COPD PATIENTS IN THE NORTHERN SUBURBS OF THE WESTERN CAPE METROPOLE HOSPITALISED DUE TO ACUTE EXACERBATION - A BASELINE STUDY.

Thesis presented in partial fulfilment of the requirements for the degree of Master of Physiotherapy at the University of Stellenbosch.

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Readmission Data Capture Sheet

Patient code:

Please tick (√) the appropriate box and fill in not applicable (n/a) if not relevant.

Hospital:

Panorama Medi-Clinic	
Louis Leipoldt Medi-Clinic	
Tygerberg	
Karl Bremer	

Admission Date		**Vital Signs**	**Adm**	**D/C**
Discharge Date		Pulse		
ICU admission	Yes/No	Respiratory Rate		
Reason for admission		Temperature		
Pneumonia		Blood pressure		
Dyspnoea				
Bronchospasm				
Unspecified infection				
Increase in sputum production		**Lung Function**		
Deterioration in respiratory symptoms		FEV1		
Deterioration in mobility		FVC		
New Arrhythmias		FEV1/FVC		
Medical condition		**Blood Gasses**		
Stroke		PaCO2		
Cor Pulmonale		PaO2		
Congestive cardiac failure		pH		
Pulmonary embolism		Oxygen Saturation		
Hypertension		Walking:	Yes /No	
Ischaemic Heart Disease		Walking with assistance	Yes /No	
Diabetes Mellitus		O2 dependant in hospital	Yes /No	
Cancer		Home O2	Yes/No	
Tuberculosis (TB)				
Post TB bronchiectasis				
Smoking? If yes, how many years?	Yes/ No	**Ex-smoker**	Yes/No	

Medication Data Capture Sheet

Patient code:

Please tick (√) the appropriate box

Hospital:

Panorama Medi-Clinic	
Louis Leipoldt Medi-Clinic	
Tygerberg	
Karl Bremer	

Indicate medication by individual name

Date

Bronchodilators	Theophylline/ Aminophylline	Cortico steriods	Antibiotics	Mucolytic Agents	Other: HPT/ Cardiac meds

Declaration

I the undersigned hereby declare that the work contained in my thesis is my own original work and that I have not previously in its entirety or in part submitted it for any degree or examination at any university. This study has been approved by the research Ethics Committee of the Faculty of Health Sciences, University of Stellenbosch, protocol number N05/07/118.

Signed by: _____

Date: _____

ABSTRACT

Acute exacerbation is an important event of COPD as it causes significant disability and mortality. Especially repeated hospitalisation of patients with acute exacerbation has been associated with reduce quality of life and excessive hospitalisation cost. Chronic Obstructive Pulmonary Disease causes significant functional limitations that translate into enormous economic and societal burden.

Study Aim: To describe the profile and selected outcomes of Chronic Obstructive Pulmonary Disease (COPD) patients admitted with acute exacerbation to hospitals in the northern suburbs of the Western Cape.

Study design: A multicenter retrospective descriptive single subject design was used.

Method: Patients admitted with the diagnosis of COPD with acute exacerbation in the time period 01June 2004-01June 2005 were followed up retrospectively for a period of 12 months. The demographics, medical condition on admission and past presentation of acute exacerbation, length of stay in hospital and the number of readmissions for acute exacerbation in the 12 month period were collected and recorded on a self designed data capture sheet.

Results: One hundred and seventy eight patients were admitted with acute exacerbation at the three hospitals. The mean age of the patients were 63 (±11.73), more males than females (103: 75) were admitted. Subjects spent a mean of 5.67 (±6.55), days in hospital with every

admission and admission frequency of up to eight periods were recorded. Of the n=178 admitted, 56% had one admission and 44% had 2 or more admissions in the study year. This resulted in a total of 338 hospital admissions with the 78 subjects responsible for the majority of admissions (238) Subjects presenting with two or more co-morbidities had a significantly greater risk of multiple re admissions. Subjects with three or more admissions had two or more co morbidities (p=0.001), comparatively those with one admission had only one co morbidity. Congestive cardiac failure (p=0.01) as well as the lack of Long Term Oxygen Therapy p=0.017) were associated with increase risk of three or more admissions.

Conclusion: Patients admitted with acute exacerbation to the hospitals where the study was conducted presented with an age ranging from 30-95 years. Patients with 2 or more admissions experience up to eight readmissions episodes in the study year. This is a cause of concern in respect of the burden of disease on especially the younger economically viable South African population. In the current study factors that influenced readmission were the presence of two or more co morbid diseases, specifically the presence of congestive cardiac failure as well as the lack of LTOT. Interventions including a pulmonary rehabilitation programme post discharge should be aimed at decreasing frequency of hospitalisation especially in those patients who are a risk of readmission.

ABSTRAK

Verergering van simptome in Kroniese Obstruktiewe Lugweg Siekte (KOLS) is baie belangrik as gevolg van die ongeskiktheid en mortalitieit wat dit veroorsaak. Dit veroorsaak vermindering in die kwaliteit van lewe en verhoog hospitaal koste verbind met die siekte. Die beperkings toe te skrywe aan die Kroniese Obstruktiewe Lugweg Siekte veroorsaak ontsettende ekonomiese en sosiale druk.

Doelstelling: Om die profiel en geselekteerde uitkomste van pasiente met Kroniese Obstruktiewe Lugweg Siekte toegelaat met verergering in die hospitale van die noordelike voorstede van die Wes Kaap te beskryf.

Studie ontwerp: ’n Multisentrum retrospektiewe beskrywende enkel persoon studie.

Studie metode: Pasiente toegelaat met verergering van Kroniese Obstruktiewe Lugweg Siekte in die periode 01Junie 2004-01Junie 2005 was retrospektief opgevolg vir ‘n periode van 12-maande. Demografiese data, mediese toestand op toelating en ontslag, lengte van hospitaal verblyf en getal toelatings in die 12- maande was gekollekteer en gedokumenteer op self ontwerpde vorms.

Resultate: Een-honderd agt en seventig pasiente was toegelaat met verergering by die drie hospitale. Die gemiddelde ouderdom van die studie populasie was 63 (±11.73) met meer mans as vrouens (103: 75) toegelaat. Die studie populasie het gemiddelde dae van 5.67 (±6.55), in die hospitaal deurgebring en toelating frekwensie van agt episodes was gedokumenteer. Van die n=178 toegelaat was 56% eenkeer toegelaat en 44% het 2 of meer

toelatings in die studie jaar gehad. Dit het in 338 hospital toelaatings veroorsaak en 78 van die studie populasie verantwoordelik vir die meeste van die toelatings (238). Die groep met drie of meer toelatings in die studie jaar het twee of meer siektetoestande (p=0.001) gehad, teenorgesteld met die wat net een toelaat was met een siektetoestand. Hart versaaking (p=0.01) en die gebrek aan suurstof by die huis (p=0.017) was verbind met meer risiko van drie of meer toelating.

Samevatting: Die ouderdoms verskil was wydbeskrywend van 30-95 jaar van die pasiente wat in die studie jaar toegelaat is by die drie hospitale. Pasiente wat 2 of meer keer toegelaat is het tot agt hertoelatings in die studie jaar gehad. Kommerwekkend is die uitwerking van die siekte op die jonger werkend populasie in Suid Afrika. In die studie was hertoelating beinvloed deur die teenwoordigheid van twee of meer siektetoestande, spesifiek hart versaaking sowel as die gebrek aan suurstof by die huis. Intervensies insluitende pulmonale rehabilitasie na ontslag se doel moet wees om vermindering van heraaldelike hospitalisasie in hoë risiko pasiente vir hospitalisasie.

DEDICATION

This thesis is dedicated to my four year old, Otashia and her unlimited supply of ‘why’.

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STUDY LEADERS

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HOSPITALS WHERE THE RESEARCH WERE CONDUCTED:

Panorama Medi Clinic, Tygerberg and Karl Bremer Hospitals.

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Chapter 1

Introduction

1.1 Introduction to the study

Acute exacerbation remains an important event in the natural history of COPD. Patients diagnosed with COPD may experience frequent episodes of acute exacerbations of three or more per year. This is more common in individuals with moderate to severe COPD (Burge and Wedzicha, 2003). Even though up to half of the exacerbations may be unreported as they may not be severe and do not require hospital admission, there are individuals that may be subjected to frequent hospitalisation due to recurrent episodes of acute exacerbation (Hunter and King, 2001; MacNee, 2003; Seemungal *et al*., 1998). As result of multiple hospitalisations patients may experience a temporary or permanent decrease in function and are there for unable to recover to their pre hospitalisation functional status (Seemungal *et al.,* 1998). Frequent readmissions remains a cause for concern as it results in increasing physical disability, social isolation, escalation of cost in respect of medical expenses and lost income as well as being associated with high mortality (MacNee, 2003).

In a developing country such as South Africa health care providers and health care facilities are under increasing pressure to provide comprehensive patient management and cost effective measures to deal with chronic diseases (Michaud, 2001). Specifically in developing countries, the allocation of scarce resources across the medical field are constantly placed under strain by large communities that have limited ability, if any, to pay for services rendered, especially in the public sector (www.doh.gov.za/mts/reports/cardiosurgery.html,

accessed 14. 08.2006). This economic burden is reported to increase further due to an increase in life expectancies because of improved access to quality health care (Mathers *et al*., 2006).

Pulmonary rehabilitation remains important in the management of COPD as it aims to improve the quality of life of the individual affected by the disease (Fan *et al.,* 2006). There is high quality evidence that a pulmonary rehabilitation programme can counteract the negative effects experienced from multiple admissions due to acute exacerbation of COPD (American Thoracic Society (ATS), 1999; Fahy, 2003; Puhan *et al.,* 2005). The rehabilitation programme usually comprises of upper and lower extremity exercises and strength training, education, behavioural intervention and nutrition (ATS, 1999; Celli, *et al.,* 2004). Documented benefits include increased exercise capacity, increase ability to perform activities of daily living, decreased episodes of acute exacerbation, a decrease in dyspnoea, a decrease in anxiety and depression, and decreased costs associated with hospitalisation (Puhan *et al.,* 2005; Reis *et al.,* 2007).

Evidence for the benefits of pulmonary rehabilitation is well known in developed countries (Celli *et al.,* 2004; Fan *et al.,* 2004; Reis *et al*., 2007). While evidence exists in respect of the mortality rates of patients suffering from COPD in developing countries like South Africa, data concerning the morbidity of the disease in the developing world is less documented (Bradshaw *et al.,* 2000; Bradshaw *et al.,* 2002; Norman *et al.,* 2001; Bradshaw and Steyn, 2001). The MRC report on chronic diseases of lifestyle in South Africa of 1995-2005 comments only on the prevalence and risk factors of chronic diseases especially self reported chronic bronchitis (Ehrlich and Jithoo, 2006). Even the aforementioned report mentions the lack of studies of COPD in the general South African population and base the report on

studies using self reported diagnosis of chronic bronchitis or COPD documented during the 1998 South African Demographic and Health Survey.

Data from the 1998 South African Demographic and Health Survey (SADHS) were also used by Bradshaw and Steyn (2001) in their report on Poverty and Chronic Diseases in South Africa. The report as well as the SADHS (1998) documented the prevalence of lung disease based on the symptoms of chronic bronchitis, asthma and abnormal peak expiratory flow rate (PEFR).The other limitation of the SADHS (1998) is that it was conducted prior to the implementation of the GOLD guidelines in 2001 that requires the diagnosis of COPD to be confirmed by spirometry although in the SADHS mention is made on the limitation of using PEFR above spirometry as the latter would be more accurate in determining COPD. Self reported diagnoses are problematic as they are based on the patients recall of the diagnosis made by a health professional and is not based on objective measures used by a physician and could have led to an under reporting of diagnoses involving COPD (SADHS, 1998; Steyn *et al.,* 2006). The report by the department of health do not provide information on the profile of COPD patients hospitalised with acute exacerbation or any information on the readmission and days spent in hospital as result of acute exacerbation (Steyn *et al.,* 2006). Unfortunately no recent health surveys except the 1998 SADHS are available on the website of the department of health.

Other factors specifically within the South African context which could potentially impact on the profile of the South African COPD patient admitted with acute exacerbation is the high prevalence of HIV/AIDS and TB found specifically in the Western Cape (www.who Tuberculosis.htm, accessed 17.03.2005). The impact of the two health care systems namely the public and private systems providing services to the South African population and

differences in admission criteria that may exist amongst the hospitals and influence readmission and the length of stay in hospital is also not clear

This lead to the question: What is the profile and selected outcomes of COPD patients admitted with acute exacerbation to hospitals in the northern suburbs of the Cape Metropole? The aim of the study was there for to describe the demographics of the COPD patient hospitalised with acute exacerbation in the Western Cape prior to recommendations regarding the implementation of a pulmonary rehabilitation programme. To answer the research question a one year retrospective medical folder search were conducted at both the public and private hospitals in the Cape Metropole.

Chapter 2

Literature Review

2.1 Introduction

In this chapter the following topics will be addressed: the current literature and debate on Chronic Obstructive Pulmonary Disease (COPD) and acute exacerbation in relation to the burden of disease; the definition of COPD, its causes, diagnosis, development and risk factors; the definition of acute exacerbation and its current management; and outcomes of COPD. Electronic searches were conducted using the databases of Pubmed Central Library, Medline and Google search engines.

2.2 Burden of COPD

Due to the changing population dynamics the increasing influence of tobacco smoke and air pollution, specifically in the developing countries, it is expected that the burden of COPD may escalate in those countries (Michaud, 2001). This was particularly evident when, in 1990, tobacco smoke as a major risk factor for COPD was ranked fourth in the Burden on Disease and Injury Attributable to Selected Risk Factors in the World, as established using the disability adjusted life year (DALY) instrument (www.goldcopd.com/, accessed 21.12.2007). It was preceded only by unsafe sex, poor water supply and sanitation, and malnutrition (www.who.int/whr, accessed 02.06.2007). In projections made on the burden of major diseases for the year 2002 to 2030 by Mathers *et al*. (2006) using updated information but similar calculations as used in the Global Burden of Disease (GBD) study, they projected a continued increase of tobacco-related diseases even in the light of the HIV/AIDS epidemic.

The DALY system was developed following the Global Burden of Disease study carried out in 1990 (sponsored by the World Bank) by researchers at Harvard University and the World Health Organization (WHO) (Mathers *et al*., 2006). The DALY system measures the difference between the population health and a specific goal. This system makes it possible to estimate the burden of major diseases injuries and risk factors. It was initially developed for use in eight regions of the world but now most countries, including the United States and others, as well as the WHO utilise this system to ascertain the impact of major diseases (Michaud *et al*., 2001; WHO, 2000). The DALY system uses estimates from the 1990 Global Burden of Disease (GBD) study, and it may have underestimated the rapid increase of infectious diseases, tobacco related illnesses, HIV/AIDS and tuberculosis, especially in sub-Saharan Africa and the subsequent impact they will have on life expectancy (Mathers *et al*., 2006).

In the preliminary estimates of the WHO GBD study of 2000, COPD resulted in the same percentage of deaths as HIV/AIDS, which highlights the significant mortality of this disease (Pauwels, 2001; WHO, 2000). Current evidence supports the anticipated escalation of the prevalence of the disease as well as the expected increasing impact of acute exacerbations with regards to the economic burden as well as the progressive disability that accompanies COPD (Mannino, 2002; Pauwels, 2001; Sullivan *et al*., 2000). The disease affects all aspects of the patient's wellbeing and has an extensive impact on patient and family as the disease becomes more debilitating over a period of time as the individual ages. It is anticipated, given all the existing developments of increase tobacco usage and rapid industrialisation, that by the year 2020 COPD will be the third leading cause of death worldwide even in the light of the intensive anti-tobacco smoking campaigns (Sullivan *et al*., 2003). This is especially evident in

the developing countries due to increase tobacco usage by the countries (Michaud *et al*., 2001).

In a prevalence survey conducted in the United States in 1995 it was found that COPD was the cause of most deaths of people above 65 years of age, and that an increase in disability due to the ageing population as well as an increase in disease prevalence were expected (Weiss *et al*., 2003). In 2004 it remained the fourth leading cause of death in the United States, with an estimated 11 million people suffering from COPD and nearly 24 million Americans presenting with evidence of impaired lung function (www.lungusa.org/site/pp.asp, accessed 17 March 2005; NHLBI, 2006).

The majority of research on COPD and acute exacerbation, their causes and risk factors have been studied within the context of first world countries (MacNee, 2003; Sullivan *et al*., 2000). Apart from the mortality rates attributed to COPD no specific information could be identified in a developing country such as South Africa regarding the economic and social burden of the disease specifically acute exacerbation. Future research is prudent to determine the magnitude of this disease in the South African population as this has extensive economical and societal implications (Michaud *et al*., 2001).

2.3 Definition of COPD

The definition of COPD and the implementation thereof depend on a specific country's health criteria and application of this definition will affect the prevalence statistics of the disease in that specific country (Mannino, 2002).

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines COPD as follows: “a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases." This definition was used by GOLD in their first publication in 2001 (GOLD, 2001) but has subsequently changed in the light of new developments. In 2006 GOLD defined COPD as follows: “Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease with some significant extrapulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterized by airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.”

The definition of COPD proposed in the combined document of the American Thoracic Society and the European Respiratory Society (ATS/ERS) of 2004 is as follows: “Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease state characterised by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily caused by cigarette smoking. Although COPD affects the lungs, it also produces significant systemic consequences.”

