ASSESSING ADMINISTRATIVE DATABASES FOR SURVEILLANCE OF DEPRESSIVE DISORDERS IN NEWFOUNDLAND AND LABRADOR

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By

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Abstract

The objective of this study was to assess the usefulness of provincial administrative databases in carrying out surveillance on depressive disorders. Electronic Medical Records (EMR) at three family practice clinics in St. John's were audited based on a sample of patients classified as being diagnosed or not diagnosed with a depressive disorder. The EMR served as the "gold standard", which was then compared to these same patients investigated through the use of various case definitions applied against the provincial hospital and physician administrative databases. Variables used in the development of the case definitions were depressive disorders diagnoses (either in hospital or physician claims data), date of diagnosis, and service providers type (general practitioners vs. psychiatrists). This study found that provincial hospital and physician databases are useful for carrying out surveillance on depressive disorders using certain types of case definitions. The inclusion of medications dispensed to patients was found to increase the sensitivity and decrease the false negative rate for certain case definitions. The availability of prescription data from population-based Pharmacy Networks in the development of case definitions presents an opportunity for the development of more advanced surveillance methods for depressive disorders in Canada.

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Dedication

I would like to humbly dedicate this dissertation to:

- My beloved late grandmother, Khanem (خانم), who gave me love and showed me how to love. She is now in heaven where she belongs and I wish I could have held her warm hands when I was writing these lines. I always miss you!

- My wonderful parents, Ata and Shahin, who have raised me to be the person I am today. You have been with me every step of the way, through good times and bad. Thank you for all the unconditional love, guidance, and support that you have always given me, helping me to succeed and instilling in me the confidence that I am capable of doing anything I put my mind to. Thank you for everything. I love you!

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- And finally to my loving aunt, Nasrin, whose care and love is unconditional and never ending moral support and prayers always acted as a catalyst in my life. And a real Sufi and soul mate who showed me faith and walked me through the "Path".

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List of Abbreviations

CCHS	Canadian Community Health Survey
CI	Confidence Interval
CIDI	Composite International Diagnostic Interview
CIHI	Canadian Institute for Health Information
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition - Text Revision
EMR	Electronic Medical Records
FN	False Negative
FP	False Positive
GP	General Practitioner
HIC	Human Investigation Committee
ICD-10	International Classification of Diseases 10th Revision
ICD-10-CA	International Classification of Diseases 10th Revision – Canadian Enhancement
ICD-9	International Classification of Diseases 9th Revision
MAOIs	Monamine-oxidase inhibitors
MCP	Medical Care Plan
MINI	Mini International Neuropsychiatric Interview
NDSS	National Diabetes Surveillance System
NLCHI	Newfoundland and Labrador Centre for Health Information
NPHS	National Population Health Survey
NPV	Negative Predictive Value
NSAIDs	Nonsteroidal Anti-inflammatory Drugs
PPV	Positive Predictive Value
ROC	Receiver Operating Characteristic
SAS	Statistical Analysis Software
SCAN	Schedules for Clinical Assessment in Neuropsychiatry
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
SSRIs	Selective serotonin reuptake inhibitors
TCAs	Tricyclic antidepressants
WHO	World Health Organization

ORGANIZATION OF THE DISSERTATION

This dissertation is organized into five chapters as follows: Chapter 1 provides background information on the purpose of the study, the research problem, and the rationale for this study. Chapter 2 describes the background information about depressive disorders, as well as a review of the relevant literature on surveillance of depressive disorders using various methods, particularly administrative databases. Chapter 3 outlines the methods used to address the research questions, while the results of this study are organized in Chapter 4. Chapter 5 presents a discussion of findings in relation to the existing literature, as well as a summary of the strengths and limitations of methods employed in this study.

CHAPTER ONE: INTRODUCTION

This chapter provides background information on the purpose and objectives of the study, the research problem, and the rationale for this study. It also outlines the organization of the dissertation.

1.1 Purpose

The purpose of this study was to assess the usefulness and validity of using provincial administrative databases for carrying out surveillance on depressive disorders. Depressive disorders focused on in this study included major depressive disorder, dysthymic disorder, and depressive disorders not otherwise specified (e.g., minor depressive disorder, recurrent brief depressive disorder).

1.2 Objectives

The objectives of this study were:

- To develop valid case definitions for surveillance of depressive disorders among the adult population in Newfoundland and Labrador using administrative data;
- To investigate predictive factors associated with diagnoses of depressive disorders, based on select case definitions.

1.3 Research Questions

The specific research questions addressed in this study were:

- Can provincial administrative databases be used to identify patients with depressive disorders in Newfoundland and Labrador, and ultimately for the surveillance of depressive disorders?
- What is the sensitivity, specificity, and positive and negative predictive values of select case definitions?
- What is the most appropriate case definition(s) for studying depressive disorders using administrative databases?
- What factors (e.g., medical conditions such as anxiety) are associated with depressive disorders coding/billing?

1.4 The Research Problem

Mental disorders are common worldwide and are associated with considerable socio-economic burden. Depressive disorders are one of the most common categories of mental disorders (Rihmer & Angst, 2005), and often accompanies other chronic diseases such as cardiovascular disease, diabetes, cancer and rheumatoid arthritis. Depressive disorders include major depressive disorder, dysthymic disorder, and depressive disorders not otherwise specified. The prevalence of major depressive disorder in Canada is estimated at 4.8% (Health Canada, 2006), with women being more impacted than men (Rihmer & Angst, 2005). The economic burden of mental disorders in Canada was estimated to be $51 billion in 2003 (Lim et al., 2008).

One of the first challenges in building epidemiologic knowledge of any health condition is to establish the burden associated with it. The field of psychiatric

epidemiology has been slow in meeting this challenge, in part because of disagreements about thresholds regarding the presence of the condition, and because of the failure to establish a reliable measure (Eaton et al., 2008).

While there have been regional studies of mental illnesses in Canada, there is a dearth of national and provincial data available on the prevalence/magnitude of mental illnesses overall. The partitioning of health systems across community and acute care services at the provincial level has fostered a fragmented approach to the collection of data on interventions specific to mental health. As a result, we do not have an accurate picture of the incidence, prevalence or nature of mental disorders in Canada, which hinders our ability to evaluate the effectiveness of policies, programs, and services aimed at mental health. As well, the lack of a comprehensive national surveillance system specific to mental disorders impedes efforts to monitor and subsequently improve mental health care delivery.

This study was undertaken to address this challenge by assessing the usefulness and validity of using administrative databases for surveillance of depressive disorders among the adult population in Newfoundland and Labrador.

1.5 Rationale for Using Administrative Data for Surveillance of Depressive Disorders

A number of methods can be employed in conducting surveillance with the selection of the method depending mostly on information needed and resources available. The most commonly recognized and used source of data in surveillance are administrative

databases and surveys. However, both sources have their limitations - the former because of concerns about the accuracy of diagnostic information, and the latter because of concerns regarding the validity of self-reporting of diagnosis (Lix et al., 2008).

Administrative databases are increasingly being used for many types of research in economically developed countries given their benefits, such as larger sample size, lower cost, and increased generalizability (Harpe, 2009). Administrative databases may include a wide variety of data fields since they can be linked together at the individual level, and include large numbers of patients spanning many years. While they are considered a valuable source for many types of research, administrative databases have not been widely used for public health surveillance. This may be due to the fact that some investigators lack familiarity with database research in general (Harpe, 2009). If used appropriately, administrative data targeted at a specific segment of the population (e.g., people with depressive disorders) can be an extremely useful tool for monitoring, planning and programming across the health care system, and ultimately provide evidence that can be used to improve the health of the population.

In Canada, the planning and delivery of mental health services is an area that the provincial and territorial governments have primary jurisdiction. The federal government, primarily through Health Canada and Public Health Agency of Canada, collaborate with the provinces and territories in a variety of ways in an effort to develop responsive, coordinated and efficient mental health service systems.

CHAPTER TWO: LITERATURE REVIEW

This chapter provides background information on depressive disorders, including its epidemiology, etiology, clinical features and risk factors. The existing literature on the surveillance of depressive disorders using various methods, particularly administrative databases, is also presented.

2.1 Depressive Disorders

Depressive disorders have been described as one of the most common illnesses of humankind, but are only recently recognized as a major health problem (Akiskal, 2005). The World Health Organization (WHO) has ranked depression fourth in a list of the most urgent health problems worldwide, and estimated that mental health disorders are the leading cause of disability in the USA and Canada (2002), accounting for 25% of all years of life lost to disability and premature mortality (World Health Organization, 2004).

Depressive disorders encompass a group of psychiatric disorders in which pathological moods and related psychomotor disturbances dominate the clinical picture. Depressive disorders are best considered as syndromes, rather than discrete diseases, given they consist of a cluster of signs and symptoms, sustained over a variable period of time. In combination this represents a marked change in an individual's functioning and tends to recur, often in periodic or cyclical manner. It should be noted that a syndrome is a set of symptoms or conditions that occur together and suggests the presence of a certain disease or an increased chance of developing the disease. A disease is the actual diagnosed impairment of health or a condition of abnormal functioning.

Depressive disorders include major depressive disorder, dysthymic disorder, and depressive disorders not otherwise specified. Major depressive disorder is the most frequent depressive disorder. Clinically, major depressive episodes and dysthymic disorder are frequently co-morbid disorders. The following section describes clinical features of major depressive disorders, dysthymic disorders, and depressive disorders not otherwise specified.

2.1.1 Major Depressive Disorder

Episodes of major depressive disorders can begin over a period of weeks or even months. The *Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition - Text Revision* (DSM-IV-TR) diagnosis of major depressive disorder (Akiskal, 2005) requires: (1) depressed mood or decreased interest in usual activities, and (2) at least four additional classic depressive signs and symptoms (e.g., poor appetite or overeating, insomnia or hypersomnia, low energy or fatigue, low self-esteem, poor concentration or difficulty making decisions, feelings of hopelessness), (3) sustained for at least two weeks, and (4) cannot be explained by another process known to cause depressive symptoms (e.g., normal bereavement, certain physical conditions commonly associated with depression, or another mental disorder). Appendix A-1 presents the DSM-IV-TR diagnostic criteria for major depressive disorder.

2.1.2 Dysthymic Disorder

Dysthymia refers to a sub-affective condition having the following conditions: (1) low-grade chronicity for at least two years, (2) insidious onset with origin often in childhood or adolescence, and (3) persistent or intermittent course (Akiskal, 2005). Dysthymia is distinguished from chronic depressive disorders by the fact that it is not a sequel to major depressive disorder. In fact, patients may complain that they have always been depressed. Thus, most cases of dysthymia are of early onset beginning either in childhood or adolescence. Appendix A-2 presents DSM-IV-TR diagnostic criteria for major depressive disorder.

2.1.3 Depressive Disorder Not Otherwise Specified

DSM-IV-TR criteria for depressive disorder not otherwise specified are presented in Appendix A-3. Use of the term 'Depressive disorder not otherwise specified' is justified when the depressive features do not merge into a full syndrome, failing to meet the 2-week duration threshold, especially when they occur in association with other disorders, life situations or physiological conditions (Akiskal, 2005). Examples of disorders in this category include those sometimes described as minor depressive disorders, or a recurrent brief depressive disorder.

2.1.3.1 Minor Depressive Disorder

Minor depressive disorders are mostly observed in primary care settings. The depression is sub-threshold, milder than major depressive disorder, yet not protracted

enough to be considered dysthymic (Akiskal, 2005). From such a sub-syndromal symptomatic depressive base, individuals predisposed to depressive illness may well fluctuate in and out of the various subtypes of depressive disorders. Appendix A-4 presents DSM-IV-TR diagnostic criteria for minor depressive disorder.

2.1.3.2 Recurrent Brief Depressive Disorder

Recurrent brief depressive disorders are considered short-lived depressions that usually recur on a monthly basis but are not menstrually related (Akiskal, 2005). Such patients are believed to be more prevalent in primary care than in psychiatric settings. Appendix A-5 presents DSM-IV-TR diagnostic criteria for recurrent brief depressive disorder.

2.2 Epidemiology of Depressive Disorders

2.2.1 Prevalence and Incidence of Depressive Disorders

Depressive disorders are the most frequent psychiatric illnesses, both in the community and other clinical settings such as secondary and tertiary care centres (Akiskal, 2005). In addition to the frequent and serious complications (e.g., suicide) that accompany such disorders, they are also strongly associated with limitations in well-being and daily functioning, which may be equal to or greater than those of several other chronic conditions. The lifetime and 1-year prevalence of major depressive disorder are estimated at 4.9% and 2.7%, respectively (Akiskal, 2005; Wittchen & Jacobi, 2005), while the prevalence of major depression was estimated to be approximately 16%-20%.

The lifetime, 1-year/6-month, and current (1-month) prevalence of different forms of DSM-IV-TR depressive disorders, according to the eight major community surveys using specific diagnostic instruments performed in the United States and Europe, are shown in Table 2.1 (Akiskal, 2005; Wittchen & Jacobi, 2005). It should be noted that, because of the tendency to forget over time (particularly in the case of male subjects), period prevalence and lifetime prevalence may be less reliable than current (point) prevalence. However, when attempting to estimate the number or rate of people with any one type of depressive disorder in the population at any given time, one needs to be cautious, as the true values are substantially lower than the sum of the prevalences of specific depressive disorders. This is because one patient might have more than one diagnosis, and different forms of depression may have a substantial overlap both cross-sectionally and longitudinally (Akiskal, 2005). In addition, a patient's diagnosis may change over time (e.g., from dysthymic disorder to major depressive disorder). It is important to note that these studies presented in Table 2.1 are partly different with regard to diagnostic scope and instruments and sampling methods. Sample sizes also varied considerably between studies from $n = 250$ to $n > 10{,}000$ subjects. The most frequently used diagnostic instrument was the Composite International Diagnostic Interview (CIDI), which was designed for clinicians, but can be administered by trained non-clinicians as well. Other instruments used were the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) and the Mini International Neuropsychiatric Interview (MINI), both of which require clinically trained interviewers. There seemed to be a tendency for experts with experience in cross-sectional clinical interviews, such as the SCAN, to consistently rate

lower depression prevalences than those working with non-clinician interviews, such as the CIDI (Wittchen & Jacobi, 2005).

Table 2.1: Lifetime, 1-Year, and Current (1-Month) Prevalence of Depressive Disorders*

		Lifetime Prevalence (%)	1-Yr Prevalence (%)	Current Prevalence (%)
Major depressive episode	*Range*	5–17	3–10	2–7
	Average	12	7	4
Dysthymic disorder	*Range*	3–6	3	3
	Average	5	n/a**	n/a
Minor depressive disorder	*Range*	10	2	n/a
	Average	n/a	n/a	n/a
Recurrent brief depressive disorder	*Range*	16	4–8	5
	Average	n/a	6	n/a
Full depressive disorders spectrum		**20–25**	**10–15**	**5–10**

* According to Eight Large-Scale Population Studies Conducted in the United States and Europe.
** Not available

A comparison of studies conducted in ten different countries published lifetime and 1-year prevalence of major depression for people between the ages of 18-65, standardized to the USA age and sex distribution (Akiskal, 2005). The lifetime prevalence varied between 1.5% and 19.0%, with the lowest figures found in Taiwan, Hong Kong, and Korea. The highest figure was found in Beirut, Lebanon. The 1-year prevalence ranged from 0.8% in Taiwan to 5.8% in New Zealand.

A recent review by Eaton et al., (2008) reported that the 1-year prevalence of major depressive disorders ranged from 0.64% in Taipei to 15.4% in Udmurtia (a federal area in Russia), with a median of 5.3 and an interquartile range of 3.6–6.5. This was as a result of

an extensive literature search of all relevant published articles from 1980 to 2007, with 42 studies selected out of approximately 4,000, representing a total sample of 290,471 persons. Six of the nine studies in the low quartile were located in East Asia, but otherwise the authors could not determine the study location, the study method, or the time that the study was carried out. It should be noted that the 1-year prevalence is a hybrid type of prevalence, considered to be between lifetime prevalence and point prevalence, and is meant to record the history of the disorder one year prior to assessment (Eaton et al., 2008). It differs from lifetime prevalence in that it focuses on only 1 year, and it differs from period prevalence in that data for individuals who entered during the year of study, but died before the assessment, are not included in the numerator. Since there is not a strong relationship between the occurrence of depressive disorders and death within 1 year, the 1-year prevalence is considered approximate to the 1-year period prevalence (Eaton et al., 2008). Given depressive disorders typically endure for more than one year, the 1-year prevalence is also considered similar to point prevalence.

According to the Canadian Community Health Survey: Mental Health and Well-Being (CCHS 1.2), the annual prevalence of major depressive disorders in Canada (age 15 years and greater) was estimated at 4.0% (95%CI [Confidence Interval]: 3.7%-4.2%), the lifetime prevalence was 10.8% (95%CI: 10.3%-11.3%), and the point prevalence was 1.3% (95%CI: 1.1%-1.4%) (Patten et al., 2006). The CCHS 1.2 was a nationally representative mental health survey conducted by Statistics Canada between May 2002 and December 2002. The target population included persons aged 15 years or over and living in private occupied dwellings (98% of the population). According to the Stirling

County Study, the overall prevalence of depression remained stable at about 5% across three separate samples (1952, 1970 and 1992) in Atlantic Canada (Murphy et al., 2000). This study began shortly after the Second World War and provides a 40-year perspective for estimating the prevalence and incidence of psychiatric disorders in an adult population. It is important to note that the diagnostic criteria of depressive disorders may have changed over the last four decades, which in turn might have affected the compatibility of rates over time. Starkes et al. (2005) in a cross-sectional study using CCHS 1.1 reported 7.3% of people in Atlantic Canada experienced an episode of major depression in the previous year, as measured by the Composite International Diagnostic Interview Short Form. Patten et al., (2006) in a study conducted in a predominantly rural health region in Southern Alberta, reported a weighted 12-month prevalence of 10.4% (95%CI: 7.9%–13%) for major depressive disorders (Patten et al., 2003). Other studies have reported that between 3% and 6% of adults will experience dysthymic disorders during their lifetime (Health Canada, 2006; Bland et al., 1988).

The annual incidence of depression has been estimated to be 0.76% for women and 0.43% for men, and up to the age of 70 years, the cumulative probability of first-episode depression was 45% in women and 27% in men (Akiskal, 2005). In Hungary (a European country in which the suicide rate is known to be high), up to the age of 60 years, the cumulative probability of a first-episode major depression was 32% for women and 18% for men (Akiskal, 2005). The incidence of major depressive disorders was reported 1.6% per year (women, 1.9%; men, 1.1% per year). Data from the longitudinal cohort of the National Population Health Survey (NPHS - Canada) over a six year period estimated

the cumulative incidence of major depressive disorders in 2002/03, 2004/05 and 2006/07 to be 2.9% (95%CI: 2.3%-3.4%), 5.7% (95%CI: 4.9%-6.4%) and 7.2% (95%CI: 6.4%-8.1%), respectively (Wang et al., 2009). The incidence of major depressive disorders in the Patten et al., (2006) study in southern Alberta (predominantly rural) was estimated at 3.8% (95%CI 2.0%–5.6%). According to the Stirling County Study, the average annual incidence of depression was 3.7-4.5 per 1,000 for various cohorts, and the incidence of depression was found to be higher among women than men (Murphy et al., 2000).

Based on the literature reporting the prevalence and incidence of depressive disorders, it is apparent that depressive disorders are common in economically developed nations. The prevalence of depression in far eastern countries is lower, probably due to cultural differences regarding such areas as psychosocial stressors and alcohol and drug consumption. In investigating the differences between ethnic groups—Caucasians, African Americans, Hispanics, and Asian Americans—a recent study from the United States found that, after adjusting for demographic factors (e.g., age, gender), Asian Americans had the lowest prevalence of both major depressive and dysthymic disorders (Akiskal, 2005). This may suggest that the prevalence of major depressive disorders in far eastern countries reported by the Cross-National Collaborative Group could, in fact, be lower than economically developed countries. However, caution is required in interpreting these rates as differences in diagnostic instruments and study design may also explain some discrepancies.

2.2.2 Risk Factors

2.2.2.1 Sex

The most consistent finding across all studies reviewed (Canadian and international) on the prevalence and incidence of depressive disorders is that it is approximately twofold more common among women than men (Patten et al., 2009; Akiskal, 2005; Eaton et al., 2008; Patten et al., 2006; Murphy et al., 2000; Patten et al., 2003; Wang et al., 2009; Parikh et al., 2001; Parikh et al., 1996). This gender difference is thought to begin in early adulthood, is most pronounced in people between the ages of 30 and 45, and persists into old age. Because there is little evidence (aside from biological–hormonal differences) to show that female gender can increase vulnerability for depression, it has been suggested that increased stress sensitivity, maladaptive coping strategies, and multiple social roles (all of which are frequently seen in women), combined with substance use disorders that can mask depressive symptoms (more frequently seen in men), may explain the gender difference (Akiskal, 2005). In addition to these psychosocial theories, recent studies show that because prior anxiety disorders are more common in women, preceding anxiety disorder may also be a significant factor that contributes to the higher depressive morbidity in women (Akiskal, 2005). Minor depressive disorders and recurrent brief depressive disorders are also more common among women, but the difference is not so marked as that with major depressions (Akiskal, 2005). Recent population-based epidemiological surveys showed that the lifetime prevalence and 1-year prevalence of major depression and dysthymia were much

higher among people with same-sex sexual behavior, particularly in the case of men (Akiskal, 2005).

2.2.2.2 Age

There is less consistency among studies regarding age-specific prevalence of depressive disorders, but rates do appear higher in young adults than older individuals. Most studies have shown that depressive disorders have higher prevalence among people younger than 45 years (Akiskal, 2005; Patten et al., 2006; Wang et al., 2009; Parikh et al., 2001; Parikh et al., 1996; Romans et al., 2007). The average age of onset of major depressive disorder is thought to fall between the ages of 30 and 35 years. Social stressors appear to place younger individuals at greater risk for depression than the elderly (Akiskal, 2005). On the other hand isolation, loss of interpersonal contacts, medical disorders, and disability, play an important role in the development of depression in later life (Akiskal, 2005; Wang et al., 2009). Early-onset depression is associated with a higher female to male ratio than late-onset (Akiskal, 2005). Because major depressive disorder is a frequent and highly recurrent illness, the probability of recurrence does not decrease with age. The incidence of major depressive disorder in old age is lower in both sexes, but first incidence and prevalence of minor depressive disorder show the opposite trend (Akiskal, 2005). Dysthymic disorder typically starts in late adolescence or early adulthood.

2.2.2.3 Marital Status

The association between marital status and depressive disorders is complex. For instance, being single, divorced, or separated can be either a risk factor for depression, or the result of adverse life events generated by depressive psychopathology. Major depressive disorder is most frequent among divorced, separated, or widowed individuals (Akiskal, 2005; Patten et al., 2006; Wang et al., 2009). Single women have lower rates of depression than married women do, but the opposite is true for men (Akiskal, 2005). However, being single as a result of having never married, as a result of the dissolution of a difficult marriage, or as a result of widowhood, represent three very different conditions. The risk of a major depressive disorder is very high among recently widowed individuals of all ages, but is particularly high in the elderly (Charbonneau et al., 2004). Patients with depressive disorders are overrepresented among the divorced, and the rate of family breakdown (i.e., separation and divorce) is elevated slightly in dysthymic patients, but substantially in major depressive patients (Akiskal, 2005). The presence of major depression is a strong predictor for future separation or divorce, which can cause serious distress for the patients and for their spouses, and may also generate negative life events for their children (Akiskal, 2005; Patten et al., 2006; Wang et al., 2009). These early negative life events (e.g., parental loss before adolescence) are well known predisposing risk factors for adult depressive disorders, particularly in the case of family loading (i.e., family history of depressive disorders).

2.2.2.4 Socioeconomic Factors

Although the relationship between depressive symptoms and low social class is well documented, most studies found only weak (but consistent) correlations between major depressive disorders and lower socioeconomic status (Akiskal, 2005; Murphy et al., 2000; Wang et al., 2009; Parikh et al., 2001). Individuals with lower socioeconomic status also are more likely to have lower levels of education, lower income, and poorer living conditions, as well as a higher rate of unemployment.

2.2.2.5 Residence

As urban communities can be more stressful than rural communities, most studies carried out in economically developed countries concluded that major depression was more frequent in urban than rural residents (Akiskal, 2005; Patten et al., 2006; Patten et al., 2003; Wang et al., 2009). Parikh et al., (1996), in examining whether rural Ontario differed from urban Ontario in depressive disorder prevalence, found that the prevalence of major depression disorder and dysthymia were similar to previous studies, but rural prevalence was unexpectedly similar to urban ones.

2.2.2.6 Comorbidity

Patients with depressive disorders are at increased risk of having one or more comorbidities (Akiskal, 2005; Patten et al., 2006; Wang et al., 2009; Himelhoch et al., 2004). Moussavi et al., (2007) studied approximately a quarter of a million respondents in 60 countries and found that depressive disorders produced a greater decrement in health

than other chronic diseases, including angina, arthritis, asthma, and diabetes. In addition, the authors reported that those with angina, arthritis, asthma, or diabetes also had increased risks of depressive disorders (Moussavi et al., 2007). It has been suggested that the most frequent disorders associated with depressive disorders are alcohol abuse or dependence, panic disorder, obsessive-compulsive disorder, and social anxiety disorder (Akiskal, 2005). Conversely, individuals with substance use and anxiety disorders also have an elevated risk of lifetime comorbid depressive disorders. Men more frequently present with substance use disorders, whereas women more frequently present with anxiety and eating disorders (Akiskal, 2005).

