

A soft mist inhaler is a newer type of inhaler that provides a pre measured amount of medicine in a slow-moving mist that helps to inhale the medicine.

Nursing Management

- ✓ Administer bronchodilators as prescribed.
- ✓ Observe for side effects: tachycardia, dysrhythmia, central nervous system excitation, nausea and vomiting.
- ✓ Assess for correct technique of metered dose inhaler or other type of administration.
- ✓ Evaluate effectiveness of nebulizer or MDI treatment.
- ✓ Assess for decreased shortness of breath, decreased wheezing or crackles, loosened secretions and decreased anxiety.
- ✓ Ensure treatment is given before meals to avoid nausea and to reduce fatigue that accompanies eating.

Nebulization

Nebulization is the process of administering medication by spraying it into the respiratory tract. Oxygen mayor may not be used to assist carrying the medication into lungs. It is the process by which liquid medication is converted into fine mist that can be inhaled. Nebulization is widely used in adults and pediatric patients for respiratory diseases. The device used is known as nebulizer.

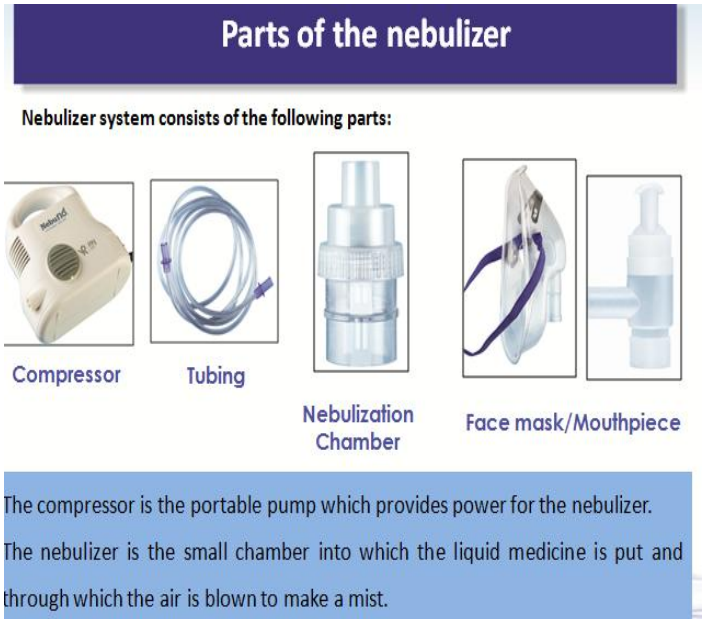
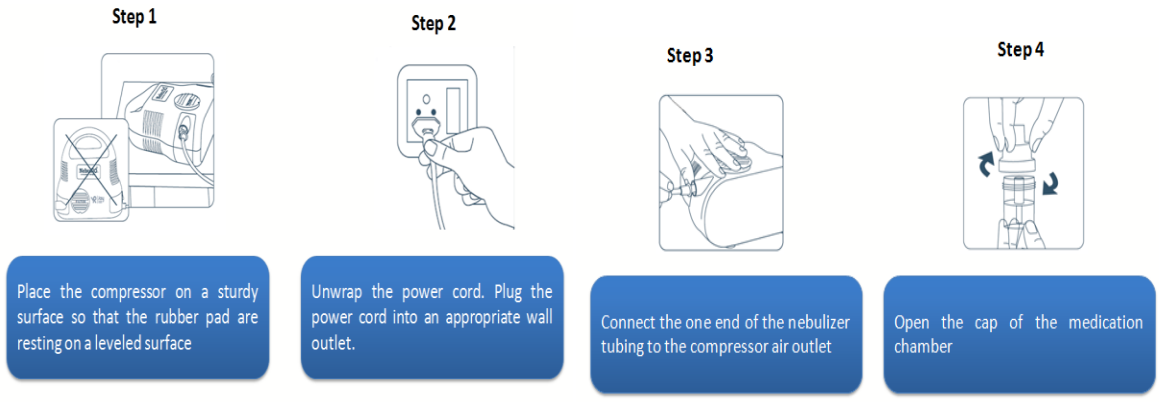


Fig 5: **Nebulizer Parts**

The compressor is the portable pump which provides power for the nebulizer. The nebulizer is the small chamber into which the liquid medicine is put and through which the air is blown to make a mist.

Usage of Nebulization



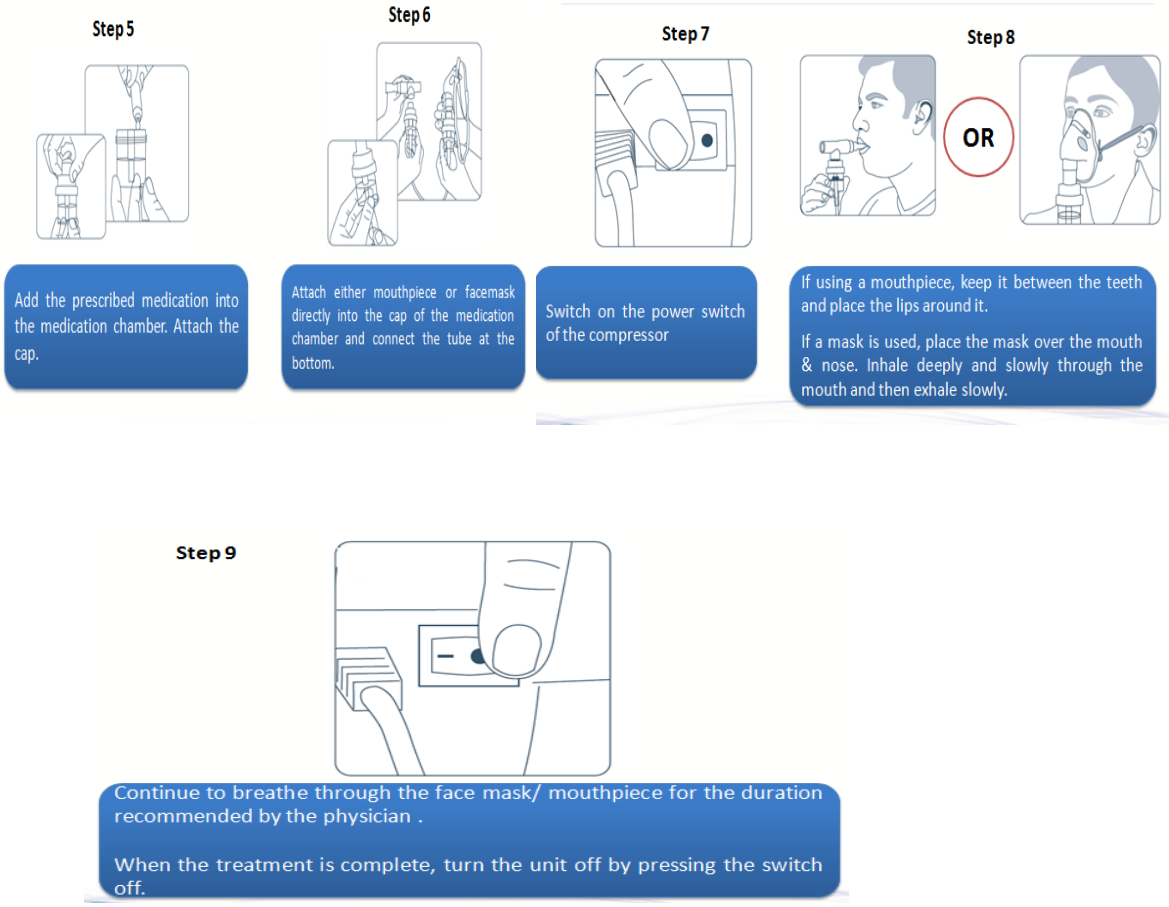


Fig 6: **steps of Nebulization**

Key Aspects of Nebulization

- Fill volume: Between 2-5 ml
- Nebulization time: between 5 to 10 mins
- Nebulization end point: Nebulize for 1 minute after the splutter is heard
- Breathing pattern of patient: Steady normal breathing with occasional deep breaths considered as optimal.
- If using oxygen as driving gas the flow rate should be 6-8 L/min.
- Mouthpiece preferred when nebulized steroids and antibiotics are used in order to prevent administration of drugs on face and eyes.
- Face mask must be used in acutely ill patients, babies and young children who are unable to co-ordinate with the mouthpiece.

