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IDENTIFYING MENTAL AND SUBSTANCE USE DISORDERS USING ADMINISTRATIVE DATA

PROVINCIAL DATA ADVISORY COMMITTEE – NEEDS-BASED PLANNING FOR MENTAL HEALTH AND SUBSTANCE USE SERVICES IN BRITISH COLUMBIA

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TABLE OF CONTENTS

Authors ii

Acknowledgments iii

Advisory Committees iv

List of Tables x

List of Figures xiii

Abbreviations 1

Introduction 2

Methodology 7

Mental and Substance Use Disorders Featured in the Report 7

Data Sources and Procedures 8

Population Data 8

Initial Dataset 8

Data Cleaning – Inclusion and Exclusion Criteria 10

Data Coding Issues 11

Expected Prevalence Estimates 12

Descriptive Data Statistics 14

Demographics 14

Hospital and MSP Claims 17
Objective I: Disorder-Specific Case Algorithms 19
Methodology 19
Results 23
Depressive Disorders 23
Anxiety Disorders 31
Schizophrenia Spectrum Disorders 37
Bipolar Disorder and Related Disorders 45
Attention-Deficit/Hyperactivity Disorder 52
Eating Disorders 58
Intellectual Disabilities 64
Neurocognitive Disorders 70
Personality Disorders 77
Alcohol-Related Disorders 84
Substance-Related Disorders 90
Prevalence of the 11 MSU Disorder Groups 97
Summary of Results 99
Objective II: Disorder-Specific Severity Algorithms 100

Introduction 100
Methodology 102
Severity Algorithms 102
Timeframe for Severity Levels 103
Longitudinal Analysis 105
Other Measures Considered Proxies for Severity 105
PharmaNet Data 106
Severity Algorithms Versus Epidemiological Severity Distribution 108
Results 109
Severity Breakdown by MSU Disorder Group 109
Longitudinal Results 110
PharmaNet Results 112
Severity Algorithms versus Epidemiological Severity Distributions 114
Summary of Results 119
Objective III: Comorbidity Analysis 120
Introduction 120
Methodology 120
Study Sample 120

Pairwise Comorbidity Measures....120
Comorbidity Patterns....121
Results....122
Pairwise Comorbidity....122
Comorbidity Patterns....128
Summary of Results....130
Discussion....132
Developing Case Definitions for the 11 MSU Disorder Groups....132
Severity Algorithms....134
Comorbidity among the 11 MSU Disorder Groups....135
Strengths and Limitations....137
Strengths....137
Limitations....138
Recommendations....139
References....141

LIST OF TABLES

Table 1 Data Files and Years of Data Requested 9

Table 2 Age and Gender Distribution of the Study Cohort 14

Table 3 Age Distribution of the Study Cohort and the PEOPLE 2016 Estimate for the 2016 BC Population 15

Table 4 Hospital Claims in BC between FY 2012/13 and 2015/16 17

Table 5 MSP Claims between FY 2012/13 and 2015/16 18

Table 6 ICD-9 and ICD-10 Codes Used in This Report 21

Table 7 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – All Depressive Disorders (MDDplus) 24

Table 8 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Depressive Disorders 26

Table 9 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Any Anxiety Disorder 31

Table 10 Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Anxiety Disorders 32

Table 11 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Schizophrenia Spectrum Disorders 37

Table 12 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Schizophrenia Spectrum and Other Psychotic Disorders 38

Table 13 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Bipolar Disorders and Related Disorders 45

Table 14 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Bipolar and Related Disorders 46

Table 15 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – ADHD 52

Table 16 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – ADHD 53

Table 17 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Eating Disorders 58

Table 18 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Eating Disorders 59

Table 19 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Intellectual Disabilities 64

Table 20 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Intellectual Disabilities 65

Table 21 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Neurocognitive Disorders due to TBI or Substance/Medication Use 70

Table 22 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Neurocognitive Disorders 72

Table 23 Epidemiological Age and Gender Distributions (Cases Per 100 Population; Adjusted to One Year) – Personality Disorders 77

