



# The respiratory system

Training resource for support workers



This workbook has been co-produced between the CSP and professional network ACPRC.  
This workbook was first produced by NHS Education Scotland.



# The respiratory system

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## 2.1 Aim of the workbook

The aim of this workbook is to introduce the Healthcare Support Worker (HCSW) to the structure and function of the respiratory system.

## 2.2 Learning outcomes

By the end of this workbook you will be able to:

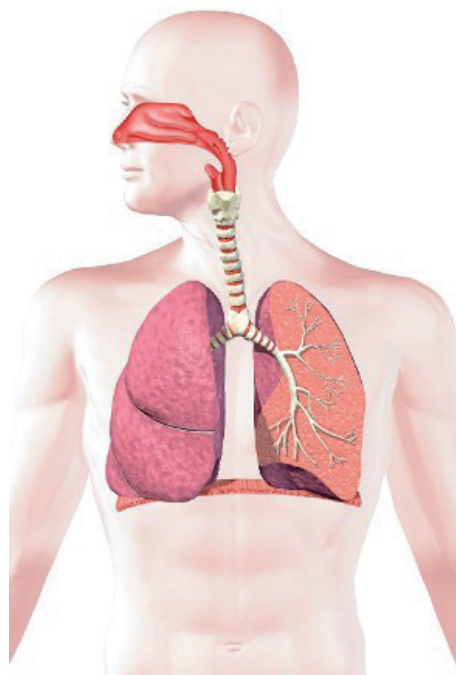
- **Describe** the structure and function of the respiratory system.
- **Describe** and recognise some of the common signs that you may observe when a patient has a disorder of the respiratory system.
- **Describe** some common respiratory conditions.
- **Describe** briefly the benefits of exercise and chest clearance in respiratory conditions.

## 2.3 The respiratory system

The primary functions of the respiratory system are to bring oxygen into the lungs, transfer the oxygen to the blood and expel the waste product called carbon dioxide.

As air is inhaled, it enters the body through the nose and the mouth. Nasal hairs and mucosa (mucus), which is secreted inside

the airways, filter out dust particles and bacteria and warm and moisten the air.

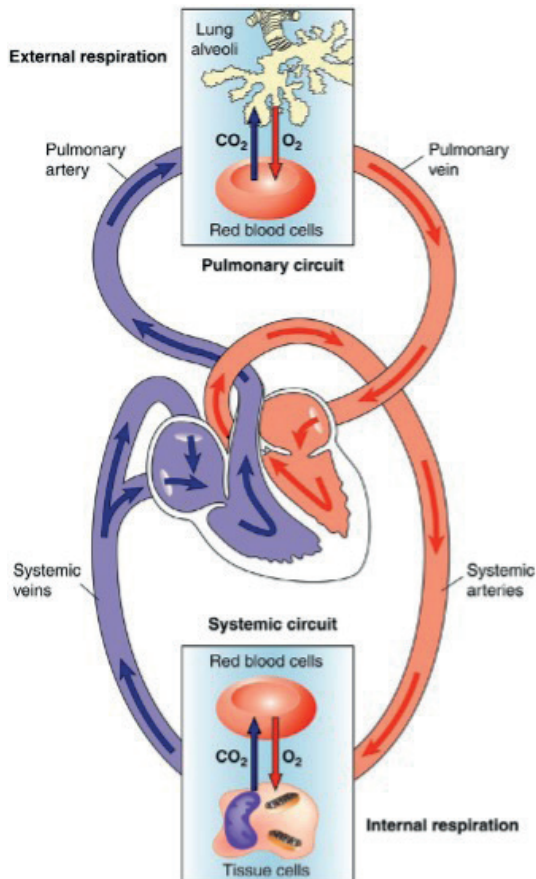


The filtering process continues as air flows down through the pharynx, larynx, trachea and bronchi to the lungs. Each lung contains a tree of branching tubes that end in tiny air sacs, or alveoli, where gases diffuse into and out of the blood stream through tiny vessels.

The entrance to the larynx (voice box) is covered by a small flap of muscular tissue (epiglottis) that closes when swallowing, so preventing food from entering the airways.

The largest airway is the windpipe (trachea), which branches into two smaller airways (bronchi) to supply the two lungs. The bronchi themselves divide many times before evolving into even smaller airways (bronchioles). The airways look like an upside down tree, which is why this part of the respiratory system is often called the bronchial tree.