Drugs to be used in Nebulizer is available in two forms

i. **Respules**
- Ready to use ampoules containing drug.
- Convenient and no dilution needed.
- Least probability of contamination

ii. **Respirator solution**
- Concentrated drugs available to be diluted (drug: normal saline in 1:3 dilution)
- Less convenient and easy with high probability of contamination

Cleaning the Nebulizer

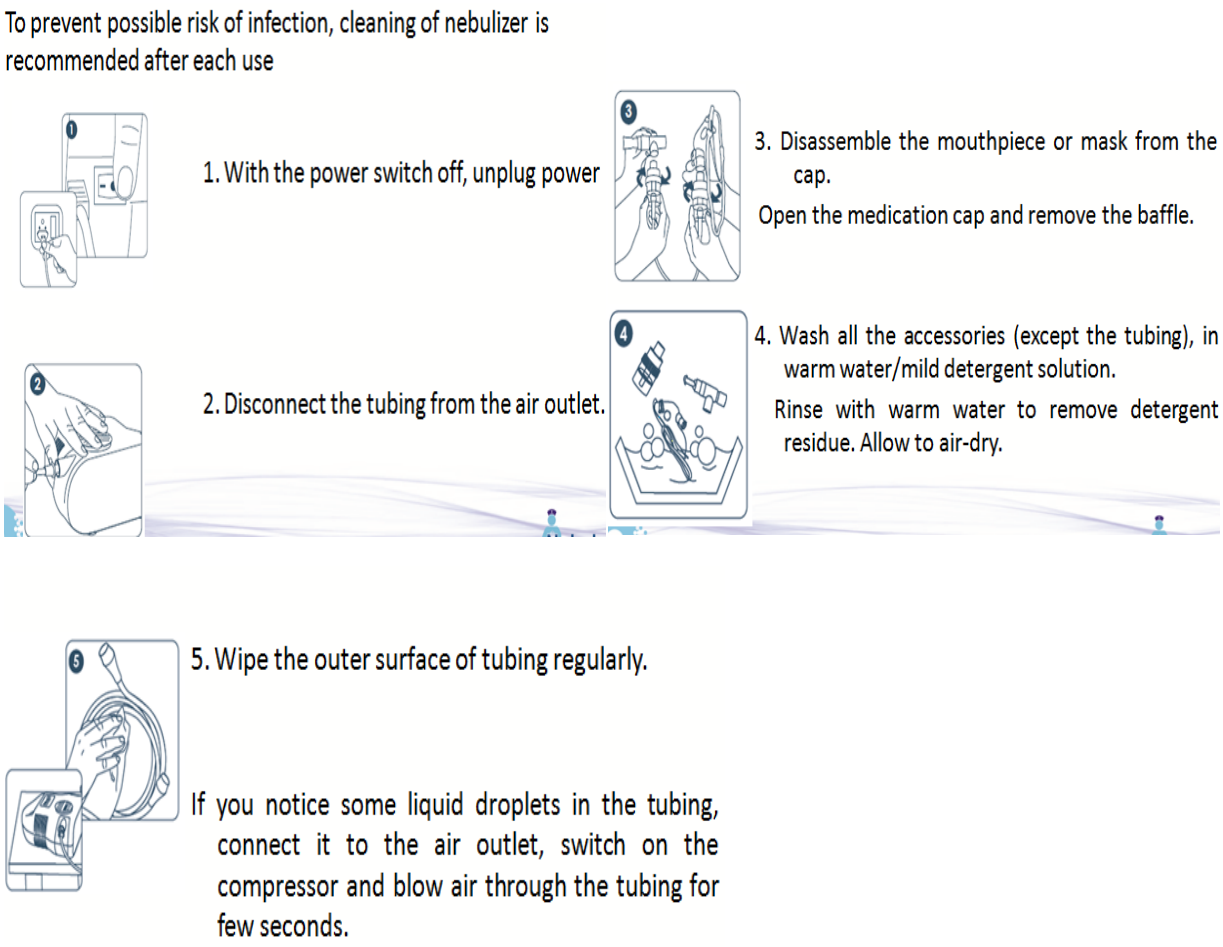


Fig 7: **Steps of cleaning the nebulizer**

Care and Maintenance of the Nebulizer

Disinfect Daily

1. Using a clean container, soak all accessories (except tubings) for 30 minutes in.
   Commercially available medical disinfectant or
   Mild detergent or
   Vinegar solution (1 part white vinegar and 3 parts warm water)
2. With clean hands rinse all the accessories with warm water and air dry

Compressor Cleaning

Wipe the outer surface of the tubing regularly.

Filter Change

The filter should be changed when it discolors totally.

Do not reuse or wash the filter or substitute any material such as cotton.

DO'S

- Wash your hands before using nebulizer
- Always use a clean and dry nebulizer
- Always keep the nebulizer in an upright position
- Whenever possible, a mouthpiece should be preferred over a face mask
- Steady normal breathing during Nebulization with occasional deep breaths is beneficial
- \Rinse the mouth with water and spit out after each Nebulization
- The nebulizer accessories should be cleaned regularly
- Always follow the manufacturer's recommendations for cleaning and maintenance of the nebulizer system
- The nebulizer parts should be checked regularly
- When used by on or near children, close supervision is necessary

DON'TS

- Do not exceed the medication dose recommended by the physician
- Do not use the nebulizer accessories if cracked
- Do not exceed the level of the drug in the medication chamber beyond 5 ml or as recommended by the manufacturer
- Do not talk during Nebulization
- Do not let the mist reach eyes, as it may cause side effects
- Do not continue the Nebulization process beyond 10 minutes or as recommended by the physician
- Do not block the air openings when the nebulizer is in use
- Do not replace or substitute the filter with cotton or any other material

- Do not towel -dry the nebulizer parts
- Do not place the nebulizer compressor system near any other liquid.

Non pharmacologic management of COPD

COPD is a leading cause of morbidity and mortality worldwide. It carries with it a significant economic, social and personal burden. The key to decrease the burden of COPD is identification and reduction of risk factor exposure like Tobacco Smoke, Occupational Exposure, Indoor and Outdoor Air Pollution. Non-pharmacological treatments have gained in popularity as an essential part of therapy, to promote self-efficacy and relieve symptoms. Such options also improve quality of life and are cost effective. The management strategies include