Table 24 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Personality Disorders 78

Table 25 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Alcohol-Related Disorders 84

Table 26 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Alcohol-Related Disorders 85

Table 27 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Substance Use Disorders 91

Table 28 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Substance Use Disorders 92

Table 29 Correspondence between Phase 1 Epidemiological and Administrative Data Prevalence Estimates (Cases per 100 Population) 98

Table 30 Severity Distribution Patterns for Anxiety Disorders during the Study Period ... 111

Table 31 Prescriptions in Adults (aged ≥15 years) Meeting an Anxiety Disorder Case Definition by Severity Level in FY 2014/15 113

Table 32 Proportions of Single and Comorbid MSU Disorder(s) in FY 2014/15 123

Table 33 Pairwise Comorbid Case Counts (*n*) in FY 2014/15 124

Table 34 Pairwise Comorbid Odds Ratios in FY 2014/15 125

Table 35 Phi Correlation Coefficients between All Pairs of Conditions in FY 2014/15 126

Table 36 Percentages of Pairwise Comorbidities in FY 2014/15 127

Table 37 Comorbidity Patterns of Unique Individuals between FY 2012/13 and 2015/16 129

LIST OF FIGURES

Figure 1 Age Distribution between the Study Cohort and the PEOPLE 2016 Estimate for the 2016 BC Population 16

Figure 2 MSP and Hospital Claims for MSU Diagnoses between FY 2012/13 and 2015/16 18

Figure 3 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Depressive Disorders 28

Figure 4 Prevalence based on Epidemiology and Administrative Alternative Case Definitions –Comparison for Depressive Disorders 29

Figure 5 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Anxiety Disorders 34

Figure 6 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Anxiety Disorders 35

Figure 7 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders 40

Figure 8 Prevalence based on Epidemiology and Alternative Case Definitions (ICD-9 295 and 297) – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders . 41

Figure 9 Prevalence based on Epidemiology and Alternative Case Definitions (ICD-9 295, 297, and 298) – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders 42

Figure 10 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Bipolar and Related Disorders 48

Figure 11 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Bipolar and Related Disorders 49

Figure 12 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for ADHD 55

Figure 13 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for ADHD 56

Figure 14 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Eating Disorders..... 61

Figure 15 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Eating Disorders..... 62

Figure 16 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Intellectual Disabilities..... 67

Figure 17 Prevalence based on Epidemiology and Alternative Case Definitions (Four-year timespan) – Comparison for Intellectual Disabilities..... 68

Figure 18 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for All Neurocognitive Disorders 74

Figure 19 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Neurocognitive Disorders 75

Figure 20 Prevalence based on Epidemiology (Adjusted) and Administrative Case Definitions – Comparison for Personality Disorders 80

Figure 21 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Personality Disorders 81

Figure 22 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Alcohol-Related Disorders 87

Figure 23 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Alcohol-Related Disorders 88

Figure 24 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Substance-Related Disorders 94

Figure 25 Timeframe for a Severe Case of Depression 104

Figure 26 Percentages of Individuals Meeting the Criteria for Severe Anxiety-Related Disorders across Different Timeframes 105

Figure 27 Severity Breakdown by Disorder Groups for FY 2015/16 109

Figure 28 AHFS Prescriptions in Adults (aged ≥15 years) Meeting an Anxiety Disorder Case Definition by Severity Level in FY 2014/15 113

Figure 29 Comparison of Severity Algorithms and Phase 1 Severity Estimates 115

Figure 30 Comorbidity Patterns between FY 2012/13 and 2015/16.....129

ABBREVIATIONS

ADHD	Attention deficit hyperactivity disorder
AHFS	American Hospital Formulary Service
BC	British Columbia
BCCDC	British Columbia Centre for Disease Control
CARMHA	Centre for Applied Research in Mental Health and Addiction
CIHI	Canadian Institute for Health Information
CM	Canadian Modification
DAD	Discharge Abstract Database
DSM	Diagnostic and Statistical Manual of Mental Disorders
FY	Fiscal year
GBD	Global Burden of Disease
ICD	International Statistical Classification of Diseases
MDD	Major depressive disorder
MoH	Ministry of Health
MSP	Medical Services Plan
MSU	Mental and substance use
NBP	Needs-based planning
NCD	Neurocognitive disorder
OR	Odds ratio
PDAC	Provincial Data Advisory Committee
PWG	Provincial Working Group
SPAC	Service Planning Advisory Committee
TBI	Traumatic brain injury