2.2.2.7 Health Services Utilization

Major depression and dysthymia are associated with increased health service utilization (e.g., general medical services or emergency services) for emotional problems (Parikh et al., 2001; Johnson et al., 1992; Olfson et al., 1992). It has been reported that patients with high health service utilization are more likely to have a high rate of untreated depression. Despite advances in both the diagnosis and treatment of depressive disorders, they still remain under-diagnosed and undertreated. North American and European surveys report that approximately half of those who develop depressive disorders seek treatment for them, but only a small proportion (approximately one-third) of diagnosed depressive disorders receive appropriate treatment (Akiskal, 2005). An increasing rate of health service utilization is related to increasing severity of depression and other psychiatric and non-psychiatric co-morbidities. Despite the fact that many

patients with depressive disorders seek help in primary care, general practitioners still have difficulties diagnosing and treating depression. Most patients who seek care for depression are treated in primary care settings, where at least 50% of patients are undiagnosed, and 40% to 55% are insufficiently treated (Charbonneau et al., 2004; Wells et al., 1999). The current prevalence of major depression in primary care is approximately 10%-15% and that of dysthymic disorder is approximately 6%-8% (Akiskal, 2005). Because depressive disorders are more common among those with comorbid chronic medical disorders, depressions with significant somatic comorbidity may remain unrecognized in primary care (Akiskal, 2005). Women more often seek treatment for their depression and are more compliant with the treatment than men, but "male depression" is unfortunately less frequently recognized (Akiskal, 2005). Concomitant depression increases the morbidity and mortality from concurrent medical illness, and patients with simultaneous medical disorders and depression are less compliant with treatment and take longer to recover than non-depressed medical patients.

2.3 Economic Burden of Depressive Disorders

Determining the costs associated with mental illness is challenging, but annual treatment costs (direct) in the USA have been estimated at $100 billion, with significantly more estimated for indirect costs; $193 billion per year is estimated for lost earnings alone (Buka, 2008). A recent review by Eaton et al., (2008) on the burden of mental disorders demonstrated that the estimates were variable across disorders, ranging from $11 billion per year for simple phobia, to more than $200 billion per year for alcohol and

drug use disorders. The direct and indirect costs of major depressive disorders in the USA were ranked third ($97.3 billion), following those for drug and alcohol abuse (Eaton et al., 2008).

Health Canada, in its 2002 Economic Burden of Illness in Canada Report (Health Canada, 2002), identified a large economic burden of mental illness from the use of direct government-funded health care services ($4.7 billion in 1998), and indirect cost of lost productivity due to short- and long- term disability and premature mortality ($3.2 billion). Lim et al., (2008) conducted a comprehensive study of the economic burden of mental illness in Canada, which incorporated the use of medical resources and productivity losses due to disability, as well as reductions in health-related quality of life using the Canadian Community Health Survey Cycle 2.1 (2003). They concluded that the economic burden was $51 billion in 2003, with over one-half resulting from reductions in health-related quality of life. The value of work loss from absenteeism accounted for about 35% of the burden, and medical expenses accounting for less than 10%.

2.4 Surveillance of Depressive Disorders

Individuals who manage programs to prevent or control specific diseases need reliable information on the status of those diseases in the population. The process that is used to collect data, manage, analyze, interpret, and report on a specific disease is called *surveillance* (Buehler, 2008). Surveillance systems are networks of people and activities that maintain this process, and because these systems are often operated by public health agencies, the term "public health surveillance" is often used. When new public health

problems emerge, the rapid implementation of surveillance is crucial to an effective early response. Likewise, public health agencies establish surveillance as a first step to inform priority setting for new programs. The scope of epidemiologic surveillance has evolved from an initial focus on infectious disease monitoring and intervention, to a more inclusive scope that includes chronic diseases, injuries, environmental exposures, and social factors that influence health status. Elements of a surveillance system include: case definition, population under surveillance, cycle of surveillance, confidentiality, and incentive to participation.

Depending on information needed and resources available, a number of methods can be employed in conducting surveillance. Administrative databases and surveys are commonly used in surveillance. However, these sources have their limitations such as concerns about the accuracy of diagnostic information in administrative databases and concerns regarding the validity of self-reporting of diagnosis in surveys (Lix et al., 2008). Linkage of surveillance records to other information sources (i.e., triangulation) can also be used to enhance the scope of surveillance data.

2.4.1 Case Definitions

Chronic disease case definitions for surveillance systems are constructed by selecting specific combinations of several data attributes: source of data, diagnosis or treatment codes, number of years of data and number of contacts in administrative records with the selected code(s) (Lix et al., 2008). There is no consensus on the optimal case definition, with the choice often dependent on the availability of data.

This following section provides a review of relevant literature on studies that have employed different types of methodologies for surveillance of mental disorders in general, and depressive disorders in particular.

2.5 Survey as a Method for Surveillance of Depressive Disorders

Surveys are one of the most common methods for surveillance of health conditions in a population. Prevalence and incidence rates obtained from surveys can be used to describe the burden of depressive disorders and to plan and evaluate disease prevention, treatment and management strategies. However, the validity of surveys depends on many factors, such as the sampling strategy, which impacts generalizability, and the accuracy of self-reporting (memory).

In Canada, two national surveys, the CCHS and NPHS, are often used to study the burden of disease. The CCHS is funded as part of the Health Information Roadmap Initiative (Gravel et al., 2004, Gravel et al., 2005, Canadian Institute for Health Information, 1999). The Health Information Roadmap is a plan to modernize and standardize health information across the country. Statistics Canada, the Canadian Institute for Health Information, and Health Canada jointly support a series of projects that make up the Roadmap Initiative. The CCHS has a 2-year collection cycle comprising of 2 surveys: a regional survey in the first year (Cycle 1.1) and a province-level survey in the second (Cycle 1.2). Each second year of the cycle is designed to focus in-depth on a particular topic. During consultations for the development of the CCHS (Beland et al., 2000), mental health was frequently identified as a high-priority topic. Consequently,

mental health and well-being was the focus of the provincial component of the first CCHS cycle (Cycle 1.2), which took place in 2002. Because information on mental disorders in Canada was for the most part incomplete and fragmented, the major objectives of the CCHS 1.2 were as follows: 1) to determine the prevalence of selected mental disorders and to assess their burden of illness; 2) to examine links between mental health and social, demographic, geographic, and economic characteristics; 3) to compare the use of mental health services with perceived needs, and 4) to assess the disability associated with mental health problems in regard to individuals and society.

The NPHS was initiated by Statistics Canada in 1994/95, targeting household residents in all Canadian provinces with certain exclusions (i.e. persons living on Indian Reserves and Crown Lands, residents of health institutions, full-time members of the Canadian Forces Bases) (Statistics Canada, 2008). The NPHS is a Canadian national health survey using multiple-stage, stratified random sampling procedures. The 1994/95 NPHS participants (n=17,276) formed a longitudinal cohort that is re-interviewed every two years. As of 2008, this cohort has been interviewed 7 times (from 1994/95 through 2006/07).

Table 2.2 presents a list of five Canadian studies investigating the burden of mental disorders in general, and depressive disorders in particular, using the CCHS and/or the NPHS surveys.

Table 2.2: Surveys as a Method for Surveillance of Mental Disorders in Canada

Study	**Target population**	**Data Source**	**Years of Study**	**Objective(s)**
Patten et al., (2006)	15 years and over	CCHS	2002	Describe the epidemiology of major depression in the Canadian population
Wang et al., (2009)	18-65 years	NPHS	1994/95-2006/07	Estimating incidence of major depressive episodes and the associations between demographic and socioeconomic variables and major depressive episodes
Patten & Beck, (2004)	15 years and over	NPHS	1994-2000	Assessing mental health care utilization among depressed patients
Vasiliadis et al., (2005)	15 years and over	CCHS	2002	Determining prevalence of health care service use for mental health reasons, service type, and examining determinants of mental health service use
Satyanarayana et al., (2009)	15 years and over	CCHS	2002	Determining the prevalence and correlates of chronic depression in comparison with non-chronic depression

Surveys are also used as a tool for surveillance of mental disorders in other countries, such as the USA and Australia. The National Comorbidity Survey is the first nationally representative mental health survey in the USA to use a fully structured research diagnostic face-to-face interview as a means to assess the prevalence and correlates of mental disorders (Kessler et al., 2003). In Australia, the National Survey of Mental Health and Wellbeing, conducted first in 1997, has been used as a survey of individuals aged 16-85 from 8,841 households across Australia (Whiteford & Groves, 2009).

Most national surveys (both Canadian and non-Canadian) use the CIDI (Composite International Diagnostic Interview), which is a comprehensive, fully-structured interview designed for the assessment of mental disorders according to the definitions and criteria of ICD-10 (International Classification of Diseases 10th Revision) and DSM-IV. The CIDI allows: 1) to measure the prevalence of mental disorders and their severity, 2) to determine the burden of these disorders, and 3) to assess service use and the use of medications in treating these disorders (CIDI, 2004). The reliability, validity and cross-national consistency of diagnostic instruments for depressive disorders have not been sufficiently established. As stated earlier in Chapter 2, it has been suggested that there is a tendency for experts with experience in cross-sectional clinical interviews (e.g., SCAN) to consistently rate lower depression prevalences than those working with non-clinician interviews (e.g., CIDI) (Wittchen & Jacobi, 2005). Further, although surveys have been used for surveillance of mental disorders (Patten et al., 2006; Wang et al., 2009; Patten & Beck, 2004; Vasiliadis et al., 2005; Satyanarayana et al., 2009), their validity depends on many factors, such as the sampling strategy, which impacts generalizability, and the accuracy of self-reporting. Further, the periodic nature of surveys and their inability to recognize emerging trends in a timely manner may be other limitations of using surveys for surveillance purposes.

2.6 Administrative Data as a Method for Surveillance of Depressive Disorders

The value of using administrative databases for surveillance of chronic diseases partly depends on the process used to identify the chronic disease of interest. Several studies

have described the processes employed to identify various chronic diseases from administrative databases. These processes most always include case definitions and the appropriate time frames required to maximize and enhance case identification. Although most of the previous studies did not focus on depressive disorders (or mental disorders in general), the processes used to identify patients with chronic diseases using administrative databases are still relevant for this study. Thus, this following section provides an overview of current literature concerning processes for the identification of individuals with depressive disorders (or mental disorders in general), as well as other chronic diseases.

Table 2.3 presents various types of case definitions used for the identification of individuals with depressive disorders, and other chronic diseases. The studies reviewed utilized varying methods to identify chronic diseases from administrative databases. Most have used physician claims data (i.e., billing data or reimbursement data). The most common approach for identifying chronic diseases involved counting the number of disease-specific physician visits. Some studies listed used a combination of both inpatient and outpatient encounters. The most common case definition used is a combination of two or more outpatient visits or one or more inpatient visit. However, it has been reported that identifying patients with chronic diseases by using one outpatient visit versus two outpatient visits resulted in higher sensitivity but lower specificity (Hux et al., 2002). In contrast, other studies did not find any additional benefit of using more than one diagnosis to define a case (Robinson et al., 1997). Further, almost none of the studies considered physician specialty in their case definitions.

In addition to only using physician visits, a combination of physician visits and prescription drug use data is common (Fultz et al., 2006). It should be noted that while this approach is valuable, some drugs may have multiple indications for different diseases which may make it difficult to link a specific drug to a specific disease.

Table 2.3: Case Definitions Used to Identify Various Chronic Diseases from Administrative Databases

Study	**Country**	**Chronic Disease(s)**	**Case Definition**
Kisely et al., (2009)	Canada (BC, ON, QC, NS, AB)	Mental disorders	≥ 1 physician visit or ≥ 1 hospitalization
Damush et al., (2008)	USA	Depression post stroke	(≥ 1 physician visit or ≥ 1 hospitalization) or Antidepressant medications
West et al., (2000)	Canada (SK)	Depression	≥ 2 physician visit and Antidepressant medications
Powell et al., (2003)	USA	Arthritis	≥ 1 physician visit or ≥ 1 hospitalization
Scales et al. (2006)	Canada (ON)	ICU admissions	≥ 1 ICU visit or ≥ 1 procedure
Baldi et al., (2008)	Italy	Cancer (Breast, Colon, Lung)	≥ 1 hospital and ≥ 1 procedure
Goff et al., (2008)	USA	Irritable Bowel Syndrome	≥ 1 physician visit or ≥ 1 hospitalization and ≥ 1 prescription antispasmodic, laxative, antidiarrheal, $5HT_3$ receptor agonist, or $5\text{-}HT_4$ receptor antagonist
Couris et al., (2009)	France	Breast Cancer	≥ 1 hospital and ≥ 1 procedure
Daley et al., (2004)	USA	Children with chronic medical conditions requiring influenza vaccination	≥ 1 visit to a pediatrician

Table 2.3: Case Definitions Used to Identify Various Chronic Diseases from Administrative Databases (**Cont'd**)

Study	Country	Chronic Disease(s)	Case Definition
Coffin et al., (2005)	Canada (Calgary)	Chronic diseases eligible for pneumococcal vaccination	≥ 1 hospitalization in one year
Fultz et al., (2006)	USA	HIV/AIDS	a) ≥ 1 inpatient or outpatient b) HIV prescription drug
Hux et al., (2002)	Canada (ON)	Diabetes	≥ 1 physician visit or ≥ 1 hospitalization within two years
James et al., (2004)	Canada (AB, SK, MB)	Diabetes	≥ 1 physician visit or ≥ 1 hospitalization within two years
Solberg et al., (2006)	USA	Diabetes, Coronary Heart Diseases, Depression	≥ 2 physician visit or ≥ 1 hospitalization within 12 months
To et al., (2006)	Canada (ON)	Asthma	≥ 1 physician visit

The timeframe required to generate sufficient numbers of healthcare visits is crucial for developing a valid case definition. The optimal timeframe needed for the identification of patients with chronic diseases varies by the type of disease. A two- to three-year timeframe has been suggested as sufficient, particularly for chronic diseases with relatively structured visiting behavior such as diabetes and hypertension (Robinson et al., 1997; Hoogenveen et al., 2002). It has been shown that the errors of prevalence estimates decreases with increasing follow up time (Robinson et al., 1997; Hoogenveen et al., 2002). For conditions such as asthma which can be challenging to diagnose, a timeframe up to five years may be required (Lix et al., 2008). In other cases, using a period longer than two years may not be feasible for ongoing surveillance system (Hux et al., 2002). Other investigators used a shorter timeframe of two years mainly because the

purpose of their investigation was to identify cases, rather than to estimate the burden of the disease (Coffin et al., 2005). Overall, there is no consensus on the optimal timeframe required to identify chronic diseases. The timeframe required to identify individuals with chronic diseases from administrative databases depends on the disease of interest, the data source(s) available, and the purpose of identification.

Most administrative health databases have one or more fields dedicated to diagnosis. The main diagnosis (versus a secondary diagnosis) may not necessarily be the most responsible reason for a specific health care visit. Thus, investigators using administrative databases with more than one diagnosis field suggested not considering the order of diagnosis in order to enhance and maximize case identification. A Swedish study (Wigertz & Westerling, 2001) showed that only 20% of asthma cases were identified when only the primary diagnosis is used for identification. In the USA the importance of the order of diagnosis depends on the data source and jurisdiction. For instance, in Medicaid database (USA) the first diagnosis listed corresponds to the relative importance of the diagnosis for a specified visit (Powell et al., 2003).

The validity of a case definition, or an identification algorithm, can be defined as the degree to which the case definition/identification algorithm identifies a target group from administrative databases. There are two types of validity: internal and external. Internal validity refers to the accurate identification of a target population from administrative databases apart from random error (Rothman et al., 2008). External validity refers to application of study findings beyond the subjects in the study. Internal validity is a prerequisite for external validity. The validity of a case definition varies depending on the

objective, diseases of interest and jurisdictions. For instance, Canadian databases differ substantially from those in USA in that historically, financial incentives for recording accurate diagnosis have been minimal compared to those of USA (Roos et al., 1999). Within Canadian provinces the validity of administrative data varies by province and diseases (Roos et al., 1999). Thus the validity of case definitions for identifying chronic diseases developed in the USA may not necessarily be applicable to Canada. Even within Canada the validity of case definitions derived from one province may not necessarily be applicable to another province. Nevertheless, if the same data sources and years are used, the diagnoses might be portable across jurisdictions.

Little research has been conducted on assessing the reliability or validity of using administrative databases to explore mental illness. A recent Canadian study by Kisely et al., (2009) evaluated the usefulness of administrative data for the surveillance of mental illness using databases from British Columbia, Alberta, Ontario, Quebec, and Nova Scotia. The primary data sources explored were provincial patient registries, physician billings databases and hospital discharge abstract databases. Their case definition included any patient with at least one physician visit, or one discharge from any hospital having a diagnosis in the most-responsible diagnosis field using one of the following codes: ICD-9 (International Classification of Diseases 9th Revision) from 290 through 319, inclusive, or their equivalent ICD-10 codes. Issues such as ease of data extraction, completeness of common data elements and comparability between provinces were explored. The prevalence of treated mental disorders across Canada was reported to be fairly consistent (15%), with women having a higher prevalence. The authors concluded

that provincial and territorial administrative data from hospital morbidity and physician billings are useful for the surveillance of treated mental disorders. They also suggested that such a surveillance system can provide longitudinal data at relatively little cost for health service provision and planning.

In 2000 West et al., (2000) conducted a study to evaluate the validity of using the Saskatchewan Health administrative claims database for conducting research on depressed patients who were using antidepressants. The study compared medical record abstractions with the Saskatchewan Health outpatient data files (Physician Service File) and found there was a 77% agreement (*kappa* 0.54) for a diagnosis of depression between the medical abstraction and the Physician Service File; 71% sensitivity, 85% specificity, 86% Positive Predictive Value (PPV) and 70% Negative Predictive Value (NPV). This study showed a high number of true-positives and true-negatives and shows promise for the use of administrative databases in exploring depression. The authors noted that the results of this study may not be generalized to other administrative databases.

Spettell et al., (2003) conducted a study to evaluate two algorithms to identify physician-recognized depression using a large USA managed health care organization database. The first algorithm was designed to maximize sensitivity and the second to decrease false positives. The results showed algorithm 1 had a sensitivity of 95%, specificity of 65%, and a PPV of 49%. Algorithm 2 had a 52% sensitivity, 88% specificity, and 60% PPV. Both algorithms had low PPV (falsely classifying patients as having depression), highlighting the difficulty in identifying depressed patients from administrative data using algorithms based only on diagnostic and pharmacy codes.

Rawson et al., (1997) examined the accuracy and reliability of hospital discharge diagnostic codes for schizophrenia and depressive disorder patients using Saskatchewan's administrative health care utilization data files. As a measure of external consistency the study compared the computerized data files of the Hospital Services Branch with patients' medical charts through data abstraction forms. The study found 77.1% agreement between primary hospital discharge diagnosis and the chart discharge diagnosis for schizophrenia. There was only 58% agreement for patients diagnosed with depression, however 93.6% of the identified patients did have some form of depression. As a measure of internal consistency a comparison was made between the hospital discharge data with physician service claim files and files from the provincial mental health branch. For schizophrenia there was 61.8% agreement between hospital data and physician service claims, and 83.4% agreement between hospital and mental health services data. For depression, there was 66.3% agreement between hospital data and physician service claims, but only 37.7% agreement between hospital and mental health services data. An examination of the mismatched codes for depressed patients indicated that they may have been coded with a depressive disorder, when in fact they had major, chronic, or neurotic depression. The study demonstrated that administrative data appears to be more reliable when looking at specific mental illnesses, such as schizophrenia, as opposed to a more general diagnosis like depression. The findings also highlight the difficulty in making an exact depression diagnosis.

A USA retrospective cohort study was carried out by Damush et al. (2008) to validate a case-finding algorithm for post-stroke depression among veteran survivors. The authors

assessed the accuracy of patients' post-stroke depression from the administrative databases (Veterans Health Administration and Medicare inpatient, outpatient, and pharmacy data) through standardized chart reviews. The authors concluded that a case-finding algorithm using outpatient ICD-9 codes or medication was the most sensitive in identifying cases of post-stroke depression. The authors also suggested that the addition of antidepressant medications in appropriate doses can improve the accuracy of the case finding algorithm for post-stroke depression in administrative data (Veterans Health Administration).

Comparing the PPV for the identification of individuals with chronic disorders from one setting to another may be challenging due to the underlying characteristics of administrative databases and the prevalence of the disease of interest (Greenland & Lash, 2008). In one study (Penberthy et al., 2003) data from a certified cancer hospital had a higher PPV for identifying cancer cases compared to data from non-certified cancer programs. The difference in the PPV may be explained by higher cancer prevalence in the certified cancer hospitals than that of a non-certified hospital.

Hux et al., (2002) showed that when using two physician claims over two years for a diagnosis of diabetes, the sensitivity was higher than when using only one diagnosis of diabetes (90% vs. 85%). Increasing the number of claims required for case definitions increased the sensitivity but reduced the specificity. In contrast, Robinson et al. (1997) did not find any meaningful gain in sensitivity by increasing the number of claims while holding the timeframe constant.

As shown in Table 2.4, the selected examples of case definitions show that the specificity of the case definitions in identifying individuals with chronic diseases across jurisdictions was generally higher than the sensitivity. This suggests that individuals without a chronic disease are less likely to be misclassified by most case definitions (i.e., lower false negative rate), and as well may indicate that there is a higher probability of misclassification among those identified with having a chronic disease (i.e., higher false negative rate).

Overall, most studies have similar case definitions that required one or more diagnoses for a particular chronic disease, with or without use of prescription drugs. Several studies have examined the validity of case definitions focusing on different types of chronic diseases. The outcome of these studies was variable with respect to sensitivity, specificity and PPV, depending on the chronic disease studied and the jurisdiction in which the study took place. The gold standard used to validate the case definitions has mostly been medical charts. It is important to note that using a chart review as the gold standard may not always be cost-effective. Further, the lack of availability of clinical information in medical charts is the other challenge in using a chart review.

Table 2.4: Validity of Various Case Definitions from Previous Studies

Study	Country	Chronic Disease(s)	Case Definition	Gold Standard	Validity
Damush et al., (2008)	USA	Depression post stroke	(≥ 1 physician visit or ≥ 1 hospitalization) or Antidepressant medications	Medical Charts	Sensitivity=62% Specificity=88.9% PPV=67.4%
West et al., (2000)	Canada (SK)	Depression	≥ 2 physician visits and Antidepressant medications	Medical Charts	Sensitivity=71% Specificity=85% PPV=86% NPV=70%
Scales et al., (2006)	Canada (ON)	ICU admissions	≥ 1 ICU visit or ≥ 1 procedure	Critical Care Research Network patient registry (CCR-Net)	Sensitivity=92% Specificity=99% PPV=84% NPV=100%
Baldi et al., (2008)	Italy	Cancer (Breast, Colon, Lung)	≥ 1 hospital and ≥ 1 procedure	Piedmont Cancer Registry of Turin (PCRT)	Breast (Sensitivity=76.7%, PPV=92.6%) Colon (Sensitivity=72.4% PPV=87.9%) Lung (Sensitivity=80.8% PPV=78.7%)
Goff et al., (2008)	USA	Irritable Bowel Syndrome	≥ 1 physician visit or ≥ 1 hospitalization and ≥ 1 prescription antispasmodic, laxative, antidiarrheal, $5HT_3$ receptor agonist, or 5-HT_4 receptor antagonist	Medical Charts	PPV=83%
Couris et al., (2009)	France	Breast Cancer	≥ 1 hospital and ≥ 1 procedure	Cancer Registry	Sensitivity=64.1% Specificity=99.9%

Table 2.4: Validity of Various Case Definitions from Previous Studies (**Cont'd**)

Study	Country	Chronic Disease(s)	Case Definition	Gold Standard	Validity
Daley et al., (2004)	USA	Children with chronic medical conditions requiring influenza vaccination	≥ 1 visit to a pediatrician	Medical Charts	Sensitivity=72% Specificity=95%
Coffin et al., (2005)	Canada (Calgary)	Chronic diseases eligible for pneumococcal vaccination	≥ 1 hospitalization in one year		Sensitivity=83% Specificity=78% PPV=87% NPV=72%
Hux et al., (2002)	Canada (ON)	Diabetes	≥ 1 physician visit or ≥ 1 hospitalization within two years	a) Prescription Drug Data b) NPHS c) Medical Charts	a) Sensitivity for 1 claim=94%, for 2 claims=91% b) Sensitivity for 1 claim=90%, for 2 claims=85%; PPV for 1 claim=44%, for 2 claims=64% c) Sensitivity for 1 claim=93.4%, for 2 claims=97.1%; PPV for 1 claim=61.3%, for 2 claims=79.8%
Penberthy et al., (2003)	USA	Cancer	≥ 1 hospitalization	Virginia Cancer Registry	PPV=84%-98%
Solberg et al., (2006)	USA	Diabetes, Coronary Heart Diseases, Depression	≥ 2 physician visit or ≥ 1 hospitalization within 12 months	Medical Charts	PPV Diabetes=0.97-1 Coronary Heart Diseases=0.95 Depression=0.65-0.99
To et al., (2006)	Canada (ON)	Asthma	≥ 1 physician visit	Medical Charts	Sensitivity=91.4%

2.7 Summary of the Literature Review

Depressive disorder is a global public health problem which is associated with substantial social and economic burden. Administrative databases provide a promising tool that can enhance existing methods of surveillance of depressive disorders which in turn can aid in planning and evaluating necessary epidemiologic and preventive programs.

