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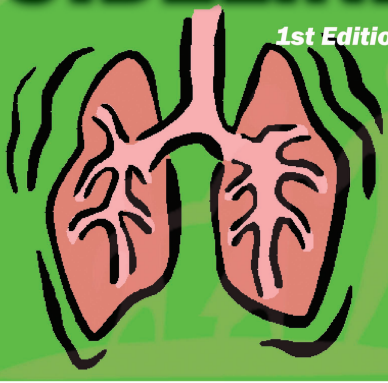
RESPIRATORY DRUG GUIDELINES

1st Edition 2008



National Drug & Therapeutics Committee Initiative

Evidence Based Drug Therapy

MINISTRY OF Health

Shaping Fiji's Health

Respiratory Drug Guidelines

First Edition
2008

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Government of Fiji Islands
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"This document has been produced with the financial assistance of the European Community and World Health Organization. The views expressed herein are those of the Fiji National Medicine & Therapeutics Committee and can therefore in no way be taken to reflect the official opinion of the European Community and the World Health Organization."

Disclaimer

The authors do not warrant the accuracy of the information contained in these guidelines and do not take responsibility for any deaths, loss, damage or injury caused by using the information contained herein. Every effort had been made to ensure the information contained in these guidelines is accurate and in accordance with current evidence-based clinical practice. However, if the evidence in the medical literature is either limited or not available, the recommendations in these guidelines are based on the consensus of the members of the subcommittee. In view of the dynamic nature of medicine, users of these guidelines are advised that independent professional judgment should be exercised at all times.

Preface

The publication of the *Respiratory Drug Guidelines* represents the culmination of the efforts of the National Medicines and Therapeutics Committee to publish clinical drug guidelines for common diseases seen in Fiji. These guidelines are targeted for health care settings. It sets the gold standards for the use of respiratory drugs in Fiji. These guidelines have taken into account the drugs available in the Fiji Essential Medicines List (EML) in recommending treatment approaches. All recommended drug therapies are either evidence-based or universally accepted standards.

It is hoped that these guidelines will be used by all health care workers in their daily care of patients suffering from respiratory diseases.

Dr. Ami Chandra
Chairman
National Medicines and Therapeutics Committee
2009

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1 Drugs Used in Respiratory Diseases

This chapter contains brief summaries of the major drugs used in the management of respiratory diseases and are recommended in these guidelines. The summaries do not contain comprehensive accounts of the pharmacology of these compounds. The reader is advised to consult standard textbooks and/or the industry product information for more details.

It is important to consider the risks and benefits of drugs (particularly corticosteroids) that are used to treat respiratory diseases. As a general principle, the lowest drug doses that achieve best therapeutic response should be used.

1.1 Beta$_2$-receptor stimulating drugs (beta$_2$-agonists)

Stimulation of beta$_2$-receptors relaxes airway smooth muscles resulting in bronchodilation. All beta$_2$-agonists may also stimulate beta$_1$-receptors; however, the effects of beta$_1$-receptor stimulation (e.g. tachycardia) are more likely to occur following systemic absorption or following inhalation of relatively large doses.

Under almost all circumstances, the preferred route of administration for beta$_2$-agonists is by inhalation.

Administration by inhalation causes bronchodilation at low doses thus minimising systemic adverse effects.

Dose-limiting adverse effects of the $beta_2$-agonists are most commonly tachycardia (which can also lead to paroxysmal tachyarrhythmias, such as atrial fibrillation or paroxysmal supraventricular tachycardia), tremors, headaches, muscle cramps, insomnia, and a feeling of anxiety and nervousness. In high doses (e.g. tablets, intravenous and emergency nebulisation) all $beta_2$-agonists can cause hypokalaemia and hyperglycaemia.

Salbutamol is the only drug in this class in the Fiji Essential Medicines Formulary (EMF) and is available in puffers, inhalation solution, as tablets, and as an intravenous preparation. It is a fast-acting bronchodilator; the effects are evident within five minutes and last for about three hours. It is used to relieve bronchoconstriction and is often referred to as a **reliever** medication.

Regular and frequent use of salbutamol without appropriate attention to other aspects of respiratory illness is inadvisable. Proper consideration of issues such as an asthma management plan, monitoring of symptoms and lung function, and suitable preventive therapy are important when salbutamol is used in the regular management of obstructive airways disease. In general, it should be reserved for intermittent symptom relief rather than regular treatment of asthma. High-volume, regular use may indicate that the underlying disease process is poorly controlled warranting modification of other aspects of drug therapy. The use of one or more canisters per month is associated with a greater risk of hospital admission.

1.2 Anticholinergic bronchodilators

Ipratropium bromide is the drug of this type available in the Fiji EMF and is given by inhalation. It is a short-acting anticholinergic drug that produces bronchodilation by blocking vagal tone and reflexes, which mediate bronchoconstriction.

Used alone, ipratropium bromide is not a powerful bronchodilator. The duration of action is approximately six hours. Although the onset of action is three to five minutes, peak effect is not reached until 1.5 to 2 hours, so ipratropium bromide should not be used for immediate relief of symptoms. The drug can be used to augment the duration of bronchodilation achieved with $beta_2$-agonist therapy and is only recommended for acute severe asthma and in chronic obstructive pulmonary disease (COPD).

Adverse effects related to the anticholinergic action of ipratropium bromide are uncommon as this drug is poorly absorbed. Some local adverse effects such as blurred vision or precipitation of glaucoma in susceptible individuals may result from inadvertent contact of nebulised drug with the eyes. Similarly, although buccal absorption is slight, some patients may experience dryness of the mouth. Systemic anticholinergic effects are very rare.

1.2 Methylxanthines (theophylline and aminophylline)

Although the mechanism of action is not well understood, xanthines may relax smooth muscle and increase diaphragm contractility. The xanthine agents available in the Fiji EMF are theophylline which is given orally, and aminophylline, a precursor of theophylline, administered intravenously. In routine use, the bronchodilator actions of theophylline offer no advantage over beta$_2$-agonists. Aminophylline should be reserved for severe acute asthma failing to respond to standard management. For patients not taking theophylline, a bolus loading dose should be given. This must be given slowly over five to ten minutes or severe side effects will result.

The efficacy of theophylline is difficult to demonstrate in patients with COPD; however, it may be helpful in some individuals. Theophylline should be considered only for patients in whom other treatment has failed to control symptoms adequately (e.g. after a trial of short- and long-acting bronchodilators) or in patients who are unable to use inhaled therapy.

These drugs have a number of unpleasant side effects including nausea and vomiting, insomnia, cardiac arrhythmias, seizures, and hypokalaemia. The liver enzymes responsible for theophylline metabolism are inhibited by a range of drugs, including macrolides (e.g. erythromycin) and quinolones (e.g. ciprofloxacin). The administration of theophylline with these drugs may cause serious theophylline toxicity. In situations where such combination therapy cannot be avoided, the patient must be monitored closely.

The enzymes responsible for the metabolism of theophylline may also be induced by cigarette smoking and by other drugs, including rifampicin, and some anticonvulsants (e.g. phenytoin, carbamazepine, barbiturates). The introduction of concurrent therapy with one of these drugs may result in a loss of the therapeutic effect of theophylline.

Theophylline has a narrow therapeutic window and the dosage for maintenance therapy should be based on assessment of clinical response and adverse effects. Lower doses may be required in the elderly or in those patients with hepatic impairment. Smokers will usually need higher doses. In the management of COPD, satisfactory clinical response may be attained with lower doses than are necessary for the treatment of asthma.

Theophylline is well absorbed after oral administration, and has a highly variable half-life of approximately eight hours in adults and four hours in children.

1.4 Corticosteroids

Corticosteroids are widely used in the treatment of asthma and other respiratory diseases to reduce bronchial inflammation and hyperresponsiveness. They are thought to reduce the synthesis and secretion of a variety of inflammatory mediators (such as prostaglandins and leukotrienes) and cytokines which are implicated in the pathogenic process underlying asthma.

Corticosteroids are used in the management of both acute severe asthma and the preventive management of asthma. The agents available on the Fiji EMF are prednisone (given orally), hydrocortisone (used parenterally), and beclomethasone

diproprionate (given by inhalation). Note that prednisone is available in the Fiji EMF and is effectively interchangeable with prednisolone.

1.4.1 Inhaled corticosteroids

Beclomethasone dipropionate is used as **preventive** therapy in asthma. It has a delayed onset of clinical effect and should be used regularly. **It is not sufficiently potent and does not have a sufficiently rapid effect to be of use in acute severe asthma.**

Inhaled corticosteroids do not generally produce systemic adverse effects until large doses are administered. Systemic effects are dependent on a complex interplay between the:

- potency of the corticosteroid
- absorption of the drug deposited in the airway, and delivery device used (metered dose inhalation [MDI] with or without spacer)
- absorption of the drug deposited in the pharynx and swallowed, and first-pass hepatic metabolism (to a minor degree).

In adults, doses at which systemic adverse effects may become manifest are those greater than 500 to 750 micrograms daily of beclomethasone. In children, doses at which systemic adverse effects may become manifest are those greater than 400 micrograms daily. Systemic adverse effects occur at lower doses in some patients and the possibility of cataracts should be considered particularly in those receiving therapy of extended duration. The dose at which the hypothalamic-

pituitary-adrenal (HPA) axis is suppressed has not yet been established for any corticosteroid, so the lowest effective dose should always be recommended.

The effect of inhaled corticosteroids on long-term growth in children is unclear. Most studies have focused on short-term growth velocity and have failed to show any reduction in final height. In fact, children with severe asthma may have improved growth velocity after starting inhaled corticosteroids perhaps by eliminating the growth-suppressive effects of poorly controlled asthma.

In low doses adverse effects are uncommon, but include hoarsess of the voice and oral/oesophageal *Candida albicans* infection (candidiasis or thrush). To minimise oropharyngeal thrush and absorption of inhaled corticosteroids, patients should be advised to rinse their throat and mouth with water and spit out after inhalation. Patients using a puffer should also be encouraged to use a spacer (especially elderly patients).

1.4.2 Oral corticosteroids

Oral prednisone is well absorbed and is eliminated by liver metabolism. Its plasma half-life is approximately three hours; however, the biological action is prolonged for up to 24 hours. Its metabolism is enhanced by drugs that induce liver enzymes (e.g. phenytoin and carbamazepine) and inhibited by drugs that inhibit liver enzymes.

Consideration of the patient's weight and age, as well as the severity of the disease being treated, should guide the dosage regimen for systemic corticosteroids. In general, the lowest

dose possible to achieve the desired clinical response should be used. Prednisone is usually given as a short course lasting several days to weeks with the aim of disease control without **exposing the patient to the drug for a long enough period for significant adverse effects to develop.**

It is generally given as a single daily dose in the morning to mimic the natural cortisol peak. Dosing in the evening often results in sleep disturbances.

The hypothalamic-pituitary-adrenal axis is suppressed by glucocorticoid therapy. The dose, duration of treatment, and individual patient characteristics affect the onset and extent of this effect. However, treatment with prednisone at doses of 5 to 10 mg for longer than two weeks can be sufficient to cause adrenal suppression. Therefore, tapering of the dose is required to avoid both adrenal insufficiency and also rebound in symptoms, which may occur with sudden cessation. The rate of reduction is dependent on the dose level, duration of treatment, and underlying disease state.

Systemic corticosteroid treatment inevitably results in adverse effects if the dose and/or duration of treatment are higher than the normal adrenal output of cortisol.

1.4.3 Parenteral corticosteroids

Hydrocortisone is used intravenously for the acute treatment of asthma. The exact time course of action is not well established but response takes at least some hours to develop.

Approximate dose equivalents of oral and parenteral corticosteroids are: oral prednisone 25 mg = hydrocortisone 100 mg intravenously (IV).

Evidence suggests that moderate to high-dose oral corticosteroids may be as effective as parenteral corticosteroid treatment for the management of acute asthma.

Very few acute adverse effects are seen, but psychosis, mood changes, hypokalaemia, and hyperglycaemia can occur.

NOTE: Prednisone is converted to prednisolone in the liver and therefore should be used in the same dose as prednisolone.

1.5 Expectorants

The clinical use of expectorants is controversial as their efficacy is still the subject of debate.

Expectorants are purported to reduce the viscosity of respiratory tract secretions and facilitate the removal of accumulated mucus and phlegm by ciliary action and coughing. By increasing respiratory tract secretions, expectorants may also soothe dry, irritated tissues and, in so doing, may reduce the urge to cough. They may also make a dry, unproductive cough more productive.

