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PHYSIOLOGICAL AND PSYCHOSOCIAL DETERMINANTS OF HEALTH-CARE SERVICE UTILISATION IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

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ABSTRACT

Introduction: There is evidence that psychosocial factors and social support are determinants of health-related quality of life (HRQoL) and health-care services use in patients with chronic diseases. **Objective:** To evaluate what physiological, psychosocial or HRQoL factors are predictors of health-care services use in COPD. **Methods:** A combination retrospective/prospective hospital-based cohort study was designed. 90 patients with stable COPD were selected from an out-patient registry at the Montreal Chest Institute. Patient evaluation included an interview with two disease specific HRQoL questionnaires: St. George's Respiratory Questionnaire and Chronic Respiratory Questionnaire; and five psychosocial questionnaires: Coping Inventory for Stressful Situations, State/Trait Anxiety Inventory, Beck Depression Index, NEO Five Factor Personality Inventory, and Interpersonal Relationships Inventory. Physiological measurements and symptom evaluation included spirometry, six-minute walking tests, and the American Thoracic Society Lung Disease Questionnaire (ATS-DLD-78). **Outcome:** Emergency room visits, return visits to the ER, and overnight hospitalisations were collected from patients' medical charts. **Results:** Independent associations were observed for age, gender, lung function, six-minute walking test distance, and use of oral cortico-steroids. HRQoL measures also demonstrated an ability to predict health-care service outcomes. Multivariate model selection identified disease severity and HRQoL as the strongest correlates of presentation for an emergency visit in COPD patients.

RÉSUMÉ

Introduction: Il a été démontré que les facteurs psychosociaux et le support social déterminent la qualité de vie et l'utilisation des services de santé chez les personnes atteintes de maladies chroniques. **Objectif**: Évaluer quels facteurs physiologiques, psychosociaux ou de qualité de vie peuvent prédire l'utilisation des services de santé chez les patients atteints de MPOC. **Méthodes**: Une étude rétrospective et prospective à été enteprise pour une cohorte basée à l'hôpital. 90 patients avec MPOC stable on été sélectionnés à partir d'un registre clinique à l'Institut Thoracique de Montréal. L'évaluation des patients incluait une entrevue avec: 1) deux questionnaires de qualité de vie spécifiques aux patients atteints de maladie respiratoire (le Questionnaire Respiratoire de St. George et le Questionnaire de Maladie Respiratoire Chronique), et 2) cinq questionnaires psychosociaux (Inventaire d'Adaptabilité en Situations Tendue, Inventaire d'Anxiété État-Trait, NEO Inventaire de Personnalité en Cinq Facteurs, Échelle de Dépression Beck, et Inventaire des Relations Interpersonneles). L'évaluation des facteurs physiologiques et des symptômes de maladie comprenait un test de spirométrie, un test ambulatoire de six minutes, et le questionnaire de la Societé Thoracique Américaine (ATS-DLD-78). Le nombre de visites à l'urgence, la répétition des visites d'urgence, et le nombre d'admissions à l'hôpital ont été relevées dans les dossiers médicaux des patients. **Résultats**: Des corrélations ont été établies entre l'utilisation des services de santé et certains facteurs tels que l'âge des patients, leur sexe, les fonctions pulmonaires, leur capacité physique (distance parcourue en six minutes), et l'usage des stéroïdes oraux. Les facteurs de qualité de vie ont aussi permis de prévoir l'utilisation des services de santé. Par procédure de sélection de modèles multivariables, des facteurs de severité de maladie et de qualité de vie ont été identifiés comme étant la raison principale des visites à l'urgence par les patients atteints de MPOC.

STATEMENT OF ORIGINALITY

The research described in this thesis consists of original work. To my knowledge only four studies have been carried out that directly measure the association between physiological, clinical, psychosocial or health-related quality of life and various health-care service utilisation in COPD patients. None, however, evaluating all these measures together in the same population. The analyses presented here can therefore shed new light on the specific characteristics of these associations.

TABLE OF CONTENTS

ABSTRACT I

RÉSUMÉ II

STATEMENT OF ORIGINALITY III

TABLE OF CONTENTS IV

LIST OF TABLES VIII

LIST OF FIGURES X

LIST OF APPENDICES X

1. INTRODUCTION 1

2. OBJECTIVES 3

- 2.1 GENERAL OBJECTIVES 3
- 2.2 SPECIFIC OBJECTIVES 3

3. LITERATURE REVIEW 4

- 3.1 DISEASE DEFINITION 4
- 3.2 IMPACT OF DISEASE ON HEALTH-CARE SERVICES 5
- 3.3 DETERMINANTS OF HEALTH-CARE SERVICES UTILISATION 5
  - *3.3.1 Sociodemographic characteristics, respiratory disease history and smoking 5*
    - 3.3.1.1 Sociodemography 5
    - 3.3.1.2 Respiratory disease and smoking history 6
  - *3.3.2 Physiological characteristics 7*
    - 3.3.2.1 Lung function impairment and physical functioning 7
    - 3.3.2.2 Somatic sensation 8
  - *3.3.3 Health-related quality of life 9*
  - *3.3.4 Psychosocial factors 11*
    - 3.3.4.1 Coping 12
    - 3.3.4.2 Anxiety 13
    - 3.3.4.3 Depression 14
    - 3.3.4.4 Personality 15
  - *3.3.5 Social support 17*
- 3.4 MARKERS OF HEALTH-CARE SERVICES UTILISATION 19

4. MOTIVATION FOR STUDY 21

5. METHODOLOGY 22

- 5.1 STUDY DESIGN AND RATIONALE 22
- 5.2 PATIENT ELIGIBILITY AND RECRUITMENT 22
  - *5.2.1 Eligibility 22*
    - 5.2.1.1 Inclusion criteria 22
    - 5.2.1.2 Exclusion criteria 22

5.2.2 Patient recruitment ... *23*
5.3 DATA COLLECTION ... 24
5.3.1 Interview procedure ... *24*
5.3.2 Study status ... *25*
5.4 STUDY MEASURES ... 25
5.4.1 Sociodemographic characteristics ... *25*
5.4.2 Respiratory disease history and smoking ... *26*
5.4.3 Lung function impairment ... *26*
5.4.4 Physical functioning and dyspnea ... *26*
5.4.5 Health-related quality of life ... *27*
5.4.6 Psychosocial measures ... *28*
5.4.6.1 Coping ... 28
5.4.6.2 Anxiety ... 28
5.4.6.3 Depression ... 29
5.4.6.4 Personality ... 29
5.4.7 Social support ... *30*
5.5 MEASUREMENT OF HEALTH-CARE SERVICES UTILISATION ... 31
5.6 STATISTICAL ANALYSIS ... 31
5.6.1 Descriptive statistics ... *31*
5.6.2 Follow-up and definition of outcome ... *32*
5.6.2.1 Subject Follow-up ... 32
5.6.2.2 Presentation for emergency visits ... 32
5.6.2.3 Relapses to the ER department ... 33
5.6.2.4 Hospitalisations ... 33
5.6.2.5 Clinic scheduling behaviour ... 33
5.6.2.6 Testing for differential frequencies in outcome events over time ... 34
5.6.3 Evaluation of retrospective data ... *34*
5.6.3.1 Univariate analysis ... 34
5.6.3.2 Correlation analysis of independent variables with HRQoL ... 35
5.6.3.3 Logistic regression ... 35
5.6.3.4 Multivariate model selection ... 36
5.6.4 Evaluation of prospective data ... *37*
5.6.4.1 Univariate analysis ... 37
5.6.4.2 Logistic regression ... 37
5.7 DEFINITION OF INDEPENDENT VARIABLES ... 37
5.7.1 Linearity assessment ... *37*
5.7.2 Sociodemographic characteristics ... *38*
5.7.3 Respiratory disease history and smoking ... *39*
5.7.4 Lung function impairment ... *40*
5.7.5 Physical functioning and dyspnea ... *41*
5.7.6 Health-related quality of life ... *41*
5.7.7 Psychosocial factors ... *42*
5.7.8 Social support ... *42*
5.8 MISSING VALUES ... 42
6. RESULTS ... 43

6.1 DESCRIPTIVE STATISTICS....................43
  6.1.1 Study population....................*43*
  6.1.2 Population profile comparison with refusal subjects....................*43*
  6.1.3 Sociodemographic and clinical characteristics....................*46*
  6.1.4 HRQoL and psychosocial measures....................*46*
  6.1.5 Health-care services utilisation....................*48*
6.2 CHI-SQUARE COMPARISONS....................53
  6.2.1 Chi square analysis of retrospective data....................*53*
    6.2.1.1 Presentation for an emergency visit....................53
    6.2.1.2 Relapses to the ER departments....................54
    6.2.1.3 Admission for overnight hospitalisation....................54
  6.2.2 Comparison of presentation for emergency visits before and after interview61
  6.2.3 Chi square analysis of other prospective data....................*67*
    6.2.3.1 Relapses to the ER departments....................67
    6.2.3.2 Admission for overnight hospitalisation....................67
6.3 CORRELATION OF EXPOSURE VARIABLES WITH HRQOL....................69
6.4 LOGISTIC REGRESSION....................72
  6.4.1 Regression analysis of retrospective data....................*72*
  6.4.2 Regression analyses of prospective data....................*77*
6.5 MULTIVARIATE MODEL SELECTION FOR PRESENTATION FOR EMERGENCY VISITS....................82

7. DISCUSSION....................84

7.1 POPULATION PROFILE....................84
  7.1.1 Representativeness of study population....................*84*
  7.1.2 Health-care services utilisation....................*84*
7.2 PSYCHOSOCIAL FACTORS....................85
  7.2.1 Psychosocial factor associations....................*86*
    7.2.1.1 Based on chi square analyses....................86
    7.2.1.2 Based on age and gender adjusted regression analyses....................86
  7.2.2 Limitations of psychosocial factors....................*87*
  7.2.3 Other research on psychosocial factors and health-care services utilisation88
7.3 HEALTH-RELATED QUALITY OF LIFE....................89
  7.3.1 Health-related quality of life associations....................*89*
    7.3.1.1 Based on chi square analyses....................89
    7.3.1.2 Based on age and gender adjusted regression analyses....................89
  7.3.2 Correlation between independent variables and HRQoL....................*90*
  7.3.3 Limitations of HRQoL....................*90*
  7.3.4 Other research on HRQoL and health-care services utilisation....................*91*
7.4 SOCIODEMOGRAPHIC CHARACTERISTICS AND RESPIRATORY DISEASE HISTORY....................92
  7.4.1 Sociodemographic characteristics and respiratory disease history associations....................*92*
    7.4.1.1 Based on age and gender adjusted regression analyses....................92
  7.4.2 Limitations of sociodemographic characteristics and disease history....................*94*
  7.4.3 Other research on sociodemographic characteristics, respiratory disease history and health-care services utilisation....................*94*
7.5 PHYSIOLOGICAL MEASURES....................94

7.5.1 Physiological measure associations *95*
7.5.1.1 Based on chi square analyses 95
7.5.1.2 Based on age and gender adjusted regression analyses 96
7.5.2 Limitations of physiological measures *96*
7.5.3 Other research on physiological measures and health-care services use *96*
7.6 MULTIVARIATE REGRESSION PROFILE OF PRESENTATION FOR AN EMERGENCY VISIT 97
7.7 ADVANTAGES AND DISADVANTAGES OF THE STUDY 98
7.7.1 Study design *98*
7.7.1.1 Study sample selection 98
7.7.1.2 Interview derived information 98
7.7.2 Statistical limitations *99*
7.8 FUTURE RESEARCH 100

8. CONCLUSION **102**

ACKNOWLEDGEMENT **104**

FINANCIAL SUPPORT **105**

9. REFERENCES **106**

LIST OF TABLES

Table 1. Comparison of means for independent variables for study participants and refusals in the COPD population* 45

Table 2: Sociodemographic and clinical characteristics in the COPD study population (N=90)* 49

Table 3: Health related quality of life (HRQoL) and psychosocial factors in the COPD study population (N=90) 50

Table 4: Outcome variables measuring health-care services utilisation in the COPD study population over the year before interview (N=90)* 51

Table 5: Outcome variables measuring health-care services utilisation in the COPD study population according to 6 month periods before and after interview (N=70) 52

Table 6a. Crude comparison of sociodemographic characteristics between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)* .56

Table 6b. Crude comparison of respiratory disease history characteristics between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)* .57

Table 6c. Crude comparison of physiological measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)* 58

Table 6d. Crude comparison of health-related quality of life measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90) ...59

Table 6e. Crude comparison of psychosocial measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)* 60

Table 7a: Comparison of sociodemographic characteristics related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)* 62

Table 7b: Comparison of respiratory disease history characteristics related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)* 63

Table 7c: Comparison of pathophysiological measures related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)* 64

Table 7d: Comparison of health-related quality of life measures related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70) 65

Table 7e: Comparison of psychosocial factors related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70) 66

Table 8. Crude comparison of health-related quality of life measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population, 6 month prospective data collection (N=70) 68

Table 9a: Correlation of sociodemographic, clinical and psychosocial measures with health-related quality of life (SGRQ) in the COPD study population (N=90) 70

Table 9b: Correlation of sociodemographic, clinical and psychosocial measures with health-related quality of life (CRQ) in the COPD study population (N=90) 71

Table 10a: Adjusted risks for sociodemographic and respiratory disease history characteristics categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)* 73

Table 10b: Adjusted odds ratios for physiological measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)* 74

Table 10c: Adjusted odds ratios for health-related quality of life measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)* 75

Table 10d: Adjusted odds ratios for psychosocial measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)* 76

Table 11a: Adjusted odds ratios for sociodemographic and respiratory disease history characteristics categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)* 78

Table 11b: Adjusted odds ratios for physiological measures categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)* 79

Table 11c: Adjusted odds ratios for health-related quality of life measures categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)* 80

Table 11d: Adjusted odds ratios for psychosocial factors categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)* 81

Table 12: Multivariate logistic regression model for presentation for emergency visits in the COPD study population, 1 year retrospective follow-up (N=90) 83

LIST OF FIGURES

Figure 1: Flowchart describing the selection of COPD subjects from the Montreal Chest Institute (MCI) registry..44

LIST OF APPENDICES

Appendix 1: Telephone/chart screening form for recruitment of COPD patients for interview...118

1. INTRODUCTION

Between 1994-95, 750,000 Canadians were diagnosed with chronic bronchitis or emphysema by health professionals (Lacasse et al., 1998, data from National Health Survey). Adding importance to this high prevalence, chronic obstructive pulmonary disease (COPD) and related disorders are the sixth leading cause of death in men and the eighth leading cause in women. These events account for 3.6 percent of all deaths in Canada (Manfreda et al., 1992). In persons over 75 years, age-specific mortality rates increased from 2.5/1000 in 1980 to 3.8/1000 in 1995 (Lacasse et al., 1998, data from Health Statistics Division of Canada). By this fact COPD is the only leading cause of death that is increasing in prevalence in North America (Canadian Thoracic Society Workshop Group, 1992; Higgins, 1989; Ferguson and Cherniack, 1993).

Unlike acute illnesses, COPD is characterised by a progressive and irreversible pathologic condition and residual disability which often requires long-term medical attention and nursing intervention (Parsons, 1990). Although associated with degree of disability and ill health, asthma and COPD are also known to directly and indirectly cause 15% of all male mortality and 6% of female mortality (Rutten-van Molken et al., 1992; Ashutosh et al., 1997). As a result COPD alone is now the fourth most common cause of death in the US (Petty, 1998 supplemental). Considering the number of hospitalisations and physician office visits for chronic respiratory disorders in the United States (US), COPD accounts for approximately 12 per cent of all hospitalisations (297,000 first-listed discharge) (Hay and Robin, 1991). Economic burden estimates available only for the US, Oster et al., (1984) report average medical costs per patient-year ranging from $587 to $6,238 (US dollars), depending on the number of years after onset of symptoms. In a prospective study of the medical costs for treatment of COPD, Bergner et al. (1988) report global costs averaging $14,647 per year (US dollars). Adding indirect costs, the annual cost increases to approximately $18.1 billion.

COPD is associated with significant social and economic costs, and lays a heavy burden on health-care services. To date, the bulk of outcome research on COPD has traditionally concentrated on establishing a correlation between physiological measurement and health-care service use (Weaver and Narsavage, 1992). Most studies interested in use of health-care services are concerned in testing health education or home care intervention programs, and base associations from their effects on outcome (Rutten-van Molken et al., 1992; Goldstein et al., 1997). Other studies suggest the use of quality of life (QoL) or health-related quality of life (HRQoL) questionnaires as predictors of health-care services use (Anderson, 1995; Osman et al. 1997). Although, authors are recognising limitations in using these measures as indexes of QoL in chronic disease populations (Harper et al., 1997). Some alternate studies in disease burdened populations identify psychosocial factors as potential predictors of HRQoL (Graydon and Ross, 1995). Such psychosocial measures are receiving renewed interest as indicators of health status and represent a growing field in health-care service research (Lewis and Bell, 1995).

Little is known about the determinants of health-care services utilisation, i.e. physician visits, emergency room (ER) visits, and hospital admissions, in patients with COPD. The potential importance of psychosocial adjustment to illness was suggested by an investigation of 215 patients with chronic non-respiratory disease, which identified this as the strongest correlate of health services consumption - not disease severity or prognosis (Browne et al., 1990). The influence of psychosocial and personality factors on overall disability in COPD has only received attention in the last few years (Ashutosh et al., 1997). If psychosocial and personality traits do affect the perception of disease severity and symptoms, it should be possible to relate them to patient dependency on health-care services.

If there are to be methods to reduce hospitalisation, ER visits and physician visits, potentially modifiable risk factors must be identified, and their relationships with each other evaluated and clarified.

2. OBJECTIVES

2.1 General objectives

The hypothesis stands that some psychosocial and personality factors intervene between disease pathophysiology and perceptions of HRQoL, either creating or moderating patient dependency on health-care services. Some patients with COPD appear to do well in their day-to-day activities, while others, with the same apparent disease severity, have difficulty (Leidy and Haase, 1996). Chronic illness patients' perceptions, experiences, expectations, and their subsequent requirements for health-care services, may depend on the behavioural expression of psychosocial states and/or personality traits, as well as on physiological and functional factors (Wiebe and Christensen, 1996).

To evaluate psychosocial factors as predictors of health-care services utilisation in COPD patients, a combination of psychosocial instruments need to be utilised to measure the spectrum of psychosocial states, from depression, to anxiety, to coping. In order to identify which are associated with or predictive of health-care services utilisation I tested a number of factors - psychosocial, social support, HRQoL, sociodemographic, respiratory disease history, and physiological. I then evaluated their association with different health-care services utilisation markers through statistical approaches.

2.2 Specific objectives

1. To identify psychosocial (depression, anxiety, coping and personality), social support, HRQoL, sociodemographic, medical and physiological measures associated with prior health-care services utilisation (ER visits and hospital admissions over the year before evaluation) by a sample of COPD patients.
2. To estimate the short-term relationship of potential psychosocial, social support, HRQoL, sociodemographic, medical and physiological factors on subsequent presentation at an emergency department (within 6 months) in the COPD patients.
3. To measure the correlation between HRQoL measures and psychosocial, social support, sociodemographic, medical and physiological factors in the sample of COPD patients.

3. LITERATURE REVIEW

3.1 Disease definition

COPD is a chronic, slowly progressive disorder characterised by airflow obstruction that does not change markedly over several months. Most of the lung function impairment is fixed, although bronchodilator or other therapies can produce some reversibility (ATS, 1995a; ERS, 1996). COPD arises from varying combinations of chronic bronchitis, small airway diseases and emphysema; it is difficult to define the relative importance of each in individual patients (Petty, 1998; Fenley, 1988)

Chronic Bronchitis is defined as cough and production of sputum on most days for 3 months or more for two consecutive years (Dantzker et al., 1993). Emphysema involves abnormal permanent enlargement and destruction of air space walls distal to the terminal bronchioles. This is often defined as "permanent, abnormal enlargement of destruction of respiratory acinus, which is accompanied by destruction of respiratory tissue" (Celli, 1996). Usually a history of cigarette smoking of more than 20 pack-years is achieved, although COPD does occur rarely in non-smokers. Patients usually present relatively late in life with symptoms of breathlessness (dyspnea) inappropriate for their age and type of exertion. These symptoms usually are manifested to clinically significant levels with mild to moderate disease.

In both North America and Britain, COPD and asthma are regarded as different disease for which treatment is different. Asthma involves episodic airway obstruction following a course of months to years. However, the differentiation of severe COPD from chronic severe asthma may be difficult since some degree of improvement (reversibility) in forced expiratory volume in the first second (FEV_1) can be produced by bronchodilation therapy. The obstruction of some patients with asthma may go on to develop irreversible airflow obstruction indistinguishable from COPD. Therefore, it seems prudent to separate these conditions at diagnosis (Rutten-van Molken et al., 1992).

Finally, the term COPD is not conventionally used to include other specific conditions that can cause airways obstruction such as cystic fibrosis, bronchiectasis, or bronchoiolitis obliterans (Celli, 1996).

3.2 Impact of disease on health-care services

COPD imposes a substantial burden on the Canadian health-care system. In Canada, 1993-94, there were 55,782 hospital separations with COPD as primary discharge diagnosis, with age-specific hospital discharge rates increasing in people over 65 years. The average in-hospital length of stay for COPD related admissions remains the same, 14.9 days in 1982 and 14.5 days in 1994 (Lacasse et al., 1998). Furthermore, Poole et al. (1997) showed that patients with COPD have a high re-admission rate with up to 60% of patients needing re-admission within one year.

Generally, this population is hospitalised twice as long as patients with other respiratory diseases (Yellowlees et al., 1987; Mannino et al., 1997). According to the 1993 US National Health Interview Survey, the average annual number of disability days was 2.2 days per condition for patients with bronchitis, and 13.1 days per condition for emphysema (Petty, 1998).

3.3 Determinants of health-care services utilisation

3.3.1 Sociodemographic characteristics, respiratory disease history and smoking

3.3.1.1 Sociodemography

Few sociodemographic markers are determinants of health-care service utilisation, and only perhaps, through their association with disease severity. When assessing severity of disease, age is the first sociodemographic factor considered. The National Longitudinal Mortality Study found education and income were significant determinants of mortality in COPD. Grouped by level of schooling, age and race standardised death rates from COPD are highest in patients who do not complete highschool (Petty, 1998), although these results were not adjusted for lung function or accessibility to health-care services. Gender may also be a factor. Isoaho et al. (1995) found that elderly female patients with COPD have more mental health problems than male patients and tend to be alone more often. Due to this they may require more attention from the primary care providers.

Another covariate with potential risk effects is socio-economic status. It can be evaluated using job title or income, years of education or ethnic background. The National Longitudinal Mortality Study reports incidences in mortality up to 378/100,000 per year for male COPD patients from low-income families (Petty, 1998). Age-adjusted mortality rates in the U.S. from 1960 to 1992 were 60% higher overall in males than females and highest especially in white males (Petty, 1998).

A proxy measure of social support and another potential risk factor of health-care services utilisation, is current marital status. It is the general impression that though such factors may not have a direct effect on health-care service utilisation, they may act indirectly through others like HRQoL or psychosocial factors (Anderson, 1995).

3.3.1.2 Respiratory disease and smoking history

Disease history may help to reflect the severity and progression of disease. A measure of the stages of symptomatic COPD, pharmacological therapy is normally undertaken in a stepwise manner consistent with national guidelines (ATS, 1995a; ERS, 1996). In that respect, prescription profiles for COPD patients, including number of types of respiratory medication could also be used to create proxy variables for disease severity.

Administration of oral cortico-steroids is usually reserved as a last step in the treatment after bronchodilator therapy, and can reflect the development of both severe acute and chronic symptoms (Kesten and Chapman, 1993; Barnes, 1998). A study by Rowlett and Dudley (1978) showed that COPD patients with good psychosocial "assets" required low doses of steroid regardless of the amount of life change, whereas patients with low psychosocial assets required low doses of steroid only when they had low life-change scores. With high life-change scores, their steroid needs increased dramatically.