SMOKING CESSATION

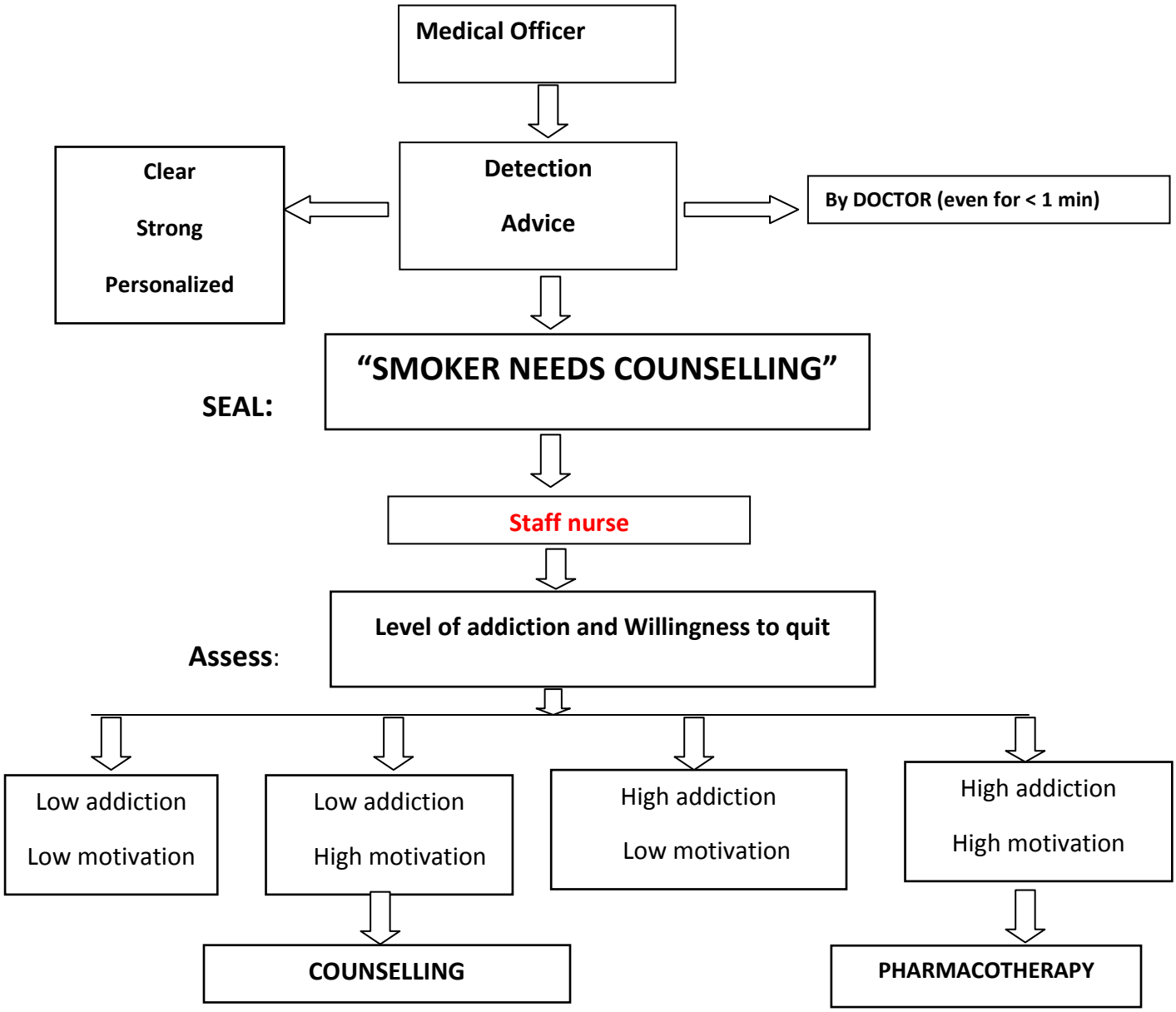
It is the most important intervention for all COPD patients who smoke regardless of disease severity. It is the intervention with greatest capacity to influence natural history of COPD.

Smoking cessation must be attempted by the **MO and COPD nurse** during every visit. Brief smoking cessation counseling is effective and every tobacco user should be offered such advice during each visit. Success of attempts at cessation of smoking depends on the number of attempts and the intensity of the efforts.

Strategies to Quit Smoking: 5 A's

1. **ASK**: *EVERY* patient at *EVERY* clinic visit about smoking status.
2. **ADVISE**: To quit
3. **ASSESS**: Determine willingness to quit
4. **ASSIST**: Aid the patient in quitting – provide practical counselling, pharmacotherapy and social support
5. **ARRANGE**: Schedule follow-up contact

Flow chart: smoking cessation



Pharmacotherapy for Smoking Cessation

Nicotine replacement products (nicotine gum, inhaler, sublingual tablet, nasal spray, transdermal patch, lozenge) increase long-term smoking abstinence rates. When nicotine products are contraindicated as in

patients with Unstable Coronary Artery Disease (CAD), Untreated Peptic Ulcer or a Recent Myocardial Infarction / stroke then other drugs recommended are Varenicline, Bupropion and Nortriptyline.

PULMONARY REHABILITATION

According to ATS ERS 2013 guidelines "Pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors." Pulmonary rehabilitation should be considered a part of integrated patient management.

Components of Pulmonary Rehabilitation Program

1. Exercise training.

COPD and Exercise: Breathing and Exercise Programs for COPD

If you have trouble breathing, exercise may be the last thing you feel like doing. But exercises for COPD can help your breathing, allowing you to stay as active as possible and improving your quality of life. Before beginning with a COPD exercise program, be sure to talk with your doctor or other health care provider.

Few General Instructions for COPD Clinic

They are instructed to have prolonged expiration to favor more lungs emptying through pursed lip breathing & diaphragmatic breathing schedules.

Pacing Techniques: Take adequate breathes in between while doing daily physical activity. They have a tendency to finish off the tasks quickly holding their breaths which can worsen their disability. eg- if they are trying to climb steps they should climb slowly step by step with pauses each step preceded by voluntary deep breaths

Exercise Progression Gradually: Each day for endurance (increasing number of times) and **strengthening** (adding resistance on weights gradually) for all group of muscles of neck, upper limb, chest, trunk and lower limbs.

How Exercises for COPD Can Help: Exercise favours the lungs and heart of patients with chronic obstructive pulmonary disease (COPD). Exercise can:

- Improves the usage of oxygen in body, which is important since people with COPD use more energy to breathe than other people do.
- Decreases the symptoms and improve breathing.
- Strengthen heart, lowers the blood pressure, and improve blood circulation.
- Improve energy, making it possible to stay more active.
- Improves sleep and make you feel more relaxed.
- Helps to maintain a healthy weight.
- Enhances the mental and emotional outlook.
- Reduces social isolation,
- Strengthen the bones.

Types of Exercises for COPD

Stretching exercises, it lengthens the muscle and increases the flexibility. Stretching strengthens the muscles and decreases the chance of injury.

Aerobic exercises use large muscle groups to move at a steady, rhythmic pace. This type of exercise helps the heart and lungs, improving the endurance by supporting the respiratory muscles. This helps the body to use oxygen more efficiently and with time, it can improve breathing. **Walking and using a stationary bike are two good choices of aerobic exercise if you have COPD**.

Strengthening exercises involves tightening muscles repeatedly to the point of fatigue. When we do this for the upper body, helps in increasing the strength of breathing muscles.

Breathing exercises for COPD strengthens the breathing muscles, helps in gaining more oxygen, and breathes with less effort. Here are two examples of breathing exercises that can be done for ~~five~~ 5 to 10 minutes, three to four times a day.

Pursed lip breathing:

Relax the neck and shoulder muscles.

Breathe in for two seconds through your nose while keeping the mouth closed.

Breathe out for four seconds through pursed lips. If this is too long for the patient, simply ask to breathe out twice as long as he can breathe in.

Use pursed-lip breathing while exercising. If the patient experiences shortness of breath, first try to slow the rate of breathing and focus on breathing out through pursed lips.

Diaphragmatic breathing:

Lie on the back with knees bent. Place a pillow under the knees for support.

Place one hand on the belly below the rib cage. Place the other hand on the chest.

Inhale deeply through the nose for a count of 3. (Patient's belly and lower ribs should rise, but chest should remain still.)

Tighten the stomach muscles and exhale for a count of 6 through slightly puckered lips.

