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Reviewing the prescribing patterns of patients diagnosed and treated for first time asthma in a private medical aid

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**Reviewing the prescribing patterns of patients
diagnosed and treated for first time asthma in a
private medical aid**

A research report submitted by:

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A Research Report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Medicine – Pharmacotherapy.

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October 2016

DECLARATION

I, Lauren Rens, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Medicine in Pharmacotherapy. It has not been submitted before for any degree or examination at this or any other University.

____  ____

21st day of October, 2016

ABSTRACT

Asthma is one of the twenty-seven conditions that is a Prescribed Minimum Benefit condition that all Medical Aids have to cover (Council for Medical Schemes, 2015). The prevalence of asthma in Southern Africa is estimated to be about 8.1% (SA Pharmaceutical Journal, 2012). Asthma is a major cause of morbidity and mortality in people and therefore prescribing patterns are important to investigate.

This research project looked at the prescribing patterns for asthma and compared it with the standard treatment guidelines for patients diagnosed with first time asthma which has been recorded by a private Medical Aid. The study looked at medications and recorded if they were prescribed according to the stepwise approach and standard treatment guidelines and if there are any areas where prescribing practises for asthma sufferers can be improved. This was done by analysing chronic application forms received by a private Medical Aid over a period of eight months. Descriptive statistics was used to summarise the demographic data and prescribing patterns. Prescribing patterns were analysed to determine any specific patterns for the different types of prescribers. Prescribing patterns were correlated with guidelines. Medication prescribed from the providers was reviewed and the total number of medication prescribed on each prescription for asthma was recorded.

The total patient population for this study was 3639 patients; from this total 2953 patients were diagnosed with first time asthma following the stepwise approach for treatment. 686 patients were diagnosed with first time asthma and did not follow the stepwise approach for treatment which was 19% of the patient population. The patients with co-morbidities whose treatment did not following the stepwise approach was 20% so the fact that patients diagnosed with other chronic conditions did not influence prescribing patterns too much compared to the whole patient population.

In all age groups general practitioners followed the stepwise approach best but in all cases they had the most variation in terms of reasons why this provider type did not follow the stepwise approach. In the age group 0-4 years, pulmonologists followed the stepwise approach the worst but again these are specialists in pulmonology and may be seeing complicated patients. In the age group 5-11 years, paediatricians had the highest percentage

of prescriptions that did not follow the stepwise approach. In the age group 12 years and older, specialist physicians had the highest percentage of prescriptions that did not follow the stepwise approach. In the adult population other prescribers like gastroenterologists, neurologists and nephrologist may have diagnosed patients with asthma as they were treating these patients for other conditions.

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LIST OF ABBREVIATIONS

COPD – Chronic obstructive pulmonary disease

ENT – Otorhinolaryngologists

FEV1 – Forced expiratory volume in one second

GP – General practitioner

HIV - Human immunodeficiency virus

ICS – Inhaled corticosteroids

IHD – Ischaemic heart disease

LABA – Long acting β 2-agonists

LFT – Lung function test

LTRA – Leukotriene receptor antagonists

NAEPP – National Asthma Education and Prevention Program

PEF – Peak expiratory flow

PMB – Prescribed Minimum Benefit

SABA – Short acting β 2-agonists

SD – Standard deviation

SpO2 – Arterial oxygen saturation

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1. INTRODUCTION

Asthma is defined as a disease of diffuse airway inflammation which is caused by a variety of triggering stimuli, which results in partial or complete bronchoconstriction, which is reversible (DiPiro *et al.*, 2011). Signs and symptoms of asthma include: dyspnoea, chest tightness, coughing, nocturnal awakening, tachypnoea, tachycardia and wheezing (Beers *et al.*, 2006; DiPiro *et al.*, 2011). Some patients show persistent changes in their airway structure. Asthma is a disease of increasing prevalence, which is a result of genetic predisposition and environmental interactions. Asthma is one of the most common chronic diseases seen in childhood. There is no cure for, or prevention of asthma.

Immunohistopathological features include: cell infiltration by eosinophils, neutrophils, T-helper type 2 lymphocytes, mast cells and epithelial cells. Diagnosis of asthma is based on history and a physical examination and is confirmed by using pulmonary/lung function tests (Beers *et al.*, 2006; DiPiro *et al.*, 2011).

Factors influencing the development of asthma include host factors like genes predisposing to atopy (allergy), genes predisposing to airway hyper-responsiveness, obesity and gender. Environmental factors include: indoor allergens like house dust mites, furred animals, fungi, moulds and yeasts, outdoor allergens like pollens and fungi, infections, occupational factors like industrial chemicals and insecticides, tobacco smoking and diet (Lalloo *et al.*, 2007).

1.1 PREVALENCE

The global prevalence of asthma ranges from 1% to 18% of the population in different countries (Bousquet *et al.*, 2005). The prevalence of asthma in Southern Africa is estimated to be about 8.1% (SA Pharmaceutical Journal, 2012). The prevalence of asthma is increasing worldwide and surveys indicate that the majority of patients in developed and developing countries do not receive optimal care and are therefore not well controlled. Steps in the management of asthma to achieve goals are to establish the diagnosis of asthma, assess the severity, and implement an asthma treatment by setting goals for control, finding ways to prevent exacerbations and treat the asthma with pharmacotherapy and to achieve and monitor control of the asthma (Lalloo *et al.*, 2007; Lalloo *et al.*, 2013; Fireman *et al.*, 2003:).

1.2 UNCONTROLLED ASTHMA

There are roughly 3 million people who suffer with asthma in South Africa, and the national death rate is ranked as one of the highest in the world. About 5% of these patients have severe asthma which is uncontrolled despite being on maximal and optimised therapy (Dheda *et al.*, 2015). In South Africa, approximately 8 - 10% of the population is asthmatic, South Africa is ranked fourth highest in terms of asthma mortality. Patients with difficult to control asthma consume a high percentage (up to 80%) of asthma-specific healthcare expenditure due to the high cost of hospitalisation, physician visits, and increased healthcare utilisation. There is considerable morbidity, and an economic burden to patients and the state from days lost from school or work (Dheda *et al.*, 2015).

Goals of asthma management include:

- Achieve and maintain control of symptoms
- Maintain normal activity levels including exercise
- Maintain pulmonary function as close to normal as possible
- Prevent asthma exacerbations
- Avoid adverse effects from asthma medications
- Prevent asthma mortality

(Lalloo *et al.*, 2007).

Reasons for poor asthma control include:

- Lack of adherence to controller medication
- Inability to use inhaler or powder device correctly
- Inadequate drug dosage
- Ongoing allergen exposures
- Uncontrolled allergic rhinitis/sinusitis
- Gastro-oesophageal reflux
- Psychosocial problems (family dysfunction, behaviour problems, depression)
- Use of medications with adverse events (e.g. β -blockers, aspirin, non-steroidal anti-inflammatories)
- Incorrect diagnosis

(Lalloo *et al.*, 2007; DiPiro *et al.*, 2011; Lalloo *et al.*, 2013).

When asthma is first diagnosed it can be classified as mild intermittent or chronic persistent asthma that may be mild, moderate or severe (Figure 1.1).

INTERMITTENT	CHRONIC PERSISTENT		
Mild	Mild	Moderate	Severe
I	II	III	IV
DAYTIME SYMPTOMS* ≤ 2/week	DAYTIME SYMPTOMS 3-4/week	DAYTIME SYMPTOMS >4/week	DAYTIME SYMPTOMS Continuous
NIGHT SYMPTOMS** ≤ 1/month	NIGHT SYMPTOMS 2-4/month	NIGHT SYMPTOMS >4/month	NIGHT SYMPTOMS Frequent
PEF ≥ 80%	PEF ≥ 80%	PEF 60-80%	PEF < 60%

Figure 1.1 Assessment of asthma severity using symptoms of PEF in patients presenting for the first time on no treatment (Lalloo *et al.*, 2007).

Acute symptoms are episodic and are managed by self-medication with a reliever medication (inhalation of β_2 -agonists). The frequent use of reliever medication indicates suboptimal control and demands attention to controller treatment (DiPiro *et al.*, 2011; Lalloo *et al.*, 2007; Lalloo *et al.*, 2013).

1.3 EXACERBATIONS

Asthma exacerbations are also referred to as acute asthma or asthma attacks, and result from frequent and progressive asthma symptoms and require early recognition to prevent morbidity and mortality. In some patients acute exacerbations may be of abrupt onset and progress rapidly to respiratory failure and death. An asthma exacerbation may be defined as a progressive or abrupt worsening in asthma symptoms, with increased use of bronchodilators with progressively decreasing response and/or a decrease in pulmonary function as measured by PEF or spirometry (Lalloo *et al.*, 2013).

The features of acute asthma are due to widespread narrowing of the airways. The pathophysiology of airway narrowing is complex and includes: smooth muscle constriction, hypersecretion of mucous and mucous plugging of small airways, oedema of the airway wall with infiltration with inflammatory cells and disruption of the airway epithelium.

1.4 DIAGNOSIS

A brief history and physical examination should be conducted when the patient presents and at the same time treatment is initiated. A detailed history may follow once the patient is stable and should include the duration and severity of symptoms, exercise tolerance, sleep disturbance, all current medications (including devices and doses prescribed and taken), time of onset and cause of the present attack, possible triggers and presence of high-risk factors. The examination should assess the presence of any complications (e.g. pneumonia, lobar collapse or atelectasis and pneumothorax). Objective functional assessments such as baseline PEF or FEV1 and arterial oxygen saturation (SpO₂) measurements (by pulse oximetry) before starting treatment should be routine. PEF measurement is preferred in emergency units, hospital wards, primary care clinics and general practitioner surgeries because it is widely available, simple, inexpensive, portable and safe. A baseline PEF measurement should be made before treatment is initiated (DiPiro *et al.*, 2011; Laloo *et al.*, 2007; Laloo *et al.*, 2013).

Diagnostic lung function values include:

- Reversibility: An increase of FEV1 of >12% and 200ml, 15-30 minutes after the inhalation of 200-400mcg salbutamol, or a 20% improvement in PEF from baseline shows reversibility and is an indication of asthma.
- Hyper-responsiveness: methacholine/histamine challenge exercise: A fall of 20% in PEF (or 15% in FEV1) measured 5-10 minutes apart – before and then after cessation of exercise (e.g. running for 6 minutes).
- Diurnal variation: diurnal variation in PEF of more than 20%.

1.5 TREATMENT

There are several classes of bronchodilators for acute asthma, each with a different mode of action and used sequentially depending on the response to treatment. They are presented in order of importance with a view to a stepwise approach to treatment (Lalloo *et al.*, 2013).

Asthma treatment includes reliever and controller medication. Reliever medication includes:

- Short-acting β_2 -agonists: Include salbutamol and fenoterol. These medicines are used for quick relief of symptoms, and in acute attacks as a “when necessary” dosage only and have a short duration of action. This is the medicine of choice for relief of bronchospasm during an acute asthma exacerbation and for the pre-treatment of exercise-induced bronchoconstriction.
- Short-acting inhaled anticholinergics. This includes ipratropium bromide which seems to be less effective than short-acting inhaled β_2 -agonists. Anticholinergics are alternative bronchodilator for patients, especially the elderly, who experience side-effects from short-acting inhaled β_2 -agonists.

Controller medication includes:

- Inhaled corticosteroids: Include budesonide, beclomethasone, fluticasone and ciclesonide. They have an anti-inflammatory action to prevent asthma attacks and are the most effective controller medication.
- Long-acting β_2 -agonists: Include formoterol and salmeterol. These medicines have a sustained bronchodilator action and are used in combination with inhaled corticosteroids. Formoterol has a more rapid onset of action than salmeterol. They should not be used as monotherapy as these medicines do not reduce airway inflammation.
- Fixed combination inhalers: Include formoterol/budesonide and salmeterol/fluticasone. They achieve asthma control in more patients, more rapidly and at a lower dose of inhaled corticosteroids than inhaled corticosteroids used alone. Formoterol/budesonide may be used for both rescue and maintenance treatment (Barnes, 2007).
- Leukotriene modifiers: They include montelukast and zafirlukast. They block the effects of leukotrienes in the airways. They are only used orally and show additive

effects when used with inhaled corticosteroids in mild to moderate asthma. They are less effective than long-acting β 2-agonists as add-on therapy. They can be used as an alternative to inhaled corticosteroids in patients with mild asthma and some patients with aspirin-induced asthma. They can be used as an alternative first-line treatment for episodic or mild persistent asthma in children younger than five years.

- Oral corticosteroids: They include prednisone, prednisolone and methylprednisolone. They are used for severely uncontrolled asthma.
- Theophylline SR: This includes theophylline anhydrous. It has a modest anti-inflammatory effect when given in a low dose. It is less effective than long-acting β 2-agonists. It has little effect as a first-time controller medication. Theophylline can be used as add-on therapy in patients who do not achieve control on inhaled corticosteroids alone (DiPiro *et al.*, 2011; Laloo *et al.*, 2007; Laloo *et al.*, 2013; National Heart, Lung, and Blood Institute, 2007).