There is limited evidence on how administrative databases can optimally be used for the purpose of population-based surveillance of depressive disorders. Most studies that used administrative data were not population-based, and validation of the case definitions have mainly used chart reviews, which are timely and expensive. The majority of studies reviewed used two or more outpatient diagnoses, or one or more inpatient diagnosis to define various chronic diseases. Of note, case definitions that have used physician visits have rarely taken into consideration the physicians' specialty.

Considering the limitations of administrative databases and a lack of a coordinated and efficient system to identify populations with depressive disorders in Canada, we may be missing an opportunity to better measure the effectiveness of policies and programs directed at mental health.

CHAPTER THREE: MATERIALS AND METHODS

This chapter outlines the methodology used to address the research questions, as well as a description of the study design, analysis, study populations, data sources, and case definitions.

3.1 Study Design

This is a cross-sectional study auditing electronic patient charts at three family practice clinics equipped with an Electronic Medical Records (EMR) system in St. John's, Newfoundland and Labrador. A sample of patients from each clinic were classified into one of two cohorts; those diagnosed with a depressive disorder (cases) and those not diagnosed with a depressive disorder (controls). The classification of patients selected from the EMRs in each of the three clinics served as the "gold standard" in the study. The gold standard was then compared with several case definitions based on hospital separation and physician claims databases.

3.2 Study Setting

The study was carried out at three family practice clinics located in St. John's (Family Practice Unit - Health Sciences Centre, Shea Heights Community Health Center, and the Ross Family Medicine Centre). These clinics are all affiliated with the Discipline of Family Medicine, Memorial University of Newfoundland, where staff practitioners are either academic physicians or residents. The three clinics have been using the EMR system developed by the Wolf Medical Software (Wolf Medical Systems, 2007) since

December 2006. Prior to 2006, the clinics used hard copy charts to document patient care. Upon implementation of EMRs in these clinics, all patient information was captured electronically.

Of note, the three clinics provided the Newfoundland and Labrador Medical Care Plan (MCP) registry with demographic (e.g., age, sex, date of birth, MCP etc.) and clinical information (e.g., diagnosis code, fee code, etc.) via a shadow billing process until June 30, 2007. The Medical Care Plan registry, maintained at the Ministry of Health, is the insurance system for fee-for-service physicians and its primary role is payment for physician services. The shadow billing process was only considered for sharing demographic and limited clinical information, not for billing purposes. It is important to note that there is no effect on the data integrity between shadow and actual billing in the clinics under study. Physicians practicing in these clinics are university-based employees and do not require to bill MCP for providing patient care. Because the physician claims database was one of the administrative data sources used in this study, only those patients who had a visit at one the three clinics between December 2006 (date of implementation of EMR) and June 2007 (end date of shadow billing process) were considered for inclusion in the study.

3.3 Study populations

3.3.1 Depressive Disorders Cohort (Cases)

Using the Wolf EMR Practice Search capability in each clinic, all patients aged 18 years or older who had a diagnosis or a co-diagnosis (e.g., past medical history or present

illness section of the electronic patient encounters) for any depressive disorders were identified for full electronic chart audit. It should be noted that the classification coding system used in the EMR system was the ICD-9 system. Upon consultation with the clinics staff physicians, it was determined that the ICD-9 diagnosis code of 311 was used for coding depressive disorders, thus code 311 was used to search and subsequently flag patients with depressive disorders in the EMR. Each patient chart (including all encounters) identified was then reviewed by a physician (i.e., the author of this dissertation who is also a general practitioner) to identify patients with true depressive disorders. The DSM-IV-TR criteria were used wherever possible to make a clinical judgment. It should be noted that clinicians may not always document all relevant clinical symptoms mentioned in the DSM-IV-TR criteria in the patient charts. The exclusion criteria were: 1) age less than 18 years, 2) non-depressive disorders diagnoses (e.g. either psychiatric or non-psychiatric conditions such as generalized anxiety disorder, schizophrenia, bipolar disorder, etc.), 3) depressive disorder encounter not within the study time frame (December 2006 to June 30, 2007), and 4) lack of clinical information in chart for diagnosis of depressive disorder. All excluded cases at this stage were independently reviewed by an experienced psychiatrist not involved in the study to maximize objectivity. A data collection form (Appendix B) was developed to collect demographic and clinical information such as age, gender, diagnosis, associated co-morbidities, and drug history including antidepressant medications (e.g. selective serotonin reuptake inhibitors—SSRIs, tricyclic antidepressants—TCAs, and monamine-oxidase inhibitors—MAOIs). Considering that low doses of some antidepressants such as

TCAs are used for analgesia and sedation rather than as antidepressants, those patients who received low doses antidepressants were excluded from the analysis. It should be noted that through auditing the charts, co-morbid anxiety was captured, while those patients with primary diagnosis of anxiety disorders were excluded. As part of the validation process and prior to use, the data collection form was reviewed by a family physician and a psychiatrist.

3.3.2 Non-Depressive Disorders Cohort (Controls)

The control patients were identified using the EMR Practice Search function in each family practice clinic. At the beginning those meeting the following criteria were excluded: 1) age less than 18 years, and 2) any psychiatric diagnoses including depressive disorders at any given time (not only limited to the study time frame). Excluded controls due to psychiatric disorders were independently reviewed by an experienced psychiatrist not involved in the study. Once the exclusions had been made, a random sample of remaining records equal in number to the depressed cohort previously flagged was drawn from each clinic population. Controls were matched to cases by age and gender (using a stratified random sampling approach). Charts selected underwent a full chart review. The data collection form used for the cases (Appendix B) was also used to collect demographic and clinical information on the controls. The data collection form was initially piloted on 20 electronic patient charts (10 for depressed patients and 10 for non-depressed patients).

3.4 Administrative Data Sources/Data Linkage

In this study, data obtained on depressed and non-depressed patients through the EMR system in the three clinics served as the "gold standard". These data were then compared to various case definitions using data from both the provincial hospital and physician claims databases for these same patients.

3.4.1 Provincial Hospital Separation Database

The provincial hospital separation database is maintained by the Newfoundland and Labrador Centre for Health Information (NLCHI). The hospital database captures demographic, clinical, and interventional information for patients admitted to all acute health care facilities and surgical day cares in the province. The database includes Newfoundland and Labrador residents and out-of-province patients receiving care in provincial acute care institutions. NLCHI currently has data from 1995/96 to 2007/08 (fiscal year). Of note, the coding classification system in the hospital database changed from ICD-9 to ICD-10-CA (International Classification of Diseases 10th Revision – Canadian Enhancement) in April 2001.

3.4.2 Provincial Fee-for-Service Physician Claims Database

The Newfoundland and Labrador Medical Care Plan (MCP) was established in 1969 with the primary function of processing payments for fee-for-service physicians in the province. The MCP is a comprehensive plan of medical care insurance designed to cover

the cost of physician services for eligible residents of the province. Each resident of Newfoundland and Labrador is provided a lifetime unique MCP number, whereas non-eligible individuals for MCP coverage (e.g., visitors, armed forces, etc.) are assigned a temporary MCP number by the hospital where they receive care. This temporary number is used for the current episode of care only and is not linkable to any previous or future episodes of care the individual may have. The physician claims database captures information on age and sex, as well as codes with information on service billed for, diagnosis, and physician involved. NLCHI currently has data from 1995 to 2007 (calendar year). The coding classification system in the physician MCP claims database has been ICD-9 since 1995.

3.4.3 Reliability and Validity of Administrative Databases

The reliability and validity of administrative health databases has been extensively documented. A summary of studies on the quality of health care administrative databases in Canada reported that demographic information on patient age, sex and residence is complete and reliable (Williams & Young, 1996). They found high levels of agreement on surgical procedure codes in hospital discharge data and physician claims. As for the diagnoses coding, hospital data on the most responsible diagnosis may vary in completeness and accuracy. Diagnoses such as acute myocardial infarction or fracture are reasonably reliable. Diagnostic data for conditions such as stroke are substantially less reliable, and the greatest disagreement with expert criteria-based reviews occurred with diagnoses such as rheumatoid arthritis where clinicians themselves may disagree. Limited

information is available regarding the accuracy of psychiatric diagnoses in both hospital and physician claim databases.

3.4.4 ICD Codes

As mentioned in Section 3.3.1, the classification coding system used in the clinics EMR system was ICD-9, and that the ICD code 311 was used to initially identify patients with depressive disorders. Thus the ICD-9 code 311 was considered to identify depressive disorders in administrative databases. There are other ICD-9 codes that are also used for depressive disorders such as 296.2 (major depression, single episode), 296.3 (major depression, recurrent episode) and 300.4 (dysthymia), but were not used in this study because the provincial fee-for-service physician claims database only captures the first three digits of ICD-9 codes. The physician claims database uses only ICD-9 while the hospital database switched from ICD-9 to ICD-10-CA in 2001. ICD-10-CA is an enhanced version of ICD-10 developed by the Canadian Institute for Health Information (CIHI) for morbidity classification in Canada. Table 3.1 presents a list of ICD-9 and ICD-10-CA codes used to identify patients with depressive disorders.

Table 3.1: ICD-9 and ICD-10-CA codes used to identify patients with depressive disorders

ICD-9 Code	**Description**
311	Depressive disorder, not elsewhere classified
ICD-10-CA Codes	
F32.0	Mild Depressive episode
F32.1	Moderate depressive episode
F32.2	Severe depressive episode without psychotic symptoms
F32.3	Severe depressive episode with psychotic symptoms
F32.8	Other depressive episodes
F32.9	Depressive episode, unspecified
F33.0	Recurrent depressive disorder, current episode mild
F33.1	Recurrent depressive disorder, current episode moderate
F33.2	Recurrent depressive disorder, current episode severe without psychotic symptoms
F33.3	Recurrent depressive disorder, current episode severe with psychotic symptoms
F33.4	Recurrent depressive disorder, currently in remission
F33.8	Other recurrent depressive disorders
F34.1	Dysthymia

3.4.5 Data Linkage

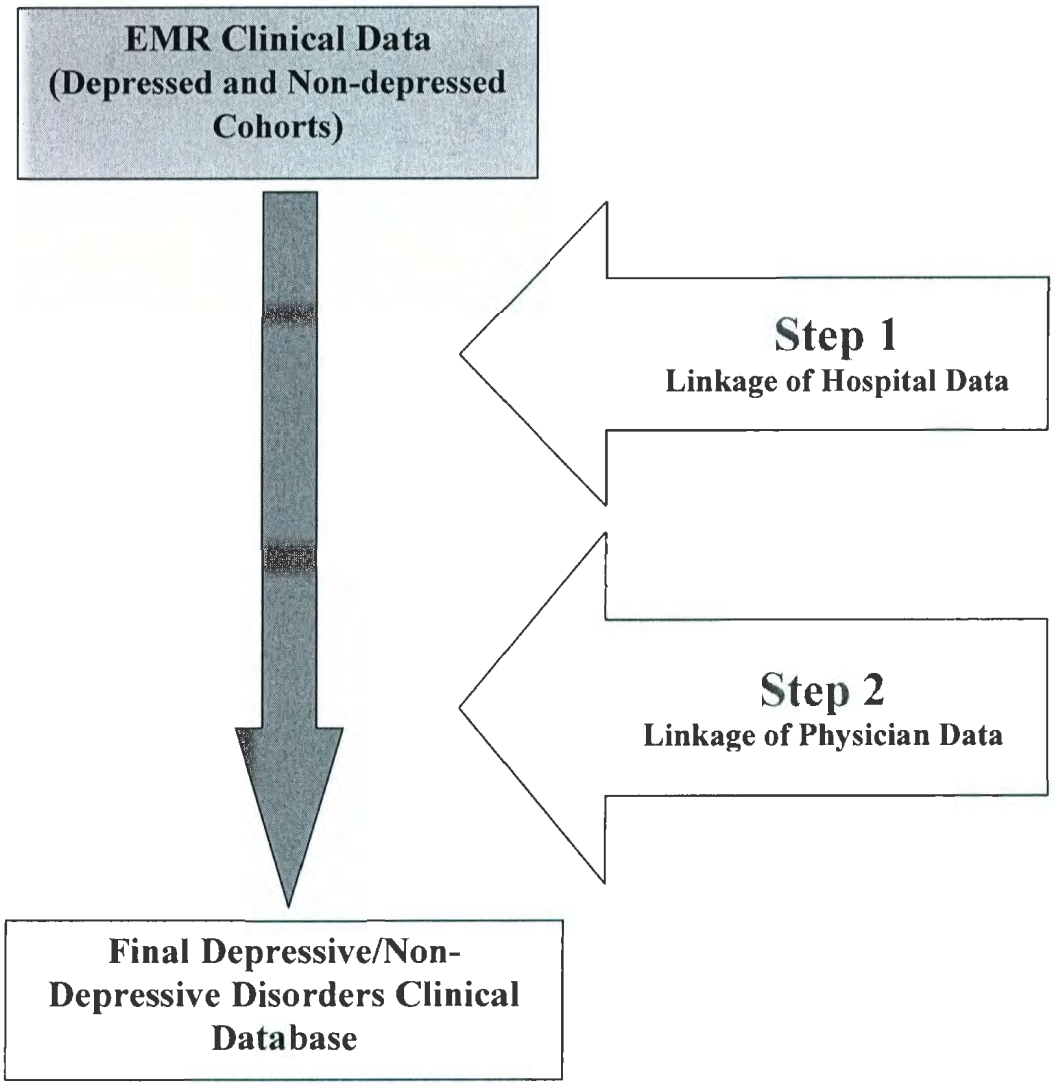
Variables of interest were extracted from the hospital database and the physician claims database. The following data were extracted from the provincial hospital database: MCP numbers (for data linkage purpose), admission date, diagnosis code (ICD-9 and ICD-10-CA), diagnosis type, and care episode identification and care episode type (acute care or surgical day care). A care episode is a unique hospitalization for an individual patient and contains diagnostic, service and demographic information associated with that specific hospitalization. Each care episode was given a unique code (a care episode ID) to represent that hospitalization. This approach was necessary given that an individual may

have multiple hospitalizations in the same reporting year. Diagnosis type is related to the relevance of the diagnosis code within an episode of care and was categorized as one of the following: most responsible diagnosis (i.e., the diagnosis most responsible for the patient's hospital stay); pre-admission co-morbidity (i.e., a condition that existed before admission that significantly influenced the patient's hospitalization); or post-admission co-morbidity (i.e., a condition that arose during a patient's hospitalization). It should be noted that all coding is performed by the hospital health record staff through extraction of information from the clinical notes. For the provincial fee-for-service physician claims, data on MCP numbers (for data linkage purposes), date of service, diagnosis code (ICD-9), provider type (e.g., general practitioner, psychiatrist) and procedure code (e.g., psychotherapy) were collected. Given that data in the hospital database is collected on a fiscal year basis, and on a calendar year in the physician claims database, to be consistent the data was extracted for the period April 1, 1995 and March 31, 2008 from both databases.

Given the nature of depressive disorders with long latency or chronic course, the patients captured in EMRs were linked to all 13 years of available hospital and physician data (April 1, 1995 to March 31, 2008). A 2-step linkage approach was used to link data from the EMRs to the hospital and physician databases (Figure 3.1). The EMR records of patients with and without depressive disorders were linked to the hospital database (via MCP number) to identify those patients having at least one hospital separation due to any condition between 1995/96 and 2007/08. In the second step these records were linked to the physician claims database (via MCP number) to capture data on physician utilization

between 1995/96 and 2007/08. Considering that the nature and the severity of depressive disorders range from mild depression to those requiring hospitalization, a number of potential case definitions were developed and compared to the results of the EMR review (i.e., gold standard).

Figure 3.1: Data linkage approach



3.5 Case Definitions

Defining a case is a fundamental element of a surveillance system and requires an assessment of the objectives and logistics of such a system. Due to the need for simplicity, surveillance case definitions are typically brief and balance competing needs

for sensitivity, specificity and feasibility (Buehler, 2008). Ideally, surveillance case definitions should both inform and reflect clinical practice, particularly for diseases with long latency or a chronic course such as depressive disorders (Buehler, 2008). In Canada, the National Diabetes Surveillance System (NDSS) is one of the surveillance systems developed to provide data about diabetes using hospital and physician administrative databases (National Diabetes Surveillance System, 2008). Considering the NDSS model and its case definitions which uses data sources similar to those employed in this study, a large number of potential case definitions were developed to be examined (Appendix C). Variables used in the development of the case definitions were depressive disorders diagnoses (either in hospital or physician claims data), date of diagnosis, and service providers type (general practitioners vs. psychiatrists). These case definitions were developed based on the fact that the severity of depressive disorders ranges from mild depression to debilitating levels requiring professional help, medication and even hospitalization. Further, depressive episodes usually run a fluctuating course and some people recover within a few years. For others, the symptoms persist for a protracted period, in which case the depression is classified as a chronic disease.

3.6 Statistical Analysis

Data obtained using the EMR review were compared to the results of linking the hospital and physician claim databases and using various case definitions. The following measures were investigated:

- Sensitivity: the percentage of individuals who are diagnosed as having a depressive disorder according to the administrative databases among patients who truly have a depressive disorder according to their EMR.
- Specificity: the percentage of individuals for whom there is no depressive disorder diagnosis on the administrative databases among patients who truly do not have a depressive disorder according to their EMR.
- Positive predictive value: the percentage of patients with depressive disorder according to their EMR among those who are classified as having depressive disorder according to the administrative databases.
- Negative predictive value: the percentage of patients not having depressive disorder (i.e., no depressive disorder diagnosis in their EMR) among those who are classified as having non-depressive disorder according to the administrative databases.

Percent agreement was calculated by summing the true-positives and true-negatives and dividing by the total study population. Cohen's *kappa* coefficient was used to quantify agreement between various case definitions and the gold standard. *Kappa* statistics and 95% confidence limits were also calculated to determine the percent agreement attributed to chance. *Kappa* is a commonly adopted measure given it corrects the agreement between two sources by taking account of the proportion of agreement expected by chance. The magnitude of agreement was assessed as follows: poor agreement: $kappa < 0.20$; fair agreement: $0.20 \leq kappa < 0.40$; moderate agreement: 0.40

$\leq$ *kappa* < 0.60; good agreement: 0.60 $\leq$ *kappa* < 0.80; and very good agreement: *kappa* $\geq$ 0.80.

In this study we hypothesized that certain conditions such as chronic pain, insomnia, anxiety and antidepressant medications could be associated with depressive disorders diagnoses. For this, multivariate logistic regression analyses were used to assess the relationship between each case definition and the various conditions. A step-wise selection strategy was used to identify parsimonious models with significant predictor variables ($p < 0.05$). Akaike's information criteria and likelihood-ratio statistics were computed to assess the overall goodness of fit for each model. Analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 15.0 (SPSS, 2006) and Statistical Analysis Software (SAS®) version 9.2 (SAS, 2008).

3.7 Ethical Considerations

The Human Investigation Committee (HIC) of Memorial University of Newfoundland (Appendix D) and the NLCHI Secondary Use Advisory Committee approved the research protocol. A number of ethical principles guided the research study. First, only an employee of the Centre for Health Information (statistician) who was not a member of the research team and had signed an Oath of Confidentiality as a condition of his employment had access to all study data. A physician (the author of this dissertation) reviewed the electronic medical charts and extracted/accessed the EMR clinical data. Following linkage of the hospital separation data and physician data to the data obtained from the clinics (EMR), the records were de-identified and key-coded by the Centre for

Health Information's statistician. The clinics from which data was obtained were the custodians of the study keys. The study keys were kept to allow for data quality processes – no identifiable data was retained at the Centre for Health Information for this study. Upon receiving approvals from the NLCHI Secondary Use Advisory Committee and HIC, the author of this dissertation obtained a de-identified copy of the database for analysis purposes.

CHAPTER FOUR: RESULTS

This chapter presents a summary of: 1) descriptive statistics, including demographic and clinical characteristics of both the depressed and non-depressed patients (e.g., age, sex, and clinics distribution, as well as co-morbidities and medication use patterns), and 2) inferential statistics, including binary classification tests (e.g., sensitivity, specificity, positive predictive value and negative predictive value, percent agreement, and *kappa* statistics), as well as multivariate logistic regression analyses used to assess the relationship between the various case definitions and selected medical conditions.

4.1 Descriptive Statistics

A total of 420 patients (all three clinics), found to have a diagnosis code for a depressive disorder (ICD-9 code of 311) through searching the EMRs, were identified and their charts reviewed. Table 4.1 presents the distribution of the 420 patients by age, sex and clinic. Of these 420 patients, 253 were found to be truly depressed (depressed cohort). Table 4.2 presents the distribution by age, sex and clinic of the depressed cohort.

Table 4.1: Distribution of Patients with a Diagnosis Code For Depressive Disorder (N=420)

Age (yr)	Health Sciences Centre			LA Miller Centre			Shea Heights Centre			All Clinics		
	M	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*
< 18	---*	---	---	0	---	---	0	---	---	0	5	5
18 – 29	---	---	11	---	---	7	---	---	13	8	23	31
30 – 39	---	---	23	---	---	17	5	14	19	12	47	59
40 – 49	12	38	50	8	19	27	7	18	25	27	75	102
50 – 59	11	32	43	11	11	22	8	13	21	30	56	86
60 – 69	9	24	33	10	15	25	2	6	8	21	45	66
70 – 79	8	14	22	10	11	21	0	---	---	18	26	44
80 +	---	---	9	5	13	18	0	0	0	7	20	27
Total	48	144	192	50	88	138	25	65	90	123	297	420

M: Male

F: Female

* Suppressed due to policies specific to patient privacy.

Table 4.2: Distribution of Truly Depressed Patients (n=253)

Age (yr)	Health Sciences Centre			LA Miller Centre			Shea Heights Centre			All Clinics		
	M	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*	*M*	*F*	*Total*
18 – 29	---*	---	7	---	---	6	---	---	10	6	17	23
30 – 39	---	---	18	---	---	13	---	---	17	11	37	48
40 – 49	7	23	30	---	---	9	6	14	20	17	42	59
50 – 59	---	---	22	---	---	9	6	9	15	12	34	46
60 – 69	5	18	23	6	8	14	---	---	6	13	30	43
70 – 79	---	---	11	---	---	6	0	---	---	5	13	18
80 +	---	---	---	---	8	12	0	0	0	5	11	16
Total	23	92	115	25	44	69	21	48	69	69	184	253

M: Male

F: Female

* Suppressed due to policies specific to patient privacy.

Using a stratified random sampling technique, 318 patients who did not have a diagnosis code for depressive disorder in their electronic chart were selected for chart

review, of which 257 were identified as truly non-depressed (non-depressed cohort). Note that no tables summarizing the distribution of the non-depressed cohort is presented given it would mirror the distribution of the depressed cohort presented in Tables 4.1 and 4.2.

Using the exclusion criteria described in the Method section, all 738 patients' charts were reviewed with 228 excluded prior to assignment of patients to the final groups of the depressed and the non-depressed cohorts. Table 4.3 presents reasons for exclusion of these patients in each cohort.

Table 4.3: Reasons for Exclusion of Patients from the Study During the Chart Review (n=228)

Reasons for exclusion	**Depressed Cohort**	**Non-Depressed Cohort**	**Total**
Did not meet clinical criteria	39	58	97
Patient's encounter was not in the study time frame (December 2006 to June 2007)	92	0	92
Lack of clinical information in the chart	36	3	39
Total	167	61	228

Table 4.4 presents demographics, co-morbidities and medication pattern for the depressed and non-depressed patients. The depressed cohort had a higher proportion of patients with anxiety, insomnia, fatigue, and chronic pain than the non-depressed cohort ($P < 0.05$). Further, the depressed cohort appeared to have a higher proportion of narcotics, anticonvulsant, gastro-intestinal, and respiratory prescriptions than the non-depressed cohort ($P < 0.05$). No significant differences were found between the demographic information of the two cohorts.