Each lung is surrounded by a serous membrane called the pleura, which comprises two layers. There is a small amount of fluid between the layers that works as a lubricant, allowing the lungs to move freely during breathing.



The process of respiration is where oxygen is carried to body cells and carbon dioxide is removed. This process takes place in three parts:

- **Pulmonary ventilation** when air is taken into the lungs
- **External respiration** the exchange of respiratory gases between the lungs and the blood
- **Internal respiration** the exchange of respiratory gases between blood and body tissues

Deoxygenated blood flows into the right side of the heart, which pumps it to the lungs to pick up oxygen (and remove carbon dioxide).

The oxygenated blood then returns to the left side, which pumps it round the body.

The diagrams (left) show the oxygenated blood in red, leaving the heart to go to the tissues and the deoxygenated blood in blue, returning to the heart to receive oxygen again.

### Evidence

Describe the main parts of the respiratory system. Name each part and what it does

## 2.4 Breathing

Air is drawn into the lungs by contraction of the diaphragm. This moves down and flattens from its resting domed shape enlarging the chest cavity. The intercostal muscles can also contract lifting the ribs up and out further increasing the chest cavity. As the chest cavity enlarges the lungs expand drawing air into the lungs and therefore a breath in. When the diaphragm relaxes back to its domed shape and the intercostals relax lowering the ribs down and in the air is pushed out of the lungs by the reduction in the size of the chest cavity.

### Gaseous exchange

In the lungs, carbon dioxide (CO<sub>2</sub>) from the blood passes into the alveoli through the respiratory membrane, a thin barrier that has several layers. Oxygen (O<sub>2</sub>) crosses the membrane in the opposite direction, from the alveoli to the blood capillaries. Oxygen is then absorbed in the red blood cells which carry the blood to the tissues.

### Evidence

Explain how the respiratory system works and the main function of the system. For example; how and why we breathe and how gas is exchanged?

## 2.5 Respiratory disorders

As a support worker you will often come across patients with respiratory disorders, some of which are described below.

### Cough

Coughing is a familiar but complicated reflex. It is one way in which the lungs and airways are protected. Along with other mechanisms, coughing helps protect the lungs against particles that have been inhaled (aspiration). Coughing sometimes

leads to the movement or clearance of sputum - a mixture of mucus, debris and cells that is produced in the lungs in greater quantities than is normal.

Chest physiotherapy may be required to assist patients to cough to clear sputum from their lungs. If people do not keep their lungs clear, they may become short of breath because the gas exchange in the lungs is impaired. The lungs may be damaged if over time they collect large volumes of sputum.

The physiotherapist may assist patients to clear sputum from their lungs using postural drainage, percussion, vibrations, breathing exercises, or relaxation. When the patient is unable to cough and clear the secretions they may require escalation of treatment, this may include positive and negative pressure treatments or invasive suctioning.

### **Dyspnoea – shortness of breath – the unpleasant sensation of difficulty in breathing**

A healthy person breathes faster during exercise and at high altitude. Although faster breathing is rarely uncomfortable, it may limit the amount of exercise that can be performed.

With dyspnoea the sensation that the person is running out of air and can't breathe fast enough or deeply enough

accompanies the faster breathing.

Dyspnoea is a sign of serious disease of the airway, lungs, or heart. The onset of dyspnoea should not be ignored but is reason to seek medical attention.

### **Wheeze – a whistling, musical sound during breathing that results from partially obstructed airways**

It may be caused by a general narrowing of the airways, (asthma or chronic obstructive pulmonary disease), by a local narrowing (as with a tumour), or by a foreign particle lodged in an airway. The most common cause of recurring wheezing is asthma although many people who have never had asthma wheeze at some time in their lives. A wheeze is sometimes audible without the use of a stethoscope.

### **Stridor – a crowing sound heard during breathing, mainly during inhalation, that results from a partial blockage of the throat (pharynx), voice box (larynx) or windpipe (trachea)**

Stridor is usually loud enough to be heard at some distance, but it may only be audible during a deep breath. The sound is caused by turbulent airflow through a narrowed upper airway – possible causes could be a tumour, an abscess or perhaps swelling in the upper airway, or a malfunction of the vocal chords.

Stridor can be a symptom of a life-threatening emergency. In such cases, a tube may be inserted through the person's mouth or nose (tracheal intubation) or directly into the trachea (tracheostomy) to allow air to get past the blockage and to save the person's life.