COPD and Exercise Guidelines

It helps to exercise at the same time each day; late morning or early afternoon may be a time when you have more energy.

Here are some other basic guidelines for exercise when you have COPD:

- Set realistic goals.
- Gradually increase the number of minutes and days you exercise. A good goal is to exercise 20 to 40 minutes, two to four times a week.
- Start out slow. Warm up for ~~a~~ few minutes.
- Choose activities you enjoy, but vary them to help you stay motivated.
- Find an exercise partner.
- Keep a record of exercises to help the patient stay on track.
- As they end their exercises, ask to cool down by moving more slowly.

COPD and Exercise Precautions

It's good to take precautions when exercising for persons with COPD, but remember that shortness of breath doesn't always mean that exercise should be stopped altogether. Instead, slow down and continue exercising. If shortness of breath becomes severe, then stop exercising.

Here are other exercise precautions:

- Balance exercise with rest. If feeling tired, start at a lower level. If you feel very tired, take rest and try again the next day.
- Wait at least one and a half hours after eating before beginning to exercise.
- Take precautions if the person is having any fluid restrictions when the person drinks fluids during exercise.
- Avoid hot or cold showers after exercising.
- If you've been away from exercise for several days, start up slowly and gradually return to the regular routine.

Exercises to be avoid when you have COPD:

- Heavy lifting or pushing.

- Chores such as shovelling, mowing, or raking.
- Push-ups, sit-ups or isometric exercises, which involve pushing against immovable objects.
- Outdoor exercises when the weather is very cold, hot, or humid.
- Walking up steep hills.

COPD and Exercise: When to Stop

If you experience any of these signs or symptoms, stop the COPD exercise program right away. Sit down and keep your feet raised while resting. If you don't feel better quickly, seek medical attention.

- Nausea
- Dizziness
- Weakness
- Rapid or irregular heart beat
- Severe shortness of breath
- Pain

  Pressure or pain in your chest or your arm, neck, jaw, or shoulder

2. Smoking Cessation
3. Patient Education
4. Nutritional support

Optimum benefits are achieved from programmes lasting 6 to 8 weeks. Supervised exercise training twice weekly is recommended and this can include any regimen from endurance training, interval training, resistance or strength training; upper and lower limbs ideally should be included as well as walking exercise, flexibility, inspiratory muscle training and neuromuscular electrical stimulation can also be incorporated.

Education

Most pulmonary rehabilitation programs include an educational component. The topics that seem most appropriate for an education program include: smoking cessation; basic information about COPD; general approach to therapy and specific aspects of medical treatment; self-management skills; strategies to help minimize dyspnoea; advice about when to seek help; decision-making during exacerbations; and advance directives and end-of-life issues.

Nutritional support:

Nutritional suggestions include:

Proteins- Primary sources like meat, fish, eggs, chicken, pulses and low-fat dairy products. Add skimmed milk powder to boiled milk, soups, and ground meat dishes. This will add extra calcium and protein. Include high protein snacks like custard and other puddings in diet. Commercially prepared supplements are also available.

Fruits- Apples, apricot and peaches and melons may cause bloating which may cause breathing problems.

Vegetables- Beans, cabbage, cauliflower, and onions may cause gas. Foods that are dried and deep fried or oily food can cause gas or indigestion.

Fluids- Drinking enough fluids is essential for clearance of pulmonary secretions. **Recommendation is 8 to 12 cups caffeine free liquids /day**. If there is fluid retention, advice fluid restricted diet. It can also be caused by excess of salt intake, and rarely by excess drinking of fluids. An excess intake of sodium can cause fluid retention and shortness of breath which can be avoided by sodium restricted diet.

Watch weight in both directions:

Underweight-If the patient is underweight, need to include healthy high calorie snacks in diet like milk, egg, nuts, oats, healthy desserts like custards and puddings.

Overweight: Achieve healthy body weight by healthy eating plan. Try to eat five to six small meals per day instead of 3 large ones. It helps to avoid filling the stomach too much making breathing easier Take the main meal early as it boosts the energy level for whole day. Choose foods that are easy to prepare.

Benefits of Pulmonary Rehabilitation in COPD

- Improves exercise capacity.
- Reduces the perceived intensity of breathlessness.
- Improves health-related quality of life.
- Reduces the number of hospitalizations and days in the hospital.
- Reduces anxiety and depression associated with COPD.
- Strength and endurance training of the upper limbs improves arm function.
- Benefits extend well beyond the immediate period of training.
- Improves survival.

- Respiratory muscle training can be beneficial, especially when combined with general exercise training.
- Improves recovery after hospitalization for an exacerbation.
- Enhances the effect of long-acting bronchodilators.

Other Supportive Treatment Options

Immunization

- Annual Influenza vaccine reduces serious illness and deaths in COPD patients
- The pneumococcal vaccine, PPSV-23, reduces the incidence of Community Acquired Pneumonia in COPD patients aged < 65 yrs with an FEV1 < 40% predicted and in those with co morbidities.
- In the general population of adults >65 years, Pneumococcal vaccine, PCV13 has demonstrated significant efficacy in reducing bacteremia and serious invasive pneumococcal disease.
- While these vaccines are recommended by most international guidelines and also the Indian guidelines, inclusion of the vaccine in SWAAS will depend on the adult vaccination guidelines of the government of Kerala.

Oxygen Therapy

Oxygen therapy is the administration of oxygen at a concentration greater than that found in the environmental atmosphere. The goal of oxygen therapy is to provide adequate transport of oxygen in the blood while decreasing the work of breathing.

A person with COPD requires long term oxygen therapy. Regular and long term oxygen therapy improves the quality of life. Many of them need to receive oxygen therapy for at least 15 hours per day.

Oxygen Administration Devices

Devices	Flow Rate (L/min)	Advantages	Disadvantages
Nasal Cannula	1-2 3-6 6	Lightweight, comfortable, inexpensive, continuous use with meals and activity	Nasal mucosal drying, variable FiO2
Simple mask	6-8	Simple to use, inexpensive	Poor fitting, variable FiO2,must remove to eat
Mask, partial rebreather	8-11	Moderate O2 concentration	Warm, poorly fitting, must remove to eat

Mask ,non-rebreather	12	High O2 concentration	Warm poorly fitting, must remove to eat
Venturi Mask	4-6	Provides low levels of supplemental O2	Must remove to eat