Figure 1.2 is a summary of a treatment plan for asthma. Control needs to be assessed and treatment managed according to the control. The graph shows what to do when the patient is controlled and when the patient is not controlled and when to consult a specialist (Laloo *et al.*, 2007).

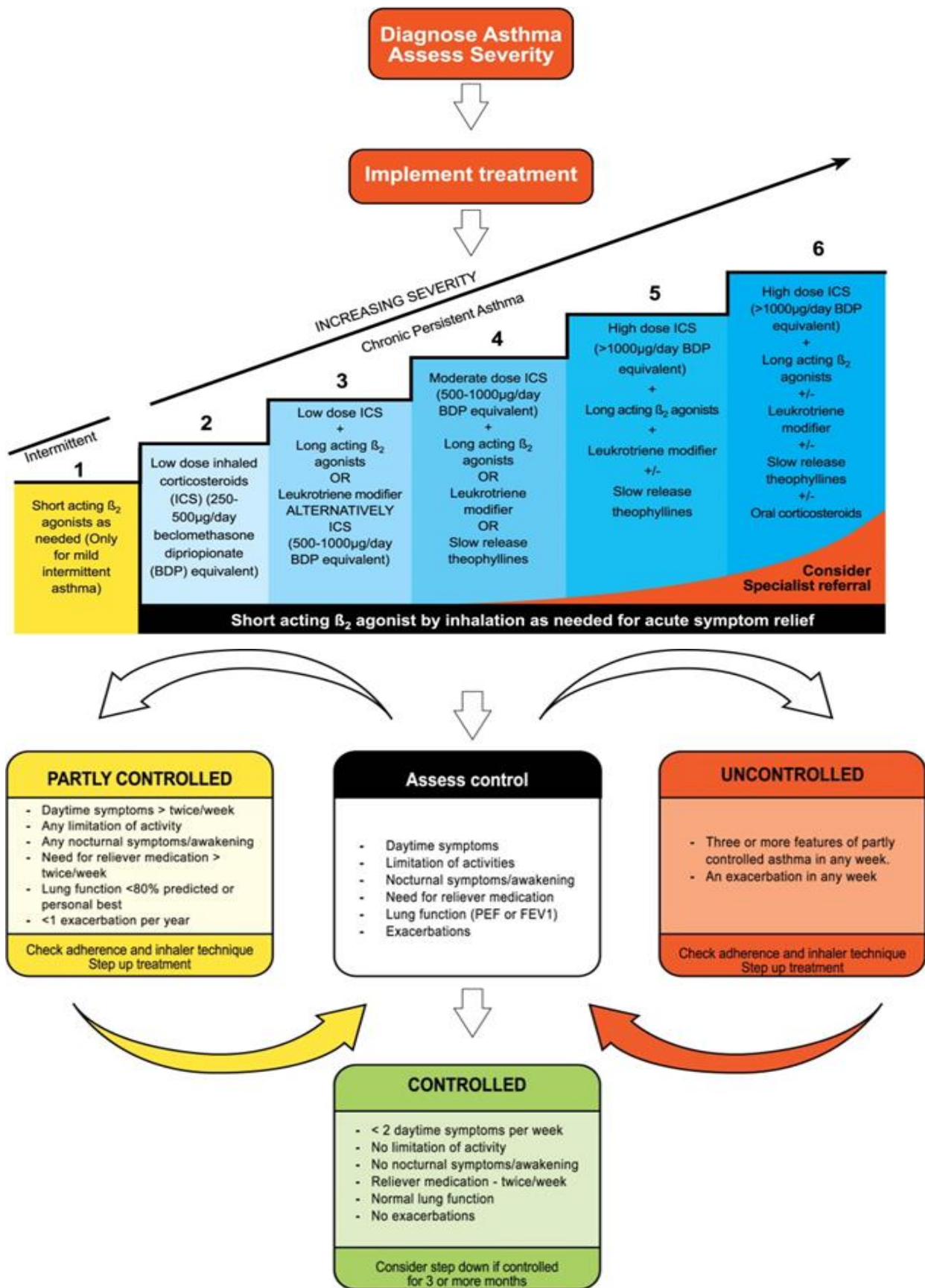
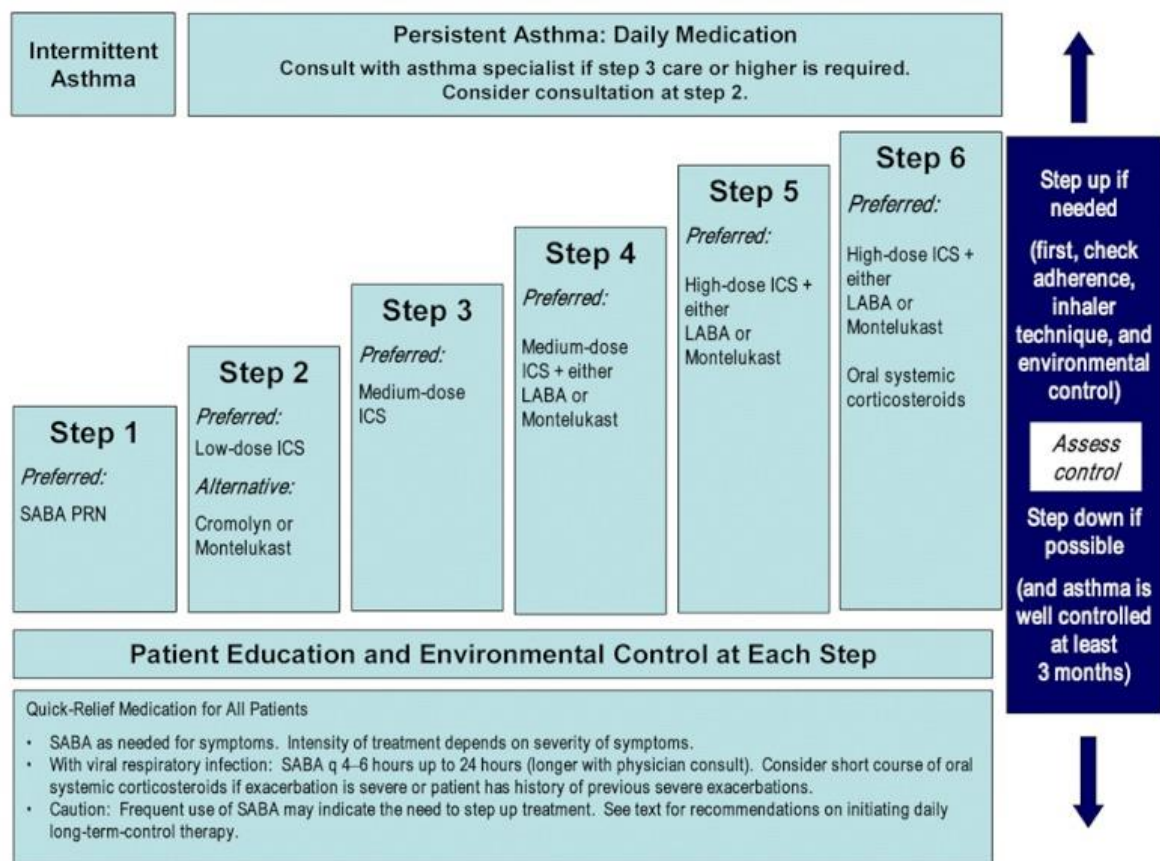


Figure 1.2 Algorithm for diagnosis and management of chronic asthma (Lalloo *et al.*, 2007).

The stepwise approach shows the medication to be used at each step for managing asthma which is recommended in the newest update by the National Asthma Education and Prevention Program (NAEPP). Non-pharmacological aspects are included in the therapy which is incorporated into steps. The guidelines were designed to give primary healthcare practitioners a framework with which to develop the proper approach to the individualised therapy for a patient. The focus of the therapy is the prevention and suppression of the underlying inflammatory process. The current therapeutic options in asthma consist of acute reliever medication which is used for acute exacerbations and long-term control medication which is used for the prevention of symptoms and exacerbations and for the suppression of inflammation. Therapy should be adjusted based on the control status of the patient (DiPiro *et al.*, 2011).

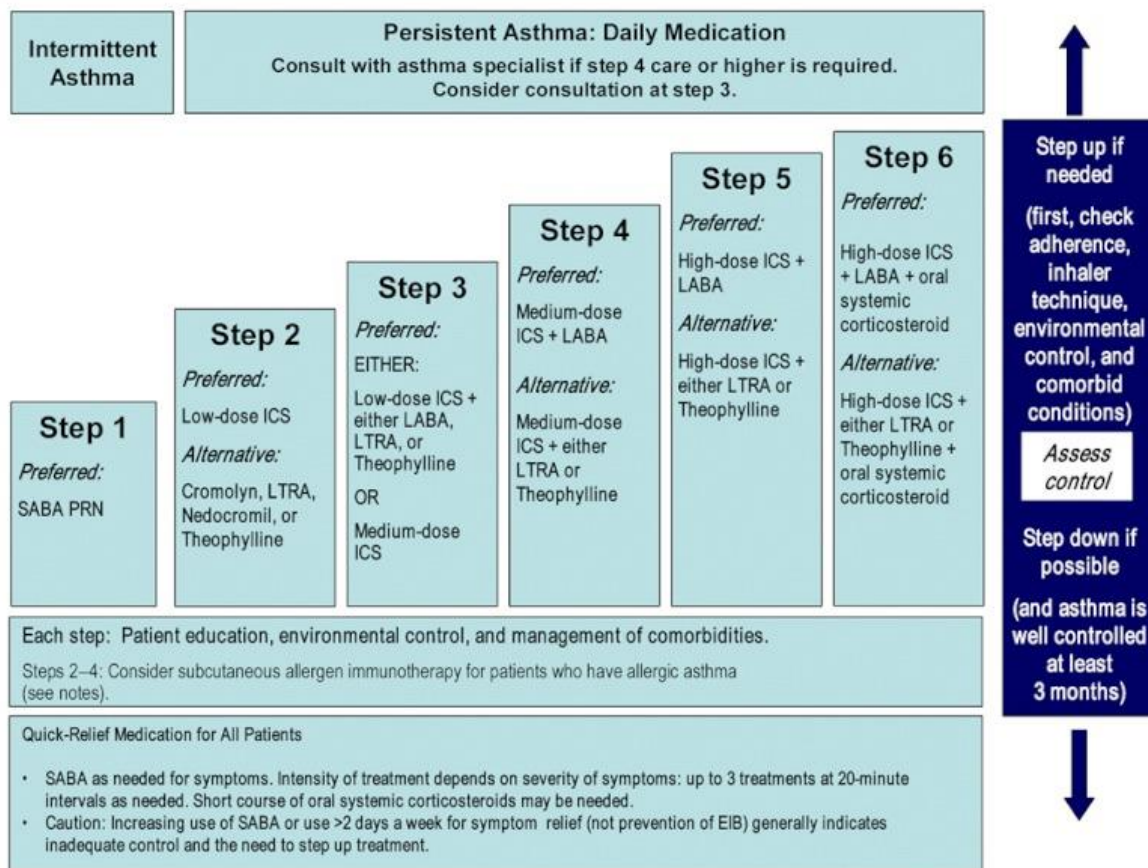
The three diagrams below will be used to indicate where the patient's treatment fits in the stepwise guidelines and what medication the patient will need to help control the asthma and prevent exacerbations of symptoms. It also shows how to treat the patient if symptoms improve or if symptoms worsen. They are divided into the different age groups which were then used in the analysis. The age groups are 0-4 years, 5-11 years and 12 years and older. These tables were used to compare the prescribing patterns of healthcare providers in these age groups. What was prescribed and by whom and any trends in providers was reviewed.