2.4 Development of COPD

COPD is a disease characterised by lung tissue destruction, mucus hypersecretion, accelerated degeneration and inflammation due to noxious gasses or particles, resulting in emphysema and chronic bronchitis, or both (Altose, 2003; Hunter and King, 2001).

COPD usually refers to chronic bronchitis and emphysema and is included under the umbrella term of Chronic Lung Disease that includes other conditions such as cystic fibrosis, bronchiectasis and asthma. The definition of COPD excludes asthma due to the reversibility of pulmonary function deficits (Hunter and King, 2001). However, individuals may present with both symptoms of asthma and COPD and therefore it has been proposed that certain patients may present with both these diseases (Mannino, 2002). Chronic bronchitis and emphysema are both diseases that do not develop or present rapidly but rather have a slow onset and patients progressively become more symptomatic and disabled (Mannino, 2002; Weiss *et al*., 2003).

Chronic bronchitis is associated with mucous gland hypertrophy and an increase in mucous production, resulting in a chronic productive cough and increase in sputum. This condition is defined as a productive cough for most days for three months of the year for at least two consecutive years, with subsequent exclusion of other causes of lung pathology. In chronic bronchitis inflammation results in scarring of the bronchial walls and excessive mucus is produced due to extensive irritation (www.lungusa.org/site/apps/s/content.asp, accessed 05 December 2006). The accumulation of secretions contributes to bacterial infections within the airways and eventually obstructs airflow. Chronic bronchitis can affect individuals of all ages but is higher in the over-45-year group (Mannino, 2002).

In emphysema, destruction of the alveolar walls and a decrease in structural support of the airways causes premature closure during expiration, resulting in hyperinflation. Destruction of the alveoli is permanent. A decrease in the surface area of the alveoli causes inadequate gas exchange, resulting in hypoxaemia, with or without hypercapnia and progressive shortness of breath (Hunter and King, 2001; Mannino, 2002).

Over a period these changes within the trachea, bronchi and bronchioles contribute to an increase in anatomical dead space and an overall increase in lung capacity, resulting in hyperinflation of the lungs and causing the hemi-diaphragms to become depressed. This contributes to the clinical presentation of a patient with an elevated clavicle, a barrel-shaped chest and defined sternocleidomastoid and abdominal musculature due to increased muscle recruitment during respiration. As result of the pathophysiological changes causing ventilation and perfusion inequalities and changes in chest wall structure this contributes to breathing inefficiency and increased metabolic cost (Hunter and King, 2001; Jones *et al*., 2003). This results in symptoms such as coughing, wheezing, shortness of breath and reduced exercise tolerance (Mannino, 2002).

As COPD is a progressive disease with insidious onset, symptoms can vary considerably amongst individuals. The presence of symptoms depends on the extent of the exposure to risk factors that an individual is subjected to and an individual's genetic predisposition to develop COPD. In their article on COPD, Weiss *et al*. (2003) consider the impact of childhood asthma and allergy on lung development during the growth period as well as the potential to affect future development and susceptibility to COPD. Thus, individuals who present with respiratory symptoms and a positive childhood history of respiratory complaints such as bronchitis and asthma and who engage in activities such as smoking may predispose them to develop COPD compared to a non-smoker with the same history. These patients may also develop more severe COPD and have an increased risk of acute exacerbations and poorer prognoses (Jeffery, 2002).

2.5 Causes of COPD and associated risk factors

There is a complex variety of factors that influence the development of COPD in an individual within a first world population: age, genetics, gender, airway responsiveness, allergy, smoking, occupational exposure, infections, nutrition and environmental allergens (www.goldcopd.com/, accessed 21.12.2007; Mannino, 2002; Weiss *et al*., 2003). In South Africa the increasing prevalence of tuberculosis (TB), exposure to industrial and mining dust, and biomass fuel used for cooking by the underprivileged in poorly ventilated houses are all recognised as additional causes for the development of COPD (Bateman *et al*., 2004).

2.5.1 Age

Historically, the risk of developing chronic lung disease has been associated with older age as the diagnosis of COPD is usually made later in life (Bateman *et al*., 2004; Sullivan *et al*., 2003). Older age combined with a strong smoking history increase the risk of developing COPD in susceptible individuals. Individuals may initially attribute their deteriorating health to growing old and only seek medical attention when symptoms significantly impede their daily living activities (Mahler, 2006).

Increasingly, younger individuals are diagnosed with COPD as advances in technology, education levels and diagnostic procedures facilitate diagnosis. Socio-economic growth also results in changing patterns in society affecting values and norms, and consequently younger people are being exposed and the effects of smoking both actively and passively and therefore the potential effects of the disease (Bradshaw and Steyn, 2001; Mannino, 2002).

2.5.2 Genetic

Only a relatively small percentage of individuals present with the genetic inherited alpha1 antitrypsin deficiency, accounting for about 5% of the emphysema statistics in the United States, primarily amongst individuals from Northern European descent (www.lungusa.org/site/apps/s/content.asp, accessed 05 December 2006). Inherited alpha1 antitrypsin (AAT) deficiency related emphysema is caused by a deficiency of the protein alpha1 antitrypsin, a lung protector released by the liver, and should be considered if non-smokers younger than 40 years of age are diagnosed with COPD (www.lungusa.org/site/pp.asp, accessed 17 March 2005).

The symptoms of AAT deficiency related emphysema may present from the age of 32 to 40 and smoking greatly increases the severity of emphysema in these individuals. Individuals who have a positive family history of emphysema or chronic bronchitis and meet the criteria of risk factors for COPD may also have genetic factors influencing their predisposition to develop the disease. This, however, is still the basis of ongoing research (Mannino, 2002; Weiss *et al*., 2003).

2.5.3 Gender

International trends suggest an increase in smoking behaviour amongst females and young adults even with intensive and ongoing anti-smoking campaigns worldwide (Mannino, 2002). In the past, the prevalence of smoking amongst males contributed to the higher rate of COPD in this group compared to females but recent trends indicate an increase in the occurrence of smoking in females, which has resulted in an increased development of COPD in this gender grouping (Hurd, 2000).

The differences in response to smoking and therefore the development of COPD could be as a result of females being more sensitive to the detrimental effects of cigarette smoke, possibly due to reduced airway size or increased airway hyper-responsiveness and hormonal influences compared to males (Weiss *et al*., 2003). The female population are however twice as likely to be diagnosed with chronic bronchitis or asthma compared to males, reflecting a component of under-reporting of COPD as the primary diagnosis especially relating to females (www.lungusa.org/site/apps/s/content.asp, accessed 05 December 2006; Weiss *et al*., 2003).

2.5.4 Airway responsiveness and allergies

Airway hyper-responsiveness and atopy may predispose an individual to lung function decline and the development of COPD (Weiss *et al*., 2003). The presence of adolescence asthma and allergies can be indicative of developmental delays in full lung growth during childhood (Weiss *et al*., 2003). This can influence the development of COPD and lung function decline in a certain group of patients (Emtner, 1999; Weiss *et al*., 2003).

In asthma, there is variability of airflow with airway hyper-responsiveness and inflammation as a result of an allergic response to trigger irritants, which leads to mucosal oedema, bronchospasm and plugging of the airways with mucus. Asthma as the diagnosis is differentiated from COPD in its response to bronchodilator therapy (Mannino, 2002). If a significant improvement in FEV_1 occurs post inhaled bronchodilator of more than 80% predicted this usually confirms the diagnosis of asthma rather than COPD (Bateman *et al*., 2004). This obstruction to airflow is either spontaneously reversible or through treatment, and this also distinguishes asthma from COPD, although a small percentage of COPD patients may have a reversibility component, as seen in asthmatics (Mannino 2002).

2.5.5 Occupational pollutants

In the workplace, chronic exposure to substances such as grain, isocyanates, cadmium, coal, adhesives and welding gas may play a role in the development of COPD, although less than that of tobacco smoke (Boschetto *et al*., 2006). Using data from the Third National Health and Nutrition Examination Survey conducted in the United States from 1988 to1994, found the exposure to pollutants in the work place resulting in COPD was an estimated 19 % overall and 31 % amongst non-smokers (Hnidzo *et al*., 2002).

This survey was designed to assess the health and nutritional status of the United States population and therefore did not necessarily reflect a wide spectrum of occupations. This study looked at occupations such as textiles and manufacturing, food manufacturing, car repair services, and occupations that involve exposure to chemicals, petroleum and others similar materials, but due to the limitations in the study design may have excluded other high risk occupations contributing to COPD. Mine workers, for example, are exposed to mining dust, especially in South Africa. This situation presents an occupational hazard as it can affect the lungs, predisposing workers to chronic lung disease (Weiss *et al*., 2003).

2.5.6 Infections

Susceptibility to early childhood respiratory tract infections such as bronchitis, pneumonia, colds and flu may result in a faster decline of lung function and predispose an individual to develop COPD (www.goldcopd.com/, accessed 21.12.2007; Mannino, 2002; Weiss *et al*., 2003). Recurrent infections reduce maximal obtainable lung growth in childhood and if these young people are exposed to the risk factors associated with COPD, especially tobacco smoke in adolescence they are more likely to develop COPD (Celli *et al*., 2004).

TB is caused by the inhalation of the bacilli from an infected individual. This then causes an inflammatory lesion within the alveoli resulting in fibrotic areas and cavitatory lesions within the lungs. Secondary, TB develops when an individual's immunity is compromised, and when poor nutrition and poor socioeconomic circumstances prevail (www. who Tuberculosis.htm, accessed 14.08.2006). It is the structural lung changes that develop post TB that emulate the characteristics of COPD.

TB, as a bacterial infection, is particularly important in the South African context as it is endemic to certain areas of the country, such as the Western Cape, and is a known risk factor for COPD as it can result in fixed airflow obstruction, which is a characteristic of COPD (Anderson and Phillips, 2006; Bateman *et al*., 2004). The incidence of TB per capita is nearly twice as high in sub-Saharan Africa compared to the South-East Asia region, which has the highest number of new TB cases globally (WHO Tuberculosis, 2006). However, TB as the primary diagnosis must be differentiated from COPD, especially in those areas that have a high prevalence of the disease, to support the correct management of these patients (www.goldcopd.com/, accessed 21.12.2007).

2.5.7 Nutrition

Some dietary supplements may have an impact on the development of COPD and research in this area is ongoing (Altose, 2003). The effect of nutrients on respiratory symptoms of bronchitis and wheezing were analysed by Schwartz and Weiss using data from the Second National Health and Nutrition Examination Survey in the United States (1990). They found a positive association between bronchitis and the sodium-to-potassium ratio but a negative association with the serum vitamin C and zinc-to-copper ratio. Wheezing was negatively

associated with serum vitamin C as well as niacin and the zinc copper ratio. In this study the interaction between smoking and nutrients was not significant.

Shahar *et al*. (1994) studied the relationship between n-3 fatty acids dietary intake and COPD in a population-based study on atherosclerosis in 8960 current or former smokers. As n-3 polyunsaturates are known to interfere with the body's inflammatory response they may have an effect on chronic inflammatory conditions such as COPD. They concluded that a high intake of omega 3 fatty acids may protect smokers from COPD. Inconclusive evidence exists thus far regarding the effect of nutrition on either the prevention or predisposition of an individual to develop COPD.

2.5.8 Smoking and environmental allergens

Cigarette smoke is probably the most important health-related environmental factor and is recognised as a major risk factor of COPD as it causes an inflammatory reaction within the lungs, increasing blood leukocytes and decreasing the CD4+/CD8+T-lymphocyte ratio by increasing the CD8+ cells (Jeffery, 2002). This results in the breakdown of lung elastin, as well as increasing the rate of forced expiratory volume in one second (FEV_1) decline (Weiss *et al*., 2003).

Although a relatively small percentage of smokers (estimated at between 15–20%) eventually develop COPD, most of the patients diagnosed with COPD have a positive smoking history (Jeffery, 2002; Weiss *et al*., 2003). Smokers who continue to smoke have a worse prognosis and increased risk of death compared to non-smokers of the same age. Normal aging cause FEV_1 to decline but it is accelerated in smokers; if a smoker stops smoking the lung damage is limited and slows the disease process (Anthonisen *et al*., 2002).

A study was carried out by the Lung Health Research group to determine if smoking cessation programmes and regular administration of an inhaled bronchodilator (ipratropium bromide) would change the forced expiratory volume in one second (FEV_1) as well as the mortality and morbidity in smokers aged 35 to 60 (Anthonisen, *et al*., 1994; Anthonissen, *et al*., 2002). Results of this randomised clinical trail showed that the FEV_1 in smokers who stopped at the beginning of the study declined at a rate of 30.2 ml/yr in males and 21ml/yr in females. In individuals who continued to smoke throughout the eleven years of the study, the FEV_1 declined at an accelerated 66.1 ml·yr-1 in males and females at 54.2 ml·yr-1.

The study was expanded to Lung Health Study 3, in which sought to determine whether differences persisted in the lung function of smokers eleven years after the original study. After the initial study, 38% of those who continued smoking and 10% of individuals who stopped smoking had their forced expiratory volume in one second ($FEV_ı$) value at less than 60% of the predicted normal value. These results showed that the lung function of smokers declined at a significantly more rapid rate compared to those who had stopped smoking (Anthonisen *et al*., 2002).

Although COPD is positively related to tobacco smoke, the non-affluent society of South Africa is more exposed to environmental air pollution than to actual tobacco smoke (Bradshaw and Steyn, 2001). Exposure to other causes of smoke inhalation such as in-house gases, burning coal and gases released from wood burning to cook and generate heat in the underprivileged communities also play a role in the development of COPD and contribute to the increased susceptibility of this group to develop COPD (www.goldcopd.com/, accessed 21.12.2007).

2.6 Diagnosis of COPD

The diagnosis of COPD is based on patient symptoms, spirometry, arterial blood gases, exercise testing and radiography. Patients, who complain of symptoms such as chronic cough, wheezing and increasing shortness of breath with activity, in the absence of any other lung pathology, should be considered and assessed for COPD. The symptoms associated with COPD such as a chronic and productive cough may present many years before substantial airflow limitation is evident.

The presence and severity of airway obstruction in COPD is usually assed by means of spirometry and not peak flow. Spirometry is more sensitive to the reduction in forced expiratory flow than measuring the peak expiratory flow and is therefore used in the diagnosis of COPD and to establish the severity of the disease (Bateman *et al*., 2004; Weiss *et al*., 2003).

COPD and asthma are both obstructive lung diseases, but in asthma there are greater changes in airflow to trigger irritants whereas COPD is a slowly progressive disease with minimal symptoms early on in the disease (Weiss *et al*., 2003). Therefore the use of peak expiratory flow may be more valid when the diagnosis of asthma is suspected. The post bronchodilator FEV_1 together with the forced expiratory volume in one second/ forced vital capacity (FEV_1/FVC) ratio is recommended by both SATS and GOLD to determine the diagnosis of COPD. A diagnosis of COPD is considered if the $FEV_1 < 80\%$, predicted in combination with FEV_1/FVC at a ratio < 70% (Bateman *et al*., 2004; Weiss *et al*., 2003).

COPD usually presents insidiously and is categorized based on spirometry into four different stages. The SATS base their lung function values with regard to FEV_1 on the European

Community for Steel and Coal (ECSC), with adaptations made for the South African population. Multiplication of spirometry values by 0.9 is advised for the ethnic groups of African and African American decent in the South African population (Bateman *et al*., 2004). At stage 0 (normal but at risk) and 1 (mild), the FEV_1 varies between ≥ 80% predicted and 60–79% respectively. These patients may have minimal respiratory symptoms and experience less impact of symptoms on activities of daily living (Bateman *et al*., 2004). However at stage 2 (moderate) and stage 3 (severe) the FEV_1 is 40–59% and < 40%, respectively. The patients exercise tolerance becomes severely affected and they may be prone to acute exacerbation (Bateman *et al*., 2004; MacNee, 2003). In the 2006 revision of the GOLD guidelines the recommended use of stage 0 was removed due to insufficient evidence for use in identifying individuals at risk to develop COPD and stage 4, very severe category included with FEV_1 <30% or FEV_1 <50% with chronic respiratory failure(www.goldcopd.com/, accessed 21.12.2007).

2.7 Defining acute exacerbation

In addition to everyday symptoms associated with the disease as experienced by COPD patients, they can suffer episodes of acute exacerbation. Acute exacerbations are more frequent in the moderate to severe stages of the disease. Currently, there is no universal agreement on the precise definition of acute exacerbation. Most literature refers to acute exacerbation as a clinical event that is dependent on the patient's symptoms to aid diagnosis (MacNee, 2003). It usually refers to deterioration in the patient's clinical status, with worsening of respiratory symptoms beyond the normal day-to-day variation experienced by the patient, requiring medical intervention (MacNee, 2003). The symptoms of acute exacerbation could include any of the following: an increase in coughing, wheezing and sputum production, and shortness of breath (Hunter and King, 2001).

Possible causes of exacerbations could include viral infections, bacterial infections, air pollution and cold weather; may be considered non-modifiable risk factors (Burge and Wedzicha, 2003). Other features that are considered modifiable by an individual and increase receptiveness to acute exacerbation include the lack of influenza immunisation, improper use of medication and continued smoking behaviour (Weiss *et al*., 2003).