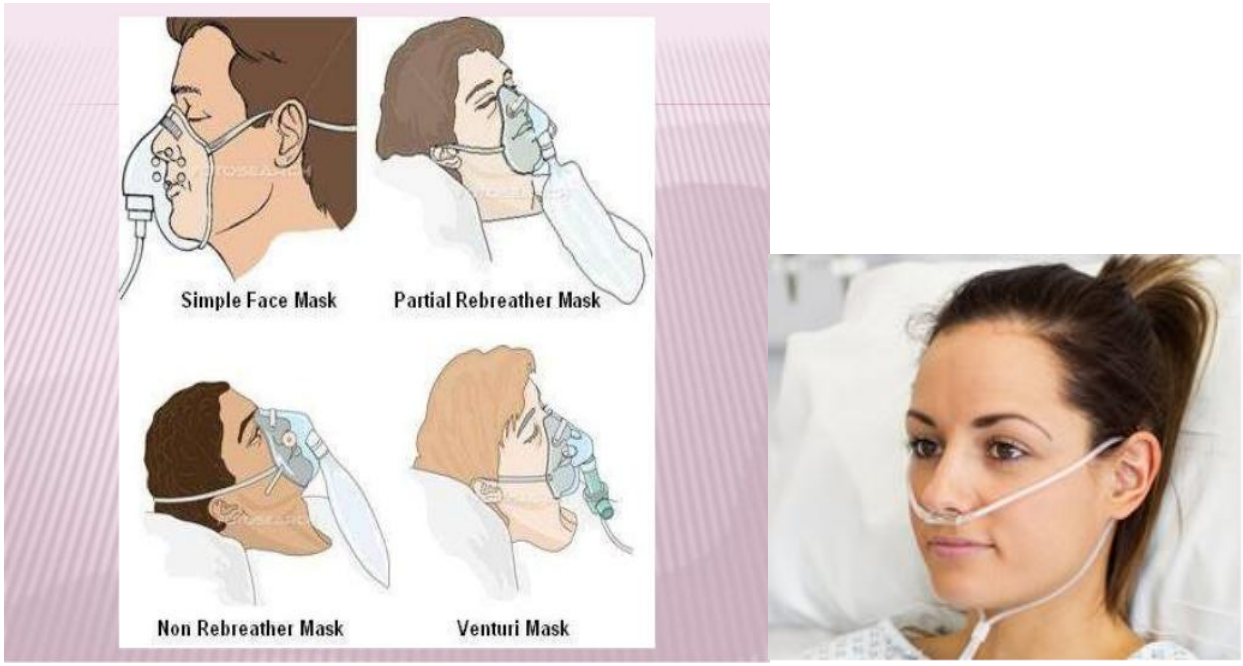


Fig 8: **Types of non-invasive oxygen therapy**[9]

Venturi mask is the most reliable and accurate method for delivering precise concentrations of oxygen through non-invasive means. The mask allows a constant flow of room air blended with a fixed flow of oxygen. It is primarily used for patients with COPD as it provides appropriate level of supplemental oxygen.

Side Effects

- Oxygen toxicity may occur when too high concentration of oxygen is administered for an extended period (longer than 48 hours). Signs and symptoms of oxygen toxicity include paraesthesia, dyspnoea, restlessness, fatigue, progressive respiratory difficulty, alveolar atelectasis etc. Oxygen toxicity can be prevented by administering oxygen only as prescribed.
- Persons getting oxygen through nasal cannula may experience nasal irritation.
- Drying and dehydration f nasal mucosa, impaired mucosal clearance and respiratory epithelial degeneration increases the risk of infection in patients receiving supplemental oxygen.

Nursing Management

- The mask should fit properly to prevent oxygen from flowing into patient's eyes.
- The nurse should check patient's skin for irritation.
- It is necessary to remove the mask so that the patient can eat, drink and take medications at which time supplemental oxygen through nasal cannula.
- Evaluate effectiveness of oxygen therapy: observe for signs of hypoxemia, Notify physician if restlessness, anxiety, somnolence, cyanosis or tachycardia is present. COPD patients require low flow oxygen rates of 1-2L/min via nasal prongs or 4L/min via venture mask.
- Teach and encourage the use of diaphragmatic breathing and pursed-lip breathing. This helps the person prolong expiration time and to avoid excessive fatigue or dyspnea during activity.

Diaphragmatic Breathing

- Place one hand on the abdomen (just below the ribs) and the other hand on the middle of the chest to increase the awareness of the position of the diaphragm and its function in breathing
- Breathe in slowly and deeply through the nose, letting the abdomen protrude as far as possible
- Breathe out through pursed lip while tightening (contracting) the abdominal muscles.
- Press firmly inward and upward on the abdomen while breathing out.
- Repeat for 1 min; follow with a rest period of 2 minutes.
- Gradually increase duration up to 5 minutes, several times a day (before meals and at bed time).

Pursed-Lip Breathing

- Inhale through the nose while slowly counting to 3
- Exhale slowly and evenly against pursed lips while tightening the abdominal muscles
- Count to 7 slowly while prolonging expiration through pursed lips
- While sitting in a chair: Fold arms over the abdomen. Inhale through the nose while counting to 3 slowly. Bend forward and exhale slowly through pursed lips while counting to 7 slowly.
- While walking: Inhale while walking two steps. Exhale through pursed lips while walking four or five steps.

Surgery

Surgical interventions like lung volume reduction (surgical/endoscopic), bullectomy and lung transplantation may be done in appropriately selected patients, wherever facilities are available at the tertiary care level.

Non pharmacologic management of Asthma

Asthma is a common clinical problem and the course of illness is greatly influenced by exposures, including indoor allergens, tobacco smoke and other physical and social aspects of the environment**.** Avoidance of trigger factors is therefore an important aspect of asthma management; both for symptom control as well as reducing exacerbations.

Non pharmacological interventions include:

1. Cessation of Smoking and Environmental Tobacco Smoke Exposure
    - At every visit, advise smokers with asthma to quit. Provide access to counselling and smoking cessation programs.
    - Strongly encourage people with asthma to avoid environmental smoke exposure.
2. Physical activity
    - Encourage people with asthma to engage in regular physical activity to improve cardiopulmonary fitness.
    - Advise patients about prevention and management of exercise- induced bronchoconstriction.

3. Avoidance of occupational exposures
    - Ask all patients with adult-onset asthma about their work history and other exposures. It is important to identify and eliminate occupational sensitizers as soon as possible, and remove sensitized patients from any further exposure to these agents.
4. Avoidance of medications that may make asthma worse
    - Always take a detailed drug history.
    - Aspirin and NSAIDs are not generally contraindicated unless there is a history of previous reactions to these agents. If asthma symptoms worsen on NSAID use advise patients to stop it.
    - Decision about prescription of oral or intra-ocular beta blockers is done on a case by case basis. Initiate treatment under close medical supervision by a specialist
    - If cardio-selective beta blockers are indicated for acute coronary events, asthma is not an absolute contraindication, but the relative risks/benefits should be considered
5. Healthy diet
    - Encourage patients with asthma to consume a diet high in fruit and vegetables for its general health benefits
    - **Patients SHOULD NOT be given wrong dietary advice like avoiding milk / curd etc.**
6. Avoidance of foods and food chemicals
    - Food avoidance should not be recommended unless an allergy or food chemical sensitivity has been clearly demonstrated, usually by carefully supervised oral challenges.
    - For confirmed food allergy, food allergen avoidance may reduce asthma exacerbations
    - Complete avoidance is not usually necessary, and sensitivity often decreases when asthma control improves.
7. Avoidance of indoor allergens
    - Allergen avoidance is not recommended as a general strategy in asthma
    - Remediation of dampness or mold in homes reduces asthma symptoms and medication use in adults
    - For patients sensitised to house dust mite and/or pets, there is limited evidence of clinical benefit for asthma with multi-component avoidance strategies(only in children)
8. Weight reduction

- Include weight reduction in the treatment plan for obese patients with asthma

9. Allergen immunotherapy
    - For adult patients with allergic rhinitis and sensitised to House Dust Mite, with exacerbations despite low to high dose ICS, adding sublingual immunotherapy (SLIT) may be considered, provided FEV1 is >70%
    - But potential benefits of allergen immunotherapy must be weighed against the risk of adverse effects and the inconvenience and cost of the prolonged course of therapy.
10. Breathing exercises
    - Breathing exercises may be useful supplement to asthma pharmacotherapy
11. Avoidance of indoor air pollution
    - Encourage people with asthma to use non-polluting heating and cooking sources, and for sources of pollutants to be vented outdoors where possible
12. Vaccinations
    - Advise patients with moderate-severe asthma to have an influenza vaccination every year, or at least when vaccination of the general population is advised.
    - There is insufficient data regarding use of pneumococcal vaccine in patients with asthma.
    - Decisions on vaccination in Asthma patients will be based on the state policy on adult vaccination
13. Avoidance of outdoor allergens
    - For sensitized patients, when pollen and mould counts are highest, closing windows and doors, remaining indoors, and using air conditioning may reduce exposure to outdoor allergens
14. Dealing with emotional Stress
    - Encourage patients to identify goals and strategies to deal with emotional stress if it makes their asthma worse
    - Relaxation strategies and breathing exercises may be helpful
    - Arrange a mental health assessment for patients with symptoms of anxiety or depression.
15. Avoidance of outdoor air pollutants/ weather conditions

- In general, when asthma is well-controlled, there is no need for patients to modify their lifestyle to avoid unfavourable outdoor
- It may be helpful during unfavourable environmental conditions to avoid strenuous outdoor physical activity and stay indoors in a climate-controlled environment; and during viral infections to avoid polluted environments

Managing co morbidities in COPD and Asthma

COPD is a disease wherein, while the lung is the major organ of involvement, many other systems and organs are also affected and co-morbidities play a significant role in the mortality and morbidity due to COPD. Asthma also is often associated with various co-morbidities which contribute to poor control of Asthma. Hence the management of co-morbidities is key in the management of these two diseases.

