Women's Respiratory Health: An Evidence Review

October 2008

British Columbia
Centre of Excellence for Women's Health

Provincial Health Services Authority
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This report was prepared for the Provincial Health Services Authority (PHSA) Population and Public Health Program.

Acknowledgement to the PHSA Population and Public Health Program for their financial support and dedication to this project.

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PHS003-016

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Foreword

The Provincial Health Services Authority (PHSA) has commissioned three papers to examine women's health in the areas of respiratory disease, diabetes and heart disease. The other two papers, "Type 2 Diabetes and Women's Health in British Columbia: A Review of the Evidence" and "Women's Heart Health: An Evidence Review", can be found at www.phsa.ca/PopulationHealth.

This work has been undertaken as a follow-up to an earlier 2007 PHSA report, "Life Expectancy as a Measure of Population Health", showing that the health of BC women is not improving as quickly as the health of women in many other jurisdictions as measured by the rate of gain in life expectancy. The main reasons for this were found to be relatively high mortality rates from diabetes, heart disease and respiratory disease.

These three papers, through a gender-based analysis, examine the possible explanations for these increased disease-specific mortality rates.

All three papers reach the conclusion that the health of BC women could be improved through addressing women's fundamental living and working conditions, particularly for "at risk" populations—the poor, single mothers, recent immigrants, aboriginal women and women of other ethnicities, maturing women, women with mental illness and/or addiction, and others who are marginalized or excluded from society.

More specific policy considerations were not included in the mandate for these three papers. In other work being conducted in PHSA, however, the following policy options are being analyzed in the BC context:

1. improved food security and income security
2. universal access to affordable child care
3. improved access to safe, affordable housing
4. improvements to the public education system
5. improvements to the built environment
6. improved access to effective preventive and curative health services.

Gender-based considerations of these policy areas will be important to offer insights as to specific action that will improve women's health.

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Executive Summary

This literature review and analysis is a response to the Provincial Health Services Authority (PHSA) women's life expectancy study which revealed that respiratory systems diseases are the 3rd leading cause of death for women ages 65-74 in British Columbia. Further, while morbidity and mortality rates for lung cancer and respiratory system diseases are decreasing for men, rates for women are rising. Other respiratory diseases such as asthma have lower associated mortality, but present significant health issues for sub-populations of women in Canada. Furthermore, many of these diseases can be prevented or symptoms reduced through smoking prevention and cessation.

In total, we reviewed 137 articles and other relevant documents discussing sex and gender issues for women's respiratory disease and health, including grey literature reports. We have divided our discussion of respiratory diseases into two categories: chronic and acute respiratory diseases. Chronic diseases covered include: asthma, chronic obstructive pulmonary disease (COPD), and lung cancer. Acute respiratory diseases discussed include: influenza, pneumonia and tuberculosis (TB). The descriptions provided for each disease indicate that while these diseases have different rates of morbidity and mortality, symptoms, and presentation, and require different methods of diagnosis, treatment and care, they also share some commonalities. In particular, many of the respiratory diseases discussed co-occur, and share similar sex and gender specific issues related to: risk, diagnosis, management and treatment.

Specifically, tobacco use is the primary preventable risk and also exacerbates symptoms associated with many of these diseases. Additional risks include exposure to environmental contaminants and secondhand smoke. Furthermore, there are both sex and gender issues affecting susceptibility. For example, biological or sex based risks include the impact of estrogen which mediates and enhances the damaging effects of smoking and SHS, through its influence on the metabolism of cigarette smoke. Cyclical changes in hormones also cause changes in airway hyper-responsiveness, exacerbating symptoms of respiratory diseases such as asthma. As well, women have relatively smaller lungs compared to men and experience greater declines in lung function associated with respiratory diseases. For example, women experience a greater decline in lung function than men with similar amounts of smoke exposure. These factors also place women who do not smoke or are light smokers at greater risk for disease in comparison to men who do not smoke or are light smokers.

Gender issues also influence susceptibility to disease. Women have been aggressively targeted by tobacco advertisements in particularly effective ways, and marketed women-specific tobacco products such as light cigarettes which may enhance their risk for respiratory diseases. Gendered roles also mean that women are often more likely to be exposed to environmental contaminants and secondhand smoke. Furthermore, the combination of gendered differences in exposure with sex differences related to susceptibility, further enhance women's risk for diseases, in particular lung cancer and COPD.

There are also multiple issues associated with disease presentation and diagnosis which affect women's respiratory health. Women and men often present with different symptoms, which may be due to, either or both, the experience of different symptoms or gendered differences in reporting. For example, women with COPD are less likely than men to report sputum production. Multiple studies have identified issues of mis-diagnosis. Women with lung cancer often have undiagnosed COPD, and women with COPD are often mis-diagnosed with asthma. Another key diagnostic issue is the under-use of spirometry by providers to accurately diagnose COPD in both women and men.

With regard to management and outcomes, women with respiratory diseases tend to report more hospitalizations, more limitations in activity and higher rates of anxiety and depression associated with respiratory diseases when compared to men. A number of studies have found that women report lower quality of life and more depression than men with respiratory diseases. Women also experience stigma associated with diseases, stemming from physical changes and signals (such as hair loss during cancer treatment, changes in physical appearance associated with COPD, or reliance on oxygen) as well as the increasing experience of social and physical isolation. The notion that respiratory diseases are self-inflicted due to their strong links to tobacco use, may further hinder women's access to necessary care and treatment. Evaluations of pulmonary rehabilitation programs indicate that men may experience greater and more sustained improvements than women.

Considerations for Action:

While there is a dearth of literature examining interventions which focus on the prevention of respiratory diseases for women or sub-populations of women, there are many opportunities to add to this body of literature. For example, expanding research on sub-populations most at-risk could inform the development of a comprehensive respiratory disease strategy at the provincial level in BC - something that currently does not exist. The current knowledge gaps do not preclude us from acting in ways where there is the greatest opportunity to achieve positive outcomes, such as developing sex, gender and diversity sensitive practices and guidelines, and reducing risk through women-specific smoking prevention and cessation activities. It is critical to evaluate the ongoing effectiveness of all of these types of activities in order to contribute to the improvement of women's respiratory health.

Based on this review, the key messages and areas where action should be considered are as follows:

1) Expanding research

The bulk of the evidence comes from population based studies with white samples. In contrast, there is very little research examining differences between sub-populations of women. Further research with diverse women could expand our knowledge of respiratory disease for all women.

2) Implementing better practices and guidelines

Prevention, diagnosis and treatment of respiratory disease would benefit from the implementation of sex, gender and diversity sensitive best practices and guidelines. In particular, these would need to address the self-efficacy of providers as well as encourage the wider use of spirometry. Educating health care providers about sex and gender based differences, such as differences in symptoms reporting may also help prevent the under and mis-diagnosis of disease. For women with respiratory diseases, women-centred pulmonary rehabilitation programs are also essential for improving management and outcomes of disease.

3) Including sex, gender and diversity lens in provincial and national strategies

A comprehensive respiratory disease strategy is currently in development at the national level in Canada, yet not at the provincial level in BC. It is imperative that ongoing and future development of such frameworks account for women's unique respiratory health needs. Strategies for respiratory diseases need to consider the sex, gender and diversity based issues in women's susceptibility to disease, presentation of symptoms and diagnosis, and management and treatment of disease.

4) Reducing risk through smoking prevention and cessation

Multi-component strategies that address reasons why diverse women smoke and work at reducing secondhand smoke exposure for women will have the greatest implications in reducing mortality from respiratory diseases. As well, links need to be made between lung health, women's health and tobacco use prevention research to consolidate efforts in preventing respiratory disease

5) Sub-populations at risk

Little has been written about different sub-populations of women and their risk, management and experiences of respiratory diseases. Yet having a low socioeconomic status (SES), being a non-white minority, and having a mental illness or addiction does place women at a greater risk for developing respiratory diseases, since evidence indicates that these women are more exposed to smoke, both actively and passively. Furthermore, non-white and low income women tend to have less access to health care resources, and suffer more often from disease and disabilities. Within the BC context, sub-populations who are most at risk, include: Aboriginal teenage girls, low income women, women with mental illness or addiction and older women.

Introduction: Overview of Respiratory Diseases

Respiratory diseases in Canada represent a huge social and economic burden. According to data from 2007, over 3 million Canadians have asthma, COPD, lung cancer or cystic fibrosis [1]. In fact, the total number of Canadians affected by respiratory disease is much higher, since this estimate does not account for other diseases, such as: sleep apnea, influenza and pneumonia [1].While some of the changes in patterns of presentation can be attributed to an aging population, patterns also reflect biological as well as gender and a range of social factors. Economically, approximately 6.5% of total health care costs in Canada are related to respiratory diseases, and this figure does not include costs attributed to lung cancer [1].

Lung cancer, COPD and pneumonia, which are the three most common respiratory diseases in Canada, were responsible for 17, 845 (or 15.6% of) deaths in men and 15, 144 (or 13.5% of) deaths in women in 2004 [1]. Lung cancer is the leading cause of death due to cancer in Canada, representing an estimated 30% of all cancer deaths in males and 25% in females [2]. For both lung cancer and COPD, late diagnosis is common, despite the fact that early diagnosis is strongly linked to better treatment and management of both diseases. For example, if diagnosed early, lung cancer could be more successfully treated in over 90% of patients [3] and the earlier COPD is diagnosed, the easier it is to manage [4-6]. While other respiratory diseases also result in death, the numbers are far fewer either because mortality rates are low (such as with asthma) or because the diseases are relatively rare (e.g. cystic fibrosis) [1].

Yet, by far, the greatest risk factor for respiratory diseases is preventable. Smoking, both active and passive, contributes to the development of and/or exacerbates the symptoms of respiratory diseases [7]. For example, secondhand smoke (SHS) can result in the development of lung cancer in non-smokers and asthma in children. Air quality and biomass exposure are other contributing factors, particularly in developing countries where airborne contaminants are more commonly encountered outside, at work and in the home.

There are also clear sex, gender and diversity implications to women's respiratory health. Evidence indicates that women may be more biologically susceptible to the dangerous effects of smoking, SHS and biomass fuel. In many developing countries (such as China) women are often exposed to biomass, and its adverse consequences during the course of cooking [8]. There are gender and diversity related reasons as to why women smoke or are exposed to airborne pollutants. For example, non-white and low income women tend to have less access to health care resources, and suffer more often from disease and disabilities [9].

Methods and Rationale

The following literature review and analysis is a response to the women's life expectancy study which revealed that respiratory systems diseases are the 3rd leading cause of death for women ages 65-74 in BC. Further, while morbidity and mortality rates for lung cancer and respiratory system diseases are decreasing for men, rates for women are rising.