The majority of acute exacerbations remain unreported. Many patients do not require hospitalisation and are treated at emergency departments and primary care centers, and then discharged home within twenty-four hours (MacNee, 2003). In its severe form however, acute exacerbation requires medical intervention, often resulting in hospitalisation. Although only a small percentage of patients may ultimately present with acute exacerbation severe enough that requires subsequent hospitalisation, this is nonetheless associated with high financial costs and reduced quality of life (QOL) due to possible readmission. The risk of hospitalisation increases with increasing age, declining lung function and moderate to severe COPD (Fan *et al*., 2002).

2.8 Current management of COPD

The emphasis in the management of COPD prior to the GOLD guidelines was predominantly aimed at improving lung function and limiting lung function decline through pharmacological interventions (Wouters *et al*., 2000). This has changed in line with the GOLD developments and ongoing research; guidelines are now aimed at managing symptoms and improving the quality of life of the COPD patient (www.goldcopd.com.com/ accessed 21.12.2007)

The GOLD guidelines were developed and implemented to consolidate the battle against this disease, in the light of the escalating burden of COPD and acute exacerbation. The guidelines

were formulated in an attempt to increase awareness of COPD as well as establishing guidelines for health care professionals dealing with this disease that is evidence based. The National Heart, Lung and Blood Institute (NHLBI) (USA) and the WHO formally launched the Global Initiative for Obstructive Lung Disease (GOLD) in 2001. The GOLD document provides a set of guidelines to assist with the implementation of the proposed draft document worldwide. The objectives of the programme were to:

- Recommend effective COPD management and preventative strategies for use in all countries.
- Increase awareness of the medical community, public health officials and the public that COPD is a public health problem.
- Decrease morbidity and mortality from COPD through implementation and evaluation of effective programmes for the diagnosis and management.
- Promote research into the reasons for increasing prevalence of COPD, including the relationship with the environment.
- Implement effective programmes to prevent COPD (Pauwels, 2001)

The South African Thoracic Society (SATS) established a similar programme and developed guidelines specific to the South African population. Important components of these guidelines include both the prevention of exacerbations as well as improving the quality of life of patients with COPD (Bateman *et al*., 2004). These guidelines also include:

- recognition of the disease
- smoking cessation to arrest disease progression
- improving breathlessness through treatment of airflow obstruction, based upon grading of severity
- improvement of quality of life

- increasing awareness of the effects of COPD on the South African population
- the importance into the exposure to domestic and occupational atmospheric pollution, previous lung infections and TB.
- prevention and treatment of complications (Bateman *et al*., 2004).

The current management of COPD focuses on assessing and monitoring the disease, reducing risk factors, managing stable COPD and managing exacerbations through pharmacological therapy, long-term oxygen therapy (LTOT) and pulmonary rehabilitation (www.goldcopd.com/, accessed 21.12.2007; Hunter and King, 2001; O'Donnell, 2002; Pauwels, 2003; Sullivan *et al*., 2003).

The management of acute exacerbation includes a combination of the following: use of bronchodilators, corticosteroids, antibiotics, oxygen therapy, mucolytic agents and treatment techniques, as well as non-invasive positive pressure ventilation (Snow *et al*., 2001).

The benefit of including pulmonary rehabilitation programme in the management of COPD and acute exacerbation will be dealt with in section 2.8.1 as pharmacology aims to control the symptoms of the disease to improve the quality of life of patients whilst pulmonary rehabilitation has a greater impact on the latter (Snow *et al*., 2001).

2.8.1 Pulmonary rehabilitation

As COPD is a debilitating disease that affects the patients' mental and physical ability as well as health-related quality of life (HRQOL), increasing emphasis is therefore placed on

treatment that will improve the individuals' quality of life, as pharmacological therapy only relieves the symptoms but cannot change the lung function decline (Güell *et al*., 2000).

Pulmonary rehabilitation attempts to improve the individuals' quality of life through a programme designed specifically to target problem areas, although it cannot alter the existing lung damage. Some of the overall benefits of rehabilitation include an increased exercise capacity, increased daily living activities, decreased episodes of acute exacerbation, a decrease in dyspnoea, a decrease in anxiety and depression, and decreased costs associated with hospitalisation (American Thoracic Society (ATS), 1999; Fahy, 2003). These benefits may contribute to evidence in support of studies indicating that patients participating in an exercise programme experienced fewer days in hospital when readmitted and a reduction in exacerbation, and therefore a decrease in cost associated with hospitalisation (Güell *et al*., 2000; Puhan *et al*., 2005). The initial cost of starting a pulmonary programme might be high but it may be offset by the benefits achieved in the rehabilitation programme.

The components of a comprehensive pulmonary rehabilitation programme comprise any combination of the following: exercise programme, education, behavioural intervention, and nutrition and outcome assessment. The programme is usually conducted by a team of professionals, including a physiotherapist, psychologist, physician, occupational therapist, dietician, social worker and biokinetician (ATS, 1999).

Exercise training forms an integral part of pulmonary rehabilitation and the benefits thereof have been well researched. These include improvement in strength and movement, endurance and a general feeling of wellbeing due to the underlying effects of increased blood flow. The benefits of exercise training may be most beneficial in the reduction of dyspnoea,

which is the most common complaint of COPD patients. In Stage1 pulmonary rehabilitation may not be considered as vital due to the absence or minimal presentation of symptoms. In the moderate and severe stages however, due to declining lung function, with increasing symptoms and consequent decrease in quality of life (QOL), pulmonary rehabilitation becomes an essential component in the patients' management. Pulmonary rehabilitation is particularly important post acute exacerbation when the patient may experience either a temporary or permanent decrease in the quality of life (Fahy, 2004).

Güell *et al*. (2000) conducted a randomised controlled trail of 60 moderate to severe COPD patients aged ≤ 75, with mean lung function values of FEV_1 35 ± 14% over a one year period and which included a two-year follow-up period as part of an outpatient rehabilitation programme in Barcelona, Spain. Patients were randomly assigned into a control or rehabilitation group, with the control group receiving standard medical treatment that included conventional pharmacological therapy, while adding rehabilitation in the pulmonary rehabilitation group and chest physiotherapy if needed. The pulmonary rehabilitation group received six months of intensive rehabilitation and a six-month maintenance programme. The rehabilitation patients reported an improvement in exercise ability on the six-minute walk test, and decrease in fatigue, dyspnoea and emotional function, as measured on the chronic respiratory questionnaire (CRQ).

In an eight-week outpatient rehabilitation programme carried out by Jenkins *et al*. (2001), with 57 patients, 49 of whom had COPD with the average FEV_1 of the total number was 41.4% and the FEV1/FVC ratio 49.3% was studied. Exercise capacity improved and there was a significant improvement in the QOL as measured on the Chronic Respiratory Disease Questionnaire (CRDQ) and the Short Form–36 item questionnaire (SF-36).

Reis *et al*. (1995) also conducted a randomised clinical trail to compare the effects of a comprehensive rehabilitation programme with those of education alone on the physiological and psychosocial outcomes in patients with mild to severe COPD. A group of 119 outpatients were randomly assigned to either an eight-week rehabilitation programme or an eight-week education programme. The programme included twelve four-hour sessions for the pulmonary rehabilitation group including education, instruction on physical and respiratory care, psychosocial support and supervised exercise training; reinforcements sessions were held over a one-year period. The education group attended four two-hour sessions that included videotapes, lectures and discussions. In comparison with the education group the rehabilitation group showed significant changes in exercise performance and symptoms. The results supported those of other studies by demonstrating improvements in exercise performance and symptoms for patients with moderate to severe COPD. The benefits of this programme were maintained for about one year but decreased over a two-year period.

2.9 Outcomes of COPD

At present, the acknowledged outcomes that have been explored in COPD are health care utilisation, HRQOL, physiological factors and mortality. All of these are aimed at improving the implementation of available preventative strategies (Camargo, 2002; Groenewegen *et al*., 2003; Sullivan *et al*., 2003).

2.9.1 Health care utilisation

COPD has been recognised as a growing health problem with an increasing impact on the medical field, society and the economy (Altose, 2003). This is especially evident in the direct medical management of the disease and indirect medical expenses in terms of lost income, caregivers, social isolation and physical disability attributed to the disease. The disease

process follows a chronic progressive course, resulting in increased utilisation of health services and concomitant increased health expenditure with time, as the patient grows older and the disease advances (www.lungusa.org/site/pp.asp, accessed 17 March 2005; Mannino *et al*., 2002).

COPD patients can experience up to three exacerbations per year. Up to half of these may be unreported as they may not be severe and not require medical intervention. Patients with a strong smoking history, for example of more than a 40 packs per year, may experience an increase in the severity and number of episodes of acute exacerbation (Francioisi *et al*., 2006). Patients with mild COPD may have fewer exacerbations compared to the moderate to severe COPD patients, who can experience more than three exacerbations per annum (MacNee, 2003). Initially there may be minimal symptoms not severe enough to limit activity as the respiratory system adapts to the pathophysiological changes occurring within the lungs. As the disease advances, increasing symptoms due to declining lung function will limit the simplest of tasks in the severe stages of the disease (O'Donnell, 2006).

In 1998, outpatient hospital or doctors' COPD visits accounted for an estimated 14.2 million visits in the United States, and in the same year there were 662,000 hospitalisations of patients with COPD (Mannino, 2002). The hospitalisation of patients where COPD is the main or contributing cause of admission continues to place a burden on the elderly; hospitalisations were highest in the age group 65–75 years at 19.9 %, over 75 years at 18.2 %, and slightly lower at 14.8 % for the 55–65 years age group (Mannino, 2002). In 2002, hospital COPD discharges in the United States were an estimated 675,878; the highest were amongst the 65 years and older group, at more than 65 % (www.lungusa.org/site/pp.asp, accessed 17 March 2005). The economic cost of lung diseases in the US is expected to increase to $144 billion, $

87 billion in direct health expenditure and $ 57 in indirect cost of mortality and morbidity (NHLBI, 2006).

A significant portion of the economic expenditure associated with COPD is due to hospitalisation as a result of frequent readmissions of patients with acute exacerbation (Fan *et al*., 2002; www.goldcopd.com/, accessed 21.12.2007). In 2001 acute exacerbations accounted for about 500 000 hospitalisations in the United States alone and $18 billion in direct health care costs (Snow *et al*., 2001). In the UK Health Authority, which serves a population of 250 000, hospitalisations specifically due to acute exacerbation have been estimated to be about 680 per annum (MacNee, 2003). No specific information in South Africa exists on the hospitalisation of COPD patients diagnosed with acute exacerbation, following a search of the electronic databases of Medical Research Council of South Africa and Statistics South Africa.

A range of factors may influence hospitalisation as COPD patients are generally older and have other associated medical conditions that can contribute to hospitalisation (www.goldcopd.com/, accessed 21.12.2007). The presence of co-morbidities such as cardiovascular disease or cancer can influence the course of COPD and result in more hospitalisations, but some debate still surrounds this aspect as not all studies performed have demonstrated similar results (Bateman *et al*., 2004; Garcia-Aymerich *et al*., 2001; Seemungal *et al*., 1998; Sullivan *et al*., 2003). However, hospitalisation may be based on a variety of factors: a low body mass index (BMI), poor performance on the 6-minute walk test, gas exchange impairment, the use of long term oxygen therapy (LTOT) as well as haemodynamic dysfunction (Kessler *et al*., 1999). The COPD Guideline Working Group of the SATS (2004), in their guidelines for hospitalisation of acute exacerbation, included factors such as infection,

pneumonia, deterioration in mobility and new arrhythmia as this can also contribute to hospitalisation, is in agreement with what is proposed by Burge et al. (2003) and MacNee (2003).

Medicare, an American health insurance programme, provides cover for persons over the age of 65 years, persons eligible for social security disability benefits and persons who have renal failure. Their statistics of 1991 showed that the length of stay averaged 7 days in hospital for acute exacerbation and the expenditure per capita was 2.4 more than normal COPD cases – most of the costs were being incurred in hospital (Fan *et al*., 2002). A study by Connors *et al*. (1996) carried out to investigate the outcomes of patients hospitalised with acute exacerbation documented the median length of stay at 9 days after admission for acute exacerbation. At present, there are no definitive data to determine the ultimate duration of hospitalisation for patients with acute exacerbation as the reasons for admission may be complex, which therefore require a longer hospitalisation period. Patients may have associated medical conditions that may influence the length of stay and not simply the primary diagnosis of acute exacerbation of COPD (Pistelli *et al*., 2003).

Patients requiring ICU admission and ventilation may ultimately have a longer hospitalisation period. Groenewegen *et al*. (2003) found that COPD patients hospitalised with acute exacerbation spent an average of 10 days in hospital, compared to ICU patients who stayed for 16.5 days.

Sin *et al*. (2000) carried out a study to determine if elderly patients over 65 years of age with shorter lengths of stay had higher readmission rates and mortality compared to those patients who stayed longer. They found that although patients younger than 74.8 years (±6.9 SD) of

age had shorter hospital stays, they were more frequently readmitted. This population-based study conducted over a 5-year period, from 01 April 1992–31 March 1997, in Ontario, Canada grouped COPD and asthma in one category. This limits the validity on the COPD population as asthma is managed differently due to the variability of its symptoms. In this study, the patients who stayed less than 4 days were 39 % more at risk of readmission and 45 % more likely to die within two weeks post discharge although they were younger than those who stayed longer.

The SATS have published proposed discharge criteria in their "Guideline for the Management of COPD" revision (2004), which are similar to trends in the United Kingdom. These guidelines include the following: COPD education, assessment of further need for oxygen, written home-action plan, rehabilitation, plan for smoking cessation, assessment of home conditions and psychosocial support. International recommended criteria for hospital discharge also support the following criteria: symptoms return to baseline, haemodynamic stability, oxygenation return to baseline, inhaled β-antagonist therapy required less frequently, ambulation resumed, ability to eat and sleep without frequent waking caused by dyspnoea, off parenteral therapy for 12–24 hours, patient and home carer understands correct use of medication, and follow-up home care arrangements (Celli *et al*., 2004). All or any of these factors can contribute to a shorter or eventual longer length of stay in hospital.

2.9.2 Health related quality of life

Health related quality of life (HRQOL) refers to changes in daily life and well-being affected by the disease and are usually measured by means of disease specific questionnaires or generic measurements, such as the St George's Respiratory Questionnaire (SGRQ), Chronic

Respiratory Disease Questionnaire (CRDQ), Chronic Respiratory Questionnaire (CRQ), Short Form 36-item questionnaire (SF-36), and others (Jones 1997; Mahler 2002; Siafakas *et al*., 1997).

The use of HRQOL tools may not necessarily influence changes in actual medical management but may indicate the effect of the disease on an individual's standard of living (Katula *et al*., 2004). Patients may experience their deteriorating health status vastly different compared to the severity of COPD expressed in terms of physiological measurements of the FEV_1 (Garrido *et al*., 2006). In their study on the negative impact of COPD on the HRQOL of patients, Garrido *et al*. (2006) found that even in the mild stages of the disease, patients may experience deterioration in HRQOL and females had lower HRQOL levels than males. Their study was carried out on stable COPD patients in a primary care setting using physician visits, health care centres and medical records. They reported the best predictors of poor HRQOL to be gender, FEV_1, use of oxygen therapy, emergency room visits and hospital admissions.

Fan *et al*. (2002) carried out a study to determine whether a self-administered questionnaire, the Seattle Obstructive Lung Disease Questionnaire (SOLDQ), a condition-specific QOL measure, could accurately predict hospitalisation and mortality. Patients with poor quality of life were found to have an increased risk for these outcomes. This study was however limited to the United Stated male veteran population and the SOLDQ results were only compared to those obtained from the SF-36 and hence results can only be interpreted in that context.

A survey conducted by means of telephonic interviews with patients and physicians in the United States from August to November 2000 revealed that 51 % of COPD patients found

their condition limited their ability to work effectively (American Lung Association, 2001). Limitations in other areas were also experienced: normal physical activity 70 %, household chores 56 % and social activities 53 %. COPD may be also a limiting factor for individuals to perform at their peak even in the mild stages of the disease (American Lung Association, 2001).

In a study of the effect of exacerbation on QOL in patients with COPD, Seemungal *et al*. (1998) established that the frequent exacerbation group had poorer scores on the SGRQ compared to the infrequent exacerbation group. In this study they measured the daily peak expiratory flow rate (PEFR), daily respiratory symptoms and QOL on the SGRQ using the patients' daily diary cards and clinic visits to record the information. Although patients only reported 50% of exacerbations, there were no differences in peak flow or symptoms during reported exacerbation and unreported episodes. In this study, the use of FEV_1 and especially the PEFR are limiting factors, as they are not ideal measurements during an exacerbation. This is because both the daily PEFR, which poorly reflects the severity of COPD, and lung function measurements expressed by means of the FEV_1 are very difficult to perform during exacerbations (Snow *et al*., 2001).

COPD patients experience dyspnoea more severely and faster when exercising compared to healthy subjects. This is the most common symptom limiting activity in COPD patients (O'Donnell, 2006). This is due to lung hyperinflation caused by expiratory flow limitation and destructive changes within the lungs, with resultant dyspnoea. Patients usually attempt to limit their activities so as not to induce shortness of breath (SOB) and become increasingly anxious of becoming SOB, with resultant muscle deconditioning (Hill *et al*., 2004). Repeated readmissions have been shown to result in muscle deconditioning and contribute to reduced

quality of life, due to immobility imposed in an attempt to decrease dyspnoea (Puhan *et al*., 2005; Siafakas *et al*., 1997).