Key: **Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy.** ICS, inhaled corticosteroid; LABA, inhaled long-acting beta₂-agonist; SABA, inhaled short-acting beta₂-agonist

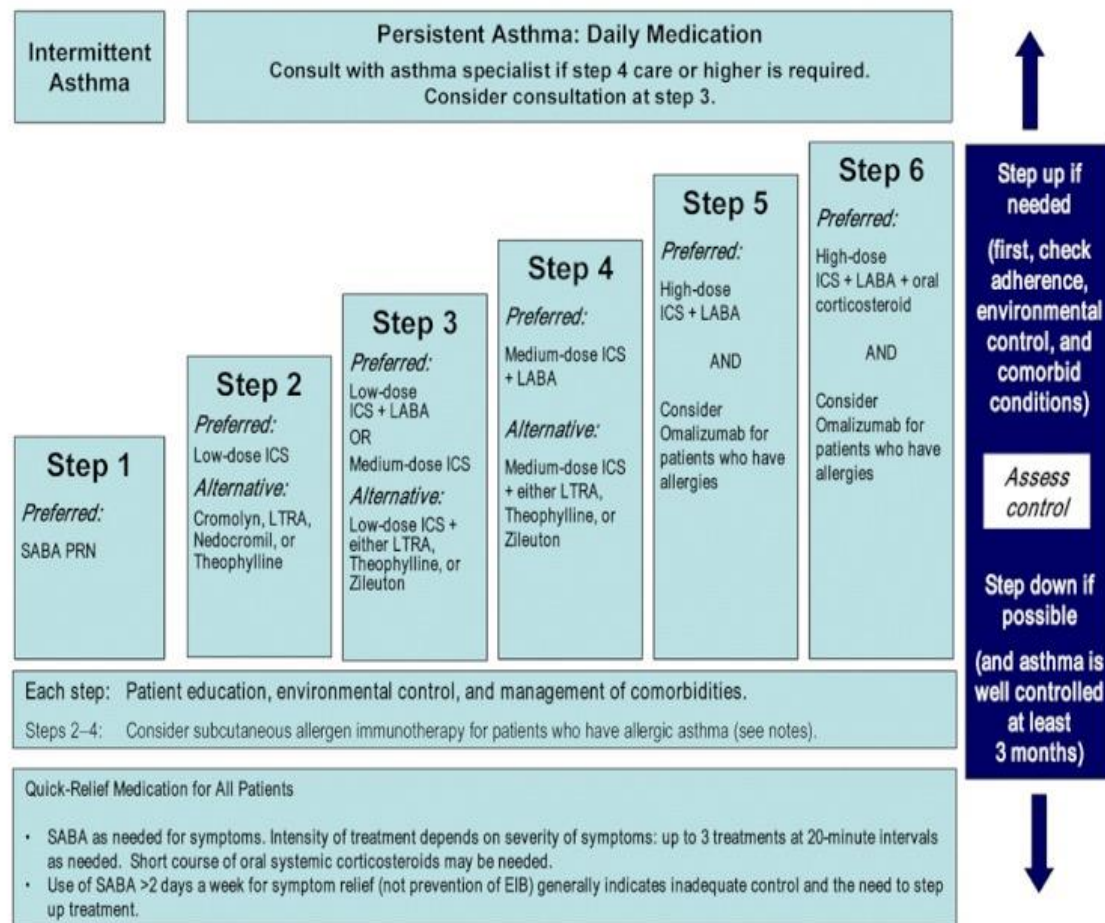
Figure 1.3 Stepwise approach for managing asthma in children 0 to 4 years old (DiPiro *et al.*, 2011).

The main difference with the stepwise approach for children 0-4 years old is that theophylline is not included in the stepwise approach but is included from step two in the other age groups.



Key: Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy. ICS, inhaled corticosteroid; LABA, inhaled long-acting beta₂-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta₂-agonist

Figure 1.4 Stepwise approach for managing asthma in children 5 to 11 years old (DiPiro et al., 2011).



— **Key:** Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy. EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, long-acting inhaled beta₂-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta₂-agonist

Figure 1.5 Stepwise approach for managing asthma in youths' ≥12 years of age and adults (Copied from DiPiro *et al.*, 2011).

The Standard Treatment Guidelines for chronic persistent asthma includes:

- General measures – patient education including advice on stop smoking. Decrease exposure to triggers such as grass, pets, dust mites, smoke, etc.
- Medicine treatment – maintenance therapy includes inhaled corticosteroids which are the mainstay of treatment in chronic asthma. Reliever or rescue therapy includes β₂-agonists like salbutamol. If there is insufficient response to adequate steroids and salbutamol the doctor may add theophylline modified release tablets. If asthma is still not well controlled the doctor may add a short course of long acting β₂-agonist therapy like formoterol. On failure of this therapy the doctor may add prednisone tablets (The National Department of Health, 2012).

2. PROBLEM STATEMENT

Asthma is one of the Prescribed Minimum Benefit (PMB) conditions, that if patients meet criteria, the condition may be registered as a chronic condition. First time applications submitted for asthma just diagnosed will be reviewed. There are guidelines which are not always adhered to (DiPiro *et al.*, 2011; The National Department of Health, 2012). Interesting prescribing patterns have been seen when analysing chronic application forms and scripts for patients diagnosed with asthma for the first time. Reviewing prescriptions on a daily basis, patients just diagnosed with asthma and treated with two inhaled corticosteroids, or only a long acting β_2 agonist or prescribed an oral corticosteroid for first time asthma is considered interesting. This research will be looking at whether prescribers are following treatment guidelines as patients need to receive the best treatment for managing their asthma according to current guidelines. The purpose of the study would be to see if medications are prescribed according to the stepwise approach and if there are any areas where prescribing practises for asthma sufferers can be improved. Some patients are not well controlled and we have to look at these reasons of non-compliance and review prescriptions to see any trends.

3. AIM

The aim of this research project is to document the prescribing patterns of asthma medication and to compare it with the standard treatment guidelines for patients diagnosed with first-time asthma as recorded by a private Medical Aid.

Patients will be considered to have their asthma diagnosed for the first time if the date of diagnosis on their application form is in the time period March to October 2013 and the date the application was received shows this to be a recent diagnosis. Previous claims will be reviewed to remove patients who previously claimed asthma medication as acute medication before the application form was submitted.

4. OBJECTIVES

1. To document patient demographics and prescribing patterns of patients diagnosed with first time asthma.
2. To compare prescribing patterns with treatment guidelines.

5. METHODOLOGY

5.1 STUDY POPULATION

During authorisation by the private Medical Aid the patient's information is captured on the database. All personal and clinical information is captured under the member's membership number which is updated and save when a new event, claim or consult occurs. Information gathered was based on the membership number where all of this information could then be found and was a reliable source. Information from study patients was retrospectively collected from the database.

Patients who were diagnosed with first time asthma during the study time period (March to October 2013) were included. This was the time period where a lot of applications were received for asthma. Applications in the beginning of the year were mostly new members joining the medical aid with existing conditions which were excluded and fewer applications are seen towards the end of the year and are often because benefits have been depleted so patients apply and were patients with existing conditions.

On the application form there was a column for doctors to complete which indicated when a patient was diagnosed so the researcher will be able to see if it was a recent diagnosis or not. Only patients who had been recently diagnosed were included in this study. Claims were reviewed to see when the patient started claiming their asthma medication. Medication prescribed was for ongoing treatment where medication was prescribed with no time limit. Acute medication prescribed for a short-term was not included in this study. This included corticosteroids and antibiotics approved for a few days as these medicines were not being used for the chronic treatment of asthma.

Both males and females were included in the study, as well as patients of all ages. Patients with other co-morbidities were also included in the study and other medication being claimed was recorded.

Patients were excluded if their request for treatment was an update as they were previously diagnosed and because their medication may have changed in the past.

Patient's histories and physical examinations could not be reviewed from the data received for the study as no information from each of these consults was available or would have been received by the Medical Aid.

5.2 DATA CAPTURING

5.2.1 DOCUMENT PATIENT DEMOGRAPHICS

The patient's age, gender, lung function tests (LFT) submitted, other tests, co-morbidities and other medication being claimed was documented. Severity of the condition was difficult to document. FEV1 improvement was documented if a lung function test had been submitted but other important information like symptoms, exacerbations, number of asthma attacks, how often patients used their reliever medication and experienced nocturnal symptoms could not be documented as this information was not available.

5.2.2 DOCUMENT PRESCRIBING PATTERNS

Prescribing patterns from providers was documented and reviewed from the application forms or prescriptions.

5.2.3 DOCUMENT MEDICATION PRESCRIBED

Type of asthma medication prescribed, the type of prescriber (e.g. general practitioner) and other medication the patient was claiming were documented.

5.3 DATA ANALYSIS

Descriptive statistics were used to summarise the demographic data and prescribing patterns. Prescribing patterns were analysed to determine any specific patterns for the different types of prescribers.

Prescribing patterns were compared with guidelines to see if the stepwise approach and Standard Treatment Guidelines were followed and to see if co-morbidities influenced the prescribing patterns. There are different steps or blocks on the stepwise approach and if the treatment prescribed corresponded to treatment in one of the blocks on the stepwise approach, the treatment was marked as following the stepwise approach.

The stepwise approach divides the members into the age groups 0-4 years, 5-11 years and 12 years and older. The age of the member in 2013 was used and if the patient was 4 turning 5 in 2013 the age when the patient was diagnosed was used.

Drug-interactions and contra-indications were reviewed according to the asthma medication approved and other medication being taken for other conditions. The number and type of interactions and indications were summarised and described. This was evaluated by viewing the medication the patient was prescribed and looking at references to check the interactions and contra-indications which included pharmacotherapy textbooks, the SAMF, package inserts and other references as indicated in the results.

5.4 ETHICS

Written consent to carry out the research was provided by this company. The Medical Aid and patient details were handled with strict confidentiality, no names or member numbers were used in the data collecting. The consent form given by the Medical Aid was not included for confidentiality reasons.

A clinical analyst was consulted who extracted the patients diagnosed with first time asthma in the required time period from the database. The clinical analyst gave the member numbers to the researcher, who then was able to access all the information from her computer. No member numbers, names and personal information was documented. The clinical analyst uses

data on a daily basis and kept information confidential. Once information had been extracted member numbers were deleted.

The proposal was submitted to the University Ethics Committee and the Wits Postgraduate Committee for approval. The approvals are found under the appendices.

6. RESULTS AND DISCUSSION

A total of 9412 patients were approved for asthma from 1 March 2013 to 31 October 2013. After removing patients who joined the Medical Aid in these 8 months who were already diagnosed with asthma, 6849 patients were left. After further reviewing each application, looking at acute claims and previous medication claimed and reviewing the application for the date of diagnosis, there were a total of 3639 patients that were diagnosed with asthma for the first time. These 3639 patients were used to review the prescribing patterns of doctors and made-up our patient population.

A total patient population for this study was expected to be 250 patients. However, a patient population of 3639 patients were evaluated. The reason for the vast difference in numbers expected and numbers received is the total population where these patients were taken from (in the medical aid) was much bigger than expected and this total population of the medical aid was underestimated.

6.1 GENDER

From the patient population 1853 (51%) are female (F) and 1786 (49%) are male (M).

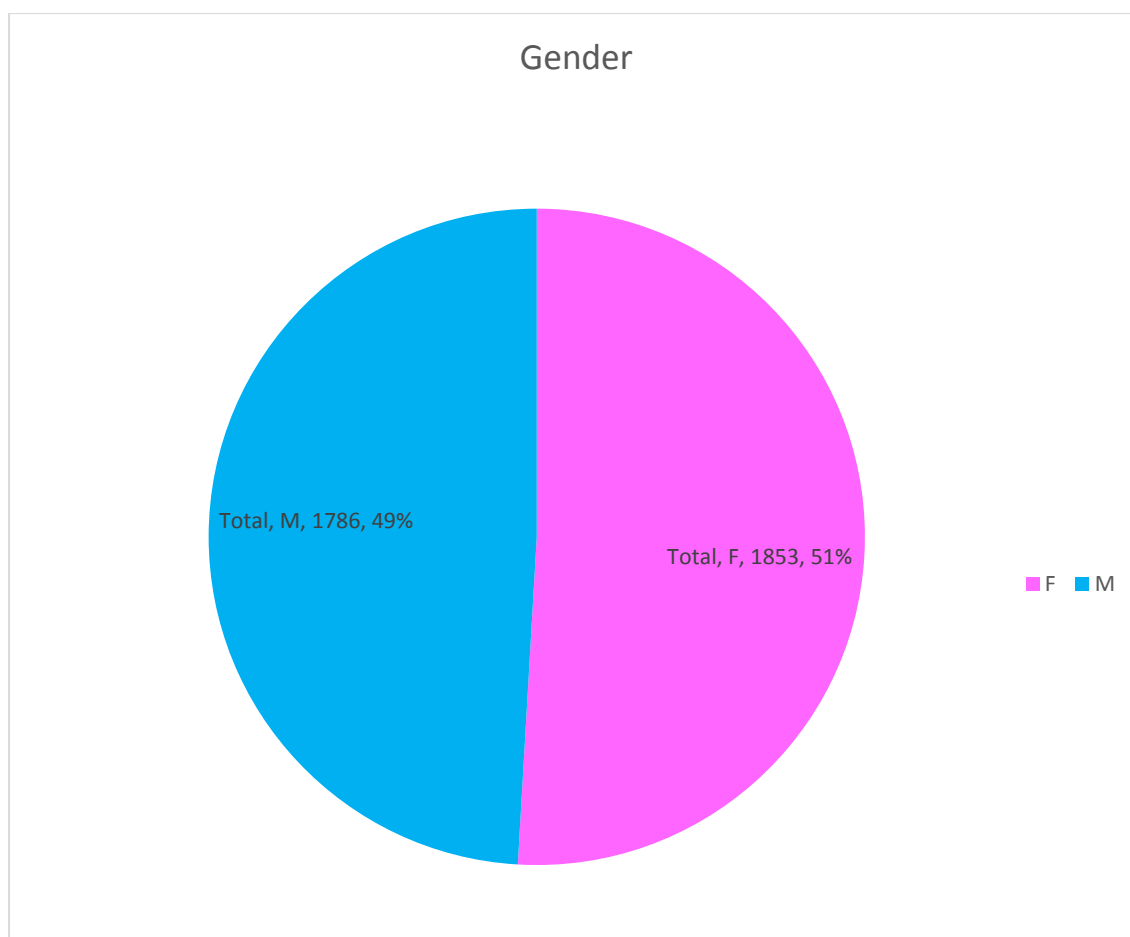


Figure 6.1 Gender of patient population

6.2 AGE

The mean age of the patient population was 23.5 (SD: 23.39033785) years old. This had been divided into the age groups as used in the stepwise approach for asthma treatment. Fifty percent of the patients were younger than 12 years of age (Figure 6.2) with most of the patients less than five years.