INTRODUCTION

Both provincial and federal governments recognize the importance of population-wide illness surveillance. While surveillance is regularly used to monitor communicable diseases, there is emerging interest in Canada in using administrative data to surveil noncommunicable diseases such as diabetes, cancer, arthritis, circulatory diseases, and mental illnesses (Health Canada, 2003). The advantages of using administrative data to ameliorate population health include the ability to assess the entire population of interest, longitudinal tracking, and linking various data sources to increase their utility and study various health outcomes (Blais et al., 2014).

The use of administrative data sources to assist in surveillance is gaining acceptance, especially given the success in the area of diabetes (Public Health Agency of Canada, 2008; Saydah et al., 2004). The Public Health Agency of Canada is working on mental health surveillance at the national level (PHAC, 2015) while interest continues to grow at the provincial level (Kisely et al., 2009, Marrie et al., 2013). A recent interprovincial report demonstrates the feasibility of obtaining mental health utilization data from participating provinces and comparing them in a standardized manner (Butler et al., 2017).

In 2017, the British Columbia (BC) Ministry of Health (MoH) requested that we at the Centre for Applied Research in Mental Health and Addiction (CARMHA) examine the feasibility of developing a standardized method of defining mental illnesses using administrative data to perform surveillance of mental and substance use (MSU) disorders on an ongoing basis and track service utilization patterns provincewide. This work is part of a multiphase project sponsored by the BC MoH entitled "Needs-Based Planning of Mental Health and Substance Use Disorders in British Columbia." Phase 1 of this work ("*Estimated Prevalence and Distribution of Select DSM-5 Mental and Substance Use Disorders in BC*") involved generating age-, gender-, and severity-specific annual population-level prevalence estimates for 11 Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) MSU disorder groups within the adult population of BC (age ≥15 years). In Phase 1 of this project, a Provincial Working Group (PWG) was created to support the analysis of

health administrative data by producing algorithms and analytic frameworks for the disorder groups of interest. The PWG membership included representation from all six health authorities. The terms of reference for this group was as follows:

> "The Provincial Working Group (PWG) provided the technical skills and expertise relating to the use of administrative data for the *Estimated Prevalence and Distribution of Selected DSM-5 Mental Disorders and Substance Use Disorder Groups in BC* study."

The PWG began the foundational work in this area during Phase 1. The MoH requested continued exploration of the use of provincial health administrative data for surveillance purposes and built on the efforts of the Phase 1 PWG. As such, the PWG was reformed as the Provincial Data Advisory Committee (PDAC) to continue the work in Phase 2. Two additional DSM-5 disorder groups were added in Phase 2 (i.e., stimulant-related disorders and personality disorders) for a total of 13 DSM-5 disorder groups. Of note, cannabis-, opioid-, and stimulant-related disorders were combined into a single substance use disorder group owing to limitations in the administrative data. Therefore, the continuation of this work yielded 11 MSU disorder group-specific algorithms.

ROLE OF THE PROVINCIAL DATA ADVISORY COMMITTEE IN THE OVERALL PROJECT

As part of the broader Needs-Based Planning Project (NBP), the PDAC sits under an Advisory Committee comprising the sponsoring organization (i.e., the MoH) as well as the project leadership from both CARMHA and co-investigators at the BC Centre for Disease Control (BCCDC). The PDAC oversaw the work of the Research Team, who were responsible for coordinating and executing the two different "working arms" of the project. First, the Service Planning Advisory Committee (SPAC) supported and oversaw efforts to size the ideal suites of services through the Research Team's facilitation of 13 disorder-specific expert panels. Second, the PDAC supported and oversaw efforts to establish case

definitions for the MSU disorders using provincial administrative health data obtained through Population Data BC.