Table 4.4: Demographic and Clinical Characteristics of the Depressed and Non-Depressed Cohorts

Factors	**Depressed (n=253)**		**Non-Depressed (n=257)**		**P-value**
	Number	*%*	*Number*	*%*	
Sex (male)	69	27.3%	70	27.2%	0.993
Age mean (±SD)	50.6 (±16.5)		50.9 (±16.6)		0.808
Co-morbidities					
Cancer	19	7.5%	13	5.1%	0.254
Endocrinological disorders	55	21.7%	55	21.4%	0.926
Mental disorders excluding depression	61	24.1%	5	1.9%	0.000
Cardiovascular disorders	115	45.5%	109	42.4%	0.489
Respiratory disorders	58	22.9%	46	17.9%	0.159
Gastrointestinal disorders	78	30.8%	69	26.8%	0.321
Neurologic disorders	45	17.8%	33	12.8%	0.121
Musculoskeletal disorders	54	21.3%	83	32.3%	0.005
Other medical conditions					
Insomnia	57	22.5%	10	3.9%	0.000
Chronic pain	67	26.5%	45	17.5%	0.014
Fatigue	29	11.5%	12	4.7%	0.005
Anxiety	113	44.7%	28	10.9%	0.000
Medication Use					
No history of medication use	0	0.0%	29	11.3%	0.000
Selective serotonin reuptake inhibitors (SSRIs)	161	63.6%	0	0.0%	0.000
Serotonin-norepinephrine reuptake inhibitors (SNRIs)	57	22.5%	1	0.4%	0.000
Monamine-oxidase inhibitors (MAOIs)	1	0.4%	0	0.0%	0.313

Table 4.4: Demographic and Clinical Characteristics of the Depressed and Non-Depressed Cohorts (**Cont'd**)

Factors	**Depressed (n=253)**		**Non-Depressed (n=257)**		**P-value**
Tricyclic antidepressants (TCAs)*	27	10.7%	2	0.8%	0.000
Other antidepressants**	229	90.5%	3	1.2%	0.000
Benzodiazepines	91	36.0%	18	7.0%	0.000
Antipsychotics	7	2.8%	0	0.0%	0.007
Other psychiatric medication	59	23.3%	11	4.3%	0.000
Narcotics	22	8.7%	8	3.1%	0.007
Nonsteroidal Anti-inflammatory Drugs (NSAIDs)	48	19.0%	64	24.9%	0.106
Anticonvulsive	17	6.7%	3	1.2%	0.001
Cardiovascular medications	90	35.6%	100	38.9%	0.436
Hormonal medications***	47	18.6%	47	18.3%	0.933
Hematologic medications	1	0.4%	0	0.0%	0.313
GI medications	81	32.0%	55	21.4%	0.007
Respiratory medications	60	23.7%	40	15.6%	0.020
Antimicrobial agents	4	1.6%	21	8.2%	0.001

* TCAs with a dose greater than 75 mg/day.

** Includes zopiclone, bupropion, and mirtazapine.

*** Includes insulin, metformin, levothyroxine, etc.

Table 4.5 presents findings of the data linkage between the depressed and non-depressed patients to the provincial hospital separation database and the provincial fee-for-service physician claims database over a 13-year time period (April 1, 1995 to March 31, 2008). All patients who had a hospitalization with a depressive disorder were identified in the depressed cohort (22 of 253), whereas none of the non-depressed cohort

patients were found to have a hospitalization as a result of a depressive disorder. Five of the 253 patients in the depressed cohort did not have a record in the physician claims database for any physician visits (for any reason). These could be individuals who do not have a valid MCP number, and would include visitors/tourists, armed-forces personnel etc. Conversely, 14 of 257 of non-depressed patients were found not to have any physician visits in the physician database.

Table 4.5: Linkage of the Depressed and the Non-Depressed Cohorts to the Hospital And Physician Databases

	Depressed Cohort (No. of patients)	**Non-Depressed Cohort (No. of patients)**
Hospital Linkage		
Patients who had at least one hospitalization due to any diseases	190	174
Patients who had at least one hospitalization due to depressive disorders	22	0
Patients who did not have any hospitalizations due to depressive disorders	231	257
Patients who did not have any hospitalization	63	83
Physician Claims Linkage		
Patients who had at least one physician visit due to any conditions	248	243
Patients who had at least one physician visit due to depressive disorders	226	45
Patients who did not have any physician visit due to depressive disorders	27	212
Patients who did not have any physician visit	5	14

Table 4.6 presents descriptive statistics on health service utilization (both hospital and physician visits) due to depressive disorders among the depressed and non-depressed cohorts. The depressed patients utilized physician services more than the non-depressed patients during the study period.

Table 4.6: Descriptive Statistics of Health Service Utilization during the Study Period

Service	**Depressed Cohort**	**Non-Depressed Cohort**
Hospitalizations		
Number of patients	22	0
Mean (±SD) number of hospitalizations	3.9 (±9.1)	-
Median number of hospitalizations	1	-
Mode number of hospitalizations	1	-
Maximum number of hospitalizations	1-43	-
Physician visits		
Number of patients	226	45
Mean (±SD) number of visits	23.2 (±38.3)	8.2 (±19.6)
Median number of visits	10	1
Mode number of visits	3	1
Maximum number of visits	399	110
Number of visits		
1 to 4 visits	62	32
5 to 8 visits	43	7
9 to 12 visits	28	1
More than 13 visits	93	5

4.2 Inferential Statistics

In this study 120 case definitions (Appendix C) were developed and compared to the gold standard (i.e., EMR) to identify the most valid case definition(s) for surveillance of depressive disorders. Of the 120 case definitions investigated, 26 were found to have a

kappa statistic greater than 0.6 (interpreted as substantial agreement). For ease of presentation, only these 26 case definitions are presented in Table 4.7. The remaining of 94 definitions, including their binary classification tests are provided in Appendix E.

Table 4.7: 26 Definitions with *Kappa* Statistics Greater than 0.6

CD1	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders any time
CD2	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders any time
CD3	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders any time
CD4	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders any time
CD5	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders any time
CD6	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first year of diagnosis
CD7	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first year of diagnosis
CD8	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first 2 years of diagnosis
CD9	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 2 years of diagnosis
CD10	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first 3 years of diagnosis
CD11	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 3 years of diagnosis
CD12	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first 3 years of diagnosis
CD13	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first 4 years of diagnosis
CD14	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 4 years of diagnosis

Table 4.7: 26 Definitions with *Kappa* Statistics Greater than 0.6 (**Cont'd**)

CD15	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first 4 years of diagnosis
CD16	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 1 GP visits due to depressive disorders within the first 1 year of diagnosis
CD17	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 1 year of diagnosis
CD18	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 1 GP visits due to depressive disorders within the first 2 years of diagnosis
CD19	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 2 years of diagnosis
CD20	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 3 GP visits due to depressive disorders within the first 2 years of diagnosis
CD21	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 1 GP visits due to depressive disorders within the first 3 years of diagnosis
CD22	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 3 years of diagnosis
CD23	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 3 GP visits due to depressive disorders within the first 3 years of diagnosis
CD24	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 1 GP visits due to depressive disorders within the first 4 years of diagnosis
CD25	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 4 years of diagnosis
CD26	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 3 GP visits due to depressive disorders within the first 4 years of diagnosis

Table 4.8 presents the sensitivity, specificity, false positive rate, false negative rate, positive predictive value, negative predictive value, percent agreement, *kappa* and its 95% CI for each of the 26 selected case definitions.

Table 4.8: Inferential Statistics for 26 Definitions with *Kappa* Statistics Greater than 0.6

≥1 hospital OR ≥1 physician anytime (CD #1)		**≥1 hospital OR ≥2 physician anytime (CD #2)**		**≥1 hospital OR ≥3 physician anytime (CD #3)**		**≥1 hospital OR ≥4 physician anytime (CD #4)**	
Sensitivity	89.3	Sensitivity	82.6	Sensitivity	77.1	Sensitivity	69.6
Specificity	82.5	Specificity	91.4	Specificity	93.0	Specificity	93.8
FP[1] rate	17.5	FP rate	8.6	FP rate	7.0	FP rate	6.2
FN[2] rate	10.7	FN rate	17.4	FN rate	22.9	FN rate	30.4
PPV[3]	83.4	PPV	90.5	PPV	91.5	PPV	91.7
NPV[4]	88.7	NPV	84.2	NPV	80.5	NPV	75.8
Percent agreement	85.9	Percent agreement	87.1	Percent agreement	85.1	Percent agreement	81.8
Kappa	0.718	*Kappa*	0.741	*Kappa*	0.702	*Kappa*	0.635
Kappa 95%CI	0.66-0.78	*Kappa* 95%CI	0.68-0.80	*Kappa* 95%CI	0.64-0.76	*Kappa* 95%CI	0.57-0.70
≥1 hospital OR ≥5 physician anytime (CD #5)		**≥1 hospital OR ≥1 physician within 1 yr (CD #6)**		**≥1 hospital OR ≥2 physician within 1 yr (CD #7)**		**≥1 hospital OR ≥1 physician within 2 yr (CD #8)**	
Sensitivity	65.6	Sensitivity	89.3	Sensitivity	70.0	Sensitivity	89.3
Specificity	94.9	Specificity	82.5	Specificity	93.8	Specificity	82.5
FP rate	5.1	FP rate	17.5	FP rate	6.2	FP rate	17.5
FN rate	34.4	FN rate	10.7	FN rate	30.0	FN rate	10.7
PPV	92.7	PPV	83.4	PPV	91.7	PPV	83.4
NPV	73.7	NPV	88.7	NPV	76.0	NPV	88.7
Percent agreement	80.4	Percent agreement	85.9	Percent agreement	82.0	Percent agreement	85.9
Kappa	0.607	*Kappa*	0.718	*Kappa*	0.639	*Kappa*	0.718
Kappa 95%CI	0.54-0.67	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.57-0.70	*Kappa* 95%CI	0.66-0.78
≥1 hospital OR ≥2 physician within 2 yr (CD #9)		**≥1 hospital OR ≥1 physician within 3 yr (CD #10)**		**≥1 hospital OR ≥2 physician within 3 yr (CD #11)**		**≥1 hospital OR ≥3 physician within 3 yr (CD #12)**	
Sensitivity	75.1	Sensitivity	89.3	Sensitivity	77.9	Sensitivity	68.0
Specificity	93.0	Specificity	82.5	Specificity	92.6	Specificity	94.2
FP rate	7.0	FP rate	17.5	FP rate	7.4	FP rate	5.8
FN rate	24.9	FN rate	10.7	FN rate	22.1	FN rate	32.0
PPV	91.3	PPV	83.4	PPV	91.2	PPV	92.0

Table 4.8: Inferential Statistics for 26 Definitions with *Kappa* Statistics Greater than 0.6 **(Cont'd)**

≥1 hospital OR ≥2 physician within 2 yr (CD #9)		**≥1 hospital OR ≥1 physician within 3 yr (CD #10)**		**≥1 hospital OR ≥2 physician within 3 yr (CD #11)**		**≥1 hospital OR ≥3 physician within 3 yr (CD #12)**	
NPV	79.1	NPV	88.7	NPV	81.0	NPV	74.9
Percent agreement	84.1	Percent agreement	85.9	Percent agreement	85.3	Percent agreement	81.2
Kappa	0.682	*Kappa*	0.718	*Kappa*	0.706	*Kappa*	0.623
Kappa 95%CI	0.62-0.74	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.64-0.77	*Kappa* 95%CI	0.56-0.69
≥1 hospital OR ≥1 physician within 4 yr (CD #13)		**≥1 hospital OR ≥2 physician within 4 yr (CD #14)**		**≥1 hospital OR ≥3 physician within 4 yr (CD #15)**		**(≥1 hospital OR ≥1 PSY[5]) OR ≥1 GP[6] within 1 yr (CD #16)**	
Sensitivity	89.3	Sensitivity	80.6	Sensitivity	71.1	Sensitivity	89.3
Specificity	82.5	Specificity	91.4	Specificity	93.4	Specificity	82.5
FP rate	17.5	FP rate	8.6	FP rate	6.6	FP rate	17.5
FN rate	10.7	FN rate	19.4	FN rate	28.9	FN rate	10.7
PPV	83.4	PPV	90.3	PPV	91.4	PPV	83.4
NPV	88.7	NPV	82.7	NPV	76.7	NPV	88.7
Percent agreement	85.9	Percent agreement	86.1	Percent agreement	82.4	Percent agreement	85.9
Kappa	0.718	*Kappa*	0.721	*Kappa*	0.646	*Kappa*	0.718
Kappa 95%CI	0.66-0.78	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.58-0.71	*Kappa* 95%CI	0.66-0.78
(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 1 yr (CD #17)		**(≥1 hospital OR ≥1 PSY) OR ≥1 GP within 2 yr (CD #18)**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr (CD #19)**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 2 yr (CD #20)**	
Sensitivity	73.1	Sensitivity	89.3	Sensitivity	77.5	Sensitivity	67.6
Specificity	93.4	Specificity	82.5	Specificity	93.0	Specificity	93.8
FP rate	6.6	FP rate	17.5	FP rate	7.0	FP rate	6.2
FN rate	26.9	FN rate	10.7	FN rate	22.5	FN rate	32.4
PPV	91.6	PPV	83.4	PPV	91.6	PPV	91.4
NPV	77.9	NPV	88.7	NPV	80.7	NPV	74.6

Table 4.8: Inferential Statistics for 26 Definitions with *Kappa* Statistics Greater than 0.6 **(Cont'd)**

(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 1 yr (CD #17)		**(≥1 hospital OR ≥1 PSY) OR ≥1 GP within 2 yr (CD #18)**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr (CD #19)**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 2 yr (CD #20)**	
Percent agreement	83.3	Percent agreement	85.9	Percent agreement	85.3	Percent agreement	80.8
Kappa	0.666	*Kappa*	0.718	*Kappa*	0.706	*Kappa*	0.615
Kappa 95%CI	0.60-0.73	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.64-0.77	*Kappa* 95%CI	0.55-0.68
(≥1 hospital OR ≥1 PSY) OR ≥1 GP within 3 yr (CD #21)		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 3 yr (CD #22)**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr (CD #23)**		**(≥1 hospital OR ≥1 PSY) OR ≥1 GP within 4 yr (CD #24)**	
Sensitivity	79.1	Sensitivity	79.1	Sensitivity	69.6	Sensitivity	89.3
Specificity	92.6	Specificity	92.6	Specificity	93.4	Specificity	82.5
FP rate	7.4	FP rate	7.4	FP rate	6.6	FP rate	17.5
FN rate	20.9	FN rate	20.9	FN rate	30.4	FN rate	10.7
PPV	91.3	PPV	91.3	PPV	91.2	PPV	83.4
NPV	81.8	NPV	81.8	NPV	75.7	NPV	88.7
Percent agreement	85.9	Percent agreement	85.9	Percent agreement	81.6	Percent agreement	85.9
Kappa	0.717	*Kappa*	0.717	*Kappa*	0.631	*Kappa*	0.718
Kappa 95%CI	0.66-0.78	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.57-0.70	*Kappa* 95%CI	0.66-0.78
(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 4 yr (CD #25)		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 4 yr (CD #26)**					
Sensitivity	81.4	Sensitivity	72.7				
Specificity	91.4	Specificity	92.6				
FP rate	8.6	FP rate	7.4				
FN rate	18.6	FN rate	27.3				
PPV	90.4	PPV	90.6				
NPV	83.3	NPV	77.5				
Percent agreement	86.5	Percent agreement	82.7				

Table 4.8: Inferential Statistics for 26 Definitions with *Kappa* Statistics Greater than 0.6 **(Cont'd)**

(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 4 yr (CD #25)		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 4 yr (CD #26)**	
Kappa	0.729	*Kappa*	0.654
Kappa 95%CI	0.67-0.79	*Kappa* 95%CI	0.59-0.72

[1] False positive rate
[2] False negative rate
[3] Positive predictive value
[4] Negative predictive value
[5] Psychiatrist visit
[6] General practitioner visit

Considering the clinical characteristics of the different types of depressive disorders, as well as the severity and chronicity (which may sustain over a period of weeks to months even years) and a sensitivity threshold of greater than 70% (with *kappa* more than 0.6), five of 26 selected case definitions were considered the most appropriate for surveillance of depressive disorders (Table 4.9). Specificity and false positive rate for these five definitions were similar (93% for specificity, 6.2-7.0 for false positive rate). Of the five definitions, a false negative rate was found to be lowest for case definition #19 ([≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time] **OR** ≥ 2 GP visits due to depressive disorders within the first 2 years of diagnosis).

Table 4.9-A: Five Most Appropriate Case Definitions

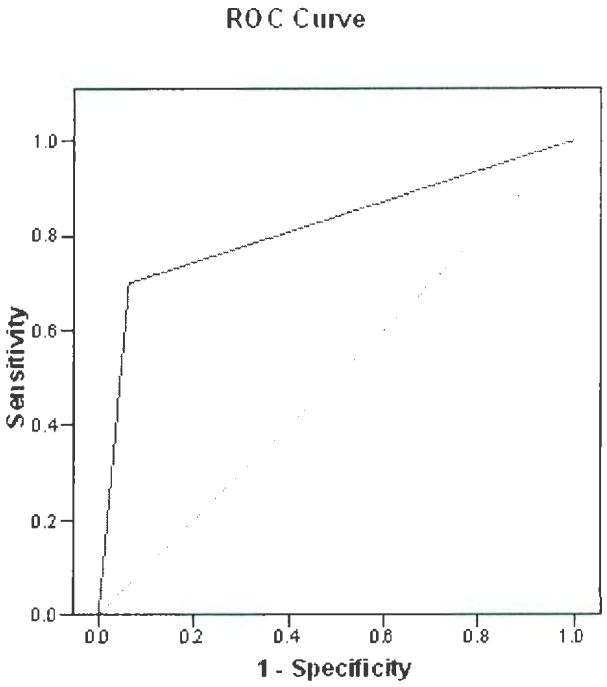
CD #7	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first year of diagnosis
CD #9	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 2 years of diagnosis
CD #17	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 1 year of diagnosis
CD #19	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 2 years of diagnosis
CD #23	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 3 GP visits due to depressive disorders within the first 3 years of diagnosis

Table 4.9-B: Inferential Statistics for Five Most Appropriate Case Definitions

≥1 hospital OR ≥2 physician within 1 yr (CD #7)		**≥1 hospital OR ≥2 physician within 2 yr (CD #9)**		**(≥1 hospital OR ≥1 PSY[5]) OR ≥2 GP[6] within 1 yr (CD #17)**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr (CD #19)**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr (CD #23)**	
Sensitivity	70.0	Sensitivity	75.1	Sensitivity	73.1	Sensitivity	77.5	Sensitivity	69.6
Specificity	93.8	Specificity	93.0	Specificity	93.4	Specificity	93.0	Specificity	93.4
FP[1] rate	6.2	FP rate	7.0	FP rate	6.6	FP rate	7.0	FP rate	6.6
FN[2] rate	30.0	FN rate	24.9	FN rate	26.9	FN rate	22.5	FN rate	30.4
PPV[3]	91.7	PPV	91.3	PPV	91.6	PPV	91.6	PPV	91.2
NPV[4]	76.0	NPV	79.1	NPV	77.9	NPV	80.7	NPV	75.7
Percent agreement	82.0	Percent agreement	84.1	Percent agreement	83.3	Percent agreement	85.3	Percent agreement	81.6
Kappa	0.639	*Kappa*	0.682	*Kappa*	0.666	*Kappa*	0.706	*Kappa*	0.631
Kappa 95%CI	0.57-0.70	*Kappa* 95%CI	0.62-0.74	*Kappa* 95%CI	0.60-0.73	*Kappa* 95%CI	0.64-0.77	*Kappa* 95%CI	0.57-0.70

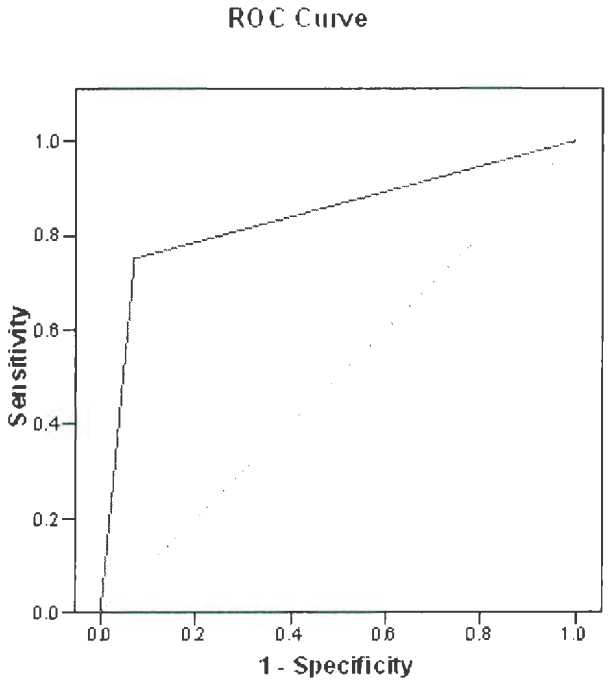
[1] False positive rate
[2] False negative rate
[3] Positive predictive value
[4] Negative predictive value
[5] Psychiatrist visit
[6] General practitioner visit

Figure 4.1 shows Receiver Operating Characteristic (ROC) Curves for the five most appropriate case definitions.



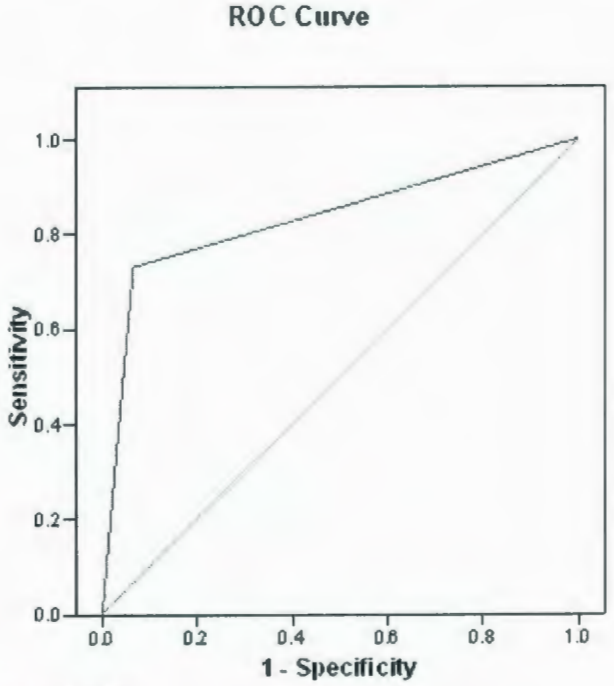
Area under the curve = 0.819

≥ 1 hospitalizations due to depressive disorders any time OR ≥ 2 physician visits due to depressive disorders within the first year of diagnosis



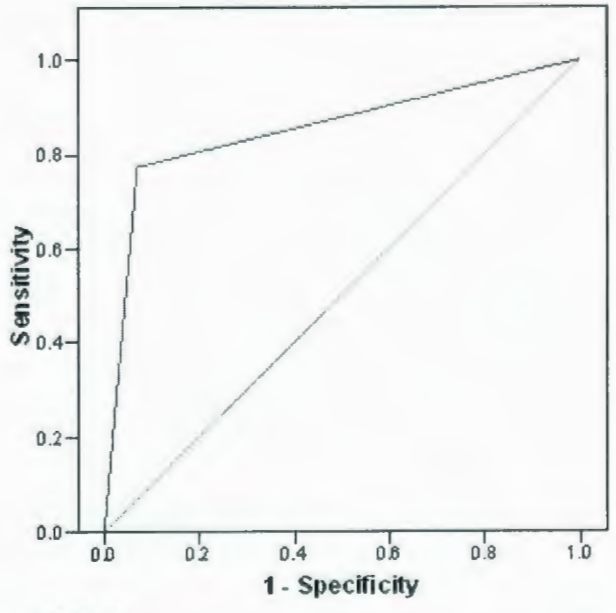
Area under the curve = 0.840

≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 2 years of diagnosis



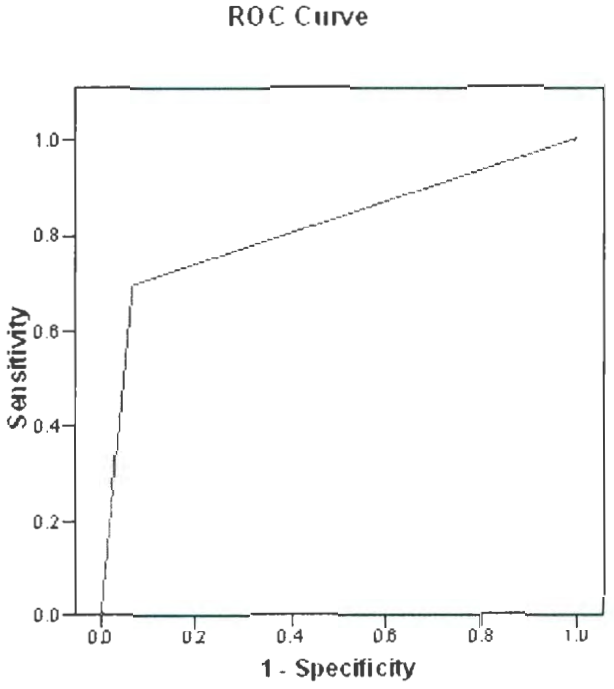
Area under the curve = 0.833

(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 1 year of diagnosis



Area under the curve = 0.852

(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 2 years of diagnosis



Area under the curve = 0.815
(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 3 GP visits due to depressive disorders within the first 3 years of diagnosis

Figure 4.1: Receiver Operating Characteristic (ROC) Curves for the five most appropriate case definitions

As noted in the Materials and Methods Section, information on medication utilization is not currently captured in the hospital or physician databases; therefore, it was not possible to consider information on drugs in the development of potential case definitions for depressive disorders. The research team examined the impact of including medication information (via the EMR) on sensitivity and specificity for the 26 selected case definitions. The medication information specific to antidepressants were combined with the case definitions either as 'AND' or 'OR'. Appendix F presents sensitivity, specificity, false positive rate, false negative rate, positive predictive value, negative predictive value,

percent agreement, *kappa* and its 95% CI measures for each case definition. Table 4.10 presents the impact of including anti-depressant medication information on the selected five most appropriate case definitions. Addition of medication data to the five case definitions increased either the specificity or the sensitivity level to 100%.