The over-all prevalence of asthma over the life-span indicates that the prevalence of current asthma peaked in the ten to twenty-four year old age-group. The prevalence of current asthma in those over 65 years has been documented in Australia as between 7.5 and 12.5%, with a predominance of females. Data from the USA suggests a prevalence between 4 and 10%, again with a predominance of females (Gillman, 2012). One of the controversies in the diagnosis of asthma in older people is the overlap with chronic obstructive airways disease so that a diagnosis of asthma is often considered less certain in this age-group (Gillman, 2012).

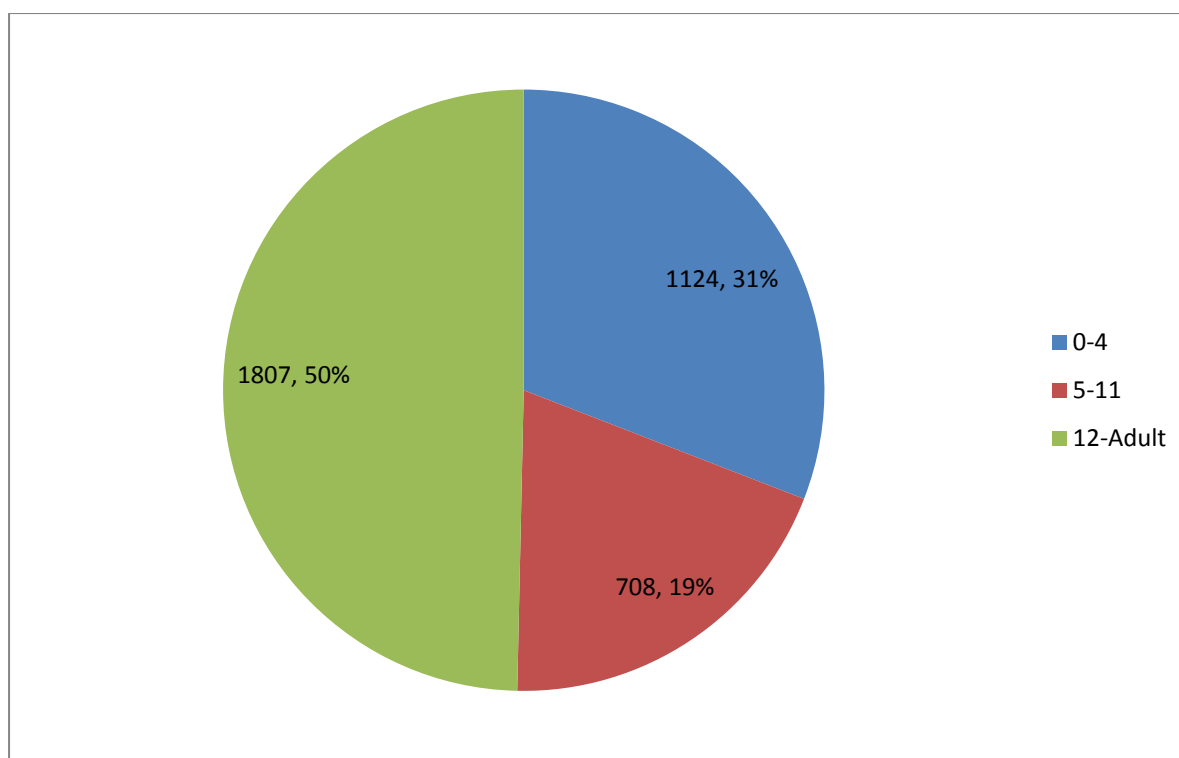


Figure 6.2 Age groups of patient population

The age groups were further divided and are presented in Figure 6.3. In the adult population the age group 31-40 years had the most number of patients.

It was not expected to see a high number of patients diagnosed later on in life and this had been confirmed that only sixteen patients were diagnosed from 81-90 years old and only one patient was over 90 years old. However, an unexpected large number (1462 patients – 40%) of adult patients from 20 to 70 years of age received a first time prescription for chronic asthma.

Differential diagnosis for adults with asthma may include chronic obstructive pulmonary disease (COPD), heart failure can cause a nocturnal cough and cardiac asthma, ischaemia heart disease (IHD) may be asthma or angina, malignancy, gastro-oesophageal reflux disease, pulmonary fibrosis, recurrent pulmonary embolism and tuberculosis. Out of all of these conditions only COPD, heart failure, IHD and asthma are Prescribed Minimum Benefit conditions and there is clinical entry criteria for COPD to be approved from the medical aid (Rull, 2010).

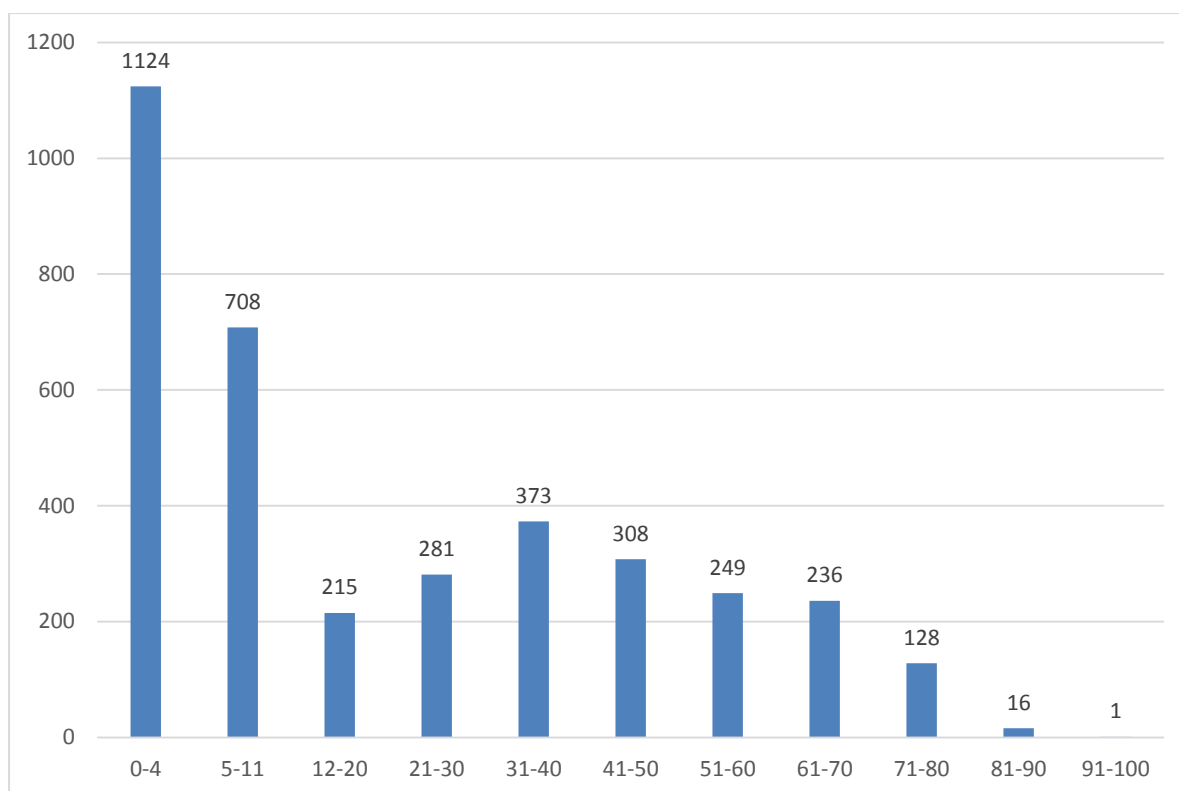


Figure 6.3 Age groups of patient population divided

6.3 TYPE OF PRESCRIBER

The majority of the chronic application forms came from general practitioners (49%), 31% from paediatricians, 10% from pulmonologists, 7% from specialist physicians and 3% of applications came from paediatric pulmonologists. The other healthcare providers made up 0.7% (twenty-six patients) in total.

The top five prescribers have been included in the graph below which include the majority of the prescriptions. No other literature reviewing the type of healthcare provider diagnosing asthma was found to compare this study to others.

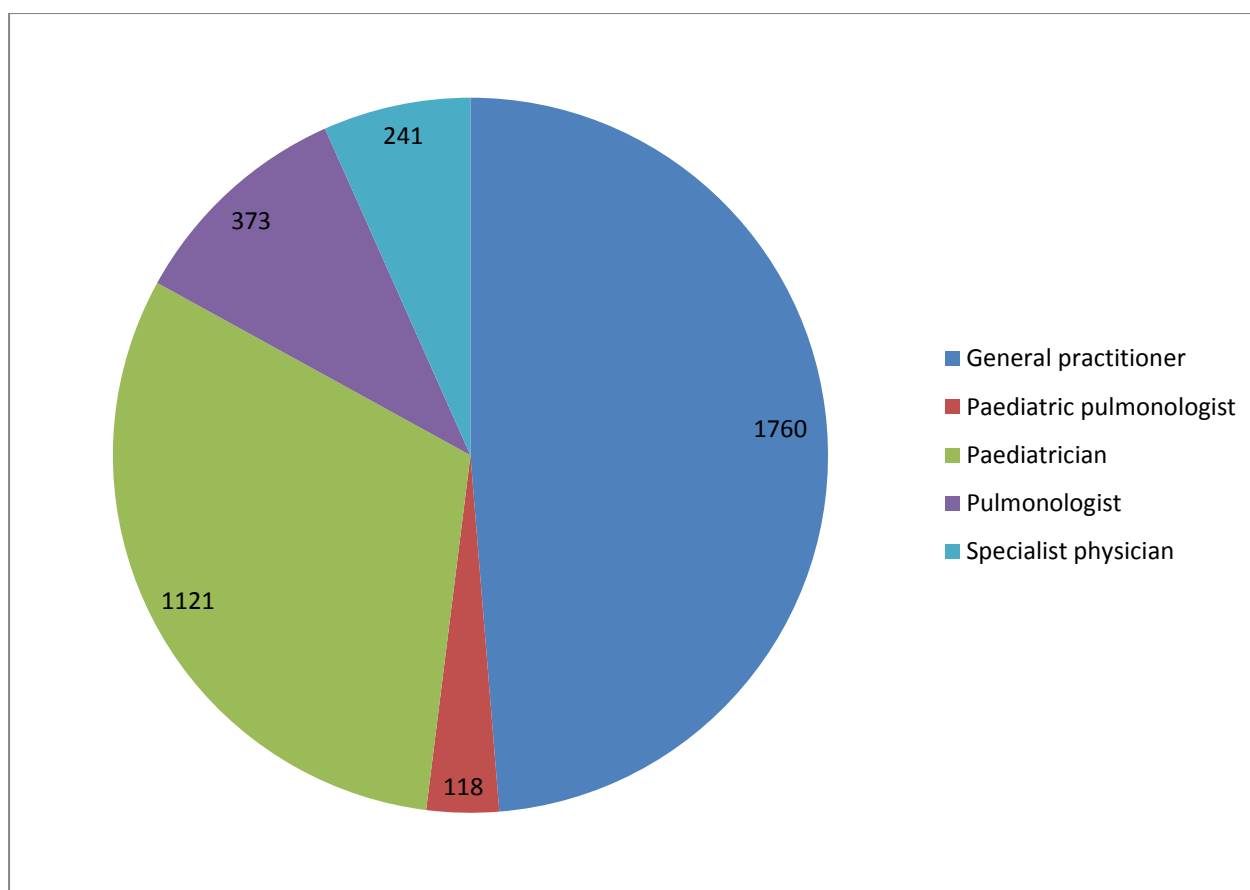


Figure 6.4 Type of prescriber diagnosing asthma

6.4 TOTAL MEDICATION PRESCRIBED

Table 6.1 indicates the number of items prescribed. One to seven medicines were prescribed, the numbers highlighted in orange show the age group with the highest number in this group and the numbers highlighted in green shows the group with the fewest amount in this group. On average 2.2289 items were prescribed per prescription with a standard deviation of 1.045320744.