The PDAC comprises the project sponsor from the MoH, the Data Research Team as well as representatives from five health authorities and the Provincial Health Services Authority. A Data Research Team comprising members of the CARMHA Research Team and the BCCDC was created to analyze the administrative data from Population Data BC and present the findings to the PDAC for review and subsequent input to the final set of results.

PROJECT OBJECTIVES

The surveillance of MSU disorders is particularly challenging for several reasons. In contrast to physical illnesses, most mental disorders cannot be diagnosed on the basis of biomarkers or test results, which challenges the validity of a diagnosis. Furthermore, the duration and presentation of episodes vary among individuals (Pies, 2007), and overlapping symptoms between mental disorders can result in misdiagnosis (John & Sharma, 2009).

In addition, the "treatment gap," defined as the difference between the expected and treated prevalence of a disorder, is generally high and vary by MSU disorders (Kohn et al., 2004). Several factors contribute to the treatment gap in mental health care, including lack of mental health literacy (Katz et al., 1997), stigma (Parikh, Lin, & Lesage, 1997), barriers to accessing care (Priester et al., 2016), and lack of adequate resources for treatment (Rush, Tremblay, & Brown, 2019). Tracking MSU health service utilization patterns and understanding why they diverge from expected illness patterns will support the planning of health resources, policies, and programs for MSU disorders. Although no organization currently performs systematic surveillance of all MSU disorders in BC, there is a recognized need for a standardized approach to measure the treated prevalence of MSU disorders and track service utilization patterns in the province on an ongoing basis.

Thus, the overall purpose of this project is to examine the feasibility of establishing a standardized approach using administrative data to monitor the treated prevalence of MSU

disorders by comparing these results with the expected epidemiological distributions. Accordingly, this project aimed to develop and test algorithms that best reflect the expected epidemiological distributions of the MSU disorder groups generated in Phase 1 for adults (age ≥15 years) based on their strengths and weaknesses. The PDAC was created to achieve the following three objectives:

> **Objective I:** Develop a set of 13 disorder group-specific algorithms defining a prevalent case within the administrative data for a given disorder
>
> **Objective II:** Further refine these algorithms by developing a set of definitions for different levels of case severity for each disorder (e.g., "mild," "moderate," and "severe")
>
> **Objective III:** Depending on the success of the first two objectives, establish rates of comorbidity across the disorder for which valid case definitions and severity definitions can be defined.[1]

Specifically, PDAC members were responsible for the following:

1. Reviewing results and providing input for the development of case definitions for a set of 13 DSM-5 MSU disorder groups using provincial health administrative data.
2. Providing input for analyses of the use of PharmaNet data to support the development of case definitions by severity level for the 13 DSM-5 MSU disorder groups.
3. Contributing technical advice to the Data Research Team as required.

[1] This objective would also support the work of the broader Needs-Based Planning Project in terms of feeding into a larger analysis of comorbidity, which is required to adjust the sizing of the suites of services.

To our knowledge, this project is the first to develop case definitions for 13 major MSU disorder groups, refine these definitions to distinguish severity levels within each disorder group, and conduct comorbidity analysis using these case definitions. The findings reported herein are the result of an extensive consultation and engagement process involving a province-wide collaboration of experts.

In addition, this report presents the methodologies and results for each of the three objectives above in separate chapters: Objective I: Disorder-Specific Case Algorithms, Objective II: Disorder-Specific Severity Algorithms, and Objective III: Comorbidity Analysis.