Table 4.10: Inferential Statistics for Five Most Appropriate Case Definitions with the Addition of Anti-Depressant Medication Information

≥1 hospital OR ≥2 physician within 1 yr AND Anti-Depressant Medication		**≥1 hospital OR ≥2 physician within 2 yr AND Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY[5]) OR ≥2 GP[6] within 1 yr AND Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr AND Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr AND Anti-Depressant Medication**	
Sensitivity	62.1	Sensitivity	66.8	Sensitivity	64.8	Sensitivity	68.8	Sensitivity	61.3
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP[1] rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN[2] rate	37.9	FN rate	33.2	FN rate	35.2	FN rate	31.2	FN rate	38.7
PPV[3]	100.0	PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV[4]	72.8	NPV	75.4	NPV	74.3	NPV	76.5	NPV	72.4
Percent agreement	81.2	Percent agreement	83.5	Percent agreement	82.5	Percent agreement	84.5	Percent agreement	80.8
Kappa	0.622	*Kappa*	0.670	*Kappa*	0.650	*Kappa*	0.689	*Kappa*	0.615
Kappa 95%CI	0.56-0.69	*Kappa* 95%CI	0.61-0.73	*Kappa* 95%CI	0.59-0.71	*Kappa* 95%CI	0.63-0.75	*Kappa* 95%CI	0.55-0.68
≥1 hospital OR ≥2 physician within 1 yr OR Anti-Depressant Medication		**≥1 hospital OR ≥2 physician within 2 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 1 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr OR Anti-Depressant Medication**	
Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	92.7	Specificity	91.9	Specificity	92.3	Specificity	91.9	Specificity	92.3
FP rate	7.3	FP rate	8.1	FP rate	7.7	FP rate	8.1	FP rate	7.7
FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	92.9	PPV	92.3	PPV	92.6	PPV	92.3	PPV	92.6
NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	96.3	Percent agreement	95.9	Percent agreement	96.1	Percent agreement	95.9	Percent agreement	96.1
Kappa	0.926	*Kappa*	0.918	*Kappa*	0.922	*Kappa*	0.918	*Kappa*	0.922

Table 4.10: Inferential Statistics for Five Most Appropriate Case Definitions with the Addition of Anti-Depressant Medication Information (**Cont'd**)

≥1 hospital OR ≥2 physician within 1 yr OR Anti-Depressant Medication		**≥1 hospital OR ≥2 physician within 2 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 1 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr OR Anti-Depressant Medication**		**(≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr OR Anti-Depressant Medication**	
Kappa 95%CI	0.89-0.96	*Kappa* 95%CI	0.88-0.95	*Kappa* 95%CI	0.89-0.96	*Kappa* 95%CI	0.88-0.95	*Kappa* 95%CI	0.89-0.96

[1] False positive rate
[2] False negative rate
[3] Positive predictive value
[4] Negative predictive value
[5] Psychiatrist visit
[6] General practitioner visit

Table 4.11 presents the results of step-wise multiple regression models found to have significant variables ($p < 0.05$). Consistently across all the models, the depressed cohort were 4-5 times more likely to have been prescribed antidepressant medications than the controls. This was also true for antipsychotic and other psychiatric medications which were significantly associated with a diagnosis of depression in all the models, but the degree of association varied. Similarly, the depressed cohort appeared to have 4-5 times higher odds of having received psychotherapy (either by general practitioners or psychiatrists) than those in the control cohort. Further, fee-for-service physician visits were found to be significantly higher for the depressed cohort in all five regression models. Cardiovascular, musculoskeletal disorders, history of no medication use, and anxiety were less likely to be noted in the depressed cohort.

Table 4.11: Step-Wise Logistic Multiple Regression Models

Model 1 - Odds Ratio Estimates ≥1 hospital OR ≥2 physician within 1 yr (CD #7)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Anxiety	0.520	0.329	0.823
Cardiovascular disorder	0.497	0.330	0.747
Musculoskeletal disorder	0.546	0.341	0.874
No medication	0.177	0.038	0.814
Antidepressant medication	4.446	2.931	6.743
Antipsychotic medication	5.513	1.231	24.682
Other psychiatric medication	2.020	1.139	3.582
Psychotherapy	4.364	2.938	6.482
Number of Fee-for-Service physician visits	7.0	4.7	11.8

Model 2 - Odds Ratio Estimates ≥1 hospital OR ≥2 physician within 2 yr (CD #9)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Anxiety	0.579	0.354	0.945
Cardiovascular disorder	0.516	0.333	0.801
Musculoskeletal disorder	0.599	0.367	0.977
Endocrinologic disorder	0.549	0.325	0.927
No medication	0.214	0.057	0.804
Antidepressant medication	5.076	3.250	7.928
Antipsychotic medication	5.050	1.017	25.069
Other psychiatric medication	2.434	1.312	4.514
NSAIDs	0.601	0.369	0.977

Model 2 - Odds Ratio Estimates ≥1 hospital OR ≥2 physician within 2 yr (CD #9)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Antimicrobial agents	0.289	0.102	0.823
Psychotherapy	5.574	3.712	8.368
Number of Fee-for-Service physician visits	8.5	5.3	15.4

Model 3 - Odds Ratio Estimates (≥1 hospital OR ≥1 PSY) OR ≥2 GP within 1 yr (CD # 17)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Anxiety	0.545	0.341	0.870
Cardiovascular disorder	0.520	0.344	0.785
Musculoskeletal disorder	0.555	0.346	0.891
Antidepressant medication	5.335	3.492	8.151
Antipsychotic medication	5.272	1.153	24.117
Other psychiatric medication	1.982	1.104	3.558
Psychotherapy	4.653	3.141	6.893
Number of Fee-for-Service physician visits	7.4	4.9	12.8

Model 4 - Odds Ratio Estimates (≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr(CD #19)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Anxiety	0.568	0.347	0.928
Cardiovascular disorder	0.490	0.318	0.753
Musculoskeletal disorder	0.526	0.324	0.855
No medication	0.221	0.059	0.833

Model 4 - Odds Ratio Estimates (≥1 hospital OR ≥1 PSY) OR ≥2 GP within 2 yr(CD #19)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Antidepressant medication	5.562	3.546	8.723
Other psychiatric medication	2.581	1.384	4.814
Antimicrobial agents	0.269	0.094	0.771
Psychotherapy	5.675	3.804	8.467
Number of Fee-for-Service physician visits	8.2	5.2	14.7

Model 5 - Odds Ratio Estimates (≥1 hospital OR ≥1 PSY) OR ≥3 GP within 3 yr (CD #23)			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Anxiety	0.568	0.354	0.911
Chronic pain	0.478	0.292	0.782
Mental disorder excluding depression	1.980	1.163	3.370
Cardiovascular disorder	0.491	0.323	0.748
No medication	0.252	0.067	0.944
Antidepressant medication	3.877	2.510	5.988
Hormonal medication	0.564	0.327	0.971
Other psychiatric medication	2.448	1.354	4.424
Antimicrobial agents	0.232	0.078	0.694
Psychotherapy	5.442	3.625	8.170
Number of Fee-for-Service physician visits	7.6	4.9	13.3

CHAPTER FIVE: DISCUSSION

The objectives of this chapter are: 1) to discuss pertinent findings of the study within the context of previous research, 2) to discuss the strengths and limitations of this study, 3) to discuss suggestions for future studies, and 4) to provide conclusions.

5.1 Discussion of Study Findings

The focus of this study was to examine the usefulness and validity of using provincial administrative databases for carrying out surveillance of depressive disorders. Depressive disorders studied included major depressive disorder, dysthymic disorder, and depressive disorders not otherwise specified (e.g., minor depressive disorders, recurrent brief depressive disorders). At the national level, the challenges in developing a mental illness surveillance system has been discussed (Patel, 2004) with several challenges identified, including: establishing the goals of the surveillance system; getting agreement on key data elements for the system; creating indicators and case definitions; identifying data sources; specifying data collection, analysis, and dissemination procedures; ensuring use of the system; and the need to evaluate the system (Health Canada, 2002). The Public Health Agency of Canada, with the mandate to strengthen Canada's capacity to protect and improve the health of Canadians, plans to develop a national picture of mental disorders using a valid and feasible methodology. This methodology will be similar to that of the National Diabetes Surveillance System, whereby provinces and territories share aggregate data based on a common case definition for select chronic diseases. This current study has shown that using administrative databases for the surveillance of

depressive disorders and research is both a valid and feasible approach. A recent study by Kisely et al. (2009) evaluated the usefulness of administrative data in the surveillance of mental illness in Canada using a population-based record-linkage analysis. Kisely et al. (2009) utilized data from physician billings, hospital discharge abstracts, and community-based clinics obtained from the following five provinces: British Columbia, Ontario, Quebec, Nova Scotia, and Alberta. The case definition used in the Kisely's study included two or more physician visits, or one hospitalization due to any mental disorders (ICD-9 codes 290-319) at any point of time. The authors concluded that using administrative data to measure the prevalence of mental health disorders that are being treated is feasible. The authors also suggest that despite suspected variations in data coding, their results showed acceptable uniformity of data across the five provinces.

This study validated the use of administrative databases versus surveys as a method for surveillance of depressive disorders. Administrative databases are increasingly being used for many types of research in economically developed countries, given their advantage of having larger sample size, lower costs, and increased generalizability (Harpe, 2009). They also can include a wide variety of data fields through linkage to other disparate health care information at the individual level, and frequently include large numbers of patients spanning many years. While they are considered a valuable source for many types of research, administrative databases have not been widely used for public health surveillance (Harpe, 2009). And although surveys have been used for surveillance of mental disorders (Patten et al., 2006; Wang et al., 2009; Patten & Beck, 2004; Vasiliadis et al., 2005; Satyanarayana et al., 2009), their validity depends on many

factors, such as the sampling strategy which impacts generalizability, and the accuracy of self-reporting. Lix et al. (2008) found that agreement between administrative databases and population surveys was highest for diabetes and hypertension, and lowest for arthritis. Okura et al. (2004) suggested that although diabetes and hypertension are not usually characterized by distinct and dramatic clinical presentations, they are chronic and require ongoing repeated health services utilizations which increases their likelihood of identification in administrative data. For arthritis, the selection of non-specific diagnostic codes by physicians, potentially inaccurate diagnoses by non-specialized practitioners, and the low probability that this condition will contribute to a hospital stay, may all be factors contributing to the lack of concordance between the two data sources (Lix et al., 2008).

Our findings showed that of all the depressed patients who were hospitalized (due to psychiatric or non-psychiatric reasons), only a small proportion (11.6%, 22/190) had hospitalizations as a result of a depressive disorder. The large discrepancy between the hospital records and gold standard in this study may be due in part to patients being hospitalized for reasons other than depression, yet subsequently receiving a co-morbid diagnosis of depression while hospitalized. Nonetheless, all patients who had a hospitalization due to depressive disorders were identified in the depressed cohort, whereas none of the non-depressed cohort patients were found to have a hospitalization as a result of a depressive disorder. This suggests high specificity of the hospital data in capturing patients with a depressive disorder diagnosis. It is worth noting that depressions requiring hospitalizations are often severe and protracted, with potential multiple

outpatient treatment failures. Identifying and diagnosing such patients may not be as challenging as those who have mild depression, who often are treated in an outpatient setting.

Of all those patients found by chart review with a depressive disorder, 89.3% (226/253) were identified in the provincial fee-for-service physician claims database as having an outpatient visit with an associated code of depressive disorder. The discrepancy between the charts and the physician claims database could partially be explained by individuals who do not have a valid MCP (health insurance) number (e.g., non-residents, armed-forces personnel, etc.) and as such would not be included in the physician claims database. In this study, we could not identify the severity of the disease (mild versus severe) due of lack of clinical information in the medical charts. It is also important to note that patients with mild depressive disorders may not easily be diagnosed in the clinic. Further, it was challenging to be able to identify the severity of depression using administrative databases. Although it is arguable that those patients who had a hospitalization or psychiatric visit may have had severe depression, not all patients with depressive disorders require hospital admissions or psychiatric visits.

Despite the fact that many patients with depressive disorders seek help in primary care, general practitioners still have difficulties diagnosing and treating depression (Charbonneau et al., 2004; Wells et al., 1999). Additionally, because depressive disorders are more common among those with comorbid chronic medical disorders, depressions with significant somatic comorbidity may remain unrecognized in primary care (Akiskal, 2005). Moreover, studies using administrative databases for conducting research on

depression often identify patients by ICD codes (West et al., 2000). Basing analyses on diagnostic codes such as the ICD classification must be done with caution because mental illnesses, due to their potential for stigma, may not be fully reported on insurance claims.

Rawson et al. (1997) evaluated the reliability of schizophrenia and depression diagnoses in several Saskatchewan health care databases. The study focused on patients who were hospitalized for these conditions, and sought confirmation of the diagnosis in both the patient charts and the Physician Services file (containing information on outpatient visits to Saskatchewan clinicians). Following a review of the hospital charts, agreement was found to be 94% for schizophrenia and 58% for depression. Agreement with the Physician Services file was lower for schizophrenia (60%) than for depression (73%). In Saskatchewan, West et al. (2000) reported similar results to that of Rawson and colleagues (1997) for a depression diagnosis according to the Physician Services file (77% vs. 73%).

In this study, considering previously developed chronic disease models and their case definitions (e.g., the National Diabetes Surveillance System model), a large number of potential case definitions for depressive disorders were developed. These case definitions were developed with the understanding that the severity of depressive disorders range from mild depression to debilitating levels requiring professional help, medication and even hospitalization. Further, depressive episodes usually run a fluctuating course with some people recovering within a few years, while for others the symptoms persist for a protracted period and become chronic. Unlike most previous studies (Kisely et al., 2009; Damush et al., 2008; West et al., 2000; Fultz et al., 2006; Hux et al., 2002; James et al.,

2004; Solberg et al., 2006; To et al., 2006), the case definitions used in this study incorporated the physician specialty (general practitioners vs. psychiatrists) when counting the number of physician visits. Surveillance case definitions must balance competing needs for sensitivity, specificity, and feasibility. Because of the need for simplicity, surveillance case definitions are typically brief (Buehler, 2008). For disease with long latency or chronic course (e.g., depressive disorders), developing a case definition depends on decisions regarding which phase to monitor: asymptomatic, early disease, late disease, or death. Ideally, surveillance case definitions should both inform and reflect clinical practices (Buehler, 2008). In this study, incorporating physician specialty (e.g., general practitioner vs. psychiatrist) enabled us to capture the range of depression from mild depressive not requiring hospitalizations or psychiatric visits, to major depression which may have required either hospitalizations or psychiatric visits. We believe this component of our study added another degree of validity with respect to the diagnosis of the patient.

Overall, none of the case definitions developed for this study resulted in exceptional performance with respect to sensitivity and specificity (e.g. > 85%). Nonetheless, five case definitions based on inpatient and outpatient ICD codes and physician specialty data were found to perform best.

This study found that valid case definitions for identifying patients with depressive disorders require at least one hospitalization and at least two fee-for-service physician visits. With respect to duration, a minimum of 2-3 years of retrospective data is required

to have hospitalizations and fee-for-service physician visits identify the majority of the cases.

The timeframe required to generate sufficient numbers of healthcare visits is crucial for developing a valid case definition. The optimal timeframe needed for the identification of patients with chronic diseases varies by type of disease. A two- to three-year timeframe has been suggested as sufficient, particularly for chronic diseases with relatively structured visiting behavior such as diabetes and hypertension (Robinson et al., 1997; Hoogenveen et al., 2002). Using a two-year time frame for our case definition was appropriate, given depressive symptoms often persist over a protracted time. This time frame is also consistent with other established chronic diseases such as diabetes in the National Diabetes Surveillance System model case definition. Previous research has shown that the errors of prevalence estimates decreases with increasing follow up time (Robinson et al., 1997; Hoogenveen et al., 2002). For conditions that may be challenging to diagnose such as asthma, a timeframe up to five years may be required (Lix et al., 2008). In other cases, using a period longer than two years may not be feasible for ongoing surveillance system (Hux et al., 2002). Other investigators used a shorter timeframe of two years mainly because the purpose of their investigation was to identify cases rather than to estimate the burden of the disease (Coffin et al., 2005).

Of the five case definitions found to perform best, the case definition, ($\geq$ 1 hospitalization **OR** $\geq$ 1 psychiatrist visit due to depressive disorders any time) **OR** $\geq$ 2 GP visits due to depressive disorders within the first 2 years of diagnosis, appears to be the most appropriate, having high sensitivity (77.5%), specificity (93%), and PPV

(91.6%), with a *kappa* statistics of 0.706. We put forward this case definition as the most appropriate for studies of depressive disorders using hospital and physician administrative databases, given: 1) there is congruence between the administrative databases and medical charts in identifying cases, 2) has high sensitivity and specificity, 3) incorporates physician specialty (general practitioners vs. psychiatrists) in the case definition, and 4) considers a minimum of 2 years of retrospective data.

In our study, the addition of drug use data from the electronic charts (EMR) (antidepressant medications) enhanced the accuracy of all five of our case definitions by improving the sensitivity level to 100% and the *kappa* statistics to over 90%, while the false negative rate reduced to zero. This finding could have important implications in the development of future case definitions by considering data from population-based Pharmacy Networks. The Newfoundland and Labrador Pharmacy Network will connect pharmacists, physicians, and other authorized health professionals to comprehensive drug data of their patients. It will contain drug information and an interactive database that will assist in identifying potential adverse drug events. Using the Pharmacy Network, health professionals will have access to complete patient-medication profiles at the point of distribution and prescribers will be able to enter and transmit medication orders online. The Newfoundland and Labrador Pharmacy Network is expected to begin a phased-in implementation across the province's community pharmacies in December 2009.

Damush et al. (2008) showed that when antidepressant medications were included in the case definition, the ability to identify post-stroke depression patients using administrative data improved. In Manitoba, Lix et al. (2008) investigated the congruence

between administrative databases and surveys in studying chronic disease by examining multiple case definitions for arthritis, asthma, diabetes, heart disease, hypertension and stroke. The authors reported that using prescription drug data, in addition to hospital and physician databases, had mixed effects on agreement in ascertaining disease state between administrative databases and surveys. While case ascertainment for asthma benefited from the use of both diagnostic and prescription drug information when the definition was based on one or two years of administrative data, improvements in agreement were less substantial for diabetes. For hypertension, there was also some improvement in agreement associated with using both diagnosis and prescription drug data for case ascertainment, but not for other diseases. It is important to note that a specific set of prescription drugs are used to treat asthma and diabetes; for other chronic diseases such as hypertension or arthritis, the drugs prescribed for an individual may be used to treat more than one chronic disease, and therefore may not be helpful for identifying cases. In our study, drug use data with medications' names and classes (e.g., SSRIs, TCA), dosages and durations were available from the electronic charts (EMR). We believe that for the purpose of surveillance of depressive disorders, the classes of antidepressant medications (as opposed to the name of each individual medication) along with the dosages should be included in the case definitions. The duration of treatment can be obtained via the dispensed dates. Provincial pharmacy networks, such as the one soon to be implemented in Newfoundland and Labrador, will provide an opportunity to include administrative medication information at a population level in the development of case definitions in the surveillance of many types of diseases.

The depressed cohort in this study had a higher proportion of patients with anxiety, insomnia, fatigue, and chronic pain than that of the non-depressed cohort. This is to be expected, as such symptoms are frequently associated with a diagnosis of depressive disorders. Further, the depressed cohort appeared to have a higher proportion of narcotics, anticonvulsant, gastro-intestinal, and respiratory prescriptions prescribed, than that of the non-depressed cohort. The depressed patients were also more likely to be more frequent users of physician services than that of the non-depressed patients. It has been reported that patients with depressive disorders are at increased risk of having one or more comorbidities (Akiskal, 2005; Patten et al., 2006; Wang et al., 2009; Himelhoch et al., 2004). Moussavi et al. (2007) studied approximately 250,000 respondents in 60 countries, and found that depressive disorders produced a greater decrement in health than other chronic diseases, including angina, arthritis, asthma, and diabetes. In addition, the authors reported that those with angina, arthritis, asthma, or diabetes also had increased risks of depressive disorders (Moussavi et al., 2007).

This study also examined factors associated with depressive disorder diagnoses, based on selected case definitions. Results of our inferential statistics (multiple regression analyses) consistently showed that, across all the models the depressed cohort was 4-5 times more likely to have been prescribed antidepressant medications than that of the controls. Similarly, the depressed cohort appeared to have 4-5 times higher odds of having received psychotherapy (either by general practitioners or psychiatrists) than those in the control cohort. It should be noted that pharmacotherapy (e.g., antidepressant medications), with or without psychotherapy, are the most important and most common

treatment choices available to depressed patients (Rush, 2005). Further, the frequency of fee-for-service physician visits was found to be significantly higher for the depressed cohort in all five regression models. It has been shown that depressive disorders are associated with increased health service utilization (e.g., general medical services or emergency services) for emotional problems (Parikh et al., 2001; Johnson et al., 1992; Olfson et al., 1992). Patients with high health service utilization are more likely to have a high rate of untreated depression (Akiskal, 2005). Despite the fact that many patients with depressive disorders seek help in primary care, general practitioners still have difficulties diagnosing and treating depression. Most patients who seek care for depression are treated in primary care settings, where at least 50% of depressed patients are undiagnosed, and 40% to 55% of those that are diagnosed are insufficiently treated (Charbonneau et al., 2004; Wells et al., 1999). North American and European surveys report that approximately half of those who develop depressive disorders seek treatment for them, but only a small proportion (approximately one-third) receive appropriate treatment (Akiskal, 2005). An increasing rate of health service utilization is related to increasing severity of depression and other psychiatric and non-psychiatric co-morbidities (Akiskal, 2005).

Multiple regression analyses in this study showed that cardiovascular and musculoskeletal disorders identified in the medical chart were less likely to be associated with the depressed cohort than the non-depressed cohort. This study does not fully explain this pattern. We used a random matching sampling technique by age and gender for selecting controls, however, we did not match by co-morbidities which may partially

explain this pattern. Further, cardiovascular and musculoskeletal disorders are not uncommon diseases in age groups 50 years and greater, and the mean age in both the depressed and non-depressed cohort in our study was slightly more than 50 years.

5.2 Strengths

First, in this study a medical chart review (EMR) was considered the gold standard, which may have decreased potential bias in identifying patients with true depressive disorders. Further, all excluded cases in this study were independently reviewed by an experienced psychiatrist not involved in the study to maximize objectivity. Other similar studies used various sources such as surveys and registries (e.g. Prescription Drug Data, NPHS, and Cancer Registry). Secondly, unlike most previous studies, the case definitions used in this study incorporated the physician specialty (general practitioners vs. psychiatrists). This approach is unique in that physician specialty (e.g., general practitioner vs. psychiatrist) added another level of confidence to the case definitions. Lastly, we included three large family practice clinics in the study which may have decreased potential selection bias.

5.3 Limitations

A major limitation of this study is that the results may not be generalizable to the non-university based practices. The study setting included only university-based clinics where most staff are either academic physicians or rotating residents. The majority of family practice clinics in the province are operated either by fee-for-service or salaried

physicians, which may have different patterns of claims submission practices compared to that of academic settings. It is also important to note that rural areas were not included in this study, which also would contribute to the generalizability issue in this study. We believe that the definitions proposed in this study need to be validated in settings other than the university practices. Secondly, the provincial fee-for-service physician claims database does not capture all patients with depressive disorders, such as those who do not have a valid MCP number (e.g., non-Newfoundland residents, armed-forces personnel etc.), or those that visit a salaried physician. There is approximately one third of the population in the province (mainly in rural areas) on whom no physician data is currently available because it is not collected (data for salaried physicians are not captured in the provincial fee-for-service physician claims database). This may have negatively impacted our estimation on the agreement between the gold standard (i.e., electronic medical chart) and administrative databases. Thirdly, the ICD-9 and ICD-10-CA codes were used in the administrative databases to identify patients with depressive disorders. The potential for misclassification of diagnostic codes by the medical record technicians needs to be considered. Fourthly, the coding classification system in the hospital database changed from ICD-9 to ICD-10-CA in April 2001. Given the mapping issue that exist for diagnosis codes in these two classification systems, potential discrepancies in identifying patients with depressive disorders between ICD-9 to ICD-10-CA is possible. It should be noted that there may not be a perfect one to one match for depressive disorders between the ICD-9 to ICD-10-CA codes. Fifthly, the time period available for reviewing the medical charts in the three family practice clinics was approximately six months, due to

the shadow billing issue (see Materials and Method, section 3.2). This rather short time period may have impacted the assessment of medical chart reviews in each clinic, particularly when a chronic disease such as depression often fluctuates over time. Sixthly, considering the timeframe (of within certain number of years of diagnosis) used in the case definitions, there is a potential bias for older patients to have a greater potential time at risk than younger patients with respect to being captured in administrative databases. Lastly, the lack of prescription drug data at the provincial level presently available in Newfoundland and Labrador limited our ability to study definitions for depressive disorders using population-based prescription drug data.