In children (or adults) a pleasant and moderately effective treatment is hot water with honey and lemon with ginger. Adults may prefer to sip hot water.

The drug available in the Fiji EMF is **sodium citrate**, claimed to act as an expectorant. In the recommended dose, it is generally well tolerated, although some patients experience gastric upsets.

Table 1. Important complications of corticosteroids.

Glucocorticoid	Mineralocorticoid
• gastrointestinal effects (e.g. dyspepsia, risk factor for peptic ulceration, gastrointestinal bleeding) • growth retardation in children • immunosuppression (risk for infections) • metabolic effects (e.g. diabetes, hypertriglyceridaemia) • myopathy • ocular effects, particularly increased intraocular pressure and cataracts • osteoporosis • pituitary-adrenal suppression • psychological disturbances (e.g. euphoria, depression, paranoid psychosis) • skin atrophy • weight gain and redistribution of fat	• hypertension • hypokalemic alkalosis • sodium-retaining effects

1.6 Antihistamines

Histamine and many other inflammatory mediator compounds are released from mast cells during type 1 (IgE-mediated) allergic reactions. Histamine released in this way stimulates H_1-receptors, which contributes to the signs and symptoms of this type of allergic reaction (i.e. redness, swelling, itching, sneezing, runny nose, nasal congestion, red eyes).

Histamine H_1-receptors antagonists can be divided into two subgroups depending on their central nervous effects (CNS) effects: sedating and less sedating. **Promethazine** is available in the Fiji EMF and belongs to the first group and produces drowsiness and sedation. These drugs may affect psychomotor performance and the ability to drive motor vehicles or to operate heavy machinery. Patients must be advised of this and cautioned against these activities. These drugs also potentiate the effect of other CNS depressants (e.g. alcohol).

Promethazine also has anticholinergic activity and may produce dry mouth, blurred vision, constipation, and urinary retention. Its use may lead to a drying effect throughout the respiratory tract and a thickening of bronchial mucus. It should not be used where their anticholinergic activity may be contraindicated (e.g. in patients with narrow angle glaucoma or prostatic hypertrophy).

1.7 Use of respiratory drugs in competitive sport

Many drugs used in the management of respiratory illnesses may be banned or restricted in the context of competitive sport. Examples include some bronchodilators, corticosteroids, and decongestants. The following drugs in the Fiji EMF have been permitted for use in national and international sporting competitions by patients with asthma:

- salbutamol
- beclomethasone
- prednisone (when used out of competition)

In all instances, it is recommended that athletes contact their national sporting organisation before taking medications. In many cases, written notification is needed via an **Abbreviated Therapeutic Use Exemption Form.** The International Olympic Committee (IOC) (http://www.olympic.org) requires that athletes wishing to take asthma medications during the games have either significant bronchodilator response or a positive bronchial challenge test.

1.8 Drug-induced lung disease

The number of drugs that have been shown to damage the respiratory system continues to grow. Drugs from the same pharmacological category tend to induce the same adverse effects. A thorough medication history should be undertaken and an adverse reaction considered in the differential diagnosis of unexplained lung disease.

Table 2. Examples of drugs that can cause lung disease.

Reaction	Drug
Bronchospasm	Beta-blockers, contrast media, nonsteroidal anti-inflammatory drugs
Cough	angiotensin converting enzyme inhibitors
Interstitial lung disease	amiodarone, methotrexate, nitrofurantoin
Pleural effusion	amiodarone, propranolol, bromocriptine, nitrofurantoin
Systemic lupus erythematosus	hydrallazine, isoniazid, phenytoin

2 Inhalational Drug Delivery Devices

Many respiratory drugs are delivered topically to the airway by inhalational devices – this achieves an effect on the airways with a rapid onset of action and minimal systemic adverse effects.

The devices available for drug delivery are metered dose inhalers (MDIs), commonly known as 'puffers' and used with or without spacers, and nebulisers.

Errors of technique occur with all devices, so it is important to check patient technique at each review. Demonstration and repetition are essential for achieving optimal patient technique.

2.1 Metered dose inhalers (MDIs) or "puffers"

A metered dose inhaler (MDI) or puffer is a multidose device usually containing micronised powdered medication and a propellant system such as hydrofluoroalkane (HFA). Care of these devices is important and the following should be observed:

- The majority of puffers need to be washed regularly to avoid blockage.

- The recommended frequency of washing ranges from daily to monthly, depending on the device. Refer to the specific product information for directions.
- Patients should shake the device every time before using it.
- If there appears to be very little liquid inside the canister when shaken, it is time to replace it.

Technique in the use of MDIs

Correct technique is vital in the use of MDIs. Since up to seventy percent of patients use an incorrect technique with a puffer resulting in inadequate drug delivery to the lungs, the following steps should be observed:

- Check patient technique and demonstrate the correct technique (if necessary) at every opportunity. It has been shown that there is deterioration in technique within two months of correct demonstration.

- The device should be held upright with the mouthpiece at the bottom. This allows an accurate dose to be dispensed into the actuator valve.

- Deposition of the drug from the inhaler to the airway is achieved by coordinating the actuation of the puffer and inhalation of the aerosol mist.

- Starting **at the end of a normal expiration**, the puffer should be actuated once at the same time as a slow deep inspiration through the mouth is undertaken. At the

completion of the slow deep inspiration, the breath should be held for approximately 10 seconds.

There are two techniques which are both satisfactory if performed well:

- Closed mouth – where the lips are sealed around the mouthpiece of the MDI.
- Open mouth – where the inhaler is held up to 6 cm away from the mouth.

The common errors when using puffers include the following:

- failing to coordinate the puffer actuation with the start of the inspiration
- inspiring too rapidly
- closing the mouth and then inspiring through the nose after actuation of the puffer
- actuating the puffer more than once during the inspiration
- failing to hold the breath.

2.2 Spacer devices

It is often appropriate to use a chamber device with the MDI. These spacers hold the aerosol cloud, which is produced from an MDI, in a confined space and allow subsequent inhalation over a longer period. Evaporation of some of the propellant produces particles of smaller size and gives the potential for greater endobronchial deposition. Spacer devices have a valve system which can help patients who have problems with coordination. They are particularly useful in decreasing the

oropharyngeal deposition of the medication and increasing the proportion of the dose delivered to the lung. With inhaled corticosteroids, spacers are an important means of reducing candidiasis and dysphonia.

Inhalation of aerosol from the spacer should commence as soon after actuation as possible to minimise deposition in the spacer and loss of the drug. One actuation of MDI per inhalation is recommended.

Spacer devices with MDI in appropriate doses may be substituted for nebulised medication. During asthma exacerbations, 4 to 10 inhalations of standard dose short-acting beta$_2$-agonists can produce a similar bronchodilator effect to standard nebulised doses.

2.2.1 Technique in the use of spacer device

The proper use of a spacer is as follows:

- Shake the MDI before use.
- Insert MDI, mouthpiece down, into the spacer.
- Actuate the MDI.
- Inhale slowly and deeply from the spacer (starting as soon after actuation as possible).
- Hold breath for 10 seconds.

Two modifications of the use of spacer devices may be applicable for children:

- Take four to six tidal breaths to inhale the aerosol.

- Use a face mask adapter to inhale from the spacer (for infants and young children).

2.2.2 Care of spacer devices

- Spacers should be washed before initial use and at least monthly thereafter.
- Use kitchen detergent mixed with warm water.
- Leave to drain (without rinsing) and allow to dry before use.
- A cloth should not be used to dry the spacer as this can produce an electrostatic charge causing drug particles to adhere to the walls of the spacer.
- Before using the spacer, it should be 'primed' by actuating three to five doses of the drug. This minimises fluctuations in inhaled doses due to variation in electrostatic charge.

2.2.3 Use of devices in children

MDIs with a spacer and mask can be used in children younger than two years of age. MDIs alone require a reasonable amount of coordination; therefore, they should not be used without a spacer.

2.3 Nebulisation

There is a tendency to overuse this expensive form of drug delivery. The inhalation, via a large-volume spacer, of four to ten separate actuations from a standard beta$_2$-agonist MDI,

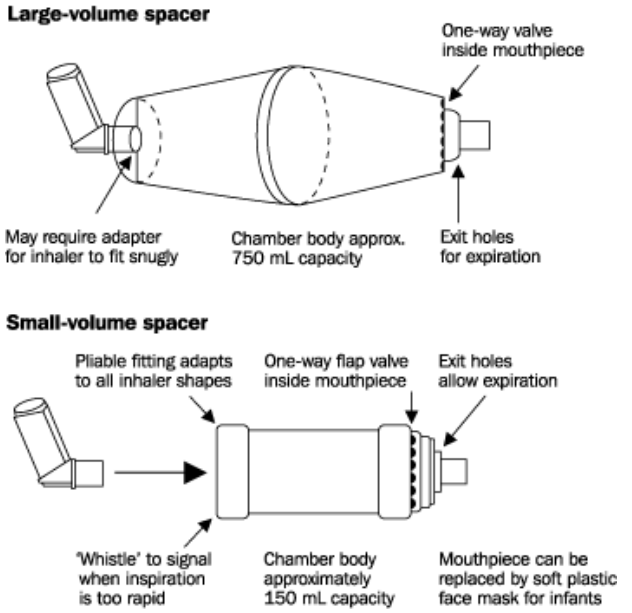

Figure 1. A schematic diagram of a spacer device.

provides an equivalent bronchodilator effect to that achieved by nebulisation.

Nebulisation aims to produce an aerosol from a solution of drug in a bowl. This may be done using a simple pump or, if electricity is not available, an oxygen cylinder can be used. In children with asthma, oxygen, if available, may be the better choice.

Technique in the use nebulisers

Nebulisers produce reasonable aerosols with a flow of at least 8 liters per minute. The nebuliser fill volume should be 2.5 to 5 ml of solution, which will usually achieve nebulisation of about 80% of the contents within the first five to ten minutes. If nebulisation is incomplete after 10 or 15 minutes, the nebuliser might be blocked or cracked, or the pump may be faulty. Pumps should be serviced and filters changed regularly every 6 to 12 months depending on the amount of use.

2.4 Oxygen therapy

Oxygen is essential for human metabolism and lack of oxygen is generally fatal within five to six minutes. Oxygen has almost no adverse effects in the acute situation and should not be withheld if there is any suggestion of it being needed. The indications for oxygen therapy are:

- respiratory arrest
- hypoxia of any cause
- acute asthma attack

- exacerbation of COPD.

Oxygen therapy should be monitored with pulse oximetry and blood gas estimation if available. Aim to achieve an oxygen saturation of at least 95%. Humidification of oxygen is not necessary.

2.4.1 Methods of Oxygen Delivery

a. Intranasal Catheters

These provide a low concentration of oxygen of between 25 and 40%. They should be used with an oxygen flow rate of between 1 and 4 liters per minute (1 – 2 liters per minute in children). Higher flow rates cause drying of the nasal mucosa and are uncomfortable. They should only be used in patients with mild hypoxia or cardiac failure or myocardial ischaemia. They do not provide a high enough oxygen concentration for patients with significant hypoxia, carbon monoxide poisoning, shock, or cardiac arrest.

b. Plastic face masks

These provide oxygen concentrations of between 35% and 70%. The oxygen flow rate should be set between 4 and 15 liters per minute. Do not use face masks with an oxygen flow rate less than 4 liters per minute. This method of oxygen delivery is suitable for patients with moderate hypoxia or shock.

c. Tight fitting face masks (eg. Laerdal, continuous positive airway pressure [CPAP] masks)

These devices can provide oxygen concentrations close to 100%. They should be used in patients with severe hypoxia or with cardiac arrest.

2.4.2 Adverse Effects of Oxygen

Patients with chronic obstructive airway disease and elevated carbon dioxide levels may occasionally have a hypoxia-dependent respiratory drive. In these patients, the administration of oxygen causes hypoventilation and an increase in the carbon dioxide level. Although this may cause problems, it is far less dangerous than hypoxia itself. In the emergency situation, it is important that hypoxia is corrected – problems with carbon dioxide retention can be handled later. Do not hesitate to give oxygen to hypoxic patients with chronic obstructive airway disease.

Administration of 100% oxygen sometimes causes pulmonary toxicity but this only occurs after 24 hours and therefore is not a problem in the emergency situation.

NOTE: If arterial blood gas determination is available, they should be measured before the commencement of oxygen therapy to establish the baseline oxygen saturation.

3 Pulmonary Function Testing

Pulmonary function tests play a role in:

- assessing breathlessness, asthma, and other chronic chest disorders
- monitoring response to treatment
- assessing fitness for surgery.