**Cyanosis – a bluish discolouration of the skin resulting from an inadequate amount of oxygen in the blood**

Occurs when oxygen depleted blood which is bluish rather than red, circulates through the skin. Cyanosis restricted to the fingers and toes usually occurs because blood flows through the limbs very slowly. It may result when the pumping action of the heart is weak or when a person is exposed to the cold. Cyanosis that occurs throughout the body can be caused by many types of severe lung disease. Also by certain blood vessels and heart malformations that shunt blood from the venous to the arterial side of the circulation.

**If you are with a patient who suddenly becomes cyanosed seek help immediately.**

**Hypoxia – is a lack of oxygen (O<sub>2</sub>) supply to the tissues**

Hypoxia can occur in the following ways:

- Hypoxic not enough oxygen to go round
- Anaemic not enough hemoglobin to carry the oxygen

- Stagnant not enough blood flow
- Histotoxic chemical poisoning.

## Evidence

Describe what is meant by the following:

Cough

Dyspnoea

Wheeze

Stridor

Cyanosis

Hypoxia

## Evidence

Can you describe an occasion on which you observed a patient with any of these signs?

What action did you take?

## 2.6 Recognising respiratory distress

You may come across patients who have become unwell and who are in respiratory distress. This situation requires medical attention which should be found

immediately. As a support worker you should be able to recognise when the patient is unwell.

- **General appearance** Does the patient appear to be in pain, fatigued, or lethargic? Are they restless or incoherent?
- **Colour** Is there a change in the patient's colour since you last saw the patient? Are they pale or flushed? Blue at the mouth and lips or fingertips - may indicate that the oxygen level is low in the blood. You should report this immediately to a nurse, doctor or registered physiotherapist.
- **Temperature** Fever is an indication of infection so the patient may feel too unwell to perform some activities with you.
- **Pulse** Pulse may be raised if the patient has low oxygen levels, fever or is very anxious.
- **Breathing rate** Is the patient breathing faster or more slowly than normal? Are the neck muscles working too hard? You may notice the patient pursing their lips during breathing – this is to create pressure in the airways to prevent airway collapse.
- **Cardiac instability; high heart rate, low blood pressure, oedema in**

**the arms or legs** Does the patient have swollen ankles or hands? Is this new for them? If so, inform a member of staff.

- **Respiratory failure** In some conditions, such as chronic bronchitis, cystic fibrosis or asthma the level of blood oxygen may become dangerously low, or the level of carbon dioxide may become dangerously high. This occurs when the movement of air in and out of the lungs is inadequate.

### Evidence

Describe how you might recognise that a patient may be suffering from respiratory distress.

If you have observed any of these signs in a patient that you have been treating, describe here what you did.

## 2.7 Treatment of respiratory distress or failure

Almost always, oxygen is given initially. Usually, the amount given is more than is needed, normal saturation targets are 94-98%. If a person has a chronic respiratory condition they may have lower target saturation (88-92%). Such people tend to slow their breathing when they're over-treated with oxygen. Oxygen may be given via nasal cannula or face mask.

The underlying cause also must be treated. This may be: antibiotics are used to fight infection.

Bronchodilators are used to open the airways.

Fluids via a vein to improve fluid homestasis.

Other medications may be given to decrease inflammation (steroids) or prevent blood clots (anti-coagulation).

Ventilation:

Noninvasive ventilation can be used to provide additional support for breathing. This can be given via a face mask, which gives extra pressure on the breath in to reduce the workload for the patient and helps keep the airways open on the breath out.

For very unwell patients, invasive ventilation is achieved by placing a plastic tube in through the nose or mouth and into the trachea; this tube is attached to a machine that forces air into the lungs. Exhalation occurs passively because of the elastic recoil of the lungs. Many types of ventilators and modes of operation may be

used, depending on the underlying disorder. If the lungs aren't functioning well, additional oxygen may be delivered through the ventilator. Mechanical ventilation can be lifesaving whenever patients are not able to move enough air in and out of their lungs.

### **Respiratory Diseases:**

Chronic respiratory diseases affect the airways and other structures of the lungs. These can be caused by tobacco smoking, chemicals, dust, frequent respiratory infections and genetics.