METHODOLOGY

MENTAL AND SUBSTANCE USE DISORDERS FEATURED IN THE REPORT

The 11 DSM-5 MSU disorder groups (from the original 13 groups) included in this project are as follows:

1. Depressive disorders
2. Anxiety disorders
3. Alcohol-related disorders
4. Schizophrenia spectrum disorders
5. Bipolar disorder and related disorders
6. Attention-deficit/hyperactivity disorder
7. Eating disorders
8. Intellectual disabilities
9. Neurocognitive disorders
10. Personality disorders
11. Substance-related disorders (includes cannabis-, opioid-, and stimulant-related disorders)

DATA SOURCES AND PROCEDURES

POPULATION DATA

Population estimates for the province of BC were obtained from the PEOPLE 2016[2] population estimates from BC Statistics as these were used in Phase 1 of the project. The epidemiological (i.e., expected) prevalence and distribution (by age and gender) of each disorder group for the BC adult population (age ≥15 years) from Phase 1 were also included in the analyses.

INITIAL DATASET

The administrative data used for the analysis in this report were obtained from Population Data BC[3] for Fiscal Years (FY) 2012/13 through 2015/16. Population Data BC provides deidentified computerized health records on BC's 4.7 million residents. Data were stored and accessed through Population Data BC's Secure Research Environment. Data files and years of data provided by Population Data BC are presented in Table 1.

Province-wide datasets were included to capture treated prevalence across BC. The Medical Services Plan (MSP) billing records included all fee-for-service claims paid to physicians and psychiatrists. The Discharge Abstract Database (DAD) included all hospital inpatient and day surgery discharges in the province. The PharmaNet database included all prescribed medication dispensed in community pharmacies. Finally, the Consolidated File

[2] See https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-projections.

[3] See https://www.popdata.bc.ca/

was used to gather demographic information on individuals included in the study, such as age, gender, geocodes, and registration data.

While the Minimum Reporting Requirement (MRR) dataset provides administrative data on mental health services received in the community by each Health Authority, it was not made available at the time of this project as further review by the MoH was required.

Table 1 Data Files and Years of Data Requested

Data File	Date of Data Requested
Medical Services Plan Payment Information (MSP) file	2012/04/01 to 2016/03/31
Discharge Abstract Database (DAD)	2012/04/01 to 2016/03/31
Consolidated File	2012/04/01 to 2016/03/31
PharmaNet MedHist	2012/04/01 to 2016/03/31

The initial datasets were based on the following data pull description:

> *The population of interest includes any individual (all sex and all ages) who received either hospital or physician services in the province of British Columbia , who was given a diagnosis of mental illness or substance abuse during the fiscal years 2012/13 to 2015/16 inclusive; this population should include anyone with the following codes in either Medical Service Plan (MSP) database or Discharge Abstracts Database (DAD):*
>
> - *ICD-9 Chapter V codes 290–319 inclusive;*
> - *MSP supplemental codes 50B or 04A*
> - *ICD-10 Chapter V codes F00* to *F99 inclusive.*

Finally, all of the above individuals must have been registered in MSP for at least one day within the outlined timeframe of interest.[4]"

The following data were supplied for this cohort :

- all MSP claims (based on service date) within the outlined timeframe;
- all hospital discharge diagnoses (based on discharge date) within the outlined timeframe;
- all prescriptions filled via PharmaNet data (for any drug) within the outlined timeframe; and
- demographic data (e.g., month and year of birth, gender, health service delivery area, health authority, etc.).

DATA CLEANING – INCLUSION AND EXCLUSION CRITERIA

For the data abstraction process, individuals were deidentified and given a unique identity number ("StudyID"). The cohort initially consisted of 1,697,266 unique StudyIDs. Among these StudyIDs, 200 were identified as having an unknown gender. Given that these individuals represented only 0.01% of the study cohort, their records were excluded from all further analyses. Moreover, three StudyIDs were determined to be service programs (i.e., not individuals) submitting data through MSP during the study period (two of which were also identified as having an unknown gender) and were excluded from all further analyses. In addition, a small proportion of individuals (0.58%, 0.62%, 0.04%, and 0.05% in FY 2012/13, 2013/14, 2014/15, and 2015/16, respectively) were missing health service

[4] As described in *Vigo 17-137_Cohort Development_2018 01 16.pdf* sent to CARMHA on 2018-17-01 from Population Data BC. This document also outlines the procedure to be used to abstract the data.

delivery area and health authority identification. The PDAC decided to include these individuals in the study cohort as their inclusion would not impact health authority-specific analysis. Thus, the final study cohort comprised 1,697,065 StudyIDs.