In order to understand respiratory diseases and its impact on women's health, we searched the following databases for relevant information: PubMed, Academic Search Premier, Embase and Contemporary Women's Health. We used the following key words: sex or gender in conjunction with pulmonary, respiratory and lung disease/ health. Other specific search terms included: COPD, lung cancer, TB, influenza, smoking, pneumonia, and asthma. In addition, we discussed the review strategy with members of the ICEBERGS team, who are a multidisciplinary team of researchers based out of UBC and the BCCEWH who study sex and gender issues of chronic obstructive pulmonary disease (COPD). In total, we reviewed 137 articles, and other relevant documents. This included a number of grey literature reports, such as information from the National Health Registries and Life and Breath: Respiratory Disease in Canada (2007).

We have divided our discussion of respiratory diseases into two categories: chronic and acute respiratory diseases. This division is partially pragmatic. As will be discussed, respiratory diseases often co-exist and overlap and share similar sex and gender specific issues related to: risk, diagnosis, management and treatment. For example, while lung cancer is not typically grouped with respiratory diseases (instead with other forms of cancer), women with COPD often develop and are diagnosed with lung cancer prior to any COPD diagnosis. As well, women with COPD are often misdiagnosed with asthma.

In order to address some of these overlaps and complexities, we will present our synthesis as follows. First we will provide a description of each disease, including any sex and gender specific trends. Then, we will follow these descriptions with further discussion on the sex, gender and diversity issues identified in the literature reviewed, according to risk, diagnosis, management and treatment. Finally we will consider the context of respiratory disease for women in British Columbia, and conclude by providing a commentary on research, program and some policy issues for women's respiratory health.

Sex, Gender and Diversity Analysis

In the process of review and synthesis, a sex, gender and diversity analysis was applied to the material. Sex and gender analysis (SGBA):

> "is an approach to research and evaluation which systematically inquires about biological (sex-based) and sociocultural (gender-based) differences between women and men, boys and girls, without presuming the nature of any differences that may exist" [10].

SGBA is a tool that promotes consideration of a range of issues related to both the research process and the application of knowledge in program or policy development. Using such an approach helps to improve our understanding of sex and gender as determinants of health, of their interaction with other determinants, and the effectiveness of how we design and implement sex- and gender-sensitive policies and programs [2]. Sex and gender are both fluid concepts that are influenced by cultural and temporal factors. Individuals

are affected by a range of biological factors such as genetics, physiological characteristics, physical characteristics, hormones, etc, as well as a range of social characteristics and factors such as gender identity, gender relations and institutional gender. In addition, both gender and sex intersect with cultural definitions, traditions, expectations and assumptions unique to particular groups. Hence, developing sophisticated understandings (and measures) of sex and gender in research and knowledge uptake is key to reflecting on how all factors affect women's health [11]. In the context of respiratory health, all of these factors interact to produce patterns and issues of concern to health program planning, policy development and treatment practices.

Applying this lens of analysis to the literature review enables us to critically examine how women's respiratory health has been studied, identify the important sex and gender specific factors and issues of concern to women and women's health advocates, and identify important gaps and future considerations for research, programs and policies.

Chronic Respiratory Diseases

1) Asthma

Asthma is a chronic inflammatory disease that is characterized by the following symptoms: coughing and wheezing, shortness of breath, and tightness of the chest [1, 12]. Asthma attacks are generally triggered by a reaction to either exercise, stress or exposure to allergens, cold air, pollutants or infections which results in an inflammation and tightening of the airways or bronchi [13]. Asthma sufferers experience a feeling of suffocation and inability to breathe that is potentially fatal.

Asthma rates in Canada have been increasing, with the current prevalence of self-reported asthma being greater among women than men [1]. While asthma is typically higher among young boys than girls, this trend changes with age. From 1994 to 2005, physician-diagnosed asthma increased by 60% for women aged 35-44 and 80% among women between 45 and 64 years of age [14]. In comparison, prevalence increased by 41% among men between the ages of 35 and 44 [14]. Asthma rates are even higher among Aboriginal women in Canada; 13.8% of Aboriginal women aged 12 and over have asthma, compared to 9.7% in other women [1].

Longitudinal studies have suggested that susceptibility to asthma is partially determined by intrauterine and childhood development, making the reduction or elimination of smoke exposure during pregnancy and childhood development an important preventive measure [1]. Other risks include: a family history of allergies, exposure to allergens, re-occurring respiratory infection, low birth-weight and respiratory distress syndrome (RDS). Development of asthma during adulthood can also result from exposure to occupational fumes or pollutants.

Diagnosis is usually determined by the physician listening to the chest for wheezing, the use of chest x-rays to dismiss the possibility of infections or heart problems, and sometimes measuring expiratory volume with the use of spirometry before and after the patient uses a fast-acting asthma medication [13].

Treatment generally involves the use of short-acting bronchodilators or beta-agonists (e.g. albuterol) to control and prevent attacks by opening up the airways, but these pharmacological treatments do not treat

inflammation. Anti-inflammatory drugs are often used for this, such as inhaled or oral corticosteroids which help decrease inflammation and the hyper-responsivity of the bronchi. Side effects attributed to prolonged use of oral corticosteroids include: increased glucose intolerance, easily bruised skin, weight gain, high blood pressure, muscle weakness, osteoporosis and cataracts [12, 13]. Leukotrine modifiers may also be used which inhibit fatty acids called leukotrines that are involved in inflammation.

2) Chronic Obstructive Pulmonary Disease (COPD)

COPD is a disease characterized by irreversible airflow obstruction or diminished ability to inhale and exhale, and includes both emphysema and chronic bronchitis. Emphysema describes the destruction of the lung parenchyma leading to shortness of breath. In comparison, chronic bronchitis describes the inflammation of the bronchial tubes resulting in a persistent cough and mucous hypersecretion [15, 16]. While some people do have either "pure" emphysema or chronic bronchitis, both of these are typically seen to a lesser or greater extent in patients with COPD. To further complicate things, any of these patients can have hyperactive airways, which is similar to asthma. The difference with asthma is that it usually develops during childhood and is associated with allergies, though some evidence does suggest that asthma may be predisposing for COPD [15].

Chronic obstructive pulmonary disease (COPD) is increasingly becoming a woman's disease. In 2005, 4.4% of men and 4.8% of women in Canada aged 54 or older had been diagnosed with COPD. This rate was yet higher for Aboriginal people living off reserve at a rate of 7.9% [1]. In the past, COPD was more common in men than women, but is now reported more in women than men under the age of 75 [1]. In 2005, more young women (aged 35 and over) than young men were diagnosed with COPD [1]. As well, it is estimated that by 2015, the greatest burden will be among women 60 years and older [15]. In 2004, COPD was the cause of 5, 152 deaths for men and 4, 455 deaths for women in Canada [1]. Yet, actual mortality rates may be even higher because pneumonia and congestive heart failure are often listed as the reason of death for persons with COPD [1]. Between 1980 and 2004, there was a dramatic increase in the mortality rate for women, while rates among men have been decreasing slightly [1]. Since 2000, female mortality due to COPD has risen at double the rate of breast cancer (9% compared to 4 %) [17]. Similarly, in the UK, incidence rates of COPD are leveling out for men, but continuing to rise for women [18].

While about 15-20% of smokers will develop COPD, nearly 90% of persons with COPD are former or current smokers [1, 15, 19]. Secondhand smoke, repeated respiratory infections and occupational exposure to pollution, dust or fumes increases risk for developing COPD [19]. A genetic deficiency of alpha-1-antitrypsin, an anti-protease which normally protects the lung tissue from damage, has also been associated with increased risk of COPD [1].

Diet and nutrition have been linked to the prevention or reduction of COPD symptoms. COPD may be caused by oxidative stress-mediated inflammation and damage of lung tissue. In particular, oxidants can cause damage by inactivating antiproteases or mediating other processes that lead to chronic lung damage. While cigarette smoke is a major source of exogenous oxidant exposure, diet may also play a role since fruits and vegetables are a primary source of anti-oxidants, flavonoids and fibre. Flavonoids, which help eliminate free radicals, can also be found in soyfoods, tea and wine. For example, dietary fibre was linked to the

reduction of cough and phlegm symptoms in a large population of middle aged Chinese women and men[1] [20].

Early symptoms are not usually recognized, so women may not notice the disease until they have already lost a substantial amount of lung functioning [1]. Persons with COPD often don't notice symptoms until after 55 years of age, and typically seek health advice based on the presence of symptoms, including: dyspnea, cough and sputum production [1, 15]. The disease is slow, progressive and debilitating. Those afflicted experience increasing reductions in airflow until regular activities become greatly reduced both at work and at home [1, 19]. The most reliable diagnostic tool is the use of a spirometry to measure expiratory volume. Yet spirometry is under-used, and therefore COPD is under-diagnosed [19]. Data from BC from 2002/03, indicates that only 37% of newly diagnosed COPD patients received a diagnosis one year prior or post-diagnosis [19].

Five stages of severity have been identified by the American Thoracic Society (ATS), based on forced expiratory volume in the 1st second (FEV1)[15]. The stages are divided beginning with "at-risk" and increasing according to intensity of symptoms, as follows:

1. stage 0: at risk; normal pulmonary functions
2. mild stage 1: mild reduction in air flow
3. moderate stage 2A: FEV1 50-80% of predicted
4. moderate stage 2B: FEV1 30% to 50% of predicted
5. severe stage 3: FEV1 less than 30% of predicted

Recommended management and treatment varies according to stage of severity. At stage 0, patients should be encouraged to quit smoking and acquire influenza and pneumonia vaccines; stage 1 patients would benefit from short-acting bronchodilators such as albuterol or ipratropium; stage 2-3 may be prescribed a combination of short acting and long acting bronchodilators and encouraged to attend pulmonary rehabilitation to increase strength and conditioning; stage 3 should also potentially be prescribed inhaled corticosteroids and the use supplemental oxygen; while stage 4 patients may be recommended for surgeries such as lung transplants or lung volume reduction.

In addition, there are a number of potential complications associated with COPD, including increased susceptibility to influenza and pneumonia, weight loss, nutritional deficits, sleep problems, and cor pulmonale [21]. Cor pulmonale is heart failure due to the increased work-load on the right ventricular from diseases of the lungs and pulmonary vascular beds [21].