5.4 Suggestions for Future Studies

Future studies should examine the implications of the limitations stated, in particular the issue of academic versus non-academic clinics. Secondly, prescription drug data at the population level should be included in the further development of case definitions in an effort to enhance the ascertainment of cases with depressive disorders. Finally, the continuity of care in primary care settings should be considered as it is associated with better problem recognition, improved preventive care, improved patient satisfaction and treatment adherence, reduced hospitalization and emergency room visits, and lower health care costs (Knight et al., 2009). Further, considering that different training and cultural backgrounds of the physicians in the province might potentially impact on identifying and diagnosing depressive disorders, more research in this area is warranted.

5.5 Conclusions

This study found that provincial administrative databases are useful for undertaking surveillance on depressive disorders among the adult population. The approach used in developing case definitions for depressive disorders was simple and practical and resulted in high sensitivity, specificity, and PPV; the comparison between the chart review and the administrative databases indicated strong agreement. Although this study focused on depressive disorders among the adult population, its methodology can be adopted for other mental disorders, as well as other cohorts such as the pediatric population.

This study advanced the methodology for identifying patients with depressive disorders from administrative databases in several ways. First, the case definitions were constructed by incorporating the specialty of the physician, which added a degree of accuracy to the identification of patients. Secondly, the study examined the addition of pharmacy data (antidepressant medications) to case definitions which maximized the accuracy of the five most appropriate case definitions (in some cases improving the sensitivity level to 100% and *kappa* statistics to over 90% with 0% false negative rate). Lastly, the study provided five valid case definitions, which can be considered as valid case definitions for the purpose of surveillance of depressive disorders among the adult population.

REFERENCES

Akiskal SH. Mood disorders. In: Kaplan BJ, Sadock VA, Editors, Kaplan and Sadock's Comprehensive Textbook of Psychiatry. 7th ed. New York: Lippincott Williams & Wilkins; 2005. p. 1560-1652.

Baldi I, Vicari P, Di Cuonzo D, Zanetti R, Pagano E, Rosato R, Sacerdote C, Segnan N, Merletti F, Ciccone G. A high positive predictive value algorithm using hospital administrative data identified incident cancer cases. J Clin Epidemiol. 2008 Apr;61(4):373-9.

Beland Y, Bailie L, Catlin G, Singh MP. CCHS and NPHS. An improved health survey program at Statistics Canada. Proceedings of the Survey Methods Section. American Statistical Association; 2000. Available: www.amstat.org/sections/srms/Proceedings/y2000fhtml September 6, 2009.

Bland RC, Newman SC, Orn H. Period prevalence of psychiatric disorders in Edmonton. Acta Psychiatr Scand. 1988;77 Suppl 338:33-42.

Buehler JW. Surveillance. In: Rothman KJ, Greenland S, Lash TL, editors. Modern Epidemiology. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 459-480.

Buka SL. Psychiatric epidemiology: reducing the global burden of mental illness. Am J Epidemiol. 2008;168:977-79.

Canadian Institute for Health Information. Health Information Roadmap: beginning the journey. Canadian Institute for Health Information; 1999. Available:

http://secure.cihi.ca/cihiweb/en/downloads/profile_roadmap_ceng-beg.pdf Accessed September 6, 2009.

Charbonneau A, Rosen AK, Owen RR, Spiro A 3rd, Ash AS, Miller DR, Kazis L, Kader B, Cunningham F, Berlowitz DR. Monitoring depression care: in search of an accurate quality indicator. Med Care. 2004 Jun;42(6):522-31.

Coffin CS, Saunders C, Thomas CM, Loewen AH, Ghali WA, Campbell NR. Validity of ICD-9-CM administrative data for determining eligibility for pneumococcal vaccination triggers. Am J Med Qual. 2005 May-Jun;20(3):158-63.

Couris CM, Polazzi S, Olive F, Remontet L, Bossard N, Gomez F, Schott AM, Mitton N, Colonna M, Trombert B. Breast cancer incidence using administrative data: correction with sensitivity and specificity. J Clin Epidemiol. 2009 Jun;62(6):660-6.

Daley MF, Barrow J, Pearson K, Crane LA, Gao D, Stevenson JM, Berman S, Kempe A. Identification and recall of children with chronic medical conditions for influenza vaccination. Pediatrics. 2004 Jan;113(1 Pt 1):e26-33.

Damush TM, Jia H, Ried LD, Qin H, Cameon R, Plue L, Williams LS. Case-finding algorithm for post-stroke depression in the veterans health administration. Int J Geriatr Psychiatry. 2008 May;23(5):517-22.

Eaton WW, Martins SS, Nestadt G, Bienvenu OJ, Clarke D, Alexandre P. The burden of mental disorders. Epidemiol Rev. 2008;30:1-14.

Fultz SL, Skanderson M, Mole LA, Gandhi N, Bryant K, Crystal S, Justice AC. Development and verification of a "virtual" cohort using the National VA Health Information System. Med Care. 2006 Aug;44(8 Suppl 2):S25-30.

Goff SL, Feld A, Andrade SE, Mahoney L, Beaton SJ, Boudreau DM, Davis RL, Goodman M, Hartsfield CL, Platt R, Roblin D, Smith D, Yood MU, Dodd K, Gurwitz JH. Administrative data used to identify patients with irritable bowel syndrome. J Clin Epidemiol. 2008 Jun;61(6):617-21.

Gravel R, Béland Y. The Canadian Community Health Survey: mental health and well-being. Can J Psychiatry. 2005 Sep;50(10):573-9.

Gravel R, Connolly D, Bedard M. Canadian Community Health Survey: Mental Health and Well-Being, 2004. Catalogue 82-617-XIE. Available: www.statcan.ca/english/freepub/82-617-XIE/ Accessed September 6, 2009.

Greenland S, Lash TL. Validity in epidemiologic studies. In: Rothman KJ, Greenland S, Lash TL, Modern Epidemiology. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 345-380.

Harpe SE. Using secondary data sources for pharmacoepidemiology and outcomes research. Pharmacotherapy. 2009 Feb;29(2):138-53.

Health Canada. A report on mental illnesses in Canada. October 2002. Cat. No. 0-662-32817-5. Available http://www.phac-aspc.gc.ca/publicat/miic-mmac/pdf/men_ill_e.pdf Accessed September 6, 2009.

Health Canada. Economic Burden of Illness in Canada, 1998. Ottawa: Health Canada, 2002. Cat. N. H21-136/1998E.

Health Canada. The Human Face of Mental Health and Mental Illness in Canada. Health Canada. No. HP5-19/2006E, 2006. http://www.phac-aspc.gc.ca/publicat/human-humain06/pdf/human_face_e.pdf Accessed September 6, 2009.

Himelhoch S, Weller WE, Wu AW, Anderson GF, Cooper LA. Chronic medical illness, depression, and use of acute medical services among Medicare beneficiaries. Med Care. 2004 Jun;42(6):512-21.

Hoogenveen R, Westert G, Dijkgraaf M, Schellevis F, de Bakker D. Disease prevalence estimations based on contact registrations in general practice. Stat Med. 2002 Aug 15;21(15):2271-85.

Hux JE, Ivis F, Flintoft V, Bica A. Diabetes in Ontario: determination of prevalence and incidence using a validated administrative data algorithm. Diabetes Care. 2002 Mar;25(3):512-6.

James RC, Blanchard JF, Campbell D, Clottey C, Osei W, Svenson LW, Noseworthy TW. A model for non-communicable disease surveillance in Canada: the prairie pilot diabetes surveillance system. Chronic Dis Can. 2004 Winter;25(1):7-12.

Johnson J, Weissman MM, Klerman GL. Service utilization and social morbidity associated with depressive symptoms in the community. JAMA 1992;267:1478-83.

Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, Rush AJ, Walters EE, Wang PS; National Comorbidity Survey Replication. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). JAMA. 2003 Jun 18;289(23):3095-105.

Kisely S, Lin E, Lesage A, Gilbert C, Smith M, Campbell LA, Vasiliadis HM. Use of administrative data for the surveillance of mental disorders in 5 provinces. Can J Psychiatry. 2009 Aug;54(8):571-5.

Knight JC, Dowden JJ, Worrall GJ, Gadag VG, Murphy MM. Does higher continuity of family physician care reduce hospitalizations in elderly people with diabetes? Popul Health Manag. 2009 Apr;12(2):81-6.

Lim KL, Jacobs P, Ohinmaa A, Schopflocher D, Dewa CS. A new population-based measure of the economic burden of mental illness in Canada. Chronic Dis Can. 2008;28(3):92-8.

Lix LM, Yogendran MS, Shaw SY, Burchill C, Metge C, Bond R. Population-based data sources for chronic disease surveillance. Chronic Dis Can. 2008;29(1):31-8.

Moussavi S, Chatterji S, Verdes E, et al. Depression, chronic disease and decrements in health: evidence from the World Health Surveys. Lancet. 2007;369:851–858.

Murphy JM, Laird NM, Monson RR, Sobol AM, Leighton AH. Incidence of depression in the Stirling County Study: historical and comparative perspectives. Psychol Med. 2000 May;30(3):505-14.

National Diabetes Surveillance System (NDSS), Public Health Agency of Canada. 2008 http://www.phac-aspc.gc.ca/ccdpc-cpcmc/ndss-snsd/english/index-eng.php Accessed September 6, 2009.

Okura Y, Urban LH, Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data was substantial for diabetes,

hypertension, myocardial infarction and stroke but not for heart failure. J Clin Epidemiol. 2004 Oct;57(10):1096-103.

Olfson M, Klerman GL. Depressive symptoms and mental health service utilization in a community sample. Soc Psychiatry Psychiatr Epidemiol 1992;27:161-7.

Patten SB, Kennedy SH, Lam RW, O'Donovan C, Filteau MJ, Parikh SV, Ravindran AV; Canadian Network for Mood and Anxiety Treatments (CANMAT). Canadian Network for Mood and Anxiety Treatments (CANMAT) clinical guidelines for the management of major depressive disorder in adults. I. Classification, burden and principles of management. J Affect Disord. 2009 Oct;117 Suppl 1:S5-14.

Parikh SV, Lam RW; CANMAT Depression Work Group. Clinical guidelines for the treatment of depressive disorders, 1. Definitions, prevalence, and health burden. Can J Psychiatry. 2001 Jun;46 Suppl 1:13S-20S.

Parikh SV, Wasylenki D, Goering P, Wong J. Mood disorders: rural/urban differences in prevalence, health care utilization, and disability in Ontario. J Affect Disord. 1996 Apr 26;38(1):57-65.

Patel S. Toward a National Strategy on Mental Illness and Mental Health. CMA Presentation to the Senate Standing Committee on Social Affairs, Science and Technology. Canadian Medical Association. March 2004. Available http://www.cma.ca/index.cfm/ci_id/33248/la_id/1.htm Accessed September 6, 2009.

Patten SB, Beck C. Major depression and mental health care utilization in Canada: 1994 to 2000. Can J Psychiatry. 2004 May;49(5):303-9.

Patten SB, Stuart HL, Russell ML, Maxwell CJ, Arboleda-Flórez J. Epidemiology of major depression in a predominantly rural health region. Soc Psychiatry Psychiatr Epidemiol. 2003 Jul;38(7):360-5.

Patten SB, Wang JL, Williams JV, Currie S, Beck CA, Maxwell CJ, El-Guebaly N. Descriptive epidemiology of major depression in Canada. Can J Psychiatry. 2006 Feb;51(2):84-90.

Penberthy L, McClish D, Pugh A, Smith W, Manning C, Retchin S. Using hospital discharge files to enhance cancer surveillance. Am J Epidemiol. 2003 Jul 1;158(1):27-34.

Powell KE, Diseker RA 3rd, Presley RJ, Tolsma D, Harris S, Mertz KJ, Viel K, Conn DL, McClellan W. Administrative data as a tool for arthritis surveillance: estimating prevalence and utilization of services. J Public Health Manag Pract. 2003 Jul-Aug;9(4):291-8.

Rawson NS, Malcolm E, D'Arcy C. Reliability of the recording of schizophrenia and depressive disorder in the Saskatchewan health care datafiles. Soc Psychiatry Psychiatr Epidemiol. 1997 May;32(4):191-9.

Rihmer Z, Angst, J. Mood disorders: Epidemiology. In: Kaplan BJ, Sadock VA, Editors, Kaplan and Sadock's Comprehensive Textbook of Psychiatry. 7th ed. New York: Lippincott Williams & Wilkins; 2005. p. 1560-1652.

Robinson JR, Young TK, Roos LL, Gelskey DE. Estimating the burden of disease. Comparing administrative data and self-reports. Med Care. 1997 Sep;35(9):932-47.

Romans SE, Tyas J, Cohen MM, Silverstone T. Gender differences in the symptoms of major depressive disorder. J Nerv Ment Dis. 2007 Nov;195(11):905-11.

Roos LL, Jebamani L, Forsyth S, Nicol JP. Canadian administrative data: quality and assessment. Manitoba Centre for Health Policy and Evaluation, Winnipeg, Manitoba, 1999 National Library Canada ISSN 1481-3823 http://www.ihe.ca/documents/1999-07paper.pdf

Rothman KJ, Greenland S, Lash TL. Validity in epidemiologic studies. In: Rothman KJ, Greenland S, Lash TL, Modern Epidemiology. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 128-147.

Rush AJ. Mood disorders: treatment of depression. In: Kaplan BJ, Sadock VA, Editors, Kaplan and Sadock's Comprehensive Textbook of Psychiatry. 7th ed. New York: Lippincott Williams & Wilkins; 2005. p. 1653-1661.

Satyanarayana S, Enns MW, Cox BJ, Sareen J. Prevalence and correlates of chronic depression in the canadian community health survey: mental health and well-being. Can J Psychiatry. 2009 Jun;54(6):389-98.

Scales DC, Guan J, Martin CM, Redelmeier DA. Administrative data accurately identified intensive care unit admissions in Ontario. J Clin Epidemiol. 2006 Aug;59(8):802-7.

Solberg LI, Engebretson KI, Sperl-Hillen JM, Hroscikoski MC, O'Connor PJ. Are claims data accurate enough to identify patients for performance measures or quality improvement? The case of diabetes, heart disease, and depression. Am J Med Qual. 2006 Jul-Aug;21(4):238-45.

Spettell CM, Wall TC, Allison J, Calhoun J, Kobylinski R, Fargason R, Kiefe CI. Identifying physician-recognized depression from administrative data: consequences for quality measurement. Health Serv Res. 2003 Aug;38(4):1081-102.

Starkes JM, Poulin CC, Kisely SR. Unmet need for the treatment of depression in Atlantic Canada. Can J Psychiatry. 2005 Sep;50(10):580-90.

Statistical Analysis Software (SAS®) version 9.2 for Windows, Cary, NC, SAS 2008.

Statistical Program for Social Sciences (SPSS) 15.0 for Windows. Chicago, IL, SPSS 2006.

Statistics Canada, 2008. National Population Health Survey Household Component, Cycle 1 to 7 (1994/95–2006/07), Longitudinal Documentation. Statistics Canada, Ottawa, Canada.

The World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). World Mental Health, World Health Organization (WHO), 2004. http://www.hcp.med.harvard.edu/wmhcidi/ Accessed September 6, 2009.

To T, Dell S, Dick PT, Cicutto L, Harris JK, MacLusky IB, Tassoudji M. Case verification of children with asthma in Ontario. Pediatr Allergy Immunol. 2006 Feb;17(1):69-76.

Vasiliadis HM, Lesage A, Adair C, Boyer R. Service use for mental health reasons: cross-provincial differences in rates, determinants, and equity of access. Can J Psychiatry. 2005 Sep;50(10):614-9.

Wang J, Williams J, Lavorato D, Schmitz N, Dewa C, Patten SB. The incidence of major depression in Canada: The National Population Health Survey. J Affect Disord. 2009 Aug 29. [Epub ahead of print]

Wells KB, Schoenbaum M, Unutzer J, et al. Quality of care for primary care patients with depression in managed care. Arch Fam Med. 1999;8:529–536.

West SL, Richter A, Melfi CA, McNutt M, Nennstiel ME, Mauskopf JA. Assessing the Saskatchewan database for outcomes research studies of depression and its treatment. J Clin Epidemiol. 2000 Aug;53(8):823-31.

Whiteford H, Groves A. Policy implications of the 2007 Australian National Survey of Mental Health and Wellbeing. Aust N Z J Psychiatry. 2009 Jul;43(7):644-51.

Wigertz A, Westerling R. Measures of prevalence: which healthcare registers are applicable? Scand J Public Health. 2001 Mar;29(1):55-62.

Williams JI, Young W. A summary of studies on the quality of health care administrative databases in Canada. In: Goel V, Williams JI, Anderson GM, Blackstien-Hirsch P, Fooks C, Naylor CD, editors. Patterns of health care in Ontario. The ICES practice atlas. Ottawa: Canadian Medical Association; 1996. p. 339-45. http://www.ices.on.ca/file/Practice2-appendix.pdf Accessed September 6, 2009.

Wittchen HU, Jacobi F. Size and burden of mental disorders in Europe--a critical review and appraisal of 27 studies. Eur Neuropsychopharmacol. 2005 Aug;15(4):357-76.

Wolf Medical Systems, Electronic Medical Records (EMR) Software. 2007 http://www.wolfmedical.com/default.html Accessed September 6, 2009.

World Health Organization. The World Health Report 2004: Changing History. Annex Table 3: Burden of Disease in DALYs by Cause, Sex, and Mortality Stratum in WHO Regions, Estimates for 2002. Geneva, Switzerland: World Health Organization; 2004. http://www.who.int.qe2a-proxy.mun.ca/whr/2004/annex/topic/en/annex_3_en.pdf Accessed September 6, 2009.

APPENDICES

Appendix A. DSM-IV-TR Diagnostic Criteria for various depressive disorders

Appendix A-1. DSM-IV-TR Diagnostic Criteria for Major Depressive Disorder

A. Presence of a single major depressive episode.

B. The major depressive episode is not better accounted for by schizoaffective disorder and is not superimposed on schizophrenia, schizophreniform disorder, delusional disorder, or psychotic disorder not otherwise specified.

C. There has never been a manic episode, a mixed episode, or a hypomanic episode.

Note: This exclusion does not apply if all of the manic-like, mixed-like, or hypomanic-like episodes are substance or treatment induced or are due to the direct physiological effects of a general medical condition.

If the full criteria are currently met for a major depressive episode, *specify* its current clinical status or features, or both:

Mild, moderate, severe without psychotic features, or severe with psychotic features

Chronic

With catatonic features

With melancholic features

With atypical features

With postpartum onset

If the full criteria are not currently met for a major depressive episode, *specify* the current clinical status of the major depressive disorder or features of the most recent episode:

In partial remission, in full remission

Chronic

With catatonic features

With melancholic features

With atypical features

With postpartum onset

Appendix A-2. DSM-IV-TR Diagnostic Criteria for Dysthymic Disorder

A. Depressed mood for most of the day, for more days than not, as indicated by subjective account or observation by others, for at least 2 years. **Note:** In children and adolescents, mood can be irritable, and duration must be at least 1 year.

B. Presence, while depressed, of two (or more) of the following:

(1) Poor appetite or overeating

(2) Insomnia or hypersomnia

(3) Low energy or fatigue

(4) Low self-esteem

(5) Poor concentration or difficulty making decisions

(6) Feelings of hopelessness

C. During the 2-year period (1 year for children or adolescents) of the disturbance, the person has never been without the symptoms in Criteria A and B for more than 2 months at a time.

D. No major depressive episode has been present during the first 2 years of the disturbance (1 year for children and adolescents); that is, the disturbance is not better accounted for by chronic major depressive disorder or major depressive disorder, in partial remission.

Note: There may have been a previous major depressive episode, provided that there was a full remission (no significant signs or symptoms for 2 months) before development of the dysthymic disorder. In addition, after the initial 2 years (1 year in children or adolescents) of dysthymic disorder, there may be superimposed episodes of major depressive disorder, in which case both diagnoses may be given when the criteria are met for a major depressive episode.

E. There has never been a manic episode, a mixed episode, or a hypomanic episode, and criteria have never been met for cyclothymic disorder.

F. The disturbance does not occur exclusively during the course of a chronic psychotic disorder, such as schizophrenia or delusional disorder.

G. The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or a general medical condition (e.g., hypothyroidism).

H. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Specify if:

Early onset: if onset is before 21 years of age

Late onset: if onset is at 21 years of age or older.

Specify if (for most recent 2 years of dysthymic disorder):

With atypical features.

Appendix A-3. DSM-IV-TR Diagnostic Criteria for Depressive Disorder Not Otherwise Specified

The depressive disorder not otherwise specified category includes disorders with depressive features that do not meet the criteria for major depressive disorder, dysthymic disorder, adjustment disorder with depressed mood, or adjustment disorder with mixed anxiety and depressed mood. Sometimes depressive symptoms can present as part of an anxiety disorder not otherwise specified. Examples of depressive disorder not otherwise specified include:

1. Premenstrual dysphoric disorder: In most menstrual cycles during the past year, symptoms (e.g., markedly depressed mood, marked anxiety, marked affective lability, and decreased interest in activities) regularly occurred during the last week of the luteal phase (and remitted within a few days of the onset of menses). These symptoms must be severe enough to markedly interfere with work, school, or usual activities and must be entirely absent for at least 1 week postmenses.
2. Minor depressive disorder: episodes of at least 2 weeks of depressive symptoms but with fewer than the five items required for major depressive disorder.
3. Recurrent brief depressive disorder: depressive episodes lasting from 2 days to as long as 2 weeks, occurring at least once a month for 12 months (not associated with the menstrual cycle).
4. Postpsychotic depressive disorder of schizophrenia: a major depressive episode that occurs during the residual phase of schizophrenia.
5. A major depressive episode superimposed on delusional disorder, psychotic disorder not otherwise specified, or the active phase of schizophrenia.

Situations in which the clinician has concluded that a depressive disorder is present but is unable to determine whether it is primary, due to a general medical condition, or substance induced.

Appendix A-4. DSM-IV-TR Research Criteria for Minor Depressive Disorder

A. A mood disturbance, defined as follows:

(1) At least two (but less than five) of the following symptoms have been present during the same 2-week period and represent a change from previous functioning; at least one of the symptoms is (a) or (b):

(a) Depressed mood most of the day, nearly every day, as indicated by subjective report (e.g., feels sad or empty) or observation made by others (e.g., appears tearful). **Note:** In children and adolescents, can be irritable mood.

(b) Markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day (as indicated by subjective account or observation made by others).

(c) Significant weight loss when not dieting or weight gain (e.g., a change of more than 5 percent of body weight in a month) or decrease or increase in appetite nearly every day. **Note:** In children, consider failure to make expected weight gains.

(d) Insomnia or hypersomnia nearly every day.

(e) Psychomotor agitation or retardation nearly every day (observable by others, not merely subjective feelings of restlessness or being slowed down).

(f) Fatigue or loss of energy nearly every day.

(g) Feelings of worthlessness or excessive or inappropriate guilt (which may be delusional) nearly every day (not merely self-reproach or guilt about being sick).

(h) Diminished ability to think or to concentrate or indecisiveness, nearly every day (by subjective account or as observed by others).

(i) Recurrent thoughts of death (not just fear of dying), recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide.

(2) The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

(3) The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse or a medication) or a general medical condition (e.g., hypothyroidism).

(4) The symptoms are not better accounted for by bereavement (i.e., a normal reaction to the death of a loved one).

B. There has never been a major depressive episode, and criteria are not met for dysthymic disorder.

C. There has never been a manic episode, a mixed episode, or a hypomanic episode, and criteria are not met for cyclothymic disorder.

Note: This exclusion does not apply if all of the manic-like, mixed-like, or hypomanic-like episodes are substance or treatment induced.

D. The mood disturbance does not occur exclusively during schizophrenia, schizophreniform disorder, schizoaffective disorder, delusional disorder, or psychotic disorder not otherwise specified.

Appendix A-5. DSM-IV-TR Research Criteria for Recurrent Brief Depressive Disorder

A. Criteria, except for duration, are met for a major depressive episode.

B. The depressive periods in Criterion A last at least 2 days but less than 2 weeks.

C. The depressive periods occur at least once a month for 12 consecutive months and are not associated with the menstrual cycle.

D. The periods of depressed mood cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

E. The symptoms are not due to the direct physiological effects of a substance (e.g., a drug of abuse or a medication) or a general medical condition (e.g., hypothyroidism).

F. There has never been a major depressive episode, and criteria are not met for dysthymic disorder.

G. There has never been a manic episode, a mixed episode, or a hypomanic episode, and criteria are not met for cyclothymic disorder.

Note: This exclusion does not apply if all of the manic-like, mixed-like, or hypomanic-like episodes are substance or treatment induced.

H. The mood disturbance does not occur exclusively during schizophrenia, schizophreniform disorder, schizoaffective disorder, delusional disorder, or psychotic disorder not otherwise specified.

Appendix B. Data Collection Form

1. Study Code:	2. List #:	3. Clinic:

4. MCP:	5. Sex: __ Male __ Female	6. Date of Birth (DD/MM/YY):

7. Has a depressive disorder diagnosis been confirmed? _____ Yes _____ No

8. Does the patient have any of the following co-diagnoses/conditions? *Check all that apply, specify disease*

___1 Cancer (_____)

___2 Endocrinological disorders (_____)

___3 Mental disorder excluding depression (_____)

___4 Circulatory disorders (_____)

___5 Respiratory disorders (_____)

___6 GI disorders (_____)

___7 Neurological disorders (_____)

___8 Musculoskeletal/Connective disorders (_____)

___9 Insomnia ___10 Chronic pain ___11 Fatigue ___12 Anxiety

___13 Other (_____)

9. Does the patient currently take any medications? *Check all that apply*

_____1 None	_____8 Other psychiatric	_____15 Gastrointestinal drugs
_____2 SSRI	_____9 Narcotics	_____16 Respiratory agents
_____3 SNRIs	_____10 NSAIDS	_____17 Antimicrobial agents
_____4 MAOIs	_____11 Anticonvulsants	_____18 Other
_____5 TCA	_____12 Cardiovascular agents	
_____6 Benzodiazepines	_____13 Hormone agents	
_____7 Antipsychotic	_____14 Hematologic agents	

Appendix C. Potential case definitions examined in the study.