The results of pulmonary function tests are reported in relation to reference values and whether they fall within the normal range for an individual of that age and gender.

Listed below are available tests that measure expiratory air flow.

3.1 Peak expiratory flow (PEF)

This method uses a portable PEF meter and can be valuable in assessing the diurnal variability of airflow obstruction (a characteristic feature of asthma), as well as the response to therapy. The technique is simple and can be performed as part of the asthma management plan. It is not as sensitive as spirometry but patients can be taught to do it.

Technique is important and the following steps should be observed:

- Insert tube firmly ino the monitor.
- Hold a few centimeters from the mouth.
- Take in a deep breath and hold it as much as possible.
- Put tube into mouth and close lips firmly around it.
- Blow into tube as hard, as fast and, as long as possible.
- Rest for 30 seconds.
- Repeat above steps thrice.
- Record best result.

3.2 Spirometry

This measures more parameters of lung function and is more accurate than PEF. However, the test is effort-dependent and should be performed by trained personnel in order to obtain reproducible results. It should be performed using the same technique as for measuring PEF.

For immediate assessment and ongoing monitoring of asthma, the forced expiratory volume exhaled in one second (FEV_1) is the most useful. For assessment of lung damage in a variety of lung diseases, the expiratory forced vital capacity (FVC) and the total lung capacity (TLC) can be helpful. Additionally, the FEV_1 can be recorded and expressed as a percentage of FVC. Results for an individual can be compared with reference values matched for age, gender, height and ethnicity. The range of normal values for the FEV_1 and FVC is between 80% and 120% of that predicted from the reference values.

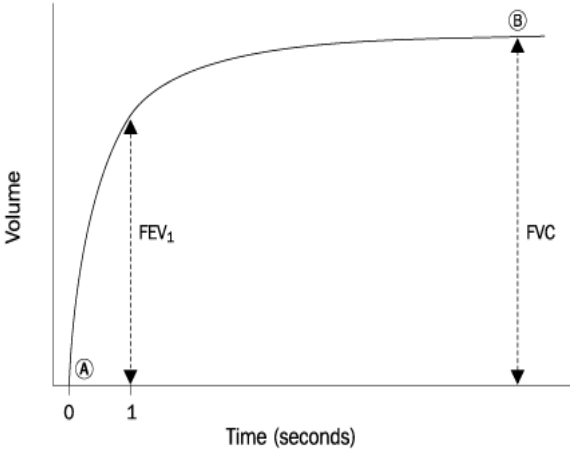

Figure 2. A normal spirogram.

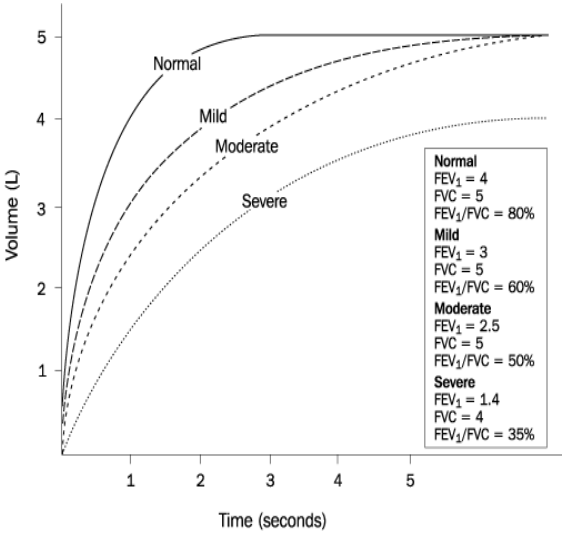

Figure 3. Spirogram showing obstructive ventilatory defect.

4 Asthma

Asthma is a common chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation causes an associated increase in airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particulary at night or in the early morning. These episodes are usually associated with widespread but variable airflow obstruction that is reversible spontaneously or with treatment.

Management includes prevention of attacks, treatment of acute attacks and, where necessary, long-term medication which works best with strict adherence. All patients, both adults and children, should be given an asthma management plan which needs frequent review and repetition to ensure full understanding by the patient or parents of the child. It is essential that they understand the difference between reliever puffers (MDIs) and the preventer puffers.

4.1 Prevention of attacks

It may be possible to prevent or reduce the severity of attacks by:

- avoidance of trigger factors where possible, e.g. known allergens, tobacco smoke, stress, infection, physical exertion, etc.
- appropriate management of acute exacerbations

- appropriate management of infections
- appropriate long-term medication use with an individual patient management plan
- regular assessment by lung function tests
- avoidance of drugs that can cause bronchoconstriction, e.g. beta-blockers, aspirin, ibuprofen and indomethacin.

4.2 Treatment of an acute attack of asthma

Severity is estimated by clinical assessment, measurement of peak expiratory flow rate and by pulse oximetry (Table 3 and Table 4).

The pulse rate may be helpful in indicating severity of an attack:

- Mild < 100 per minute
- Moderate 100-120 per minute (children 100-200 per minute)
- Severe > 120 per minute (children > 200 per minute).

Wheezing is an unreliable indicator of the severity of an asthma attack and may be absent in a severe attack. The patient will lack sufficient air flow to allow him or her to perform lung function tests. Inability to speak in sentences or phrases (i.e. only one word at a time) is also a marker of severity. Altered level of consciousness is another feature.

Cyanosis indicates life-threatening asthma.

Table 3. Assessment of severity of asthma in adults.

Classification of severity	Common features (before introduction of appropriate treatment)
Very mild	Episodic
Mild	Occasional symptoms (up to two per week)
Moderate	• Symptoms in most days • Exacerbations < 6 to 8 weeks apart which affect daytime activity and sleep • Exacerbation last for several days • Occasional A & E visits
Severe	• Persistent • Limited activity level • Nocturnal symptoms > one per week • Frequent A & E visits and hospital admissions in the past year • FEV_1 may be significant reduced

(Adapted from: Asthma management handbook. Sydney: National Asthma Campaign Ltd; p. 22).

All patients with moderate or severe asthma should be given oxygen.

Patients with severe asthma should be managed in an intensive care unit if possible, and may, occasionally, require intubation and mechanical ventilation.

Table 4. Assessment of severity of asthma in children.

Age	Mild	Moderate	Severe	Life-theatening
< 2 years	Cough and wheeze without distress, cyanosis or increased respiratory rate; able to speak normally between breaths	$SaO_2 \geq$ 92%, audible wheeze, using accessory muscles, feeding	SaO_2 < 90%, cyanosis, marked respiratory distress, too breathless to feed	SaO_2 < 92%, silent chest, poor respiratory effort, agitation or altered consciousness, cyanosis
2 – 5 years		$SaO_2 \geq$ 92%, peak flow > 50% best or predicted, no clinical features of severe asthma	SaO_2 < 92%, peak flow < 50% or predicted, too breathless to talk, HR > 120/min, RR > 30/ min, use of accessory muscles	

Adapted from *BNF for children.* BMJ Publishing Group, 2005.

4.2.1 Treatment in Adults

a. Oxygen

- *Give oxygen by face mask to maintain oxygen saturation ≥ 92%.*

b. Beta-adrenergic agonists

Use beta-adrenergic agonists to reverse bronchospasm. In very severe asthma, intravenous salbutamol may be considered in addition to nebulised therapy.

- Give s*albutamol 5 mg by nebuliser (mixed with 1 ml of normal saline) with oxygen and repeat every 30 minutes; nebulise continuously in severe asthma;*

OR

- Give s*albutamol by puffer using spacer (up to 50 puffs) if nebulisers are not available.*

PLUS, if very severe,

- Give s*albutamol 5 micrograms per kg intravenously (to a maximum of 250 micrograms) over one minute then commence an infusion at 5 micrograms per kg per hour.*

NOTE: Continuous nebulised salbutamol is probably as

effective as intravenous salbutamol.

c. Anticholinergics

These agents have a synergistic effect with beta-adrenergic agonists. In severe asthma consider the use of ipratropium bromide.

- Give *ipratropium bromide 500 micrograms by nebuliser and repeat every 6 hours.*

d. Corticosteroids

Steroids reduce inflammation of the airways. Their effects are delayed for at least four hours but they are important to prevent relapse. Oral steroids are as effective as those given parenterally in most patients.

- Give *hydrocortisone 200 mg intravenously stat then 100 mg intravenously 6- hourly;*

  OR

- Give *prednisone 50 mg orally daily.*

e. Other Drugs

i. Aminophylline

Aminophylline provides no additional benefit to

optimal doses of beta-adrenergic agonists. It has a number of undesirable side effects including seizures, ventricular tachycardia, hypokalaemia, and vomiting. **Routine use in asthma is not recommended**. However, it may be of benefit in patients with severe asthma who require hospitalisation. A loading dose is given to patients who are not taking oral theophylline followed by a maintenance infusion; otherwise, start with maintenance infusion.

- *Aminophylline 5 mg per kg (to a maximum of 250 mg) intravenously over 5 minutes followed by an infusion of 0.3 to 0.6 mg per kg per hour.*

ii. Adrenaline

Adrenaline does not appear to have any advantage over salbutamol. It may be used as a last resort or when intravenous access or nebulisers are not available.

- Give *1:1,000 adrenaline 0.5 to 1 ml intramuscularly or subcutaneously.*

NOTE: Adrenaline may be given down the endotracheal tube – the dose is five times the intravenous dose and it should be diluted in 10 ml of normal saline.

4.2.2 Children

Prior to the administration of any form of treatment, the severity of asthma should be assessed (Table 4).

a. Oxygen

- Give *oxygen via face mask to all children with acute asthma.*

b. Beta-adrenergic agonists

Use beta-adrenergic agonists to reverse bronchospasm. In very severe asthma, intravenous salbutamol may be useful in addition to the nebulised route.

- Give *salbutamol 2.5 mg for children ≤ 5 years or 5 mg for children > 5 years with oxygen at 4 to 6 liters per minute. Repeat every 20 minutes if necessary.*

  PLUS, if condition deteriorates,

- Give *continuous nebulised salbutamol.*

- *A loading dose of intravenous salbutamol may be given* ***but only in consultation with the paediatric team****:*

  Give salbutamol 5 to 10 micrograms per kg intravenously over one minute for one hour

Maintenance dose is 1 to 5 micrograms per kg per minute.

NOTE: The patient will need to have electrocardiographic (ECG) monitoring and serum potassium levels checked regularly to detect for hypokalaemia.

c. Anticholinergics

These agents have a synergistic effect with beta-adrenergic agonists.

- Give *ipratropium bromide 250 micrograms mixed with each salbutamol nebuliser given. This may be repeated every 20 minutes for three doses in the first hour and then every 4-6 hourly.*

d. Corticosteroids

Steroids reduce inflammation of the airways. Their effects are delayed for at least four hours but they are important to prevent relapse. Oral steroids are as effective as those given parenterally in most patients.

- Give *hydrocortisone 2 to 4 mg per kg (maximum dose: 100 mg) stat then every 6 hours thereafter;*

OR

- Give *prednisone 1 to 2 mg per kg (maximum dose: 60 mg) orally daily. This can be given for 3 to 5 days then ceased*

without tapering the dose.

e. Other drugs

i. Aminophylline

Aminophylline provides no additional benefit to optimal doses of beta-adrenergic agonists. It has a number of undesirable effects including seizures, ventricular tachycardia, hypokalaemia, and vomiting. Routine use in asthma is not recommended. However, it may be of benefit in patients with severe asthma but, it can be used after consultation with the paediatric team. A loading dose is given to patients who are not taking oral theophylline.

- Give *aminophylline 5 mg per kg (to a maximum of 250 mg) intravenously over 20 to 30 minutes (with cardiac monitoring). The maintenance dose is 1 mg per kg per hour.*

ii. Adrenaline

Adrenaline does not appear to have any advantage over salbutamol. It may be used in severe asthma when intravenous access is not available. Consult paediatric team prior to its use.

- Give *adrenaline 1:1,000 at 0.01 ml per kg intramuscularly or subcutaneously to a maximum*

of 0.5 ml. This dose can be repeated every 15 minutes for 3 to 4 doses OR 4-hourly pro re nata (PRN).

4.3 Management after an acute attack

4.3.1 Adults

All patients will need follow up and some form of on going therapy based on the severity of asthma (Table 3).

- Review trigger factors to identify the possible cause of the attack.
- Discuss avoidance measures of identified trigger factors.
- Start or adjust patient's management therapy.
- Design or adjust the patient's asthma action plan.
- Review adherence to prescribed medication regimen.

a. Mild episodic

Patient may only need to use:

❖ *Salbutamol puffer 1 to 2 puffs PRN up to 8 puffs a day (with spacer for children or adults with poor coordination).*

They should be advised of the symptoms of an acute attack and told to seek medical advice if their need to use the puffer increases or they are using more than 8 puffs a day.