A further marker of disease severity may be smoking history. Measured in pack-years, long-term and intense smoking is associated with decreased lung function (ATS, 1995). Thus, smoking is thought to play a prominent role in the development of COPD.

3.3.2 Physiological characteristics

3.3.2.1 Lung function impairment and physical functioning

Lung function and exercise tolerance or physical functioning are the two most common measures of COPD patient physiology used to monitor disease progression (Petty, 1998). People with COPD often report difficulty in performing daily activities, particularly in the area of home management and social interaction. It is possible that individuals functioning at lower levels are withdrawing into a shell while those at higher levels are finding meaning in their day-to-day activities, enabling them to transcend their illness (Leidy and Haase, 1996).

Severity of illness or impairment is usually measured by pulmonary function tests, where FEV_1 and forced vital capacity (FVC) are expressed as a percentage of predicted values (ATS, 1995b). Disability or physical functioning related to exercise capacity can be measured on a stationary bicycle or a treadmill in the laboratory or more simply by a 6 or 12 minute walking test over level ground (Butland, et al., 1982).

Spirometric values, used to measure lung function, are considered significant predictors of performance in daily activities. According to Celli (1996), the rate of FEV_1 decline is the factor best correlated with COPD mortality. Accounting for only 4 to 9% of the observed variance in measures like HRQoL, application of results in long-term prognosis is unreliable (Jones et al., 1992). Leidy and Traver (1995), in a cohort study of COPD patients, found that pulmonary function is not a significant predictor of overall physical, or psychosocial functional performance. Stehr et al. (1991) found return visits to the emergency department occur more often in COPD patients who have a higher FVC although they provide no explanation for this seemingly contradictory result to popular belief, other than selection bias.

The relationship between exercise tolerance and daily functioning has proven to be somewhat stronger (McSweeny et al., 1982; Weaver and Narsavage, 1992). One measure, the six-minute walking test is among the better predictors of HRQoL ($r= 0.33$ to 0.72 with dimensions of the CRQ) (Guyatt et al., 1991). However, no direct associations between health-care services utilisation and physical functioning tests have been established in COPD. The belief is that dyspnea serves as the mitigating factor between exercise tolerance, pulmonary function and health-care services use (Eakin et al., 1993; Sassi-Dambron et al., 1995). Consequently, pulmonary function or exercise capacity may not serve as independent correlates of health-care service utilisation, but may only do so through their relationship with other psychosocial or HRQoL factors.

Researchers have also attempted to measure functional performance through interviews and questionnaires (Browne et al., 1990). However, influenced by psychosocial, cultural and occupational activities, they find it difficult to explain the variation in measurements (Leidy and Hasse, 1996).

3.3.2.2 Somatic sensation

Review of the available literature shows that dyspnea, defined as the subjective sensation of difficult or laboured breathing, is a cardinal symptom of the failing lung and significantly affects all domains of HRQoL (Siafakas et al., 1997). Also called shortness of breath, dyspnea represents a complex interplay of physiological and psychological mechanisms. By various methods, investigators have found significant bivariate relationships between dyspnea and overall, physical, or psychosocial performance as well as HRQoL (Guyatt et al., 1993; Jones et al., 1992; Eakin et al., 1993). Fear and anxiety may also accompany sensations of dyspnea. In a study by Poole et al. (1997), more than 60% of the COPD patients stated they required help when they were more breathless than usual. The distress created by dyspnea can then be part of a vicious cycle leading to fear of future attacks in shortness of breath which may then lead to further visits to health-care centres.

Burns and Howell (1969) found that "disproportionately severe breathlessness" relates to psychological disturbances (depression, anxiety, and hysterical reactions) in lung disease patients. This in turn may induce, intensify, and extend the dyspnea. In other words, feelings raised with dyspnea may then trigger further attacks and consequently lead to a cyclic effect of increasing numbers of attacks and emotional reactions (Sandhu, 1986) which could then result in further health-care service utilisation.

3.3.3 Health-related quality of life

HRQoL questionnaires provide a method of quantifying the effect of disease on patients' lives. They summarise a number of aspects of the disease and provide an overall estimate of the effect of disease and benefits due to therapy (Jones et al., 1994). Over the past 15 years, investigators have developed a number of instruments to measure health status in patients with chronic disease. The availability of a variety of questionnaires has led to confusion regarding which instrument is the most appropriate to use and how to interpret the results with respect to outcomes in COPD populations (Lacasse et al., 1997).

The concept of HRQoL usually refers to the patients' perception of performance in at least one of four domains: somatic sensation, physical function, emotional state and social interaction (Lacasse et al., 1997a). These domains are generally treated separately in questionnaires used to measure HRQoL. Most prominent of the current COPD specific HRQoL measures are the Chronic Respiratory Questionnaire (CRQ) and the St.-George's Respiratory Questionnaire (SGRQ). Two other popular measures, the Sickness Impact Profile (SIP) and the Short-Form Questionnaire (SF-36) are more generic.

In a study on severe COPD patients Traver (1988) found that patients with higher (worse) Sickness Impact Profile (SIP) scores used more acute health-care services although their symptom severity did not differ. Siu (1993) found that the Short Form 20 (SF-20) predicted admission to hospital in elderly non-disease specific patients. It remains, however, that though such instruments seem to reflect this clinical assessment, these scales still lack sensitivity for use in making clinical decisions, particularly in COPD populations (Mahler and Mackowiak, 1995; Hajiro et al., 1998).

A recent study by van Schayck (1997) found the disease specific CRQ and SGRQ are more sensitive in establishing a decreased HRQoL for COPD. Although used in a few studies on COPD patients, the generic questionnaire SIP was found to be lengthy and, like the SF-36, unable to detect changes in disease compared to different HRQoL questionnaires (Lareau et al., 1996; Rafanan et al., 1998). Another recommendation, based on a pilot study by Martin (1994), is that the CRQ may be useful for clinical settings but not for research, as the questionnaire is not standardised and is usually administered in two sittings. On the other hand, the CRQ and SGRQ may measure different domains of quality of life (Guimont et al., 1998).

Even with the advent of psychosocial measurement instruments, and with the extensive research that has been done on developing sensitive HRQoL measurements, little research has been dedicated to using these instruments to predict health-care services utilisation in COPD populations. In one of the few studies on health-care services utilisation on COPD patients Osman et al. (1997) investigated the association between SGRQ scores and hospital re-admission in COPD patients following an exacerbation. Results showed that patients with poor HRQoL are at greater risk of hospital re-admission after an initial admission, are more often provided with home nebulisers, and are more likely to be referred to respiratory specialists. In particular, while adjusting for age, gender, FEV_1 and FVC, they observed a small but significant risk of re-admission with increased impact of the disease, as reflected in SGRQ scores.

Measuring a complex structure of interrelated factors from physiology to methods of dealing with symptoms, the ability of disease specific HRQoL questionnaires to predict health-care service outcomes may be due to the psychosomatic dimensions of the questionnaires. Guyatt et al. (1987) has suggested that HRQoL scales should provide a way of eliciting areas of distress for patients. Engstrom et al. (1996) found that the CRQ is not significantly affected in patients with mild to moderate loss of pulmonary function, possibly due to coping and/or pulmonary reserve capacity. However, in later stages of the disease, it was sensitive enough to discriminate between patients with different levels of pulmonary dysfunction.

SGRQ dimensions have also demonstrated complex relationships with coping ability (Ketelaars et al., 1996). Osman et al. (1996) also found that the SGRQ appears to distinguish patients who cope relatively well, despite having high symptom levels. On the other hand, studies have not shown a strong correlation between the SGRQ and physiological factors or disease outcome (Wijkstra, 1994; van Schayck, 1997). It may therefore be necessary to evaluate the different physiological, psychosocial or social factors both separately and together when trying to establish associations between HRQoL and health-care services utilisation.

3.3.4 Psychosocial factors

The insidious onset of chronic obstructive pulmonary disease generally subjects patients to a slowly deteriorating course of disease rather than to a sudden catastrophic event that overwhelms their mental resources (Agle and Baum, 1977). Also of importance is that many of the behaviours observed in COPD patients are often chronic and constant themselves - subjects of permanent habits or practices which are difficult to change if not targeted directly (Parsons, 1990; Ojanen et al., 1993; Anderson, 1995).

Reactions to dyspnea, wheezing, cough, sputum production, and fatigue that accompany COPD, can be anxiety, fear, and/or depression. These psychosocial states may in turn, serve as stimuli, further compromising the patients' physiological and emotional states. Thus the close, circular relationship between dyspnea, fatigue, depression, and anxiety, makes these phenomena difficult to study (Leidy and Traver, 1996).

Browne et al. (1990), using the Psychosocial Adjustment to Illness Scale-Self Reporting (PAIS-SR) on non-respiratory chronic disease patients, found psychosocial factors to be predictors of health-care services utilisation. Lewis and Bell (1995), investigating the effect of pulmonary rehabilitation on COPD patients, measured health services use by the number of days spent in hospital the previous year. However, they failed to produce significant results from their small convenience sample of 30 patients divided into two intervention groups. They also encountered numerous limitations with the PAIS-SR finding that the instrument had inherent problems when used in a population of aged adults. This is of primary concern as the majority of COPD patients are elderly and retired.

It is therefore important in chronic illnesses to identify the different problem areas that result from the presence of COPD. Otherwise, a patient with COPD may move into a position of severe lifelong dependency on health-care services (Rowlett and Dudley, 1978). That is, early identification and treatment of poor psychosocial characteristics including: coping ability, anxiety, depression, and even personality traits, may be beneficial in prevention or unnecessary extension of hospitalisation (Rabinowitz and Florian, 1992). Furthermore, assessing patient responses and reactions may help disclose these kinds of over dependent characteristics, and alert the physician to the likelihood of compliance with treatment (Sandhu, 1986).

3.3.4.1 Coping

Agle and Baum (1977) postulated early on that knowledge of methods of adaptation, or mal-adaptation, are useful to better plan appropriate management. Agle and Baum describe coping as a form of emotional defence that often operates without the individual being aware of its existence, some being adaptive but others interfering with optimal adjustment. Consistent with the stress-illness literature, individuals with long-term physical illness are vulnerable to the effects of acute stress, resulting from symptomatic distress and/or an acute exacerbation of the illness (Lazarus, 1985; Leidy, 1990).

The Ways of Coping Questionnaire (WCQ) is a widely used measure for coping (Folkman and Lazarus, 1985). Not primarily based on the quantification of life changes or stress literatures, this questionnaires measures coping responses in hypothetical situations. When testing the questionnaire, Endler et al. (1993) found that items used to create particular subscales for the WCQ tended to change from one factor analysis to another. A more recent study on COPD patients, also found that the long version of the WCQ is biased in differentiating patient outcomes, and that the instrument should be refined before further use with chronically ill populations (Narsavage and Weaver, 1994).

The more recent Coping Inventory for Stressful Situations (CISS) measures three basic coping styles or strategies: task oriented coping, emotion-oriented coping, and avoidance-oriented coping. Emotion-oriented coping has been associated in chronic disease patients with later stages of disease than problem-solving coping, and has been linked to increased health services use, poor adherence to medical advice, medication and self-management (Maes et al., 1996). Unlike some other coping scales, the CISS has a stable factor structure, high internal reliability stable test-retest reliability, and adequate construct and criterion-related validity (Endler and Parker, 1990a).

Jensen (1983) attempted to associate measures of coping with stress with incidence of hospitalisation. However, he was unable to establish significant results using the Rahe's Schedule of Recent Experience questionnaire. Jensen's results may have been non-significant in distinguishing patients for two reasons: firstly the initial sample size (even before assignment to separate intervention groups) was small (60 patients) and involved a heterogeneous sample of chronic airway disease patients (from chronic asthma to chronic bronchitis). Secondly, the instrument was not found to be reliable in measuring stress in very ill patients.

3.3.4.2 Anxiety

Some investigators contend that anxiety is the single strongest predictor of both physical and psychosocial stress levels in COPD patients (Post and Collins, 1981). For example, in studies carried out by Yellowlees (1987) and Pollack et al. (1996), it was found that as many as one third of COPD patients interviewed suffer from anxiety disorders, whereas other investigators report rates as low as 2% (Lacasse et al. 1997a).

Breathlessness itself is an anxiety provoking situation and a variety of studies have indicated that COPD patients suffer from feelings of anxiety (Beck et al., 1988; Dudley et al., 1980). Anxiety also makes the perception of dyspnea seem more acute which may result in the patient avoiding even minimal physical activity (Agle and Baum, 1977). Thus, believed to contribute to increased dyspnea if unchecked, anxiety may lead to the need for medical intervention (Gift, 1996).

In the anxiety literature there has been a distinction between state and trait anxiety (Spielberger, 1972). State anxiety is defined as a momentary emotional response including unpleasant feelings of tension and apprehension, whereas trait anxiety is conceptualised as the likelihood or predisposition that a person will experience state anxiety in a stressful situation. A widely used and accepted anxiety questionnaire is the State Trait Anxiety Inventory (STAI) (Spielberger, 1983). Although this questionnaire has not be used to investigate health-care services utilisation, it has been extensively used in COPD populations and in studies of intervention projects (Lou, 1991; Bergeron, 1983).

Another anxiety questionnaire, the Endler Multidimensional Anxiety Scale (EMAS) was developed to correct the similarity between the STAI and depression measures (Endler and Parker, 1990b). The EMAS, however, is a new instrument that has not yet been validated on a COPD population.

3.3.4.3 Depression

Depression is also a persistent characteristic in COPD patient populations (Yellowlees, 1987; Lacasse et al., 1997a). It is characterised by pessimism and feelings of hopelessness and worthlessness (Sandhu, 1986). It is known that patients with COPD are at high risk of depression, considered by many to be an adjustment disorder and the consequence of the disease (McSweeny, 1988; Leidy and Traver, 1996).

In the study conducted by Yellowlees (1987) it was found that as many as 16% of COPD patients are diagnosed as suffering from depression. Depression prevalence rates in patients with moderate to severe COPD are approximately 42% and reach rates as high as 76% (Lacasse et al., 1997a). Depression in this case was defined as reactive depression, which according to the DSM III-R is an adjustment disorder of depressive mood (Gift and McCroone, 1993).

The most consistently used and validated depression questionnaire is the Beck Depression Inventory (BDI) (Beck et al., 1988). Although Endler et al. (1992) found that this instrument was correlated with the STAI, Gorenstein et al., (1995) found the correlation was minimised in factor analysis. A more transient psychosocial measure than the other factors, depression has not been investigated in a longitudinal study on health-care services utilisation in COPD. However, the BDI has been extensively used in COPD research (Goupil et al., 1990; Vezina, et al., 1991; Endler et al., 1992; Anderson, 1995).

3.3.4.4 Personality

Personality traits have been identified as the causal factors of psychosocial states such as depression and anxiety, and coping traits (Costa et al., 1996). For example, varieties of personality traits have been linked with depressive symptomatology (Endler et al., 1992). The majority of empirical and theoretical papers concerning psychosocial factors in chronic illness have described adverse personality traits that predispose individuals to or characterise those with specific long-term illnesses (Ringsberg et al., 1993; Ashutosh et al., 1997). Personality trait instruments are therefore useful to identify patients who fall in the less extreme range of psychosocial states, but may still be susceptible to becoming depressed or anxious when faced with the threat of an exacerbation.

Rotter's locus of control theory reflects the extent to which individuals expect desirable outcomes to be contingent upon their own actions or the influence of external factors. Internal locus control expectancies have been significantly associated with favourable adherence to treatment regimens in patients with chronic non-respiratory disease (Poll and De-Nour, 1980; Stanton, 1987). However, other research suggest a lack of consistency between locus of control instruments and health-related behavioural outcomes (Wallston, 1992). A Multidimensional Health Locus of Control Scale has also been tested on a COPD population, however, it too was found unreliable in predicting patient compliance with a rehabilitation program (McDonald, 1984).

Another personality instrument is the Minnesota Multi-dimensional Personality Inventory (MMPI) (Ringsberg et al., 1993; Lewis and Bell, 1995; Ashutosh et al., 1997). Ashutosh et al. found that patients with severe COPD showed a significant difference in MMPI scores between those who later died and those who were still alive at the end of four years, irrespective of the degree of pulmonary impairment function or oxygenation. A linear relationship is also reported between MMPI Panic-fear scores, intensity of pharmacotherapy and length of hospitalisation in patients with different lung diseases (Heller and Dirks, 1978).

A significant limitation of this instrument, however, is that the MMPI may not be well suited for research because of its length. Consisting of 600 items, the MMPI was originally designed as a measure for clinical psychopathology (Wiebe and Christensen, 1996). Further concern with this questionnaire is its strong correlation with psychosocial factors like depression and anxiety (Costa and McCrae, 1985). More importantly, it has only recently been translated into French and has not been tested or administered to a French Canadian population.

An earlier instrument, Costa and McCrae's (1985) NEO Five Factor Personality Inventory (NEO-FFI), has received increased attention in health-related research over the past few years (Eysenck, 1990). Since its creation, the NEO-FFI has been applied to chronic shoulder pain patients (Muten, 1991). The greatest advantage of the NEO-FFI is that it is shorter and can be easily self-administered. Furthermore, measuring more fundamental personality characteristics, the NEO-FFI can be evaluated independently of other psychosocial factors like depression, coping and anxiety (Costa and McCrae, 1985).

Based on research over the last decade, McCrae (1992) and McCrae and John (1992) derived a five-factor model breaking down aspects of personality into five dimensions: Neuroticism, Extroversion, Openness to experience, Agreeableness, and Conscientiousness. In a comparative study of the NEO-FFI and the MMPI, Wiebe and Christensen (1996) states that the five factor model of the NEO-FFI provides a better theoretical structure for the assessment of personality characteristics relevant to chronic disease patients and the interaction between patients and their health situation. Christensen and Smith (1995) reported a significant negative correlation between Neuroticism and medication adherence in a sample of renal dialysis patients. Conscientiousness has also been associated with adherence to treatment regimen (Costa and McCrae, 1985).

3.3.5 Social support

According to Barstow (1974) probably the single most important prognostic factor in adjustment is a supportive significant other in the home. The general hypothesis proposed is that social support for COPD patients can alleviate the burden on health care (Jensen, 1983). It has also been suggested that support people should be included in intervention programs (Murray et al., 1995). Social activities, with implied reciprocity, and altruistic vocational activities, may not only serve as sources of personal satisfaction but also as negotiating tools in the endeavour to maintain independence (Jensen, 1983).

As observed by Lazarus (1985), people who have social support cope better with stressful situations than those who do not have this resource. Graydon and Ross (1995) found that the more social support COPD patients perceived they had, the fewer symptoms they experienced. A social support questionnaire that has been used in COPD populations is the Personal Resource Questionnaire (PRQ) (Brandt and Weinert, 1981; Lee et al., 1991;

Anderson, 1995; Graydon and Ross, 1995). Although this questionnaire has been used in COPD populations, no validated French translation could be found.

The Interpersonal Relationship Inventory (IRI) (Tilden et al., 1990) is among the most promising measures of social support in special populations like chronic disease patients. Developed and tested in a nursing research environment, the questionnaire measures the availability of support resources and the conflict individuals have with their resources. In addition to measuring markers of support resources available to the individual, the IRI measures individuals' satisfaction with the resources and the presence of a confidant. Administered on clinical populations and chronic disease oncology patients, the IRI is a valid instrument for measurement of social support, and shows potential in a chronic disease population such as ours (Tilden, 1985). Due to the very cultural nature of social support questionnaires, the fact that the IRI has been translated for, and tested in, French Canadian populations gives it an advantage over other questionnaires. Furthermore, when the IRI social support scores are compared to the PRQ, the measures show a strong correlation. However, the IRI does not duplicate the PRQ, rather, with its additional scores on conflict, expands on the second questionnaire (Tilden et al., 1990).

Jensen (1983) postulated that some highly stressed patients with few supports might be using emergency room and hospital facilities as a social support mechanism. Jensen found COPD patients with high stress and low social asset scores were more likely to be subsequently hospitalised six months after pulmonary rehabilitation as well as those receiving no rehabilitation. Traver (1988) found that relatives' perceptions of COPD patients' psychosocial symptoms and dissatisfaction with free-time activity helped identify patients who were frequent users of emergency health-care services, independent of disease severity. Stehr et al. (1991) also found that COPD patients more likely to return to the ER are those who have experienced a loss of a first-order relative. Of the COPD patients who say they need assistance for their shortness of breath, Poole et al. (1997) found none of them request extra support from community services when they have an exacerbation. Blake (1991), measured number of hospital days, bed-disability days, restricted-activity days, and physician visits prospectively, and found low social support scores to be associated with higher rates of physician visits in non-pulmonary disease patients.

3.4 Markers of health-care services utilisation

In this era of increased fiscal constraint, where tertiary care facilities account for a substantial portion of the health-care budget, use of hospital wards, intensive care units, and emergency rooms are regarded as precious interventions. In an attempt to incorporate direct and indirect markers of health-care services utilisation, Browne et al. (1990) created a health service utilisation inventory. At interview, 45 chronic disease patients completed the inventory recording events from hospitalisations and ER visits (direct measures of health-care services utilisation) to dollars spent on transportation and number of medications (indirect, economic measures of health-care services utilisation). Based on recall data, patients were asked to remember events up to six months prior to the interview and were not blinded to the study objectives.

Goldstein et al. (1997) in an economic analysis of respiratory intervention (rehabilitation) program also made a distinction between direct 'hotel' costs involving services that required long and short-term institutionalisation of patients (hospital, ER, etc) versus the less expensive outpatient approach including transportation and clinic costs. However, they hypothesise that medical or psychosocial circumstances may preclude regular attendance. It is not always preferable to base measurement of outcome on economic scales, however. Since costs of services vary between health-care systems, the use of actual outcome measures is more appropriate for generalisation of results to other COPD populations.

In one of the few studies evaluating prospective utilisation of health-care services, Osman et al. (1997) attempted to determine whether HRQoL scores could predict hospital re-admission in hospitalised COPD patients. Patients were administered the SGRQ while in hospital and were followed for twelve months during which occurrence of a hospital re-admission was recorded. With a similar outcome measure, hospital re-admission was used to evaluate a disease management intervention program for chronic disease patients (Weinberger et al., 1996). Stehr et al. (1991) found a strong correlation between return visits to the emergency room and psychosocial factors. Most other studies, including those testing intervention programs, used occurrence of hospitalisation as a marker of health-care service utilisation (Jensen, 1983; Connors et al., 1996; Poole et al., 1997). Siu (1993) attempted to predict hospital admission within three months of interview using the SF-20 questionnaire. Others used duration of hospital stay in the previous year (Lewis and Bell, 1995) or over a subsequent two years after rehabilitation (Cox et al., 1993), and following implementation of clinical guidelines (Kong et al., 1997). Of the approaches used to measure health-care services utilisation, the most reliable seem to be those derived from objective sources other than from the patient, i.e. number of ER visits, hospital admissions, etc., which can be collected from medical charts.

4. MOTIVATION FOR STUDY

The problems of individuals with chronic illness are multifaceted, and the attention required by these individuals has become increasingly complex (Canadian Thoracic Society Workshop, 1992). The goals for those with chronic illness have been redefined to include improved HRQoL, maximised self-care, home care management, optimal level of function, and cost-effective care (Lacasse et al., 1996; Vazquez and Buceta, 1993).

In end-stage chronic disease, the actions and advice of health professionals play an essential role in the maintenance of health and the prevention of disease complications. Chronically ill patients must cope with a loss of independence, the threat of disease progression, and in most cases, the challenge of modifying their behaviour to meet the demands of a prescribed treatment regimen (Wiebe and Christensen, 1996). Less adjusted chronically ill patients seem to be concentrating in tertiary care clinics (Atkins et al., 1984). This subgroup of chronically ill individuals may consume a disproportionate amount of health-care resources compared with their psychosocially well-adjusted counterparts (Browne et al., 1990). It is possible social and psychological features alone might distinguish this more poorly adjusted and costly subgroup (Jensen, 1983).