The age group 12 years and older had the most prescriptions with one and two items on the prescription. There were 1807 (50%) patients in this age group and 671 (37%) prescriptions had only one medication on it. This age group also had the most number of prescriptions where two items were prescribed 718 (40%). The age group 5-11 years had the fewest number of prescriptions (708). 55% of their prescriptions had one or two items prescribed. 55% of the 0-4 year olds also had one or two items per prescription.

The 0-4 year old patients had the most number of prescriptions with three, four and five items. 27% (309) of prescriptions had three items, 15% (167) had four items and 3% (32) of prescriptions had five items. The total number of prescriptions for the age group was 1124.

24% of prescriptions had three items on for the age group 5-11 years old. 19% had four items on the prescription which is the highest percentage in all age groups and 3% had five items prescribed for asthma.

Reviewing the number of items on the prescription for the 12 years and older age group, 15% of prescriptions had three items, 6% had four items prescribed and 2% had five items prescribed.

None of the prescriptions had six items on it but there was one prescription for the 12 years and older age group which had seven items prescribed for asthma. This prescription was from a general practitioner.

When looking at treatment for patients diagnosed with asthma for the first time; one, two or three items can be explained, but prescribing five and seven medications for asthma is a lot.

Table 6.1 Total medications prescribed per prescription per age group

NUMBER OF MEDICATION	ALL PATIENTS (%)	0-4 YEARS (%)	5-11 YEARS (%)	12 YEARS AND OLDER (%)
1	997 (27.4%)	188 (16.7%)	138 (19.5%)	671 (37.1%)
2	1393 (38.3%)	428 (38.1%)	247 (34.9%)	718 (39.7%)
3	754 (20.7%)	309 (27.5%)	168 (23.7%)	277 (15.3%)
4	411 (11.3%)	167 (14.9%)	134 (18.9%)	110 (6.1%)
5	83 (2.3%)	32 (2.8%)	21 (3.0%)	30 (1.7%)
6	0	0	0	0
7	1 (0.03%)	0	0	1
Total	3639 (100%)	1124 (31%)	708 (19%)	1807 (50%)

KEY: Green = least number, Orange = most number.

General practitioners prescribed a total of one or two medicines per prescription most frequently compared to the other healthcare providers. Three medicines per prescription were prescribed most frequently by paediatricians, paediatric pulmonologists prescribed four medicines per prescription the most and pulmonologists prescribed five medicines per prescription the most.

One or two medicines per prescription was prescribed the least by paediatric pulmonologists and general practitioners prescribed three, four and five medicines per prescription the least compared to the other healthcare practitioners.

When asthma is first diagnosed by a healthcare provider one or two medicines per prescription should be the most common as this is a first time diagnosis. If the initial treatment does not help then the provider should add medicine, a stepwise approach should be followed (DiPiro *et al.*, 2011). An initial prescription of four and five medicines does not make sense and is not good practice. There are no other references where the number of medication can be viewed to compare this information. If a patient is not controlled, only then would more medication be added, so an initial prescription of five medicines does not make sense.

Table 6.2. Total medications prescribed for each provider

NUMBER OF MEDICATION	GENERAL PRACTITIONER (%)	PAEDIATRICIAN (%)	PULMONOLOGIST (%)	SPECIALIST PHYSICIAN (%)	PAEDIATRIC PULMONOLOGIST (%)
1	727 (41.3%)	105 (9.4%)	61 (16.4%)	83 (34.4%)	5 (4.2%)
2	759 (43.1%)	383 (34.2%)	128 (34.3%)	97 (40.3%)	19 (16.1%)
3	207 (11.8%)	390 (34.8%)	80 (21.4%)	43 (17.8%)	31 (26.3%)
4	54 (3.1%)	209 (18.5%)	78 (20.9%)	15 (6.2%)	55 (46.6%)
5	12 (0.7%)	34 (3.1%)	26 (7.0%)	3 (1.3%)	8 (6.8%)
6	0	0	0	0	0
7	1 (0.06%)	0	0	0	0
TOTAL	1760	1121	373	241	118

KEY: Green = least number, Orange = most number.

6.5 MEDICATION PRESCRIBED

Reviewing medication prescribed is very important to ensure that patients are treated appropriately. Table 6.3 shows all the medication prescribed for the total population, per age group and as per the stepwise approach.

Treatment for the initial diagnosis of asthma ideally should start with a short acting β 2-agonist as monotherapy or in combination with an inhaled corticosteroid only. Out of the 3639 patient population there were 458 (12.6%) patients who were initially prescribed this treatment.

Looking at the total patient population, inhaled corticosteroids in combination with long act β 2-agonists was prescribed the most, which made up 898 (24.7%) of the total prescriptions. 724 (19.9%) prescriptions included an inhaled corticosteroid, long acting β 2-agonists and a short β 2-agonist. 569 (15.6%) prescriptions had an inhaled corticosteroid with a short acting β 2-agonist.

242 (21.5%) prescriptions included an inhaled corticosteroid with a short acting β 2-agonist in the 0-4 year old age group, 162 (14.4%) included an inhaled corticosteroid with a short acting β 2-agonist and a leukotriene receptor antagonist. 148 (13.2%) prescriptions included an inhaled corticosteroid, long acting β 2-agonist and a leukotriene receptor antagonist.

In the 5-11 year old age group 172 (24.3%) prescriptions had an inhaled corticosteroid with a short acting β 2-agonist and a leukotriene receptor antagonist prescribed, 128 (18.1%) prescriptions included an inhaled corticosteroid with a long acting β 2-agonist and 124 (17.5%) prescriptions had an inhaled corticosteroid prescribed with a short acting β 2-agonist.

In our final age group which included the greatest number of prescriptions, 668 (37%) prescriptions had an inhaled corticosteroid prescribed with a long acting β 2-agonist, 441 (24.4%) prescriptions included an inhaled corticosteroid, long acting β 2-agonist and a short acting β 2-agonist and 203 (11.2%) prescriptions had an inhaled corticosteroid prescribed with a short acting β 2-agonist.

Leukotriene receptor antagonists were prescribed in more children than in adults. Leukotriene receptor antagonists are on the stepwise approach from step two.

Table 6.3 Combination of medication prescribed

	ALL PATIENTS	AGE 0-4 YEARS	AGE 5- 11 YEARS	AGE 12 YEARS AND OLDER
MEDICATION	TOTAL	TOTAL	TOTAL	TOTAL
Anticholinergic	12	2	2	8
ICS	176	56	41	79
ICS, Anticholinergic	17	6	1	10
ICS, LABA	898	102	128	668
ICS, LABA, Anticholinergic	54	3	3	48
ICS, LABA, LTRA	309	148	69	92
ICS, LABA, LTRA, Anticholinergic	6	0	1	5
ICS, LABA, LTRA, Oral steroid	3	0	0	3
ICS, LABA, Methylxanthine	9	0	0	9
ICS, LABA, Methylxanthine, Anticholinergic	3	0	0	3
ICS, LABA, Methylxanthine, LTRA	5	0	0	5
ICS, LABA, Methylxanthine, LTRA, Anticholinergic	2	0	0	2
ICS, LABA, Methylxanthine, LTRA, Oral steroid	1	0	0	1
ICS, LABA, Methylxanthine, Oral steroid	2	0	0	2
ICS, LABA, Methylxanthine, Oral steroid, Anticholinergic	1	0	0	1
ICS, LABA, Oral steroid	6	0	0	6
ICS, LABA, Oral steroid, Anticholinergic	1	0	0	1
ICS, LTRA	88	68	17	3
ICS, LTRA, Anticholinergic	8	6	1	1
ICS, Methylxanthine	2	0	0	2
LABA	10	1	1	8
LABA, Anticholinergic	1	0	0	1
LABA, Oral steroid	1	0	0	1
LTRA	176	113	33	30
LTRA, Anticholinergic	4	3	0	1
LTRA, Oral steroid	2	0	0	2
Methylxanthine	7	0	0	7
Methylxanthine, Anticholinergic	1	0	0	1
Methylxanthine, Oral steroid	1	0	0	1
Oral steroid	2	0	0	2
SABA	64	5	15	44
SABA, Anticholinergic	1	0	0	1
SABA, ICS	569	242	124	203
SABA, ICS, Anticholinergic	2	1	0	1
SABA, ICS, LABA	724	111	172	441

	ALL PATIENTS	AGE 0-4 YEARS	AGE 5- 11 YEARS	AGE 12 YEARS AND OLDER
MEDICATION	TOTAL	TOTAL	TOTAL	TOTAL
SABA, ICS, LABA, Anticholinergic	9	0	0	9
SABA, ICS, LABA, LTRA	134	54	45	35
SABA, ICS, LABA, LTRA, Anticholinergic	1	0	0	1
SABA, ICS, LABA, Methylxanthine	17	0	1	16
SABA, ICS, LABA, Methylxanthine, Anticholinergic	1	0	0	1
SABA, ICS, LABA, Methylxanthine, LTRA	1	0	0	1
SABA, ICS, LABA, Methylxanthine, LTRA, Anticholinergic	1	0	0	1
SABA, ICS, LABA, Oral steroid	2	0	0	2
SABA, ICS, LTRA	210	162	34	14
SABA, ICS, LTRA, Anticholinergic	1	0	1	0
SABA, ICS, Methylxanthine	8	0	0	8
SABA, ICS, Oral steroid	2	0	1	1
SABA, LABA	1	1	0	0
SABA, LTRA	51	37	11	3
SABA, Methylxanthine	2	0	0	2
SABA, Methylxanthine, Anticholinergic	1	0	0	1
SABA, Oral steroid	1	0	1	0
No medicine for asthma prescribed	28	3	6	19

KEY: ICS = Inhaled corticosteroid, LABA = long acting β 2-agonist, LTRA = Leukotriene receptor antagonist, SABA = short acting β 2-agonist

Looking at the chronic application forms submitted, 1267 patients were diagnosed with allergic rhinitis on the same application form and the doctor requested either an anti-histamine or a nasal corticosteroid or both when submitting the prescription for asthma medication.

6.6 DRUG INTERACTIONS AND CONTRA-INDICATIONS

There is an increased prevalence of asthma with increased use of paracetamol (DiPiro *et al.*, 2011). Bronchospasms can be induced by a wide variety of medications including penicillins, sulphonamides, cephalosporins, *N*-acetylcysteine, aspirin, non-steroidal anti-inflammatories, cimetidine and narcotic analgesics. B-adrenergic receptor blockers are medicines that can be harmful to patients with asthma. The more cardioselective agents like acebutolol and atenolol may also cause asthma attacks (DiPiro *et al.*, 2011).

There were a total of 2583 (71%) patients who had been prescribed or dispensed a medication which can increase the prevalence of asthma or may be harmful to patients with asthma and may cause bronchospasms. This is the majority of the patient population. This is not to say this will happen but doctors and pharmacists need to be aware of it to treat patients and prevent bronchospasms in patients. It may also be the cause of the bronchospasms in some patients so a proper patient history is necessary. B-adrenergic receptor blockers should be avoided in patients with asthma (Frishman, 2003). There were 175 patients who were dispensed a B-adrenergic receptor blocker. These patients would need to be reviewed and see if more appropriate hypertensive medication can be used to best manage asthma with the other co-morbidities.

Drug interactions with salbutamol include digoxin or diuretics where there is an increased risk of cardiac arrhythmias (Ventolin package insert, 2014), Symbicord (budesonide and formoterol) used with anti-arrhythmias, phenothiazides, MAOIs, tricyclic antidepressants and antihistamines can prolong the QTc interval and increase the risk of ventricular arrhythmias (SAMF, 2010). Sympathomimetic agents in combination with theophylline may potentiate cardiac effects (Das Pail, 2015).

Salbutamol was prescribed for 1775 patients. There were four patients who were prescribed salbutamol with digoxin. Two of those were prescribed by specialist physicians and the other two by general practitioners. There were 121 patients who were prescribed salbutamol with a diuretic. Seventy-two of those were from general practitioners, one was from a paediatrician, 33 were from pulmonologists, one was from a rheumatologist and fourteen were from specialist physicians.

Out of the 326 patients prescribed budesonide and formoterol a total of 163 patients were also prescribed a medicine which has a drug interaction with budesonide and formoterol in combination. These included anti-arrhythmias, phenothiazides, MAOIs, tricyclic antidepressants and antihistamines (SAMF, 2010). There may be more patients prescribed these medicines together as patients can buy antihistamines over-the-counter. It is important for doctors and pharmacists to get a good patient history and to find out all other medicine the patient is taking to avoid drug interactions.