If unable to use a puffer with or without a spacer,

- *Salbutamol tablets 4 mg orally 6- to 8- hourly;*

  OR

- *Theophylline SR 300 mg orally twice a day.*

b. Moderate persistent asthma

- *Salbutamol puffer 1 to 2 puffs PRN up to 8 puffs a day (with spacer for adults with poor coordination);*

  OR, if unable to use a puffer with or without a spacer,

- *Salbutamol tablets 4 mg orally 6- to 8- hourly;*

  OR

- *Theophylline SR 300 mg orally twice a day;*

  AND ADD,

- *Beclomethasone diproprionate puffer 100 micrograms twice a day.*

Review any trigger factors, asthma management plan, and arrange for follow-up, if possible.

c. Severe persistent

If symptoms persist or deteriorate, continue any existing oral therapy and inhaled salbutamol and consider:

- ❖ *Using a spacer with 5 to 10 puffs inhaled over 5 to 10 minutes every 2 hours;*
- ❖ *If unavailable, give inhaled salbutamol 5 mg over 10 minutes 2- to 4- hourly;*
- ❖ *Increase beclomethasone diproprionate puffer dose to 200 micrograms twice daily.*

If symptoms persist, start

- ❖ *Prednisone 25 to 50 mg orally daily for 1 to 2 weeks.*

If response is good, taper off prednisone over 10 days. Some patients with severe asthma will need long term:

- ❖ *Prednisone 5 to 7.5 mg orally daily.*

If none of the above treatments produce improvement, the patient should be referred urgently to the hospital for acute management.

4.3.2 Children

All should have follow-up and some form of on going therapy and asthma plan.

- Review trigger factors to identify possible cause of the attack.
- Discuss avoidance measures of identified trigger factors.
- Start or adjust the patient's maintenance therapy.
- Design or adjust the patient's asthma action plan.

- Review adherence to prescribed medication regimen.

a. Mild episodic

❖ Give *salbutamol puffer 1 to 2 puffs PRN up to 8 puffs a day (with spacer).*

Parents should be advised of the symptoms of an acute attack and told to seek medical advice if their need to use the puffer increases or they are using more than eight puffs a day;

OR

If aged 1 to 5 years and unable to use puffer with or without spacer,

❖ Give *salbutamol (2 mg per 5 ml):*
- *< 3 years: 2 to 5 ml three times a day*
- *3 to 5 years: 5 ml three times a day.*

b. Moderate persistent

❖ Give *salbutamol puffer 1 to 2 puffs PRN up to 8 puffs per day (with spacer);*

OR, if unable to use puffer with or without spacer,

❖ *Theophylline elixir (80 mg per 15ml), 4 mg per kg (for children 1 to 9 years) orally every 4 to 6 hours.*

AND ADD,

For children over 6 years and/or unable to use an inhaler with spacer,

- *Beclomethasone diproprionate puffer 50 to 100 micrograms twice daily.*

For children under 6 years old and/or unable to use inhaler with spacer,

- *Prednisone 1 mg per kg orally for 3 days and review.*

If prednisone dose cannot be reduced or discontinued, seek medical advice.

c. Severe persistent

If symptoms persist or deteriorate, continue any existing oral therapy and inhaled salbutamol and give, if possible:

- *Salbutamol 5 to 10 puffs inhaled using a spacer over 5 to 10 minutes every 2 hours.*
- *If available, give nebulised salbutamol 5 mg over 10 minutes every 2 to 4 hours.*
- *Increase beclomethasone diproprionate puffer dose to 100 micrograms twice a day.*

For children unable to inhale with a spacer, give

- *Theophylline elixir (180 mg per 15 ml) 4 mg per kg orally every 4 to 6 hours (for children 1 to 9 years old);*

AND

- *Prednisone 2 mg per kg orally daily for 1 to 2 days.*

If none of the above treatments produce improvement, the patient should be referred immediately to the hospital.

4.4 Review and education

Optimal self-management and education with regular clinical review result in significant reductions in emergency health care utilization. A structured program conducted over time that teaches detection and management of deteriorating asthma and optimal use of medications is required. The essential components of this program are:

- written information about asthma
- self-monitoring and feedback
- education about optimal delivery device technique
- provision of an individualised written asthma action plan
- regular medical review and assessment of medications (including corticosteroid reduction when the patient has been stable for a reasonable length of time, e.g. three months).

4.5 Improving adherence to medications

If asthma is poorly controlled despite apparently adequate treatment, consider poor adherence to medications as the most likely cause. Adherence to medications falls with improvement in symptoms. Strategies that may improve adherence include:

- Utilising an open, non-judgemental approach when discussing about adherence.
- Allowing the patient to express their concerns about medications and addressing these concerns.
- Improving the patient's understanding of asthma management over a period of time; comprehensive information can rarely be retained after one visit.
- Explanining the goals of treatment; adherence will be improved if your aims are in concordance with the patient's goals.
- Keeping treatment simple and setting achievable goals in collaboration with the patient (using once- or twice-daily dosing where possible, using as few medications as possible).
- Discussing potential adverse effects.
- Identifying useful daily associations to simplify medication adherence (e.g. using preventive therapy in the bathroom, after brushing the teeth, etc.).
- Obtaining support of the patient's family and peers.
- Regular communication with the doctor.
- The need for infants or toddlers to use oral or inhaled corticosteroids.
- The need for older children to use maintenance inhaled corticosteroid therapy at doses greater than 600 micrograms daily of beclomethasone (or the equivalent dose of other drugs).
- The need for discussion on complications of treatment.
- Consider occupational factors as trigger factors for asthma.
- The need for a detailed discussion on control of the home environment.

4.6 Asthma management plan

In the management of asthma, both patients and health professionals should use the same framework of management and similar terminology. To facilitate this, a six-point management plan[1] has been proposed:

- assess asthma severity
- achieve best lung function
- maintain best lung function – identify and avoid trigger factors
- maintain best lung function – optimise medication program
- develop an asthma action plan
- educate and review regularly.

4.7 Asthma action plan

All patients should have an individualized asthma action plan (in **written** form) that outlines how to:

- recognize symptoms of asthma deterioration
- start treatment
- reach medical attention.

Action plans may be based on peak expiratory flow (PEF) measurements or asthma symptoms or both. Plans should be

[1] By the Thoracic Society of Australia and New Zealand, The Royal Australian College of General Practitioners, the Pharmaceutical Society of Australia and the Asthma Foundation, through the National Asthma Council.

simple, individualized, and based on two to four action points. Plans based on PEF measurements should use personal best PEF as action points. All patients with asthma should know how to obtain prompt medical assistance.

The principles of asthma action plans are:

- Increase the dose and frequency of inhaled $beta_2$-agonist.
- Increase the dose of inhaled corticosteroid or commence prednisone if the patient is already on a high dose of inhaled corticosteroid.
- Obtain prompt medical attention.
- In an emergency, immediate use of a high-dose inhaled short-acting $beta_2$-agonist (e.g. salbutamol 6 to 10 inhalations by MDI or 5 mg by nebuliser) and transfer to an emergency department (preferably by an ambulance that carries supplemental oxygen).

An example of an asthma management plan is shown in Box 1 (Adapted from Global Initiative for Asthma. 2006. Available at <http://www.ginasthma.com>).

Box 1. An example of an asthma plan to maintain asthma control.

Your regular treatment
Each day take _____
Before exercise, take _____

When to increase the treatment
Assess the level of asthma control

- In the past week, have you had:
- Daytime asthma symptoms more than two times?
- Activity or exercise limited by asthma?
- Waking at time because of asthma?
- The need to use your rescue medication more than two times?
- If you are monitoring peak flow, peak flow less than ___?

If you answered **YES** to **three or more** of these questions, your asthma is uncontrolled and you may need to step up your treatment.

How to increase your treatment
Step up your treatment as follows and assess improvement every day: _____ (Write in next treatment step here).
Maintain this treatment for _____ (specify number).

Emergency / Severe loss of asthma control

- If you have severe shortness of breath, and can only speak in short sentences.
- If you are having severe attack of asthma and are frightened.
- If you need your reliever medication more than every 4 hours and are not improving.

Take 2 to 4 puffs _____(reliever medication).
Take ____ mg of _____ (oral gluocorticoid).
Go to the nearest health care facility.
Continue to use your _____ (reliever medication) until you are able to get medical help.

5 Chronic Obstructive Pulmonary Disease (COPD)

5.1 Definitions

Chronic obstructive airways disease (COPD) is characterised by airflow obstruction that is not fully reversible. The airflow limitation is, in most cases, both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases, most commonly cigarette smoke. COPD is usually some combination of:

- emphysema, where the lung parenchyma is structurally damaged, with destruction of alveolar septa and formation of abnormally enlarged airspaces
- airway damage with airway wall thickening and narrowing of the airway
- chronic bronchitis which is defined clinically as a cough productive of sputum, occurring on a daily basis for three months in each of two consecutive years.

Some patients may have bronchodilator responsiveness whether or not they have a history of asthma. The dyspnoea of COPD is frequently associated with cough, sputum production, recurrent respiratory infections, and wheezing. These symptoms may only be evident during infective exacerbations.

The development of dyspnoea is usually insidious occurring for several years and may be the patient's only symptom.

Generally, COPD affects middle-aged and older people, and **cigarette smoking is the major causative factor.** Figure 4 illustrates the accelerated decline in lung function caused by smoking.

5.2 Measurement of lung function

The spirometric abnormalities associated with COPD are a reduction in post-bronchodilator forced expiratory volume in 1 second (FEV_1), and a reduction in the FEV_1/forced vital capacity (FVC) ratio to less than 70% (i.e. an obstructive pattern).

5.3 Management of chronic stable COPD

5.3.1 Smoking cessation

Smoking cessation is the only intervention that has been shown to improve the natural history of COPD. To prevent deterioration, it is vital that the patient stops smoking (refer to Figure 4).

5.3.2 Bronchodilators for long-term treatment of COPD

In the long-term treatment of COPD, bronchodilators are recommended for the relief of wheezing and shortness of

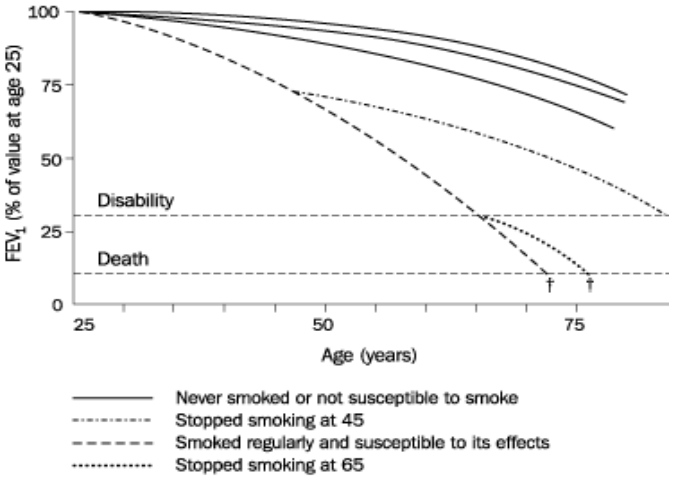

Figure 4. Smoking and loss of forced expiratory volume in 1 second (FEV_1).

The differences between the lines illustrate effects that smoking and stopping smoking can have on the FEV_1. This figure shows the rate of loss of FEV_1 for one particular susceptible smoker; other susceptible smokers will have different rates of loss, thus reaching 'disability' at different ages.
† = death, the underlying cause of which is irreversible chronic obstructive pulmonary disease, whether the immediate cause of death is respiratory failure, pneumonia, cor pulmonale, or aggravation of other heart disease by respiratory insufficiency

This figure was first published in Fletcher C and Peto R. The natural history of chronic airflow obstruction. *BMJ* 1977;1:1645-1648 and is reproduced by permission from the BMJ Publishing Group.

breath. Anticholinergic agents are more effective in COPD than they are in asthma.

Bronchodilators can improve the FEV_1, FVC, and exercise tolerance independently of each other. Spirometric changes are not seen in all patients, but improvement in symptoms and functional capacity can occur even without spirometric changes.

- Give *salbutamol 100 to 200 micrograms MDI by inhalation, up to four times daily;*

  OR

- *Ipratropium bromide 40 to 80 micrograms by inhalation, up to four times daily.*

NOTE: Ipratropium bromide is not available in the Fiji EMF.