Literature review identifies five areas in which psychosocial intervention may be required. These include compliance, development of new attitudes, positive approach to life changes, modification of interactions with the social environment, and working through losses due to disease (Rabinowitz and Florian, 1992). Jensen (1983) was one of the first to argue that health-care planners may be able to identify and treat high-risk COPD patients effectively and economically if they consider social support and psychosocial factors.

The goal of this study, therefore, was to determine what psychosocial, HRQoL and/or physiological factors are the most important correlates of health service utilisation among COPD patients. Upon answering this, one can then create a predictive index with which to target an appropriate clinical intervention or management program for COPD patients displaying low levels of adjustment based on such indicators.

5. METHODOLOGY

5.1 Study design and rationale

The goal of this study was to first identify and then evaluate correlates of health-care services utilisation in a sample of COPD patients. Exposure assessment was measured at a single point in time during an interview at the MCI. Outcome assessment of health-care services utilisation was collected over time following a cohort approach. Initially, markers of health-care services utilisation were collected retrospectively over a period of one year before the interview. Then when enough time had elapsed after interview for a subset of subjects, outcome markers were also collected prospectively for six months after interview.

5.2 Patient eligibility and recruitment

5.2.1 Eligibility

5.2.1.1 Inclusion criteria

COPD diagnosis (ATS, 1987) entailed an FEV_1 <80% of predicted values (Knudson et al., 1976) and FEV_1/FVC <70% pre-bronchodilation. Patients had to be 40 years or older a smoking history of at least 10 pack-years. Patients should be able to read and write French and English. Patients must also have had to be capable of using their prescribed medication, able to attend their medical visits (not receiving physician visits at home), able to perform lung function tests, six-minute walking tests, complete study questionnaires, and sign a written consent form to participate in the study.

5.2.1.2 Exclusion criteria

Patients could not be currently enrolled in or have participated in a pulmonary rehabilitation program in the year prior to their interview. This was to avoid selecting subjects who may have received different psychosocial and physical training. Patients with unstable medical or surgical conditions that could interfere with their ability to perform the function tests or complete the questionnaires were excluded from the study. Such conditions included uncontrolled congestive heart failure (CHF), unstable coronary heart disease (CHD), arthritis with functional limitation, or active cancer during the previous year. COPD patients also had to be stable with no change in respiratory medication or symptoms taken during the month before interview. Patients who had visited a hospital or clinic for an exacerbation within the previous month were also excluded. Conformity with these criteria was ascertained in a telephone-screening interview. Non-participation in a rehabilitation program during the year preceding interview was also verified with the physiotherapists in charge of COPD subjects at the MCI.

Study population eligibility criteria were chosen to produce, as closely as possible, a study population that would resemble the majority of COPD patients that are followed at a respiratory clinic. Although some of the criteria serve to exclude the most severe subjects, such cases would require more unusual and persistent medical attention characteristic of an end stage disease rather than what is generally carried out for COPD patients.

5.2.2 Patient recruitment

Patient selection and recruitment were carried out from a COPD patient database at the Montreal Chest Institute (MCI) clinical research centre. The study population involved a sample of patients diagnosed with stable COPD based on the ATS criteria (1987). The MCI serves as a tertiary care centre with facilities for overnight hospitalisations, an intensive care unit and emergency unit, as well as a day outpatient clinic including a drop-in service for persons with respiratory diseases. There is also a day hospital ward providing acute care for those patients who are able to sleep at home.

Recruitment into the study was carried out by a combination of methods. Two database reviews were performed. First, I searched a research database created by previous COPD studies carried out at the MCI and at the MCI outpatient clinic. This represented the majority of subjects recruited since most COPD patients admitted to the outpatient clinic have either signed a consent form to be approached for research or have already participated in a study at the MCI. Second, I carried out a database review of the patients registered at the MCI which records hospitalised patients and visits to the emergency department. Patients attending clinic in subsequent weeks but not on either database were also invited to participate at the time of their clinic visit. All potential patients' medical diagnosis information, obtained from medical records at the MCI, was screened for eligibility before establishing contact with the patients. Potential subjects were then selected at random from the patient list created for further screening. Subjects were repeatedly called by telephone until they were reached by the research assistant or until the end of the study recruitment period: July 1997 to March 1998.

Disease stability was confirmed by telephone according to the patients' respiratory symptoms and medication taken in the previous month. Symptoms and medication status were also verified again before starting the interview. Since the purpose of this study was to determine the predictive factors for health-care services utilisation in the general COPD population, which is stable most of the time, patients undergoing exacerbation at the time of the interview, were not examined. Occurrence of an exacerbation was identified by the presence of extreme dyspnea, change in spirometric values (FEV_1% predicted), or a change in respiratory symptoms from time of telephone screening, and had to be confirmed by the physician on call in the outpatient clinic. No such cases occurred during the recruitment. Screening forms for chart review and telephone interviews are provided in Appendix 1.

5.3 Data collection

5.3.1 Interview procedure

Upon arrival for their interview, subjects were provided with documentation describing the study and asked to read and sign a consent form. Consent forms and study protocol were submitted to and approved by the MCI ethics committee. The patients were again asked the same questions from the telephone screening about their symptoms and medication to verify disease status and stability. Once stability was confirmed, patients were given five brief self-report questionnaires (2-5 minutes each) to fill in followed by physiological tests.

The five self-report questionnaires given were used to evaluate the patients' psychosocial states and traits. After measuring lung function at rest, the subject performed the first of three walking tests. The research assistant then administered the two HRQoL questionnaires. The order of administration of the SGRQ and CRQ were alternated for each patient. A third questionnaire measuring the patients' symptoms and medical history, the ATS-DLD-78 was also administered. The two other walking tests were interspersed between these questionnaires. The research assistant was trained to administer the lung function and walking tests, and to interview patients with last three questionnaires. Due to copyright laws, the psychosocial and HRQoL questionnaires could not be provided. All subjects were given a unique identifier number and all questionnaire responses and test results were kept anonymous.

5.3.2 Study status

Prospective data collection in still ongoing, and the study database is also currently being used to serve as a population source for other research projects initiated at the MCI. The data analysed in this study represents both the status of the cohort before the study initiation and the most recent update on health-care services utilisation since the interviews. Prospective outcome follow-up was the limiting step of the whole data collection process, and thus, the population used for the prospective evaluation in this study had to be restricted based on time period for the Master's degree.

5.4 Study measures

5.4.1 Sociodemographic characteristics

Demographic information was collected in part with the revised version of the American Thoracic Society's Lung Disease Questionnaire, the ATS-DLD-78 (ATS, 1995a). Originally developed and validated in English, it also exists in French, translated and validated in Quebec (Osterman et al., 1991). The questionnaire is administered by interview and collects information on age, marital status, race, mother tongue, level of schooling, and previous job title.

5.4.2 Respiratory disease history and smoking

At the beginning of the interview, subjects were asked what date they were first diagnosed with COPD and when they were first admitted to the MCI. The year of diagnosis or first admittance for COPD was recorded. Subjects were also asked if they were on long-term oxygen therapy at the time of interview, and whether they used the apparatus during the day, night or both.

In addition to information on demography, the ATS-DLD-78 questionnaire measures disease symptoms and smoking history. The questionnaire contains items on presence and severity of symptoms (breathlessness, wheeze, cough, and phlegm), on complete current and past smoking history (tobacco type, frequency, duration and intensity) and on symptoms of dyspnea. The questions were then used to create clinical diagnosis scores for general dyspnea (Eakin et al., 1993).

5.4.3 Lung function impairment

Lung function was measured using a spirometry test performed according to the revised standards set by the American Thoracic Society (ATS, 1987). Spirometry was done before bronchodilator use and 20-45 minutes after (salbutamol 200μg by inhalation). The best FEV_1 and FVC measures in litres from any of three forced expiratory trials were retained for the purpose of analysis. These were used to calculate their percent of predicted values derived from reference equations based on age, race, gender and height (Knudson et al., 1976).

5.4.4 Physical functioning and dyspnea

Physical functioning was measured by six-minute walking tests (6MWT). These tests are standardised and used to determine the maximum distance covered by the subject over level ground in six minutes (Butland et al., 1982). As there is a known learning effect with walking tests, it is recommended that two practice tests be performed before collecting experimental data (Butland et al., 1982; Menard-Rothe et al., 1997). For this reason, three tests were carried out under supervision of the research assistant and the maximum value was kept.

Dyspnea after exercise was measured using a Visual Analogue Scale (VAS). This measures magnitude of effort required to breathe when performing usual activities of daily living (Mahler et al., 1984; Stoller et al., 1986). Dyspnea was measured after each 6MWT following a similar protocol as described in Carrieri-Kohlman et al. (1996). This method of measuring dyspnea has been validated in several experimental studies and its importance reviewed (Eakin et al., 1993).

5.4.5 Health-related quality of life

Two health-related quality of life questionnaires, specific to COPD patients were used: the CRQ and the SGRQ. The CRQ consists of 20 questions grouped into four domains: dyspnea, fatigue, emotion and mastery or control of symptoms. As recommended by the authors, the research assistant administered the questionnaire to the subject. The first administration form of the CRQ was used to measure the baseline HRQoL status. Versions of the questionnaire have been validated in both English and Dutch (Wijkstra et al., 1994). Validity in French has also recently been carried out in a sister study in Quebec (Bourbeau et al., 1998). The interviewer administered CRQ refers to two weeks preceeding time interviewed. Test-retest reliability statistics for the English version on larger sample populations (>40 subjects), however, are lacking (Wijkstra et al., 1994).

The SGRQ is designed to test the impact of chest disease on daily life and well-being by measuring frequency of respiratory problems in patients' lives. The questionnaire consists of 21 questions grouped into three domains: symptoms (problems caused by specific respiratory conditions), activity (physical activities limited by shortness of breath) and impact (social and psychological effects of the disease). Scores for each domain are calculated as a percent based on weights given for each response. The SGRQ items refer to a few days before for the activity and impact domains, and 12 months before for symptoms (Jones et al., 1992). Given by either interview or self-report the SGRQ has been widely validated on COPD populations (Jones et al., 1992; 1994; Ketelaars et al., 1996; Okubadejo et al., 1996a; 1996b; Osman et al., 1997). For the purpose of standardisation and comparison with the CRQ, the questionnaire was administered by interview. The instrument has also been systematically translated into French and validated on a French-Canadian COPD population (Bourbeau et al., 1998).

5.4.6 Psychosocial measures

5.4.6.1 Coping

The coping questionnaire (CISS), for adults is a self-reported questionnaire consisting of 48 questions. The CISS is used to evaluate types of reactions during various difficult, stressful, or upsetting situations. The questionnaire measures three basic coping styles or strategies: task oriented coping, emotion-oriented coping, and avoidance-oriented coping. Task coping primarily refers to the efforts aimed at solving a problem, and emphasises on the tasks of planning and attempts to solve the problem. Emotion coping describes reactions that are self-oriented, aimed at reducing stress. Reactions, which are not always successful, include emotional responses, self-preoccupation, and fantasising. The third domain, avoidance coping, describes activities and cognitive changes aimed at avoiding the stressful situation. This can occur via *distracting* oneself with other situations or tasks or via *social diversion* as a means of alleviating stress (Endler and Parker, 1990b).

The CISS has a high internal reliability stable test-retest reliability, and adequate construct and criterion-related validity (Endler and Parker, 1993a). A French translation of the CISS has also been validated (Endler and Parker, 1990b).

5.4.6.2 Anxiety

Anxiety was measured with a self-reported questionnaire, the STAI Y-1 and Y-2 forms. The STAI has been developed to distinguish between level of trait anxiety and state anxiety (Spielberger, 1972). The questionnaire consists of 40 questions grouped into 2 domains: 20 questions measuring "how the subject feels right now", and 20 questions where the subject indicates "how they feel in general". Subjects responded to questions using a four-point rating scale (1=not al all to 4=very much so). Trait anxiety refers to relatively stable individual differences in the degree to which subjects are prone to become anxious – to differences between people in their tendency to perceive stressful situations as dangerous or threatening. Individuals then respond to such situations with an effect, usually as an elevation, in their state anxiety. Persons with high trait anxiety exhibit high state anxiety more frequently than low trait anxiety individuals (Spielberger, 1983). Furthermore, high trait anxiety persons are also more likely to respond with greater increases in intensity of state anxiety.

A long established questionnaire, the STAI has been validated for application on COPD populations (Lou, 1991). This questionnaire has also been systematically translated into French and validated on chronic asthmatic patients (Bergeron, 1983).

5.4.6.3 Depression

Depression was measured with the BDI. The most consistently used and validated depression questionnaire (Beck et al., 1988), the BDI is completed by self-report. The questionnaire consists of 21 questions, and is used to evaluate a person's risk of depression. For each item, subjects are asked to respond keeping in mind their feelings during the past week. The instrument has been extensively validated on COPD populations (Endler et al., 1992; Anderson, 1995) as has its French version on COPD patients in Quebec (Goupil et al., 1990; Vezina, et al., 1991).

5.4.6.4 Personality

The personality questionnaire, NEO-FFI, is a self-reported or interviewer administered questionnaire, which includes 60 questions answered on a scale of 1 to 5. The NEO-FFI form S, self-report version of the questionnaire, was used in this study. The NEO-FFI is a comprehensive personality inventory breaking down aspects of personality into five dimensions: Neuroticism, Extraversion, Openness to experience, Agreeableness, and Conscientiousness. Neuroticism describes the general tendency of an individual to experience negative affects such as fear, sadness, embarrassment, anger, guilt, and disgust. Extroversion indicates the tendency for a person to be social, assertive, and active. Openness to experience refers to the presence of elements like an active imagination, aestheticism, sensitivity, intellectual curiosity, attentiveness to inner feelings, and independence of judgement. An individual with a high level of agreeableness is fundamentally altruistic, sympathetic to others and eager to help, whereas a disagreeable person is egocentric, sceptical of others' intentions, and competitive rather than co-operative. Lastly, a conscientiousness person is purposeful, strong-willed, and determined. Since its creation, the NEO-FFI has been applied to chronic shoulder pain patients (Muten, 1991) and has been systematically translated into French (Costa and McCrae, 1985).

5.4.7 Social support

The IRI has been used to evaluate the level and type of social support using a 5-point Likert scale (Tilden, 1985). This 26 item self-report questionnaire measures the availability of support resources and their satisfaction with them. That is, social support is defined as the perceived availability, or enactment of helping behaviours, by members of the social network. Conflict is defined as perceived discord or stress in relationships caused by behaviours of others or the absence of behaviours, such as the withholding of help. The shorter 26-item version of IRI was chosen for this study over the former 39-item inventory. This was done partly in consideration of time constraints for the interview, and because this version does not include the subscale on reciprocity, which is found to be redundant to social support and its validity alone is equivocal (Tilden and Stewart, 1985). In addition to evidence of validity for the support and conflict subscales, the inventory also demonstrates consistent reliability and strong test-retest stability (Tilden et al., 1990). A French version of the IRI is being validated in Quebec.

5.5 Measurement of health-care services utilisation

The retrospective outcomes for all subjects were collected for the preceding year. Subjects' medical charts from the MCI were reviewed, and with their written permission, from all other hospitals they had visited during the previous 12 months. To supplement the chart reviews, day hospital and clinic scheduling databases were reviewed.

In addition, outcomes were similarly collected prospectively for a sub-sample of 70 subjects from the day of their interview until the study cut-off date in June 1998. The prospective data collection period covered at least six months of follow-up for all 70 subjects. All COPD related ER, hospital, emergency 'drop-in' and scheduled outpatient clinic visits were recorded, taking into account number of events admission and discharge dates.

5.6 Statistical analysis

5.6.1 Descriptive statistics

The proportion of subjects belonging to different category levels within each variable was determined for all categorical variables. The mean, median and standard deviation were calculated for continuous variables. All extreme values (greater than 90% variance) were individually checked in order to correct for errors in data entry. Random data entry checks were also carried out during the data entry phase. No cases of misclassification were identified.

Due to the large proportion of subjects who were eligible but refused or could not be reached, I compared subjects from the original cohort who were deemed eligible at first screening but did not participate in the study for certain sociodemographic and respiratory disease history characteristics that were available. Using data collected during the telephone interview I compared the distributions for age, gender, smoking status, FEV_1, FVC at rest, and oral cortico-steroid use in non-participants with subjects interviewed.

5.6.2 Follow-up and definition of outcome

5.6.2.1 Subject Follow-up

Follow-up was carried out in two stages: initial retrospective outcome data collection covering one year before study interview, and a second prospective six-month follow-up period after interview. Retrospective follow-up had the same relative starting point for all subjects, t_0, defined as one year before the time at which the interview took place. Time zero, t_0 was not the same point in calendar time for all subjects.

Prospective follow-up began with the same relative starting point or each subject, t_1, and lasted six months. A subset of the first 70 subjects interviewed was followed-up after their interview and the same outcomes were tabulated. The selection of the first 70 subjects represented the largest sample of study subjects that could be followed-up before preparation for this thesis. The inclusion of a prospective follow-up period served to 1) investigate any postulated cause-and-effect relationships between independent variables and outcome, and 2) to compare results with prospective and retrospective data in order to evaluate the stability of the associations.

5.6.2.2 Presentation for emergency visits

When making distinctions between types of health-care services utilisation, it is important to understand that outcomes that involve hospital admissions or related interventions are not only dependent on the COPD patient's characteristics, but also on the decisions made by the health-care professionals treating them. That is, where emergency visits are prompted by patient symptoms and their perceptions, admission (hospitalisation) also depends on the physician and may be poorly standardised despite putative criteria.

Thus the assumption is that presentations to the ER or at a drop-in respiratory clinic usually occur solely as a result of the COPD subject's response to a threatening respiratory event or situation. Uninfluenced by other factors such as physician decisions and hospital protocol, this variable was therefore the primary outcome of interest in this study. Although other outcome variables (described below) were investigated all were highly correlated with this variable as most visits and admissions to the different health-care services began with a visit to the ER or as a drop-in clinic visit.

5.6.2.3 Relapses to the ER department

For subjects admitted to the ER or for an emergency outpatient clinic visit, I also recorded whether or not they returned to the MCI or any other hospital for an emergency visit within four weeks of the previous visit. Relapse visits that occurred after the duration of follow-up, i.e. after the six-month cut-off date for prospective data collection, were recorded as part of the previous follow-up period. Although a longer relapse time than used by other studies, four week intervals were chosen to increase chances of a relapse event to occur without waiting too long that the relapse would be due to a new and separate respiratory event unrelated the cause of the initial visit.

5.6.2.4 Hospitalisations

Average length of hospitalisation was calculated in this study for those subjects admitted to hospital measured in number of days for overnight hospital admissions and number of hours per day for day hospital visits. However, dependent on few events for all study subjects (Rutten-van Molken et al. 1992), these results were only useful as descriptive measures and were not investigated further.

5.6.2.5 Clinic scheduling behaviour

In addition to recording emergency 'drop-in' visits at the outpatient clinic, data collection also included information on number of scheduled outpatient clinic visits at the MCI and other health clinics. Visits that where either cancelled or missed by subjects were excluded. I created a categorical variable measuring above and below average number of scheduled clinic visits based on a average MCI hospital rate of two scheduled physician visits per six months.

Though number of scheduled visits may reflect patient demand on health-care services they are also influenced by individual physicians, constraints imposed by provincial health-care practice protocols, and by diagnostic criteria attributed to treatment of COPD. This measure is therefore difficult to interpret and was also only evaluated qualitatively.

5.6.2.6 Testing for differential frequencies in outcome events over time

With different periods of follow-up, I was also concerned that rates of outcome occurrence for individual subjects would be different over the whole duration of the study. In an attempt to measure risk effects over time indirectly, I grouped outcome events into three six-month periods: 1) 6 to 12 months before interview, 2) 0-6 months before interview, and 3) 0-6 months following the interview date. Frequencies of outcome events were coded for each six-month period, for each study subject.

In order to test for changes in outcome results in this 'before-and-after' study design, I compared prevalence of occurrence for each outcome variable for each individual using a McNemar's test. This is a non-parametric test for two related dichotomous variables, which tests for changes in responses using the chi-square or binomial distribution. Typically, a significance value less than 0.05 is considered significant (Kleinbaum, 1994).

5.6.3 Evaluation of retrospective data

5.6.3.1 Univariate analysis

Independent comparison of means for continuous variables were performed to identify which independent variables were significantly associated with each of the dichotomous outcomes. Assumptions of normality were verified for all continuous variables from histogram plots as well as mean and median values before comparison tests were performed. Significance was determined by t-tests for equality of means using two-tailed p-values derived from chi-square distributions. For categorical independent variables, Kruskal Wallis chi-squared tests were performed against dichotomous outcome variables. Two-tailed p-values were calculated from student t-tests.

5.6.3.2 Correlation analysis of independent variables with HRQoL

Measurement of association between continuous independent variables was carried out by correlation analysis. Measuring the strength of linear association between variables, strong positive or negative associations between HRQoL dimension scores and continuous psychosocial, physiological, and sociodemographic variables were flagged. Although correlation coefficients do not take into account whether variables are cause or effect measures, they indicate significant associations that may create collinear relationships that can influence variable associations in multivariate regression models.

5.6.3.3 Logistic regression

Logistic regression was used to estimate the effects of each of the independent variables on presentation for an emergency visit. The first step was to estimate the risk effects between each independent variable and the probability of outcome by crude logistic regression analyses (Hosmer and Lemeshow, 1989).

With a dichotomous outcome, the logistic regression model calculates a conditional mean for the outcome variable (given the value of the independent variable) between 0 and 1. The logistic regression formula is often mathematically expressed in terms of the logit transformation:

$$\begin{aligned} g(x) &= \ln[\pi(x)/1-\pi(x)] \\ &= \beta_0+\beta_1 x \end{aligned}$$

Where $\pi(x)$ is the conditional mean probability of the outcome given the exposure x and β is the regression parameter associated with the explanatory variable x. The β_1 for variable x is known as the log odds. This is often expressed as an odds ratio (OR) calculated by the transformation:

$$\psi = e^{\beta_1}$$

The odds ratio approximates how much more likely (or unlikely) the outcome will be present among those with x=1 (exposed) than among those with x=0 (unexposed) (Hosmer and Lemeshow, 1989). In the rare disease situation (or in this case rare use of health-care services), the odds ratio closely relates in magnitude to the relative risk estimated in incidence statistics.

Where higher scores were known to reflect better functioning, such as for lung function impairment (FEV_1%, FVC%), walking test distance, CRQ dimension scores and social support, categories representing subjects with higher scores were used as the reference category to calculate ORs. Confidence intervals (CI) for regression parameters and p-values for Wald statistics were obtained directly from the statistical software. I assessed statistical linear trends for ordinal variables in models that contained the explanatory variable coded in 4, 5 or 6 categories considered as continuous instead of categorical so that one parameter was obtained. The p-values resulting from such models represent p-values for trend.

5.6.3.4 Multivariate model selection

In order to determine more complex relationships between exposure variables and any of the health-care service utilisation outcomes, the stepwise selection method was used to search for combinations of sociodemographic, clinical, physiological, psychosocial, and HRQoL variables that accounted for the greatest variance in the model. Multivariate model selection was based on a baseline model for age and gender.

As suggested by Hosmer and Lemeshow (1989), all variables with a p-value of 0.25 or less in the univariate regression analysis and ones of plausible biological importance were considered for the multivariate models. The use of such a high p-value for selection of potential explanatory variables is based on previous tests which show that the use of more traditional levels of significance often failed to identify variables of known importance (Robins and Greenland, 1986). Multivariate models were therefore built starting with all variables identified in this manner. Variables were then removed or added one at a time based on statistical significance and change in parameter estimates for all other variables still in the model (Hosmer and Lemeshow, 1989). The adequacies of the models were monitored by the Akaike information criteria which adjusts the –2 log likelihood for the number of parameters in the model, penalising when more degrees of freedom are used (Breslow and Day, 1987).