2.9.3 Physiological factors

Body mass index

Damage resulting from COPD extends further than the lungs. It has a significant systemic component in terms of muscle dysfunction, muscle wasting, osteoporosis and weight loss (Andreassen *et al*., 2003; Bolton *et al*., 2004). Increasingly, body weight is recognised as an important factor in COPD; unexplained weight loss in this group is of great concern as it indicates severe disease and places patients at risk of early mortality (MacNee, 2003). Body weight is calculated as the sum of fat mass and body cell mass (BCM), and is measured by establishing the fat-free mass (FFM) as this is easier to determine than the body cell mass. The BCM is an indicator of the amount of actively metabolising and contractile tissue, including muscle mass. It is rather difficult to establish the lean muscle mass and therefore the FFM index is used (Wouters, 2000).

In general terms, weight loss and loss of fat mass is described as the result of an imbalance between energy expenditure and nutritional intake (Andreassen *et al*., 2003). Patients with COPD have a higher resting energy expenditure compared to normal individuals; their energy expenditure from the disease process exceeds the nutritional intake and nutritional supplements may not necessarily complement the shortcomings. However, weight loss and specifically muscle wasting in COPD is mediated by a number of factors. These factors include malnutrition as well as hypoxia, pulmonary inflammation, protein synthesis and protein breakdown, as well as an imbalance in the hormones involved in this process (Debigaré *et al*.,

2001; MacNee, 2005). Initially, body weight may be maintained in the early stages of the disease but muscle wasting may be present, and rapid and unexplained weight loss becomes more evident as the disease progresses (Garcia-Aymerich *et al*., 2003).

BMI is calculated using the weight/metre² (kg/m²). Normal BMI is considered to be between 21 kg/m² and 25 kg/m², and patients can be grouped in underweight < 21 kg/m² and overweight > 30 kg/m² categories (Bateman *et al*., 2004; Celli *et al*., 2004). COPD patients who present with a BMI of less than 21 kg/m², compared to individuals with a BMI > 26kg/m², are reported to have a 50% mortality rate (Bateman *et al*., 2004; Landbo *et al*., 1999). Current evidence increasingly suggests that the impact of a low BMI may be one of the important factors to consider when deciding on hospitalisation of the COPD patient, and it can influence survival (Landbo *et al*., 1999).

In a study conducted by Bolton *et al*. (2004) on the associated loss of fat-free mass and bone mineral density (BMD) in COPD they demonstrated an association between the loss of BMI and BMD, and greater losses with severe disease. In their study 81 clinical stable COPD subjects and 38 healthy subjects were subjected to dual-energy X-ray absorptiometry to determine body composition and BMD. Urinary protein breakdown markers, inflammatory mediators and their soluble receptors were also determined. Their results indicated the loss of fat free mass and BMD was related and that greater losses occurred in subjects with severe lung disease.

All of the above factors contribute to muscle weakness and eventually atrophy, increasing the risk of respiratory muscle dysfunction and mortality in the underweight patient (Bateman *et al*., 2004; Wouters, 2000). Underweight patients may also have weaker respiratory muscles

compared to patients of normal weight and present with increased reports of dyspnoea (Hill *et al*., 2004; O'Donnell 2002; Wouters, 2000). Patients adapt their lifestyles accordingly to avoid becoming short of breath and this, combined with poor nutritional status and possible steroid myopathy could exacerbate the problems associated with muscle weakness (Wouters, 2000). Long-term corticosteroid use in COPD patients can cause myopathy and worsen the problem of muscle weakness (Wouters, 2000). The underweight patients in treatment are usually given nutrition supplements.

Blood gas abnormalities

The main function of the lungs is ventilation and perfusion, which is helped by muscle contraction and the measure of elasticity of the lungs. During inspiration the airflow into the alveoli is produced by a pressure difference caused by contraction of the intercostal muscles and the diaphragm. This allows for expansion of the lungs and ribcage, increasing the intrathoracic pressure (Soicher *et al*., 1998). Inspiration is an active process whereas expiration is a passive process, occurring when the stretched elastic tissue recoils and forces all the inspired air out of the lungs. Due to the destruction of the alveoli in emphysema the surface area in contact with the capillaries is reduced, causing inadequate gas exchange. In chronic bronchitis mucus hyper-secretion obstructs the airways, resulting in poor ventilation. As a result of the changes associated with emphysema and chronic bronchitis within the lungs and supporting structures the normal functioning ability of the lungs is affected, resulting in hypoxaemia with or without hypercapnia (Jones *et al*., 2003).

Blood gas abnormalities normally worsen during an acute exacerbation but the patient's pre-hospitalisation status needs to be considered as many COPD patients suffer from chronic

hypercapnia. A low PaO_2 of less than 6.7 kPa (50 mmHg), high $PaCO_2$ and a pH lower than 7.35 could indicate acute respiratory failure and require hospitalisation (Kessler *et al*., 1999).

The prescription of LTOT is indicated in patients who present with oxygen saturation below 90% at rest or who are hyoxaemic, with or without hypercapnia, and who do not smoke. Due to the combustible nature of oxygen it is not advisable to prescribe LTOT in those patients who continue to smoke. Use of LTOT has resulted in a decrease in respiratory failure and associated complications because of reduced hypoxemia on the vital organs, and hence there is an improved survival rate (Bateman *et al*., 2004; Hunter and King, 2001). Patients with home oxygen may have a reduced need for hospitalisation but are required to use oxygen for at least 16 hours a day (Bateman *et al*., 2004). The under-prescription of LTOT has however been associated with an increase risk for hospitalisation (Garcia-Aymerich *et al*., 2001).

Haemodynamic status

Amongst the many complications associated with COPD, secondary pulmonary hypertension is considered one of the important problems of this disease. Pulmonary hypertension and right ventricular failure may occur due to an increase in pulmonary artery pressure due to continuous pulmonary vasoconstriction. Although the effects of hypoxia on the pulmonary arterioles is considered the main reason for this vasoconstriction, chronic inflammation, structural changes and eventual destruction of the pulmonary vascular bed all contribute to secondary pulmonary hypertension (Hopkins *et al*., 2002; Morrell *et al*., 2005). It is associated with high mortality and may be more evident in patients with severe lung disease (Morrell, 2005).

2.9.4 Mortality

In South Africa, COPD is classified under the umbrella term of non-communicable diseases. In the period 1997–2004 there was a slight increase in the number of deaths for males between the ages 55–59 and females 45–54 years. Communicable infectious diseases such as TB demonstrated a significantly greater increase in prevalence (Anderson and Phillips, 2006). In a study conducted in Cape Town and sub-districts on the causes of death and premature mortality, COPD was in 11th position (homicide, ischaemic heart disease and HIV/AIDS were amongst the top three) (2001). The same study showed the following results: death rates and premature mortality (expressed as years of life lost) due to COPD for males were higher than for females: the former (males) were ranked eight and tenth respectively, and the latter (females) tenth and nineteenth, respectively.

Although COPD did not account for substantial and dramatic increases in mortality, it is still amongst the top 10 causes of deaths in both the Tygerberg East and West districts. In Cape Town and the 11 sub-districts where data were collected on the 10 most common causes of death, COPD as a cause of death was present in eight of the areas (Groenewald *et al*., 2001).

COPD accounted for the highest percentage of the deaths, at 42%, followed by stroke 34.5% then asthma 34.3% in the non-communicable disease category in South Africa (Bradshaw and Steyn, 2001). These statistics were taken from the 1996 death registry of South Africa. However, statistics on mortality in South Africa from this timeframe have to be interpreted with care as a large percentage of death were ‘misclassified’ (15%) and an estimated 20% of deaths were not registered in the death registry of 1996. The figures are nevertheless indicative of the effect that COPD has on the South African population.

In the United States COPD accounted for 4% of all deaths in 1995, and in 2002 it was the fourth leading cause of death preceded only by heart attacks, cancers and strokes (NHLBI, 2006). The death rate among men remained stable in the United States but at the same time in the period from 1993–2003 increased in the female population. This could be due to the increased incidence of cigarette smoking in this group (Hurd, 2000; NHLBI, 2006). The death rate of females in the United States compared to their counterparts in countries like England, France, Finland, Australia, Japan, Poland and Germany also increased substantially between 1980 and 2003 (NHLBI, 2006).

The follow up of patients admitted with acute exacerbation showed a 49% increase in mortality rate at two years post-hospitalisation and a high readmission rate in the study by Connors *et al*. (1996). In this study of 1016 patients admitted with acute exacerbation it was found that the severity of illness, BMI, age, prior functional status, PaO2, congestive cardiac failure, serum albumin and the presence of cor pulmonale were independently related to survival time (1996).

In COPD a high $PaCO_2$ and chronic hypercapnia were identified as factors contributing to an increased risk for mortality by Groenewegen *et al*. (2003). In their study, all COPD patients hospitalised with acute exacerbation were followed up for a period of one year to assess the mortality rates and potential determinants of mortality in hospital and over the one-year period. Patients requiring Intensive Care Unit (ICU) admission for acute exacerbation have been associated with higher mortality rates as they are critically ill and usually require ventilation (2003). A further study conducted by Gudmundsson *et al*. (2006) on mortality of COPD patients discharged from hospital, however, found diabetes to be one of the most important risk factors for mortality post-admission of COPD patients.

Developing countries are gradually becoming more exposed to western influences and could suffer a substantial burden of increase in the prevalence of chronic diseases such as COPD, cardiovascular disease, and other diseases now actively combated in developed countries through proactive campaigns on health education, anti-tobacco legislation and lifestyle changes, as well as improved access to health services (Bradshaw and Steyn, 2001). Although life expectancy and mortality rates do not indicate the exact state of health of a population, the figures can assist in the decision-making process as to where resources should be distributed, as it reflects the impact of diseases on the population (Michaud, 2001).

The need to ascertain the impact of COPD on a developing country such as South Africa is of paramount importance, particularly as the disease causes significant functional disability that translates into vast socio-economic consequences (Michaud, 2001). In this context, would the profile of the South African COPD patient admitted with acute exacerbation be similar to patients in the developed countries?

Chapter 3

Methodology

3.1 Introduction

In this chapter the methodology used to answer the research question will be described and discussed. The setting in which the research was carried out will be described. The patient identification, sampling procedure, development of the instrument, data compilation and data capture are also explained in this chapter.

3.1.1 Research question

What is the profile and selected outcomes of Chronic Obstructive Pulmonary Disease (COPD) patients admitted with acute exacerbation to hospitals in the northern suburbs of the Western Cape?

3.1.2 Objectives of the research

1) To describe the demographics of the COPD patient hospitalised with an acute exacerbation to Tygerberg Hospital, Karl Bremer Hospital and Panorama Medi-Clinic with reference to:
    - age
    - height
    - weight
    - gender
    - smoking history
    - socio economic status

- co morbidities

2) To describe the present and past clinical presentations of acute exacerbation requiring hospitalisation in a 12-month period in relation to:
   - respiratory rate
   - pulse
   - blood pressure
   - temperature
   - oxygen saturation
   - arterial blood gases
   - lung function values
   - reason for admission

3) To describe selected outcomes of COPD patients admitted with acute exacerbation in relation to:
   - length of stay in hospital.
   - number of readmissions for acute exacerbation in the previous year.

3.2 Study design

The study design was a multicentre retrospective observational study.

3.3 Setting

The hospitals that participated in the study included two public hospitals-a tertiary and a secondary health care facility and one private health care facility.

3.4 Population

All COPD patients that were hospitalised in the selected secondary, tertiary and private institutions in the northern suburbs of the Western Cape.

3.5 Sample

A sample of convenience was used. The following hospitals were selected as they are within 20 km of each other, which facilitated the logistics of data collection.

- Tygerberg Hospital
- Karl Bremer Hospital
- Panorama Medi-Clinic
- Louis Leipoldt Medi-Clinic

3.5.1 Inclusion criteria

Subjects were included if they had the diagnosis of COPD:

- They were hospitalised with an acute exacerbation.
- They were admitted during the period 01June 2004–01June 2005.

3.5.2 Exclusion criteria

Subjects were excluded if:

- They were discharged within 24 hours from the ward or emergency departments of all the involved hospitals.
- They died within 24 hours of admission.

- The medical folders were unattainable by the researcher after two submissions to the medical records department.
- The institution did not give permission for the study to be conducted at their facility.

3.6 Instrumentation

The researcher developed the following data capturing sheets based on a review of current literature and after consultation with various physiotherapists and physicians, to obtain the relevant information required for the study.

3.6.1 Patient data capture sheet (Addendum A)

The data capture form was developed to record patient characteristics, the reason for hospital admission and the present medical condition of the patient. All information was gathered retrospectively using the medical folder of the patient.

Patient characteristics

Based on literature, the following variables to establish a patient profile were included: age, weight, height, gender and socio-economic status (Garcia-Aymerich *et al*., 2001; Gudmundsson *et al*., 2006; Weiss *et al*., 2003). Refer to section 2.5.1 -2.5.8.

Reason for admission

The complaints of an increase in dyspnoea, cough, sputum and sputum purulence are the most common symptoms when experiencing an acute exacerbation (Weiss et al., 2003) and were hence included in this section. In the development of this section, indication for hospitalisation as contained in the SATS 2004 document and current trends were taken into account (MacNee, 2003). Refer to Section 2.9.1.

Present medical condition

Physiological values in respect of oxygen saturation, temperature, pulse, respiratory rate, arterial blood gases and lung function values were used to document the status of the patient on initial presentation and this information was therefore included on the data forms (Franciosi *et al*., 2006; Kessler *et al*., 1999). FEV□ can be used as an indicator of disease severity. It declines at a more rapid rate as the disease advances, especially in smokers, and lung function values were thus included in this section (Weiss *et al*., 2003). Refer to Section 2.9.3.

3.6.2 Readmission data capture sheet (Addendum B)

This data capture form was developed to record the patient's previous hospitalisations due to acute exacerbation, co-morbidities and vital signs.

Readmission

Patients may be at increased risk of readmission once hospitalised with an acute exacerbation (Snow *et al*., 2001). Repeated hospitalisation of COPD patients with acute exacerbation is linked to reduced Quality Of Life, as well as being an indicator of disease severity (Burge and Wedzicha, 2003; MacNee, 2002). Refer to section 2.9.1.

Past medical history

Patients over 50–60 years of age frequently have associated diseases such as cancer and cardiovascular conditions that may have an effect on the course of COPD (Burge and Wedzicha, 2003; Sullivan *et al*., 2003). Refer to section 2.9.1.

Length of stay

At present there are no definitive data to determine the ultimate duration of hospitalisation for patients suffering acute exacerbation. A shorter hospitalisation period may indicate worse outcomes, but this has not been definitively established (Burge and Wedzicha, 2003). Refer to section 2.9.1.

3.7 Medication data capture sheet (Addendum C)

This data capture sheet was developed to document the medication prescribed to the patients during acute exacerbation.

3.8 Patient confidentiality data capture sheet (Addendum D)

This data capture sheet was developed to ensure patient confidentiality and anonymity, by delegating a numerical code to the patient's name. The patient's name and folder number was recorded on this form and a specific number was designated to the patient's name. The patient's details were kept in a safe environment to enable the researcher to extract data from the patient's medical folder when required, during the course of the research, where after it would destroyed.

3.9 Patient identification

Patients were identified by means of two procedures in the planning stage: a hospital and a medical folder procedure were put in place. The following systems were then established at the various hospitals to identify patients included in the sample:

Hospital procedures

Panorama Medi-Clinic

- Here all the wards have an admission and discharge book. These books were accessed to identify patients admitted with the symptoms of acute exacerbation within the period 01 June 2004–01June 2005.
- The patient's name, medical folder number and diagnosis were extracted from the admission book.
- The admission and discharge book were also used to determine readmission of the identified subjects admitted with symptoms of acute exacerbation since on each admission patients are given a different folder number.

Tygerberg and Karl Bremer Hospitals

- At Tygerberg Hospital, the F1 medical emergency unit keep daily statistics with the patient's personal details and diagnosis.
- At Karl Bremer Hospital, the clerical department is able to create an admission and discharge report, with the patient's name and diagnosis.
- All patients admitted with symptoms of acute exacerbation within the period 01 June 2004–01 June 2005 were identified from these statistical records.

Medical folder

- The researcher was able to identify patients by accessing the admission records kept at the different hospitals.
- The folders of the identified subjects were requested from medical records once all potential candidates for the study were identified.

- These medical folders were searched to verify the diagnosis of COPD with acute exacerbation.
- All previous admissions for an acute exacerbation requiring hospitalisation for a period of 12 months prior to the last admission closest to 01 June 2005 were recorded.

3.10 Pilot study

A pilot study was conducted two weeks prior to the main study at Karl Bremer and Tygerberg Hospital by the researcher.

The objectives of the pilot study were to determine:

- the accessibility of the medical folders, and
- the validity of information gathered in the study.

3.10.1 Pilot study procedure

- Candidates were identified from the admission records of the selected hospitals.
- The medical folders of the selected patients were searched to confirm the diagnosis of COPD, and only then were the patients placed on the pilot study database.
- Only COPD patients hospitalised with symptoms of an acute exacerbation in the period 02 June 2005–31June 2005 were included in the study.
- All information pertaining to the first admission was entered on the patient data capture sheet 1 and medication data capture sheet 3 (see Addenda 1 and 3).