All included StudyIDs had a valid date of birth by month and year, ranging from December 1900 to March 2016. As the day of birth was not supplied as part of the deidentification process, a default date of the 15th of the month was set as the date of birth for all StudyIDs.

DATA CODING ISSUES

ICD-9 CODING OF DIGITS AFTER DECIMAL

Hospital records use ICD-10 codes validated by the Canadian Institute for Health Information (CIHI) and contain, where appropriate, a digit after the decimal. In contrast, MSP claims using ICD-9 codes are not validated, and there is no requirement for MSP diagnostic codes to include an entry after the decimal. Therefore, most MSP claims in BC are missing digits after the decimal level, reducing specificity for certain disorders. Accordingly, case definitions were coded at the three-digit level for ICD-9 codes and the full-digit level for hospital ICD-10 codes. An exception was made for neurocognitive disorders (NCDs) due to traumatic brain injury or medication for which ICD-9 codes were narrowed to the decimal level. See *Neurocognitive Disorders* for more details.

USE OF SUPPLEMENTAL DIAGNOSTIC CODE 50B

Another challenge arose from the existence of the supplemental ICD-9 diagnostic code "50B" ("Anxiety/Depression"). This code can be applied for the diagnosis of either anxiety or depressive disorders or both, which made it difficult to determine disorder-specific algorithms as both anxiety and depression are considered separate disorders. The PWG made extensive efforts to address this issue and proposed the following solution:

- A series of claims with “311” and “50B” would count as a depression case.
- A series of claims with “300” and “50B” would count as an anxiety case.
- A series of claims with only “50B” would count as an anxiety case.

Data supporting this recommendation are presented in Jones & Su (2016). In addition, review of how some BC physician billing guidelines describe the diagnostic codes for depression and anxiety supported this approach.[5] The PDAC accepted this solution and recommended its implementation on the condition that 50B remained a supplemental code.

EXPECTED PREVALENCE ESTIMATES

The age- and gender-specific epidemiological prevalence (“expected prevalence” hereafter) reported herein for comparison were derived for each of the 13 disorder groups during Phase 1 of this project (see Vigo et al., 2019). For each disorder group, methodological triangulation was used to collate and average the age- and gender-specific prevalence obtained from various data sources to create a single distribution curve for each disorder group. The sources for age- and gender-specific prevalence included the CCHS-2012 Mental Health Supplement or any other national-level surveys, any age- and/or gender-specific prevalence estimates that had been identified through the systematic literature review in Phase 1, and any previously published administrative data.

For each disorder group, the estimated median prevalence at each age was determined on the basis of the available data, and the overall distribution curves were smoothed using the

[5] Documented in the minutes of the Provincial Working Group Meeting on 2016-21-09. Available from CARMHA by request.

Locally Weighted Smoothing (LOESS) function in the core R package.[6] These smoothed prevalence curves were then adjusted in magnitude to meet the estimated overall annual prevalence obtained from the meta-analysis (Vigo et al., 2019).

While the triangulation of data created a merged set of age- and gender-specific prevalence, it affected the age- and gender-specific estimates for some disorder groups at certain ages. The age- and gender-specific prevalence estimates for older age groups were particularly affected, because missing data in the oldest age groups in one data source resulted in estimates based on more limited data for that age group. Consequently, the increase in the expected prevalence for older adults for eating disorders and intellectual disabilities was influenced by this methodological process.

[6] R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

DESCRIPTIVE DATA STATISTICS

DEMOGRAPHICS

The study cohort of 1,697,065 individuals with a diagnosis of an MSU disorder during fiscal years (FY) 2012/13 to 2015/16 inclusive included 973,325 (57%) females and 723,740 (43%) males.