5.6.4 Evaluation of prospective data

5.6.4.1 Univariate analysis

As was done for the retrospective outcome results, univariate analyses were also carried out with relation to relapses to the ER department and overnight hospitalisations occurring during the six months following the interviews.

5.6.4.2 Logistic regression

Giving the longest follow-up period possible within the time constraints of the study, the first 70 subjects interviewed had sufficient data for prospective evaluation. For all 70 subjects the six-month follow-up period corresponded with fall/winter months and overlapped by at least two months. Using the same methods as in the evaluation of the retrospective data, adjusted logistic regression analyses were repeated using presentation for an emergency visit collected prospectively. The multivariate models created for the retrospective data by stepwise selection were also tested for measures association on the prospective data.

5.7 Definition of Independent variables

The coding of each variable was carefully assessed in view of substantive knowledge from prior research and empirical data distribution. Choice of cut-offs values for the categorisation of continuous variables was determined through experimentation with crude logistic regression risk models described below. Similar point estimates and extensive overlap of the 95% confidence intervals (CI) for two categories in series were considered as evidence for combining successive categories.

5.7.1 Linearity assessment

Continuous independent variables were assessed for linearity in their relation with the logistic regression outcome (presentation for an emergency visit), collected both retrospectively and prospectively. This was done by running a logistic regression model with the continuous variables categorised into four or more categories and plotting the midpoints of these categories against the logit or log-odds of the probability of the outcome (Hosmer and Lemeshow, 1989). Linearity was assumed when the resulting graphs of logits, as a function of the median values for each category, showed a linear trend. Quartile, quintile or sextile values from the independent variable distributions for all 90 subjects were used to determine category cut-off points. From these results I also checked for dose response relationships in risk which would indicate ordinal measures. For cases where linearity was satisfied, the independent variable was tested for association in continuous or ordinal form. However, where linearity was not satisfied, two options remained: 1) testing for higher level associations, such as quadratic or cubic trends, or 2) using the independent variable in categorical form with three or more categories to reflect the changes in risk with increasing level.

Due to the relatively small sample size for this study, however, there was little power to use multiple category variables. Therefore, for those continuous variables that did not show very stable linear trends, the extreme values were grouped together to create a binary variable. Although this introduces measurement error, since the distribution of continuous values are now grouped into two exposure categories, this form was preferred as it could provide a stable association while reducing the number of parameter estimates to one. Using median values as the binary variable cut-off point optimises the likelihood of getting equal numbers of subjects in the different categories (Breslow and Day, 1987). Whereas, continuous variables were tested in original form for all analyses, most of the independent variables were also used in dichotomous form in the logistic regression analyses. The chosen coding for the different exposure measures are discussed in the following sections.

5.7.2 Sociodemographic characteristics

Age at interview was collected as a continuous variable in years. Several coding schemes were evaluated and compared to find the best functional form for this *a priori* confounder variable. Preference was made for percentile cut-off values over coding by decade in order to increase the number of subjects in each category.

Ethnicity, or race, was initially coded into five categories that included white, black, oriental, Native American, or other. Due to the relatively small proportion of non-white subjects, it was decided to dichotomise this variable into white and non-white individuals, a coding often encountered in epidemiological studies in elderly north-American populations.

Marital status was measured in four categories: married, single, widowed, separated and divorced. Due to the small numbers of subjects in each, widowed, separated and divorced subjects were grouped together to create a three-category variable.

Several variables that reflect socio-economic status were collected using the modified version of the ATS-DLD-78 questionnaire: primary job title and education. Level of education attained, was calculated in years of schooling. The continuous variable was also coded into categorical form using the median value (11 years) which corresponded with the end of secondary school in most areas.

Using the ATS-DLD-79 coding scheme for job title as a template, an abbreviated version was created for this study. Subjects were grouped into five categories: 1) engineers, physicians and other professional or academic positions, 2) office managers, supervisors and those with their own business, 3) technicians, construction workers and other skilled labour workers, 4) clerical staff and service workers such as janitors, and 5) those who never had paid employment. These categories were collected to represent general income level (ATS, 1995a). Since all subjects interviewed were retired, this variable referred to the previous job title held longest.

5.7.3 Respiratory disease history and smoking

It is clear that the clinical presentation of COPD can vary in severity from mild disease without disability to a severely disabled state with chronic respiratory failure. To assess severity of disease, time lived with disease was one of the variables considered. In order to measure the duration of time lived with COPD, subjects were asked when they were first diagnosed with COPD and the resulting duration in years lived with COPD as of the date of interview was calculated for each subject. If date of diagnosis could not be recalled, first admission date to the MCI or any other hospital for COPD was used. Then, in order to determine the time since subjects were diagnosed with COPD, the earlier of these two dates were used.

As pharmacotherapy is usually initiated based on a diagnosis of moderately severe disease, types of medication related to COPD were taken into account. The number of types of respiratory medication being taken at time of interview was collected.

Whether subjects had regularly used oral cortico-steroids for at least three months during the previous year was also recorded. Although, there is controversy on the benefit and suitability of oral cortico-steroids in COPD (Celli, 1996), such medication is usually administered as a last step in treatment and can reflect either severity in disease physiology or presentation of symptoms.

Tobacco smoking was assessed in two different ways: current and lifetime exposure. Current exposure was simply coded into current or ex-smoker. Lifetime exposure to tobacco smoke was calculated in pack-years of smoking. Subjects were asked when they began and stopped smoking, and how many cigarettes, cigars and/or pipefuls they smoked per day. From this information a cumulative smoking history variable, measuring number of pack-years smoked in a lifetime, was created. The formula was based on the transformation of 25 cigarettes = 5 cigars = 6 pipefuls = 1 pack. By this formula one pack-year was equivalent to smoking one pack per day for one year.

5.7.4 Lung function impairment

Clinical markers of disease severity were also measured including FEV_1% predicted (pre- and post-bronchodilation), FVC% predicted, and FEV_1/FVC translated into percent using the Knudson method (Knudson et al., 1976). Response to bronchodilator therapy was calculated as a percentage difference between FEV_1's measured before and after bronchodilation over the pre-bronchodilation FEV_1 litre measure.

5.7.5 Physical functioning and dyspnea

The maximum distance walked in six minutes was used to reflect functional exercise capacity. Since a linear trend was detected, although weak, a binary and three-category version of the variable were used. Dyspnea after exertion was measured on a VAS scale of 0 to 10.

In addition to the dyspnea score measured after each 6 minute walking test, overall dyspnea at rest was calculated on a scale of 1 to 5 based on the Medical Research Council formula from answers to five items in ATS-DLD-78 (ATS, 1987). These items serve to determine the degree of breathlessness experienced while performing various levels of physical activity commonly encountered in every day life. Subjects with scores from 1 to 2 were grouped together representing mild dyspnea, scores of 3 to 4 became moderate dyspnea, and those with a score of 5 were said to have severe dyspnea (Eakin et al., 1993).

5.7.6 Health-related quality of life

Original HRQoL variables were calculated in continuous form using weighted values for each item answer in the questionnaire. Furthermore, different domains were created based on formulas provided by the questionnaire authors representing different aspects of the HRQoL being measured (Jones et al., 1992; Guyatt, 1993). The SGRQ scores, calculated in percent, ranged from 0 to 100%. Scores for the CRQ questionnaire were also calculated as a continuous variable and then transformed onto a scale of 0 to 7. Treating these variables in continuous form for univariate analyses, The most stable associations for regression analyses were with the variables in dichotomous form.

5.7.7 Psychosocial factors

All psychosocial variables were initially calculated as continuous scores for each dimension using formulas provided with the questionnaires. I then investigated the option of creating categorical variables using norms established by earlier research on elderly populations for a few of the psychosocial questionnaires. This was available for the CISS (Endler and Parker, 1990b), STAI (Speilberger, 1983), and the NEO-FFI (Costa and McCrae, 1985). However, when choosing a comparison group to establish categorical cut-off values the choice of reference group must come from a related population of chronic disease patients or a population similar to the study in demographics and setting. If the reference population is not a related to the study sample for the psychosocial factor in question, estimating risk with same categories can result in no association with outcome when one truly exists within the study population. In this case categorical variables based on percentiles (median) from the study population distribution were used.

5.7.8 Social support

Since clinical norm values corresponding to an aged population without mental disorders could not be obtained for the IRI, percentile measures from investigation of all 90 subjects were used to create categorical forms of the social support domains.

5.8 Missing values

As in any questionnaire, survey or interview, some questions were left unanswered by the study subjects. However, such cases were rare since the research assistant verified if subjects had answered all questions after each questionnaire. As defined by the psychosocial questionnaire protocols, any questions with missing values were arbitrarily assigned the middle score on the answer scale. In two cases subjects did not complete all three six-minute walk tests, one because they were out of time, and the other because they were out of breath. For these subjects, six-minute walking test distances and dyspnea scores were derived from two exercise trials. In logistic regression analyses subjects with missing values were simply excluded, however, where possible missing values were replaced with the most conservative variable measure.

6. RESULTS

6.1 Descriptive statistics

6.1.1 Study population

Database review identified 430 patients followed at the MCI with primary diagnosis of COPD. After initial filtering of medical records for eligibility criteria 208 subjects were deemed eligible for a second screening by telephone. All 208 potential subjects were progressively selected and contacted over the 9 months of recruitment (July, 1997 to April, 1998). Twelve subjects concurrently undergoing exacerbations or with interfering medical complications were deemed ineligible after telephone screening. Two subjects could not be reached after repeated tries. During the second screening, 194 subjects were invited to participate in the study and present themselves at the MCI for a second interview. One hundred subjects responded positively to the invitation and were given an interview date set within the subsequent two weeks. Ten subjects later cancelled their interview stating they were either "had unforeseen obligations" or "were too busy to participate". The resulting 90 subjects were interviewed from July 31, 1997 to May 12, 1998. The subject selection procedure and flow chart are illustrated in figure 1.

6.1.2 Population profile comparison with refusal subjects

Table 1 illustrates characteristics of the 104 subjects who refused to participate in the study. For comparison, I obtained measures for certain sociodemographic, lung function and respiratory disease variables from telephone screening forms and hospital charts. Refusal subjects were more likely to be female (48% vs. 28%) and current smokers (36% vs. 22%). Both groups had similar COPD according to the expiratory flow ratio, number of medication, and use of oral cortico-steroids. In addition to there being little absolute difference in exposure measures between subjects participating and not participating in the study, the differences were not significant either at the p-value <0.05 level for McNemar tests.

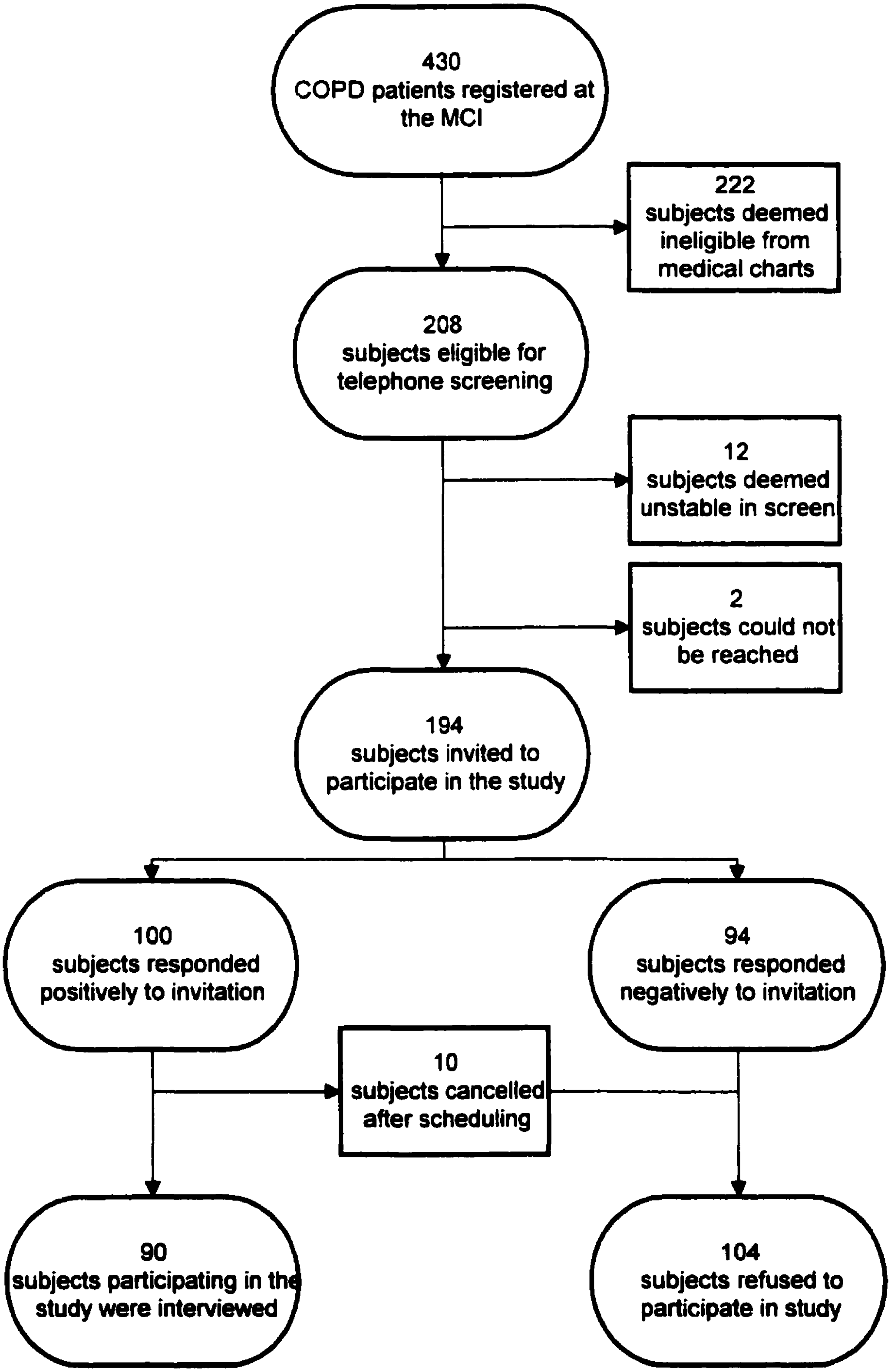

Figure 1: **Flowchart describing the selection of COPD subjects from the Montreal Chest Institute (MCI) registry.**

Table 1. Comparison of means for independent variables for study participants and refusals in the COPD population*

	Interview status			
	Yes (N=90)		No (N=104)	
Independent variable	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
Sociodemographic characteristic				
Age (years)	**68.0**	7.6	**68.5**	10.1
Gender				
Male	**65**	(72%)	**54**	(52%)
Female	**25**	(28%)	**50**	(48%)
Lung function impairment				
FEV_1L pre-bronchodilation	**1.07**	0.43	**1.00**	0.42
FVC L pre-bronchodilation	**2.81**	0.94	**2.01**	0.90
FEV1/FVC pre-bronchodilation (%)	**39.4**	12.8	**51.6**	15.5
Respiratory disease and smoking history				
Number of types of medication (#)	**2.84**	0.91	**2.84**	0.97
Oral cortico-steroids				
No	**77**	(86%)	**86**	(86%)
Yes	**13**	(14%)	**14**	(14%)
Current smoker				
No	**70**	(78%)	**64**	(64%)
Yes	**20**	(22%)	**36**	(36%)

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

6.1.3 Sociodemographic and clinical characteristics

Table 2 illustrates the means and frequencies for sociodemographic characteristics, respiratory disease and smoking history, lung function impairment and physical functioning. Most subjects were male (72%) with a normal age distribution (68 years ±7.6 years) and ranged from 50 to 87. Number of years of schooling was also normally distributed with most subjects attending until the end of secondary school (10.7 years ±3.9). Subjects were mostly white (97%), married (59%), and primarily French speaking (82%). The predominant job titles were for clerical and service positions such as janitors and electricians (33%), followed by skilled labour workers (27%) including chefs, construction workers and seamstresses. Subjects were diagnosed with COPD an average of 6.9 years (±5.8 years) before the interview and 13 (14%) had taken oral cortico-steroids regularly for at least three months during the year before interview.

Lung function was low in the subjects (mean FEV_1 of 37.8%±14.8) with only slight improvement after bronchodilator use (15.5%±13.1). Mean FEV_1/FVC ratio before bronchodilation was 39.4% (±12.8%). Exercise capacity, demonstrated by the maximum distance walked in six minutes (six-minute walking test) was 389.9 metres (±105). This was better compared to other COPD study populations that showed six-walking test distances of 235.1±92.0 metres. Based on the ATS criteria, general dyspnea was measured by a score of one to five, 54% reported a maximum score of five. A score of one indicates almost no limitations in day-to-day life due to shortness of breath, and five indicates being out of breath while walking on level ground, dressing or undressing.

6.1.4 HRQoL and psychosocial measures

Table 3 illustrates the means and standard deviations for the different HRQoL and psychosocial factors measured in the study population. SGRQ HRQoL dimensions scores were highest (worst) for symptoms caused by respiratory conditions (60.0% ±17.8), and for activities that cause or are limited by breathlessness (67.1% ±17.4) indicating poor HRQoL. CRQ HRQoL dimension scores, were lowest for dyspnea (3.3units ±1.0) indicating 'moderate shortness of breath'. Subjects, however, also showed highest dimension scores for mastery (mean of 5.1 units ±1.2) indicating subjects could control their symptoms 'most of the time'.

Task coping was the main coping style displayed by subjects (54.4 ±12.2 on a scale of 16-80), however, compared to a general population of adults this mean was lower (Endler and Parker, 1990b). Mean scores for the other coping domains were within the ranges demonstrated by general adults. As observed in the literature (Endler et al., 1993), avoidance-oriented coping seemed to be made up of two divergent methods, distraction and social diversion.

Trait anxiety was also more predominant than state anxiety (45.2 ±8.6 versus 37.2±10.0). The study population exhibited more trait and state anxiety than seen in a general adult population (Spielberger, 1983). Level of depression was also higher than a population of undergraduate students (Santor et al., 1995) but lower than other populations of COPD patients who show means of 15.0 (Ojanen et al., 1993) and 13.8 (Light et al., 1985).

Of the personality traits, conscientiousness was strongest (34.1 ±7.2 on a scale of 0-48). The least apparent trait was neuroticism (19.3 ±8.7). Mean scores for personality traits were similar to scores for the general adult population (Costa and McCrae, 1985). Availability and use of social support resources (49.3 ±10.0) was obviously higher than the subjects' conflicts with these resources (30.7 ±10.8). Level of conflict was also lower than observed in general adults (Graydon and Ross, 1995). All the distributions were close to normal as indicated by the similar median values.

In some studies, researchers have observed different scores for psychosocial and HRQoL measures between men and women with same instruments used in this study (Spielberger, 1983; Endler and Parker, 1990b; Costa and McCrae, 1985; Graydon and Ross, 1995; Quirk and Jones, 1997; Larson et al., 1998). In order to test whether there were any differences in responses to questionnaires or clinical measures between subjects of different gender, race, language, or medical treatment in the study population, I performed chi square tests grouping by the test variable categories. No significant differences in scores (p-value<0.05) were observed between men/women, white/other, francophone/anglophone subjects, or subjects on/off long-term oxygen therapy at home.

6.1.5 Health-care services utilisation

Markers of health service utilisation for the COPD study population are described in table 4. Referring to the year preceding the interview (retrospective data), these measures describe the background health-care services utilisation behaviour in the 90 COPD subjects. Over the preceding year, a mean of 5.2 (±3.4) physician visits in clinic were scheduled and kept. On average there were more overnight hospitalisations than day hospitalisations (0.6 ±1.1 admissions for overnight versus 0.3 ±0.8 admissions for day hospital). Fifty four (54%) had at least one ER, and although a number of subjects had experienced one or more overnight or day hospitalisation, the majority (69% and 86% respectively) were not hospitalised at all during the previous year.

Table 5 shows markers of health service utilisation for retrospective and prospective periods of follow-up, subdivided into three periods of six-month follow-up. The periods correspond to 1) twelve to six months before interview, 2) up to six months before interview, and 3) six months after interview. The study population for table 5 includes the first 70 subjects interviewed for whom prospective follow-up data was possible. Matching for corresponding periods of follow-up one year apart, twelve to six months before interview (period 1) and up to six months after interview (period 3), levels of health-care services utilisation were comparable. Exceptions did exist for length of hospital stays. In particular, length of day hospital stay was longer in period 3 than in period 1. There was little difference between periods for numbers of admissions to other departments, particularly between periods 1 and 3. Significant differences (p-value<0.05) were observed only for occurrence of overnight hospitalisation when compared with period 2 (up to six months before interview).

Table 2: Sociodemographic and clinical characteristics in the COPD study population (N=90)*

Independent variable	Mean	Std.Dev.	Median
Sociodemographic characteristic			
Age (years)	68.0	7.6	69
Education (years)	10.7	3.9	10
Gender			
Male	65	(72%)	
Race			
White	87	(97%)	
Mother tongue			
French	74	(82%)	
Marital status			
Married	53	(59%)	
Single	9	(10%)	
Widowed	17	(19%)	
Separated	11	(12%)	
Previous job title			
Professional	13	(14%)	
Business manager	15	(17%)	
Skilled labour	24	(27%)	
Clerical service	30	(33%)	
No paid employment	8	(9%)	
Respiratory disease and smoking history			
Time since diagnosis of COPD (years)	6.9	5.8	5.0
Types of respiratory medication (#)	2.8	0.9	3
Long-term oxygen therapy	11	(12%)	
Regular oral cortico-steroid use	13	(14%)	
Smoking history (pack-years)	66.7	44.3	57
Current smoker	20	(22%)	
Lung function impairment			
FEV$_1$ pre-bronchodilation (% predicted)	37.8	14.8	34
FEV$_1$ post-bronchodilation (% predicted)	43.3	16.4	41
FVC pre-bronchodilation (% predicted)	75.0	19.7	71.5
FEV$_1$/FVC pre-bronchodilation (%)	39.4	12.8	37
Response to bronchodilation (%)	15.5	13.1	12.7
Physical function and dyspnea			
6 minute walking test (metres)	389.9	105.0	400
Dyspnea score on exertion (scale 0-10)	5.8	2.2	5.9
ATS dyspnea score			
Mild (1-2)	19	(21%)	
Moderate (3-4)	22	(24%)	
Severe (5)	49	(54%)	

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

Table 3: Health related quality of life (HRQoL) and psychosocial factors in the COPD study population (N=90)

Independent variable	Scale	Mean	Std. Dev.	Median	Population Means*
HRQoL					
St. George Respiratory Questionnaire (SGRQ)					
Symptoms†	(0-100%)	60.0	17.8	62.8	
Activity†	(0-100%)	67.1	17.4	67.1	
Impact†	(0-100%)	36.1	19.2	33.0	
Total†	(0-100%)	49.4	16.1	49.6	
Chronic Respiratory Questionnaire (CRQ)					
Dyspnea	(0-7)	3.3	1.0	3.2	
Fatigue	(0-7)	4.1	1.3	4.3	
Emotion	(0-7)	4.4	1.1	4.6	
Mastery	(0-7)	5.1	1.2	5.1	
Total	(0-7)	4.2	0.9	4.3	
Psychosocial domain					
Coping Inventory for Stressful Situations (CISS)					
Task coping	(16-80)	54.4	12.2	54	58.5-58.6
Emotion coping	(16-80)	42.4	11.7	42.5	39.2-42.6
Avoidance coping	(16-80)	41.7	13.0	40	38.1-44.7
Distraction	(8-40)	19.0	6.8	18.5	17.5-20.5
Social diversion	(5-25)	14.6	5.3	14.5	13.3-16.6
State/Trait Anxiety Inventory (STAI)					
State anxiety†	(20-80)	37.2	10.0	36	32.2-34.5
Trait anxiety†	(20-80)	45.1	8.6	44	31.8-33.9
Beck Depression Index (BDI)					
Depression†	(0-63)	10.9	7.7	9.25	8.1-8.5
NEO Five Factor Inventory (NEO-FFI)					
Neuroticism†	(0-48)	19.3	8.7	18.5	17.0-20.5
Extroversion	(0-48)	25.7	6.3	26	27.2-28.1
Openness	(0-48)	25.5	6.2	25	27.0-27.1
Agreeableness	(0-48)	32.1	4.7	32	31.9-33.8
Conscientiousness	(0-48)	34.1	7.2	34	34.1-35.0
Interpersonal Relationship Inventory (IPR)					
Social support	(13-65)	49.3	10.0	51	50.7
Conflict†	(13-65)	30.7	10.8	28	35.8

* Means taken from general adult population surveys performed by: Endler and Parker, 1990b; Spielberger, 1983; Santor et al., 1995; Costa and McCrae, 1985; Tilden et al., 1990.