COPD is not reversible—no medications have been shown to change the decline in lung function. Oral glucocortisoids or corticosteroids are sometimes prescribed for treating airway inflammation, but have numerous side effects, including: muscle weakness, increased risk of osteoporosis, diabetes, hypertension

1 Non-starch polysaccharides (NSP) which are a major component of dietary fibre, as well as total fruit and soy isoflavones had the greatest effect. This evidence suggests that a diet high in fibre from fruit and soyfoods may reduce respiratory symptoms.

and greater risk of infection [21]. While exposure to smoke results in exacerbations of COPD, Canadian data from 2005 indicates that almost 40% of people with COPD continued to smoke [1].

Further, there is relatively low public awareness of COPD. Although it is the 4th leading cause of death in Canada, in 2006 less than half of Canadians (46%) had heard of "chronic obstructive pulmonary disease" and only 13% of "COPD" [17]. However, women were found more likely to be aware of this disease than men, and more likely to have heard of a spirometry.

3) Lung cancer

Lung cancers include tumours of the lung and bronchus. All lung cancers begin in the epithelial tissue, with the majority occurring on the bronchial lining [19]. Again, smoking is the primary cause, accounting for at least 80% of new lung cancer in women and 90% in men [1, 19]. Risk increases with intensity of smoking and number of years spent smoking [1]. Even after quitting, risk of a former smoker remains higher than that of those who have never smoked. Secondhand smoke (SHS) exposure is another primary risk factor for non-smokers [1]. Non-smokers exposed to SHS are at a 30-50% increased risk of developing lung cancer [19]. Other risk factors include exposure to: asbestos, arsenic, polycyclic aromatic hydrocarbons, silica, radon and other airborne fumes and pollutants [1, 19].

There are two main types of lung cancer: small cell lung cancer and non-small cell lung cancer [3]. The latter includes the following sub-types: squamous cell carcinoma, adenocarcinoma and large cell carcinoma. In small cell lung cancer, cells are small but multiply quickly and can potentially spread throughout the body. Squamous cell carcinoma forms in the lining of the bronchial tubes, while adenocarcinoma forms in the mucous-producing glands of the lungs. Lastly, large cell lung cancer forms near the surface of the lungs.

Lung cancer is another major respiratory health issue for women. Incidence and mortality rates, for example, have been increasing among women in Canada since 1987, yet decreasing among men [1]. Similarly, in the US, women's lung cancer rates increased by 600% between 1950 and 2000, largely due to increased prevalence of smoking among women, according to Patel and colleagues [22]. Lung cancer is the leading cause of death due to cancer, accounting for 29% and 22% of all cancer-related deaths among Canadian men and women, respectively [1, 23], and has surpassed breast cancer as the leading cause of cancer mortality for women [23, 24]. Yet, for men over 70, hospitalization rates are nearly twice as high as for women. In terms of mortality, rates have decreased by 14% for men between 1987 and 2004, and increased by 73% for women [1].

Numerous studies have found that fruit and vegetable consumption can reduce the risk of lung cancer [25-27]. Indeed, Feskanich et al. (2000) found on examining the Nurses Health Study (NHS) data (n=77.283 women) and comparing it to the Health Professionals Study (n=47,778 men) that the protective aspect of fruit and vegetable consumption against lung cancer was higher among women than men [27]. Over the whole sample of women in the NHS, there was a 57% lower risk of lung cancer among those with highest fruit and vegetable intake, and a 44% lower risk among the men in the HPS. They also found that the protective effects of fruit and vegetable were drastically lowered among smokers (24%). Similarly, Speizer et al (1999) examined the differences between carotenoid containing vegetables using the same sample from the NHS and found that carrots (containing β carotene) decreased the risk of developing lung cancer, although this risk was still greater for women with higher cholesterol intake [28].

It has also been suggested that high dietary intake of total fat, saturated fat or cholesterol may be related to increased risk of lung cancer [25]. In a case control population based study of 934 women in Iowa, both smoking and non-smoking, who had lung cancer, consumption of red meat was associated with an increased risk, even after controlling for total fat, saturated fat, cholesterol, fruit, yellow-green vegetable consumption and smoking history. Specifically, frequent red meat consumption was responsible for increased lung cancer, independent of total fat, saturated fat or cholesterol. Yet Speizer, in examining the role of dietary fats in the Nurses Health Study sample, found no evidence that fats increased the risk for lung cancer, but risk was slightly higher in women with higher cholesterol intake [28].

Previous lung disease is an additional risk factor for lung cancer for non-smoking women [29, 30]. Wu and colleagues assert that prior non-malignant lung disease (including asthma, chronic bronchitis, pneumonia, emphysema) is a significant risk factor for lung cancer independent of active or passive smoking status [30]. In short, according to Alavanja, about 16% of lung cancer is attributable to prior lung disease.[2] Wu et al. (1995) found that any prior lung disease resulted in elevated risk for lung cancer, with younger cases (under 55yrs) showing elevated risk from pneumonia and tuberculosis [30]. According to Brownson and Alavanja (2000), however, the elevated risk was associated with a history of emphysema [31].

Pneumonia has also been linked to lung cancer [30, 32, 33]. In the Alavanja study, the authors estimate that previous pneumonia accounts for 50% of the attributable risk of lung cancer associated with previous lung disease [29]. In a German case control study, prior pneumonia and tuberculosis were linked to elevated risk for lung cancer in the sample, while bronchitis, asthma and emphysema were not associated with elevated risk [26]. There are also studies that indicate that the range of chronic obstructive lung diseases increase the risk of lung cancer, possibly by reducing lung function to such an extent that lung tissue is exposed for longer periods to carcinogens. Lastly, tuberculosis poses a higher risk for developing lung cancer in former smokers, but not in non-smokers [29].

The possible mechanisms for these links are not all clear, but include scarring from prior disease, impaired clearance of carcinogens, and chronic inflammation or depleted immune responses [30]. Brownson and Alavanja suggest that lung damage from previous lung disease affects airway clearance and immune functions, leading to heightened susceptibility to carcinogens [31]. Further, the impact of previous lung disease on lung cancer development is greater in former smokers[3]

Because screening for lung cancer is not very effective or widely used, survival rates are often low [1]. Only a small percentage of lung cancer is localized at the time of diagnosis. Once diagnosed, however, numerous clinical studies show better survival rates for women than men [34-38].

Lung cancer treatment involves combinations of: surgical resection, chemotherapy and radiotherapy [1]. Yet, lung transplant is not widely acceptable, and is only available to persons under 65 years of age [15]. Even then, the 5 year survival rate is only 50% so the effects are not lasting [15]. The best candidates for this operation are women who demonstrate bolus changes in the top area of their lungs [15].

2 Specifically, Alavanja et al suggest that pneumonia and asthma posed higher risk for lung cancer in non-smoking women. For ex smokers, previous emphysema and tuberculosis also significantly raised the risk of lung cancer. Previous lung diseases such as these contributed to higher risk for both adenocarcinomas as well as other cell types of lung cancer. Chronic bronchitis, however, contributed to raising the risk of non adenocarcinoma only, and pleurisy did not contribute to higher risk at all.

3 Former smokers, who had been quit for more than 15 years, were over twice as likely to develop lung cancer as never-smoking women. Indeed, previous smoking accounted for 15% of the lung cancer in nonsmoking women in the Alavanja study (population based, case-control of 1,986 women). Wu et al found that risk for lung cancer development associated with prior lung disease was 15% and remained unchanged after adjustment for exposure to SHS in childhood and adulthood .

4) Other chronic respiratory diseases

Other chronic respiratory diseases include cystic fibrosis, and sleep apnea [1]. Cystic fibrosis (CF) is an autosomal recessive disease, with a carrier rate of 1 in 25 [1]. CF is often viewed as a child's disease because symptoms tend to develop within the first few months to first few years of life. Typically those afflicted died young, but now persons with CF are living longer, often into their 20s and 30s [1]. People with CF develop abnormal amounts of mucous in the lungs, interfering with their ability to breathe. They are also at greater risk for lung and lower tract respiratory infections, and are unable to produce pancreatic enzymes necessary for the digestion of food, often resulting in malnutrition. Therapy includes: nutritional and enzyme supplements, inhaled mucolyptics, chest physiotherapy, and treatment of respiratory infections [1]. Survival for women with CF is lower than for men, even after adjusting for differences in risk factors [39]. In general, women have a worse prognosis and report a poorer health related quality of life than men [40].

Obstructive sleep apnea is a chronic disorder in which obstructed airflow caused by collapsed soft tissue results in breathing impairments during sleep [41]. It is characterized by pauses in breathing during sleep, where the afflicted person is momentarily roused. Sleep apnea is commonly associated with obesity in women and men. Some symptoms include: loud snoring, interrupted sleep, and fatigue during the daytime. Women and men at risk are often referred to a sleep clinic for testing. Treatment typically entails: lifestyle changes (to reduce obesity and quit smoking), the use of appliances to open the airways, and oxygen or other medications that encourage breathing.

Acute Respiratory Diseases:

1) Influenza and Pneumonia

Influenza and pneumonia continue to be a major causes of mortality for elderly women and men, and are the leading cause of death from infectious disease [1]. Women and men with less immunity are also at a greater risk. Influenza is a highly contagious respiratory disease resulting from a virus. Symptoms include; fever, pains, weakness, and sore throat. Pneumonia is also an infectious disease, caused by bacterial, viral or mycoplasm infection. Symptoms of pneumonia include cough, fever, shortness of breath and sputum production [42]. Bacterial pneumonia tends to be the most dangerous and potentially fatal. Influenza and pneumonia are linked, since viral pathogens may cause respiratory damage, thereby encouraging the spread of bacterial infection.

Influenza can be classified into three types: A, B and C [43]. While both A and B are associated with seasonal epidemics, only type A has produced pandemics [43]. A viruses are classified by 2 surface proteins, hemagglutinin (H) and neurominidase (N). As well, mutations which produce changes in these proteins (called antigenic drift) are ongoing. More dramatic changes can occur to the surface of these proteins through reassortments of viruses or mutations of non-human viruses, resulting in new subtypes. When these can be passed via humans, a pandemic can occur [43].

The danger in infectious respiratory illness is the potential for complications with other diseases or illnesses [44]. For example, people who have weakened immunity from other diseases may be more at risk for infection and death from influenza or pneumonia [45]. Influenza vaccines can help prevent infection, particularly for at-risk persons such as the elderly or people with other respiratory illnesses such as COPD or lung cancer [46], and women with HIV infection [47]. Furthermore, women with pneumonia have a higher risk of mortality than men [48, 49].

2) Tuberculosis (TB)

Tuberculosis (often called TB) is an airborne infectious disease that usually targets the lungs, but can attack almost any part of the body [50]. In Canada, 62% of all reported cases in 2006 were TB of the lung [50].