### **Asthma**

Asthma affects the small airways (bronchioles) that carry air in and out of the lungs. In 2019, about 262 million people worldwide have the condition, this includes 11% of children aged 6 to 7 years. In the UK 8 million people (12% of the population) have been diagnosed with asthma.

An 'asthma attack' describes the symptoms of tightness in the chest, a wheezing or whistling noise in the chest, coughing and difficulty breathing. These symptoms occur when the airway becomes narrowed,

inflamed and blocked by plugs of mucus.

Patients are treated using drugs known as bronchodilators, which reduce the narrowing of the airways, and by inhaled steroids which reduce the inflammation.

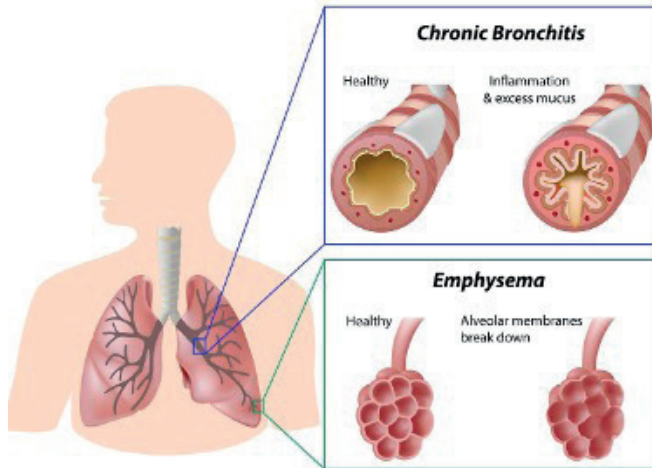
### **Pleurisy**

The pleura is the double-layered membrane that covers the lungs. One layer is attached to the surface of the lung and the other to the inside of the chest wall. The two layers are in close contact and are separated only by a thin layer of lubricating fluid produced by the membranes.

Pleurisy causes roughening of the surfaces in contact, and as these rub against one another there is a sharp pain. This usually occurs at a particular point on breathing in, often at the end of a deep breath. It may also be brought on by coughing or by twisting the body. There is likely also to be fever and general discomfort.

There are many causes of pleurisy. Pleurisy may develop if there is some disease process in the underlying lung, such as pneumonia, cancer or tuberculosis. Other causes include viral infections of the pleura. Pleurisy may also be a feature of rheumatoid arthritis.

## Chronic Obstructive Pulmonary Disease (COPD)



### **COPD (Chronic Obstructive Pulmonary Disease)**

COPD is the overall term used to describe a variety of illnesses, including chronic bronchitis, or emphysema).

People with COPD have permanently damaged lungs, usually through smoking or air pollution, and find it difficult to breathe most of the time. Other causes include occupational exposure to dusts, indoor pollution from wood and coal burning stoves, and certain inherited diseases.

People with COPD are at higher risk of developing other health conditions.

COPD is the third leading cause of death worldwide.

COPD can cause destruction of the tiny air sacs in the lungs, chronic airway inflammation and production of sputum causing a chronic cough.

### **Bronchiectasis**

Bronchiectasis is a chronic condition where the airways become wide due to damaging

of airway tissue and muscle. There is an excess of sputum which gathers in the wide airways, leading to infection. Common symptoms include chronic productive cough, and shortness of breath.

Bronchiectasis is caused by previous pneumonia that damage the airways, underlying problem with the immune system, inhalation of fungal spores.

It affects 1 in 100 adults in the UK.

### **Cystic fibrosis (CF)**

CF is a relatively common inherited disorder in the UK. One in every 2,500 babies is born with CF. 1 in 25 people carry the defective gene. It affects more than 7,500 babies, children and young adults in the UK. CF contains a defective version of a protein. This is responsible for the transport of salts and water across the cell membranes. This means that in certain parts of the body, the secretions lack water becoming thick and sticky. This means the lungs, pancreas, intestines and other organs tend to get clogged up with thick sticky mucus.

Physiotherapists are involved with these patients to clear sputum from their lungs. With children, there are several techniques that are used to clear the patient's secretions and to help them maintain a healthy life. Patients may perform exercise and games as well as more traditional methods for sputum removal.