† Higher scores depict poor functioning, otherwise higher scores depict good functioning.

Table 4: Outcome variables measuring health-care services utilisation in the COPD study population over the year before interview (N=90)*

Outcome	Mean	Std. Dev.	Median
Continuous variable			
Scheduled clinic visits	5.2	3.4	5
Unscheduled and ER visits	1.2	2.1	1
Hospitalisations			
Day	0.3	0.8	0
Overnight	0.6	1.1	0
Length of day hospital stay (hours/day)†	6.4	2.5	6.3
Length of overnight hospital stay (days)†	8.6	6.5	8.1

Categorical variable	Frequency	(%)
Scheduled clinic visits		
(≤4/year)	45	(50%)
(>4/year)	45	(50%)
Unscheduled and ER visits		
0	41	(46%)
1	21	(23%)
2	13	(14%)
3+	15	(17%)
Visits to day hospital		
0	77	(84%)
1	6	(7%)
2	2	(2%)
3+	5	(6%)
Overnight hospitalisations		
0	62	(69%)
1	11	(12%)
2	11	(12%)
3+	5	(7%)
Relapses to ER‡		
0	35	(71%)
1	8	(16%)
2	4	(8%)
3+	2	(4%)

* Mean ± standard deviation (Std. Dev.) presented unless (%) is indicated.

† Refers to number of admissions: 56 for overnight hospitalisations and 26 for day hospital visits.

‡ Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

Table 5: Outcome variables measuring health-care services utilisation in the COPD study population according to 6 month periods before and after interview (N=70)

	Retrospective data		Prospective data
Outcome	**1st period†**	**2nd period‡**	**3rd period§**
Continuous variable	**Mean ±Std.Dev**	**Mean ±Std.Dev**	**Mean ±Std.Dev**
Length of day hospital stay (hours/day)*	4.6 ±1.8 (N=8)	5.9 ±2.0 (N=14)	7.4 ±1.6 (N=43)
Length of overnight hospital stay (days)*	9.7 ±9.6 (N=27)	12.0 ±7.5 (N=5)	8.5 ±9.4 (N=27)
Categorical variable	**Frequency**	**Frequency**	**Frequency**
Scheduled outpatient clinic visits			
(≤2/6 months)	44	35	45
(>2/6 months)	26	35	25
Emergency visits			
0	41	50	40
≥1	29	20	30
Visits to day hospital			
0	65	63	58
≥1	5	7	12
Overnight hospitalisations			
0	56	65	54
≥1	14	5	16
Relapses to ER¶			
0	22	13	17
≥1	7	7	13

* Refers to number of admissions (N) for overnight and day hospital visits.

† 12 to 6 months before interview. ‡ <6 months before interview. § up to 6 months after interview.

¶ Subjects at risk for relapse either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

6.2 Chi-square comparisons

6.2.1 Chi square analysis of retrospective data

6.2.1.1 Presentation for an emergency visit

Univariate analyses of retrospective data collected for all 90 subjects are illustrated in tables 6a to 6e. Subjects were grouped by presentation to hospital for an emergency visit or not during year before interview.

Subjects with emergency visits were older (68.9 vs. 66.9 years) though the difference was not significant (p-value=0.204) (table 6a). The only sociodemographic variable that was significantly associated with emergency visits, as indicated by p-values less than 0.05, was job title (p-value=0.043). However, the difference in job title was mainly due to a few subjects without any paid employment. After exclusion of this category the level of significance dropped substantially (p-value=0.477).

Considering respiratory disease history (table 6b), subjects who presented themselves for an emergency visits had lived fewer years with their disease (5.9 vs. 8.3 years, p-value=0.053), and were more likely to have used oral cortico-steroids (16% vs. 7%, p-value=0.194). Although differences were small, subjects with emergency visits generally had lower lung function than those without any visits (table 6c). Distance covered in the six-minute walking test, however, was significantly different between outcome groups (419.3m vs. 366.4, p-value=0.017).

Though no significant differences in HRQoL dimension scores were observed (table6d), SGRQ HRQoL scores were generally higher (worse) for admitted subjects and CRQ scores lower. Due to the large standard deviations for the mean calculations, however, most of these differences were too slight to be significant. Differences in scores for the psychosocial variables were small and generally inconsistent (table 6e). Social support was, however, lower for emergency visit subjects (48.2 vs. 50.7, p-value=0.245)

6.2.1.2 Relapses to the ER departments

Tables 6a to 6e also compare subjects for occurrence of relapse visits to an emergency department within four weeks of discharge from previous admission. Among the 49 subjects admitted for an emergency event, 14 subjects relapsed for a COPD exacerbation or complication.

Few sociodemographic or clinical measures were significantly associated with relapse to the ER departments (tables 6a to 6c). Subjects generally smoked more (84.1 vs. 64.1 pack-years, p-value=0.159), had lower lung function (FEV_1 pre-bronchodilation 33.6 vs. 37.4% predicted, p-value=0.365), and 5 to 10% higher (poorer) SGRQ scores. HRQoL variables found to be independent determinants of at least one emergency relapse were (table 6d): SGRQ impact score (p-value=0.008), total score (p-value=0.01), and activity score (p-value=0.066). Furthermore, CRQ dimensions dyspnea (p-value=0.016) and total score (p-value=0.091) were also significantly associated. 'Relapsers' were also more depressed than non-relapsers (13.1 vs. 8.9, p-value=0.056) (table 6e).

6.2.1.3 Admission for overnight hospitalisation

The last comparisons shown in tables 6a-6e are between subjects who were and were not admitted for at least one overnight hospitalisation during the year before interview. Of the 90 subjects interviewed, 28 had been hospitalised for at least one night.

The only sociodemographic variable showing significant differences in means was age (71.0 vs. 66.6 years, p-value=0.01) (table 6a). After exclusion of the no paid employment category, previous job title no longer showed a significant association (p-value=0.340). Of the respiratory disease history variables, long-term oxygen therapy at home was the most significant (p-value=0.013) (table 6b). As observed for the other outcomes in table 6c, hospitalised subjects had consistently lower lung function (table 6c) and were not able to walk as far in six minutes as non-hospitalised subjects (332.5 vs. 415.8, p-value=0.000).

Again HRQoL measures showed the strongest associations (table 6d): activity (p-value=0.01), impact (p-value=0.045), and total (p-value=0.019) scores from the SGRQ. Of the CRQ dimensions, only emotion showed any significance (p-value=0.082). No psychosocial domain scores were significantly associated with overnight admission to hospital (table 6e).

Compared to all subjects presenting themselves for an emergency visit during the same period of time (but not necessarily admitted for overnight hospitalisation), hospitalised subjects were older (71.0 years for hospitalised subjects vs. 68.9 years for all subjects with emergency visits), had lower lung function (FEV_1 pre-bronchodilation 34.2% predicted vs. 36.5% predicted), and walked less distance in six minutes (332.5 metres vs. 366.4 metres). In general, hospitalised subjects had comparable SGRQ and CRQ scores to relapsers which were worse than all subjects with emergency visits, and were more depressed (12.0 vs. 10.7 units). I also ran comparison tests between subjects with emergency visits who were hospitalised and those who weren't. Significant differences were observed in walking test distances (420.4 vs. 323.4 metres, p-value=0.013).

Table 6a. Crude comparison of sociodemographic characteristics between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)*

	Emergency visits					Relapse visits§					Hospitalisation				
	No (N=41)		Yes (N=49)			No (N=35)		Yes (N=14)			No (N=62)		Yes (N=28)		
Sociodemographic variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value†**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**
Age (years)	66.9	7.7	68.9	7.4	0.204	68.8	8.7	69.2	7.2	0.864	66.6	7.6	71.0	6.8	0.010
Education (years)	10.7	3.8	10.6	4.0	0.893	10.7	3.8	10.5	4.1	0.878	10.7	3.7	10.6	4.3	0.335
	N	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Gender															
Male	32	(78%)	33	(67%)		24	(69%)	9	(64%)		44	(71%)	21	(75%)	
Female	9	(22%)	16	(32%)	0.259	11	(31%)	5	(36%)	0.773	18	(29%)	7	(25%)	0.693
Race															
White	40	(98%)	47	(96%)		33	(94%)	14	(100)		60	(97%)	27	(96%)	
Other	1	(2%)	2	(4%)	0.665	2	(6%)	0		0.361	2	(3%)	1	(4%)	0.933
Mother tongue															
French	32	(78%)	39	(80%)		25	(71%)	14	(100)		50	(81%)	21	(75%)	
English	9	(22%)	10	(20%)	0.858	10	(29%)	0		0.025	12	(19%)	7	(25%)	0.544
Marital status															
Married	26	(63%)	27	(55%)		21	(60%)	6	(42%)		36	(58%)	17	(61%)	
Single	4	(10%)	5	(10%)		1	(3%)	4	(29%)		5	(8%)	4	(14%)	
Separated	11	(27%)	17	(35%)	0.701	13	(37%)	4	(29%)	0.027	21	(34%)	7	(25%)	0.533
Previous job title															
Professional	8	(20%)	5	(10%)		4	(11%)	1	(7%)		9	(15%)	4	(14%)	
Business manager	9	(22%)	6	(12%)		6	(17%)	0			13	(21%)	2	(7%)	
Skilled labour	12	(29%)	12	(25%)		9	(26%)	3	(22%)		20	(32%)	4	(14%)	
Clerical service	12	(29%)	18	(37%)		10	(29%)	8	(57%)		20	(32%)	10	(36%)	
No paid employment	0		8	(16%)	0.043	6	(17%)	2	(14%)	0.295	0		8	(29%)	0.000

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

§ Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

Table 6b. Crude comparison of respiratory disease history characteristics between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)*

	Emergency visits					Relapse visits§					Hospitalisation				
	No (N=41)		Yes (N=49)			No (N=35)		Yes (N=14)			No (N=62)		Yes (N=28)		
Respiratory disease history	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value†**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**
Time since diagnosis of COPD (years)	**8.3**	5.6	**5.9**	5.9	0.053	**5.6**	5.28	**7.1**	7.40	0.446	**7.4**	5.5	**6.1**	6.7	0.326
Types of medication (#)	**2.8**	1.1	**2.9**	0.7	0.194	**2.8**	0.76	**3.1**	0.36	0.114	**2.8**	1.0	**2.9**	0.8	0.930
Smoking history	**64.5**	45.4	**68.6**	43.7	0.664	**64.1**	34.1	**84.1**	63.7	0.159	**63.4**	41.6	**74.2**	49.7	0.284
	N	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Long-term oxygen therapy															
No	**38**	(93%)	**41**	(84%)		**29**	(83%)	**12**	(86%)		**58**	(94%)	**21**	(75%)	
Yes	**3**	(7%)	**8**	(16%)	0.194	**6**	(17%)	**2**	(14%)	0.807	**4**	(7%)	**7**	(25%)	0.013
Regular oral cortico-steroids															
No	**37**	(90%)	**40**	(82%)		**30**	(86%)	**10**	(71%)		**55**	(89%)	**22**	(79%)	
Yes	**4**	(10%)	**9**	(18%)	0.247	**5**	(14%)	**4**	(29%)	0.243	**7**	(11%)	**6**	(21%)	0.205
Current smoker															
No	**32**	(78%)	**38**	(78%)		**27**	(77%)	**11**	(79%)		**48**	(77%)	**22**	(79%)	
Yes	**9**	(22%)	**11**	(22%)	0.955	**8**	(23%)	**3**	(21%)	0.914	**14**	(23%)	**6**	(21%)	0.903

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

§ Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

Table 6c. Crude comparison of physiological measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)*

	Emergency visits					Relapse visits§					Hospitalisation				
	No (N=41)		Yes (N=49)			No (N=35)		Yes (N=14)			No (N=62)		Yes (N=28)		
Lung function impairment	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value†**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**
FEV_1 pre-bronchodilation (% predicted)	**38.7**	17.1	**36.5**	12.9	0.485	**37.4**	12.9	**33.6**	12.8	0.365	**38.9**	15.9	**34.2**	11.8	0.167
FEV_1 post-bronchodilation (% predicted)	**43.5**	18.3	**42.0**	14.3	0.672	**42.6**	14.9	**38.4**	12.5	0.358	**44.2**	17.4	**39.4**	12.4	0.191
FVC pre-bronchodilation (% predicted)	**75.2**	16.1	**74.9**	22.5	0.945	**75.7**	22.1	**72.9**	24.1	0.695	**76.7**	19.0	**71.4**	21.1	0.245
FEV_1/FVC pre-bronchodilation (%)	**40.2**	15.1	**38.8**	10.8	0.602	**39.1**	11.4	**36.6**	8.6	0.477	**40.3**	14.1	**37.5**	9.6	0.356
Response to bronchodilation (%)	**13.5**	13.2	**17.1**	13.0	0.194	**15.6**	12.3	**17.3**	13.6	0.675	**14.8**	13.0	**17.2**	13.5	0.424
Physical functioning															
6 minute walking test (m)	**419.3**	104.7	**366.4**	100.1	0.017	**367.0**	94.8	**356.8**	121.2	0.755	**415.8**	97.9	**332.5**	98.6	0.000
Dyspnea on exertion (0-10)	**5.7**	2.0	**5.9**	2.5	0.734	**5.6**	2.7	**6.5**	1.8	0.245	**5.7**	2.2	**6.1**	2.4	0.417
ATS dyspnea score	**N**	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Mild	**8**	(20%)	**11**	(22%)		**10**	(29%)	**1**	(7%)		**15**	(24%)	**4**	(14%)	
Moderate	**8**	(20%)	**14**	(29%)		**10**	(29%)	**4**	(29%)		**15**	(24%)	**7**	(25%)	
Severe	**25**	(62%)	**24**	(49%)	0.489	**15**	(42%)	**9**	(64%)	0.225	**32**	(52%)	**17**	(61%)	0.550

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

§ Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

Table 6d. Crude comparison of health-related quality of life measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)

	Emergency visits					Relapse visits†					Hospitalisation				
	No (N=41)		Yes (N=49)			No (N=35)		Yes (N=14)			No (N=62)		Yes (N=28)		
Health-related quality of life dimension	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value***	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***
St. George Respiratory Questionnaire															
Symptoms (0-100%)‡	**59.8**	20.4	**60.2**	15.6	0.917	**57.1**	16.4	**65.0**	12.1	0.108	**58.4**	18.9	**63.7**	14.7	0.194
Activity (0-100%)‡	**66.1**	19.0	**67.8**	16.1	0.634	**64.4**	16.4	**73.9**	14.0	0.063	**63.9**	17.4	**74.0**	15.5	0.010
Impact (0-100%)‡	**36.0**	20.8	**36.1**	18.1	0.990	**31.4**	15.7	**46.6**	20.6	0.007	**33.4**	19.2	**42.1**	18.3	0.045
Total (0-100%)‡	**49.1**	17.5	**49.7**	15.1	0.855	**45.7**	13.9	**58.1**	15.6	0.010	**46.8**	16.1	**55.3**	14.9	0.019
Chronic Respiratory Questionnaire															
Dyspnea (0-7)	**3.3**	0.9	**3.3**	1.1	0.805	**3.6**	1.0	**2.8**	1.0	0.016	**3.3**	0.9	**3.3**	1.3	0.851
Fatigue (0-7)	**4.0**	1.3	**4.2**	1.3	0.443	**4.4**	1.2	**3.8**	1.4	0.186	**4.2**	1.2	**3.9**	1.5	0.357
Emotion (0-7)	**4.5**	1.1	**4.4**	1.1	0.820	**4.6**	1.1	**4.3**	0.8	0.379	**4.6**	1.1	**4.2**	1.1	0.082
Mastery (0-7)	**5.0**	1.2	**5.2**	1.2	0.387	**5.3**	1.2	**5.1**	1.0	0.628	**5.1**	1.2	**5.1**	1.2	0.848
Total (0-7)	**4.2**	0.9	**4.3**	0.9	0.765	**4.4**	0.9	**4.0**	0.7	0.091	**4.3**	0.8	**4.1**	0.9	0.252

* P-values for chi square t-tests calculated for two-tailed significance.

† Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

‡ Higher scores depict poor functioning, otherwise higher scores depict good functioning.

Table 6e. Crude comparison of psychosocial measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population over the year before interview (N=90)*

	Emergency visits					Relapse visits†					Hospitalisation				
	No (N=41)		Yes (N=49)			No (N=35)		Yes (N=14)			No (N=62)		Yes (N=28)		
Psychosocial domain	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value***	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***
Coping Inventory for Stressful Situations															
Task coping (16-80)	**54.0**	12.6	**54.8**	11.9	0.744	**52.4**	12.5	**60.0**	9.4	0.046	**53.3**	12.1	**56.8**	12.1	0.210
Emotion coping (16-80)	**42.1**	10.5	**42.5**	12.6	0.868	**42.1**	13.3	**42.9**	10.4	0.838	**42.5**	11.8	**42.0**	11.6	0.862
Avoidance coping (16-80)	**44.3**	13.4	**39.8**	12.4	0.101	**38.9**	12.3	**41.6**	11.6	0.475	**43.1**	13.1	**38.8**	12.4	0.139
Distraction (8-40)	**20.5**	7.3	**17.8**	6.1	0.058	**17.2**	6.3	**19.1**	5.0	0.329	**19.7**	7.0	**17.4**	6.1	0.130
Social diversion (5-25)	**15.3**	5.5	**14.1**	5.1	0.288	**13.7**	4.9	**14.7**	5.1	0.528	**15.1**	5.4	**13.5**	4.8	0.173
State/Trait Anxiety Inventory															
State anxiety (20-80)‡	**36.2**	10.5	**38.0**	9.7	0.397	**36.5**	8.7	**39.7**	8.5	0.249	**36.4**	10.7	**38.8**	8.2	0.313
Trait anxiety (20-80)‡	**45.3**	10.1	**45.0**	7.3	0.898	**44.3**	7.4	**46.4**	6.7	0.361	**45.0**	9.1	**45.5**	7.6	0.774
Beck Depression Index															
Depression (0-63)‡	**11.4**	7.7	**10.7**	7.7	0.636	**8.9**	6.6	**13.1**	7.0	0.056	**10.5**	7.6	**12.0**	7.8	0.389
NEO Five Factor Inventory															
Neuroticism (0-48)‡	**19.4**	9.5	**19.3**	8.2	0.938	**18.4**	8.6	**20.6**	6.1	0.400	**19.4**	9.1	**19.3**	7.9	0.966
Extroversion (0-48)	**25.9**	6.3	**25.6**	6.3	0.837	**25.6**	5.8	**25.5**	7.7	0.949	**26.5**	6.3	**24.0**	5.9	0.085
Openness (0-48)	**25.8**	5.8	**25.2**	6.6	0.673	**25.8**	6.2	**25.4**	8.3	0.849	**26.2**	6.0	**24.0**	6.9	0.127
Agreeableness (0-48)	**33.1**	4.7	**31.3**	4.6	0.081	**31.1**	5.0	**31.4**	3.9	0.977	**32.7**	4.5	**30.9**	5.0	0.098
Conscientiousness (0-48)	**35.8**	8.0	**32.8**	6.2	0.050	**31.2**	6.5	**36.3**	5.4	0.012	**34.6**	7.7	**33.0**	5.8	0.306
Interpersonal Relationship Inventory															
Social support (13-65)	**50.7**	9.7	**48.2**	10.2	0.245	**48.9**	9.2	**46.4**	11.9	0.436	**49.8**	9.9	**48.1**	10.2	0.444
Conflict (13-65)‡	**30.9**	11.3	**30.5**	10.5	0.876	**30.5**	10.2	**30.2**	11.6	0.936	**31.2**	11.3	**29.6**	9.8	0.523

* P-values for chi square t-tests calculated for two-tailed significance.

† Subjects at risk for relapse (49) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

‡ Higher scores depict poor functioning, otherwise higher scores depict good functioning.

6.2.2 Comparison of presentation for emergency visits before and after interview

Tables 7a to 7e show comparisons between exposure levels grouped by outcome data collected both retrospectively and prospectively in the subset of 70 COPD subjects. In order to verify the stability of exposure associations with the primary outcome variable over time (presentation for an emergency visit), chi square analyses were carried out on the same subset of subjects followed prospectively, matching for the same six months of follow-up before and after interview (one year apart). Considering the small number of subjects for each exposure times outcome category, statistically significant results were not expected.

The sociodemographic or respiratory disease history variables significantly associated with presentation for an emergency visit after interview (table 7a to 7c) were pre-bronchodilation FVC% predicted (77.0 vs. 67.7% predicted, p-value=0.038). In addition, several HRQoL dimension variables were significantly associated with outcome (table 7d). Of those SGRQ symptom (53.4 vs. 67.2, p-value=0.002) and total dimension (43.9 v. 51.8, p-value=0.044) scores, as well as CRQ dyspnea (3.8 vs. 2.9, p-value=0.000), fatigue (4.6 vs. 3.9, p-value=0.016) and total dimension (4.6 vs. 4.0, p-value=0.006) scores were significantly associated. As observed for retrospective data, psychosocial factors were relatively similar between outcome groups (table 7e).

Tables 7a to 7e show that trends were similar across all exposures for both follow-up periods. Means for the continuous measures age, types of respiratory medication, smoking history, lung function impairment, SGRQ scores, and the psychosocial factors coping, anxiety, and social support scores almost equivalent. In particular SGRQ scores showed consistently similar absolute differences. Furthermore, total SGRQ score did demonstrate borderline significance both for prospective and retrospective follow-up (p-values=0.044 and 0.075 respectively).