The following problems were identified:

1. The accessibility of folders

   The ability to access the medical folders were limited by: outpatient clinics requiring patients' medical folder for follow up appointments and therefore the folder was unavailable. Two requests to the medical records were made to obtain the folder, whereafter the patient was excluded from the study if the folder was unavailable, as the diagnosis of COPD could not be confirmed.

2. Missing folders

   When the medical records staff reported the folder untraceable or entirely lost the patient was excluded from the study as the diagnosis of COPD could not be confirmed.

3. Missing information and illegible and missing microfilms

   The validity of information gathered in the study was hindered by missing information and illegible and missing microfilms, specifically at Tygerberg Hospital.

   - All missing information in the subjects folder were left blank on the data form as well as on the excel spreadsheet.
   - Illegible and missing microfilms: If the patients' folders were obtained and diagnosis confirmed but the microfilms were incomplete or damaged, the patient was still included as a subject. However, only legible microfilms and documentation could be use in data extraction.

4. The combination of data form two and three in to a single form facilitated effective and efficient data collection. The necessary changes were made and then combined into addendum two.

3.10.2 Procedure

Obtain admission records at the selected hospitals

↓

Identify patients by symptoms (Refer to sections 2.4 and 2.7).

↓

Private Hospital: n =86 Secondary Hospital =423 Tertiary Hospital =221

↓

Obtain and search medical folders to determine diagnosis of COPD with acute exacerbation.

↓

Private Hospital =31 Secondary Hospital =119 Tertiary Hospital =28

↓

Search patient's medical record retrospectively for a 12-month period prior to the last admission date (June 2005) for all acute exacerbations resulting in hospitalisation.

↓

Data extraction onto data capture forms

↓

Data processing and analysis

3.11 Procedure of main study

The main study, retrospectively, commenced on 01 June 2004.

Patients were identified; data extracted and captured using the following methods by the researcher.

3.11.1 Sampling procedure

- Subjects were identified from the systems in place at the specified facilities where they were admitted.
- The admission records of the medical wards from 1 June 2004 to 1 June 2005 were scrutinised
- The folder number of all subjects admitted with at least one of the following symptoms was documented. Refer to section 2.7
- The medical folder of all the identified subjects were requested from medical records at each of the facilities.
- The researcher then accessed the records to identify subjects with a primary diagnosis of COPD.
- Only the subjects that fulfilled above-mentioned criteria were finally included in the sample.
- Only medical folders that were acquired from medical record department could be scrutinized to determine the inclusion of the subject as a candidate for the study.

3.11.2 Database compilation

- The subject's last admission for an acute exacerbation, closest to 01 June 2005, was used to compile the final database.
- The medical folder of each subject was reviewed retrospectively for one year prior to the admission date closest to June 2005.
- The name and file number of each subject was recorded on a separate patient confidentiality data sheet (see Addendum 4). All data were coded accordingly.
- Addendum 4 was destroyed after all relevant documentation was obtained from the subject's folder.

3.11.3 Data extraction

- All relevant data was extracted for each admission in the data collection period, Addenda A and B and was completed using the administrative information, physician's notes and nursing progress notes.
- Addendum C was completed using the prescription chart in the subject's medical folder.
- The patient's name and folder number were recorded on Addendum D.
- Weekly visits to all of the facilities were conducted, until all relevant data were captured from all subjects' records for a period of four months by the researcher.
- All information pertaining to repeat hospitalisations were documented on the readmission data capture sheet (see Addendum B)
- All missing information, damaged and missing microfilms were treated and documented as absent information.

- Absent information and values were left blank on the data capture forms as well as when entering data on the computer.
- As soon as all the data were captured on the data forms, the data were entered on the excel spreadsheet and thereafter submitted for statistical analysis.
- Results were verified by an independent observer by extracting names from the sample and thereafter confirming accuracy of information entered from the data capture forms onto the Excel spreadsheet.

3.12 Statistical analysis

Summary statistics were generated and displayed using frequency tables, histograms, means and standard deviations. For comparison of ordinal/continuous variables between various different groups, one-way ANOVA was used. Assumptions for the ANOVA analyses were checked at all times. Categorical variables were compared using cross tabulation and the Chi-square test.

3.13 Ethical considerations

- The research protocol was approved by the ethics committee of Stellenbosch University for approval: project number N05/07/118.
- Permission was obtained from the medical superintendent and hospital director at the various hospitals for the research to be conducted at their facilities. Verbal consent was obtained at Panorama Medi-Clinic, Karl Bremer and Tygerberg both gave written consent. (See Addendum E and F)
- As this is a retrospective study no written consent was obtained from the patients.

- As this was an observational study, it would by no means affect the current and prospective medical management of the relevant patients.
- The information obtained will remain strictly confidential by delegating a numerical code to the patient's identity and will store in a secure environment.
- A data sheet (see Addendum D) was created with the patients name and delegated numerical code, to enable the researcher access the patient's medical folder. Only the researcher has access to it. Once all the relevant data were extracted from the medical folder, the data sheet (see Addendum D) will be were destroyed.
- The results are available to all the hospitals where the research was conducted, with no reference to patients' identities.
- During the course of the research project consent was not obtained from Louis Leipoldt Medi-Clinic, and therefore no data were collected at their facility. (Extensive attempts by means of telephonic contact to Medi-Clinic research personnel as well as forwarding the research proposal to their legal department to obtain permission to conduct the research unfortunately did not render any results.)

Chapter 4

Results

4.1 Introduction

In this chapter the results will be presented and discussed as follows. Firstly, a description of the total population with respect to the sample demographics followed by a description of the medical conditions in relation to admission one, admissions two or three and more than three admissions will be given. Selected outcomes of the 178 subjects will then be described with respect to the admission frequency and length of hospital stay. Finally, factors influencing the outcomes of the 178 subjects will described with respect to hospital readmission, age and readmission, gender and readmission, co morbidities and readmission and, finally, LTOT and readmission.

4.2 Sample demographics

The demographics of the 178 subjects obtained from the tertiary and secondary state and one private hospital were the following: age, co morbidities, smoking status and social status. These are expanded on in sections 4.2.1– 4.2.4.

In the period 01June 2004 –01June 2005, 178 subjects were identified at the two state and one private hospital in the Cape Metropolitan area (see Section 4.5.1). The majority of subjects had one or more co morbidity (79%) while only 21% of subjects had no co morbidity. All of the subjects had a positive smoking history: 66% were ex-smokers and 34% continued to smoke. The secondary state hospital had the majority of subject admissions n=119 (67%), the private hospital n=31 (17%), and the tertiary hospital n=28 (16%). See Table 4.1

Table 4.1 Characteristics of the subjects

DEMOGRAPHICS	TOTAL
Number of subjects	178
Age (years) (Mean:SD)	63 (11.73)
Gender (male : female)	103 : 75
Number of co morbidities (yes : no)	140 : 38
History of smoking Currently smoking (no : yes)	178 (100%) 117 : 61
Social status (%) ➢ Employed ➢ Unemployed ➢ Receiving disability grant ➢ Pensioner	 11 20 10 58

4.2.1 Age of the subjects

The mean age of this population (n=178) was 63 (SD 11.73). There were n= 51(29%) subjects between the ages of 65 and 75. Only a few subjects were older than 75. Fifty-six per cent of subjects were younger than 65 years of age, while one subject was as young as 30 on entry into the study. The ages of the subjects on entry into the study are presented graphically in Figure 4.1.

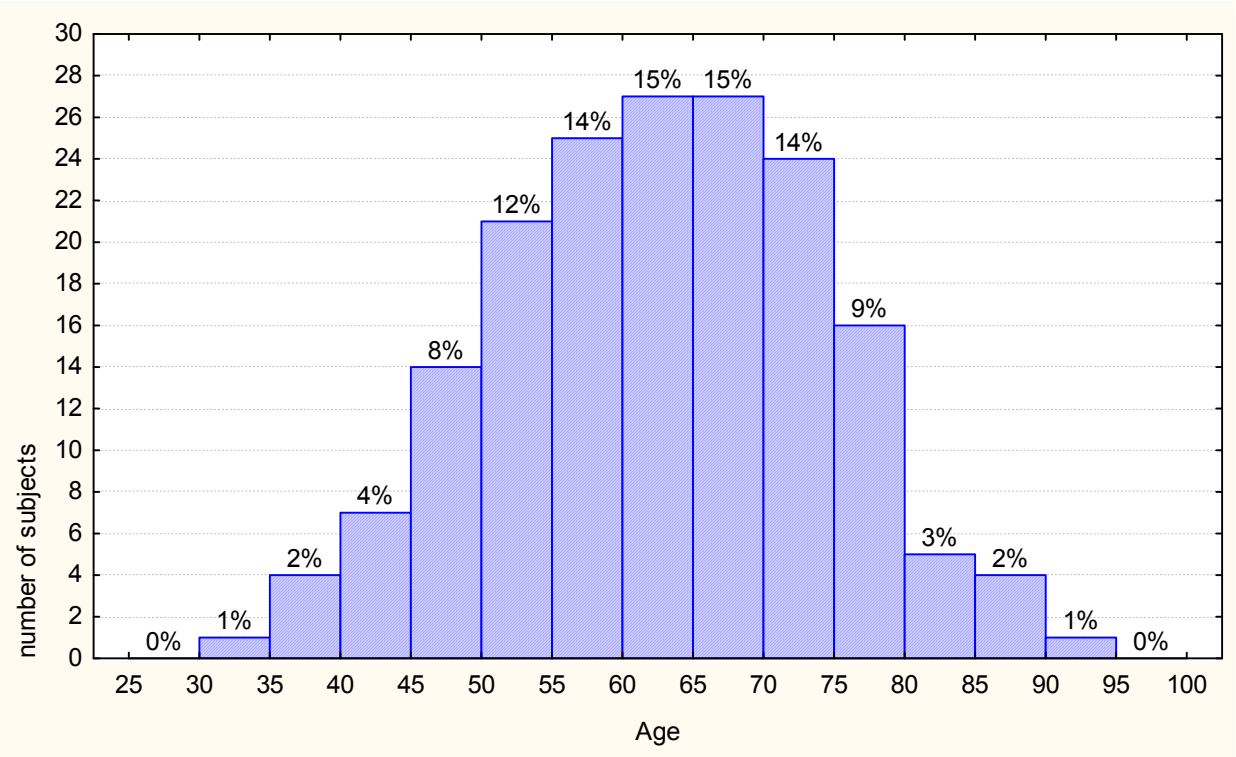


Figure 4.1 Age of subjects on entry into the study

4.2.2 Co morbidities of the subjects

The majority of subjects in this population had one or more co morbidities; only 21% of the subjects had no co morbidity. Seventy-nine percent had co morbidities recorded. The co morbidities recorded were based on the most frequently observed co morbidities in COPD subjects and these included the following: diabetes mellitus (DM), ischaemic heart disease (IHD), congestive cardiac failure (CCF), stroke, Tuberculosis (TB), hypertension (HPT), cor pulmonale, cancer and asthma. See Figure 4.2 below depicts the co morbidities observed in the subjects.

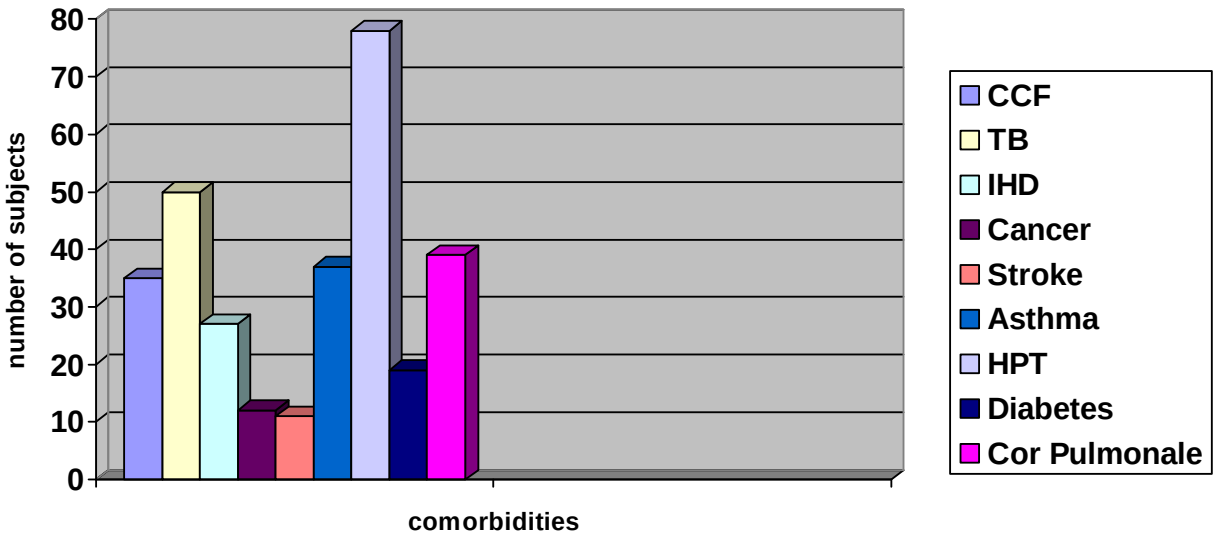


Figure 4.2 Associated co morbidities of subjects

4.2.3 Smoking status of the subjects

In the present sample, only ex-smokers and subjects who continued to smoke were identified. Hence, all 178 subjects had a positive smoking history. The number of ex-smokers (n=117) was significantly higher than the number of current smokers (n=61) in the current sample. See Figure 4.3 below.

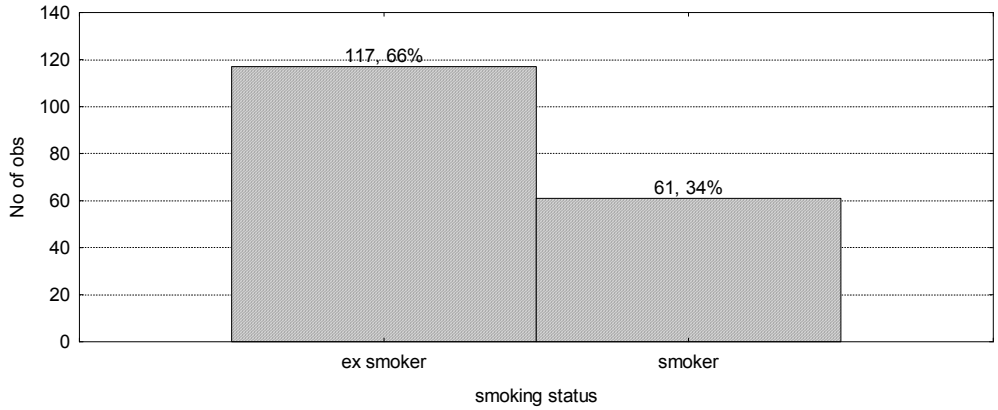


Figure 4.3 Smoking status

4.2.4 Social status of the subjects

Figure 4.4 depicts the employment status of subjects on their first admission. The largest percentage of the sample comprised predominantly pensioners, individuals 60 years and older or persons on early pension.

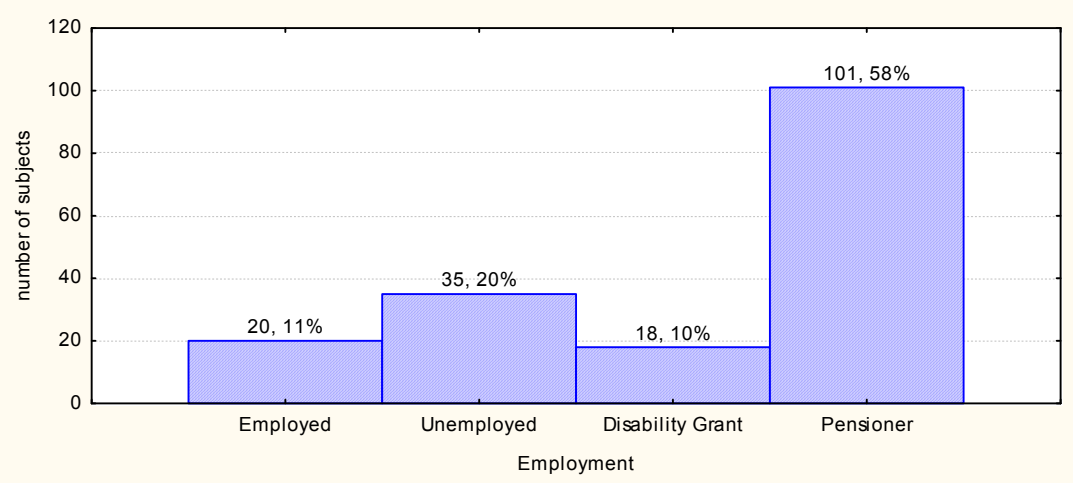


Figure 4.4 Social status of the subjects on entry into the study

4.3 Clinical presentation of the subjects

No comprehensive analysis could be obtained to establish the medical status of subjects on admission and discharge as data concerning the medical status of the patient were not in the medical folder, there for objective #2 (refer to Section 3.2.1) could not be accomplished. All relevant clinical data relating to the clinical presentation of the patients were collected where available: pulse, respiratory rate, blood pressure, temperature, oxygen saturation, blood gases and lung function. The clinical presentation on admission and discharge will be described as obtained for the 178 subjects in relation to admission 1, admissions 2 or 3, and > 3 admissions in respect of the available vital signs.