Table 2 presents the age and gender distribution of the study cohort at the end of FY 2015/16 (i.e., March 31st, 2016). The age groups ranged from 0–4 to >90 years, with most individuals falling within the 25–29 years to 65–69 years age groups. The gender distribution across age groups was similar.

Table 3 presents the age distribution of the study cohort compared to the BC PEOPLE 2016 population. The age distribution between the individuals who utilized MSU services and the overall population in BC was comparable, particularly among those aged 20–84 years. MSU service utilization was lowest among the youngest age groups and highest among the older age groups. Figure 1 illustrates the overlap between the study cohort and the overall BC population.

Table 2 Age and Gender Distribution of the Study Cohort

	n		%	
Age Group	**Female**	**Male**	**Female**	**Male**
0–4	7,369	11,335	1%	2%
5–9	15,114	26,635	2%	4%
10–14	18,926	27,962	2%	4%
15–19	37,818	31,775	4%	4%
20–24	53,958	42,068	6%	6%
25–29	63,818	43,818	7%	6%
30–34	74,780	48,173	8%	7%
35–39	72,835	47,699	7%	7%
40–44	71,804	48,381	7%	7%
45–49	76,757	53,721	8%	7%

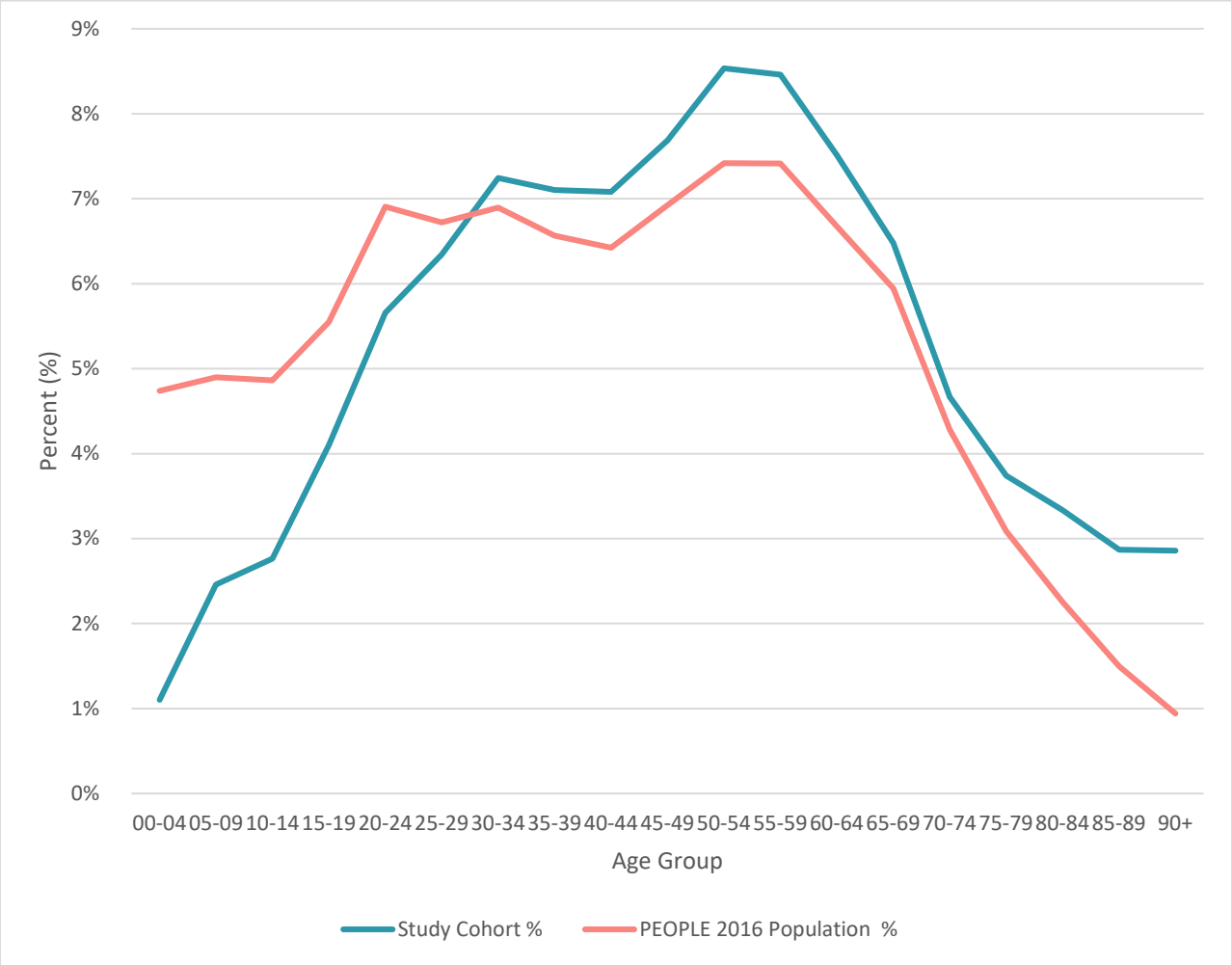
	n		%	
Age Group	**Female**	**Male**	**Female**	**Male**
50–54	84,677	60,166	9%	8%
55–59	84,196	59,378	9%	8%
60–64	73,907	53,589	8%	7%
65–69	62,829	47,107	6%	7%
70–74	44,860	34,317	5%	5%
75–79	36,104	27,358	4%	4%
80–84	31,995	24,612	3%	3%
85–89	28,714	19,975	3%	3%
≥90	32,864	15,671	3%	2%
Total	973,325	723,740	100%	100%