Table 7a: Comparison of sociodemographic characteristics related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)*

	Prospective					Retrospective				
	No (N=40)		Yes (N=30)			No (N=41)		Yes (N=29)		
Sociodemographic variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value†**
Age (years)	**66.5**	8.9	**69.2**	7.1	0.153	**67.4**	8.1	**69.0**	7.9	0.432
Education (years)	**10.6**	3.0	**10.9**	4.1	0.778	**10.7**	3.1	**10.8**	4.1	0.912
	N	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Gender										
Male	**30**	(75%)	**20**	(67%)		**30**	(71%)	**20**	(71%)	
Female	**10**	(25%)	**10**	(33%)	0.445	**12**	(29%)	**8**	(29%)	1.000
Race										
White	**37**	(93%)	**30**	(100)		**40**	(95%)	**27**	(96%)	
Other	**3**	(7%)	**0**		0.125	**2**	(5%)	**1**	(4%)	0.810
Mother tongue										
French	**30**	(75%)	**28**	(93%)		**32**	(76%)	**26**	(93%)	
English	**10**	(25%)	**2**	(7%)	0.044	**10**	(24%)	**2**	(7%)	0.070
Marital status										
Married	**27**	(67%)	**14**	(47%)		**26**	(62%)	**15**	(54%)	
Single	**2**	(5%)	**6**	(20%)		**3**	(7%)	**5**	(48%)	
Separated	**11**	(28%)	**10**	(33%)	0.089	**13**	(31%)	**8**	(28%)	0.383
Previous job title										
Professional	**7**	(17%)	**4**	(13%)		**7**	(17%)	**4**	(14%)	
Business manager	**8**	(20%)	**4**	(13%)		**10**	(24%)	**2**	(7%)	
Skilled labour	**11**	(28%)	**9**	(30%)		**12**	(28%)	**8**	(29%)	
Clerical service	**14**	(35%)	**12**	(40%)		**13**	(31%)	**13**	(46%)	
No paid employment	**0**		**1**	(4%)	0.714	**0**		**1**	(4%)	0.252

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

Table 7b: Comparison of respiratory disease history characteristics related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)*

	Prospective					Retrospective				
	No (N=40)		Yes (N=30)			No (N=41)		Yes (N=29)		
Respiratory disease history	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**
Years since diagnosis of COPD	**8.3**	5.8	**7.7**	6.1	0.693	**8.1**	5.6	**8.0**	6.4	0.915
Types of medication (#)	**2.8**	1.0	**3.0**	0.7	0.234	**2.8**	1.0	**3.0**	0.7	0.386
Smoking history (pack-year)	**60.4**	38.3	**66.7**	35.3	0.482	**60.8**	38.6	**66.7**	34.7	0.523
	N	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Long-term oxygen therapy										
No	**37**	(92%)	**28**	(93%)		**39**	(93%)	**26**	(93%)	
Yes	**3**	(8%)	**2**	(7%)	0.893	**3**	(7%)	**2**	(7%)	1.000
Regular oral cortico-steroids										
No	**35**	(87%)	**23**	(77%)		**37**	(88%)	**21**	(75%)	
Yes	**5**	(13%)	**7**	(23%)	0.234	**5**	(12%)	**7**	(25%)	0.154
Current smoker										
No	**30**	(75%)	**25**	(83%)		**31**	(74%)	**24**	(86%)	
Yes	**10**	(25%)	**5**	(17%)	0.400	**11**	(26%)	**4**	(14%)	0.234

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

Table 7c: Comparison of pathophysiological measures related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)*

	Prospective					Retrospective				
	No (N=40)		Yes (N=30)			No (N=41)		Yes (N=29)		
Lung function impairment	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value†**
FEV$_1$ pre-bronchodilation (% predicted)	**39.5**	17.0	**33.8**	13.4	0.138	**38.5**	16.9	**34.9**	13.7	0.358
FEV$_1$ post-bronchodilation (% predicted)	**44.7**	18.4	**38.9**	14.7	0.167	**43.3**	17.9	**40.5**	15.8	0.495
FVC pre-bronchodilation (% predicted)	**77.0**	18.2	**67.7**	18.2	0.038	**75.4**	16.5	**69.4**	21.3	0.194
FEV$_1$/FVC pre-bronchodilation (%)	**39.7**	13.9	**40.1**	12.8	0.911	**40.1**	14.8	**39.5**	11.0	0.848
Response to bronchodilation (%)	**15.2**	13.5	**16.1**	13.7	0.786	**14.0**	13.5	**17.9**	13.3	0.244
Physical functioning										
6 minute walking test (m)	**404.9**	102.4	**396.0**	107.4	0.726	**419.0**	102.0	**374.1**	102.6	0.076
Dyspnea on exertion (0-10)	**5.9**	2.2	**6.1**	1.8	0.693	**5.7**	2.2	**6.4**	1.8	0.175
ATS dyspnea score	**N**	**(%)**	**N**	**(%)**	**P-value‡**	**N**	**(%)**	**N**	**(%)**	**P-value‡**
Mild	**10**	(25%)	7	(23%)		**10**	(24%)	7	(25%)	
Moderate	**9**	(23%)	**9**	(30%)		**10**	(24%)	**8**	(29%)	
Severe	**21**	(52%)	**14**	(47%)	0.774	**22**	(52%)	**13**	(46%)	0.871

* Mean ± standard deviation (Std. Dev.) presented unless N (%) is indicated.

† P-values for chi square t-tests calculated for two-tailed significance.

‡ P-values for student t-tests calculated for two-tailed significance.

Table 7d: Comparison of health-related quality of life measures related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)

	Prospective					Retrospective				
	No (N=40)		Yes (N=30)			No (N=41)		Yes (N=29)		
Health-related quality of life dimension	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***
St. George Respiratory Questionnaire										
Symptoms (0-100%)†	**53.4**	20.3	**67.2**	12.8	0.002	**56.8**	20.2	**63.1**	15.7	0.173
Activity (0-100%)†	**62.3**	18.7	**67.8**	15.4	0.196	**62.4**	18.0	**68.1**	16.3	0.176
Impact (0-100%)†	**30.3**	19.1	**37.8**	19.7	0.113	**30.2**	19.8	**38.4**	18.4	0.086
Total (0-100%)†	**43.9**	17.0	**51.8**	14.8	0.044	**44.4**	16.7	**51.6**	15.4	0.075
Chronic Respiratory Questionnaire										
Dyspnea (0-7)	**3.8**	0.9	**2.9**	0.7	0.000	**3.47**	0.8	**3.29**	1.0	0.414
Fatigue (0-7)	**4.6**	1.2	**3.9**	1.0	0.016	**4.26**	1.2	**4.32**	1.1	0.819
Emotion (0-7)	**4.7**	1.1	**4.4**	1.0	0.150	**4.61**	1.1	**4.51**	1.0	0.694
Mastery (0-7)	**5.3**	1.3	**5.0**	1.0	0.188	**5.21**	1.3	**5.12**	1.1	0.746
Total (0-7)	**4.6**	0.9	**4.0**	0.7	0.006	**4.38**	0.9	**4.29**	0.8	0.672

* P-values for chi square t-tests calculated for two-tailed significance.

† Higher scores depict poor functioning, otherwise higher scores depict good functioning.

Table 7e: Comparison of psychosocial factors related to emergency visits in the COPD study population for 6 month prospective and corresponding retrospective periods of data collection (N=70)

	Prospective					**Retrospective**				
	No (N=40)		**Yes (N=30)**			**No (N=41)**		**Yes (N=29)**		
Psychosocial domain	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***
Coping Inventory for Stressful Situations										
Task coping (16-80)	**52.9**	13.3	**55.5**	10.9	0.396	**53.1**	12.9	**55.4**	11.4	0.460
Emotion coping (16-80)	**40.3**	10.6	**41.8**	12.1	0.590	**40.7**	10.9	**41.3**	11.7	0.829
Avoidance coping (16-80)	**43.1**	13.4	**41.7**	13.6	0.670	**43.5**	13.3	**41.1**	13.6	0.472
Distraction (8-40)	**20.0**	6.6	**18.8**	7.5	0.468	**20.1**	7.3	**18.6**	6.6	0.382
Social diversion (5-25)	**14.7**	5.4	**15.2**	5.3	0.690	**15.2**	5.5	**14.4**	5.1	0.542
State/Trait Anxiety Inventory										
State anxiety (20-80)†	**35.4**	9.1	**36.7**	8.8	0.551	**35.8**	9.8	**36.2**	7.7	0.867
Trait anxiety (20-80)†	**44.1**	9.2	**44.6**	7.9	0.794	**44.3**	9.6	**44.3**	7.2	0.978
Beck Depression Index										
Depression (0-63)†	**9.6**	8.0	**10.1**	5.7	0.780	**10.6**	7.4	**8.6**	6.6	0.229
NEO Five Factor Inventory										
Neuroticism (0-48)	**17.9**	9.6	**20.0**	7.0	0.307	**18.4**	9.4	**19.4**	7.4	0.649
Extroversion (0-48)	**25.7**	6.2	**26.9**	6.0	0.423	**26.1**	6.4	**26.3**	5.8	0.881
Openness (0-48)	**25.7**	4.9	**27.6**	6.5	0.164	**26.4**	5.4	**26.8**	6.2	0.739
Agreeableness (0-48)	**32.8**	5.0	**31.4**	4.4	0.218	**33.5**	4.1	**30.3**	4.8	0.004
Conscientiousness (0-48)	**34.6**	7.9	**34.1**	6.6	0.801	**35.4**	7.6	**32.9**	6.8	0.164
Interpersonal Relationship Inventory										
Social support (13-65)	**49.4**	10.5	**48.5**	8.4	0.716	**49.9**	9.5	**47.6**	9.6	0.341
Conflict (13-65)†	**29.1**	10.7	**32.4**	10.7	0.202	**31.2**	10.9	**29.4**	10.5	0.499

* P-values for chi square t-tests calculated for two-tailed significance.

† Higher scores depict poor functioning, otherwise higher scores depict good functioning.

6.2.3 Chi square analysis of other prospective data

Although not shown for all independent variables, chi square analyses for prospective data were also carried out for the same outcomes evaluated retrospectively in tables 6a to 6e. Table 8 presents the most important results observed. Differences in HRQoL dimension scores between subjects grouped by occurrence of relapse visits to the ER or admitted to overnight hospital during the 6 months after the interviews are shown.

6.2.3.1 Relapses to the ER departments

Within the subset of 30 subjects who presented themselves for at least one emergency visit after interview, 12 returned for another emergency visit within four weeks. Although there were no significant comparisons between relapsers and non-relapsers, some important differences were observed. Compared to the general group of subjects with emergency visits, relapsers 5-10% worse SGRQ scores (i.e. total score: 55.4 vs. 47.9, p-value=0.165). CRQ scores also demonstrated important differences. The fatigue dimension score also showed borderline difference between relapsers and non-relapsers (3.5 vs. 4.2, p-value 0.091).

6.2.3.2 Admission for overnight hospitalisation

Also presented in table 8, subjects admitted for hospitalisation during the six months following interview tended to have similar or lower scores for HRQoL variables than those hospitalised before interview. Hospitalised subjects showed significantly poorer SGRQ scores across all dimensions with 10-15% difference between prospective groups (i.e. total score: 57.5 vs. 44.3%, p-value=0.004). Significant differences were likewise seen for CRQ dyspnea, fatigue and total dimension scores (total score: 3.8 vs. 4.5, p-value=0.006). Although not shown in table 8, significant differences were also observed for lung function (FVC: 64.6 vs. 75.5% predicted, p-value=0.040) and six-minute walking test distance (347.5 vs. 416.9 metres, p-value=0.018).

Table 8. Crude comparison of health-related quality of life measures between subjects with/without emergency visits, relapses to the ER department and overnight hospitalisations in the COPD study population, 6 month prospective data collection (N=70)

	Relapse visits†					**Hospitalisation**				
	No (N=17)		**Yes (N=12)**			**No (N=54)**		**Yes (N=16)**		
Health-related quality of life dimension	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**P-value***	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**P-value***
St. George Respiratory Questionnaire										
Symptoms (0-100%)‡	**65.7**	10.1	**70.4**	16.0	0.344	**56.8**	19.3	**67.9**	13.9	0.036
Activity (0-100%)‡	**64.9**	14.9	**70.5**	16.0	0.340	**61.8**	17.8	**74.3**	12.6	0.011
Impact (0-100%)‡	**32.6**	18.1	**41.8**	18.6	0.191	**30.2**	18.7	**44.6**	18.7	0.009
Total (0-100%)‡	**47.9**	13.4	**55.4**	14.9	0.165	**44.3**	16.3	**57.5**	13.0	0.004
Chronic Respiratory Questionnaire										
Dyspnea (0-7)	**3.1**	0.4	**2.8**	0.9	0.257	**3.6**	0.9	**2.8**	0.8	0.001
Fatigue (0-7)	**4.2**	1.0	**3.5**	1.0	0.091	**4.5**	1.2	**3.6**	0.9	0.005
Emotion (0-7)	**4.4**	1.1	**4.3**	0.9	0.949	**4.7**	1.0	**4.2**	1.2	0.132
Mastery (0-7)	**5.0**	1.0	**4.8**	1.2	0.571	**5.3**	1.3	**4.8**	1.1	0.164
Total (0-7)	**4.1**	0.6	**3.9**	0.7	0.304	**4.5**	0.8	**3.8**	0.7	0.006

* P-values for chi square t-tests calculated for two-tailed significance.

† Subjects at risk for relapse (29) either returned or not to the ER department within four weeks of discharge from a previous emergency visit.

‡ Higher scores depict poor functioning, otherwise higher scores depict good functioning.

6.3 Correlation of exposure variables with HRQoL

Tables 9a and 9b show correlation matrices between HRQoL dimensions and other variables. In order to investigate the psychometric properties of HRQoL measures and their relationship with physiological characteristics, Pearson's correlation analyses were carried out between the SGRQ and CRQ dimension scores and the remaining continuous exposure measures collected during the interviews.

Shown in table 9a, the SGRQ activity and impact dimensions were somewhat correlated with physiological measures, strongest of which were with the activity dimension: FEV_1% predicted (-0.5237 p-value<0.001), six-minute walking test distance (-0.5020 p-value<0.001), and ATS dyspnea score (0.6847 p-value<0.001). Trait anxiety, depression and neurotic personality were also correlated at the <0.001 significance level for three of the four SGRQ dimensions. Degree of correlation between these variables and the SGRQ impact dimension was over 50% for depression (0.55283 p-value<0.001) and higher for trait anxiety (0.5603 p-value<0.001).

Table 9b shows correlation measures between exposures and CRQ dimensions. In contrast to the SGRQ dimensions, the most substantial correlation with the CRQ dimensions were psychometric: state anxiety, trait anxiety, depression, and neuroticism. All but one CRQ dimension, dyspnea, were strongly correlated with these psychosocial factors. Correlations ranged from –0.4163 between CRQ fatigue and neuroticism (p-value<0.001) to –0.6977 between CRQ total score and trait anxiety (p-value<0.001). The only physiological measure correlated with the CRQ dimensions was the ATS dyspnea score (-0.5136 p-value<0.001 with total score).

Table 9a: Correlation of sociodemographic, clinical and psychosocial measures with health-related quality of life (SGRQ) in the COPD study population (N=90)

	St. George Respiratory Questionnaire dimensions			
Independent variable	**Symptoms**	**Activity**	**Impact**	**Total**
Sociodemographic characteristic				
Age (years)	-0.1768	-0.0907	-0.0603	-0.0982
Education (years)	-0.0753	-0.0647	-0.1363	-0.1197
Respiratory disease history				
Time since diagnosis (years)	0.1265	0.2497	0.1888	0.2255
Types of medication (#)	0.0609	0.3093*	0.1279	0.1965
Smoking history (pack-years)	0.2943*	0.2786*	0.3891**	0.3906**
Lung function impairment				
FEV_1 pre-bronchodilation	-0.2424	-0.5237**	-0.3024*	-0.4084**
FEV_1 post-bronchodilation	-0.2076	-0.4992**	-0.2483	-0.3599**
FVC_1 pre-bronchodilation	-0.3264*	-0.1864	-0.1756	-0.2309
FEV_1/FVC pre-bronchodilation	0.0132	-0.4913**	-0.2134	-0.2961*
Response to bronchodilation	0.1957	0.1783	0.2219	0.2338
Physical functioning				
6 minute walking test (metres)	-0.1790	-0.5020**	-0.4102**	-0.4546**
Dyspnea on exertion scale	0.1485	0.2883*	0.3509**	0.3451**
ATS dyspnea score	0.2096	0.6847**	0.6023**	0.6415**
Psychosocial domain				
Coping Inventory for Stressful Situations				
Task coping	0.0125	0.0163	0.0078	0.0118
Emotion coping	0.0109	0.1019	0.1802	0.1487
Avoidance coping	-0.1327	0.0044	-0.0769	-0.0730
Distraction coping	-0.1137	0.0905	0.0187	0.0201
Social diversion	-0.1194	-0.0595	-0.1424	-0.1331
State Trait Anxiety Inventory				
State anxiety	0.1770	0.3140*	0.3512**	0.3576**
Trait anxiety	0.2796*	0.4077**	0.5603**	0.5393**
Beck Depression Index				
Depression	0.2284	0.3812**	0.5283**	0.4983**
NEO Five Factor Inventory				
Neuroticism	0.2553	0.3173*	0.4821**	0.4542**
Extroversion	-0.2841*	-0.1633	-0.2358	-0.2527
Openness	-0.0960	-0.1091	-0.0037	-0.0547
Agreeableness	-0.1946	-0.1030	-0.2879*	-0.2525
Conscientiousness	-0.1500	-0.2180	-0.2380	-0.2503
Interpersonal Relationships Inventory				
Social support	-0.0086	-0.0706	-0.0921	-0.0841
Conflict	-0.0950	-0.1481	-0.0742	-0.1125

Two-tailed significance derived by Pearson's analysis: * p-value < 0.01, ** p-value < 0.001.

Table 9b: Correlation of sociodemographic, clinical and psychosocial measures with health-related quality of life (CRQ) in the COPD study population (N=90)

	Chronic Respiratory Questionnaire dimensions				
Independent variable	**Dyspnea**	**Fatigue**	**Emotion**	**Mastery**	**Total**
Sociodemographic characteristic					
Age (years)	0.2503	0.1575	0.0733	-0.0074	0.1502
Education (years)	0.0391	0.0693	0.0112	0.1679	0.0838
Respiratory disease history					
Time since diagnosis (years)	-0.0867	0.0148	-0.0470	-0.1142	-0.073
Types of medication (#)	-0.1214	-0.0257	0.1030	0.1004	0.0299
Smoking history (pack-years)	-0.1894	-0.2754*	-0.2219	-0.2457	-0.3032*
Lung function impairment					
FEV$_1$ pre-bronchodilation	0.3038*	0.1357	0.1061	0.0472	0.1886
FEV$_1$ post-bronchodilation	0.2912*	0.0826	0.0617	-0.0072	0.1344
FVC$_1$ pre-bronchodilation	0.0968	0.1403	0.2072	0.0546	0.1760
FEV$_1$/FVC pre-bronchodilation	0.2556	0.0272	-0.0322	-0.0003	0.0683
Response to bronchodilation	-0.0730	-0.1589	-0.1560	-0.1842	-0.1884
Physical functioning					
6 minute walking test (metres)	0.2752*	0.3323*	0.2299	0.2143	0.3401*
Dyspnea on exertion scale	-0.1281	-0.1095	-0.1196	-0.2896*	-0.2029
ATS dyspnea score	-0.3078*	-0.4475**	-0.3794**	-0.4447**	-0.5136**
Psychosocial domain					
Coping Inventory for Stressful Situations					
Task coping	-0.0858	-0.0702	-0.0011	0.0399	-0.0355
Emotion coping	-0.0174	-0.1893	-0.2910*	-0.2015	-0.2452
Avoidance coping	0.0144	0.0240	0.1255	-0.0364	0.0561
Distraction coping	0.0217	0.0860	0.0802	-0.1000	0.0395
Social diversion	-0.0363	-0.0238	0.0863	0.0157	0.0243
State Trait Anxiety Inventory					
State anxiety	-0.1721	-0.3820**	-0.6091**	-0.5124**	-0.5735**
Trait anxiety	-0.3210*	-0.5189**	-0.6373**	-0.6109**	-0.6977**
Beck Depression Index					
Depression	-0.3185*	-0.6189**	-0.5328**	-0.5734**	-0.6711**
NEO Five Factor Inventory					
Neuroticism	-0.2816*	-0.4163**	-0.5712**	-0.5272**	-0.6032**
Extroversion	0.0423	0.2285	0.1942	0.0943	0.1922
Openness	-0.0439	-0.1003	-0.1447	-0.0494	-0.1199
Agreeableness	0.1257	0.1626	0.2350	0.0770	0.2095
Conscientiousness	0.0426	0.2121	0.2031	0.2324	0.2296
Interpersonal Relationships Inventory					
Social support	-0.0304	-0.0905	0.2558	0.1467	0.1164
Conflict	0.0019	-0.0328	-0.2919*	0.0495	-0.1230

Two-tailed significance derived by Pearson's analysis: * p-value < 0.01, ** p-value < 0.001.

6.4 Logistic regression

6.4.1 Regression analysis of retrospective data

As suggested by Hosmer and Lemeshow (1989), I first ran crude logistic regression models for each of the variables kept in their original continuous forms to test for significance in associations (not illustrated). However, in the crude logistic regression models with exposure variables categorised by quintile and sextile measures, the coefficients of effect were irregular indicating unstable associations between exposure measures with numerous categories or in continuous form, and the outcome. As predicted by the results from the linearity analyses, most continuous variables showed no associations with presentation for emergency visits indicated by the inclusion of the null value (OR=1.0) in all of the variables' 95%CI.