4.3.1 Vital signs

At all three admissions subject had the following vital signs on admission:

1 Subjects with one admission presented with an elevated mean pulse of 101 beats/min (60–90 normal) and a mean respiratory rate of 26 breaths/min (12–18 normal)

2 Subjects with 2–3 admissions presented with a pulse mean of 106 beats/minute and a mean respiratory rate of 28 breaths/min.

3 Subjects with > 3 admissions presented with a mean pulse of 120 beats/min and a mean respiratory rate of 32 breaths/min.

Both respiratory and pulse rates normalised towards discharge for subjects with fewer than three admissions, however pulse and respiratory values of subjects that where admitted more than three times remained elevated at discharge.

Missing information

The following clinical variables had less than 10% missing values: smoking, pulse on admission and discharge, blood pressure on admission and discharge, co morbidities, temperature on admission, reason for admission, gender, age, social history, ambulant or non-ambulant, LTOT and hospital oxygen. Table 4.2 displays 10-99% of missing values as found during the data extracted period for the 338 hospitalisations.

Table 4.2 Missing data

	number missing	% missing
PaO2 discharge (D/C)	336	99
PaCO2 D/C	336	99
pH D/C	336	99
O2 saturation D/C	336	99
# times TB	330	98
Height	319	94
FEV_1	303	90
FVC	303	90
FEV_1/FVC	303	90
Dyspnoea admission (adm.)	282	83
PaO2	281	83
PaCO2	281	83
pH	281	83
Baseline dyspnoea	251	74
O2 saturation	247	73
Weight	228	67
Respiratory rate D/C	198	59
Respiratory rate adm.	124	37

4.4 Selected outcomes

Admission frequency and the length of stay of subjects hospitalised with acute exacerbation of COPD were investigated. Each of the subjects was reviewed over a 12-month period. The selected outcomes of the 178 subjects are described in respect of admission frequency and length of hospital stay (sections 4.4.1 and 4.4.2).

4.4.1 Admission frequency

Of the n=178 admissions in the current study, 100 subjects were admitted once and 78 subjects (44%) were admitted two or more times in the 12-month follow-up period. The majority of the 78 subjects had a least two admissions (25%), with four subjects having as many as eight readmissions in the preceding 12-month period (see Figure 4.5).

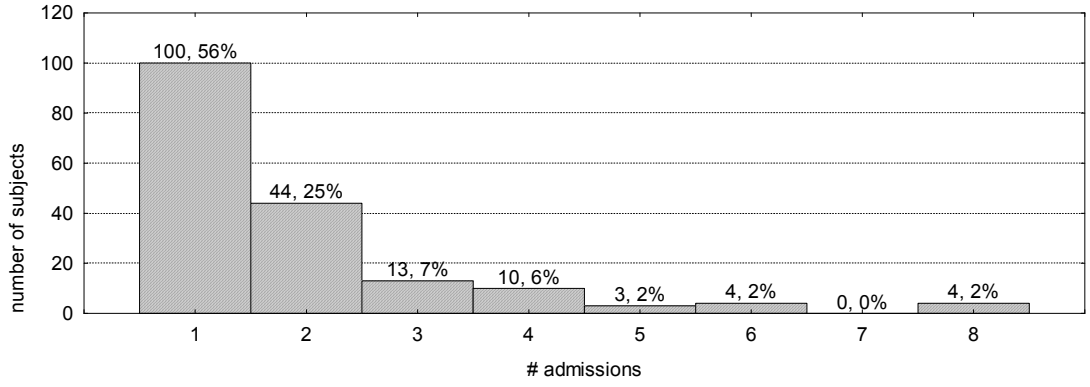


Figure 4.5 Admission frequency of the subjects as observed in the 12-month follow up period of the study

4.4.2 Length of stay (LOS)

The mean LOS per subject was 5, 67 (± 6.55) days per admission. There were no differences observed amongst the three hospitals in respect of the LOS. However, subjects admitted once within the study period stayed the longest, with a mean of 6.2 days per admission. Those admitted two or three times stayed on average 5.5 days per admission and subjects who were admitted more than three times had an average stay of six days in hospital.

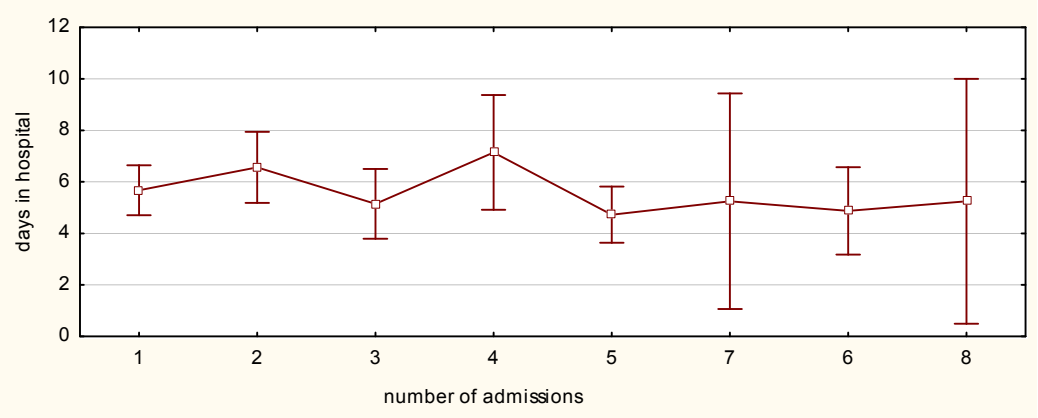


Figure 4.6 Length of stay (days in hospital)

4.5 Factors influencing outcomes

The factors that influenced the outcomes of the 178 subjects are now described as follow: hospital readmission, age and readmission, gender and readmission and co morbidities and readmission in respect of admission1, admission 2 and ≥ 3 admissions. LTOT and readmission will be described in relation to admission1, admission 2 or 3 and > 3 admissions (see sections 4.5.1– 4.5.5).

4.5.1 Hospital readmission

The 178 rendered 338 hospital readmissions, however those admitted more than twice (n=78) contributed to the majority of readmissions (n=238). Although the secondary hospital had the majority of subject admissions, subjects admitted to the tertiary hospital were more likely to be readmitted mean 2.3 compared with <2 at the secondary hospital. However this was not significant (p=0.49). Figure 4.7 depict the readmissions as observed at the three hospitals.

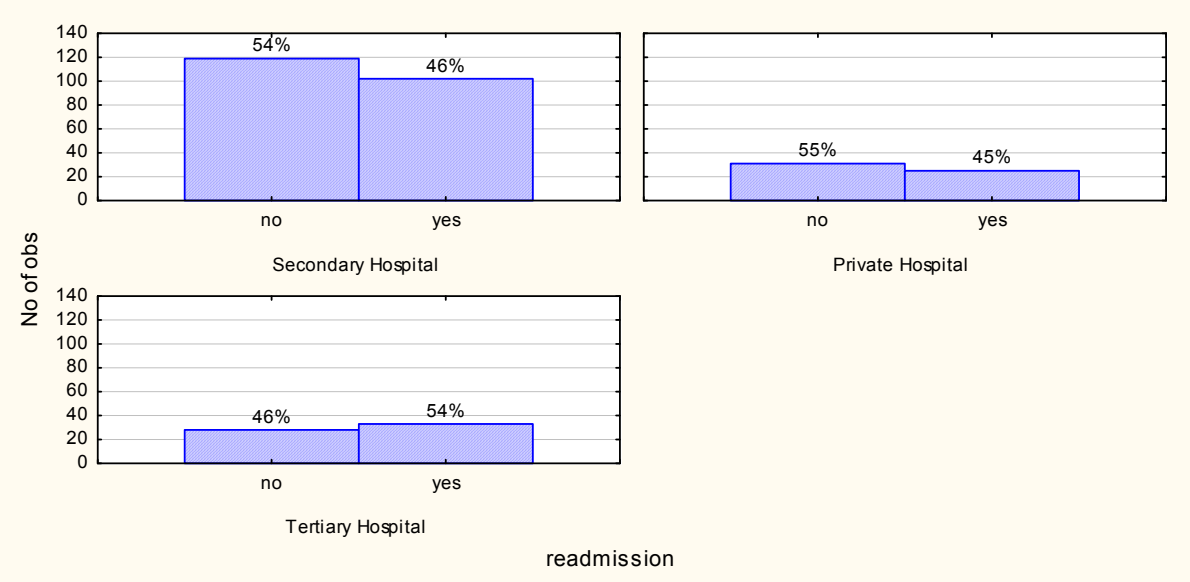


Figure 4.7 Readmission at the three hospitals

4.5.2 Age and readmission

Although subjects with one admission were younger (mean age 62) compared to subjects with two and more admissions (mean age 64 years and older), there was no correlation between age and the risk for readmission in the current sample (p=0.5). Subjects at the private hospital were slightly older (mean age of 65 years) than individuals at the secondary and tertiary hospital (mean age 63 and 62 years respectively). However, being older and

hospitalised at the private hospital was not associated with an increased risk of readmission (p= 0.28)

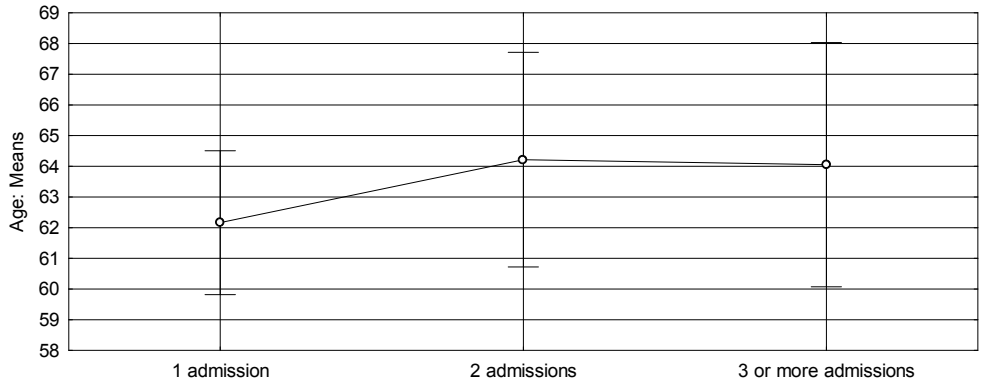


Figure 4.8 Relationship of age and frequency of admissions

Figure 4.9 Age of the subjects as admitted at the three hospitals

4.5.3 Gender and readmission

On first admission there were more males than females. This however proceeded to equalise, with minimal differences seen between subjects with two and more admissions. There were however more females than males in subjects with ≥ 3 admissions. Using statistical procedure, the chi-square test, a significant trend could be observed (refer to Figure 4.1), indicating an increased risk for readmission in female subjects who required ≥3 admissions (p= 0.16).

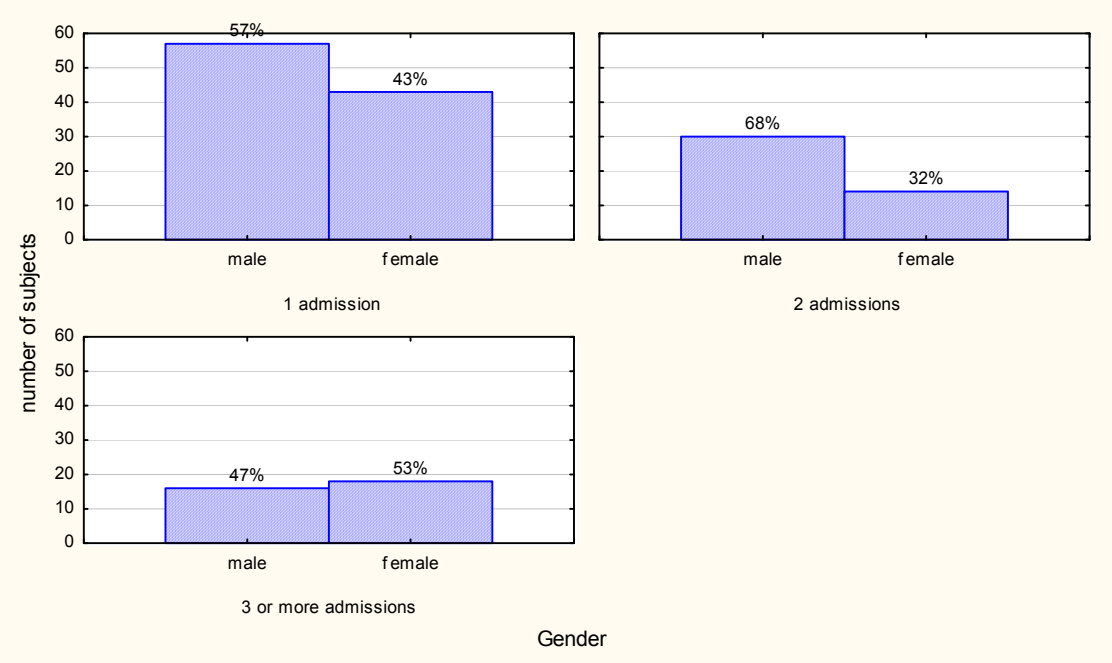


Figure 4.10 Gender distribution of the subjects at each of the admission periods

4.5.4 Co morbidities and readmission

Subjects with more than three admissions had at least two co morbidities compared to those with ≤3 admissions who had only one co morbidity. Subjects with two or more co morbidities had an increase risk for readmission (p=0.02). However, subjects with congestive cardiac failure were specifically more at risk for three or more readmissions (p=0.01).

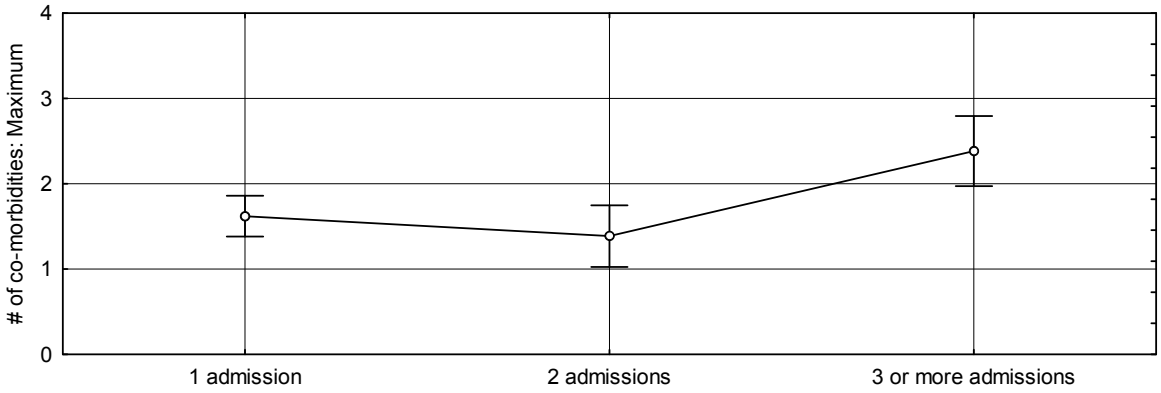
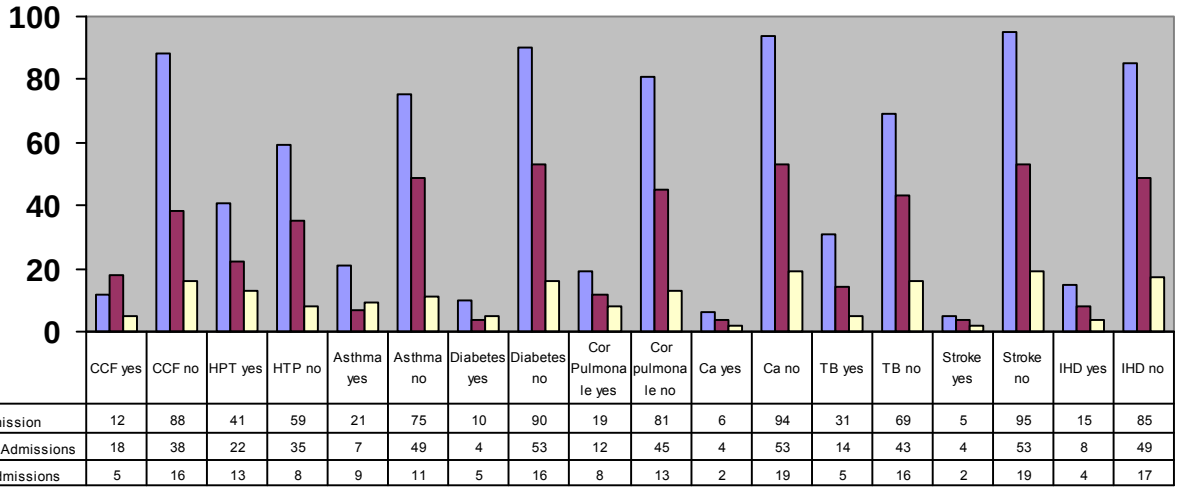


Figure 4.11 Number of co morbidities at each admission period



	CCF yes	CCF no	HPT yes	HTP no	Asthma yes	Asthma no	Diabetes yes	Diabetes no	Cor Pulmonale yes	Cor pulmonale no	Ca yes	Ca no	TB yes	TB no	Stroke yes	Stroke no	IHD yes	IHD no
1 Admission	12	88	41	59	21	75	10	90	19	81	6	94	31	69	5	95	15	85
2 or 3 Admissions	18	38	22	35	7	49	4	53	12	45	4	53	14	43	4	53	8	49
> 3 Admissions	5	16	13	8	9	11	5	16	8	13	2	19	5	16	2	19	4	17

Figure 4.12 Number of subjects with co morbidities at each admission period

4.5.5 Long-term oxygen therapy (LTOT) and readmission

Only 16 subjects in this sample (n=178) had oxygen therapy available at home. The risk of readmission was highest in the group with no LTOT available to them (p=0.017) (see Figure 4.13).