There were a total of 64 patients who were prescribed theophylline. Twenty-four of those were prescribed theophylline with a sympathomimetic. It is important for all doctors treating patients to find out what medication they are taking to prevent drug interactions. It is important for pharmacists to ask patients what medication they are taking as a lot of these medicines are dispensed over-the-counter without a prescription. This number may be higher as not all medication taken over-the-counter will be claimed through the medical aid and therefore this data will not be included.

Anticholinergics do not have a FDA label indication for asthma. Ipratropium bromide is only indicated in acute severe asthma not completely responsive to β_2 -agonists alone as it does not improve outcomes in chronic asthma and is therefore not on the stepwise approach and should not be prescribed for patients diagnosed with first time asthma (DiPiro *et al.*, 2011). There were 150 patients prescribed an anticholinergic on their initial prescription.

6.7 TESTS

In the patient population only 218 (6%) patients had a lung function test submitted with their application. When diagnosing asthma, doctors will be looking at the reversibility and the percentage improvement of FEV1 post bronchodilator. Twenty-one patients diagnosed with asthma the FEV1 readings post bronchodilator decreased and had a negative value. This is unusual as FEV1 post bronchodilator should improve by more than 12% to show reversibility and to diagnose asthma (Lalloo, 2007). The doctor would have to see the whole patient profile and see if there was a different reason for the poor result like the member was tired and did not have a proper seal around the machine when blowing into it when performing the lung function test. These results would need to be questioned as they do not indicate asthma. Of the twenty-one prescriptions, nine were from a specialist physician, ten from a pulmonologist and two from a general practitioner. The post bronchodilator FEV1 of 73 patients improved up to 9% and 123 patients by 10% or more. 88 patients had a FEV1 improvement of greater than 12% which would indicate asthma.

It is difficult to perform lung function tests on children and therefore is hard to diagnose asthma based on lung function in children younger than 5 years. It is difficult to know whether young children who wheeze or have other asthma symptoms will benefit from long-term control medicines. Quick-relief medicines tend to relieve wheezing in young children

whether they have asthma or not (National Heart, Lung, and Blood Institute, 2014). The lung function tests submitted were all for adults 35 years and older.

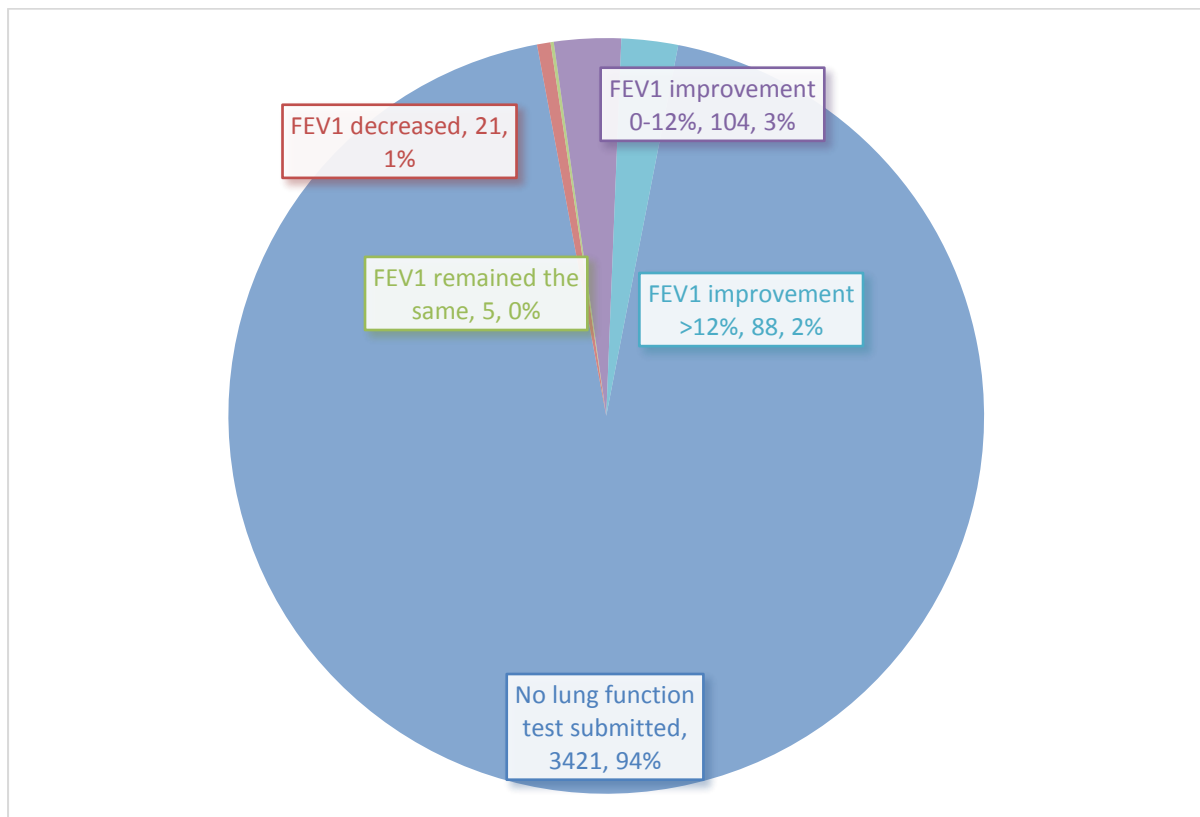


Figure 6.5 Lung function test submitted

According to the claim records, only 1400 (38%) patients had other tests done prior to being diagnosed with asthma (Figure 6.6). The tests included flow volume tests (624), x-ray of the chest (735), carbon monoxide diffusing capacity (37), peak expiratory flow (99), allergy: skin-prick tests (163), IgE: total (208), determination of resistance to airflow (80), functional residual capacity (52), evaluation of bronchospasm (20), thoracic gas volume (32), IgE screening test for atopy (36), antigen specific IgE (58), combined antigen specific IgE (13), pulmonary stress testing (9), N₂ single breath distribution (5), maximum inspiratory/expiratory pressure (2), forced expirogram (13) and allergy: patch tests (10). These tests help to make a diagnosis of asthma. This is not to say that the rest of the patients had no tests done; only tests submitted to the medical aid could be seen and included.

The graph below shows the number of patients who had a lung test or procedure done.

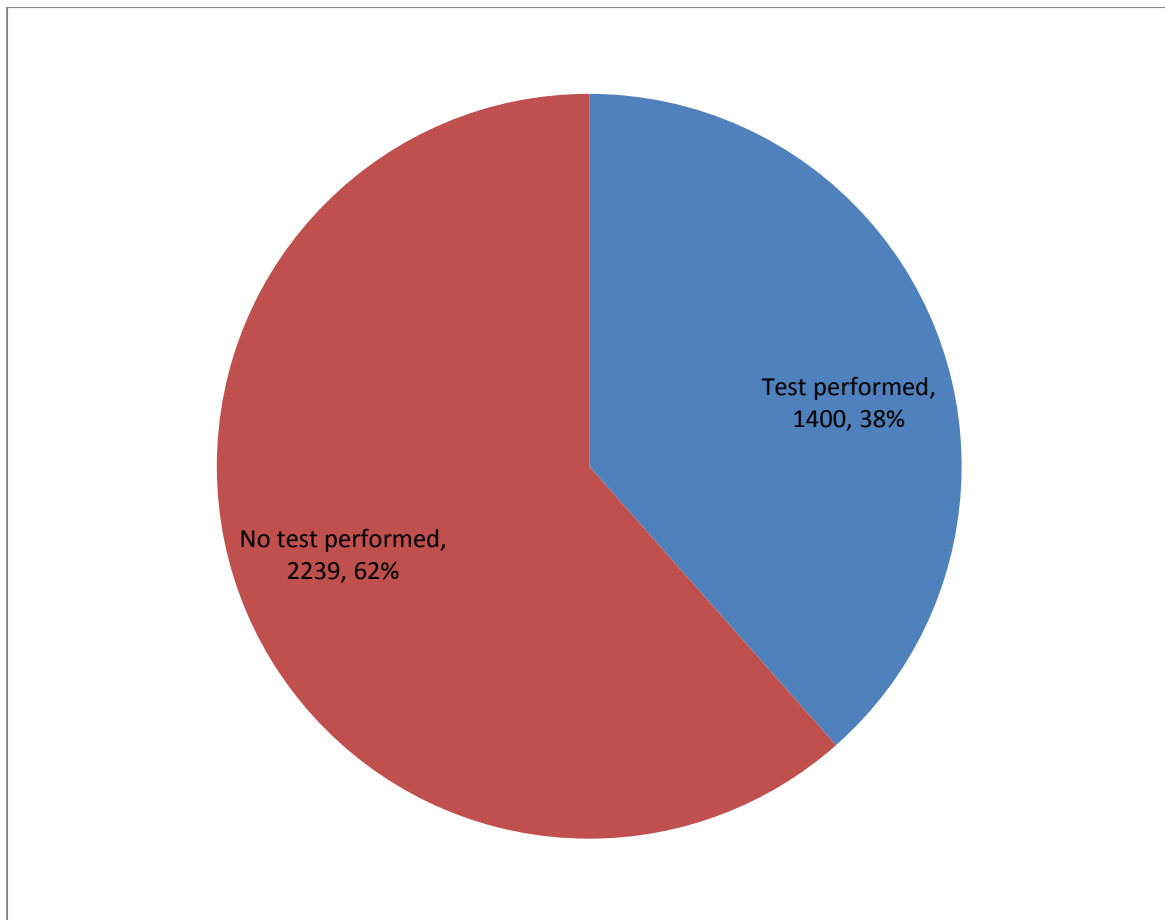


Figure 6.6 Tests performed

6.8 CO-MORBIDITIES

Chronic conditions approved by the Medical Aid were included in the data as these were co-morbidities that were recorded. Out of the 3639 patient population there were 2934 (81%) patients who do not have any other chronic conditions approved. There were 705 (19%) patients who have other chronic co-morbidities approved which included hyperlipidaemia, hypertension, diabetes type 2, ischaemic heart disease, ankylosing spondylitis, major depression, arthropathic psoriasis, atrial fibrillation and atrial flutter, congestive heart failure, rheumatoid arthritis, chronic obstructive pulmonary disease (COPD), hypothyroidism, glaucoma, chronic kidney disease, bipolar affective disorder, epilepsy, stroke, schizophrenia, diabetes type 1, ventricular tachycardia, systemic lupus erythematosus, bronchiectasis, cardiac arrhythmia, cystic fibrosis, menopause, cardiomyopathy, ulcerative colitis, pulmonary embolism, congenital mitral stenosis, Parkinson's disease, emphysema, generalized anxiety disorder, osteoporosis, HIV, hypopituitarism, and primary adrenocortical insufficiency.

Of these 705 patients, 139 patients were prescribed treatment which did not follow the stepwise approach. These included prescriptions from cardiologists, specialist physicians, Otorhinolaryngologists (ENT's), nephrologists, paediatricians, paediatric pulmonologists, pulmonologists and general practitioners. The mean age of these patients was 59 years (SD: 14.45226513). 20% of this patient population did not follow the stepwise approach, in most cases it is because the doctor prescribed an anticholinergic or because the doctor prescribed a long acting β 2-agonist with theophylline and a leukotriene receptor antagonist. Twenty-nine patients had other reasons including a long acting β 2-agonist prescribed without an inhaled corticosteroid. The prescriptions that stand out include eight patients prescribed medication to treat allergies only. The other conditions these patients are diagnosed with include human immunodeficiency virus (HIV), hypertension, menopause, hyperlipidaemia, chronic ischaemic disease and diabetes type 2. *N*-acetylcysteine (Acc200) was prescribed with theophylline and salbutamol for a patient diagnosed with congestive heart failure. Theophylline was prescribed with prednisone for a patient who was diagnosed with rheumatoid arthritis, the prednisone could then be used for both conditions and it was prescribed from a specialist physician. The other interesting one was oxygen prescribed as monotherapy for asthma for an 88 year old with glaucoma from a specialist physician. This patient would still need medication to control or relieve symptoms of asthma.

The stepwise approach is a guide for treatment of patients with asthma. 2953 (81%) patients were diagnosed with first time asthma following the stepwise approach for treatment. 686 (19%) patients were diagnosed with first time asthma and did not follow the stepwise approach. This was further broken down into the different age groups. Ages 0 - 4 years had a total of 884 (79%) following the stepwise approach and 240 patients (21%) not following the stepwise approach for treatment. Ages 5 - 11 years had 574 patients following the stepwise approach and 134 patients (19%) not following the stepwise approach for treatment. Ages 12 – adult had 1494 patients following the stepwise approach and 312 patients (17%) not following the stepwise approach for treatment (DiPiro *et al.*, 2011).

6.9 ADHERENCE TO THE STEPWISE APPROACH

The graph below shows the number of patients who had treatment prescribed from doctors for asthma who did follow the stepwise approach and the number of patients whose treatment did not follow the stepwise approach; this has been divided into the different age groups.