Managing co-morbidities in COPD

COPD often coexists with other diseases (co morbidities) that may have a significant impact on disease course. Some of these arise independent of COPD, others may be due to common risk factors, or one disease may increase the risk or severity of other disease. The risk of co morbidities can be increased by reduced physical activity or continued smoking in COPD patients. Co morbidities like lung cancer, heart failure, Tuberculosis and depression; with symptoms associated with COPD may be overlooked. In general, the presence of co morbidities should not alter COPD treatment and co morbidities should be treated per usual standards regardless of the presence of COPD.

Common co morbidities occurring in patients with COPD

• Cardiovascular disease (CVD) • Heart failure • Ischemic heart disease (IHD) • Arrhythmias • Peripheral vascular disease • Hypertension • Osteoporosis	• Anxiety and depression • COPD and lung cancer • Metabolic syndrome and diabetes • Gastroesophageal reflux (GERD) • Bronchiectasis • Obstructive sleep apnea

Cardiovascular Disease

It is frequent and important co morbidity in COPD. The prevalence of systolic or diastolic heart failure in COPD patients ranges from 20-70%. Unrecognised heart failure may mimic or accompany acute exacerbations of COPD. It should be suspected when a COPD patient presents with sudden onset or worsening of breathlessness, pedal oedema, abdominal distension; examination may reveal basal creps, elevated JVP. Acute heart failure should be treated according to usual heart failure guidelines. Non invasive ventilation has been found to improve outcomes.

Ischemic heart disease should be considered in all patients depending on their risk factors. In those with ischemic heart disease, COPD exacerbations increase myocardial damage. ECG should be taken in those patients with risk factors and those presenting with chest pain associated with worsening dyspnoea to rule out CAD. Cardiac arrhythmias are another frequent problem associated with COPD. Atrial fibrillation is frequent and is often associated with severe worsening dyspnoea. Bronchodilators used in COPD can precipitate arrhythmias, though most of them are safe, Special caution should be exercised while using short acting beta 2 agonists and theophylline.

Hypertension is likely to be the most frequent co morbidity associated with COPD. Diastolic dysfunction arising due to hypertension can cause exercise intolerance and may mimic COPD exacerbation. Management of hypertension in COPD has no difference and is according to the usual guidelines.

Osteoporosis

Often under diagnosed and associated with poor health status and prognosis. Systemic corticosteroids significantly increase the risk for osteoporosis and repeated courses for exacerbations should be avoided as far as possible.

Anxiety and Depression

These are important co morbidities in COPD. They are associated with poorer prognosis, smoking, younger age, poor quality of life, female gender and history of cardiovascular disease.

Studies have found that physical exercise has a beneficial effect on depression in general; therefore importance of pulmonary rehabilitation should be stressed. These conditions should be identified and referred for appropriate treatment.

Lung Cancer

There is a strong association between COPD and lung cancer. Higher age, greater smoking history and the presence of both emphysema and airflow limitation increases the risk of lung cancer. In all COPD patients presenting with a new symptom such as hemoptysis, change in character of cough, worsening of dyspnoea, hoarseness of voice, loss of weight and appetite there should be a suspicion of lung cancer.

Appropriate primary investigations like Chest Xray, sputum cytology for malignant cells if facility is available and referral to a higher centre with facility for further investigation should be done. It should be stressed that, as for COPD, the best prevention of lung cancer is smoking cessation.

Metabolic Syndrome and Diabetes

The prevalence of metabolic syndrome has been found to be 3% in COPD, also the presence of diabetes affect prognosis. Management is according to the usual guidelines.

Gastro Esophageal Reflux Disease (Gerd)

It is an independent risk factor for exacerbations and is associated with worse health status. The presenting symptoms are heartburn, belching, reflux of contents into throat and sometimes chronic cough. Proton pump inhibitors can be used for treatment and some studies have suggested their role in reducing exacerbations.

Obstructive Sleep Apnea

OSA is another co morbidity presenting with symptoms of apneas during sleep, increased day time sleepiness, excessive fatigue, early morning headache, more in obese patients who also have associated co morbidities like uncontrolled diabetes, hypertension, ischemic heart disease and/or hypothyroidism. COPD patients with these symptoms should be referred for a sleep study. The apneic events in patients with combined COPD and OSA tend to have more profound hypoxemia and more cardiac arrhythmias. Also the incidence of day time pulmonary hypertension is more in these patients.

COPD As Part Of Multimorbidity

An increasing number of people in any aging population will suffer from multi-morbidity, defined as the presence of two or more chronic conditions, and COPD is present in the majority of multi-morbid patients. Multi-morbid patients have symptoms from multiple diseases and thus symptoms and signs

are complex and most often attributable to several causes in the chronic state as well as during acute events. Treatments should be kept simple in the light of the unbearable polypharmacy that these patients are often exposed to.

Managing co-morbidities in Asthma

Several co morbidities are commonly present in asthma patients that can contribute to poor asthma control, and impaired quality of life. These include

Obesity

Asthma is more difficult to control in obese patients, also it is more common in obese than non obese patients. Document BMI for all obese patients with asthma. ICS are the main stay of treatment. Weight reduction should be included in the treatment plan for all obese patients with asthma.

Gastro Esophageal Reflux Disease (Gerd)

In patients with confirmed asthma, GERD should be considered as a possible cause of a dry cough. For patients with asthma and symptoms of GERD, an empirical trial of proton pump inhibitors or motility agent may be considered. For persistent symptoms, 24 hour pH monitoring and endoscopy should be considered and referred to appropriate centre.

Anxiety and Depression

These are also associated with worst asthma symptom control and adherence to medication and worse asthma related quality of life. They also have been associated with increased exacerbations and emergency visits. Panic attacks may be mistaken for asthma. Where appropriate, patients should be referred to psychiatrists or evaluated with a disease-specific psychiatric diagnostic tool to identify potential cases of depression and /or anxiety.

Rhinitis, Sinusitis and Nasal Polyps

Most patients with asthma have concomitant rhinitis, and 10-40% of patients with allergic rhinitis have asthma. Allergic rhinitis can be seasonal, perennial or intermittent. Rhinitis is the irritation and

inflammation of the mucous membranes of the nose. Allergic rhinitis may be accompanied by ocular symptoms. Rhinosinusitis is the inflammation of the nose and PNS, characterized by more than two symptoms including nasal blockage/obstruction and /or nasal discharge. It can be acute or chronic

Examination of upper airways should be arranged for patients with severe asthma.

Evidence based guidelines recommend intranasal corticosteroids for treatment of both allergic rhinitis and chronic rhinosinusitis.