Case Definition #1	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders any time
Case Definition #2	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders any time
Case Definition #3	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders any time
Case Definition #4	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders any time
Case Definition #5	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders any time
Case Definition #6	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 6 physician visits due to depressive disorders any time
Case Definition #7	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 7 physician visits due to depressive disorders any time
Case Definition #8	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 8 physician visits due to depressive disorders any time
Case Definition #9	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first year of diagnosis
Case Definition #10	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #11	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #12	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #13	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #14	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 6 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #15	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 7 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #16	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 8 physician visits due to depressive disorders within the first year of diagnosis
Case Definition #17	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first 2 years of diagnosis
Case Definition #18	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥

	2 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #19	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #20	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #21	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #22	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 6 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #23	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 7 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #24	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 8 physician visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #25	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 1 physician visit due to depressive disorders within the first 3 years of diagnosis
Case Definition #26	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #27	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #28	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #29	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #30	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 6 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #31	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 7 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #32	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 8 physician visits due to depressive disorders within the first 3 years of diagnosis
Case Definition #33	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥

	1 physician visit due to depressive disorders within the first 4 years of diagnosis
Case Definition #34	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 2 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #35	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 3 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #36	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 4 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #37	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 5 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #38	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 6 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #39	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 7 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #40	≥ 1 hospitalizations due to depressive disorders any time **OR** ≥ 8 physician visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #41	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 1 GP visit due to depressive disorders any time
Case Definition #42	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 2 GP visits due to depressive disorders any time
Case Definition #43	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 3 GP visits due to depressive disorders any time
Case Definition #44	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 4 GP visits due to depressive disorders any time
Case Definition #45	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 5 GP visits due to depressive disorders any time
Case Definition #46	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 6 GP visits due to depressive disorders any time
Case Definition #47	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 7 GP visits due to depressive disorders any time
Case Definition #48	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 8 GP visits due to depressive

	disorders any time
Case Definition #49	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 1 GP visit due to depressive disorders within the first 1 year of diagnosis
Case Definition #50	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 2 GP visits due to depressive disorders within the first 1 year of diagnosis
Case Definition #51	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 3 GP visits due to depressive disorders within the first 1 year of diagnosis
Case Definition #52	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 4 GP visits due to depressive disorders within the first 1 year of diagnosis
Case Definition #53	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 5 GP visits due to depressive disorders within the first 1 year of diagnosis
Case Definition #54	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 6 GP visits due to depressive disorders within the first 1 year of diagnosis
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Case Definition #56	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 8 GP visits due to depressive disorders within the first 1 year of diagnosis
Case Definition #57	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 1 GP visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #58	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 2 GP visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #59	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 3 GP visits due to depressive disorders within the first 2 years of diagnosis
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Case Definition #62	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 6 GP visits due to depressive disorders within the first 2 years of diagnosis
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	disorders within the first 2 years of diagnosis
Case Definition #64	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 8 GP visits due to depressive disorders within the first 2 years of diagnosis
Case Definition #65	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **AND** ≥ 1 GP visits due to depressive disorders within the first 3 years of diagnosis
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	disorders within the first 4 years of diagnosis
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Case Definition #81	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 1 GP visits due to depressive disorders any time
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Case Definition #114	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 2 GP visits due to depressive disorders within the first 4 years of diagnosis
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Case Definition #119	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 7 GP visits due to depressive disorders within the first 4 years of diagnosis
Case Definition #120	(≥ 1 hospitalizations **OR** ≥ 1 psychiatrist visit due to depressive disorders any time) **OR** ≥ 8 GP visits due to depressive disorders within the first 4 years of diagnosis

Appendix D. Ethics Approval Letters

Faculty of Medicine

Human Investigation Committee
2nd Floor, Eastern Trust Bldg.
95 Bonaventure Avenue
St. John's, NL Canada A1B 2X5
Tel: 709 777 6974 Fax: 709 777 8776
hic@mun.ca www.med.mun.ca/hic

November 27, 2008

Reference #08.189

Dr. Reza Alaghehbandan
28 Pippy Place
St John's, NL
A1B 3X4

Dear Dr. Alaghehbandan:

RE: **Assessing administrative databases for surveillance of depressive disorders in Newfoundland and Labrador**

Your application received an expedited review by the Human Investigation Committee. Full approval was granted for one year effective November 27, 2008.

This approval will lapse on November 27, 2009. It is your responsibility to ensure that the Ethics Renewal form is forwarded to the HIC office prior to the renewal date. The information provided in this form must be **current to the time of submission** and submitted to HIC **not less than 30 nor more than 45 days** of the anniversary of your approval date. The Ethics Renewal form can be downloaded from the HIC website
http://www.med.mun.ca/hic/downloads/Annual%20Update%20Form.doc

The Human Investigation Committee advises THAT IF YOU DO NOT return the completed Ethics Renewal form prior to date of renewal:

Your ethics approval will lapse
You will be required to stop research activity immediately
You may not be permitted to restart the study until you reapply for and receive approval to undertake the study again

Lapse in ethics approval may result in interruption or termination of funding

For a hospital-based study, it is **your responsibility to seek the necessary approval from Eastern Health and/or other hospital boards as appropriate.**

Modifications of the protocol/consent are not permitted without prior approval from the Human Investigation Committee. Implementing changes in the protocol/consent without HIC approval may result in the approval of your research study being revoked, necessitating cessation of all related research activity. Request for modification to the protocol/consent must be outlined on an amendment form (available on the HIC website) and submitted to the HIC for review.

This research ethics board (the HIC) has reviewed and approved the research protocol and documentation as noted above for the study which is to be conducted by you as the qualified investigator named above at the specified site. This approval and the views of this Research Ethics Board have been documented in writing. In addition, please be advised that the Human Investigation Committee currently operates according to *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and applicable laws and regulations. The membership of this research ethics board is constituted in compliance with the membership requirements for research ethics boards as per these guidelines.
Notwithstanding the approval of the HIC, the primary responsibility for the ethical conduct of the investigation remains with you.

We wish you every success with your study.

Sincerely,

Fern Brunger, PhD
Co-Chair
Human Investigation Committee

Richard S. Neuman, PhD
Co-Chair
Human Investigation Committee

CC Dr. C. Loomis, c/o Office of Research, MUN
Mr. W. Miller, c/o Patient Research Centre, Eastern Health
HIC meeting date: December 4, 2008

MEMORIAL UNIVERSITY

Faculty of Medicine

Human Investigation Committee
2nd Floor, Eastern Trust Bldg.
95 Bonaventure Avenue
St. John's, NL Canada A1B 2X5
Tel: 709 777 6974 Fax: 709 777 8776
hic@mun.ca www.med.mun.ca/hic

July 15, 2009

Reference #08.189

Dr. Reza Alaghehbandan
28 Pippy Place
St John's, NL
A1B 3X4

Dear Dr. Alaghehbandan:

This will acknowledge receipt of your amendment form dated **July 10, 2009,** wherein you request to access and use de-identifying data for your research study entitled **"Assessing administrative databases for surveillance of depressive disorders in Newfoundland and Labrador"**.

The Co-Chairs of the Human Investigation Committee reviewed your amendment and granted approval as submitted.

This Research Ethics Board (the HIC) has reviewed the amendment for the study which is to be conducted by you as the qualified investigator named above at the specified study site. This approval and the views of this Research Ethics Board have been documented in writing. In addition, please be advised that the Human Investigation Committee currently operates according to the Tri-Council Policy Statement and applicable laws and regulations.

Sincerely,

Fern Brunger, PhD
Co-Chair
Human Investigation Committee

John Harnett, MD, FRCPC
Co-Chair
Human Investigation Committee

C Dr. C. Loomis, Office of Research , MUN
Mr. W. Miller, Patient Research Centre
Meeting date: July 23, 2009

Appendix E: 94 case definitions with their binary classification tests

>=1 hospital OR at least 6 physician over 12 years		**>=1 hospital OR at least 7 physician over 12 years**		**>=1 hospital OR at least 8 physician over 12 years**		**>=1 hospital OR at least 3 physician within first 1 year**	
Sensitivity	60.5	Sensitivity	56.9	Sensitivity	51.8	Sensitivity	43.5
Specificity	96.1	Specificity	96.9	Specificity	96.9	Specificity	95.3
FP[1] rate	3.9	FP rate	3.1	FP rate	3.1	FP rate	4.7
FN[2] rate	39.5	FN rate	43.1	FN rate	48.2	FN rate	56.5
PPV[3]	93.9	PPV	94.7	PPV	94.2	PPV	91.9
NPV[4]	71.2	NPV	69.6	NPV	67.1	NPV	58.1
Percent agreement	78.4	Percent agreement	77.1	Percent agreement	74.5	Percent agreement	66.8
Kappa	0.567	*Kappa*	0.54	*Kappa*	0.488	*Kappa*	0.367
Kappa 95%CI	0.50-0.63	*Kappa* 95%CI	0.47-0.61	*Kappa* 95%CI	0.42-0.56	*Kappa* 95%CI	0.30-0.43
>=1 hospital OR at least 4 physician within first 1 year		**>=1 hospital OR at least 5 physician within first 1 year**		**>=1 hospital OR at least 6 physician within first 1 year**		**>=1 hospital OR at least 7 physician within first 1 year**	
Sensitivity	40.7	Sensitivity	35.6	Sensitivity	28.5	Sensitivity	23.7
Specificity	95.7	Specificity	96.5	Specificity	97.3	Specificity	98.4
FP rate	4.3	FP rate	3.5	FP rate	2.7	FP rate	1.6
FN rate	59.3	FN rate	64.4	FN rate	71.5	FN rate	76.3
PPV	90.4	PPV	90.9	PPV	91.1	PPV	93.8
NPV	62.1	NPV	60.3	NPV	58.0	NPV	56.7
Percent agreement	68.4	Percent agreement	66.3	Percent agreement	63.1	Percent agreement	61.4
Kappa	0.366	*Kappa*	0.322	*Kappa*	0.259	*Kappa*	0.223
Kappa 95%CI	0.30-0.43	*Kappa* 95%CI	0.26-0.39	*Kappa* 95%CI	0.20-0.32	*Kappa* 95%CI	0.17-0.28
>=1 hospital OR at least 8 physician within first 1 year		**>=1 hospital OR at least 3 physician within first 2 years**		**>=1 hospital OR at least 4 physician within the first 2 years**		**>=1 hospital OR at least 5 physician within first 2 years**	
Sensitivity	21.3	Sensitivity	64.8	Sensitivity	51.8	Sensitivity	44.7
Specificity	98.8	Specificity	94.6	Specificity	95.3	Specificity	96.1
FP rate	1.2	FP rate	5.4	FP rate	4.7	FP rate	3.9
FN rate	78.7	FN rate	35.2	FN rate	48.2	FN rate	55.3
PPV	94.7	PPV	92.1	PPV	91.6	PPV	91.9
NPV	56.1	NPV	73.2	NPV	66.8	NPV	63.8

Percent agreement	60.4	Percent agreement	79.8	Percent agreement	73.7	Percent agreement	70.6
Kappa	0.203	*Kappa*	0.595	*Kappa*	0.473	*Kappa*	0.409
Kappa 95%CI	0.15-0.26	*Kappa* 95%CI	0.53-0.66	*Kappa* 95%CI	0.40-0.54	*Kappa* 95%CI	0.34-0.48
>=1 hospital OR at least 6 physician within first 2 years		**>=1 hospital OR at least 7 physician within first 2 years**		**>=1 hospital OR at least 8 physician within first 2 years**		**>=1 hospital OR at least 4 physician within first 3 years**	
Sensitivity	37.9	Sensitivity	34.4	Sensitivity	31.2	Sensitivity	58.1
Specificity	96.5	Specificity	98.1	Specificity	98.1	Specificity	94.6
FP rate	3.5	FP rate	1.9	FP rate	1.9	FP rate	5.4
FN rate	62.1	FN rate	65.6	FN rate	68.8	FN rate	41.9
PPV	91.4	PPV	94.6	PPV	94.0	PPV	91.3
NPV	61.2	NPV	60.3	NPV	59.2	NPV	69.6
Percent agreement	67.5	Percent agreement	66.5	Percent agreement	64.9	Percent agreement	76.5
Kappa	0.346	*Kappa*	0.326	*Kappa*	0.294	*Kappa*	0.528
Kappa 95%CI	0.28-0.41	*Kappa* 95%CI	0.26-0.39	*Kappa* 95%CI	0.23-0.36	*Kappa* 95%CI	0.46-0.60
>=1 hospital OR at least 5 physician within first 3 years		**>=1 hospital OR at least 6 physician within first 3 years**		**>=1 hospital OR at least 7 physician within first 3 years**		**>=1 hospital OR at least 8 physician within first 3 years**	
Sensitivity	50.6	Sensitivity	44.3	Sensitivity	41.9	Sensitivity	39.1
Specificity	95.7	Specificity	96.1	Specificity	97.3	Specificity	97.7
FP rate	4.3	FP rate	3.9	FP rate	2.7	FP rate	2.3
FN rate	49.4	FN rate	55.7	FN rate	58.1	FN rate	60.9
PPV	92.1	PPV	91.8	PPV	93.8	PPV	94.3
NPV	66.3	NPV	63.7	NPV	63.0	NPV	62.0
Percent agreement	73.3	Percent agreement	70.4	Percent agreement	69.8	Percent agreement	68.6
Kappa	0.465	*Kappa*	0.405	*Kappa*	0.393	*Kappa*	0.37
Kappa 95%CI	0.40-0.53	*Kappa* 95%CI	0.34-0.47	*Kappa* 95%CI	0.33-0.46	*Kappa* 95%CI	0.30-0.44
>=1 hospital OR at least 4 physician within first 4 years		**>=1 hospital OR at least 5 physician within first 4 years**		**>=1 hospital OR at least 6 physician within first 4 years**		**>=1 hospital OR at least 7 physician within first 4 years**	
Sensitivity	62.5	Sensitivity	55.3	Sensitivity	47.8	Sensitivity	45.5
Specificity	94.2	Specificity	95.7	Specificity	96.1	Specificity	97.3

FP rate	5.8	FP rate	4.3	FP rate	3.9	FP rate	2.7
FN rate	37.5	FN rate	44.7	FN rate	52.2	FN rate	54.5
PPV	91.3	PPV	92.7	PPV	92.4	PPV	94.3
NPV	71.8	NPV	68.5	NPV	65.2	NPV	64.4
Percent agreement	78.4	Percent agreement	75.7	Percent agreement	72.2	Percent agreement	71.6
Kappa	0.568	*Kappa*	0.512	*Kappa*	0.441	*Kappa*	0.429
Kappa 95%CI	0.50-0.64	*Kappa* 95%CI	0.44-0.58	*Kappa* 95%CI	0.37-0.51	*Kappa* 95%CI	0.36-0.50
>=1 hospital OR at least 8 physician within first 4 years		**(>=1 hospital OR >=1 PSY[5]) AND at least 1 GP[6] visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) AND at least 2 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) AND at least 3 GP visit for 311 over 12 years**	
Sensitivity	40.3	Sensitivity	14.2	Sensitivity	14.2	Sensitivity	14.2
Specificity	97.3	Specificity	99.2	Specificity	99.2	Specificity	99.2
FP rate	2.7	FP rate	0.8	FP rate	0.8	FP rate	0.8
FN rate	59.7	FN rate	85.8	FN rate	85.8	FN rate	85.8
PPV	93.6	PPV	94.7	PPV	94.7	PPV	94.7
NPV	62.3	NPV	54.0	NPV	54.0	NPV	54.0
Percent agreement	69.0	Percent agreement	57.1	Percent agreement	57.1	Percent agreement	57.1
Kappa	0.378	*Kappa*	0.135	*Kappa*	0.135	*Kappa*	0.135
Kappa 95%CI	0.31-0.44	*Kappa* 95%CI	0.09-0.18	*Kappa* 95%CI	0.09-0.18	*Kappa* 95%CI	0.09-0.18
(>=1 hospital OR >=1 PSY) AND at least 4 GP visit for 311 over 12 years		**(>=1 hospital OR >=1 PSY) AND at least 5 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) AND at least 6 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) AND at least 7 GP visit for 311 over 12 years**	
Sensitivity	14.2	Sensitivity	14.2	Sensitivity	14.2	Sensitivity	14.2
Specificity	99.2	Specificity	99.2	Specificity	99.2	Specificity	99.2
FP rate	0.8	FP rate	0.8	FP rate	0.8	FP rate	0.8
FN rate	85.8	FN rate	85.8	FN rate	85.8	FN rate	85.8
PPV	94.7	PPV	94.7	PPV	94.7	PPV	94.7
NPV	54.0	NPV	54.0	NPV	54.0	NPV	54.0
Percent agreement	57.1	Percent agreement	57.1	Percent agreement	57.1	Percent agreement	57.1
Kappa	0.135	*Kappa*	0.135	*Kappa*	0.135	*Kappa*	0.135
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.09-0.18	*Kappa* 95%CI	0.09-0.18	*Kappa* 95%CI	0.09-0.18

(>=1 hospital OR >=1 PSY) AND at least 8 GP visit for 311 over 12 years		**(>=1 hospital OR >=1 PSY) AND at least 1 GP visit for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) AND at least 2 GP visit for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) AND at least 3 GP visit for 311 within first 1 year**	
Sensitivity	14.2	Sensitivity	23.3	Sensitivity	19.8	Sensitivity	17.4
Specificity	99.2	Specificity	98.1	Specificity	98.8	Specificity	98.8
FP rate	0.8	FP rate	1.9	FP rate	1.2	FP rate	1.2
FN rate	85.8	FN rate	76.7	FN rate	80.2	FN rate	82.6
PPV	94.7	PPV	92.2	PPV	94.3	PPV	93.6
NPV	54.0	NPV	56.5	NPV	55.6	NPV	54.9
Percent agreement	57.1	Percent agreement	61.0	Percent agreement	59.6	Percent agreement	58.4
Kappa	0.135	*Kappa*	0.215	*Kappa*	0.187	*Kappa*	0.163
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.16-0.27	*Kappa* 95%CI	0.13-0.24	*Kappa* 95%CI	0.11-0.21
(>=1 hospital OR >=1 PSY) AND at least 4 GP visit for 311 within first 1 year		**(>=1 hospital OR >=1 PSY) AND at least 5 GP visit for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) AND at least 6 GP visit for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) AND at least 7 GP visit for 311 within first 1 year**	
Sensitivity	15.8	Sensitivity	15.0	Sensitivity	14.6	Sensitivity	14.2
Specificity	98.8	Specificity	99.2	Specificity	99.2	Specificity	99.2
FP rate	1.2	FP rate	0.8	FP rate	0.8	FP rate	0.8
FN rate	84.2	FN rate	85.0	FN rate	85.4	FN rate	85.8
PPV	93.0	PPV	95.0	PPV	94.9	PPV	94.7
NPV	54.4	NPV	54.3	NPV	54.1	NPV	54.0
Percent agreement	57.6	Percent agreement	57.5	Percent agreement	57.3	Percent agreement	57.1
Kappa	0.147	*Kappa*	0.143	*Kappa*	0.139	*Kappa*	0.135
Kappa 95%CI	0.10-0.20	*Kappa* 95%CI	0.10-0.19	*Kappa* 95%CI	0.09-0.19	*Kappa* 95%CI	0.09-0.18
(>=1 hospital OR >=1 PSY) AND at least 8 GP visit for 311 within first 1 year		**(>=1 hospital OR >=1 PSY) AND at least 1 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) AND at least 2 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) AND at least 3 GP visit for 311 within first 2 years**	
Sensitivity	14.2	Sensitivity	23.3	Sensitivity	21.3	Sensitivity	18.6
Specificity	99.2	Specificity	98.1	Specificity	98.4	Specificity	98.8
FP rate	0.8	FP rate	1.9	FP rate	1.6	FP rate	1.2
FN rate	85.8	FN rate	76.7	FN rate	78.7	FN rate	81.4
PPV	94.7	PPV	92.2	PPV	93.1	PPV	94.0

NPV	54.0	NPV	56.5	NPV	56.0	NPV	55.2
Percent agreement	57.1	Percent agreement	61.0	Percent agreement	60.2	Percent agreement	59.0
Kappa	0.135	*Kappa*	0.215	*Kappa*	0.199	*Kappa*	0.175
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.16-0.27	*Kappa* 95%CI	0.14-0.25	*Kappa* 95%CI	0.12-0.23
(>=1 hospital OR >=1 PSY) AND at least 4 GP visit for 311 within first 2 years		**(>=1 hospital OR >=1 PSY) AND at least 5 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) AND at least 6 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) AND at least 7 GP visit for 311 within first 2 years**	
Sensitivity	17.0	Sensitivity	15.4	Sensitivity	14.6	Sensitivity	14.2
Specificity	98.8	Specificity	98.8	Specificity	99.2	Specificity	99.2
FP rate	1.2	FP rate	1.2	FP rate	0.8	FP rate	0.8
FN rate	83.0	FN rate	84.6	FN rate	85.4	FN rate	85.8
PPV	93.5	PPV	92.9	PPV	94.9	PPV	94.7
NPV	54.7	NPV	54.3	NPV	54.1	NPV	54.0
Percent agreement	58.2	Percent agreement	57.5	Percent agreement	57.3	Percent agreement	57.1
Kappa	0.159	*Kappa*	0.143	*Kappa*	0.139	*Kappa*	0.135
Kappa 95%CI	0.11-0.21	*Kappa* 95%CI	0.10-0.19	*Kappa* 95%CI	0.09-0.19	*Kappa* 95%CI	0.09-0.18
(>=1 hospital OR >=1 PSY) AND at least 8 GP visit for 311 within first 2 years		**(>=1 hospital OR >=1 PSY) AND at least 1 GP visit for 311 within first 3 years**		**(>=1 hospital OR >=1 PSY) AND at least 2 GP visit for 311 within first 3 years**		**(>=1 hospital OR >=1 PSY) AND at least 3 GP visit for 311 within first 3 years**	
Sensitivity	14.2	Sensitivity	22.9	Sensitivity	22.9	Sensitivity	20.6
Specificity	99.2	Specificity	98.4	Specificity	98.4	Specificity	98.8
FP rate	0.8	FP rate	1.6	FP rate	1.6	FP rate	1.2
FN rate	85.8	FN rate	77.1	FN rate	77.1	FN rate	79.4
PPV	94.7	PPV	93.5	PPV	93.5	PPV	94.5
NPV	54.0	NPV	56.5	NPV	56.5	NPV	55.8
Percent agreement	57.1	Percent agreement	61.0	Percent agreement	61.0	Percent agreement	60.0
Kappa	0.135	*Kappa*	0.215	*Kappa*	0.215	*Kappa*	0.195
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.16-0.27	*Kappa* 95%CI	0.16-0.27	*Kappa* 95%CI	0.14-0.25
(>=1 hospital OR >=1 PSY) AND at least 4 GP visit for		**(>=1 hospital OR >=1 PSY) AND at least 5 GP visit**		**(>=1 hospital OR >=1 PSY) AND at least 6 GP visit for**		**(>=1 hospital OR >=1 PSY) AND at least 7 GP visit for 311 within first**	

311 within first 3 years		**for 311 within first 3 years**		**311 within first 3 years**		**3 years**	
Sensitivity	17.0	Sensitivity	15.4	Sensitivity	14.6	Sensitivity	14.2
Specificity	98.8	Specificity	98.8	Specificity	99.2	Specificity	99.2
FP rate	1.2	FP rate	1.2	FP rate	0.8	FP rate	0.8
FN rate	83.0	FN rate	84.6	FN rate	85.4	FN rate	85.8
PPV	93.5	PPV	92.9	PPV	94.9	PPV	94.7
NPV	54.7	NPV	54.3	NPV	54.1	NPV	54.0
Percent agreement	58.2	Percent agreement	57.5	Percent agreement	57.3	Percent agreement	57.1
Kappa	0.159	*Kappa*	0.143	*Kappa*	0.139	*Kappa*	0.135
Kappa 95%CI	0.11-0.21	*Kappa* 95%CI	0.10-0.19	*Kappa* 95%CI	0.09-0.19	*Kappa* 95%CI	0.09-0.18
(>=1 hospital OR >=1 PSY) AND at least 8 GP visit for 311 within first 3 years		**(>=1 hospital OR >=1 PSY) AND at least 1 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) AND at least 2 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) AND at least 3 GP visit for 311 within first 4 years**	
Sensitivity	14.2	Sensitivity	26.1	Sensitivity	23.7	Sensitivity	21.7
Specificity	99.2	Specificity	98.1	Specificity	98.4	Specificity	98.8
FP rate	0.8	FP rate	1.9	FP rate	1.6	FP rate	1.2
FN rate	85.8	FN rate	73.9	FN rate	76.3	FN rate	78.3
PPV	94.7	PPV	93.0	PPV	93.8	PPV	94.8
NPV	54.0	NPV	57.4	NPV	56.7	NPV	56.2
Percent agreement	57.1	Percent agreement	62.4	Percent agreement	61.4	Percent agreement	60.6
Kappa	0.135	*Kappa*	0.243	*Kappa*	0.223	*Kappa*	0.207
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.18-0.30	*Kappa* 95%CI	0.17-0.28	*Kappa* 95%CI	0.15-0.26
(>=1 hospital OR >=1 PSY) AND at least 4 GP visit for 311 within first 4 years		**(>=1 hospital OR >=1 PSY) AND at least 5 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) AND at least 6 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) AND at least 7 GP visit for 311 within first 4 years**	
Sensitivity	18.6	Sensitivity	18.2	Sensitivity	16.2	Sensitivity	14.2
Specificity	98.8	Specificity	98.8	Specificity	99.2	Specificity	99.2
FP rate	1.2	FP rate	1.2	FP rate	0.8	FP rate	0.8
FN rate	81.4	FN rate	81.8	FN rate	83.8	FN rate	85.8
PPV	94.0	PPV	93.9	PPV	95.3	PPV	94.7
NPV	55.2	NPV	55.1	NPV	54.6	NPV	54.0
Percent agreement	59.0	Percent agreement	58.8	Percent agreement	58.0	Percent agreement	57.1