Patients who followed the stepwise approach had medication prescribed according to one of the steps from one to six on the stepwise approach. Patients were marked as not following the stepwise approach when their medication prescribed was not one of the steps on the stepwise approach.

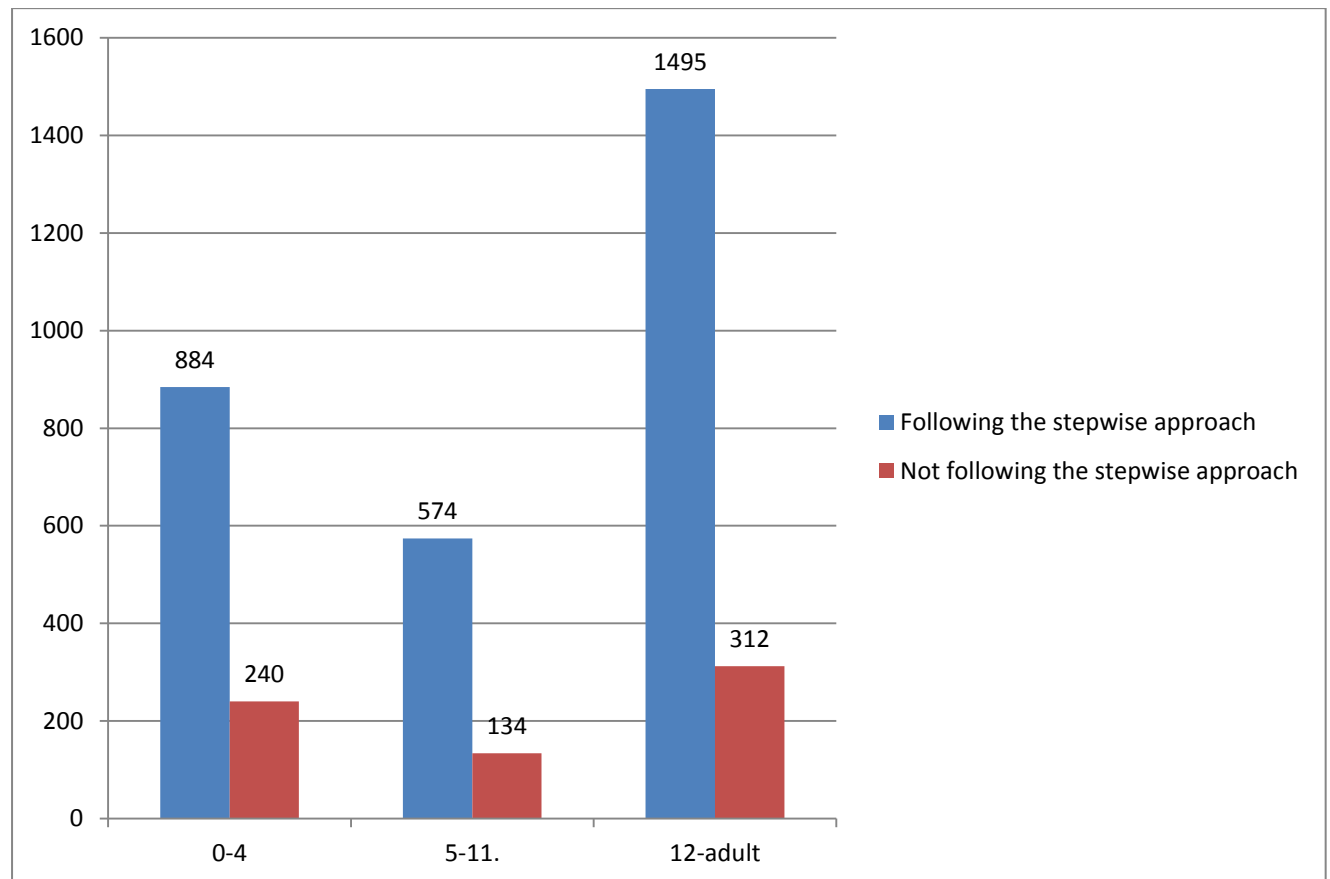


Figure 6.7 Number of patients following and not following the stepwise approach

The providers for each of these age groups were reviewed. Each prescriber was looked at individually to see how many of their patients were treated using the stepwise approach for treating asthma. This was further broken down to see the reason the prescription did not follow the stepwise approach.

For ages 0 – 4 years, general practitioners, paediatric pulmonologists, paediatricians and pulmonologists diagnosed asthma and prescribed treatment for these patients. A general practitioner motivated for 295 patients. Of those 36 (12%) did not follow the stepwise approach with their treatment, twenty-three patients were prescribed a long acting β 2-agonist with a montelukast. On the stepwise approach patients should be prescribed either a long

acting β 2-agonist or montelukast. Seven patients did not follow the stepwise approach as anticholinergics are not on the stepwise approach for treatment but these patients were prescribed an anticholinergic. The other reasons the patients did not follow the stepwise approach include a long acting β 2-agonist prescribed with no inhaled corticosteroid, only medication used for allergies was prescribed, two inhaled corticosteroids prescribed and combinations of these reasons above (DiPiro *et al.*, 2011).

Paediatric pulmonologists prescribed treatment for 72 patients of which twelve (17%) patients' treatment did not follow the stepwise approach for treatment as the doctor prescribed a long acting β 2-agonist with a montelukast. On the stepwise approach patients should be prescribed either a long acting β 2-agonist or montelukast.

Paediatricians prescribed treatment for 746 patients of which 189 patients' (25%) treatment did not follow the stepwise approach. The treatment for 164 patients did not follow the stepwise approach as the doctor prescribed a long acting β 2-agonist with a montelukast. Treatment for twenty-one patients did not follow the stepwise approach as anticholinergics were prescribed and anticholinergics are not included on the stepwise approach. The other reasons treatment did not follow the stepwise approach include hydroxyzine prescribed which is not on the stepwise approach, only nasal corticosteroids prescribed and combinations of the reasons above.

Pulmonologists prescribed treatment for eleven patients of which three patients' (27%) treatment did not follow the stepwise approach. The two reasons treatment did not follow the stepwise approach include the doctor prescribed a long acting β 2-agonist with a montelukast and anticholinergics prescribed for asthma and anticholinergics are not included on the stepwise approach.

Table 6.4 shows the reasons the prescriptions from different providers did not follow the stepwise approach for the 0-4 year age group.

Table 6.4 Age 0 – 4 reasons providers did not follow the stepwise approach

PROVIDER	REASON PRESCRIPTION DID NOT FOLLOW THE STEPWISE APPROACH	TOTAL
General practitioner	LABA or montelukast and patient has both	23
	Anticholinergic not on treatment guidelines	7
	LABA prescribed with no ICS	2
	Only meds for allergies prescribed	1
	2 ICS prescribed	1
	Anticholinergic not on treatment guidelines, 2 ICS prescribed	1
	LABA or montelukast and patient has both, 2 ICS prescribed	1
Paediatric pulmonologist	LABA or montelukast and patient has both	12
Paediatrician	Anticholinergic not on treatment guidelines	21
	Hydroxyzine not on the treatment guidelines	1
	LABA or montelukast and patient has both	164
	LABA or montelukast and patient has both, Anticholinergic not on treatment guidelines	1
	Only a nasal steroid prescribed	2
Pulmonologist	LABA or montelukast and patient has both	1
	Anticholinergic not on treatment guidelines	2

KEY: LABA = Long acting β 2-agonist, ICS = Inhaled corticosteroid

For ages 5 – 11 years old; general practitioners, paediatric pulmonologists, paediatricians, pulmonologists and specialist physicians diagnosed asthma and prescribed treatment for these patients. Three hundred and two patients were diagnosed and treated by general practitioners. Of the 302 patients, 37 (12%) of patients' treatment did not follow the stepwise approach. Treatment of twenty seven of these patients did not follow the stepwise approach as the doctor prescribed a long acting β 2-agonist with a montelukast. The other reasons include anticholinergics prescribed which are not on the stepwise approach, two inhaled corticosteroid prescribed for the patient, a long acting β 2-agonist prescribed with theophylline, oxymetazoline (Iliadin) and betamethasone (Betnesol) prescribed which are not included on the stepwise approach, long acting β 2-agonists prescribed as monotherapy, only medication indicated for allergies prescribed, oral corticosteroids prescribed without a long acting β 2-agonist or montelukast and oral corticosteroids prescribed without an inhaled corticosteroid.

Paediatric pulmonologists prescribed treatment for 40 patients of which treatment for seven patients (18%) did not follow the stepwise approach. The reason for four of these patients

was because the doctor prescribed a long acting β 2-agonist with a montelukast. The other reasons include anticholinergics prescribed which are not included on the stepwise approach and one prescription only included medication used to treat allergies.

Paediatricians prescribed treatment for 343 patients of which 88 (26%) prescriptions did not follow the stepwise approach. Patients' treatment did not follow the stepwise approach as the doctor prescribed a long acting β 2-agonist with a montelukast. The other reasons include anticholinergics prescribed which are not included on the stepwise approach, one prescription only included medication used for allergies and a combination of the reasons above.

Pulmonologists prescribed treatment for nineteen patients of which treatment for two patients (11%) did not follow the stepwise approach. The two reasons these prescriptions did not follow the stepwise approach are the doctor prescribed a long acting β 2-agonist with a montelukast and anticholinergics were prescribed which are not included on the stepwise approach.

Specialist physicians prescribed treatment for four patients and all of these prescriptions followed the stepwise approach for treatment.

Table 6.5 indicates the reasons the prescriptions from different providers did not follow the stepwise approach for the 5-11 year age group.

Table 6.5 Age 5 – 11 reasons providers did not follow the stepwise approach

PROVIDER	REASON PRESCRIPTION DID NOT FOLLOW THE STEPWISE APPROACH	TOTAL
General practitioner	Oxymetazoline (Iliadin) and Betamethasone sodium phosphate (Betnesol) are not on treatment guidelines, anticholinergic not on treatment guidelines	1
	Anticholinergic not on treatment guidelines	2
	2 ICS prescribed	1
	LABA or montelukast and patient has both	27
	LABA or theophylline and patient has both	1
	LABA prescribed as monotherapy	1
	Only allergy meds prescribed for asthma	2
	Oral corticosteroid prescribed with ICS, no LABA or montelukast	1
	Oral corticosteroids without ICS	1
Paediatric pulmonologist	Anticholinergic not on treatment guidelines	1
	LABA or montelukast and patient has both	4
	Only meds for allergy prescribed	2
Paediatrician	Anticholinergic not on treatment guidelines	4
	LABA or montelukast and patient has both	82
	LABA or montelukast and patient has both, Anticholinergic not on treatment guidelines	1
	Only meds for allergy prescribed	1
Pulmonologist	LABA or montelukast and patient has both	1
	Anticholinergic not on treatment guidelines	1

KEY: LABA = Long acting β 2-agonist, ICS = Inhaled corticosteroid

When looking at the ages twelve years and older this makes up the biggest patient population and has the most variation in terms of prescriber types. General practitioners prescribed medication for asthma for 1163 patients in this group which is the most by far. Of these 1163 patients 151 prescriptions did not follow the stepwise approach which is 13% of the patients. The most common reason the medication prescribed did not follow the stepwise approach was the doctor prescribed anticholinergics which are not included on the stepwise approach. This included 51 prescriptions. The second most common reason was the doctor prescribed a long acting β 2-agonist with a leukotriene receptor antagonist which included 48 prescriptions. Seventeen treatments did not follow the stepwise approach as the doctor prescribed a long acting β 2-agonist with theophylline. Other reasons treatment did not follow the stepwise approach include two inhaled corticosteroids prescribed on one prescription, *N*-acetylcysteine (Acc200) was prescribed for asthma which is not on the stepwise approach, two long acting β 2-agonists prescribed, long acting β 2-agonists prescribed without an inhaled corticosteroid, only medication used to treat allergies prescribed, long acting β 2-agonists prescribed with a leukotriene receptor antagonist and theophylline, oral steroids prescribed

without an inhaled corticosteroid, oral steroids prescribed without long acting β 2-agonists, promethazine (Phenergan) prescribed which is not on the stepwise approach and combinations of the reasons above.

Pulmonologists diagnosed and prescribed treatment for 343 patients of which 69 (20%) prescriptions did not follow the stepwise approach. The most common reason was the doctor prescribed a long acting β 2-agonist with a leukotriene receptor antagonist which included prescriptions for 37 patients. Nineteen prescriptions did not follow the stepwise approach as anticholinergics were prescribed. Other reasons included Alcophyllax® and adrenaline prescribed for asthma which are not included on the stepwise approach, a long acting β 2-agonist prescribed with theophylline, a long acting β 2-agonist, leukotriene receptor antagonist and theophylline prescribed together, only medication used to treat allergies was prescribed, promethazine prescribed for asthma which is not on the stepwise approach and combinations of reasons above.