Tables 10a-10e illustrate the odds ratios for different independent variables. Adjusting *a priori* for age and gender, I ran logistic regression models using dichotomous forms of the independent variables based on median values. Even categorised in dichotomous form few variables were significant in the logistic regression evaluations. However, based on the magnitude of their OR, a few variables did show strong effects. These variables were: age over 70 years (OR=2.26, 95%CI 0.95-5.36), time since diagnosis of COPD in years (OR=0.34, 95%CI 0.14-0.81), long-term oxygen therapy (OR=2.44, 0.59-10.16), regular oral cortico-steroid use (OR=2.53, 95%CI 0.68-9.37), and distraction coping (OR=0.40, 95%CI 0.16-0.95). Although not significant, lower lung function and lower physical functioning (indicated by a shorter distance walked in six minutes) were associated with higher risks of presentation for an emergency visit. Categorised by quartiles (<340, 340-399, 400-462, and >462 metres), walking test distance suggested a dose response relationship with risk of outcome – OR decreased from 2.37 to 1.59 to 1.34 with greater distance walked (p-value for trend=0.1845)

Table 10a: Adjusted risks for sociodemographic and respiratory disease history characteristics categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)*

Independent variable	Category	Outcome	OR	95% CI†
Sociodemographic characteristic		**Yes/No**		
Age	<70 years	21/25	**1.0**	(ref)‡
	70+ years	28/26	**2.26**	0.95-5.36
Gender	Male	33/32	**1.0**	(ref)
	Female	16/9	**1.95**	0.73-5.20
Education	1-10 years	25/21	**1.0**	(ref)
	>10 years	23/20	**0.91**	0.39-2.15
Race	White	47/40	**1.0**	(ref)
	Non-white	2/1	**1.40**	0.12-16.18
Mother tongue	French	39/32	**1.0**	(ref)
	English	10/9	**0.82**	0.29-2.34
Marital status	Married	27/26	**1.0**	(ref)
	Single	5/4	**1.04**	0.24-4.58
	Separated	17/11	**0.98**	0.32-2.98
Previous job title	Clerical	18/12	**1.0**	(ref)
	Labour	12/12	**0.75**	0.24-2.35
	Manager	6/9	**0.47**	0.13-1.76
	Professional	5/8	**0.41**	0.97-1.74
Respiratory disease history				
Time since diagnosis of COPD (years)	1-5 years	32/16	**1.0**	(ref)
	>5 years	17/25	**0.34**	0.14-0.81
Types of medication	(# of types)	49/41	**1.13**	0.71-1.82
Long-term oxygen	No	41/38	**1.0**	(ref)
	Yes	8/3	**2.44**	0.59-10.16
Regular oral cortico-steroids	No	40/37	**1.0**	(ref)
	Yes	9/4	**2.53**	0.68-9.37
Tobacco smoking (pack-years)	20-57	25/22	**1.0**	(ref)
	>57	24/19	**1.15**	0.49-2.72
Current smoker	No	38/32	**1.0**	(ref)
	Yes	11/9	**1.23**	0.41-3.69

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 10b: Adjusted odds ratios for physiological measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)*

Independent variable	Category	Outcome	OR	95% CI†
Lung function impairment		Yes/No		
FEV$_1$% predicted	33.5+%	24/21	**1.0**	(ref)‡
pre-bronchodilation	<33.5%	25/19	**1.28**	0.54-3.07
FEV$_1$% predicted	42+%	22/19	**1.0**	(ref)
post-bronchodilation	<42%	27/21	**1.45**	0.59-3.57
FVC% predicted	76+%	25/20	**1.0**	(ref)
pre-bronchodilation	<76%	24/21	**1.06**	0.45-2.52
FEV$_1$/FVC%	71.5+%	26/19	**1.0**	(ref)
pre-bronchodilation	<71.5%	24/21	**1.09**	0.45-2.62
Response to bronchodilation	<16%	23/22	**1.0**	(ref)
	16+%	26/18	**1.47**	0.60-3.60
Physical functioning				
6 minute walking test	>400	19/23	**1.0**	(ref)
distance	0-400	30/18	**1.64**	0.68-3.96
Dyspnea on exertion	0-6.0	23/23	**1.0**	(ref)
	6.0-10	27/17	**1.51**	0.64-3.57
ATS dyspnea	Mild	11/8	**1.0**	(ref)
score	Moderate	14/8	**1.34**	0.37-4.89
	Severe	24/25	**0.66**	0.22-1.99

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 10c: Adjusted odds ratios for health-related quality of life measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection (N=90)*

Independent variable	Category	Outcome	OR	95% CI†
Health-related quality of life dimension		**Yes/No**		
St. George Respiratory Questionnaire				
Symptoms	<63%	24/22	**1.0**	(ref)‡
	63+%	26/18	**1.21**	0.50-2.89
Activity	<68%	25/22	**1.0**	(ref)
	68+%	25/18	**1.14**	0.48-2.67
Impact	<34%	28/20	**1.0**	(ref)
	34+%	22/20	**0.84**	0.36-1.97
Total	<50%	28/21	**1.0**	(ref)
	50+%	22/19	**0.75**	0.32-1.76
Chronic Respiratory Questionnaire				
Dyspnea	3.3+	24/15	**1.0**	(ref)
	<3.3	26/25	**0.62**	0.26-1.48
Fatigue	4.4+	23/19	**1.0**	(ref)
	<4.4	27/21	**0.95**	0.40-2.23
Emotion	4.7+	26/21	**1.0**	(ref)
	<4.7	24/19	**0.75**	0.31-1.81
Mastery	5.2+	26/19	**1.0**	(ref)
	<5.2	24/21	**0.85**	0.36-2.00
Total	4.4+	24/20	**1.0**	(ref)
	<4.4	26/20	**0.82**	0.34-1.97

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 10d: Adjusted odds ratios for psychosocial measures categorised by presentation for emergency visit in the COPD study population, 1 year retrospective data collection(N=90)*

Independent variable	Category	Outcome	OR	95% CI†
Psychosocial domain		Yes/No		
Coping Inventory for Stressful Situations				
Task coping	<55	24/22	**1.0**	(ref)‡
	55+	26/18	**1.13**	0.48-2.66
Emotion coping	<43	25/22	**1.0**	(ref)
	43+	25/18	**1.62**	0.67-3.95
Avoidance coping	<41	30/18	**1.0**	(ref)
	41+	20/22	**0.50**	0.21-1.20
Distraction coping	<18.5	31/17	**1.0**	(ref)
	18.5+	18/24	**0.40**	0.16-0.95
Social diversion	<14.5	34/22	**1.0**	(ref)
	14.5+	15/19	**0.51**	0.21-1.26
State/Trait Anxiety Inventory				
State anxiety	<37	23/22	**1.0**	(ref)
	37+	27/18	**1.15**	0.49-2.71
Trait anxiety	<45	27/19	**1.0**	(ref)
	45+	23/21	**0.69**	0.29-1.64
Beck Depression Index				
Depression	<9.26	25/20	**1.0**	(ref)
	9.26+	25/20	**0.90**	0.38-2.11
Psychosocial domain				
NEO Five Factor Personality Inventory				
Neuroticism	<19	29/20	**1.0**	(ref)
	19+	21/20	**0.66**	0.27-1.57
Extroversion	<27	29/22	**1.0**	(ref)
	27+	21/18	**0.83**	0.35-1.97
Openness	<26	29/18	**1.0**	(ref)
	26+	21/22	**0.70**	0.29-1.65
Agreeableness	<33	30/17	**1.0**	(ref)
	33+	20/23	**0.42**	0.17-1.00
Conscientiousness	<35	31/16	**1.0**	(ref)
	35+	19/24	**0.48**	0.20-1.13
Interpersonal Relationships Inventory				
Social support	52+	18/19	**1.0**	(ref)
	<52	32/21	**1.61**	0.64-4.03
Conflict	<29	29/20	**1.0**	(ref)
	29+	21/20	**0.64**	0.27-1.52

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

6.4.2 Regression analyses of prospective data

Tables 11a-11e show crude logistic regression model results for the same variables against outcome data collected prospectively for the six months of follow-up after interview, and retrospectively for the same six months one year before. Seventy subjects were included in the analyses. Outcome was coded in the same way, grouping by presentation to an emergency department or not during the six-month periods.

The independent variables that were strongly associated with emergency visits after interview were: regular use of oral cortico-steroids (OR=2.04, 95%CI 0.56-7.43), and heavy tobacco smoking >70 pack-years (OR=2.34, 95%CI 0.86-6.33). HRQoL scores were also strong indicators of risk, for example, SGRQ symptoms score (OR=1.84, 95%CI 0.67-5.01). Also striking were the strong associations between lower CRQ scores and outcome: CRQ dyspnea score (OR=3.99, 95%CI 1.40-11.40), fatigue score (OR=4.16, 95%CI 1.47-11.78), and total score (OR=3.79, 95%CI 1.28-11.26).

Although not shown, associations between independent variables and emergency visits occurring a year earlier (12 to 6 months before interview) were similar to risk estimates obtained for emergency visits occurring in the same calendar months after interview. The strongest associations were observed for the variables: regular use of oral cortico-steroids (OR=2.55, 95%CI 0.71-9.14), and heavy tobacco smoking >70 pack-years (OR=1.69, 95%CI 0.64-4.44). HRQoL SGRQ dimension score risks for retrospective data were in general higher than for prospective data, i.e. for the SGRQ symptoms score the odds ratio was 2.42 (95%CI 0.87-6.74) for emergency visits collected retrospectively.

Table 11a: Adjusted odds ratios for sociodemographic and respiratory disease history characteristics categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)*

Independent variable	Category	Yes/No	OR	95% CI†
Sociodemographic characteristic				
Age	<70 years	18/16	**1.0**	(ref)‡
	70+ years	12/24	**0.46**	0.17-1.22
Gender	Male	20/30	**1.0**	(ref)
	Female	10/10	**1.34**	0.46-3.91
Education	1-10 years	14/22	**1.0**	(ref)
	>10 years	16/18	**1.38**	0.52-3.65
Race	White	30/37	**1.0**	(ref)
	Non-white	0/3	---	----
Mother tongue	French	28/30	**1.0**	(ref)
	English	2/10	**0.24**	0.05-1.22
Marital status	Married	14/27	**1.0**	(ref)
	Single	6/2	**6.68**	1.09-40.82
	Separated	10/11	**2.13**	0.58-7.91
Previous job title	Clerical	12/14	**1.0**	(ref)
	Labour	9/11	**0.92**	0.27-3.18
	Manager	4/8	**0.57**	0.13-2.49
	Professional	4/7	**0.75**	0.16-3.62
Respiratory disease history				
Time since *Dx* of COPD	1-5 years	12/19	**1.0**	(ref)
	>5 years	18/21	**1.32**	0.49-3.52
Medication types	(# of types)	30/40	**1.39**	0.79-2.45
Long-term oxygen therapy	No	28/37	**1.0**	(ref)
	Yes	2/3	**1.04**	0.15-7.07
Regular oral cortico-steroids	No	23/35	**1.0**	(ref)
	Yes	7/5	**2.04**	0.56-7.43
Tobacco smoking (pack-years)	20-57	13/25	**1.0**	(ref)
	>57	17/15	**2.34**	0.86-6.33
Current smoker	No	25/30	**1.0**	(ref)
	Yes	5/10	**0.38**	0.10-1.43

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 11b: Adjusted odds ratios for physiological measures categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)*

Independent variable	Category	Outcome	OR	95% CI†
Lung function impairment		Yes/No		
FEV_1% predicted pre-bronchodilation	33.5+%	13/21	**1.0**	(ref)‡
	<33.5%	17/19	**1.44**	0.54-3.89
FEV_1% predicted post-bronchodilation	42+%	12/18	**1.0**	(ref)
	<42%	18/21	**1.23**	0.44-3.45
FVC% predicted pre-bronchodilation	76+%	11/23	**1.0**	(ref)
	<76%	19/17	**2.27**	0.81-6.32
FEV_1/FVC% pre-bronchodilation	71.5+%	16/21	**1.0**	(ref)
	<71.5%	14/19	**0.98**	0.36-2.66
Response to bronchodilation	<16%	15/21	**1.0**	(ref)
	16+%	15/18	**1.37**	0.51-3.73
Physical functioning				
6 minute walking test distance	>400	15/20	**1.0**	(ref)
	0-400	15/20	**1.14**	0.40-3.25
Dyspnea on exertion	0-6.0	15/21	**1.0**	(ref)
	6.0-10	15/19	**1.03**	0.39-2.73
ATS dyspnea score	Mild	7/10	**1.0**	(ref)
	Moderate	9/9	**1.35**	0.34-5.28
	Severe	14/21	**1.03**	0.30-3.46

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 11c: Adjusted odds ratios for health-related quality of life measures categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)*

Independent variable	**Category**	**Outcome**	**OR**	**95% CI†**
Health-related quality of life dimension		**Yes/No**		
St. George Respiratory Questionnaire				
Symptoms	<63%	13/25	**1.0**	(ref)‡
	63+%	17/15	**1.84**	0.67-5.01
Activity	<68%	17/22	**1.0**	(ref)
	68+%	13/18	**0.86**	0.32-2.30
Impact	<34%	16/24	**1.0**	(ref)
	34+%	14/16	**1.34**	0.50-3.57
Total	<50%	17/26	**1.0**	(ref)
	50+%	13/14	**1.48**	0.54-4.07
Chronic Respiratory Questionnaire				
Dyspnea	3.3+	8/24	**1.0**	(ref)
	<3.3	22/16	**3.99**	1.40-11.40
Fatigue	4.4+	10/27	**1.0**	(ref)
	<4.4	20/13	**4.16**	1.47-11.78
Emotion	4.7+	16/25	**1.0**	(ref)
	<4.7	14/15	**1.50**	0.54-4.17
Mastery	5.2+	13/23	**1.0**	(ref)
	<5.2	17/17	**1.73**	0.64-4.62
Total	4.4+	11/26	**1.0**	(ref)
	<4.4	19/14	**3.79**	1.28-11.26

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

Table 11d: Adjusted odds ratios for psychosocial factors categorised by presentation for emergency visit in the COPD study population, 6 month prospective data collection (N=70)*

Independent variable	Category	Outcome	OR	95% CI†
Psychosocial domain		Yes/No		
Coping Inventory for Stressful Situations				
Task coping	<55	13/22	**1.0**	(ref)‡
	55+	17/18	**1.72**	0.64-4.60
Emotion coping	<43	16/24	**1.0**	(ref)
	43+	14/16	**1.06**	0.39-2.90
Avoidance coping	<41	14/22	**1.0**	(ref)
	41+	16/18	**1.30**	0.49-3.44
Distraction	<19	17/19	**1.0**	(ref)
	19+	13/21	**0.74**	0.28-1.96
Social diversion	<15	17/25	**1.0**	(ref)
	15+	13/15	**1.06**	0.39-2.91
State/Trait Anxiety Inventory				
State anxiety	<37	15/22	**1.0**	(ref)
	37+	15/18	**1.35**	0.51-3.61
Trait anxiety	<45	16/23	**1.0**	(ref)
	45+	14/17	**1.10**	0.41-2.95
Beck Depression Index				
Depression	<9.26	15/25	**1.0**	(ref)
	9.26+	15/15	**1.75**	0.65-4.68
Psychosocial domain				
NEO Five Factor Personality Inventory				
Neuroticism	<19	16/26	**1.0**	(ref)‡
	19+	14/14	**1.44**	0.53-3.91
Extroversion	<27	14/22	**1.0**	(ref)
	27+	16/18	**1.59**	0.58-4.37
Openness	<26	11/21	**1.0**	(ref)
	26+	19/19	**1.97**	0.72-5.35
Agreeableness	<33	18/18	**1.0**	(ref)
	33+	12/22	**0.49**	0.18-1.32
Conscientiousness	<35	16/19	**1.0**	(ref)
	35+	14/21	**0.77**	0.29-2.06
Interpersonal Relationships Inventory				
Social support	52+	10/17	**1.0**	(ref)
	<52	20/23	**2.39**	0.77-7.39
Conflict	<29	12/26	**1.0**	(ref)
	29+	18/14	**2.54**	0.93-6.95

* Adjusted for age and gender.

† 95% confidence intervals (CI) around odds ratio (OR) estimates.

‡ Reference category for individual variables.

6.5 Multivariate model selection for presentation for emergency visits

Although automated model selection procedures did not produce a multivariate model because of the weak independent associations of each variable in the models, through manual inclusion and exclusion of variables it was possible to create a model based on changes in log likelihood ratios. Table 12 shows the resulting model derived by this selection process. Though differences in log likelihood ratios between simpler and more complex models were not significant, the final model choice was based both on model p-values and odds ratios. The model predicted 72.2% of the variance in the observed data with a model p-value of 0.0136 based on the –2log likelihood score. However, when the independent variable SGRQ total score was added, the new model showed similar power and significance: 71.1% for the model with SGRQ total dimension (p-value0.0153). Further incorporating other psychosocial factors into the HRQoL model only decreased power and significance.

When tested against prospective outcome data for the subset of 70 subjects, the baseline model predicted 60% of the observed data although the overall model was not significant. Inclusion of either HRQoL questionnaire scores increased the model's power: SGRQ total score (OR=1.23, 95%CI 0.40-3.76) predicted 61.4% of the variance, and the CRQ total score (OR=3.78, 95%CI 1.13-12.70) increased prediction to 65.7%. Time since diagnosis, reflecting duration lived with disease, did not remain significant or show any increased risk association with subsequent presentation for an emergency visit in the multivariate model.

Table 12: Multivariate logistic regression model for presentation for emergency visits in the COPD study population, 1 year retrospective follow-up (N=90)

Independent variable	Category	β*	OR	95%CI†
Age	64-72	0.2270	**1.25**	0.42-3.75
	>72	1.5175	**4.56**	1.20-17.29
Gender	Female	0.8173	**2.26**	0.75-6.88
FEV1% pre-bronchodilation	<33.5% predicted	0.3792	**1.46**	0.51-4.18
Time since diagnosis	>5 years	-1.2525	**0.29**	0.11-0.76
6-minute walking test distance	<400 metres	0.1277	**1.14**	0.41-3.14
Oral cortico-steroid use	Yes	0.9746	**2.65**	0.62-11.40
Constant		-0.3193		

* Regression coefficient or log odds of independent variable.

† 95% confidence interval for odds ratio (OR).

7. DISCUSSION

7.1 Population profile

7.1.1 Representativeness of study population

Selection of the study population resulted in a representative sample of the target population (table 1). The means and frequency comparisons for both participating and refusal COPD subjects documents similar age, gender and respiratory disease history characteristics between the two groups. It may then be reasonable to draw conclusions from the study sample of participants that can then be applied to a more general population of stable COPD patients. Comparability of HRQoL and psychosocial factors, however, is more limited as it is difficult to know how my sample relates to target populations in these areas. Comparisons with populations of general adults were carried out and indicate strong similarities however.

7.1.2 Health-care services utilisation

Most subjects in this study had relatively low levels of use of health-care services compared to groups of COPD patients studied by Dunham et al. (1984) who reported an average of 17.41 days spent in hospital over a one year period. Unfortunately, frequencies of health-care service use events in the current study population were lower than initially expected (table 4) contrary to hospitalisation and clinic visit rates observed by the Browne et al. (1990). Lewis and Bell (1995), who observed similar hospitalisation rates to this study, suggest this may be due to a trend over the past eight years showing a decrease in number of hospitalised days per admission.

Since hospital stays varied across follow-up period and reflect a small number of events (table 5), duration of hospital stays was not considered to be a reliable marker of health-care service utilisation in the study population (Celli, 1996). Goldstein et al. (1997), in an evaluation of 84 COPD patients, also found hospitalisations for respiratory exacerbation were not sufficiently long enough to investigate the influence of rehabilitation on the rate or duration of subsequent hospitalisation.

Frequencies of visits across the different data collection periods, however, were similar. Furthermore, the majority of the visits before and after the interviews were by the same subjects. This was important because it supported the assumption of constant rate of outcome over time necessary for prospective and retrospective regression analyses, and because it indicated that the bulk of health-care service utilisation is limited to a small but consistent group of patients. The finding that a small group of subjects consume a majority of the resources is consistent with the literature (Dunham et al. 1984; Browne et al., 1990).

7.2 Psychosocial factors

Evidence of psychosocial disorders was not present in the study population though all subjects were patients with a chronic disease (table 3). Most of the psychosocial factors measured in the study population were similar to measures found in general adult populations.

Average state anxiety, indicating current or recent anxiety, was somewhat lower than trait anxiety. This was expected since the questionnaire was administered during a structured interview while the subjects were in stable condition. This difference may also reflect both the individual differences in frequency and intensity with which anxiety states have been manifested in the past, and the probability state anxiety would be experienced in the future (Spielberger, 1972). Though anxiety levels were higher than observed in general adults, they were lower compared to other COPD populations (Light et al., 1985).

Prevalence of depression in the subjects interviewed was also lower than observed in other COPD populations (Light et al., 1985). This measure may reflect either the concurrent non-threatening health status of the individual or situation existing at the time of the interview, or a general characteristic of these subjects who have existed with their disease for a number of years (Spielberger, 1972; Anderson, 1995). It would therefore seem that the presence of disease is a constant source of worry for COPD subjects though many may have learned to deal with it in different ways.

7.2.1 Psychosocial factor associations

7.2.1.1 Based on chi square analyses

Differences in means between subjects with and without the respective health-care service markers were small and inconsistent for the psychosocial factors investigated in this study (table 6e). Comparisons using the prospective data set did not show any stronger relationships with short-term occurrence of emergency visits (table 7e) or with any of the other outcomes also investigated retrospectively.

7.2.1.2 Based on age and gender adjusted regression analyses

When evaluated by logistic regression, few psychosocial variables depict strong associations (table 10d). In fact, some of the variables thought to be risk factors of health-care service utilisation such as anxiety and depression (Jensen, 1983; Anderson, 1995) showed protective associations with outcome although the estimates were generally inconstant and statistically non-significant. The exception, when evaluated against emergency visits after interview, were social support and conflict (table 11d).

Though a relationship between anxiety and health-care services use was expected with the high levels of anxiety observed in the study subjects, the associations were not substantiated. First suspicion was that the observation was a result of effect modification with time lived with COPD. That is, at the beginning of their disease progress, subjects may perceive an exacerbation as a physical danger and panic, while others, who are familiar with false alarms may respond with caution. Controlling for time lived with COPD in the regression model, however, did not create a relationship. These results seem consistent with other studies who have found that persons with high trait anxiety do not always respond differently to physical dangers or imminent surgery from persons with low trait anxiety (Auerbach, 1973; Martinez-Urrutia, 1975).

Coping ability may involve two extremes, which would explain the absence of association. Subjects with high coping scores may try alternate methods or sources to control their symptoms before visiting the health-care services (Dudley, 1981; Maes et al., 1996). On the other hand, poorly coping patients, who can be identified by the presence of high levels of agitation, depression, and irritability (Rowlett and Dudley, 1978), have been described to frequently refuse to follow prescribed treatment regimes, and alienate their families and the treatment staff (Post and Collins, 1981). Such patients take a largely passive approach to their treatment, becoming resentful of the hospital personnel who are held responsible for their perceived lack of improvement. Future research may benefit from the inclusion of measures of passivity and dependency rather than personality scores.

7.2.2 Limitations of psychosocial factors

The low levels of depression observed in the study subjects may reflect a selection bias where participating subjects were less depressed than non-participants. It was not possible to determine the extent of this from the telephone screening forms. Compared to other COPD populations, the subjects interviewed in this study had lower anxiety and depression. A more homogeneous population may have been selected and therefore the evaluation showed no association due to selection bias. If a larger prospective study is designed, non-participants should also be screened with some of the psychosocial questionnaires.

Coping ability and personality traits were also widely distributed over the 90 subjects interviewed (table 6e). These distributions indicate variability in the scores for the psychosocial factors. However, it is difficult to compare the extent of the variability to other populations. Furthermore it is unlikely that, with the sample size in this study, the degree in variability would allow for powerful calculations.

The lack of association in the regression models may be a consequence of the arbitrary cut-off values used to create the psychosocial domain variables. In some cases authors suggest using a 'normal adult profile' to compare to for two reasons: 1) specific diagnoses may be associated with particular profiles which can be seen most clearly when plotted against the normal adult profile, and 2) the use of non-clinical norms can serve as a valuable reminder that individuals in clinical situations are similar in many respects to normal volunteers (Costa and McCrae, 1985). However, after using norms from the general adult populations to create categorical variables, testing for some of the psychosocial factors still did not show any further associations. It therefore seems that different diagnostic scores used to identify neurotic, disagreeable, etc. subjects need to be created for COPD populations. In an attempt to approximate this, the analyses were also repeated using means from clinical populations as cut-off values. Reference populations included general medical and surgery patients for the STAI (Spielberger, 1983) and psychiatric patients for the CISS (Endler and Parker, 1990b). The risk estimates, however, did not change significantly.

7.2.3 Other research on psychosocial factors and health-care services utilisation

Although Wiebe and Christensen (1996) associated personality traits with medical treatment compliance, this seems to reflect a different aspect of health-care service use. Subjects may respond differently when the health-care intervention is imposed. Research evaluating behavioural rehabilitation programs may therefore need to make the distinction between which outcome measures to use, health-care service utilisation, treatment compliance or QoL, by which they should gauge the benefits of intervention (Fix et al., 1978; Atkins et al., 1984; Kaptein, 1997).

Using a simple questionnaire Jensen (1983) found an association between lower social assets and higher probability of subsequent hospitalisation in COPD patients. As assistance from peers at home can vary over time, it is not surprising that this study only found a strong association between social support, and subsequent emergency visits. Although, the scores also reflect the subjects impression of their social support resources, the physical presence of support persons during moments of respiratory exacerbation may be necessary to have an effect health-care service use (Stehr et al., 1991).

7.3 Health-related quality of life

The variances in HRQoL scores were modest (table 3). Comparing results from 12 published and unpublished studies involving 1,808 patients, Jones (1997) found SGRQ symptom scores of around 72, activity scores of 75, and impact scores of 54 for a group of severe chronic hypoxia and hypercapnia patients. In moderately severe COPD patients (mean FEV_1% of 53% predicted), the scores were 62 for symptoms, 55 for activity, and 36 for impact of disease. SGRQ HRQoL level for this study's subjects was therefore between the two other COPD population groups. CRQ scores also demonstrated similar scores to other COPD populations though means were slightly lower (Martin, 1994). Subjects participating in the study by Martin were similar in age to my study population.

7.3.1 Health-related quality of life associations

7.3.1.1 Based on chi square analyses

The SGRQ was shown to be the more discriminative measure of the two HRQoL questionnaires tested, especially for more extreme outcomes such as relapse to the ER or hospitalisation collected retrospectively (table 6d). However, when the instrument measures were tested against the same outcomes collected prospectively (table 7d), both HRQoL questionnaires demonstrated strong associations with emergency visits. Further comparison with other outcomes collected prospectively (table 8) also indicated increasing predictive ability as the outcomes became more severe.