Communicating with patients and patient education

Patients with COPD and Asthma have chronic diseases which need prolonged treatment and often with variable response to treatment. There are also apprehension and confusion among our population regarding the use of inhaled medications, which are key in the management of COPD and Asthma. Also, these are various dubious practitioners / quacks who promise quick cure for these diseases drawing patients away from proper and scientific treatment. In view of all these factors, health education of patients and communicating to them addressing their expressed and un-expressed fears and concerns is key to successful management of COPD and Asthma.

The major issues that need to be addressed are

1. Explaining to patients how the disease occurs and what the prognosis is, what the scientific treatment of the disease is, and why prolonged treatment is required
2. Explaining to patients on the necessity and safety of inhaled medications
3. Making patients understand what should be avoided in COPD and Asthma
4. Promoting health diet and exercise
5. Facilitating the screening for co-morbidities in COPD and Asthma

Understanding the disease –

COPD – Points to explain

1. Symptoms
2. Why the disease occurs – that is risk factors (smoking, passive smoking, domestic smoke and occupational exposures)
3. Why only some smokers develop the disease (genetic factors)

4. That the disease is progressive, but preventable and treatable
5. Importance of smoking cessation
6. Importance of regular use of drugs
7. Importance of exercise (pulmonary rehabilitation) and diet

Asthma – Points to explain

1. Symptoms
2. Why the disease occurs genetic factors, childhood factors
3. Help understand triggers which cause exacerbations
4. That the disease can be fully controlled and the person can live a normal life, however that it is not “curable”
5. Importance of allergen avoidance
6. Importance of regular use of drugs, particularly the controller medications
7. Importance of exercise and diet

Explaining to patients on the necessity and safety of inhaled medications – patients often have apprehensions on the safety and necessity of inhaled medications, and their questions and unexpressed concerns have to be addressed. The points to explain include

1. Why inhaled medications are preferred over oral drugs
2. Why the inhaled drugs need to be used for a long period of time
3. Teaching how to use inhaled medications (annexure 2)
4. Reviewing inhaler technique during follow-up visits and importance of bringing inhalers to check technique
5. Importance of absolute compliance with medications, regular use of drugs

Making patients understand what should be avoided in COPD and Asthma

1. Smoking cessation in COPD (and also Asthma)
2. Avoiding allergen exposure in Asthma
3. Drugs to avoid in Asthma

Promoting health diet and exercise

1. Proper diet is essential in COPD (and also Asthma) but patients might not be able to take proper meals due to dyspnoea and GERD, they have to be advised on what diet to take and the need for small frequent meals
2. Avoiding food which cause allergy in Asthma. However food fads like avoiding milk and curd, etc should be discourages as these are nutritious food that patients need

Facilitating the screening for co-morbidities in COPD and Asthma

1. Co-morbidities cause morbidity and mortality in COPD and Asthma and also lead to poor control of symptoms despite proper treatment. Hence patients should be encouraged to get screened for the common co-morbidities
2. Linking of patients to the appropriate public health program for management of these co-morbidities is also important

Annexure 1 Equipment and drugs required for the Kerala COPD prevention and control program

PHC level

3. Mini-spirometer (COPD-6 or equivalent) - 1
4. Peak flow meter – as per number of Asthma patients
5. Pulse oxymeter – 1
6. Oxygen concentrator – 2
7. Weighing machine – 1 (exclusively for spirometry and COPD care)
8. Apparatus / facility for measuring height (exclusively for spirometry and COPD care)
9. Nebuliser- 1
10. Oxygen masks
11. Nasal prongs for oxygen inhalation
12. Mouth pieces for using with minispirometer/COPD 6

Drugs required

1. Nebuliser solutions
    a. Salbutamol
    b. Ipratropium
    c. Budesonide/ Fluticasone solution
2. Meter dose inhalers
    a. Formeterol + budesonide, salmeterol + fluticasone,
    b. Ipratropium
    c. Salbutamol, salbutamol + Ipratropium
    d. Tiotropium
3. Tablets
    a. Salbutamol – 2mg and 4 mg
    b. Deriphyllin (plain 100mg / retard 150mg)
    c. Montelukast 5mg / 10 mg
    d. Antihistamines (levo-cetrizine and desloratidine)
    e. Prednisolone 10mg
4. Nasal sprays
    a. Fluticasone
5. Injectables
    Inj. Deriphylline
    Inj. Methyprednisolone / Inj. Hydrocortisone

Annexure 2 Instructions on use of inhaler devices

Inhaled medications are preferred in COPD and Asthma due to the following reasons

- Quick onset of action. Due to this they are the preferred drugs in management of exacerbations too.
- Lower dosage used.
- Lesser side effects.

Various devices are available for drug delivery of inhaled medications in COPD and Asthma. However for the SWAAS program the two types of devices being used are pressurised metered dose inhalers with spacers (pMDI) and nebulisers. However since patients might also prefer other forms of devices, all type of devices are being discussed in this section. The common drug delivery devices for inhaled medications include

- Pressurised Metered Dose Inhaler (pMDI or MDI)
- Pressurised Metered Dose Inhaler (pMDI or MDI) with spacer
- Dry powder inhaler
- Nebulisers.

While inhaled medications are essential for the treatment of COPD and Asthma, patients are often unable to take these medications properly. In a study in Trivandrum medical college, it was found that the majority of patients on inhaled medications were not using their devices in the ideal way. Hence training of patients and regular follow-up, review of technique and re-training are essential in ensuring proper use of these medications.

The technique of the commonly used inhaler devices is described below

Pressurised Meter Dose Inhalers (pMDI / MDI)

1. Remove cap and shake inhaler
2. Breathe out gently to the maximum possible extent
3. Put mouthpiece in mouth and at start of inspiration, which should be slow and deep, press canister down and continue to inhale deeply
4. Hold breath for 10 seconds, or as long as possible then breathe out slowly
5. Wait for a few minutes before repeating steps 2-4

Pressurised Meter Dose Inhalers (pMDI / MDI) with spacer

1. Remove cap, shake inhaler and insert into the spacer device

2. Place mouthpiece of the spacer in mouth
3. Start breathing in and out slowly and gently. (This will make a clicking sound as the valve opens and closes)
4. Once breathing pattern is well established, depress canister and leave device in same position as you continue to breathe (tidal breathing) several more times (about five to eight times)
5. Remove device from mouth
6. Wait about five minutes before repeating sections 1-5

Dry Powder Inhalers (DPI). There are various kinds of dry powder inhalers available in the market and these have various techniques of use. What is described here is the technique for the “Rotahaler” which is one of the commonest devices in use in our state

1. Insert a rotacap, transparent end first, into the raised square hole of the rotahaler.
2. Rotate the base of the Rotahaler in order to separate the two halves of the rotacap.
3. Breathe out gently to the maximum possible extent
4. At the start of inspiration, place the rotahaler firmly in the mouth and breathe in as deeply and quickly as possible.
5. Hold your breath for 10 seconds or as long as possible.
6. Breathe out slowly.

After use of the inhaled drugs, mouth and throat must be gargled to wash out the drug deposited in the mouth and throat.

Nebulisers

1. Unscrew the top of the nebuliser chamber. Measure out the correct amount of drug solution and pour into the nebuliser chamber.
2. Sometimes you may need to dilute the drug solution. Add the required amount of normal saline. DO NOT dilute the drug solution with water. You need around 4-5ml solution in the nebuliser chamber for it to work properly.
3. Screw on the top of the nebuliser chamber and attach the face mask or mouthpiece to the top of the chamber.
4. Place the facemask over your mouth and nose and place the strap over your head; alternatively, if you use a mouthpiece place it between your lips.