## Evidence

Describe what it meant by the following:

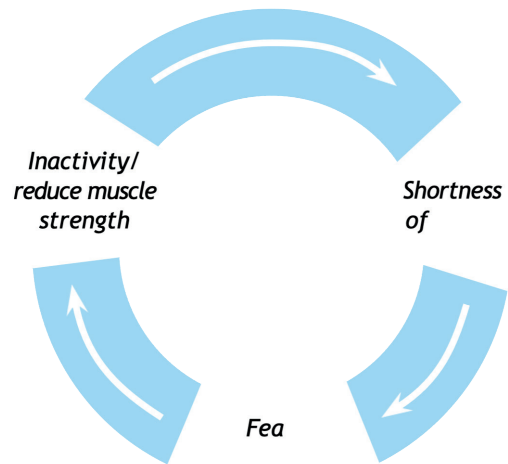
Asthma

COPD

Bronchiectasis

Cystic fibrosis

capability to utilise oxygen and improve muscle strength.



Patients with chronic respiratory conditions often get trapped in a cycle of inactivity. As they begin to get more short of breath they tend to become less active due to fear. As a result they become deconditioned and lose muscle strength. Weaker muscles require more oxygen to function, meaning the patient has to breathe harder resulting in more breathlessness and so the cycle continues. Exercise can help break this cycle resulting in;

- a reduction in breathlessness
- a reduction in anxiety and depression
- an increase in confidence
- an increase in functional ability.

Exercise may also facilitate mucous clearance.

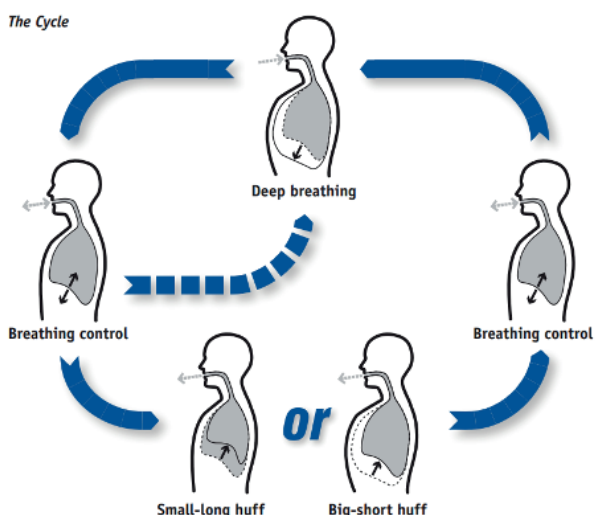
## 2.8 Exercise in respiratory disease

Patients with chronic respiratory diseases, including cystic fibrosis, asthma and COPD may benefit from exercise. Exercise has been shown to improve cardiovascular fitness and endurance, improve the body's

## Airway clearance treatments

Some Physiotherapy Support workers are training in non complex airway clearance techniques.

These can include Active Cycle of Breathing Techniques. This is a pattern of breathing starts with breathing control at rest, followed by deep breathing, and huffing (forced breath out) and repeated to aid sputum mobilization and clearance. A leaflet on this is available on the ACPRC website: [https://www.acprc.org.uk/Data/Publication\\_Downloads/GL-05ACBT.pdf](https://www.acprc.org.uk/Data/Publication_Downloads/GL-05ACBT.pdf)



ACBT can be used as a stand alone treatment technique or combined with other techniques such as postural draining, manual techniques (percussion and vibrations),

Other treatments for chest clearance may include Autogenic drainage, positive expiratory pressure (PEP), Continuous positive airway pressure (CPAP), high frequency chest wall oscillation,

intrapulmonary percussive ventilation, adjuncts such as Acapella, Aerobika. These would be started by a registered Physiotherapist, but these use of some of these techniques may be supervised by a support worker.

## Evidence

Describe briefly the benefits of exercise and airway clearance in respiratory conditions.

## Acknowledgements

NHS Tayside

## 2.9 The respiratory system workbook completion

Your supervising physiotherapist will sign your portfolio to indicate that you have completed this workbook successfully.

Objective	Physiotherapist's Signature	Date
Describe the main parts of the respiratory system and describe the function of the system		
Describe some common signs of respiratory disorders		
Discuss how you might recognise a patient that may be suffering from respiratory distress		
Describe and discuss some common respiratory diseases		
Explain the effect exercise and airway clearance can have on respiratory conditions		

Support worker (name)	
Support worker's signature	
Physiotherapist (name)	
Physiotherapist's signature	
Date	

## 2.10 The respiratory system reflection

What did you learn from this module?

How has this influenced your work?

Date module completed

# Notes

# Notes

# Notes



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