Tuberculosis rates in Canada are generally low, yet remain high for Aboriginal people, homeless people and persons born in foreign countries where TB rates are high [1]. In 2000, 65% of all cases were among foreign born persons living in Canada [50]. Canadian born Aboriginal people made up a further 20% of reported cases.

As well, TB often co-occurs with the HIV epidemic [1]. Tuberculosis kills more than 1 million women per year worldwide [51]. In women aged 15-44 in developing countries, TB is the 3rd most common cause of mortality, resulting in more deaths for women than any other infectious disease, including AIDS or malaria [51].

Sex, Gender and Diversity Issues:

1) Susceptibility

In 2002, over 13, 400 adult deaths from lung cancer and 8, 200 adult deaths from respiratory diseases resulted from smoking [1]. Gendered patterns of smoking and smoke exposure, as well as biological, hormonal, and genetic factors overlap and influence women's susceptibility to respiratory diseases [52].

Women who smoke less than men show similar levels of impaired lung function, and smoking decreases women's lung function more than men's [17, 53, 54]. This translates into greater risk for respiratory illnesses. Given the same amount of exposure, women are more likely to develop lung diseases earlier and have more severe expression [53, 55]. Women who smoke have also been shown to have lower levels of physical fitness, more respiratory tract symptoms, slower rates of lung growth, greater addiction to nicotine and poorer physical health [21].

For similar amounts of smoking, women are twice as likely to develop lung cancer, compared to men [17, 34, 56, 57]. Women also develop lung cancer at an earlier age than men, and are more likely to develop adenocarcinoma than small cell lung cancer or squamous cancer, and adenocarcinoma is less linked to active smoking than the other forms of lung cancer [34]. For example, in a review by Ernster (1996), the sex differences in the distribution of different types of lung cancer, and an apparently greater susceptibility to lung cancer among women when controlling for the same exposures to smoking was noted [58].

In addition, there are more lung cancers among women who have never smoked, compared to men who have never smoked [22, 57]. Zang and Wynder (1996) assessed data from 1889 subjects in a hospital based case control study and concluded that women are more susceptible to tobacco carcinogens, independent of smoking history, body size or base line exposure [59]. Tang et al, in a 1998 case control study, confirmed that women smokers are more genetically susceptible than men smokers to lung cancer, with the same amount of smoking. In contrast, a clinical commentary by Patel and colleagues (2004) found mixed results regarding women's greater susceptibility to lung cancer, but they indicate that women are likely more susceptible to cigarette smoke and exhibit biological differences in relation to lung cancer [22].

Further, there may be numerous instances where both sex and gender interact to create respiratory diseases in women. For example, estrogen may be a sex specific element that mediates exposures to gendered risk factors such as cooking fumes, smoking behavior or SHS. There are overlapping biological (sex-based) and sociological (gender-based) reasons for differences in women's susceptibility to respiratory diseases. While sex influences the physiological conditions of women's respiratory health, gender affects the social, cultural and economic context of women's behaviours, roles and exposure in a variety of realms, thereby influencing their respiratory health.

a) Biological or sex-based risks

Women's enhanced susceptibility to the effects of cigarettes may be due to: greater deposition of toxic substances in the lung, impaired clearance of toxins, and /or exaggerated biological responses to these toxins [60]. A systematic review of large cohort studies found that women who smoke have a greater decline

in lung function than men, especially women who are over 45 years of age [61]. Yet, in the first year following cessation, women's FEV1 increase more than in men [62].

While there has been very little research examining the sex and gender implications of occupational exposure, one article which reviewed current findings (there were only 9 studies in total) revealed that overall, toxic air pollutants either have a stronger impact on COPD in women or similar effect on both women and men [63]. Occupational exposure may result in greater airflow obstruction and chronic bronchitis symptoms among women compared with men. In one study, looking at women's exposure to biomass, after exposure, the rate of FEV1 decline slowed less in nonsmoking women than in non-smoking men [64].

Some evidence shows that women may have increased bronchial hyperresponsivity when compared with men, which may increase women's risk of developing respiratory diseases (including asthma and COPD) when confronted with smoke and airborne contaminant exposure [65]. Women also have relatively smaller airways in comparison to men, which may enhance their susceptibility to smoke and pollutant exposures [52].

COPD is a risk factor for lung cancer since risk of lung cancer increases with decreasing lung function. Yet risk is amplified for women because for the same marginal decrease in FEV1, after adjustment for smoking history, women are still two times more likely to develop lung cancer than are men [17]. As women age they have been found to experience greater restrictions in lung capacity than men [17]. Further, gastrin releasing peptide receptor (GRPR) can cause growth stimulation in lung cancers and may be activated at an earlier stage in women who are exposed to tobacco smoke, either actively or passively [52]. An increased expression of the receptor in females for all levels of smoking has been reported [52].

i) Hormonal influences

Changes in sex hormones may impact women's susceptibility to certain respiratory diseases. For example, hormones may contribute to age related increases in women's asthma as well as pre-menstrual asthma (PMA), and changes in asthma symptoms during pregnancy [52]. Approximately 40% of women with asthma report PMA [52]. Cyclical changes in women's sex hormones may result in the upregulation of beta2 adrenoreceptors, resulting in increased airway responsiveness to adenosine monophosate [52].

While some women effectively use oral contraceptives or hormone replacement therapies (HRT) to manage the influence of hormonal fluctuations on asthma symptoms [52], other women report increased presentation of asthma symptoms. Women who are taking exogenous hormones (HRT) have also been found to have an increased risk of adenocarcinoma of the lung when compared to patients with early menopause, and this risk is greater for smokers [52].

Specifically, the contribution of hormone replacement therapy to the outcome of lung cancer in women was studied by Ganti and colleagues (2006) who conducted a retrospective chart review of 498 US women and found that women with lung cancer who took HRT were younger than those who did not, and were less likely to survive as long [66]. They conclude that HRT adversely affects the development of lung cancer in women. These effects were particularly strong for women with histories of smoking. The mechanism appears to be related to estrogen's role in stimulating genes in pulmonary cells and accelerating growth pathways that contribute to carcinogenesis in the lung. In addition, with women with lung cancer who are also smokers, there is a suggestion that estrogen interacts with the carcinogens in cigarette smoke.

Some authors have found that obesity may cause changes in estrogen levels that increase the risk of asthma for women [12]. For example, longitudinal data from Canada found that BMI was a significant predictor of asthma in women but not in men [67]. Yet further research is needed that looks at changes in asthma severity during weight and hormonal fluctuations. Obesity may increase bronchial hyper-responsiveness (BHR) through its effect on estrogen levels [68]. During obesity, estrogen levels increase, and there is also a decrease in sex hormone binding globulin, resulting in even greater estrogen levels which affect sensitive tissues such as the bronchi [68]. In a cross-sectional study by Sood and colleagues (2005), obese women exhibited a higher prevalence of symptomatic BHR with an odds ratio of 1.63 (p5% CI 1.16-2.29) which was not observed in men [68].

While changes in women's hormones post-menopause have been associated with the onset of asthma for women, the data looking at the link between sex hormones and the development of COPD is mixed [69]. For example, rates of newly diagnosed COPD were similar in hormone users and non-users in a study by Barr [70]. Yet, it has been suggested that COPD and other respiratory diseases, including pneumonia and lung cancer are also influenced by estrogen [56].

Not all sex related differences in lung cancer can be explained by hormonal differences, but there is mounting evidence that estrogen mediates and potentially enhances the effects of risk factors such as exposures to smoking, SHS, radon or cooking fumes [56]. Estrogen may influence the metabolism of cigarette smoke, resulting in increased damaging effects [57, 59]. Sometimes metabolism can transform harmless substances into toxic chemicals through a process called metabolic bioactivation. For example, one important xenobiotic substrate for CYP enzymes in cigarette smoke is polycyclic aromatic hydrocarbon, which is relatively harmless but upon activation by CYP enzymes, can become very toxic. Research suggests that there are sex differences in the metabolism of cigarette smoke [24, 54]. Some evidence shows that female hormones accelerate metabolism of cigarette smoke (likely through CYP pathways), into various metabolites, some of which are potent oxidants and oxidizers [24, 60]. Because estrogen does not modify detoxifying enzymes such as glutathione S-transferase, female smokers experience increased oxidative stress in the lungs, and an increase in toxic and carcinogenic molecules [24]. Women smokers have been shown to have increased lung expression of CYP enzymes compared with men who smoke.

ii) Genetic susceptibility and family history

There is also growing evidence that sex differences exist in genetic susceptibility to the harmful effects of tobacco smoke, contributing to lung cancer. Increased oxidative stress for women results in metabolites that may interact with and bind to DNA, resulting in DNA adduct formation which is associated with increased cancer risk [22, 52, 60]. If DNA fails to repair, mutations may lead to lung cancer. This is more common in women than men. For example, the DNA adducts in peripheral blood leukocytes and the normal lung tissues of patients with lung cancer are higher in women for all levels of smoking compared to men. Women are more susceptible to DNA damage and more likely to develop DNA adducts when exposed to cigarette smoke and at the same time, have decreased capacity for DNA repair [24]. Women have a DNA repair capacity that is 10-15% lower than in men [24]. In one study, when lung tumours were analysed, those in women were more likely to show carcinogen DNA-adduct levels and p53 mutations [57].

Bennett and colleagues (1999) explored the hypothesis that exposure to SHS contributed to lung cancer in non-smoking genetically predisposed women [71]. Using archived tumour tissue, they found that deficiency in GTMS1 activity (Glutathione S-transferase M1), a product of germ line polymorphisms in genes associated with cancer susceptibility, that detoxifies chemical carcinogens in tobacco smoke, was significantly linked

to developing lung cancer in non smoking women. In addition, they found an increasing risk for lung cancer with increased exposure to SHS [71]. Therefore, exposure to SHS is potentially differentially affecting non-smoking women, based on their own biological susceptibilities and gene-environment interaction.

Familial history also affects risk of lung cancer. Wu and colleagues (1996) investigated family history of lung cancer as a risk factor for non-smoking women [72]. They found that there was a three-fold increase in lung cancer associated with the same disease in mothers and sisters (regardless of whether they were smokers or non-smokers), a risk not apparently related to the same disease in fathers and brothers. Wu et al. (1996) conclude that lung cancer in nonsmokers runs in families.[4] Further study is required to determine what part is biological susceptibility and which is due to common environmental exposures [73].

b) Social or gender-based risks

i) Active smoking

The increase in women's rates of smoking over the past 50 years has increased the number of women susceptible to diseases such as COPD and lung cancer [1]. In 2006, only slightly more men (20%) 15 years or older were smokers than the same age group of women (17%) [1]. For teen girls, this is 14% versus 16% in boys. For adults aged 20-24, these rates are 30% in men and 24 % in women [1]. According to US data, slightly more girls than boys are current smokers (17.8% versus 17.7%) [74]. Furthermore, there are disproportionate smoking rates for certain sub-populations of girls and women, including low socioeconomic groups and non-white minorities.