If the response to initial single-agent therapy is unsatisfactory or the patient has moderate to severe disease, a combination of the above two drugs can be used.

Patients with poor inhalation technique can use a large-volume spacer – this improves lung deposition of the aerosol. In patients who are unable to use an MDI (with or without a spacer),

- Give *salbutamol 4 mg orally 8-hourly as tolerated;*

  OR

❖ *Theophylline SR 300 mg orally twice daily.*

The effect of these agents may be monitored by self-reported symptoms, or by PEF, or spirometry.

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5.3.3 Corticosteroids for long-term treatment of COPD

Only ten percent of patients with stable COPD benefit in the short term from corticosteroids. There are no distinguishing clinical features to predict which patients may benefit. Oral corticosteroid reversibility tests do not predict response to inhaled corticosteroids; they should not be used to identify which patients should be prescribed inhaled corticosteroids.

a. Inhaled corticosteroids

The aim of treatment with inhaled corticosteroids is to reduce exacerbation rates and slow the decline in health status and not to improve lung function *per se*. The effect of inhaled corticosteroids on mortality is uncertain. **Benefits are not seen in patients with COPD who continue to smoke cigarettes.**

Inhaled corticosteroids should be prescribed for patients:

- with an FEV_1 less than or equal to 50% of the predicted value
- who have documented evidence of responsiveness to inhaled corticosteroids (on PEF or spirometry)

- who have had two or more exacerbations requiring treatment with antibiotics or oral corticosteroids in a 12-month period.

❖ Give *beclomethasone dipropionate 300 to 400 micrograms by inhalation twice daily.*

To minimise oropharyngeal candidiasis and systemic absorption of inhaled corticosteroids, patients should be advised to rinse their throat and mouth with water and spit out after inhalation. Patients using a puffer should also be advised to use a spacer to lessen the risk of candidiasis and dysphonia.

Ideally, the response to corticosteroids should be closely monitored with measurement of PEF or spirometry.

Patients who do not suffer frequent exacerbations should be assessed after about six weeks of treatment. Because of the potential risks of long-term corticosteroid use, only those patients in whom clear objective benefit has been obtained should continue with the treatment. Inhaled corticosteroid doses should be gradually reduced to the minimum dose that maintains subjective benefit.

b. Oral corticosteroids

Oral corticosteroids are not recommended for maintenance therapy in COPD. However, they may be needed in some patients with advanced COPD in whom corticosteroids cannot be withdrawn following an acute exacerbation. In these cases, the dose of oral corticosteroid should be kept as low as possible.

c. Combined therapy for long-term treatment of COPD

If patients remain symptomatic on monotherapy, their treatment should be intensified by combining therapies from different drug classes. Combined therapy should be discontinued if there is no improvement in symptoms or in the lung function tests.

5.4 Complications of COPD

5.4.1 Management of pulmonary hypertension and cor pulmonale

Cor pulmonale is defined as an alteration in the structure and function of the right ventricle caused by a primary disorder of the respiratory system. Pulmonary hypertension is the common link between lung dysfunction and the heart in cor pulmonale. Hypoxic patients with COPD develop pulmonary hypertension, which may be present for years without causing symptoms. In some patients, it leads to the development of the clinical syndrome of cor pulmonale. This should be considered if patients with COPD have:

- peripheral oedema
- raised jugular venous pressure
- a systolic parasternal heave
- a loud pulmonary second heart sound.

In addition to therapy for COPD,

❖ Give *frusemide 40 to 80 mg orally daily.*

5.4.2 Obstructive sleep apnoea

Obstructive sleep apnoea is common in patients with COPD, particularly in those with advanced disease. Patients with COPD and co-existing sleep apnoea may have hypoxaemia that worsens during sleep and in the recumbent position. Management should be tailored and designed to optimise the patient's physical and social performance as well as autonomy.

5.5 Acute exacerbation of COPD

Exacerbation of COPD is a common problem in emergency medicine. The response of COPD to treatment is generally slower than that of asthma and most patients require admission.

5.5.1 Oxygen

It is essential that oxygen be given to maintain oxygen saturation greater than 92%. Although administration of oxygen can cause an elevation in arterial carbon dioxide levels in a few patients, this is far less of a problem than hypoxia itself. For mildly hypoxic patients, oxygen via an intranasal catheter will be sufficient while those with more severe hypoxia may require oxygen via a face mask. Use the lowest flow rate necessary to maintain an adequate arterial oxygen saturation.

CAUTION: In patients with $C0_2$ retention, oxygen saturation

should be maintained as high as possible without causing an unacceptable rise in partial pressure of carbon dioxide ($paCO_2$).

5.5.2 Bronchodilators

Salbutamol and ipratropium have a synergistic action.

- Give *salbutamol 5 mg via nebuliser every 2 to 4 hours;*

  PLUS

- Give *ipratropium bromide 500 micrograms via nebuliser every 4 hours.*

If a nebuliser is not available, use puffers with a spacer.

5.5.3 Corticosteroids

Oral and parenteral routes are equally effective.

- Give *hydrocortisone 100 mg intravenously 6-hourly;*

  OR

- Give *prednisone 40 mg orally daily.*

5.5.4 Antibiotics

Since many exacerbations of chronic obstructive pulmonary disease (COPD) are due to viral infections or non-infective causes, antibiotics are only occasionally indicated. At least half of patients with chronic bronchitis are persistently colonised with *Haemophilus influenzae*, *Streptococcus pneumoniae*, or *Moraxella catarrhalis*; hence, **a positive sputum culture is not necessarily indicative of acute infection.** However, these organisms may be responsible for more severe exacerbations, in which antibiotics have been shown to be of benefit. The aim of treatment with antibiotics in acute exacerbations of chronic bronchitis is to reduce the volume and purulence of sputum. Antibiotics have been shown to be effective only when all three cardinal symptoms of acute bacterial exacerbations are present: increased dyspnoea, increased sputum volume, and sputum purulence.

When indicated,

- Give *amoxycillin 500 mg orally every 8- hourly for 5 to 7 days;*

  OR, if penicillin sensitive,

- Give *erythromycin 500 mg orally 6-hourly for 5 to 7 days;*

  OR

- *Chloramphenicol 500 mg orally 6-hourly for 5 to 7 days.*

6 Cough

Cough is a frequent symptom and sign of an underlying disease, but is not in itself a diagnosis. Management should concentrate on defining and then treating the underlying cause, if appropriate and possible.

Cough may be due to:

- smoking
- infections (e.g. viral sore throat, tracheitis, pneumonia, tuberculosis, etc.)
- asthma
- rhinitis/postnasal drip
- carcinoma of the bronchus or lung
- bronchiectasis
- interstitial lung disease
- aspiration (e.g. neuromuscular disorders, stroke)
- heart failure, especially if cough is nocturnal
- oesophageal reflux
- drugs (e.g. angiotensin converting enzyme inhibitors).

6.1 Cough in adults

The most important aspect of management is the diagnosis and treatment of any underlying condition and reassurance where appropriate. Cough linctuses and cough suppressants are of little value and sipping hot water, with or without lemon, honey, and ginger is as effective as anything.

If cough is associated with a sore throat or upper respiratory infection,

- Give *paracetamol 1 gram orally 6-hourly (maximum dose 8 grams a day for no more than 3 days).*

6.2 Cough in children

Many of the common causes of cough in adults occur in children. More so than in adults with chronic cough, there is considerable controversy regarding the importance of postnasal drip and gastro-oesophageal reflux in the aetiology of chronic cough in children. Some additional factors that need to be considered are outlined below.

Recurrent viral bronchitis is the most common cause of recurrent cough in children. Specific infections, such as pertussis, tuberculosis (TB) and those due to *Mycoplasma pneumoniae*, cause cough as a part of typical clinical syndromes. *Chlamydophila* (formerly known as *Chlamydia*) infection may cause a prolonged cough in the first few months of life.

Croup

Croup is a viral infection of the upper airway which affects children from the ages of six months to three years. It is characterised by fever, a harsh cough, a hoarse voice, and stridor. Children who have stridor while at rest or who have signs of respiratory distress (i.e. suprasternal retraction, tachypnea, restlessness) should be admitted. Pulse oximetry is

useful – an oxygen saturation of 93% or less while breathing air is also an indication for admission. Most cases of croup however are mild and self-limited.

a. Mild croup

These patients will have stridor only with exertion or crying and no signs of respiratory distress. Avoid exposure to cold air. Give paracetamol for fever.

- Give *paracetamol 20 mg per kg every 6 hours.*

b. Moderate croup

These patients will have stridor at rest and some signs of respiratory distress but oxygen saturation should be greater than 90% on air.

- Give *oxygen to maintain an oxygen saturation greater than 93%;*

  PLUS

- Give *dexamethasone 0.6 mg per kg intramuscularly as a single dose.*

c. Severe croup

These patients will have signs of marked respiratory distress

plus hypoxia or cyanosis. Admission to an intensive care unit is desirable and intubation may be necessary.

- Give *oxygen to maintain an oxygen saturation greater than 93%;*

  PLUS

- Give *dexamethasone 0.6 mg per kg intramuscularly as a single dose;*

  FOLLOWED BY,

- *Prednisone 1 mg per kg daily for 2 to 3 days if symptoms persist.*

  PLUS

- Give nebulised *adrenaline (only with advice) 0.5 ml per kg of 1:1,000 solution in 3 ml of normal saline to a maximum of 2.5 ml in children* $\leq$ *4 years and 5 ml if* $>$ *4 years.* This may be repeated upon consultation.

  NOTE: Patients who fail to respond to nebulised adrenaline may require endotracheal intubation. Nebulised adrenaline provides only temporary relief of airway obstruction lasting one to two hours. Patients should be closely observed after this period for recurrence of obstruction.

6.2.3 Cough and asthma

In the absence of wheeze or evidence of reversible airway obstruction, the presence of cough alone is unlikely to be due to asthma. Recent studies suggest that many children with these symptoms have increased cough receptor sensitivity secondary to viral respiratory infections. These children do not generally respond to anti-asthma medications, especially inhaled corticosteroids.

a. Mechanical causes

A persistent non-productive irritant cough with no obvious cause may be an indication for bronchoscopy to exclude the following: a foreign body, an unusual focal lesion of the bronchial wall, or an extrinsic lesion pressing on the airway. Aspiration of milk should be considered as a cause in infants when cough is related to feeding.

b. Smoking

Smoking should be considered as a cause of cough in children. Environmental tobacco smoke exposure from parental smoking may also be a cause of cough, especially in children under two years of age.

6.2.4 Therapy

Antitussive medications have a very limited place in paediatric practice. If parents ask for something to soothe the child's

throat, suggest hot water with honey, lemon, and ginger. This may be sipped as often as required.

7 Upper Respiratory Tract Infections

7.1 Rhinitis

Rhinitis is common. In a patient complaining of rhinitis symptoms – sneezing, rhinorrhoea, nasal obstruction, post-nasal drip, itching of the nose – it is important to exclude any underlying or associated pathology (e.g. chronic sinusitis, nasal polyps) before commencing drug treatment. Unilateral foul-smelling discharge, especially in children, may indicate a foreign body in the nasal cavity.

Causes of rhinitis include:

- infections – viral, bacterial or fungal
- environmental allergens
- occupational exporsure (e.g. wood dust, grains, chemical, latex, aerosols of nickel salts)
- drug use (e.g. aspirin, antihypertensives, oral contraceptives)
- drug abuse (e.g. cocaine sniffing)
- hormonal changes related to menstrual cycle, pregnancy, or puberty.

Rhinitis can occasionally be caused by emotional changes, by some foods, or by other conditions such as gastro-oesophageal reflux, especially in children.

7.2 Acute viral rhinitis ("common cold")

In the large majority of cases, antibiotics should not be given and management should be non-pharmacological. Fever with significant facial pain and frank pus from the nose suggests sinusitis and antibiotic treatment may be indicated.

- Give *amoxycillin 500 mg orally 8-hourly for 7 days. In children, 30 mg per kg orally 8-hourly for 7 days.*

Adequate hydration, especially in children, is the most important aspect of management.

If fever and/or headache are present:

- Give: *paracetamol 1 gram 4- to 6-hourly orally in adults (maximum of 8 grams a day usually for three to five days); and paracetamol 20 mg per kg every 6 hours for children (for a maximum of 48 hours).*

7.3 Allergic rhinitis

Over the last decade, the prevalence of allergic rhinitis has increased worldwide. It might be caused by environmental allergens and can be aggravated by chemical irritants (e.g. active or passive smoking). If possible, establish the cause of the allergy and advise the patient on techniques to minimize exposure to both allergens and irritants. Allergic rhinitis and asthma often co-exist and this association should be looked for.