5. Sit up, well supported, in a chair or in bed and keep the nebulizer chamber upright.
6. Switch the compressor unit on and breathe in and out as normal.
7. Whilst your nebuliser is in use, small drops of drug solution may form on the sides of the nebuliser chamber. You can knock these droplets back into the drug solution by gently tapping the side of the nebuliser chamber with your fingernail.
8. When the nebuliser starts to 'splutter' the treatment has finished - this will take between 10 and 20 minutes. A small amount of solution may be left in the nebuliser at this stage, but this is normal.

Nebulisers are devices to be used in health care settings, under supervision and monitoring of health care providers. Never prescribe a nebuliser for self use at home by patients unless there is a compelling and justifiable reason for the same.

Annexure 3 Commonly used oral and inhaled medicines and doses

Salbutamol (SABA) - 100- 200 mcg upto qid

Ipratropium (SAMA) - 20 mcg upto qid

Tiotropium (LAMA) - 18 mcg od

Formoterol (LABA) - 6mcg bd

Formoterol (LABA) + Budesonide (ICS)- available in 100 mcg, 200 mcg and 400 mcg MDIs (metered dose inhalers)and DPIs (dry powder Inhalers) used twice daily

Nebulisation

Salbutamol - 2.5 mg

Ipratropium -500 µg

Oral

Tab. Salbutamol 2-4 mg bd/tds

Tab. Methyl Xanthines (Deriphylline) 100- 400 mg/day

Inhaled medications are preferred over oral medications

Steroids (prednisolone 30 – 40 mg/day)

Annexure 4 Pulmonary Rehabilitation Protocol

1st week :

Day 1 – Assessment (6MWT, Gold Criteria, Bode Index, SGRQ/CAT score), Induction and Patient education (the disease, correct use of medications, importance of exercise)

Day 2 – Breathing pattern retraining, diaphragmatic breathing ex's, purse lip breathing ex's, pacing methods, dyspnea relieving positions, range of motion and stretching ex's

Day 3 – Airway clearance techniques, thoracic expansion ex's, inspiratory muscle training, walking retraining **&** Advice range of motion & stretching ex's at home

2nd week:

Day 4 – Review status, warm up, lower limb endurance training, cool down

Day 5 - Progression of endurance training (lower limb)based on patient response

Day 6 - Same as Day 5 **&** Initiation of walking exercise regime at home

3rd week:

Day 7 – Review status, warm up, endurance training (upper limb & lower limb), cool down

Day 8 – Progression of endurance training (upper limb & lower limb) based on patient response

Day 9 - Same as Day 8 **&** Inclusion of upper limb endurance training to home programme

4th week:

Day 10 - Review status, warm up, endurance training, strengthening exercises, cools down

Day 11 – Progression of strength training (upper limb & lower limb) based on patient response

Day 12 – Same as day 11 **&** Addition of strength training to home exercise regime

5th week:

Day 13 – Review status, warm up, training using functional activities, cool down

Day 14 – Progression of strength and endurance training using functional activities

Day 15 – Same as day 14 **&** Functional activities included to home programme

6th week:

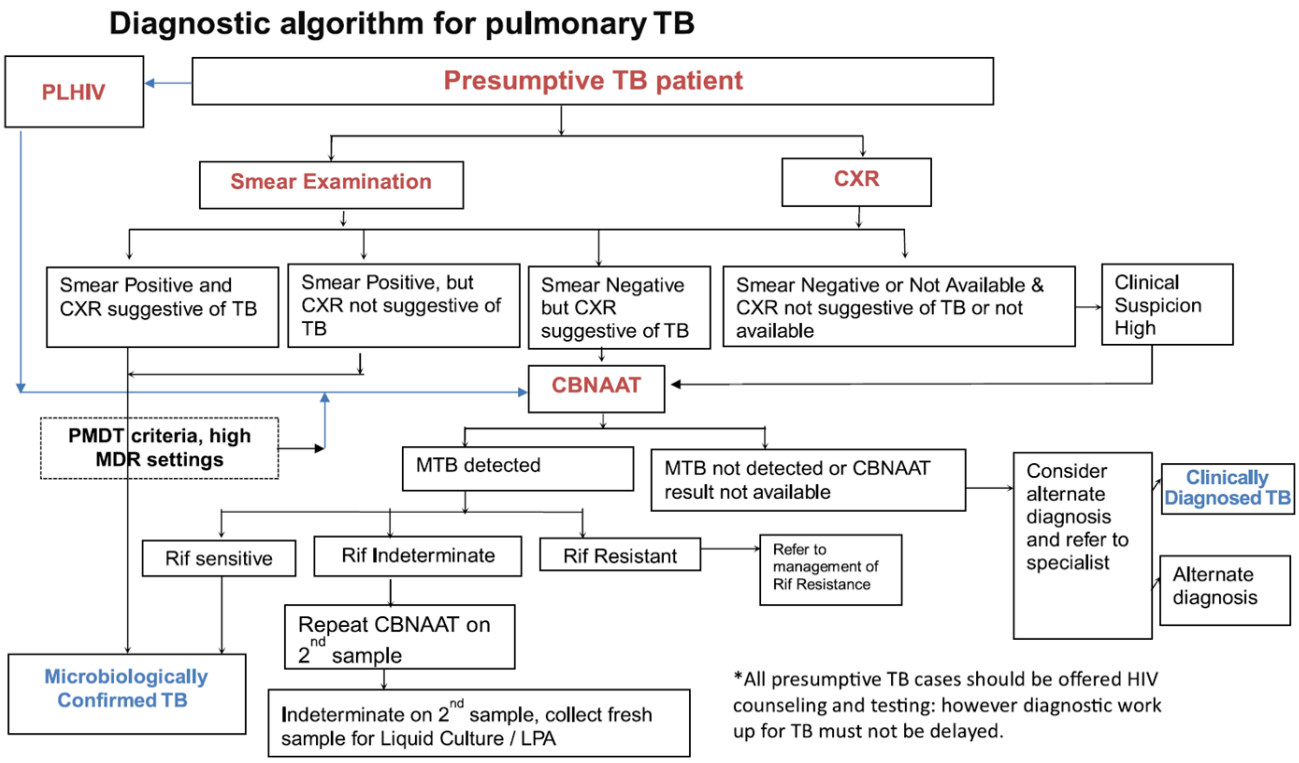
Day 16 – Review status, designing an appropriate home based exercise programme

Day 17 - Final assessment of the patient and modification of the regime, if necessary

Day 18 – Review by pulmonologist, physiotherapist and other specialists, as required

[Note: Protocol could be modified based on patient conditions]

Annexure 5: RNTCP Diagnostic Algorithm



References

1. Sustainable Development Goals- United Nations
2. GOLD guidelines 2017
3. GINA Guidelines 2017
4. INSEARCH Study
5. Global Burden of Diseases 2016
6. Spirometry: step by step, V.C. Moore, Breathe 2012 8: 232-240; DOI: 10.1183/20734735.0021711
7. Asthma Canada. SPACERS[INTERNET]2009-2019 Available from: https://asthma.ca/spacers
8. Suzanne C Smelter,Brenda G Bare,Janice L Hinkle,Kerry H Cheever.(2010).Twelfth Edition. Brunner & Suddarth's Textbook of Medical Surgical Nursing.
9. Dr Rajiv Desai. OXYGEN THERAPY[internet] 2018[cited February 12, 2018] Available from: http://drrajivdesaimd.com/2018/02/12/oxygen-therapy/
10. https://www.cdc.gov/asthma/pdfs/Inhaler_Spacer_FactSheet.pdf accessed on 17/05/17
11. http://www.asthma.ca/adults/treatment/spacers.php accessed on 17/05/17
12. https://www.nhp.org/provider/asthma/MDI_with_spacer-EN.pdf accessed on 17/05/17