Specialist physicians prescribed treatment for 237 patients of which 77 (32%) prescriptions did not follow the stepwise approach. The main reason for this was a long acting β 2-agonist was prescribed with a leukotriene receptor antagonist which included 35 prescriptions. Seventeen prescriptions included anticholinergics which are not included on the stepwise approach. Other reasons include cotrimoxazole prescribed to treat asthma, a long acting β 2-agonist prescribed with theophylline, a long acting β 2-agonist prescribed with theophylline and a leukotriene receptor antagonist, a long acting β 2-agonist and oral corticosteroids prescribed without an inhaled corticosteroid, oral steroids prescribed without a long acting β 2-agonist or an inhaled corticosteroid, oxygen prescribed for asthma which is not included on the stepwise approach and a combination of the reasons above.

Paediatricians prescribed treatment for 32 patients of which nine prescriptions did not follow the stepwise approach (28%). All nine of these prescriptions did not follow the stepwise approach as a long acting β 2-agonist was prescribed with a leukotriene receptor antagonist.

Cardiologists prescribed treatment for asthma for nine patients of which two prescriptions did not follow the stepwise approach as the doctor prescribed an anticholinergic.

Endocrinologists prescribed treatment for six patients of which two (33%) of the prescriptions did not follow the stepwise approach. The reasons include a long acting β 2-agonist prescribed with theophylline and a leukotriene receptor antagonist and only medication used to treat allergies was prescribed for asthma.

ENT's (Otorhinolaryngologists) prescribed medication for asthma for two patients. One of the prescriptions did not follow the stepwise approach as only medication used to treat allergies was prescribed for asthma.

Nephrologists treated asthma in three patients of which one prescription did not follow the stepwise approach as the doctor prescribed an anticholinergic.

Gastroenterologists prescribed medication for two patients, a neurologist diagnosed asthma for a patient, paediatric pulmonologists diagnosed and treated asthma for six patients, a psychiatrist diagnosed and prescribed treatment for one patient and a rheumatologist treated asthma for two patients. All of these doctors followed the stepwise approach.

Table 6.6 shows the reasons the prescriptions prescribed from different providers did not follow the stepwise approach for the 12 years and older age group.

Table 6.6 Age 12 and older reasons providers did not follow the stepwise approach

PROVIDER	REASON PRESCRIPTION DID NOT FOLLOW THE STEPWISE APPROACH	TOTAL
Cardiologist	Anticholinergic not on treatment guidelines	2
Endocrinologist	LABA or LTRA or theophylline but all prescribed	1
	Only allergy meds prescribed for asthma	1
ENT	Only meds for allergy prescribed	1
General practitioner	2 ICS prescribed	7
	Acc200 is not on the treatment guidelines and should be used with caution in asthmatics	1
	Anticholinergic not on treatment guidelines	51
	Anticholinergic not on treatment guidelines, 2 ICS prescribed	2
	LABA or LTRA but both prescribed	48
	LABA or LTRA but both prescribed, Anticholinergic not on treatment guidelines	3
	LABA or LTRA or the theophylline but all prescribed	1
	LABA or LTRA or theophylline but all prescribed, Anticholinergic not on treatment guidelines	1
	LABA or theophylline but both prescribed	17
	LABA or theophylline but both prescribed, Anticholinergic not on treatment guidelines	1
	LABA, LTRA or theophylline but all prescribed, 2 LABAs prescribed, Anticholinergic not on treatment guidelines	1
	LABA prescribed with no ICS	5
	LABA prescribed with no ICS, Anticholinergic not on treatment guidelines	1
	Only meds for allergy prescribed	9
	Oral steroids prescribed without ICS	1
	Oral steroids prescribed without LABA	1
	Promethazine is not on the treatment guidelines	1
Nephrologist	Anticholinergic not on treatment guidelines	1
Paediatrician	LABA or LTRA but both prescribed	9
Pulmonologist	Alcophyllex and adrenaline not in treatment guidelines	1
	Anticholinergic not on treatment guidelines	19
	Anticholinergic not on treatment guidelines, either LABA or theophylline but both prescribed	1
	LABA or LTRA but both prescribed	37
	LABA or LTRA but both prescribed, Anticholinergic not on treatment guidelines	2
	LABA or LTRA or theophylline but all prescribed	1
	LABA or theophylline but both prescribed	3
	Only meds for allergy prescribed	3
	Promethazine is not on the treatment guidelines	2

PROVIDER	REASON PRESCRIPTION DID NOT FOLLOW THE STEPWISE APPROACH	TOTAL
Specialist physician	Anticholinergic not on treatment guidelines	17
	LABA or LTRA but both prescribed	35
	LABA or LTRA but both prescribed, Forvent not on the treatment guideline	1
	LABA or LTRA but both prescribed, Purbac not on the treatment guidelines	1
	LABA or LTRA or theophylline but all prescribed	4
	LABA or LTRA or theophylline but all prescribed, Anticholinergic not on treatment guidelines	2
	LABA or theophylline but both prescribed	7
	LABA or theophylline but both prescribed, Anticholinergic not on treatment guidelines	2
	LABA and oral corticosteroid without ICS	1
	LABA prescribed with no ICS	3
	Oral steroids prescribed without ICS	1
	Oral steroids prescribed without LABA or ICS	2
	Oxygen is not on the treatment guidelines	1

KEY: LABA = Long acting β 2-agonist, ICS = Inhaled corticosteroid, LTRA = Leukotriene receptor antagonist

Table 6.7 shows the comparison between the prescriber and the number of patients, whose treatment prescribed for these patients diagnosed with first time asthma, did not follow the stepwise approach. This is divided into each age group. This table does not take into account the total number of prescriptions completed by each provider. In the age group 0-4 years, the paediatricians had the highest number of treatments prescribed that did not follow the stepwise approach. In the age group 5-11 years, the most number of prescriptions which did not follow the stepwise approach was prescribed by paediatricians. In the age group 12 years and older, the most number of prescriptions which did not follow the stepwise approach came from general practitioners but general practitioners also had the greatest number of prescriptions completed in the age group.

Table 6.7 Total number of prescriptions which did not follow the stepwise approach

AGE	PROVIDER	TOTAL
0-4	General practitioner	36
	Paediatric pulmonologist	12
	Paediatrician	189
	Pulmonologist	3
5-11	General practitioner	37
	Paediatric pulmonologist	7
	Paediatrician	88
	Pulmonologist	2
	Specialist physician	0
12-Adult	Cardiologist	2
	Endocrinologist	2
	ENT	1
	Gastroenterologist	0
	General practitioner	151
	Nephrologist	1
	Neurologist	0
	Paediatric pulmonologist	0
	Paediatrician	9
	Psychiatrist	0
	Pulmonologist	69
	Rheumatologist	0
	Specialist physician	77

This research project was looking at prescribing patterns and looking at whether doctors were following guidelines and the stepwise approach when treating patients with asthma. Out of the 3639 patients, 2953 (81%) patients were diagnosed with first time asthma following the stepwise approach for treatment. 686 (19%) patients were prescribed medicine that did not follow the stepwise approach. The patients with co-morbidities whose treatment did not follow the stepwise approach was 20%, so the fact that patients diagnosed with other chronic conditions did not influence prescribing patterns too much compared to the whole patient population.

1760 prescriptions came from general practitioners of which 224 (13%) prescriptions did not follow the stepwise approach. Pulmonologists sent through 373 of the prescriptions to the medical aid of which 74 (20%) of these prescriptions did not follow the stepwise approach. Specialist physicians had a total of 241 of the prescriptions of which 77 (32%) prescriptions did not follow the stepwise approach. Paediatricians sent through a total of 1121 prescriptions

of which 286 (26%) did not follow the stepwise approach. Paediatric pulmonologists prescribed a total of 118 prescriptions of which nineteen (16%) of the prescriptions did not follow the stepwise approach. This would indicate that general practitioners prescribed treatment which followed the stepwise approach best and specialist physicians prescribed treatment for patients with asthma the worst in terms of following the stepwise approach. It is difficult to say best and worst as it is difficult to see all aspects of the patient. Allergies are not taken into consideration and specialists are more likely to see complicated patients in which standard treatment may not be indicated. The patients' age and co-morbidities that are not approved from the medical aid, and therefore not taken into consideration, are also factors.

From another study it was concluded that a large proportion of drugs prescribed for asthma are not according to the recommended guidelines of the Department of Health or the expert guideline recommendations for asthma management (Steyn, 2006).

In all age groups general practitioners followed the stepwise approach best but they had the most variation in terms of reasons why this provider type did not follow the stepwise approach. In the age group 0-4 years, pulmonologists followed the stepwise approach the worst but again these are specialists in pulmonology and may be seeing complicated patients. In the age group 5-11 years, paediatricians had the highest percentage of prescriptions that did not follow the stepwise approach. In the age group 12 years and older, specialist physicians had the highest percentage of prescriptions that did not follow the stepwise approach. In the adult population other prescribers like gastroenterologists, neurologists and nephrologist may have diagnosed patients with asthma as they were treating these patients for other conditions.

The standard treatment guideline for chronic persistent asthma says that maintenance therapy includes inhaled corticosteroids which are the mainstay of treatment in chronic asthma (The National Department of Health, 2012). Reliever or rescue therapy includes β 2-agonists like salbutamol. If there is insufficient response to adequate steroids and salbutamol the doctor may add theophylline modified release tablets. If asthma is still not well controlled the doctor may add a short course of a long acting β 2-agonist therapy like formoterol. On failure of this therapy the doctor may add prednisone tablets. This is very similar to the stepwise approach except that long acting β 2-agonists are used in combination with inhaled corticosteroids as

maintenance therapy and leukotriene receptor antagonists can be used in place of theophylline.

7. LIMITATIONS

There are a few limitations of this study:

- The information obtained in this project will not reflect the greater population; the information is not generalizable to the greater population or to other Medical Aids.
- Data is only as good as what is provided on the application form and database for patients, so some information may be missing.
- Depending on the plan type, not all doctors' visits or medication may be reflecting on the database.
- The doctor who diagnosed the patient may not be the same doctor who filled in the Chronic Application Form so we may document prescribing patterns from the incorrect doctor when looking at what type of doctor prescribed the medication.
- The doctor may have only filled in the chronic application form when the patient was controlled on the medication so this may not be the initial treatment the patient was prescribed. The patient may have been taking acute medication so the system may skew the data.
- Not all doctors submit Lung Function Tests so documenting the information from the Lung Function Tests may be inaccurate as it will not reflect all the patients which have been looked at.
- It is difficult to get the full picture in terms of treatment for the patient and severity from limited information provided by the Medical Aid.
- Patients may have had other tests done which were not submitted to the Medical Aid and have therefore not been included.
- Honesty on the application form cannot be confirmed so a doctor may say the patient has just been diagnosed with the condition to avoid penalisation but may have had the condition for many years.
- Prescribers may prescribed medicine for asthma as the condition will be approved as there is no clinical entry criteria, whereas other conditions, like chronic obstructive pulmonary disease, has got clinical entry criteria for approval and allergic rhinitis is not a PMB condition.

8. RECOMMENDATION

The findings of the study will be presented to the Medical Aid.

Follow-up studies need to be done to determine the reasons why so many patients were initiated on more than two medicines and why adults were diagnosed at a late stage of their lives.

Follow-up studies are also recommended to evaluate prescriptions against patient information with the prescribers directly to review the clinical picture of patients diagnosed.

9. CONCLUSION

Asthma is a complicated disease. Patients have different symptoms, have co-morbidities and are on medication to treat other conditions. The goal of treatment for patients suffering with asthma is to get the patient back to normal lung function, prevent irreversible lung damage and prevent asthma attacks. Patients should continue with life as they once did before their diagnosis of asthma. It is difficult to say that the prescription is wrong as it does not follow the stepwise approach as it is difficult to see the whole picture with bits of information that has been received from a medical aid.

The total patient population for this study was 3639 patients; from this total 2953 (81%) patients were diagnosed with first time asthma following the stepwise approach for treatment. 686 patients were diagnosed with first time asthma and did not follow the stepwise approach for treatment which is 19% of the patient population. The patients with co-morbidities whose treatment did not following the stepwise approach was 20% so the fact that patients diagnosed with other chronic conditions did not influence prescribing patterns too much compared to the whole patient population.

49% of the chronic application forms came from general practitioners, 31% from paediatricians, 10% from pulmonologists, 7% from specialist physicians and 3% of applications came from paediatric pulmonologists. Specialists are prescribing more than two

medicines per prescription for asthma for an initial diagnosis with general practitioners prescribing one or two items on the prescription for asthma.

From the patient population 1853 (51%) are female and 1786 (49%) are male. The mean age of the patient population is 23.5 years old. Fifty percent of the patients are younger than 12 years of age with most of the patients less than five years.

Treatment of patients diagnosed with asthma should be the responsibility of all healthcare providers to ensure the best outcome of the patients so that the patient can return to normal function.

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