Tobacco marketing has increasingly targeted women, portraying smoking as glamorous, and also a way to control weight and stay thin [23, 75]. This marketing hinges on gendered body ideals that encourage women to strive for unrealistic standards of beauty and thinness. These messages encourage women to smoke, and also influence the type of cigarettes many women smoke, such as "light" cigarettes.

While men tend to smoke more cigarettes than women [24, 76], women often smoke lighter cigarettes and may inhale more deeply resulting in different risks such as greater airway damage [54]. Lighter cigarettes also have higher yields of N-nitrosamines, which may be partially responsible for the increase in rates of lung cancer in women [54].

There are also gender differences in why women and men smoke. According to Greaves and Richardson (2007), women smoke for different reasons including: to organize social relationships, create an image, control emotions, and as a form of social support and control [54]. In contrast, men may use tobacco to reflect independence and risk-taking, and resilience to harmful substances. Furthermore, men are less likely than women to smoke as a result of stress.

ii) Secondhand smoke (SHS) and airborne contaminant exposure

Secondhand smoke (SHS) impacts women differently than men. While more men than women report smoking in their workplace in Canada (49% vs 40%), women are often exposed to SHS in the home [75]. Exposure to SHS is widely perceived to be more of a risk for women, due to the lag in smoking trends

4 For smokers with first degree relatives with lung cancer, the risk of acquiring lung cancer is also elevated, and for familial history of any cancer, risks are elevated.

between men and women resulting in more non-smoking women living with smoking men [56]. As well, women working at home may be more often subjected to indoor allergens and other airborne contaminants [13]. In addition, children who live in a smoking household are at a greater risk for developing asthma, bronchitis, pneumonia, middle ear disease, Sudden Infant Death Syndrome (SIDS), a reduction in lung function and COPD later in life [18].

Hirayama (1981) published the landmark study on lung cancer in women exposed to secondhand smoke, through their husband's smoking [77]. In Japan at that time, male smoking rates were extremely high (73%) while women's rates were low (15%) producing a natural experimental situation for examining the effects of exposures to SHS in women. He found in a prospective population study of women and men that women had a higher risk of developing lung cancer when their husbands were smokers, but that husbands smoking had no effect on other cancers, or mortality from heart and stroke. Hirayama suggested that non-smokers are not therefore a homogenous group, and should be subdivided for research purposes by exposure to passive smoke. Since then, multiple studies on the effects of passive smoking on the development of lung cancer have yielded mixed results [73] with some confirming the risk of spousal exposure and some not.

Having said this, in 2000, Lee and colleagues found that in an age matched case control study that ETS exposure in childhood and adulthood accounted for 37% of lung tumours in non-smoking Taiwanese women [78]. For example, a non-smoking woman whose father smoked (in her presence) in childhood had a 70% higher risk of lung cancer development than one whose father never smoked. In particular, the negative effect of SHS exposure during childhood was greatest, suggesting that imperfect metabolism, detoxification and immunity in children may be contributing to the deleterious effects of SHS with respect to lung cancer (along with other respiratory diseases). Siegfried's review (2001) suggested that men are potentially exposed to more SHS, when workplaces and homes are taken together but women are more susceptible to developing lung cancer as a result of childhood SHS exposure. Siegfried suggests that women may not be exposed to more SHS, but rather are more susceptible to the carcinogens in SHS, suggesting a potential sex difference [56].

There may also be gendered patterns of exposure to airborne contaminants. Examples of potential risks to respiratory health include moulds, nitrous dioxide, formaldehyde, radon and emission from wood burning stoves or the burning of fossil fuels [1]. For example, one Australian study found that occupational exposure to biological dusts was associated with an increased risk of COPD which was higher for women than men. In another study, women were more likely to develop COPD due to exposure to a natural fibre in Sicily [79]. Similarly, Chiu and co-authors (2006) found that women who lived in Taiwanese cities with the worst air pollution were more likely to develop lung cancer compared to those living in cities with better pollution indices [80]. This study is important in that only 3-4% of Taiwanese women smoke and women with lung cancer also have a low smoking rate, suggesting that the contributions of active smoking were not perceived to be confounding the relationship of air pollution.

Women are more often exposed to biomass because of its use during cooking and heating, since many women spend more time in the domestic sphere. Radon, fumes from cooking fuels and heating stoves and SHS are three lung carcinogens to which women are exposed by virtue of spending more time in the home, and are specifically a threat in developing countries [56]. For example, studies have found that women were more exposed to biomass (animal manure, peat, etc) in both China [81], and Turkey [82-84] resulting in respiratory symptoms and diseases. In developed countries, however, these risks can be perceived to be either minimal, or not necessarily gender related.

In contrast, Ernster (1996) concluded that among US women at least, the contributions of occupational exposures such as manufacturing, smelting, foundry work, and high levels of coal dust and smoke, and environmental exposures to lung cancer in women from sources such as biomass fuel, cooking smoke, and coal burning for heat, were likely not high contributors to the risk for lung cancer in women [58].

c) Pregnancy

Women who are pregnant also have greater risks for acute respiratory diseases, which can result in maternal complications [42]. Pregnant women may be more susceptible to influenza and also more at risk during an influenza pandemic [43, 85]. Because of anatomical changes during pregnancy such as the enlarging of the uterus and elevation of the diaphragm, women may be less able to clear respiratory secretions and have decreased lung capacity [43]. Having other respiratory diseases such as asthma, CF and infections such as influenza also places women at a greater risk for developing pneumonia or influenza during pregnancy [42].

In 2006, 10% of women aged 20 to 44 smoked during pregnancy in the past 5 years [1]. This is a significant contributor to the development of respiratory diseases for the child as well as the woman. For example, children of women who smoke during pregnancy are more susceptible to respiratory distress syndrome (RDS) and also the development of asthma, and may have greater future risk of COPD.

d) Diversity

Women are more likely to have a lower socioeconomic status (SES), less access to health care resources, and live in areas with more air pollution which may contribute to greater risk of respiratory diseases [54]. Although few studies have considered diverse women's respiratory diseases, evidence suggests that sub-populations of women may be more at risk for certain respiratory diseases.

Globally, women who are poor have relatively greater rates of infectious diseases such as TB [52]. Tuberculosis is a considerable health risk in many developing countries and is also a greater risk for non-white groups in developed countries. For example, rates are higher among Aboriginal people in Canada, and Asians, Hispanics/ Latinas, and Native Hawaiians in the US [9]. In the US and Canada, foreign born persons have higher rates of TB than US or Canadian born persons.

A cross-sectional study in Norway found that persons with lower educational attainment were at a greater risk for COPD independent of smoking and occupational exposures, yet this was stronger for men than women [86]. They indicate that their findings support other studies which have also found a stronger relationship between education and lung diseases in men than women. They suggest that this may be because education is a poorer indicator of social class for women than men, since women may rely more on their husband's social class (especially older women) and because the income level for the same educational level differs between women and men [86]. In contrast, Osann (1991) notes an inverse gradient of education associated with lung cancer in women, which may reflect occupational exposure or a combination of other factors [87].

In the US, risk and mortality from respiratory diseases is greater for African American women. For example, one study found that African Americans were the most susceptible (SI= -1.42%) and Caucasian males the most protected (SI= -0.93%) from smoking related illnesses [88]. Other studies have also found that women

and African Americans present respiratory symptoms at an earlier age and with fewer pack-years of smoking than Caucasians and males [89]. Yet, incidence of the only currently known genetic risk factor for COPD, alpha-1 antitrypsin deficiency, is higher among Caucasians than African Americans [88].

Furthermore, non-white minorities may be more exposed to smoke, both actively and passively, contributing to greater morbidity and mortality. For example, smoking rates are higher for Aboriginal people in Canada. Rates of smoking for First Nations on reserves are 58.8%, and 36% for Aboriginal people living off reserves [1]. For young adults on reserves (aged 20-24), the rates are approximately 70%, making the risk for developing respiratory related illness substantially greater. Similarly, in the US, smoking is higher among American Indian and Alaskan women, yet lower for Asian women [23]. Smoking rates also tend to be higher among people with a lower income or SES [23]. Women and men on a fixed income have less resources and opportunities for smoking cessation. For example, they may not be able to afford nicotine replacement therapies (NRT) or other treatments or therapies [23].

A literature review by Johnson et al. (2006) reveals that tobacco use among people with mental illness is approximately double that of the general population, and even greater for persons with alcohol and drug dependencies [90]. These higher rates of smoking result in greater rates of morbidity and mortality from respiratory diseases. Furthermore, findings from this review indicate that there are specific dependence and cessation issues for persons with mental illness and addictions which impede respiratory health, and must be considered when tailoring cessation programs. Other studies also reveal links between mental illness and increased risk for respiratory diseases in women and men [91, 92]. Sanchez-Mora et al. (2007) found a high prevalence of respiratory morbidity in patients (both women and men) with chronic mental illness who were hospitalized in long-term care facilities, largely due to factors such as poverty, tobacco use, overcrowding, and dietary deficits [93].

Persons suffering from respiratory illnesses have also been found to experience lower levels of mental health. In a study by Goodwin et al. (2006), obstructive lung function was associated with lower overall well-being and higher rates of depression in women and men [94]. Similarly, Patten et al. (2007), found an association between chronic respiratory conditions and major depressive disorder, bipolar disorder, panic disorder, social phobia, and substance dependence [95]. Furthermore, mood and anxiety disorders were found to be more common in women in this study. Studies with women have found that experiencing chronic respiratory illness often results in depression [14, 96].

e) Other factors

Ernster (2000), in her review of risk factors notes that breast cancer patients treated with radiotherapy have a 2-3 fold greater risk of developing lung cancer, compared to breast cancer patients who do not have radiotherapy, and this risk in greater in smokers compared to non-smokers. This effect was delayed, and was noted 10 years post breast cancer treatment [75].

According to Akhmedkhanov and colleagues (2002), there is an inverse relationship between regular aspirin use and lung cancer in women. This study followed up on a result from 1988, that indicated the same relationship, but clarified that this inverse relationship is true for women, but not for men. This relationship was strongest for women who had taken aspirin for 5 years prior to diagnosis, compared to short term use, such as 4 weeks prior to diagnosis, which did not show a relationship to risk of lung cancer at all. In addition,

aspirin use was related to prevention of non small cell cancers only. The likely mechanism is in reduction of inflammatory responses that inhibit the synthesis of prostaglandins from arachidonic acid [97].