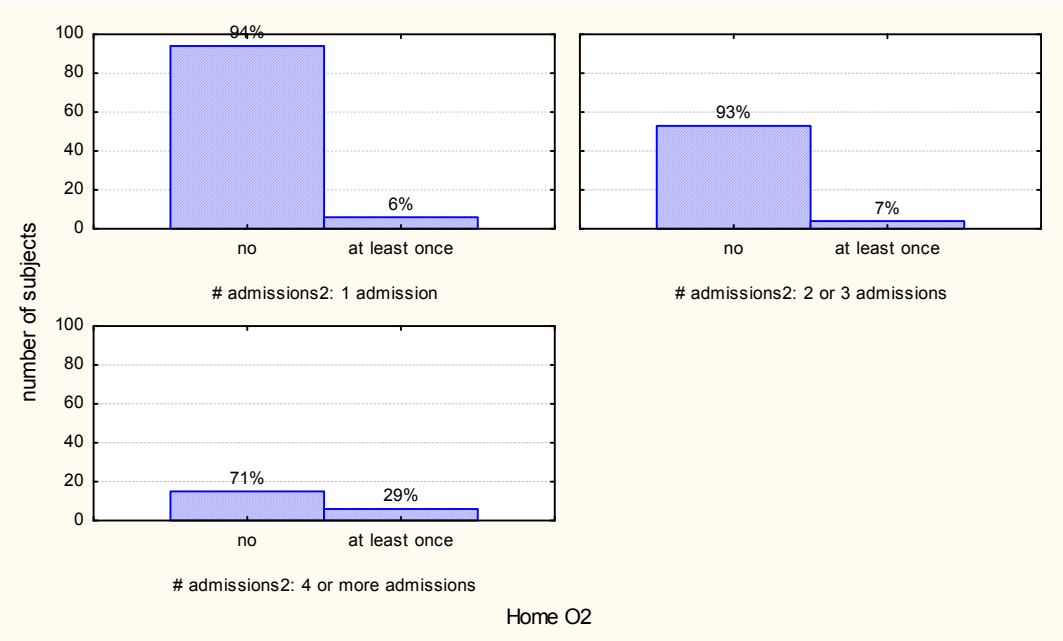


Figure 4.13 The number of subjects with LTOT at each of the admission periods

Chapter 5

Discussion

5.1 Introduction

This chapter will discuss the results obtained after completion of the data compilation phase. As mentioned at the outset (Section 3.1.2), the objectives of this study were to describe the profile of COPD patients hospitalised with acute exacerbation in the Cape Metropolitan area, to describe the medical condition of the patient on admission and discharge, as well as to describe the readmission and length of stay of these patients. Factors that were found to influence the characteristics and selected outcomes of the current study population are now discussed accordingly.

Except for the age variation, patients admitted with acute exacerbation in this study presented with a similar profile to patients in developed countries with regard to co morbidities, gender and smoking history (Franciosi et al., 2006; Garcia-Aymerich et al., 2001; Garcia-Aymerich et al., 2003: Groenewegen et al., 2003: Miravitlles et al., 2000; Sin et al., 2000).

5.2 Demographics of the sample

The demographic profile of this study population (n=178) was predominantly male, with a mean age of 63 (11.73), presenting with evidence of one or more co morbid diseases, and a positive history of smoking. In this section the demographics of the study population will be discussed under the following headings: age, gender, social history, co morbidities and smoking behaviour (see sections 5.2.1–5.2.5).

5.2.1 Age

The mean age of the current subjects hospitalised with acute exacerbation was 63 (±11.73) yrs, varying from 30–95. This is in contrast to studies carried out in countries as United States and Europe here the mean age for subjects requiring hospital admission for acute exacerbation was >65 (Franciosi et al., 2006; Miravitlles, et al., 2000; Seemungal et al., 1998). These studies were performed in industrialised countries where the identification of COPD occurs at an earlier stage due to better health systems and increases in life expectancy are evident. In those countries the appropriate medical interventions and lifestyle changes occur at an earlier stage of disease, which can contribute to the differences in age observed in the current study and the above-mentioned studies (www.lungusa.org/site/pp.asp, accessed 17 March 2005; www.euro.who.int/ehr2005, accessed 06 July 2007).

Although the current South African study data were obtained from both first and third world health environments the majority of South Africans depend on the public health service. After an extensive search of electronic data bases the author was unable to identify comparable data of patients hospitalised with acute exacerbation in a third world environment.

The major concern identified in the current study was the large proportion (56 %) of subjects younger than 65 years of age admitted at least once in the study period with an acute exacerbation. Only 29 % of subjects in the current study were 65–75 years of age. This is in contrast with studies carried out in developed countries, where patients admitted with acute exacerbation were generally older, namely 65–75 years of age (Garcia-Aymerich et al., 2003; Groenewegen et al., 2003, Miravitlles et al., 2000).

The significant variation in age (30–95) amongst the current subjects admitted with acute exacerbation can possibly be attributed to the increase in exposure to tobacco smoke. In South Africa light and heavy smoking is highest in the age group 35–44 yrs for males and females, which substantiates the increase in smoking behaviour observed amongst especially the younger population worldwide (Bradshaw et al., 1996; www.who.int/whr, accessed 02.06.2007). Indoor pollution resulting from domestic use in sub-Saharan Africa could expose individuals at a much younger age, especially females, to harmful levels of pollution and increase the risk profile of these subjects (GOLD, 2000). Air pollution has been recognised as contributing to 20% of all COPD diagnosed worldwide placing further emphasis on this environmental risk factor (www.who.int/whr, accessed 02.06.2007).

Episodes of acute exacerbation are not uncommon in patients presenting with COPD. It is considered prevalent among patients with moderate to severe COPD and is associated with increased frequency and disease severity (Burge et al., 2003; Garcia-Aymerich et al., 2001). The presence and severity of symptoms have also been associated with the extent of exposure to risk factors contributing to COPD. Thus susceptible individuals with a long and intensive history of smoking will suffer more with acute exacerbation compared to individuals who smoke less or who stop smoking (Franciosi et al., 2006).

It is especially respiratory infections, both viral and bacterial, that are associated with acute exacerbation. Such infections are common in both young and old individuals, but especially in patients with COPD. Patients with COPD are predisposed to respiratory infections due to the cycle of chronic inflammation of the bronchial tree causing pooling of mucus clogging up the airways and leading to poor cilia action caused by irritants like tobacco smoke or other noxious gases (www.goldcopd.com/, accessed 21.12. 2007 ; Pistelli et al., 2003). Patients have difficulty clearing secretions effectively and the

continuous exposure to risk factors, either air or occupational pollution, and cigarette smoke, will aggravate the symptoms of dyspnoea, wheezing and secretions, and can influence admission for acute exacerbation (Pistelli et al., 2003).

The data in this study were obtained from both first and third world environments and the age differences between subjects admitted at the three hospitals were not significant. This suggests that all sectors of the South African society are exposed to similar types of risk factors. Inevitably some variations amongst the affluent and non-affluent communities exist and contribute to differences in risk profiles of the various groups. Age in itself does not appear to contribute to acute exacerbation. It is the culmination of exposure to risk factors resulting in the damage to the lung tissue that is most important.

5.2.2 Gender of the study sample

The gender composition in the current study demonstrated more male (103) than female (75) subjects admitted with acute exacerbation, in a ratio of 1:3:1. These results are similar to studies in developed countries, demonstrating the increasing prevalence of COPD amongst females. The increased tobacco usage amongst females observed in both developed and developing countries contributes to the prevalence of COPD amongst susceptible women (www.goldcopd.com/, accessed 21.12. 2007).

The reasons for females developing severe COPD that can influence admission can be attributed to differences in the decline of FEV_1 associated with the response to tobacco smoke inhalation as well as their genetic predisposition to develop more severe COPD with a similar smoking history (de Torres et al., 2007; Prescott et al., 1997).

Silverman et al. (2000) have reported that females who smoke have a significantly increased risk of developing severe COPD compared to males. The decline in FEV_1 of

smoking females compared to smoking male subjects was significantly greater, indicating that females may suffer more from the adverse affects of tobacco smoke (with a similar pack-year history) than their male counterparts (Prescott et al., 1997). However, further studies need to be conducted to establish the exact reasons for this discrepancy.

The development of COPD in women has also been associated with anatomical differences between males and females. A recent study published reported that females have anatomically smaller lumen sizes with disproportionate thicker airway walls, less extensive emphysema, smaller hole sizes and less peripheral involvement than males, although they generally had a shorter smoking history compared to the male subjects (Martinez et al., 2007). These differences also relate to the subjective experience of the disease that has been noted to be different between males and females.

For the same level of airway obstruction and a similar smoking history, females experienced increased dyspnoea and walked less on the 6-minute walk test (Torres et al., 2007). As the criteria for admission for an acute exacerbation are not always clear; a patient's subjective experience of a symptom like dyspnoea could influence the admission rate.

5.2.3 Social history

The majority of patients in this study population were pensioners (58%). This is not surprising as 59% of patients were older than 60, with 60 being the cut-off date for retirement for females and 65 for males in South Africa.

What is however disconcerting is that of the remaining 41% of the study population only 11% were employed, with 10% disability grant recipients. This could be due to the high unemployment evident in the South African population today. This study did not explore the reasons for disability grants but the discrepancy could possibly be related to a decrease quality of life associated with an increased number of admissions (Puhan et al., 2005). The fact that in this study there is evidence of a younger population suffering from COPD could impact on the burden of this disease on the economical viable sector of the population. Further studies are needed to quantify this burden and explore the modifiable exposures contributing to this result.

5.2.4 Co morbidities

Co morbidities found in the present study of subjects admitted with acute exacerbation were comparable to those observed in international studies. The majority of the current 178 subjects recorded one or more co morbid diseases; only 21 % of subjects recorded no known co morbidities (Connors et al., 1996; González et al., 2004).

One of the reasons proposed for the increase in especially chronic disease in the developing countries is the influence of developed countries and the impact of rapid industrialisation (Bradshaw and Steyn, 2001).

Chronic diseases are a significant cause of disability and deaths in both the developing world and the developed world although the prevalence of certain diseases may be country specific (www.who Tuberculosis.htm, accessed 17.03.2005). Chronic diseases are lifestyle diseases that share similar risk factors, including poor diet, lack of exercise and increased exposure to tobacco smoke. Exposure to these risk factors happens over a

period of time and the symptoms of these chronic diseases are not immediately evident (Bradshaw and Steyn, 2001).

The risk factors mentioned above also contribute to the development of other lifestyle diseases such as specific cancers, heart disease and respiratory conditions. Specifically in South Africa, the rapid transformation has been noted to result in changes in lifestyle in all sectors of the South African society, but particularly in the underprivileged groups. This can potentially contribute to an increased prevalence of chronic diseases as COPD amongst the poorer communities (Bradshaw and Steyn, 2001). As the poorer communities are exposed to similar social transformations that have occurred in the affluent communities they will also be exposed to similar health problems.

The co morbid diseases observed in patients hospitalised with acute exacerbation in the current study are very similar to those studied in developed countries (Bradshaw and Steyn, 2001; Pistelli et al., 2003). However, the similarities may be attributed to influence from developed countries that should not be underestimated, and which require further attention. In the South African context the expectation would be to observe different trends and predominance of certain disease above others due to the complexities of a multi cultural society each with different habits, lifestyles and diet.

5.2.5 Smoking behaviour

In the present study all the subjects had a history of smoking either current or past. Smoking is a well established risk factor for COPD (www.goldcopd.com/, accessed 21.12. 2007).

COPD has predominantly been recognised to be prevalent in males due to their historical smoking behaviour but increased tobacco smoking is now found in females as well as young individuals and this may be one reason for the positive smoking history in the current study (American Thoracic Society, 2006; www.goldcopd.com/, accessed 21.12.2007; www.who.int/whr, accessed 02.06.2007).

In the Lung Health Study the decline in FEV_1 was slightly different for males and females who smoked; FEV_1 decline for males was greater (30.2 ml/yr) compared to females (21.5 ml/yr) (Anthonisen, et al., 2002). Although this difference was not significant when the FEV_1 was expressed as a percentage of the predicted normal value, it highlights the differences in response to tobacco smoke inhalation amongst individuals.

The significance of tobacco smoke is the effects of chronic inflammation, breakdown of lung elastin and mucus hypersecretion within the lungs. COPD does not occur in all smokers but 15–20% of all smokers eventually develop symptomatic signs of the disease. The reason for only a minority of smokers developing symptomatic COPD can be due to susceptibility of the individual to develop the disease. When individuals, prone either through genetic influences, history of respiratory infections in childhood or asthma, start to smoke the disease process is initiated. Initially the disease start at a low intensity but eventually as the risk exposure continues development of the disease advances.

5.3. Medical condition of the study subjects

Due to insufficient data, objective #2, the aim of which was to describe the medical condition of subjects on admission and discharged when hospitalised with acute exacerbation, could not be accomplished.

Missing data

Significant in this study was the large percentage of missing values; these ranged from 0 % to 99 %. Especially blood gases on admission and discharge, spirometry, weight and height had more than 60 % missing values. Internationally, criteria for hospital admission are determined by certain outcome measures such as severity of symptoms, quality of life, physiological factors (blood gases), frequency of admission and economic cost (Jr Carmargo., 2002; MacNee, 2003).

The clinical data in respect of vital signs, lung function and blood gases are important clinical factors as they influence the management of the patient. It establishes the severity of the condition on admission and assists with the decision whether to stabilise the patient in the emergency unit or admit the patient to the ward. The records also serve as a baseline for future admissions as the patient may deteriorate with a decline in lung function, and evidence of worsening blood gases can indicate significant deterioration of respiratory system and may require change in medication or the prescription of LTOT.

Reasons for data not being available could include staff shortage, poorly equipped units, equipment malfunction or equipment being unavailable owing to its being repaired, and a variety of other reasons, including financial as well as staff redeployment to busier areas in the hospital. There is insufficient information to ascertain if any admission and discharge criteria exist for patients hospitalised with acute exacerbation at the involved facilities.

5.4 Selected outcomes

In the current study n=178 subjects resulted in 338 hospitalisation throughout the three hospitals with 78 of the subjects resulting in two or more admissions. The majority of hospitalisations (238) were as result of the 78 subjects requiring two or more admissions. There was no significant difference in the profile of this small group of patients (n=78)

presenting in either the private or the state institutions. The factors investigated included, the age, co morbidities, smoking history, social history, and gender. This could be because of the small number of patients readmitted making it difficult to identify differences in the profile or alternatively that contrary to common belief the patients receive similar care in these two diverse health care systems.

The small number of patients (n=78) identified in this study as being readmitted more than once, concurs with research in developed countries indicating increased health care utilisation by a small proportion of patients (Stanford *et al*., 2005; Strassels *et al*., 2001). Recorded admission frequencies of up to eight episodes for the 78 subjects were noted during the follow-up period. Although the majority of the 78 subjects (25 %) in the current study were only readmitted twice, four subjects (2 %) required eight readmissions in the study period.

In the following section the selected outcomes of the subjects will be discussed with reference to the variables that were significantly associated with the selected outcomes: co morbidities and readmission, long-term oxygen therapy (LTOT) and readmission, and length of stay (LOS) and readmission (see sections 5.4.1–5.4.3).

5.4.1 Co morbidities and readmission

In the current study the presence of two or more co morbidities was associated with an increased risk of readmission of up to three or more times (p=0.02). Specifically, congestive cardiac failure (p=0.01) was significantly associated with an increased risk of increased admissions. These results are comparable to other studies that showed an increased presence of co morbidities with patients requiring hospital admission and the presence of significant cardiac diseases increasing the risk for readmission. In a study by

Connors *et al*. (1996) cor pulmonale and congestive cardiac failure were independent risk factors associated with poor survival after admission for acute exacerbation.

González *et al*. (2004) also reported cor pulmonale to be one of the independent risk factors for hospitalisation with moderate to severe COPD. All the subjects in the study were male and this hence limited the results to male subjects only, whereas the current study was conducted with no gender specification.

A reason for the presence of significant cardiac disease influencing admission may be the extent of lung damage attributed to the severity of the disease. An increase in pulmonary artery pressure and right ventricular failure may ensue as a result of the severity of destruction of the pulmonary vascular bed as well as the vasoconstriction of the arterioles, causing hypoxia (Kessler *et al*., 1999). Heart failure in COPD is associated with a significant decrease in lung function, which can possibly be due to infection (Pistelli *et al*., 2003). Infections of the tracheobronchial tree are thought to be the main cause of acute exacerbations as they are commonly found in those patients admitted with acute exacerbation, although in a significant proportion of patients the cause of acute exacerbation remains unidentified (www.goldcopd.com/, accessed 21.12. 2007)

5.4.2 Long term oxygen therapy and readmission

In the current study, subjects admitted for acute exacerbation without long-term oxygen therapy demonstrated an increased risk of admission (p=0.01). This result is similar to those of the study Garcia-Aymerich *et al*. (2001) who found that the under-prescription of LTOT was one of the independent associated factors for an increased risk of readmission with acute exacerbation.