Allergic rhinitis is classified as either intermittent (lasting for less than four days of the week **or** less than four weeks) or persistent (lasting for more than four days of the week **or** more than four weeks). The severity of symptoms is classified as either mild or moderate/severe.

7.3.1 Mild disease

Mild disease minimally impairs daily activities (including work, sport, school, and leisure) and does not usually cause sleep disruption. If the patient has persistent disease with significant sleep disturbance,

- Give *promethazine 10 mg orally at bedtime*.

Patients should be advised that sedating antihistamines may interact with alcohol and may affect the ability to drive and operate machinery.

6.3.2 Moderate/severe disease

Rhinitis is defined as moderate/severe disease if it interferes with sleep and/or impairs activities of daily living, leisure, work, school, or sport. Intranasal corticosteroids can be helpful in this situation. They have a slow onset of action and need to be used continually for maximum effect. They are effective for the relief of all rhinitis symptoms (including nasal congestion) and often relieve eye symptoms. Patients need to be advised to shake the device and to clear the nasal passages before using the nasal spray (the use of a saline nasal spray may be helpful).

❖ Give *beclomethasone dipropionate 50 micrograms per spray, 2 to 4 sprays into each nostril twice daily (children 3 to 12 years: 1 spray into each nostril twice daily).*

7.4 Nonallergic rhinitis

The mainstay of management of nonallergic rhinitis is to try to identify any cause and correct this if possible. Intranasal corticosteroids often provide symptom relief but may have to be continued for prolonged periods.

7.5 Intractable rhinitis

If symptoms of rhinitis are continuous and not controlled by maximum doses of intranasal corticosteroids, the diagnosis should be reviewed – consider enlarged adenoids in children or chronic sinusitis in adults. If nasal polyposis that has not responded to intranasal corticosteroids is present, referral to an ear nose and throat (ENT) surgeon may be helpful because surgical resection may be needed.

In children who have rhinitis for more than three months, a bacterial infection may be present. For recommendations about choice of antibiotic and length of treatment, see the section on sinusitis in the Fiji's *Antibiotic Guidelines* (Second edition, 2003/2004). For severe and persistent allergic rhinitis in adults that has not responded to topical corticosteroids, consider:

❖ *Prednisone 10 to 25 mg orally once daily for 7 to 10 days.*

However, prednisone should not be used for rhinitis for a long duration.

7.6 Acute epiglottitis

Epiglottitis is a medical emergency and failure to provide prompt treatment may be fatal. It is due to infection of the epiglottis with *Haemophilus influenzae* bacteria. Epiglottitis mainly affects children between the ages of three to eight years but is occasionally seen in adults as well. In Fiji, this condition is rarely seen with *Haemophilus influenzae* serotype B (Hib) vaccine in the immunization schedule. Hence, every case of acute epiglotittis should be investigated fully. It is characterised by fever, inspiratory and expiratory upper airway noises, a severe sore throat, dysphagia, and drooling. The patient usually looks very unwell. There is a very high risk of acute airway obstruction. All patients should be referred immediately to an anaesthetist and admitted to an intensive care unit. Attempting to view the throat or otherwise upsetting the child may cause airway obstruction and should be avoided. Keep the patient sitting up and provide oxygen as tolerated.

- Give *ceftriaxone 100 mg per kg stat then 50 mg per kg intravenously daily;*

  OR

- Give *chloramphenicol 40 mg per kg stat then 25 mg per kg intravenously 6-hourly.*

It is desirable to change to oral therapy as early as possible.

8 Lower Respiratory Tract Infections

8.1 Acute bronchitis

In an immunocompetent adult or child, acute bronchitis is mostly caused by viral infections and does not require antibiotic therapy. Randomised controlled trials show that antibiotic therapy do not provide an overall benefit to the patient and may actually cause harm.

If acute bronchitis is severe, the sputum is voluminous and purulent, and associated with fever, secondary bacterial infection is assumed.

- *Amoxycillin 500 mg orally 8-hourly for 5 to 7 days.*

Alternatively,

- *Doxcycline 100 mg orally 12-hourly for 7 days;*

  OR

- *Tetracycline 500 mg orally 6-hourly for 5 to 7 days;*

  OR

- *Erythromycin 500 mg orally 6-hourly for 5 to 7 days.*

8.2 Acute exacerbation of chronic bronchitis

Acute exacerbation could be either due to viral or bacterial infection. The common causative organisms include *Streptococcus pneumoniae, Haemophilus influenzae,* or *Moraxella catarrhalis*. The indications for antibiotic therapy are increased cough and dyspnoea together with increased sputum volume and/or purulence. The treatment is as for acute bronchitis above.

8.3 Pneumonia

8.3.1 Adults

a. Community-acquired

The choice of antibiotic is usually empirical. In immunocompetent otherwise healthy patients, it is usually caused by a single microorganism such as *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Mycoplasma pneumoniae,* or *Chlamydia. Staphylococcus aureus* is not an uncommon cause of community-acquired pneumonia in Fiji.

NOTE: In immunocompromised patients such as diabetics, elderly patients, or patients with co-existent illness (e.g. cancer, liver disease, heart failure, or renal failure), a broad-spectrum antibiotic cover may be required.

i. Mild Disease

- *Amoxycillin 500 mg orally 8-hourly for 7 to 10 days;*

  OR

- *Procaine penicillin 3.6 grams (4 megaunits) intramusculary daily for 7 to 10 days.*

Alternatively:

- *Tetracycline 500 mg orally 6-hourly for 7 to 10 days;*

  OR

- *Doxycycline 100 mg orally 12-hourly for 7 to 10 days.*

If hypersensitive to penicillin, or *Mycoplasma*, or *Chlamydia* are the suspected causative organisms:

- *Erythromycin 500 mg orally 6-hourly for 10 to 14 days;*

  OR

- *Doxycyline 100 mg orally 12-hourly for 10 to 14 days.*

ii. Moderate disease

- *Penicillin G 1,200 mg (2 megaunits) intravenously 6-hourly for 7 to 10 days.*

In patients hypersensitive to penicillin,

- *Chloramphenicol 1 gram intravenously 6-hourly for 7 to 10 days.*

If the clinical response to parenteral therapy is satisfactory, oral therapy can be started after a few days,

- *Amoxycillin 500 mg to 1 gram orally 8-hourly;*

OR

- *Chloramphenicol 500 mg to 1 gram orally 6-hourly.*

iii. Severe disease

In adults, severe pneumonia should be suspected if any of the following features are present:

- respiratory rate > 30 per minute
- PaO_2 < 60 mm Hg or SaO_2 < 90% on room aire
- $PaCO_2$ > 50 mm Hg on room air
- chest X-ray evidence of bilateral involvement or involvement of multiple lobes

- increase in size of chest X-ray opacity by 50% or more within 48 hours of admission
- requirement for mechanical ventilation or inspired oxygen > 35% to maintain SaO_2 > 90%
- haemodynamic compromise:
    - systolic blood pressure < 90 mm Hg
    - diastolic blood pressure < 60 mm Hg
- recent deterioration in renal function
- white blood cell count < 4 or > 30 × $10^3/\mu L$.

Empirical therapy for severe community-acquired pneumonia includes:

❖ *Penicillin G 1,200 mg (2 megaunits) intravenously 6-hourly;*

PLUS

❖ *Cloxacillin 2 grams intravenously 6-hourly;*

PLUS

❖ *Gentamicin 4 to 6 mg per kg intravenously once daily (maintenance dose adjusted according to renal function).*

If the pneumonia is severe or the patient is not responding to the therapy above, then ADD the following:

- *Erythromycin 500 mg orally or intravenously (by slow infusion over one hour) 6- hourly.*

If hypersensitive to penicillin:

- *Ceftriaxone 2 grams intravenously daily;*

PLUS

- *Erythromicin 500 mg to 1 gram intravenously (by slow infusion over one hour) 6-hourly.*

Definitive therapy should be instituted based on bacteriological data.

If *Streptococcus anginosus* is proven:

- *Penicillin G 3 megaunits (1,800 mg) intravenously 4-hourly for 21 days.*

If *Pseudomonas aeruginosa* is proven:

- *Piperacillin 4 grams intravenously 6-hourly;*

PLUS

- *Gentamicin 240 mg intravenously once daily (to be adjusted for renal function).*

If *Staphylococcus aureus* is proven:

- *Cloxacillin 2 grams intravenously 6-hourly for 3 to 4 weeks (can be changed to oral therapy once patient's condition is stabilized).*

All severe pneumonia requires consultant advice.

8.3.2 Children

Infants under two months of are considered to have severe pneumonia. *See moderate to severe disease below.*

i. Mild Disease

Infants (2 months to one year – 6 to 9 kg):

Clinically cough and tachypnea (respiratory rate 50 breaths per minute or more). No chest indrawing.

- *Procaine penicillin 400,000 units per dose intramusculary daily for 5 days;*

  OR

- *Amoxycillin syrup (125 mg per 5 ml) 10 to 20 mg per kg per dose (maximum 125 mg) orally 8-hourly for 5 days;*

  OR

- *Cotrimoxazole syrup (40 mg trimethoprim and 200 mg sulphamethoxazole in 5 ml); dosage for*

cotrimoxazole is calculated as trimethoprim 2.5 mg per kg per dose orally 12-hourly for 5 days.

Review child in two days or sooner if the child is not improving.

Children aged 1 to 5 years:

Cough, no chest indrawing. Fast breathing is 40 breaths per minute or more.

- *Procaine penicillin 400,000 units per dose intramusculary daily for 5 days;*

  OR

- *Amoxycillin syrup (125 mg per 5 ml) 10 to 20 mg per kg per dose (maximum 250 mg per dose) orally 8-hourly for 5 days;*

  OR

  Cotrimoxazole syrup (40 mg trimethoprim and 200 mg sulphamethoxazole in 5 ml); dosage for cotrimoxazole is calculated as trimethoprim 2.5 mg per kg per dose orally 12-hourly for 5 days.

Review as above.

Children aged over 5 years:

- *Procaine penicillin 25,000 to 50,000 units per kg (maximum 2 megaunits) intramuscularly daily for 5 days;*

  OR

- *Amoxycillin syrup 10 to 20 mg per kg per dose (maximum 500 mg per dose) orally 8-hourly for 5 days.*

ii. Moderate to severe disease

Clinical finding of chest indrawing in a child with cough, fever. Before starting antibiotics, blood or any other samples should be taken for culture.

Infants less than 2 months:

All pneumonia in infants less than two months should be regarded as severe, and therefore, the child should be admitted and treated.

Severely malnourished children should receive double antibiotic therapy to cover gram-positive and gram-negative organisms, until culture and sensitivity results are available.

Regimen 1:

- *Penicillin G 50,000 units per kg per dose intravenously for 7 days:*
  - *6-hourly in infants over 3 weeks old*
  - *8-hourly in infants 1 to 3 weeks old*
  - *12-hourly in infants < 7 days old.*

PLUS

- *Gentamicin 2 to 2.5 mg per kg per dose intravenously 12-hourly in infants < 2 months.*

Regimen 2:

- *Ampicillin 50 mg per kg per dose intravenously 6-hourly;*

PLUS

- *Gentamicin 2.5 mg per kg per dose intravenously 12-hourly in infants < 2 months.*

If there is any suggestion of staphylococcal infection:

- *Cloxacillin 25 mg per kg per dose intravenously 6-hourly*

PLUS

- *Gentamicin 2 to 2.5 mg per kg per dose intravenously 12-hourly as above.*

The total duration of therapy is 7 to 10 days.

Children aged 2 months and over:

- *Penicillin G 50,000 units per kg per dose (maximum 1 mega unit per dose) intravenously 6-hourly for 3 days **followed** by procaine penicillin 50,000 units per kg per dose (maximum 2 megaunits) intramuscularly to complete at least 7 days;*

  OR

- *Ampicillin 25 mg per kg per dose (maximum 1 gram per dose) intravenously 6-hourly for 3 days **followed** by amoxicillin 20 mg per kg per dose (maximum 500 mg) orally 8-hourly to complete at least 7 days;*

  OR

- *Chloramphenicol 12.5 to 25 mg per kg per dose (maximum 1 gram per dose) intravenously 6-hourly for at least 3 days **followed** by chloramphenicol 12.5 to 25 mg per kg per dose (maximum 500 mg per dose) orally 6-hourly to complete at least 7 days.*

Atypical pneumonia:

Mycoplasma pneumoniae can cause pneumonia in children. Onset is more gradual than pneumonia due to *Streptococcus pneumoniae* or *Haemophilus influenzae.*

- *Erythromycin 10 to 12.5 mg per kg per dose (maximum 500 mg per dose) intravenously 6- to 8-houly by slow infusion in normal saline OR orally (depending on clinical condition) for 7 to 10 days.*

8.3.3 Hospital-acquired pneumonia

This refers to pneumonia not present at the time of admission or developing in patients after 48 hours of hospitalisation. It is usually due to gram-negative organisms but *Staphyococcus aureus* is not uncommon in Fiji.