2) Presentation and Diagnosis

Women and men present with different symptoms for various respiratory diseases. While the reasons for this are not entirely clear, sex and gender related factors are involved. As well, women are often under-diagnosed or mis-diagnosed for certain diseases, due to these differences in presentation as well as gender bias and self-efficacy issues in the health system. Further research is needed to examine these issues.

a) Presentation

Some evidence suggests that women and men present with different symptoms or forms of respiratory disease. In a retrospective analysis of over 1000 lung cancer patients in Geneva, de Perrot and co-authors (2000) report that, compared to men, women with non small cell lung cancer are more likely to be asymptomatic, and non-smokers or light smokers are more likely to get adenocarcinomas compared to men [35]. Osann (1991) reported that women with lung cancer who had smoked were more likely to get squamous cell, small cell and large cell cancers than never smoking women with lung cancer, who most often got adenocarcinomas [87]. Women tend to have more asymptomatic presentations, whereas men displayed weight loss, hemoptysis, thoracic pain and lung infection. Hence, more asymptomatic tumours were discovered in women than men during routine chest X-rays [35]. A small study by Ouellette and colleagues (1998) in Quebec, reported that men were more likely to present with chest pain, hemoptysis, and cough, while women presented with pain, cough and dyspnea [76].

Studies looking at women's presentation of COPD, have found that women report different symptoms than men, and develop COPD at a younger age [54]. For similar severity of COPD, women report worse symptoms [17]. They have relatively greater reductions in breathing capacity in comparison to men, due to smaller lung capacity and airways, and less ventilatory muscle mass [17]. Women also use a greater quantity of their lung capacity, resulting in more shortness of breath and increased effort to breathe [17]. Some evidence suggests that men may have more emphysema and women more inflammation of the airway wall [60].

It is also possible that women and men experience the same symptoms, but report differently [98]. For example, women are less likely to report sputum production, whereas men may be less likely to report breathlessness due to gender-specific norms and ideals [98]. Part of this may be that women are less likely to admit to sputum production due to shame or embarrassment.

b) Issues with diagnosis

Because women and men have minimal symptoms in the early stages, it is difficult to diagnose and treat COPD effectively. Often, the initial diagnosis for COPD for women is made at hospitalization, when the disease is in its advanced stages [17, 60]. Women and men are asymptomatic for as long as 30 years, at which point the symptoms may be attributed to old age rather than disease. Up to 50% of lung function can be lost before symptoms are recognized and reported.

Undiagnosed COPD often precedes a diagnosis with lung cancer. Women with COPD often develop lung cancer, in part due to a steady decline in lung function, but lung cancer is usually detected before they are ever diagnosed with COPD [60]. Women who develop lung cancer after COPD present with greater inflammation in their lungs than women who do not develop lung cancer [60].

Further, women with COPD are more often diagnosed with asthma than men (58% versus 42% of the time) [52, 99]. Spirometry is under-used, particularly for women, but could substantially reduce the risk of under- or mis-diagnosis for both women and men [17, 54, 98]. As well, the use of methacholine challenge tests for asthma should help alleviate bias [98]. Spirometry needs to be used more aggressively for women, especially: smokers, ex-smokers, women with a cough, dyspnea or sputum, and women with frequent respiratory tract infections [17].

Another barrier to effective diagnosis of women's respiratory disease is the self-efficacy of individual health care providers. For example, it is possible that physicians may be reluctant to label respiratory symptoms as COPD because it is regarded as irreversible and difficult to treat or manage [15, 100]. Health care providers should be advised in ways they can improve women and men's lives through early and accurate diagnosis.

Diagnosis with respiratory disease may prompt women, and those around them, to quit smoking. In a study of 65 women, Sarna (1995) examined smoking behaviours of women post lung cancer diagnosis and found that 51% had quit at the time of diagnosis [101]. Yet, symptoms post diagnosis and treatment did not differ between the smokers (n=5) and the non-smokers. While some family members of the women diagnosed with lung cancer did also quit, 58% of the women lung cancer survivors in the study had family members who continued to smoke. Sarna concludes that lung cancer diagnosis is a pivotal time for smoking cessation and should be acknowledged and supported by health professionals, particularly in hospital settings. In another study examining quality of life for women with lung cancer, Sarna and colleagues (2005) report that 13% of the women continued to smoke [96].

i) Sex and gender bias in diagnosis

The known rates of respiratory diseases are based on either: administrative databases, self-report, or lung function testing in large population based samples [98]. Each method may contribute to under-reporting. For example, codings used in administrative data may be gender biased, and there is evidence that women may self-report more than men [98]. Some authors suggest that women's greater diagnosis with asthma may also be a result of women visiting the physician more often than men [13, 14, 100]. Further research is needed exploring gender differences in reporting symptoms, accessing health care services, and potential gender biases in the health care system.

Some studies have shown that sleep apnea is more common in men than women. But this difference may also be related to gender biases resulting in under-diagnosis [102]. One study examined whether clinical guidelines are gender biased but did not find differences in symptom reporting; snoring was the strongest indicator for both women and men. Instead, health care providers may not attend to symptoms in women as in men [103]. For example, women with sleep apnea are less likely to be referred to sleep laboratory tests, even though women experience similar well-known symptoms of sleep apnea, such as snoring and daytime fatigue [104].

Similarly, Chapman and co-authors (2001) examined whether women were less likely to receive a diagnosis of COPD and whether under-use of lung function measures was a contributing factor [100]. They found

that initially, COPD was more often given as a likely diagnosis for men than women (58% vs. 42%, $p<0.05$). After spirometry, diagnosis rates for both men and women improved, but women were still less likely to be diagnosed (74% vs. 66%, p not significant). Using a survey for a random sample of physicians (96 American and 96 Canadian), they presented a hypothetical case of cough and dyspnea, differing only in sex and age of the patient (random age was assigned between 47 and 59 for each of the sexes) [100]. This study demonstrates that even when women and men present the same symptoms, providers may not interpret symptoms in the same way.

Further, sex and gender may interact to influence women's diagnosis with respiratory diseases. For example, while more women have TB (ratio of women to men is 1.5-2.1/ 1), more males are often diagnosed with TB than women [51, 105, 106]. Men are also more likely to have positive skin tuberculin tests, while less women are positive on sputum sampling [52]. Differences in immune responses may account for some of these differences. Finally, there may also be gender differences in perceptions and behaviors associated with TB, as well as a gender bias by health care providers. For example, researchers in Vietnam have suggested that women may practice more self-medication prior to seeking medical advice [107].

3) Management and Treatment

a) Management and outcomes

In general, women with respiratory diseases tend to report more hospitalizations, more limitations in activity and higher rates of anxiety and depression associated with disease. These overlapping issues may contribute to higher rates of mortality. Pulmonary rehabilitation has been shown to be effective for both women and men, but may be more effective for men over time.

i) Limitations in activity

Women with COPD are more likely to limit activities due to difficulties in breathing, yet are less likely to reduce cigarette consumption following diagnosis with COPD [17, 54]. Similarly, some evidence shows that women report a lower level of health and more limitations due to asthma, more symptoms and triggers, more use of medications and more acute visits for asthma [108]. Women are also more likely to have been given an asthma care plan, received asthma education class, and use peak flow metre. In general, women report poorer quality of life than men but better quality of care.

ii) Hospitalizations

Hospitalization rates for men with COPD in Canada are higher than in women, matching the highest incidence rates which are for elderly men [1]. But hospitalization rates between 1989 and 2004/05 rose in women over 60 years of age, partially due to increased smoking among women. Women are less likely to seek emergency care within the first 24 hours of exacerbation of COPD [98]. Yet men exhibited a higher risk of repeat hospital admissions for acute exacerbations than women [98]. In contrast, other evidence suggests that women have higher hospitalization rates than men for COPD due to later stage of diagnosis [15].

Women are more likely to be hospitalized for asthma. For example, one study in this review found that women were 3.7 times more likely to be hospitalized for asthma [109]. Yet, men who are hospitalized tend

to have longer hospital stays, suggesting potential differences in severity between women and men [109]. A study by Trawick and co-authors (2001) observed longer hospital stays for women, when comparing women and men who were all high-risk asthma patients [110]. Women may be more likely to be admitted, because of differences in: size of airways and responses to airway narrowing, and use of inhalers. Other possibilities include: physician biases regarding education and treatment, differences in access to care, the influence of sex hormones, and greater household exposures for women related to gendered roles (e.g. child care, cleaning, and cooking) [109].

iii) Quality of life

One questionnaire based study of female and male outpatient asthmatics found that women reported poorer health related quality of life (HRQL) than men, alongside with greater depression and anxiety [111]. In one review, the authors found that women who were hospitalized for asthma exhibited more anxiety and depression than men [109].

Data analysis showed that women with chronic cough were more likely to seek medical help than men (3 to 1), likely because women more often had physical complaints and psychosocial issues related to symptoms [99]. For example, women were more likely to report stress incontinence, extreme physical complaints (sick stomach, retching, etc), a lack of social support and feelings of shame [99].

Women with COPD often report feelings of loneliness (96.7% of patients with COPD and 93% of their spouses report moderate to high feelings of loneliness) [112]. Women with COPD also report lower quality of life scores and greater depression, anxiety and fatigue compared to men [98]. Similarly, one qualitative study of women with COPD in pulmonary rehabilitation found that women frequently cited a variety of issues, including: fatigue, depression, stigma, intimacy issues and loss of social support. Many women who participated in this study had lost jobs, family, and relationships due to their disease.

Sarna and colleagues (2005) examined the quality of life (QOL) in 217 women diagnosed with lung cancer, in a prospective cross sectional descriptive study, and found that younger age, depression and co morbidities exacerbated the negative meanings of illness and lowered the QOL [96]. Generally, their study showed that QOL diminished with increases in physical symptoms, and was affected by disruptions in psychological well being, particularly related to fears of reoccurrence. A third of the women had depressed mood. In a previous study she had found that for non-Caucasian women, spiritual QOL was higher than for others, as was a positive Meaning of Illness (MOI) [113]. Overall, Sarna and colleagues suggest that more attention be paid to the emotional and physical well being of women with lung cancer post treatment completion, such as in person or telephone support or other proactive measures.

iv) Stigma

Stigma has been identified as an important issue for women with respiratory disease. In particular, smoking related diseases may be under-diagnosed due to a social perception that the disease is self-inflicted [15, 112]. Unlike some other diseases, sufferers may be held accountable for their illness [112]. There is some evidence that delays in diagnosis for both lung cancer and COPD are due in part to forms of structural discrimination such as the failure of doctors to take 'smokers cough' seriously [114-116]. As well, terms sometimes used by health professionals to describe people with emphysema as "pink puffers" and those with chronic bronchitis as "blue bloaters" further stigmatize people with COPD [112]. Indeed, there is evidence that physicians in Canada are actively biased against people with smoking-related diseases. Thus,

in a recent survey commissioned by the Canadian Lung Association, up to 25% of doctors admitted to discriminating against smokers in terms of quality of health care [6]. Another recent US survey also found that almost 9 of 10 physicians described COPD as a "self-inflicted" disease [114]. Indeed, a general lack of awareness of COPD combined with a nihilistic approach to the disease amongst health professionals [6] has meant that there are few support services available for those people who suffer from this illness.