The decision to provide LTOT for individuals is recommended in the very severe stage of COPD with the FEV_1 < 30 % (percentage predicted normal value), oxygen saturation below 90% or PaO2 < 7.3 kPa. A possible reason proposed by Garcia-Aymerich *et al*. (2001) for the under-prescription of LTOT is attributed to patients still continuing to smoke. However this argument is not relevant in the current study as 66% (117) of the study subjects were ex-smokers during the study period.

A plausible reason might be budget constraints as the availability of health resources are dictated by priority diseases as the HIV/AIDS epidemic and related conditions. The main emphasis of the health sector will focus on those diseases but may unfortunately result in the neglect of chronic disease as COPD. Second, the decision to provide LTOT requires knowledge of the severity of disease by performing required lung function test by means of spirometry, but this was not recorded in the majority of subjects' medical records. Therefore, another reason for the under-prescription of LTOT can be attributed to a lack of knowledge regarding the existing severity of lung disease to be able to assess the need for oxygen at home. In the South African context the impact of providing LTOT at primary healthcare centers on readmission rates could be investigated.

5.4.3 Length of stay and readmission

The number of days spent in hospital (LOS) in the current study were in line with data from developed countries and no significant differences were observed amongst the patients at admission 1, admissions 2 or 3 and >3 admissions. Even patients with > 3 admissions did not result in a significant increase in the number of days in hospital. The mean number of days in hospital was 5.67 per admission, which is similar to the results of studies in developed countries (Cotton *et al*., 2000; Sin *et al*., 2000). The length of stay may vary according to the criteria used for hospital admission and discharge as observed in the

studies by Connors *et al*. (1996) and Sullivan *et al*. (2000). The median number of days was 9–10 in the two studies but this can be attributed to differences in health practices of various countries or extenuating circumstances influencing admission.

The occurrence of eight readmission frequencies may be considered in the light of the argument proposed by Burge *et al*. (2003), namely that readmission within 14 days may actually be a relapse and not a new episode of acute exacerbation. In the light of the proposed theory, these patients may actually have required and would have benefited from a longer hospitalisation period, and this may ultimately influence readmission frequency. However, no definitive studies have been carried out exist to determine the exact LOS for patients admitted with acute exacerbation as they may have associated conditions influencing their hospitalisation (Cotton *et al*., 2000).

Patients hospitalised with acute exacerbation takes longer to recover even when receiving optimal medical care and eventually struggle with the simplest tasks involving activities of daily living (Fan *et al*., 2002). The repeat cycle of readmission further compromises their quality of life (Man *et al.,* 2004, Reis *et al.,* 2007).

Benefits of increase in exercise ability, decrease fatigue and dyspnoea were demonstrated when patients enrolled in a pulmonary rehabilitation programme (Güell *et al*., 2000; Puhan *et al*., 2005). Specifically post acute exacerbation these benefits were observed compared with patients receiving standard medical care that does not include pulmonary rehabilitation (Güell *et al*., 2000; Jenkins *et al*., 2001; Man *et al.,* 2004). In the randomised controlled trail of Man *et al.* (2004) they observed a reduction in hospital admission, days spent in hospital and increase in exercise ability after patients enrolled in a pulmonary rehabilitation programme following hospitalisation for an acute exacerbation. Patients also

experience fewer days in hospital when readmitted and reduction in exacerbation, and therefore a decrease in cost associated with hospitalisation (Reis *et al.,* 2007).

In summary from the demographics and outcomes observed in this study it is clear that many of the lifestyle diseases observed amongst COPD patients such as high blood pressure, cardiovascular conditions and diabetes mellitus can benefit from a comprehensive pulmonary rehabilitation programme (Reis *et al.,* 2007).

Chapter 6

6.1 Conclusion

The aim of the study was to describe the age, gender, social history, co morbidities and smoking history as well as the readmission frequency and length of stay of COPD patients hospitalised with acute exacerbation in the Cape Metropolitan area. Although patients in this study were admitted at three hospitals comprising of both public and private institutions, there were no significant differences either the profile or the outcomes between the hospitals.

Patients admitted with acute exacerbation at these hospitals demonstrated an age variation of between 30 to 95 years, mostly male although the male to female ratio were very similar. Very few active smokers were identified as the sample consisted predominantly of ex–smokers. Co morbidities were frequently observed in the sample especially high blood pressure, tuberculosis, congestive cardiac failure and cor pulmonale. The mean length of stay in hospital was 5.67 (±6.55) days.

Of the n=178, 100 (56 %) of the patients were admitted once and n=78 (44 %) admitted two or more times in the study year. Although less than 50 % of patients were admitted two or more times they experience up to eight admissions during the 12-month study period due to acute exacerbation. The n=178 patients resulted in 338 hospital admissions. As can be seen from the results of the study majority of patients were under the age of 65 years, the work able component of the population. And although less than 50 % of patients were readmitted this has substantial economic impact for these individuals who are employed in respect of lost income and to the country in loss of productivity.

Pulmonary rehabilitation programmes have been associated with decrease in readmission of COPD patients with episodes of exacerbation. The fact that less than 50 % of this sample was admitted more than twice and some patients up to eight times leads to the question of the availability and utilization of pulmonary rehabilitation programmes.

In the current study factors that influenced readmission were a history of three or more admissions in the study year, two or more co morbid diseases, and the presence of congestive cardiac failure and the lack of LTOT. Another factor that may also contribute to the risk of readmission and deserve further consideration is female gender, but larger studies are required to investigate this factor.

A challenging limitation of the study was the poor record keeping observed in respect of the missing data as obtained from the medical folders and this affected the results obtained. The poor documentation reported in this study is in contras to the GOLD guidelines as endorsed by the South African Thoracic Society which sets standards for the treatment, management and hospitalisation of patients with COPD and acute exacerbation. The implementation of these standards is dependent on reliable medical records to manage the patients' condition (Bateman *et al.,* 2004; www.goldcopd.com/, accessed 21.12.2007).

In summary patients hospitalised with acute exacerbation at the hospitals where the study were conducted exhibits similar characteristics and outcomes as found in developed countries (González *et al.,* 2004; Kessler *et al.,* 1999). Pulmonary rehabilitation has proven benefits in developed countries and it is strongly recommended that a pulmonary rehabilitation be commenced in the northern suburbs of the Cape Metropole. The initial programme could be initiated at the secondary hospital as it was recorded to have the

highest admission rate amongst the three hospitals. The feasibility of incorporating such a programme into either the work place or home needs to be investigated as many of the patients hospitalised were young enough to be employable. The cost benefit of the implementation of pulmonary rehabilitation program needs to be investigated. As can be concluded from the study results the socioeconomic burden is considerable even in this small proportion of patients that required frequent admission and necessitates an urgent intervention in terms of a pulmonary rehabilitation programme.

6.2 Limitations

The current study has several limitations and this will be dealt with accordingly.

6.2.1 Burden of disease

As can be seen from the results of the study majority of patients were under the age of 65 years, the work able component of the population. And although less than 50 % of patients were readmitted this has substantial economic impact for these individuals who are employed in respect of lost income and to the country in loss of productivity. Studies looking at the impact of hospitalisation on the individual and the extended family and what preventative measures can be taken needs further consideration.

6.2.2 Patient identification

Although all efforts were made to include all COPD patients hospitalised with acute exacerbation the ability to obtain all the medical folders for screening was a significant limiting factor. Following the pilot study the decision was made to exclude patients from the study when after two requests to the medical record department for a medical folder produced no results. The reason for this decision was that the diagnosis of acute exacerbation could not be verified without a medical record, and the reality of the time

constraints within which the study had to be completed. This may have led to the exclusion of a number of patients and thus contributed to the low number of patients in the current study. However, the decision would not have favoured one hospital to another and thus the picture of the burden to all sectors of the health service provided in the Northern Suburbs as portrayed in this study would be realistic.

6.2.3 Missing information

The lack of record keeping observed in the current study as documented by the large percentage missing values resulted in the failure to describe the medical condition on admission and discharge of the patients admitted with acute exacerbation. The requirement of hospitalisation reflects the level of illness of patients as the patient cannot be cared for at home as well as assisting in the planning of immediate and future interventions but this could not be determined in the current study. However the obvious deduction would be that patients were fairly ill as a number of patients required up to eight admissions in the 12-month study period. Alternatively patients were discharged prematurely because of the shortage of beds which will inevitably influence both admission and discharge criteria as proposed by South African Thoracic Society (Bateman *et al*., 2004, www.goldcopd.com/, accessed 21.12.2007)

Due to the retrospective study design only information available in the medical folder could be used in data extraction. Future studies aimed at describing the profile of COPD patients hospitalised with acute exacerbation should preferably be of a prospective design. This could possible facilitate the process of data collection.

6.2.4 Hospitalisation

The subjective experience of increase in wheezing, dyspnoea and sputum production associated with acute exacerbation inevitably allows for clinical interpretation of the severity of symptoms. This will influence hospital admission due to variation that will exist in clinical judgement. That is why SA recommendations include criteria for admission. Other factors that may influence hospital admission between the state and private hospitals are availability of beds and staff at the state hospitals against the paying client at the private hospital. These are economic factors and regrettably cannot be controlled.

Although the strict criteria were set and adhered to by the researcher based on all the requirements for hospitalisation from extensive literature search, the retrospective study design may allow for the some imprecision as the primary diagnosis of COPD is based on medical folder information and not substantiate by availability of lung function values. Unfortunately a few patients may have been included in the study that may have not been suffering with acute exacerbation but required hospitalisation for other illnesses as COPD is a subset of obstructive lung disease which includes cystic fibrosis, bronchiectasis and asthma.

The other limitation in the current study is that the present data only reflects actual hospital ward admissions and not the emergency ward admissions that may presumably be much higher. Although this was a specific decision of the current study as the significance of hospitalisation with acute exacerbation is the associated with disease severity and decrease quality of life experience as result of readmission. Especially in the public hospitals the patients may not be hospitalised as frequently as in the private although no significant differences were seen as they appear to have similar admission frequency statistically. A study on the visitation of the emergency departments by patients with acute

exacerbation would be beneficial in determining whether patients use this service frequently and why or do they wait until very ill and subsequent need hospitalisation.

The availability and access of pulmonary rehabilitation programmes in the northern suburbs were not investigated in this study as this would provide insight into the subjective experience of the disease process on the patient. The results of a pulmonary rehabilitation programme may decrease the number of admissions as well as provide cost benefits and improvement of quality of life (Puhan *et al*., 2006,).

6.3 Recommendations

Based on the results of this study as well as the limitations identified in the research procedure the following recommendations are made:

- Considering the increase in chronic diseases in the South African population access to reliable and valid information to assist in establishing the impact and burden of these diseases is needed and depends on accurate and legible documentation. This is an obvious requirement to maintain and document adequate information but is not being applied. In this study the information documented did not comply with the guidelines as published by SATS. The reasons for this could be due to either the guidelines not followed or that it was not documented.
- Pulmonary rehabilitation programmes have been associated with decrease in admission of COPD patients with episodes of exacerbation. The fact that less than 50% of this sample was admitted more than twice and some patients up to eight times leads to the question of the availability and utilization of pulmonary rehabilitation programmes.

- The economic impact of this disease on the South African workforce needs to be investigated as a large proportion of the study population were younger than 60 years of age. Occupational air pollution also plays a role in the development of COPD. The impact of this combined with the other modifiable factors needs to be further investigated. This could potentially open an area for physiotherapists to assess the possibility of establishing a pulmonary rehabilitation program in the workplace. These programmes should be aimed at the younger COPD patient with mild disease as increasingly younger individuals are diagnosed with COPD and continue exposure to risk factors over a prolonged period of time will increase the severity of the disease.
- Viral and bacterial infections as a cause of COPD acute exacerbation are well documented but in the South African context COPD patients that are immunocompromised due to HIV/AIDS and Tuberculosis may be at increase risk of hospital admission (www.who Tuberculosis.htm, accessed 14.08.2006). This is an aspect in the field of COPD that requires further investigation. Prospective studies specifically investigating the role of infections in the South African COPD patient presenting with acute exacerbation are needed.
- A concerned identified in the current study was the need to establish the socioeconomic burden of COPD but due to the study design was not investigated.

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Addendum A

Patient Data Capture Sheet

Patient code:

Please tick (√) the appropriate box and fill in not applicable (n/a) if not relevant.

Hospital:

Panorama Medi-Clinic	
Louis Leipoldt Medi-Clinic	
Tygerberg	
Karl Bremer	

Reason for admission	Bronchospasm	Unspecified infection	Increase in sputum production	Deterioration in symptoms
	New arrhythmias	Pneumonia	Deterioration in mobility	Dyspnoea
Date of Birth			Gender	Male/female
Employment status	Employed	Unemployed	Pensi1r	Disability Grant
Weight in kg			Height in cm	

Admission Date		Vital Signs	Adm	D/C
Discharge Date		Pulse		
ICU admission	Yes/No	Respiratory Rate		
Medical condition		Temperature		
Stroke		Blood pressure		
Cor Pulmonale		Oxygen Saturation		
Congestive cardiac failure		Lung Function	Admission	
Pulmonary embolism		FEV1		
Hypertension		FVC		
Ischaemic Heart Disease		FEV1/FVC		
Diabetes Mellitus		Blood Gasses		
Cancer		PaCO2		
Tuberculosis (TB)		PaO2		
Post TB bronchiectasis		pH		
Smoking? If yes, how many years?	Yes/ No	Walking with assistance:	Yes /No	
Ex-smoker	Yes /No	O2 dependant in hospital	Yes /No	
		Home O2	Yes/No	

Addendum B

Readmission Capture Sheet **Patient code:**

Please tick (√) the appropriate box and fill in not applicable (n/a) if not relevant.

Hospital:

Panorama Medi-Clinic	
Louis Leipoldt Medi-Clinic	
Tygerberg	
Karl Bremer	

Admission Date		**Vital Signs**	**Adm**	**D/C**
Discharge Date		Pulse		
ICU admission	Yes/No	Respiratory Rate		
Reason for admission		Temperature		
Pneumonia		Blood pressure		
Dyspnoea				
Bronchospasm				
Unspecified infection				
Increase in sputum production		**Lung Function**		
Deterioration in respiratory symptoms		FEV1		
Deterioration in mobility		FVC		
New Arrhythmias		FEV1/FVC		
Medical condition		**Blood Gasses**		
Stroke		PaCO2		
Cor Pulmonale		PaO2		
Congestive cardiac failure		pH		
Pulmonary embolism		Oxygen Saturation		
Hypertension		Walking:	Yes /No	
Ischaemic Heart Disease		Walking with assistance	Yes /No	
Diabetes Mellitus		O2 dependant in hospital	Yes /No	
Cancer		Home O2	Yes/No	
Tuberculosis (TB)				
Post TB bronchiectasis				
Smoking? If yes, how many years?	Yes/ No	**Ex-smoker**	Yes/No	

Addendum C

Medication Data Capture Sheet

Patient code:

Please tick (√) the appropriate box

Hospital:

Panorama Medi-Clinic	
Louis Leipoldt Medi-Clinic	
Tygerberg	
Karl Bremer	

Indicate medication by individual name

Date

Bronchodilators	Theophylline/ Aminophylline	Cortico steriods	Antibiotics	Mucolytic Agents	Other: HPT/ Cardiac meds

Addendum D

Patient Confidentiality Data Capture Sheet

Patient Name	Medical File Number	Patient Code
1.		01
2.		02
3.		03
4.		04
5.		05
6.		06
7.		07
8.		08
9.		09
10.		10
11.		11
12.		12
13.		13
14.		14
15.		15
16.		16
17.		17
18.		18
19.		19
20.		20
21.		21
22.		22
23.		23
24.		24
25.		25

Addendum H

Vocabulary

AAT =alpha1 antitrypsin

Adm= admission

AIDS= acquired immune deficiency syndrome

ATS= American Thoracic Society

BCM=body cell mass

BMI=body mass index

Ca= cancer

CCF=congestive cardiac failure

COPD= Chronic Obstructive Pulmonary Disease.

CRDQ= Chronic Respiratory Disease Questionnaire

CRQ= Chronic Respiratory Questionnaire

DALY =disability-adjusted life years

D/C =discharge

DM=diabetes mellitus

ERS= European Respiratory Society

FEV_1 = forced expiratory volume in one second

FFM=Fat Free Mass

FVC= forced vital capacity

GOLD=Global Initiative for Obstructive Lung Disease

GBD= Global Burden of Disease study

HIV= human immunodeficiency virus

HRQOL= Health Related Quality Of Life

HPT= hypertension

IHD= ischaemic heart disease

LTOT= Long Term Oxygen Therapy

LOS= length of stay

NHLBI= National Heart Lung and Blood Institute

O_2 = Oxygen

PaO_2=Arterial pressure of oxygen

$PaCO_2$ =Arterial pressure of carbon dioxide

PEFR= peak expiratory flow rate

pH= relates to the acid/ base status of blood

SATS= South African Thoracic Society

SF-36= Short Form 36-item Questionnaire

SGRQ= St George's Respiratory Questionnaire

SOLDQ= Seattle Obstructive Lung Disease Questionnaire

SOB= Short of Breath

TB=Tuberculosis

WHO= The World Health Organisation