- *Cloxacillin 2 grams intravenously 6-hourly for 14 to 21 days;*

  PLUS

- *Gentamicin 240 mg intravenously once daily for 14 to 21 days (maintenance dose adjusted for renal function);*

  PLUS

- *Metronidazole 400 mg orally 8-hourly or 500 mg per rectum 12-hourly for 14 to 21 days.*

8.3.4 Pneumonia in neutropenic patients or patients with respiratory device

Gram-negative bacilli including *Pseudomonas aeruginosa* are common causative agents.

- *Piperacillin 3 grams intravenously 6-hourly;*

  PLUS

- *Gentamicin 240 mg intravenously once daily (maintenance dose adjusted for renal functions);*

  PLUS

- *Erythromycin 500 mg to 1 gram intravenously (infused over one hour) 6-hourly.*

Once bacteriological status is known, modify regimen accordingly. Total duration of therapy is 14 to 21 days.

8.3.5 Pneumonia in immunosuppressed patients

Pneumonia in these patients may be recurrent and due to unusual organisms. A microbiologist or physician should be consulted regarding diagnosis and treatment. Refer to section on *Pneumocystis* pneumonia at Fiji's *Guidelines on Antiretroviral Therapy*.

8.3.6 Aspiration pneumonia

Minor degrees of aspiration pneumonia do not require antibiotic therapy. For severe disease or abscess formation, more prolonged and high dose treatment is indicated.

For *Streptococcus anginosus*, anaerobes, and occasionally gram-negative bacilli and staphylococci, give

- *Penicillin G (2 megaunits) intravenously 4- to 6-hourly for 10 to 14 days;*

  PLUS

- *Metronidazole 400 mg orally 8-hourly for 10 to 14 days.*

Modify antibiotic therapy once the causative organism is identified.

Alternative therapy for penicillin hypersensitive patients:

- *Chloramphenicol 500 mg to 1 gram intravenously or orally 6-hourly.*

NOTE: In addition, cloxacillin or gentamicin may be required if infection with either staphylococci or aerobic gram-negative bacteria is proven or suspected. If *Streptococcus anginosus* is isolated, high dose penicillin will be required and for a longer duration, usually 21 days.

9 Suppurative Lung Disease

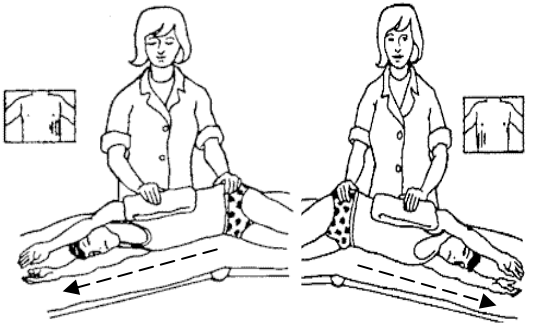
9.1 Bronchiectasis

Bronchiectasis is a disease characterised morphologically by the permanent dilation of bronchi and bronchioles, and clinically by recurrent or persistent bronchial infection and cough. Most patients with bronchiectasis have chronic cough with sputum production. The sputum is usually copious, purulent and may be blood-stained and foul-smelling. Exacerbations of bronchiectasis are related to retained inflammatory secretions and bronchial sepsis. The condition is categorised according to the radiological appearance of the airways.

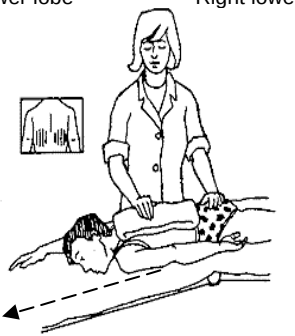
Bronchiectasis can present as a local process in one lobe or segment, or as a generalized process in both lungs. Childhood pneumonia is probably the most common cause. When focal disease is present, the cause may be intraluminal (e.g. foreign body, broncholith, or endobronchial tumour), or due to extrinsic compression of the airway by enlarged lymph nodes.

General measures

It is generally accepted that keeping the airways free from secretions as much as possible is an important part of management of bronchiectasis. However, it is difficult to find evidence from the literature that supports this contention.



Left lower lobe Right lower lobe



Lower lobes, posterior segments

Figure 5. Techniques of postural drainage in bronchiectasis. (Note: Broken arrows indicate that the table is titled towards that direction).

Ideally, patients should be referred to a physiotherapist experienced in this area so that an appropriate routine may be developed. This may include regular postural drainage (see Figure 5) with or without percussion and advice about coughing techniques.

For patients with significant airflow obstruction, nebulized bronchodilators may assist with clearing secretions.

- *Salbutamol 100 to 200 micrograms MDI by inhalation up to four times daily;*

  OR

- *Ipratropium bromide 40 to 80 micrograms by inhalation up to four times daily.*

If the response to initial single-agent therapy is unsatisfactory or the patient has moderate to severe disease,

- *Give salbutamol 100 to 200 micrograms MDI by inhalation up to four times daily;*

  PLUS

- *Ipratropium bromide 40 to 80 micrograms by inhalation up to four times daily.*

Patients with poor inhalation technique can use a large-volume spacer. This improves lung deposition of the aerosol.

In patients who are unable to use an MDI (with or without a spacer),

- *Salbutamol 4 mg orally up to 8-hourly as tolerated;*

  OR

- *Theophylline SR 300 mg orally twice daily.*

The effect of these agents may be monitored by self-reported symptoms, by PEF measurements or by spirometry.

9.2 Infection

If sputum becomes infected, it is important to give antibiotics as early as possible.

a. Mild disease

- *Amoxycillin 500 mg orally 8-hourly for 7 to 10 days.*

Alternatively:

- *Cefactor SR 375 mg orally 12-hourly for 7 for10 days (for in-patient use only).*

b. Moderate to severe disease

- *Chloramphenicol 500 mg 6-hourly orally or intravenously for 7 to 10 days.*

Alternatively,

- *Amoxycillin 500 mg orally 8-hours for 7 to days;*

  PLUS

- *Metronidazole 400 mg orally 8-hourly for 7 to 10 days;*

  OR

- *Cefactor SR 375 mg orally 12-hourly for 7 to 10 days (as a single agent);*

  OR

- *Doxycycline 100 mg 12- hourly for 7 to10 days (as a single agent).*

9.2 Lung abscess

Lung abscesses usually develop either as a result of the aspiration of organisms in patients with dental caries or as a consequence of severe necrotising pneumonia. Patients with altered conscious states (e.g. from anaesthesia, alcohol intoxication, or postictal) and/or with swallowing difficulties are at particular risk. Septic emboli are occasionally a cause in intravenous drug users, often with right-sided endocarditis.

The treatment of a lung abscess requires adequate drainage of the infected material and appropriate antibiotics. Where possible, attempts should be made to identify the causative organism. If there is a possibility that the patient may have aspirated a foreign body (e.g. a tooth, a peanut), then bronchoscopy is appropriate. If the abscess has clearly

cavitated and the patient has a productive cough, the abscess is probably draining into the airways and antibiotics and physiotherapy should be sufficient.

- Give *penicillin G 2 mega units intravenously 6-hourly;*

  PLUS

- *Cloxacillin 2 grams intravenously 6-hourly;*

  PLUS

- *Metronidazole 400 mg orally 8-hourly.*

The duration of treatment is controversial but is generally prolonged. Antibiotics usually are administered parenterally until the clinical condition stabilizes and then can be given orally, generally lasting for six to ten weeks. Surgical intervention is indicated in a non-resolving lung abscess.

9.3 Parapneumonic effusion and empyema in adults

Pleural effusion may complicate up to fifty percent of cases of pneumonia, and if not detected and managed appropriately, it may develop into a thoracic empyema. If there is clinical suspicion of a parapneumonic effusion, this should be confirmed by a chest X-ray. The fluid should be aspirated and cultured if empyema is suspected. If possible, the pleural fluid can be collected in a heparinized container for measurements of

pH and LDH levels. **Adequate drainage of empyema is essential. The duration of therapy is usually prolonged**.

- Give *Penicillin G 2 mega units intravenously 6-hourly;*

  PLUS

- *Cloxacillin 2 grams intravenously 6-hourly;*

  PLUS

- *Metronidazole 400 mg orally 8-hourly.*

The duration of therapy is usually prolonged; in most cases, it is for four to six weeks.

9.4 Lung abscess and/or empyema in children

Usually, this is staphylococcal in etiology. Other organisms including anaerobes may be involved; consider the addition of other antibiotics, if necessary, e.g. metronidazole or chloramphenicol. Empyema must be drained adequately. Surgical drainage of the lung abscess will depend on the size.

- *Cloxacillin 50 mg per kg per dose (maximum 2 grams per dose) intravenously 6-hourly for 2 weeks* ***followed*** *by fluocloxacillin 25 mg per kg per dose (maximum 500 mg per dose) orally 6-hourly.* Treatment is usually for 10 to 14 days, or longer if required depending upon the response.

PLUS

- *Gentamicin 2 to 2.5 mg per kg per dose (maximum 80 mg per dose) intravenously 8-hourly for 5 to 7 days (to start at the same time as cloxacillin).*

The clinician may decide to add rifampicin 10 to 15 mg per kg (maximum 600 mg) orally daily for 10 to 14 days together with cloxacillin (never alone).

10 Interstitial Lung Disease

Many different pathological processes can affect the lung interstitium. These are due to infection by viruses, bacteria and fungi (the pneumonias); cardiogenic oedema; and fibrotic reaction to accumulation of nonorganic dust particles (the pneumoconioses). There are also many other conditions in which the lung interstitium becomes inflamed, infiltrated or fibrosed. They are characterized by a restrictive pattern on spirometry testing.

10.1 Cryptogenic fibrosing alveolitis (idiopathic pulmonary fibrosis)

Cryptogenic fibrosing alveolitis or idiopathic pulmonary fibrosis is a specific form of chronic fibrosing interstitial pneumonia limited to the lung. Cryptogenic fibrosing alveolitis is the most common nonspecific interstitial lung disease of unknown aetiology in the elderly population, although it can occur at any age. It has a peak age of onset at 50 to 60 years and a smoking history is common. The pathology is that of "usual interstitial pneumonia" with patchy foci of fibroproliferation. The usual prognosis is poor, with death occurring approximately two years after diagnosis.

The diagnosis is dependent upon:

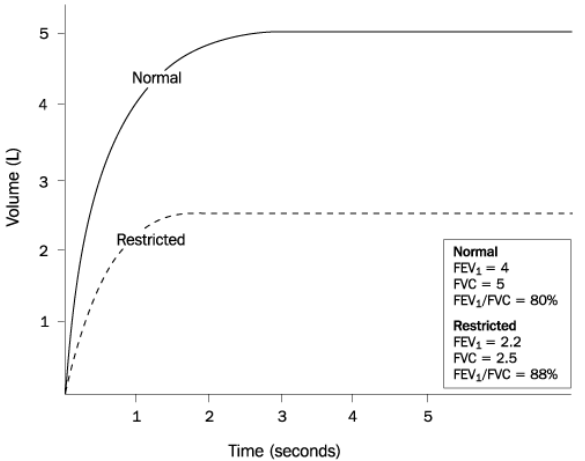


Figure 6. Spirogram showing restrictive ventilatory defect in interstitial lung disease.

- a typical history of slowly progressive breathlessness over months to years
- usually diffuse bilateral fine crackles on chest auscultation
- basal and peripheral reticular shadowing on chest X-ray or computerized tomography (CT) of the lungs
- restrictive lung function abnormalities.

The best therapeutic response is achieved using a combination of prednisone and azathioprine.

❖ *Prednisone 0.5 mg per kg daily for 4 weeks; then*
0.25 mg per kg for 8 weeks; then
0.125 mg per kg daily thereafter (approximately 30 to 40 mg per day tapered to 7.5 to 10 mg per day).