7.3.1.2 Based on age and gender adjusted regression analyses

If the assumptions made for the regression analysis are correct, the risks estimated for events before and after exposure assessment should be similar. HRQoL dimensions were more indicative of expected trends when analysed against prospective outcome (table 11c). The increase in risk of subsequent presentation for emergency visits observed for subjects with poorer symptoms, impact and total dimension scores indicate that the SGRQ may indeed have a promise as a predictive measure of demand on health-care services by COPD patients.

More striking, perhaps, were the significantly high-risk estimates associated with three of the four CRQ dimensions. The lack of consistent associations observed between the CRQ dimensions and health-care service utilisation collected retrospectively may be a reflection of the questionnaire's design. Developed primarily to measure change in HRQoL, associations with health-care use outcomes have been based on changes in CRQ scores over time rather than from one administration (Donner et al., 1997). The CRQ, however, does seem to have a strong predictive ability when projected against outcomes collected after HRQoL assessment. Though this may be true for outcome data occurring over the short-term, when correlated with events over a longer period, such as one year, these associations with the SGRQ or CRQ may not persist.

7.3.2 Correlation between independent variables and HRQoL

The strong correlation between some of the psychosocial variables and HRQoL measures (table 8) brought up an interesting association that may have bearing on the risk relationships between the HRQoL dimensions and presentation for an emergency visit. The fact that both CRQ and SGRQ instrument scores were related to similar psychometric characteristics, anxiety, depression and neuroticism, indicates that the associations observed between the HRQoL dimensions and outcome may be due to their psychometric properties. Furthermore, these correlation may indicate a causal pathway between the psychosocial factors (anxiety, depression and neuroticism), HRQoL and outcome. Such collinearity would explain why HRQoL and psychosocial measures together did not add predictability to the multivariate models.

7.3.3 Limitations of HRQoL

A limitation of the study is that only subjects who were able to perform a walking test were included. This could create a selectively biased sample because very severe cases are excluded who could have much worse HRQoL scores. Therefore, though significant associations were observed in this study sample, the true risks in the general COPD population may in fact be greater than estimated.

7.3.4 Other research on HRQoL and health-care services utilisation

Osman et al. (1997) found that among a group of 266 COPD patients, those with poorer SGRQ subscales were more likely to be readmitted. This occurred even though subjects were under the care of a large number of consultants in both respiratory medicine and other specialities providing. Furthermore, Osman et al. found that the association between SGRQ scores and readmission were independent of physiological measures and disease severity. In contrast to this study, however, Osman et al. found only minor correlations between SGRQ scores, lung function and age.

Traver (1988) also established a retrospective association between severe COPD patients who used acute health-care services and SIP scores. Although differences in scores were significant for this generic HRQoL questionnaire, with over half of the patients on long-term oxygen therapy, the study population was not representative of a general COPD population. It is therefore difficult to compare this study with that of Traver.

Jones et al. (1992) in an evaluation of the SGRQ determined that at least a difference of 4% was needed to indicate a significant clinical difference in total or subscale scores. Differences in scores between subjects in this study with and without outcome were over 13% for some of the SGRQ dimension scores, though statistically significant differences also existed for differences as small as 8%.

Other studies have observed similar correlations between HRQoL measures and psychosocial or physiological factors. In a pulmonary rehabilitation centre, Ketelaars et al., (1996) found significant correlation between FEV$_1$%, 12 minute walking tests, coping strategies and SGRQ dimensions. A correlation has also been found between physical disability measured by walking tests and SGRQ (Eiser et al., 1997; Emery et al., 1991; Jones et al., 1992) and dyspnea (Rafanan et al., 1998).

Studies have also shown that the relationship between respiratory impairment, reflected by pulmonary function and CRQ measures in COPD patients is negligible (Guyatt et al., 1987). The strongest correlates of HRQoL, as observed by Curtis et al., (1994) are dyspnea, anxiety and depression, rather than exercise performance or spirometry. Morgan et al., (1997) found that exercise performance, measured by walking tests has a better correlation with CRQ, but not as strong as dyspnea, anxiety or depression. Social support has likewise been reported as a determining factor of HRQoL (Bartow, 1974; Sexton and Munro, 1988).

The differing psychometric properties of the SGRQ and the CRQ may indicate why the instruments perform differently when projected against health-care services use. For example, the similar associations observed for FEV_1, 6MWT, task coping and the SGRQ symptoms scores - for both prospective and retrospective data. The risk associations observed for the CRQ with prospective data may reflect its stronger psychosocial properties and its ability to measure subsequent change in health status rather than prior health-care services utilisation.

7.4 Sociodemographic characteristics and respiratory disease history

The profile of the study subjects was that expected of an elderly, retired population (table 2). The average age was well into the 60's, with moderate level of education. Though more than half were still married, a significant proportion had lost their spouse through divorce, separation or death (31%).

Time in years since diagnosis of COPD, 6.9 years, was also relatively short compared to other COPD populations studied who show an average time of 13.8 years lived with the disease (Martin, 1994). Although this measure may have been prone to misclassification, the true duration would only have been longer.

7.4.1 Sociodemographic characteristics and respiratory disease history associations

7.4.1.1 Based on age and gender adjusted regression analyses

Individually, age and gender were two of the strongest determinants of the risk of presentation for an emergency visit over the year before interview, higher risks were observed for older subjects and for females (table 10a). When examining a study in COPD, one always wishes to know the age of the subjects, the sex ratio and FEV_1% predicted, so that the population can be compared to other studies. However, as other studies have found (Ketelaars et al., 1996) these characteristics are not closely associated with other factors like HRQoL. Though the sociodemographic variables age and gender were adjusted for *a priori* they showed little evidence of confounding. Although, risk coefficients did not change by more than 10% between crude or adjusted regression models for each independent variable (Mickey and Greenland 1989), the general effect of adjusting for age and gender was to increase the risk associations observed in crude models.

As in the study by Browne et al. (1990), this research project took place in Canada where the provincial health insurance system is thought to remove financial deterrents to a person's use of the health-care services. The expectation was therefore that health-care services utilisation in this setting not show an association with financial factors that would affect an individual's use of health systems in other jurisdictions. Though the models were not significant, a consistent trend in reduction of risk was observed with higher income jobs (table 10a and 11a). This indicated that there may be an underlying relationship between presentation for emergency visits with job status or related characteristics like income or perceived responsibility.

As expected, subjects on long-term oxygen therapy were more likely to present for an emergency visit during the year before interview (table 10a). However, what is more interesting is that subjects who had regularly used oral cortico-steroids were also more likely to have an emergency visit. Although there is much controversy on use and prescription of oral cortico-steroids for COPD patients (Barnes, 1998), the results suggest that prescription of medication at the MCI is generally reserved for either more severe patients or patients requiring more medical attention. The effect of this variable therefore depicts confounding by indication.

7.4.2 Limitations of sociodemographic characteristics and respiratory disease history

Inclusion of the variables for age and gender in the logistic regression models was based on Hosmer and Lemeshow's (1989) argument that any scientifically or socially important variable should be included in risk models regardless of their significance. The observation of differential responses between men and women and between age groups for the instruments by other researchers (Spielberger, 1983; Endler and Parker, 1990b; Costa and McCrae, 1985; Graydon and Ross, 1995; Quirk and Jones, 1997; Larson et al., 1998) provided additional reason for adjusting for these variables in the study.

7.4.3 Other research on sociodemographic characteristics, respiratory disease history and health-care services utilisation

Most studies on health-care services utilisation also adjusted *a priori* for age and gender (Browne et al., 1990; Stehr, et al., 1991). Although no studies on use of oral coritco-steroids and health-care services have been reported, Osman et al., (1997) did find an association between the probability of readmission and home nebuliser use. However, the association became non-significant after adjusting for SGRQ score. Mitchell et al. (1984) also observed psychological benefits with cortico-steroid use.

7.5 Physiological measures

In physiological characteristics, the subjects also represented a standard population of COPD subjects. With a mean FEV_1 of 37.8% predicted before bronchodilation, the population was classed as stage II (with an average FEV_1 pre-bronchodilation between 35-49% predicted). According to this scheme, this study population is representative of a smaller group of more severely ill subjects who are normally under the care of respiratory specialists (ATS, 1995a). In these groups, COPD has a more profound impact on HRQoL and is believed to result in greater health care expenditure (Celli, 1996).

Surprisingly, subjects performed well in the walking test averaging 390 meters in six minutes. Compared to other COPD populations with mean six-walking test distance of 235.1±92.0 metres (Menard-Rothe et al., 1997), this distance was higher. It is recognised that an evaluation confined to a fairly narrow assessment of physiological status gives, however, little information about patients' overall functioning (Rutten-van Molken et al., 1992).

7.5.1 Physiological measure associations

7.5.1.1 Based on chi square analyses

The lack of significant associations with lung function impairment variables observed in the study is indicative of a common problem with such measures (table 6c). Authors suggest that a clinically important difference can vary from 5.3% to 13% depending on the measure of comparison (Redelmeir et al., 1996). Nonetheless many continue to rely on this measure to make management decisions (Celli, 1996; Stubbing et al., 1998). This study's results do not indicate that relying on these measures would be sufficient. Greater differences in lung function measures between outcome groups than suggested by Redelmeir et al. (1996) were observed in both retrospective and prospective data sets. Though differences were not large enough to establish significant associations with outcome or to base diagnostic decisions, the trends did show an advantage to using lung function as a qualitative indicator of health-care services use. The basic issue here seems to be the variability of FEV_1 which can vary within the same individual during the same day (Knudson et al., 1976), along with measures of disability, functional limitation and disease manifestation (Seemungal et al., 1998).

Walking test distance, however, did show significant associations with health-care services utilisation both before and after assessment. Furthermore, an indication of its sensitivity to severity in health-care services utilisation, the differences observed for walking test distances increased as outcomes became more severe, from presentation for an emergency visit, to relapses to the ER, to overnight hospitalisation. This would seem to suggest that walking test distance is indicative of functional limitations and endurance.

7.5.1.2 Based on age and gender adjusted regression analyses

The results from this study indicate that less distance walked in six minutes was linked to a risk effect on presentation for an emergency visit (table 10b). This relationship is further strengthened by the appearance of what seems to be a dose response relationship. This test may reflect the underlying functional status of the subjects and would support the argument for inclusion of exercise training modules in rehabilitation programs (Ramirez-Venegas et al., 1997).

7.5.2 Limitations of physiological measures

To deal with the possibility of effect modification by season, health-care services data collection was matched for the same calendar months of follow-up (table 8). The main concern with making multiple comparisons between several exposures and outcomes is that by chance, five percent of the associations will be significant (Moore and McCabe, 1993). When the same comparisons were repeated on the prospective data set, the same associations were observed as for outcome before the interviews. The consistent trends in independent variable effects demonstrated the stability of the associations observed.

7.5.3 Other research on physiological measures and health-care services utilisation

Though it is generally thought that lung function is unlikely to show an association with outcomes like health-care service utilisation, Osman et al. (1997) found consistently lower FEV_1 and FVC % predicted values among COPD patients who survived after admission to hospital. Though the differences were non-significant, they do support a similar trend in association with disease severity and outcome to that found in this study.

Although few studies have evaluated the relationship between walking tests and health-care services utilisation in COPD patients, Browne et al. (1990) found significant associations between functional ability (measured by scales scored by a clinician). In contrast, though dyspnea scores may be becoming the preferred measure of disease severity (Sassi-Dambron et al., 1995; Carrieri-Kohlman, 1996; Siafakas et al., 1997), no associations have been found between dyspnea and health-care service use. With its relation to both physical functioning measures and patient impressions, this measure may prove to be a strong indicator of health-care service outcomes.

7.6 Multivariate regression profile of presentation for an emergency visit

Although several multivariate models were derived from the stepwise selection procedures, only a model including sociodemographic and respiratory disease characteristics was strong enough to produce stable OR. Further including other psychosocial or HRQoL factors identified two factors that indicated either strong risk effects or improvements in the model: trait anxiety and SGRQ total score. Including both these variables together in the models, however, decreased the power. This relationship illustrates the collinear relationship between trait anxiety and the SGRQ also seen from the correlation tables.

The main interpretation that can be drawn from the baseline multivariate model is that health-care services utilisation seems to be associated with factors that measure disease severity. The model indicates a dose response relationship between probability of outcome and age, and that females are more likely to present for an emergency visit. Furthermore, though both walking test distance and FEV_1 were non-significant, their effects are consistent with univariate analyses indicating higher probability of an emergency visit with lower physical and lung functioning. FEV_1 and walking test distance may reflect the rate of depletion in physical functioning whereas the other variables including use of oral cortico-steroids may reflect disease severity. Lastly, subjects who had lived longer with their disease are also less likely to have an emergency visit, even after controlling for age. This last measure may be related to other factors such as social support or reflecting a level of acclimatisation to "false alarms". However, this relationship was not sustained against the occurrence of emergency visits after the interviews.

When tested against prospective outcome results, the risk associated with SGRQ total score was fairly strong. Even stronger, however, was the risk estimate for the CRQ total score. Projected against short-term occurrence of emergency visits, a model consisting of sociodemographic variables and variables reflecting disease severity seemed to be further improved by using the CRQ questionnaire. As indicated by its strength of association with retrospective data over the year before interview, the SGRQ may in fact be the preferred choice of measure in programs measuring long-term effects. Further testing against long-term prospective outcomes remains necessary in order to make a complete comparison with the risk associations derived from retrospective data. Therefore, since clinical and HRQoL measures address different aspects of the disease, and both seem to be associated with health-care services use, a meaningful predictive index should include both.

7.7 Advantages and disadvantages of the study

7.7.1 Study design

7.7.1.1 Study sample selection

Subjects who volunteer to undergo various diagnostic and therapeutic procedures in medication trials may have better coping skills and higher psychological stability than those who decline to participate. If this is also true for this study, then the estimates of association with HRQOL would be more homogeneous and would underestimate the range of HRQoL scores making the sample representative of a mentally healthier population than would be encountered in a respiratory clinic or hospital. Additionally, this population is predominantly older, male, and francophone, reducing the degree with which the study can be generalised to other COPD populations.

7.7.1.2 Interview derived information

The interviews elicited information on HRQoL and psychosocial characteristics, referring usually to longer periods of time before interview, rather than current or recent events. In studying the occurrence of prior health-care service events, long-term measures were most appropriate due to the sequence of exposure and outcome measurements. Other studies that compared exposure factors with health-care service utilisation have also referred to prior events and found stable associations (Traver, 1988; Browne et al., 1990; Lewis and Bell, 1995; Kong et al., 1997).

There are advantages and disadvantages to performing interviews and for using written questionnaires. Some believe that sensitive information, e.g. sexual behaviour, would be better obtained if the subject were writing instead of telling the interviewer. For this reason, measurement of sensitive and embarrassing factors, such as depressive moods, social interaction activities, etc. was done using written questionnaires. On the other hand, the use of an interview can ensure that a reasonable amount of time is spent providing answers, which is not necessarily the case when a questionnaire is handed out. An interview also ensures that subjects leave fewer questions unanswered. By using a combination of both methods, I was able to benefit from the advantages of either method for the different situations.

7.7.2 Statistical limitations

There are few studies that investigate the relationship between a combination of psychosocial variables and hospital outcomes. Measuring of exposure at a single point in time with a retrospective collection of outcome, I make the assumption that the degree of exposure over time of follow-up is constant and unaffected by outcome events. However, research supports the hypothesis that psychosocial factors like coping and personality are indeed stable over time (Lazarus, 1985; Anderson, 1995). The inconsistencies of some of the psychosocial scores may indicate a limitation in using such measures without repeated administrations to calculate more reliable results.

Another possibility for some of the significant associations observed is as a product of chance occurrences. This can be an important concern when testing multiple factors in a small sample population such as in this study (Moore and McCabe, 1993). This may explain the association observed with the variable for time since diagnosis in the multivariate regression analysis.

A further assumption required for linear or logistic regression analysis, prospective or otherwise, is that the rate of outcome incidence is constant over time. Due to the progressive nature of the disease, it could be argued that this assumption is erroneous. In theory, a more complex Cox model can be tested to take into account time of follow-up to outcome event. Such a model would allow for control for varying rates of outcome with time, assuming a constant independence of observations and proportionality of hazards. Unfortunately, due to the very rare nature of outcome events in this population of subjects, cox regression analysis could not be tested (Kleinbaum, 1996). However, since it was found that rate of emergency visits and hospitalisations did not vary significantly over the six-month follow-up periods, it is unlikely that substantially different results would have been observed by cox regression.

7.8 Future research

A larger prospective study would obviously be necessary to further research the relationship between psychosocial factors and health-care services utilisation. In order to completely evaluate the interaction between the different psychosocial factors and their resulting influence on health-care services use, periodic interviews during follow-up would be necessary to measure all the transient factors as they changed and to establish which ones remained constant in COPD patients.

There are several methods by which to analyse a cohort study. Over the time of follow-up I could look at the time to each event. If done, this could help establish whether there is a trend in health-care service utilisation over time, and also help determine if there is a seasonal variation in occurrence of different health events. In order to determine if a trend exists, a longer time of follow-up would be needed, especially to describe any seasonal variation, which would require follow-up over several years.

Collection of outcome data, however, could have been more extensive. Use of diary cards may have allowed for an assessment of the latency sometimes observed between the time of onset of patients' symptoms and subsequent presentation to the emergency department. In such cases there may be a relationship between psychosocial factors or HRQoL and delay time. For example, patients who were able to cope less effectively, had higher anxiety, or who had poor HRQoL may show up in the drop-in clinic or ER sooner after their symptoms start even though they were not experiencing a major exacerbation. At the other extreme, patients who deny their symptoms, or who always try to cope on their own may wait until too late after an exacerbation has begun before going to the ER and would subsequently require more drastic health-care interventions.

8. CONCLUSION

In summary, this research project served to identify independent correlates of several health-care services utilisation outcomes, and evaluate their ability to predict subsequent presentation to emergency services which then lead to uses of other health-care services. These determinants were time lived with disease, regular use of oral cortico-steroids, lung function impairment, physical functioning, and HRQoL questionnaires specific to COPD - the SGRQ and CRQ.

Of the independent variables flagged as significant in the retrospective analysis, FEV_1% predicted, 6MWT and HRQoL measures showed persistent associations with health-care outcomes. Furthermore, the levels of these measures steadily decreased as the degree of outcome became more severe, from ER visits, to relapses to the ER, to hospital admissions. Though time since diagnosis did show a significant relationship with previous emergency visits, the association could not be repeated with the prospective data and is probably a result of chance.

Although regression analysis identified fewer associations as would be indicated by the comparison of means analysis, it was apparent that strong collinearity existed between the different physiological, psychosocial and HRQoL scores. This would indicate that HRQoL scores may be good substitutes for the physical tests and questionnaires commonly employed in clinical and psychological evaluations of COPD subjects.

An attempt was made to evaluate the inter-relationships between sociodemographic, clinical, psychosocial, and HRQoL measures and their effect on presentation to emergency services by subjects with COPD. These analyses depict strong psychometric properties for the HRQoL instruments and their ability to predict emergency visits when considered with variables of disease severity.

As a pilot project, this study identified HRQoL dimensions over psychosocial factors as determinants of health-care services utilisation although both were strongly correlated. Further testing and evaluation of these HRQoL measures in a larger cohort of COPD patients, clinical scores for these factors could be established that could help categorise patients who may depend more heavily on health-care services. These instruments could then be used in addition to the traditional physiological and clinical measures usually collected, and serve to better manage COPD patients by helping them deal with the impact of their chronic disease at every level.

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APPENDIX 1.

Telephone/chart screening form for recruitment of COPD patients for interview

Telephone/Chart Screening form for Recruitment of COPD Patients for Lung Disease and Attitude study

Medical chart screening:

Medical chart number: ______________

Surname: ______________________________ Name: ______________________

Address: ___________________________ City: ______________

Postal Code: __ __ __-__ __ __

Telephone(h):(__ __ __)__ __ __-__ __ __ __ Telephone(w):(__ __ __)__ __ __-__ __ __ __

Date of birth: ___/___/___ Age: ________yrs Sex: Male____ Female____
dd mm yy

Smoking history: Smoker___ Ex-smoker___ Language spoken: English____ French____

Consent to participate in research? 0-No 1-Yes 8-N/A

Currently participates in a research project? 0-No 1-Yes 8-N/A

Participated in a rehabilitation program? 0-No 1-Yes 8-N/A If yes, when: ___/___/___
dd mm yy

The following criterias can be verified with the patient's medical hospital chart. If patient does not meet the following criterias, do not continue further.

Inclusion criterias 0-No 1-Yes 9-Inc

- 1. Male or female patient ≥ 40yrs of age ___
- 2. Patient is known to have COPD, clinical diagnosis of chronic bronchities or emphysema ___
- 3. Patient has a pre <u>or</u> post-bronchodilator FEV1 ≤ 80% of Knudson's predicted value and a FEV1/FVC ratio ≤ 70% ___

Exclusion criterias

- 4. The patient shows clinical or laboratory diagnosis of any of the following major organic disesases:
  - Acute myocardial infarctus ___
  - Lung cancer (operated at least 1 yr ago, no surgery/chemotherapy) ___
  - Malignant neoplasia (active, no surgery/chemotherapy) ___
  - Severe pyschiatric disorders (such as schizophrenia, PMD, psychosis) ___
  - Severe respiratory infection (multilobar, septicemia, empyema) ___
  - Uncontrolled cardiovascular problems (CHF, unstable angina, HBP) ___

Telephone screening:

Symptoms:

0-No 1-Yes

a. Do you have a cough? ___

If yes, during the last 4 weeks, is your cough:

1-Less frequent

2-Like usual

3-More frequent ___

0-No 1-Yes

b. Do you bring up phlegm from your chest? ___

If yes, during the last 4 weeks, do you bring up phlegm:

1-Less frequent

2-Like usual

3-More frequent ___

0-No 1-Yes

c. Are you short of breath? ___

If yes, during the last 4 weeks, are you short of breath:

1-Less frequent

2-Like usual

3-More frequent ___

Have you had to go to the ER, hospital, or visit your doctor for uncontrolled respiratory symptoms within the last 4 weeks? 0-No 1-Yes ___

If yes, why:

____

____

____

____

____

Verification of symptom stability: 0-No 1-Yes

Have the symptoms been stable within the last 4 weeks? ___

If no, specify:_______________________________________

____

Medication:

0-No 1-Yes

Are you currently taking respiratory medication? ___

If yes, which one?

Medications	How often do you use this medication per day?
a)________	a)________
b)________	b)________
c)________	c)________
d)________	d)________

Has your respiratory medication changed or have you had to increase your medication within the last 4 weeks? 0-No 1-Yes ___

If yes, which are the new medications and why?

a)________	Reason ________
b)________	Reason ________
c)________	Reason ________
d)________	Reason ________

Verification of medication stability: 0-No 1-Yes

Has there been a change of medication within the last 4 weeks? ___

If yes specify:________

____

Are you receiving treatment for any other health problems besides your respiratory problems? YES NO

If yes, specify:________

Have you had any new health problems in the past year? YES NO

If yes, specify:________

Have you had any surgery in the past year? YES NO

If yes, specify:________

Have you visited any other hospital or clinics for respiratory problems in the past 12 months? YES NO

If yes,specify:

____

____

____

____

If yes, ask patient to bring at appointment all pertinent information for signing of hospital consent.

	0-No 1-Yes 9-Inc
◆ 1. Patient is a smoker or ex-smoker with a smoking history ≥ 20 pack years	___
◆ 2. Patient is capable of taking his/her prescribed medication, go for visits to the clinic, undergo tests and complete questionnaires	___
◆ 3. Patient is capable to understand and give consent in either english or french writen	___
◆ 4. During the telephone call, the patient considers his COPD or his/her respiratory condition to be stable within the last 4 weeks	___
◆ 5. Patient has refused to participate	___

Is the patient eligible for the study? YES NO

If no, specify:____

____

____