Negative attitudes also appear to extend to the public, as the Canadian Lung Association survey found that many Canadians believe that people who smoke deserve whatever disease they get [6]. Such findings suggest that a great deal of the stigma attached to smoking-related diseases exists because the people are seen to have brought their ill health upon themselves – a message that has likely contributed to the tobacco control campaign of social denormalization.

Despite the indications that people experiencing smoking-related diseases are discriminated against by both medical professionals and the public, there has been very little research that specifically sets out to explore the experiences of these women and men. The limited available evidence does suggest that people experiencing lung cancer and COPD are stigmatized because of the association between the disease and smoking and the perception of these diseases as self-inflicted [14, 112, 115, 116].

Johnson has identified some gender specific issues associated with stigma and COPD [112]. People with respiratory disease such as COPD experience a "closing in" of their world as activities become increasingly more difficult [15]. Further, women with COPD are easily identifiable with oxygen equipment and limits to activities [112]. This 'marking' of women with COPD is also enhanced by changes in physical appearance, such as weight loss or the development of a barrel chest, which may be especially troubling for women, who are encouraged to meet social standards of beauty [112]. Similarly, women with lung cancer experience similar marks of stigma. Cancer treatments can lead to hair loss, scars and other physical changes [112]. Some women may cope by wearing a wig [117]. Women with COPD and other respiratory diseases may also delay or avoid seeking care due to the shame felt with this disease, or may limit using some medications [112].

v) Diversity

Black children with asthma have reported greater restrictions of activity and more hospitalizations than White children with asthma. Some evidence has shown that Black persons have greater hospitalization and prevalence rates than Whites [108]. Both women and African Americans report less frequent asthma attacks than males and Whites but more asthma related ED visits and hospitalizations [108]. African American children and adults with asthma also have greater risk of mortality, and the death rate is increasing more quickly in African Americans than White Americans [118]. Similarly, Black patients with pneumonia report lower quality of care [29].

vi) Pulmonary rehabilitation

Pulmonary rehabilitation often includes a combination of exercise therapy, nutritional counseling, and education [98].Pulmonary rehabilitation is important for persons with respiratory disease, by helping patients to manage and maintain daily living and prevent sedentariness [15]. Most studies examining its effectiveness have only included men but there is some evidence suggesting that both women and men report improvements in health related quality of life (HRQL) after rehabilitation [98]. But, men have demonstrated more sustained and increasing improvements over time when compared with women [98].

In one study, women in rehabilitation indicated that they benefited most from using breathing and meditation techniques, rest, and avoidance of triggering exposures (smoke, dust, etc) [14]. Findings suggest that nurses who work in pulmonary rehabilitation should be taught methods to help women control dyspnea. Programs also need to incorporate social support and ways of dealing with isolation and depression [51].

vii) Sex and gender issues in treatment

Some treatments may be less effective for women. For example, buproprion has been shown to be more effective for smoking cessation in men than women (34). One study also showed that budesonide, used for men and women with COPD, led to a reduction in phlegm for men but not women [98].

In addition, there are sex and gender based differences in the treatments that women and men received. In the de Perrot (2000) study, after diagnosis with lung cancer, women were less likely to receive bronchoscopy and more likely to receive fine needle biopsy under fluoroscopy than men. Pneumonectomy was more likely performed in men, and segmentectomy performed in women [35]. In the Ouellette study (1998), women were given CT scans of the brain more often than men, most likely due to their higher incidence of adenocarcinoma which has the highest propensity of all lung cancers to metastasize to the brain [76].

Women may also receive less aggressive therapies and treatments than men. For example, oxygen therapy decreases mortality but is under-prescribed for women. Oxygen therapy should be prescribed to prevent oxygen levels from going below 90% saturation during regular exertion [15]. As well, women have more asthma related hospitalizations and trips to the emergency room, and yet receive less aggressive asthma treatment than men. Corticosteroids may not be prescribed initially for women because of its potential effect on osteoporosis and pregnancy [12].

Conversely, because women are more often labeled as having asthma, they may be prescribed corticosteroids, resulting in loss of bone density [98, 100]. Even asthma patients taking low levels of prednisone will likely experience some bone loss [13]. Yet bone loss is most severe with oral steroids, rather than inhaled steroids. The use of estrogen replacement therapy, or supplement use (vitamin D and calcium) and weight bearing exercises may help protect asthma patients somewhat.

As well, women may have barriers to certain treatments. Women often have multiple roles and responsibilities, which may limit access to some health care resources and treatments. For example, women with TB in developing countries often can not access treatments due to demands in the home, agriculture and waged work, that must be fulfilled [51]. Therefore, women may not have the time or capacity to access necessary health care. While the WHO has implemented an initiative called DOTS (directly observed therapy), where health care workers observe the patients using treatment, this approach may be inaccessible for women who do not have the time or resources to meet with health care workers.

Yet, women may have better outcomes after treatment for some respiratory diseases. Several authors have studied mortality rates after treatment for lung cancer and found that women do live longer following lung resection [37, 119]. Similarly, in the de Perrot (2000) study, women had a better prognosis than men independent of age, symptoms, smoking habits, type of surgery, histology and stage of disease [35]. These authors stress that to further and better treat women, sex stratified clinical trials are required to more fully examine sex specific treatment protocols such as using anti-estrogen treatment, for example, or potential differentiation in selection of patients for therapy based on sex.

BC Context

a) Social climate

Findings from BC indicate that the population here is the least sympathetic towards smokers—51% of people surveyed stated that someone who smokes deserves the consequences [6]. This is a troubling finding, in consideration of how this contributes to stigma and creating barriers to health care both by patients and by health care providers [6]. For example, 8% of physicians in BC admitted to discriminating against smokers for health care [6]. As Johnson (2007) has indicated, stigma may have greater repercussions for women, who are already more likely to be living alone and have less access to social support and health care resources [112]. Denormalization may actually increase stigmatization [54].

Yet the smoking rate in BC is the lowest in Canada, which is an important rate to maintain and further reduce in order to prevent more disease and death from respiratory illnesses. It is crucial to find sex, gender and diversity sensitive ways to support diverse women's smoking cessation.

b) Health care

Although BC has the highest rate of physicians with access to spirometry (85%), only 33% of physicians have used this tool and even less (15%) are comfortable with interpreting findings [6].

In total, there are 9 pulmonary rehabilitation services in BC, with 14 programs [6]. Survey data shows that approximately 70% of physicians have recommended COPD patients for pulmonary rehabilitation [6]. Pulmonary rehabilitation programs need to be expanded to increase the range of access for diverse populations.

c) Sub-populations at risk

- **Women who smoke.** Recent data from CTUMS (2007) indicates that the prevalence of smoking among teenage boys and girls is the same, at 15%. In British Columbia, broad population statistics reflect the lowest rate of smoking in Canada [120, 121], but specific subpopulations are at higher risk for smoking, such as Aboriginal people, and girls in particular [122]. Data from 2003 indicates that 16.1% of women 12 years and older in BC were current daily or occasional smokers [122].
- **Aboriginal women.** Forty percent of Aboriginal women in BC were current daily or occasional smokers. Morbidity and mortality related to tobacco use remains very high among Aboriginal people in Canada. Men and women on native reserves have a 40% higher rate of stroke and a 60% higher rate of heart disease than other Canadians. Lung cancer is a major cause of death – Inuit women have among the highest rates in the world. There is also evidence that environmental tobacco smoke (ETS) contributes significantly to respiratory disease in Aboriginal children [123].

  Smoking rates among Aboriginal teenaged girls are the highest of any group in British Columbia. 32% of female Aboriginal teenagers report current smoking, compared with 22% of Aboriginal male teenagers,

17% of all BC female teens and 13% of all BC male teens [1]. Given that 50% of the Aboriginal population are aged 25 years or less [124], the early age of smoking initiation, and the high prevalence of tobacco use, tobacco use, prevention and cessation research and program development is an urgent priority. Traditionally, high smoking rates among Aboriginal and other populations have been explained in terms of the accumulation of statistical risk factors for tobacco use, including parent and peer smoking [125], history of abuse and traumatic life events [126], and low-self esteem and depression [127]. However, further research is needed to explore how these and other factors overlap.

- **Women with mental illness and/or addictions.** Women with mental illness and/or addictions are another sub-population at risk in BC, given that smoking rates for persons with mental illness are approximately double that of the general population, and even greater for persons with alcohol and drug dependencies [90]. Furthermore, findings from this review indicate that there are specific dependence and cessation issues for persons with mental illness and addictions which impede respiratory health, and which need to be considered when tailoring cessation programs.
- **Women with low socioeconomic status.** Women who are living on a low income are more likely to smoke and live in areas with greater air and water pollution than middle and higher income women, and thus face a greater risk of developing lung diseases [54]. In BC, women are more likely than men to have incomes under the poverty line. The average income of women in BC was $23, 500 in 2005, which is lower than the Canadian average of $26, 800 and only 64% of men's earnings in BC ($41, 900) [128]. Women also have a slightly higher chance of being exposed to low-income for at least one year (19%) compared to men (17%)[128]. It is further estimated that ¼ of all BC women and almost ½ of BC's single mothers earn less than the low-income cut-off ratio [129].
- **Older women.** In particular, older women are at a greater risk for developing COPD. In BC, 5% of women and men have been diagnosed with COPD, and approximately 47% of these cases are women but as discussed in this review, many more women are undiagnosed or misdiagnosed, and these rates are rising. This is a disease which affects older populations disproportionately [130], and is an important concern in light of the growing aging population in BC. The rate of elderly women in BC has increased by 72% since 1981, and the growth rate of elderly women, 65 years and older is approximately twice that of women under 65 years of age [131]. Further, older women often live in poverty and with little social support. Special consideration should be given to the health needs of older women, in regards to: prevention, diagnosis and treatment.