PLUS

❖ *Azathioprine 50 mg orally daily, increasing by 25 mg every 1 to 2 weeks up to a maximum of 150 mg (approximately 2 to 3 mg per kg) orally daily.*

This should only be added if frequent monitoring of full blood count and liver function tests is possible. If this regimen is used, a therapeutic trial of at least three months is necessary. If the patient continues to deteriorate on clinical and/or physiological criteria, consider discontinuing medication.

10.2 Other interstitial pneumonias

Interstitial pneumonias, other than cryptogenic fibrosing alveolitis, include the following:

- desquamative interstitial pneumonia (DIP)
- nonspecific interstitial pneumonia (NSIP)
- organising pneumonia (OP) – previously known as "bronchiolitis obliterans organizing pneumonia" (BOOP) or "chronic organizing pneumonia" (COP).

These interstitial lung diseases were formerly included under the broad heading of cryptogenic fibrosing alveolitis/idiopathic

pulmonary fibrosis, but are now recognised as separate conditions with individual pathological, clinical and radiological characteristics. All conditions have a better prognosis than cryptogenic fibrosing alveolitis and this is related to corticosteroid responsiveness. Treatment should commence with:

❖ *Prednisone 30 to 50 mg orally, daily, with duration and subsequent tapering dependent on clinical, physiological and radiological response.*

10.3 Sarcoidosis

Sarcoidosis is a multisystem granulomatous disease. The mediastinal lymph nodes or lungs are affected in more than ninety percent of cases. Overall, the prognosis in sarcoidosis is good with at least fifty percent of pulmonary abnormalities eventually showing complete radiological clearing. The best outlook is in young patients presenting with subacute symptoms, erythema nodosum and bilateral hilar lymphadenopathy. Prognosis is worse in middle-aged patients presenting with an insidious onset of sarcoidosis, diffuse lung infiltration and pulmonary function abnormalities. Hypercalciuria is very common; however, frank hypercalcaemia occurs only occasionally.

Corticosteroids usually improve systemic symptoms, pulmonary function and radiological appearances but:

- **Acute** or **subacute** sarcoidosis with bilateral hilar lymphadenopathy is likely to settle spontaneously and corticosteroids are seldom required.

- **Musculoskeletal pains** and **erythema nodosum** should be controlled with nonsteroidal anti-inflammatory drugs (NSAIDs).
- Corticosteroids are indicated if pulmonary infiltrates are associated with **breathlessness** and significantly **impaired pulmonary function** or if pulmonary function is worsening over time.
- **Hypercalcaemia** should be treated with corticosteroids in addition to dietary control of calcium and vitamin D intake and high fluid intake.
- **Uveitis** normally requires corticosteroids, either topically or systemically, or both.
- **Central nervous system**, **cardiac**, or other **severe extrathoracic organ involvement**, e.g. hepatitis, should be treated with corticosteroids.

If corticosteroids are to be given, use

❖ *Prednisone 20 to 40 mg orally daily for 6 to 8 weeks.*

If there is no response after 6 to 8 weeks, taper the dose to zero. If there is a response, taper the dose to 10 to 15 mg orally daily as a maintenance dose for 6 to 12 months. Illness may present as acute or subacute episodes of pyrexia, chills and malaise with shortness of breath.

10.4 Drug-induced interstitial lung disease

Lung parenchymal interstitial eosinophilic infiltration gives breathlessness and sometimes a cough. The patient may also wheeze (suggesting an airway component as well). A

maculopapular rash occurs frequently. There may be pyrexia. An immunological reaction is the likely cause.

Drugs that may be implicated include:

- antibiotics (nitrofurantoin, penicillins, sulfonamides including cotrimoxazole, tetracyclines)
- anti-inflammatory drugs (aspirin, sulfasalazine)
- antiarrhythmics (amiodarone)
- cytotoxic drugs (methotrexate, bleomycin)
- antipsychotics and antidepressants (chlorpromazine, imipramine)
- anticonvulsants (carbamazepine, phenytoin)

For treatment of this condition, removal of the drug is paramount.

In severe or moderately severe cases, judged on clinical criteria, a short course of prednisolone can be given.

❖ *Prednisone 20 to 40 mg orally daily for 2 weeks.*

11 Pre- and Post-Operative Respiratory Assessment

Patients who have respiratory impairment due to respiratory disease need proper assessment prior to surgery and may require specific interventions or precautions before and after the operation.

11.1 Nature of the risks

In general, deficiencies of the respiratory system can be overcome during surgery by the use of assisted ventilation, high concentrations of supplemental oxygen, and effective intra-airway suction to remove secretions. However, the postoperative period is a time of major morbidity and mortality for patients with respiratory disease. This is due to **increased demands** on, and **reduced capacity** of, the respiratory system.

- Increased demands on the respiratory system – fever, sepsis and tissue repair cause the basal metabolic rate to increase two- to three-fold postoperatively. These factors increase oxygen consumption and carbon dioxide production, and hence the requirement for increased ventilation.

- Reduced ventilatory capacity of the respiratory system – this can be due to pain from abdominal and thoracic

wounds, the need to lie supine, and the use of sedatives and analgesics. It can also be due to atelectasis, sputum retention, pneumonia, and fluid overload adversely affecting both gas-exchange and ventilatory capacity.

11.2 Risk groups

The risk of perioperative complications depends on the nature of the respiratory disease and the type of the procedure. People with respiratory disease at most risk of postoperative complications are those:

- who smoke
- with limited ventilatory reserve – unstable asthma or severe airflow obstruction, interstitial lung disease or diseases associated with weak respiratory muscles
- with mucus hypersecretion – chronic bronchitis, bronchiectasis, cystic fibrosis
- with reduced ability to protect the upper airway or to clear secretions from the lungs – neuromuscular disorders affecting the bulbar muscles and cough mechanism
- with uncontrolled reflux
- with obstructive sleep apnoea
- who are obese
- prone to pulmonary oedema because of coexistent cardiac disease
- prone to respiratory centre depression – chronic CO_2 retention (including severe sleep-disordered breathing).

Procedures that put patients with respiratory disease at most risk are those that involve the thorax and upper abdomen.

11.3 Assessment

Clinical and respiratory function assessment should be conducted in all cases. Sometimes more detailed testing is required. The nature and duration of the surgery and the type of anaesthesia (general, intravenous sedation, sedation, regional nerve block, etc.) are important considerations.

11.3.1 Clinical assessment

- Smoking – use a multifaceted approach to smoking cessation and if feasible, postpone surgery until the patient has not smoked for six weeks. For further information on smoking cessation, refer to Fiji's *Cardiovascular Drug Guidelines*.
- Chronic bronchitis and bronchiectasis – take measures to improve mucus clearance (refer to section on bronchiectasis).
- Unstable asthma – take measures to control (refer to section on asthma).
- Respiratory impairment (usually identified because of breathlessness and reduced exercise capacity) – due to asthma, chronic obstructive pulmonary disease, pulmonary fibrosis, pulmonary vascular disease, or respiratory muscle weakness.

Respiratory function tests, consisting of spirometry should be performed on all patients with clinical evidence of respiratory impairment.

11.3.2 Respiratory function tests

Patients with a forced expiratory volume in 1 second (FEV_1) > 60% of its predicted value have a low risk of postoperative complications (even following major operations such as pneumonectomy) and no further respiratory assessment is required.

Lobectomy is associated with a low risk of postoperative complications if FEV_1 > 40% and this probably applies to other relatively high-risk operations such as chest or upper abdominal surgery. The lower limit of respiratory function required for medium or low impact surgery (i.e. not interfering with respiratory muscles or cough) is not known. However, an individual with any of the following has a very limited respiratory reserve and requires expert preoperative assessment:

- FEV_1 < 40% of predicted value
- partial pressure of carbon dioxide ($PaCO_2$) > 50 mm Hg
- moderate or severe pulmonary hypertension
- oxygen saturation (SaO_2) 90% or less at room air
- patients on long-term domiciliary oxygen.

In some cases, additional physiological investigations, including exercise testing, can be performed before the contemplated surgery that requires using general anaesthesia.

11.4 Postoperative management

The key requirements in the early postoperative period are:

- good pain control (epidural analgesia may be indicated); care should be taken with asthmatics (aspirin-sensitive patients should not be given NSAIDs)
- supplemental oxygen, humidified for 'mouth breathers'
- nebulised bronchodilators
- effective deep breathing and coughing, and later, incentive spirometry
- physiotherapy to assist with deep breathing and clearing of secretions
- early ambulation
- increased corticosteroid dosage in appropriate situations (e.g. asthma)
- occasional need for continuous positive airway pressure or bi-level positive airway pressure.

Necessary prevention or early identification of potential complications involves:

- frequent clinical examination to detect fever, inspiratory crackles, disorientation
- continuous or regular monitoring of oxygen saturation and partial pressure of carbon dioxide, if indicated
- staff being alert to the dangers of oversedation, vomiting and aspiration, reflux, fluid overload, and cardiac arrhythmias

- formal monitoring of pain control and the patient's ability to cough effectively
- monitoring sputum volume and purulence
- monitoring FEV_1/peak expiratory flow (PEF) when appropriate.

Abnormal chest findings, fever or hypoxaemia warrant investigation, including a chest X-ray.

12 Miscellaneous Conditions

12.1 Scuba diving

People with any significant obstructive airways disease including asthma and COPD should be automatically disqualified from scuba diving. This is because of the theoretical risk of localised gas trapping due to airway narrowing, or the presence of bullae giving an increased risk of barotraumas. Individuals with wheeze precipitated by exercise or cold temperature should be advised not to dive.

Any history of spontaneous pneumothorax precludes scuba diving because of the almost certain presence of bullae or blebs on the visceral pleura. **Lung bullae and history of pneumothorax increase the risk of barotrauma and are a contraindication to diving.**

12.2 Decompression

Divers with or without respiratory disorders may develop decompression sickness (the bends) and need decompression in a hyperbaric oxygen chamber. They should be transported for treatment as a matter of urgency.

Decompression sickness should be suspected if the patient has been scuba diving and experience the following symptoms:

- altered responsiveness
- paraesthesia
- weakness/paralysis
- pain (often around the joints)
- breathing difficulty
- vision or speech difficulty
- other neurological symptoms.

The initial management of decompression sickness consist of the following:

- Lay the diver down flat.
- Provide basic life support as necessary.
- Provide as near as possible 100% oxygen.
- Give intravenous fluids (normal saline or Hartmann's solution).
- Perform physical and neurological examination.
- Record details of the dive, symptoms and signs, and the treatment given.

12.2 Pregnancy and respiratory drugs

The major period of danger for teratogenic effects of drugs is the first trimester of pregnancy, although some drugs can interfere with functional development of organ systems and the central nervous system in the second and third trimesters, respectively.

There is no convincing evidence that any of the drugs commonly used to treat respiratory disorders cause particular

problems during pregnancy. **As a general principle, the lowest dose achieving best control should be used.** Inhalation has particular advantages as a means of drug administration during pregnancy. The therapeutic effect may be achieved without the need for plasma concentrations liable to have a pharmacological effect on the fetus.

Attacks of asthma during pregnancy may reduce the amount of oxygen available to the fetus, so it is particularly important that asthma is well controlled. If this is achieved, asthma has no important effects on pregnancy, labour or the fetus. Severe exacerbations should be treated promptly with conventional therapy. Most asthma medications are safe to use during pregnancy.

12.3 Breastfeeding and respiratory drugs

The benefits of breastfeeding are sufficiently important to recommend that breastfeeding should be continued unless there is substantial evidence that the drug taken by the mother will be harmful to the infant and that no therapeutic equivalent can be given.

Most drugs are excreted only to a minimal extent in breast milk and in most cases the dosage to which the infant is ultimately exposed is very low and is well below the therapeutic dose level for infants. In most situations, drugs cross the placenta more efficiently than they pass into breast milk. **For these reasons the time of dosing in relation to breast feeding does not make much difference.**

Inhalation has particular advantages as a means of maternal drug administration during breastfeeding because the therapeutic effect may be achieved without reaching plasma concentrations that may contribute to the drug entering breast milk.

Table 5. Respiratory drugs in pregnancy and breastfeeding.

Drug	Status in pregnancy	Use in breastfeeding
Aminophylline	Safe	Use with caution; monitor infant for irritability
Beclomethasone diproprionate	Can be used because it is inhaled	May be safe to use
Dexamethasone	Safe	Safe
Hydrocortisone	Safe	Safe
Ipratropium bromide	Safe because it is inhaled	Safe
Prednisone	Safe	Safe
Promethazine	May cause foetal drowsiness	Safe in single dose
Salbutamol	Safe	Safe
Theophylline	Crosses placenta in significant amounts; avoid if possible	Use with caution; monitor infant for irritability