Kappa	0.175	*Kappa*	0.171	*Kappa*	0.155	*Kappa*	0.135
Kappa 95%CI	0.12-0.23	*Kappa* 95%CI	0.12-0.22	*Kappa* 95%CI	0.11-0.20	*Kappa* 95%CI	0.09-0.18
(>=1 hospital OR >=1 PSY) AND at least 8 GP visit for 311 within first 4 years		**(>=1 hospital OR >=1 PSY) OR at least 1 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) OR at least 2 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) OR at least 3 GP visit for 311 over 12 years**	
Sensitivity	14.2	Sensitivity	29.6	Sensitivity	29.6	Sensitivity	29.6
Specificity	99.2	Specificity	96.5	Specificity	96.5	Specificity	96.5
FP rate	0.8	FP rate	3.5	FP rate	3.5	FP rate	3.5
FN rate	85.8	FN rate	70.4	FN rate	70.4	FN rate	70.4
PPV	94.7	PPV	89.3	PPV	89.3	PPV	89.3
NPV	54.0	NPV	58.2	NPV	58.2	NPV	58.2
Percent agreement	57.1	Percent agreement	63.3	Percent agreement	63.3	Percent agreement	63.3
Kappa	0.135	*Kappa*	0.263	*Kappa*	0.263	*Kappa*	0.263
Kappa 95%CI	0.09-0.18	*Kappa* 95%CI	0.20-0.33	*Kappa* 95%CI	0.20-0.33	*Kappa* 95%CI	0.20-0.33
(>=1 hospital OR >=1 PSY) OR at least 4 GP visit for 311 over 12 years		**(>=1 hospital OR >=1 PSY) OR at least 5 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) OR at least 6 GP visit for 311 over 12 years**		**(>=1 hospital OR >=1 PSY) OR at least 7 GP visit for 311 over 12 years**	
Sensitivity	29.6	Sensitivity	29.6	Sensitivity	29.6	Sensitivity	29.6
Specificity	96.5	Specificity	96.5	Specificity	96.5	Specificity	96.5
FP rate	3.5	FP rate	3.5	FP rate	3.5	FP rate	3.5
FN rate	70.4	FN rate	70.4	FN rate	70.4	FN rate	70.4
PPV	89.3	PPV	89.3	PPV	89.3	PPV	89.3
NPV	58.2	NPV	58.2	NPV	58.2	NPV	58.2
Percent agreement	63.3	Percent agreement	63.3	Percent agreement	63.3	Percent agreement	63.3
Kappa	0.263	*Kappa*	0.263	*Kappa*	0.263	*Kappa*	0.263
Kappa 95%CI	0.20-0.33	*Kappa* 95%CI	0.20-0.33	*Kappa* 95%CI	0.20-0.33	*Kappa* 95%CI	0.20-0.33
(>=1 hospital OR >=1 PSY) OR at least 8 GP visit for 311 over 12 years		**(>=1 hospital OR >=1 PSY) OR at least 3 GP visits for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) OR at least 4 GP visits for 311 within first 1 year**		**(>=1 hospital OR >=1 PSY) OR at least 5 GP visits for 311 within first 1 year**	
Sensitivity	29.6	Sensitivity	57.7	Sensitivity	48.6	Sensitivity	45.1

Specificity	96.5	Specificity	94.2	Specificity	94.6	Specificity	95.7
FP rate	3.5	FP rate	5.8	FP rate	5.4	FP rate	4.3
FN rate	70.4	FN rate	42.3	FN rate	51.4	FN rate	54.9
PPV	89.3	PPV	90.7	PPV	89.8	PPV	91.2
NPV	58.2	NPV	69.3	NPV	65.1	NPV	63.9
Percent agreement	63.3	Percent agreement	76.1	Percent agreement	71.8	Percent agreement	70.6
Kappa	0.263	*Kappa*	0.520	*Kappa*	0.433	*Kappa*	0.409
Kappa 95%CI	0.20-0.33	*Kappa* 95%CI	0.45-0.59	*Kappa* 95%CI	0.36-0.50	*Kappa* 95%CI	0.34-0.48
(>=1 hospital OR >=1 PSY) OR at least 6 GP visits for 311 within first 1 year		**(>=1 hospital OR >=1 PSY) OR at least 7 GP visits for 311 within first 1 years**		**(>=1 hospital OR >=1 PSY) OR at least 8 GP visits for 311 within first 1 years**		**(>=1 hospital OR >=1 PSY) OR at least 4 GP visit for 311 within first 2 years**	
Sensitivity	39.9	Sensitivity	37.2	Sensitivity	35.2	Sensitivity	56.5
Specificity	95.7	Specificity	96.1	Specificity	96.5	Specificity	94.6
FP rate	4.3	FP rate	3.9	FP rate	3.5	FP rate	5.4
FN rate	60.1	FN rate	62.8	FN rate	64.8	FN rate	43.5
PPV	90.2	PPV	90.4	PPV	90.8	PPV	91.1
NPV	61.8	NPV	60.8	NPV	60.2	NPV	68.8
Percent agreement	68.0	Percent agreement	66.9	Percent agreement	66.1	Percent agreement	75.7
Kappa	0.358	*Kappa*	0.334	*Kappa*	0.318	*Kappa*	0.512
Kappa 95%CI	0.29-0.43	*Kappa* 95%CI	0.27-0.40	*Kappa* 95%CI	0.25-0.38	*Kappa* 95%CI	0.44-0.58
(>=1 hospital OR >=1 PSY) OR at least 5 GP visit for 311 within first 2 years		**(>=1 hospital OR >=1 PSY) OR at least 6 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) OR at least 7 GP visit for 311 within first 2 years**		**(>=1 hospital OR >=1 PSY) OR at least 8 GP visit for 311 within first 2 years**	
Sensitivity	50.2	Sensitivity	45.8	Sensitivity	43.1	Sensitivity	40.7
Specificity	95.7	Specificity	95.7	Specificity	96.1	Specificity	96.1
FP rate	4.3	FP rate	4.3	FP rate	3.9	FP rate	3.9
FN rate	49.8	FN rate	54.2	FN rate	56.9	FN rate	59.3
PPV	92.0	PPV	91.3	PPV	91.6	PPV	91.2
NPV	66.1	NPV	64.2	NPV	63.2	NPV	62.2
Percent agreement	73.1	Percent agreement	71.0	Percent agreement	69.8	Percent agreement	68.6
Kappa	0.461	*Kappa*	0.417	*Kappa*	0.394	*Kappa*	0.370
Kappa 95%CI	0.39-0.53	*Kappa* 95%CI	0.35-0.49	*Kappa* 95%CI	0.33-0.46	*Kappa* 95%CI	0.30-0.44

(>= 1 hospital OR >=1 PSY) OR at least 4 GP visit for 311 within first 3 years		**(>= 1 hospital OR >=1 PSY) OR at least 5 GP visit for 311 within first 3 years**		**(>= 1 hospital OR >=1 PSY) OR at least 6 GP visit for 311 within first 3 years**		**(>= 1 hospital OR >=1 PSY) OR at least 7 GP visit for 311 within first 3 years**	
Sensitivity	61.3	Sensitivity	53.8	Sensitivity	49.0	Sensitivity	47.0
Specificity	93.8	Specificity	95.3	Specificity	95.3	Specificity	95.7
FP rate	6.2	FP rate	4.7	FP rate	4.7	FP rate	4.3
FN rate	38.7	FN rate	46.2	FN rate	51.0	FN rate	53.0
PPV	90.6	PPV	91.9	PPV	91.2	PPV	91.5
NPV4	71.1	NPV	67.7	NPV	65.5	NPV	64.7
Percent agreement	77.6	Percent agreement	74.7	Percent agreement	72.4	Percent agreement	71.6
Kappa	0.552	*Kappa*	0.492	*Kappa*	0.445	*Kappa*	0.429
Kappa 95%CI	0.48-0.62	*Kappa* 95%CI	0.42-0.56	*Kappa* 95%CI	0.38-0.51	*Kappa* 95%CI	0.36-0.50

(>= 1 hospital OR >=1 PSY) OR at least 8 GP visit for 311 within first 3 years		**(>=1 hospital OR >=1 PSY) OR at least 4 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) OR at least 5 GP visit for 311 within first 4 years**		**(>=1 hospital OR >=1 PSY) OR at least 6 GP visit for 311 within first 4 years**	
Sensitivity	44.7	Sensitivity	64.4	Sensitivity	57.3	Sensitivity	51.0
Specificity	96.1	Specificity	93.4	Specificity	95.3	Specificity	95.3
FP rate	3.9	FP rate	6.6	FP rate	4.7	FP rate	4.7
FN rate	55.3	FN rate	35.6	FN rate	42.7	FN rate	49.0
PPV	91.9	PPV	90.6	PPV	92.4	PPV	91.5
NPV	63.8	NPV	72.7	NPV	69.4	NPV	66.4
Percent agreement	70.6	Percent agreement	79.0	Percent agreement	76.5	Percent agreement	73.3
Kappa	0.409	*Kappa*	0.579	*Kappa*	0.528	*Kappa*	0.465
Kappa 95%CI	0.34-0.48	*Kappa* 95%CI	0.51-0.65	*Kappa* 95%CI	0.46-0.60	*Kappa* 95%CI	0.40-0.53

(>=1 hospital OR >=1 PSY) OR at least 7 GP visit for 311 within first 4 years		**(>=1 hospital OR >=1 PSY) OR at least 8 GP visit for 311 within first 4 years**	
Sensitivity	48.6	Sensitivity	45.5
Specificity	95.7	Specificity	95.7
FP rate	4.3	FP rate	4.3
FN rate	51.4	FN rate	54.5

PPV	91.8	PPV	91.3
NPV	65.4	NPV	64.1
Percent agreement	72.4	Percent agreement	70.8
Kappa	0.445	*Kappa*	0.413
Kappa 95%CI	0.38-0.51	*Kappa* 95%CI	0.34-0.48

[1] False positive rate
[2] False negative rate
[3] Positive predictive value
[4] Negative predictive value
[5] Psychiatrist visit
[6] General practitioner visit

Appendix F: 26 selected cases with the addition of anti-depressant medication information (either as 'AND' or 'OR') with their binary classification tests

>= 1 hospital OR At least 1 physician AND Anti-depressant meds over 12 years		**>= 1 hospital OR At least 2 physician AND Anti-depressant meds over 12 years**		**>= 1 hospital OR At least 3 physician AND Anti-depressant meds over 12 years**		**>= 1 hospital OR At least 4 physician AND Anti-depressant meds over 12 years**	
Sensitivity	80.6	Sensitivity	73.9	Sensitivity	68.4	Sensitivity	61.3
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP[1] rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN[2] rate	19.4	FN rate	26.1	FN rate	31.6	FN rate	38.7
PPV[3]	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV[4]	84.0	NPV	79.6	NPV	76.3	NPV	72.4
Percent agreement	90.4	Percent agreement	87.1	Percent agreement	84.3	Percent agreement	80.8
Kappa	0.808	*Kappa*	0.741	*Kappa*	0.685	*Kappa*	0.615
Kappa 95%CI	0.76-86	*Kappa* 95%CI	0.68-0.80	*Kappa* 95%CI	0.63-0.75	*Kappa* 95%CI	0.55-0.68
>= 1 hospital OR At least 5 physician AND Anti-depressant meds over 12 years		**>= 1 hospital OR At least 1 physician AND Anti-depressant meds within first 1 year**		**>= 1 hospital OR At least 2 physician AND Anti-depressant meds within first 1 year**		**>= 1 hospital OR At least 1 physician AND Anti-depressant meds AND Anti-depressant meds within first 2 years**	
Sensitivity	57.7	Sensitivity	80.6	Sensitivity	62.1	Sensitivity	80.6
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN rate	42.3	FN rate	19.4	FN rate	37.9	FN rate	19.4
PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV	70.6	NPV	84.0	NPV	72.8	NPV	84.0
Percent agreement	79.0	Percent agreement	90.4	Percent agreement	81.2	Percent agreement	90.4
Kappa	0.579	*Kappa*	0.808	*Kappa*	0.622	*Kappa*	0.808
Kappa 95%CI	0.51-0.64	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.56-0.69	*Kappa* 95%CI	0.76-0.86
>= 1 hospital OR At least 2 physician AND Anti-depressant meds AND Anti-		**>= 1 hospital OR At least 1 physician AND Anti-depressant meds AND Anti-**		**>= 1 hospital OR At least 2 physician AND Anti-depressant meds AND Anti-**		**>= 1 hospital OR At least 3 physician AND Anti-depressant meds AND Anti-**	

depressant meds within first 2 years		**depressant meds within first 3 years**		**depressant meds within first 3 years**		**depressant meds within first 3 years**	
Sensitivity	66.8	Sensitivity	80.6	Sensitivity	69.2	Sensitivity	59.7
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN rate	33.2	FN rate	19.4	FN rate	30.8	FN rate	40.3
PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV	75.4	NPV	84.0	NPV	76.7	NPV	71.6
Percent agreement	83.5	Percent agreement	90.4	Percent agreement	84.7	Percent agreement	80.0
Kappa	0.670	*Kappa*	0.808	*Kappa*	0.693	*Kappa*	0.599
Kappa 95%CI	0.61-0.73	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.63-0.75	*Kappa* 95%CI	0.53-0.66
>= 1 hospital OR At least 1 physician AND Anti-depressant meds AND Anti-depressant meds within first 4 years		**>= 1 hospital OR At least 2 physician AND Anti-depressant meds AND Anti-depressant meds within first 4 years**		**>= 1 hospital OR At least 3 physician AND Anti-depressant meds AND Anti-depressant meds within first 4 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 AND Anti-depressant meds within first 1 year**	
Sensitivity	80.6	Sensitivity	71.9	Sensitivity	62.8	Sensitivity	80.6
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN rate	19.4	FN rate	28.1	FN rate	37.2	FN rate	19.4
PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV	84.0	NPV	78.4	NPV	73.2	NPV	84.0
Percent agreement	90.4	Percent agreement	86.1	Percent agreement	81.6	Percent agreement	90.4
Kappa	0.808	*Kappa*	0.721	*Kappa*	0.630	*Kappa*	0.808
Kappa 95%CI	0.76-0.86	*Kappa* 95%CI	0.66-0.78	*Kappa* 95%CI	0.57-0.69	*Kappa* 95%CI	0.76-0.86
(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 AND Anti-depressant meds within first 1 year		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 AND Anti-depressant meds within first 2 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 AND Anti-depressant meds within first 2 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 AND Anti-depressant meds within first 2 years**	
Sensitivity	64.8	Sensitivity	80.6	Sensitivity	68.8	Sensitivity	59.3
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0

FN rate	35.2	FN rate	19.4	FN rate	31.2	FN rate	40.7
PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV	74.3	NPV	84.0	NPV	76.5	NPV	71.4
Percent agreement	82.5	Percent agreement	90.4	Percent agreement	84.5	Percent agreement	79.8
Kappa	0.650	*Kappa*	0.808	*Kappa*	0.689	*Kappa*	0.595
Kappa 95%CI	0.59-0.71	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.63-0.75	*Kappa* 95%CI	0.53-0.66
(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 AND Anti-depressant meds within first 3 years		**(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 AND Anti-depressant meds within first 3 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 AND Anti-depressant meds within first 3 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 AND Anti-depressant meds within first 4 years**	
Sensitivity	70.4	Sensitivity	70.4	Sensitivity	61.3	Sensitivity	80.6
Specificity	100.0	Specificity	100.0	Specificity	100.0	Specificity	100.0
FP rate	0.0	FP rate	0.0	FP rate	0.0	FP rate	0.0
FN rate	29.6	FN rate	29.6	FN rate	38.7	FN rate	19.4
PPV	100.0	PPV	100.0	PPV	100.0	PPV	100.0
NPV	77.4	NPV	77.4	NPV	72.4	NPV	84.0
Percent agreement	85.3	Percent agreement	85.3	Percent agreement	80.8	Percent agreement	90.4
Kappa	0.705	*Kappa*	0.705	*Kappa*	0.615	*Kappa*	0.808
Kappa 95%CI	0.65-0.76	*Kappa* 95%CI	0.65-0.76	*Kappa* 95%CI	0.55-0.68	*Kappa* 95%CI	0.76-0.86
(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 AND Anti-depressant meds within first 4 years		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 AND Anti-depressant meds within first 4 years**					
Sensitivity	72.7	Sensitivity	64.4				
Specificity	100.0	Specificity	100.0				
FP rate	0.0	FP rate	0.0				
FN rate	27.3	FN rate	35.6				
PPV	100.0	PPV	100.0				
NPV	78.8	NPV	74.1				
Percent agreement	86.5	Percent agreement	82.4				
Kappa	0.729	*Kappa*	0.646				

Kappa 95%CI	0.67-0.79	*Kappa* 95%CI	0.58-0.71

>= 1 hospital OR At least 1 physician OR Anti-depressant meds over 12 years		**>= 1 hospital OR At least 2 physician OR Anti-depressant meds over 12 years**		**>= 1 hospital OR At least 3 physician OR Anti-depressant meds over 12 years**		**>= 1 hospital OR At least 4 physician OR Anti-depressant meds over 12 years**	
Sensitivity	99.2	Sensitivity	99.2	Sensitivity	99.2	Sensitivity	98.8
Specificity	81.3	Specificity	90.3	Specificity	91.8	Specificity	92.6
FP[1] rate	18.7	FP rate	9.7	FP rate	8.2	FP rate	7.4
FN[2] rate	0.8	FN rate	0.8	FN rate	0.8	FN rate	1.2
PPV[3]	83.9	PPV	90.9	PPV	92.3	PPV	92.9
NPV[4]	99.1	NPV	99.1	NPV	99.2	NPV	98.8
Percent agreement	90.2	Percent agreement	94.7	Percent agreement	95.5	Percent agreement	95.7
Kappa	.804	*Kappa*	0.894	*Kappa*	0.910	*Kappa*	0.914
Kappa 95%CI	0.75-0.85	*Kappa* 95%CI	0.86-0.93	*Kappa* 95%CI	0.87-0.95	*Kappa* 95%CI	0.88-0.95
>= 1 hospital OR At least 5 physician OR Anti-depressant meds over 12 years		**>= 1 hospital OR At least 1 physician OR Anti-depressant meds within first 1 year**		**>= 1 hospital OR At least 2 physician OR Anti-depressant meds within first 1 year**		**>= 1 hospital OR At least 1 physician AND Anti-depressant meds OR Anti-depressant meds within first 2 years**	
Sensitivity	98.4	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	93.8	Specificity	81.5	Specificity	92.7	Specificity	81.5
FP rate	6.2	FP rate	18.5	FP rate	7.3	FP rate	18.5
FN rate	1.6	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	94.0	PPV	83.9	PPV	92.9	PPV	83.9
NPV	98.4	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	96.1	Percent agreement	90.6	Percent agreement	96.3	Percent agreement	90.6
Kappa	0.922	*Kappa*	0.812	*Kappa*	0.926	*Kappa*	0.812
Kappa 95%CI	0.89-0.96	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.89-0.96	*Kappa* 95%CI	0.76-0.86
>= 1 hospital OR At least 2 physician AND Anti-depressant		**>= 1 hospital OR At least 1 physician AND Anti-depressant**		**>= 1 hospital OR At least 2 physician AND Anti-depressant**		**>= 1 hospital OR At least 3 physician AND Anti-depressant**	

meds OR Anti-depressant meds within first 2 years		**meds OR Anti-depressant meds within first 3 years**		**meds OR Anti-depressant meds within first 3 years**		**meds OR Anti-depressant meds within first 3 years**	
Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	91.9	Specificity	81.5	Specificity	91.5	Specificity	93.1
FP rate	8.1	FP rate	18.5	FP rate	8.5	FP rate	6.9
FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	92.3	PPV	83.9	PPV	91.9	PPV	93.3
NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	95.9	Percent agreement	90.6	Percent agreement	95.7	Percent agreement	96.5
Kappa	0.918	*Kappa*	0.812	*Kappa*	0.914	*Kappa*	0.929
Kappa 95%CI	0.88-0.95	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.88-0.95	*Kappa* 95%CI	0.90-0.96
>= 1 hospital OR At least 1 physician AND Anti-depressant meds OR Anti-depressant meds within first 4 years		**>= 1 hospital OR At least 2 physician AND Anti-depressant meds OR Anti-depressant meds within first 4 years**		**>= 1 hospital OR At least 3 physician AND Anti-depressant meds OR Anti-depressant meds within first 4 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 OR Anti-depressant meds within first 1 year**	
Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	81.5	Specificity	90.3	Specificity	92.3	Specificity	81.5
FP rate	18.5	FP rate	9.7	FP rate	7.7	FP rate	18.5
FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	83.9	PPV	90.9	PPV	92.6	PPV	83.9
NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	90.6	Percent agreement	95.1	Percent agreement	96.1	Percent agreement	90.6
Kappa	0.812	*Kappa*	0.902	*Kappa*	0.922	*Kappa*	0.812
Kappa 95%CI	0.76-0.86	*Kappa* 95%CI	0.86-0.94	*Kappa* 95%CI	0.89-0.96	*Kappa* 95%CI	0.76-0.86
(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 OR Anti-depressant meds within first 1 year		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 OR Anti-depressant meds within first 2 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 OR Anti-depressant meds within first 2 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 OR Anti-depressant meds within first 2 years**	
Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	92.3	Specificity	81.5	Specificity	91.9	Specificity	92.7

FP rate	7.7	FP rate	18.5	FP rate	8.1	FP rate	7.3
FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	92.6	PPV	83.9	PPV	92.3	PPV	92.9
NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	96.1	Percent agreement	90.6	Percent agreement	95.9	Percent agreement	96.3
Kappa	0.922	*Kappa*	0.812	*Kappa*	0.918	*Kappa*	0.926
Kappa 95%CI	0.89-0.96	*Kappa* 95%CI	0.76-0.86	*Kappa* 95%CI	0.88-0.95	*Kappa* 95%CI	0.89-0.96
(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 OR Anti-depressant meds within first 3 years		**(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 OR Anti-depressant meds within first 3 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 OR Anti-depressant meds within first 3 years**		**(>= 1 hospital OR >= 1 PSY) OR at least 1 GP visit for 311 OR Anti-depressant meds within first 4 years**	
Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0	Sensitivity	100.0
Specificity	91.5	Specificity	91.5	Specificity	92.3	Specificity	81.5
FP rate	8.5	FP rate	8.5	FP rate	7.7	FP rate	18.5
FN rate	0.0	FN rate	0.0	FN rate	0.0	FN rate	0.0
PPV	91.9	PPV	91.9	PPV	92.6	PPV	83.9
NPV	100.0	NPV	100.0	NPV	100.0	NPV	100.0
Percent agreement	95.7	Percent agreement	95.7	Percent agreement	96.1	Percent agreement	90.6
Kappa	0.914	*Kappa*	0.914	*Kappa*	0.922	*Kappa*	0.812
Kappa 95%CI	0.88-0.95	*Kappa* 95%CI	0.88-0.95	*Kappa* 95%CI	0.89-0.96	*Kappa* 95%CI	0.76-0.86
(>= 1 hospital OR >= 1 PSY) OR at least 2 GP visit for 311 OR Anti-depressant meds within first 4 years		**(>= 1 hospital OR >= 1 PSY) OR at least 3 GP visit for 311 OR Anti-depressant meds within first 4 years**					
Sensitivity	100.0	Sensitivity	100.0				
Specificity	90.3	Specificity	91.5				
FP rate	9.7	FP rate	8.5				
FN rate	0.0	FN rate	0.0				
PPV	90.9	PPV	91.9				
NPV	100.0	NPV	100.0				
Percent agreement	95.1	Percent agreement	95.7				

Kappa	0.902	*Kappa*	0.914
Kappa 95%CI	0.86-0.94	*Kappa* 95%CI	0.88-0.95

[1] False positive rate
[2] False negative rate
[3] Positive predictive value
[4] Negative predictive value
[5] Psychiatrist visit
[6] General practitioner visit