Considerations for Action

Based on this review, there are a number of key messages and areas where action should be considered. They are as follows:

a) Expanding research

Sex, gender and diversity issues need to be included in research, programs and policies associated with respiratory diseases. Few studies examine issues for diverse groups of women such as non-white minorities or women on low income. Often gender differences are not specifically discussed even when both women and men are included in the study design [8]. This was commonly found when searching for articles on gender and sex issues of respiratory diseases. In addition, links need to be made between research on lung health, women's health and tobacco prevention to effectively address women's respiratory diseases [54]. Connections must also be made between research, programs and policy so that emerging findings are translated to health care settings and decision makers [132].

For example, despite the growing evidence suggesting sex differences in lung cancer, the field is hampered by earlier assumptions that perceived lung cancer as a male disease, and clinical trial designs that either excluded women or did not include women in studies of cancer prevention and early stages of diagnosis and cancer development. Patel and colleagues (2004) suggest that future lung cancer research specifically include women according to the true incidence of lung cancer in women. Emerging data on sex differences in lung cancer also indicate that screening, evaluation and treatment should be sex specific and tobacco cessation and lung cancer prevention programs reflect these data [52].

In studies examining the effects of smoking on respiratory disease for women and men, analyses are either performed for each separately or control for gender, thereby eliminating the possibility for any discussion of gender differences [53]. As well, there is little research looking at sex and gender issues related to TB, pneumonia, influenza and other respiratory diseases. Further, the studies that do exist tend to focus on women during pregnancy, reinforcing a narrow and normative approach to women's health.

Furthermore, much of the evidence we have comes from population based studies with white samples, and we still know little about diverse women's respiratory health. There is very little research exploring why differences exist between different races/ ethnicities and other sub-populations of women. In BC in particular, more research, policy and program development for Aboriginal girls and low income women is a significant priority.

b) Implementing better practices and guidelines

As indicated in this synthesis, the use of spirometry has been identified as an important diagnostic tool, yet is under-used for women and men. Further, physicians in BC have the greatest national access to this tool, but it is still under-used for COPD diagnosis. Greater awareness and training related to the use of this could result in earlier diagnosis for women. Physicians need to be educated on the benefits of using spirometry and receive training so they are comfortable performing this test and interpreting results [17].

Further, physicians should be encouraged to follow up with at risk patients and should be advised on gender differences in symptom reporting.

In general, more gender and diversity sensitive guidelines, programs and policies are required. Programs are needed that address issues of awareness for the public and for health care providers. Only 45% of Canadians have heard of "chronic obstructive pulmonary disease" and 17% of "COPD" [6]. Further, 56% of physicians indicated that COPD is not considered a government priority. While there are pulmonary rehabilitation programs across the country, access remains low. This is particularly true for sub-populations such as women who are Aboriginal, living in rural areas or living on a fixed income. For example, one review found that many educational materials and policy documents continue to present COPD as a disease affecting men or do not discuss gender differences, thereby reducing women's access to proper diagnosis, interventions and treatments [54, 132]. This is further exemplified in the national report card on COPD in Canada, which does not discuss sex or gender issues.

c) Developing a provincial and national strategy

Currently, there is no existing Canada wide strategy on respiratory diseases [5], yet there is a lung health framework currently being developed through the Canadian Lung Association. Steering committees have been meeting since 2006, and will be through 2008, to plan ways to improve respiratory health and health care for Canadians through research, policy, programs and education [133]. In order for these to effectively address women's unique health needs, these will need to be considerate of sex, gender and diversity issues which shape women's respiratory health.

While there is no provincial strategy for respiratory diseases, there has been a chronic disease prevention and management framework in BC led by the Ministry of Health since 2006. Respiratory diseases and lung cancer are included within this framework. This framework seeks to engage policy and community level changes to improve chronic disease prevention and management. For example, a Chronic Disease Management Toolkit was developed and physicians were encouraged to improve the prevention of chronic disease [134]. Yet this framework does not include a specific sex and gender based component.

Developing respiratory health strategies which address gender and sex differences in health will become increasingly more important as the Canadian population ages, and the potential for huge social, economic and health-care burdens grows. In Canada, for example, the annual direct cost of the disease is $1997. 81 per patient [5]. One of the challenges in organizing a national strategy is the variety of respiratory diseases, including both chronic and infectious varieties. There are more than 30 diseases, only of which a few were covered by this synthesis [5]. As well, national and provincial strategies would need to address the unequal distribution of disease for women, Aboriginal people, and lower income populations. For example, Aboriginal people have a higher burden of COPD and asthma than non-Aboriginal people in Canada. Unique strategies are needed to address specific issues with these various sub-populations. Respiratory diseases, such as COPD, need to be centrally on provincial and national health agenda.

d) Preventive health: reducing risk

The highest rates of mortality are associated with diseases which are primarily associated with smoking or smoke exposure, such as COPD and lung cancer. Infectious respiratory diseases may sometimes be the ultimate cause of death, but often this is an exacerbation of a prior disease such as COPD or lung cancer. Yet, there is significant hope in the improvements observed for smokers who successfully quit. Speizer and colleagues (1999) in a prospective cohort study of the Nurses Health Study found that risk of lung cancer decreased rapidly after smoking cessation and 15 years later was at the level of risk of never smokers [28]. Former smokers progressively decrease their chances of developing cancer and other respiratory diseases over time. While there are steady improvements in health, former smokers may never achieve the same risk level of someone who has never smoked. For example, former smokers experience progressively decreasing risk for 25 years post cessation [73], but never achieve the same risk level of never smoking women in that period. Therefore, smoking prevention and cessation is a number one priority. It is important to prevent girls and boys from starting smoking and identify effective strategies for encouraging and supporting women and men in their cessation efforts.

Studies suggest that when women quit they recover greater lung function than men who quit smoking [60]. Yet, women have a harder time quitting and experience greater relapse rates than men [23]. For example, while up to 50% of women who smoke quit smoking during pregnancy, many of these women (70-90%) relapse within one year post-partum [135]. Women may not receive information or advice related to nicotine replacement therapies (NRT) as often as men [23, 136]. Yet, NRT may be an important quit tool for women, especially women who are concerned about weight gain.

Women also experience greater rates of depression, which may impact their relatively higher relapse rates [52]. It has been suggested that using bupropion during quitting may be helpful for women who are experiencing depression, since this is a mild antidepressant which is effective for smoking cessation in some people [52]. In addition, social support and follow-up will be crucial for gaining and maintaining women's smoking cessation.

Since women have more trouble quitting smoking, it is important to address the issue of maintenance and provide effective follow up and support for women who are trying to quit, especially women who have less social support or access to health care resources [137]. Given the adverse consequences of exposure to SHS, gender sensitive policies are also needed to address issues of exposure for women [15]. Reducing exposure to SHS and other contaminants is key to preventing flare ups in symptoms associated with various respiratory diseases.

i) Smoking cessation interventions for women

Studies examining cessation interventions for women tend to focus on pregnant or postpartum women. While this is a significant concern, the disproportionate amount of activity and research in this area potentially invalidates women's health in and of itself. Yet some interventions have included other sub-populations of women and therefore have implications for the development of effective tobacco cessation for women in BC.

In particular, some evidence suggests that multi-component interventions may be effective for improving women's quit attempts and cessation. One multi-component motivational cessation intervention with low SES women found that smokers who were exposed to an intervention were more likely to have quit (14.5% versus 7.7%) or had exhibited more attempts or motivations to quit when compared with a control group

[138]. The intervention included: a video segment and posters displayed in waiting rooms of clinics, advice to quit by a primary health care provider and a motivational book on quitting smoking. A smoking cessation counselor also followed up with patients via phone call and mail support. Further research is needed exploring the usefulness of multi-component cessation interventions for women who smoke.

Women who demonstrate intention to quit and self-efficacy may be more likely to participate in interventions [139]. In addition, community based participatory interventions in which women who smoke are integral to the planning of program have been shown to result in cessation and more quit attempts [140]. One intervention with COPD patients also found that using spirometry to measure airflow limitation was effective for women and men, and resulted in more quit attempts [141]. Cumulatively, these findings suggest that improving: women's awareness of and perception of risk through diagnosis, and self-efficacy to quit as well as including women in program development will contribute to more effective cessation interventions.

The effects of pharmacological interventions are different between women and men. While bupropion has generally been found to be more effective for men than women, one study which looked at the effectiveness of buproprion for smoking cessation for women and men with COPD found that smoking cessation was improved for both women and men compared to a control group who were taking a placebo [142]. In addition, one review of smoking cessation interventions suggests that NRT may also be as effective for women when behavioral counseling is provided [136]. Counseling is important for addressing depression and emotional issues, as well as weight gain, social support issues, and environmental cues.

Finally, a number of studies included in the review discuss psychosocial issues and depression for women, which may significantly imped women's success at quitting smoking. Interventions which incorporate social support may be useful for women who are trying to quit smoking, particularly women from lower SES groups who have less access to social resources. Strategies that may be helpful include: increasing women's access to leisure and recreational facilities as well as employment training, and teaching coping skills such as breathing and exercise. Potential also lies in making cessation aids more accessible to women and men who are trying to quit, by providing health care coverage for tools such as NRT. The implementation of a rehabilitation program for women who smoke may prove useful for women who are attempting to quit. Group programs may also provide opportunities for women to improve social networks. One challenge to facilitating cessation interventions for women is accessibility, since women may not have the time or economic or social resources to access cessation programs.

Conclusion

There is a wide range of respiratory diseases. These are present in different global and regional patterns, and genders, age groups and other sub-populations. In general, asthma has high prevalence but low mortality rates for women. TB has high rates globally and in certain sub-populations in Canada including Aboriginal women, and therefore should be part of a provincial and national strategy. Other infectious respiratory diseases such as influenza and pneumonia are significant causes of mortality for elderly persons in Canada, often due to complications with other respiratory illnesses. Yet, the diseases which carry the greatest morbidity and mortality risks for women in Canada are COPD and lung cancer. Furthermore, these diseases are largely preventable through smoking prevention and cessation.

Strategies for respiratory diseases need to consider the sex, gender and diversity based factors in women's susceptibility to disease, presentation of symptoms and diagnosis, and management and treatment of disease. Future programs, policies and research need to include a sex, gender and diversity lens in order to accommodate and broaden what we know about diverse women and men, and apply this to health care actions. Furthermore, links need to be made between the lung health, women's health and tobacco prevention research to consolidate efforts in preventing respiratory diseases. Specifically, multi-component strategies that address reasons why diverse women smoke and work at reducing smoke exposure for women will have the greatest implications in reducing mortality from respiratory diseases.

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