Table 3 Age Distribution of the Study Cohort and the PEOPLE 2016 Estimate for the 2016 BC Population

	Study Cohort		PEOPLE 2016 Population	
Age Group	*n*	%	*n*	%
0–4	18,704	1%	224,709	5%
5–9	41,749	2%	232,177	5%
10–14	46,888	3%	230,502	5%
15–19	69,593	4%	263,011	6%
20–24	96,026	6%	327,416	7%
25–29	107,636	6%	318,645	7%
30–34	122,953	7%	326,799	7%
35–39	120,534	7%	311,276	7%
40–44	120,185	7%	304,459	6%
45–49	130,478	8%	328,223	7%
50–54	144,843	9%	351,646	7%
55–59	143,574	8%	351,460	7%
60–64	127,496	8%	316,413	7%
65–69	109,936	6%	281,778	6%
70–74	79,177	5%	203,001	4%
75–79	63,462	4%	146,412	3%
80–84	56,607	3%	106,733	2%
85–89	48,689	3%	70,872	1%
≥90	48,535	3%	44,592	1%

Total	1,697,065	100%	4,740,124	100%

Figure 1 Age Distribution between the Study Cohort and the PEOPLE 2016 Estimate for the 2016 BC Population



HOSPITAL AND MSP CLAIMS

Table 4 presents various details of hospital counts during the study period. Almost half (45.6%) of the study cohort had at least one hospital claim for any diagnosis (including non-MSU diagnoses) during the study period. For psychiatric diagnoses, 4.3% of individuals had at least one hospital claim with an MSU diagnosis being most responsible for that claim. The CIHI defines the "most responsible diagnosis as the "diagnosis or condition that can be described as being the most responsible for the patient's stay in a facility" (CIHI, 2019). Nearly twice as many individuals (7.2%) received a secondary diagnosis for an MSU disorder [i.e., "a secondary diagnosis or condition for which a patient may or may not have received treatment, has been assigned an ICD-10-CA code and does not satisfy the requirement for determining comorbidity" (CIHI, 2019)]. Among the 7.2% of individuals with a secondary MSU diagnosis, 4.5% never had a hospital claim for the MSU disorder being the most responsible diagnosis, implying that 2.7% of individuals had both most responsible and secondary hospital claims for MSU disorders during the study period. Only 0.87% of the study cohort had only a secondary MSU hospital diagnosis.

Table 4 Hospital Claims in BC between FY 2012/13 and 2015/16

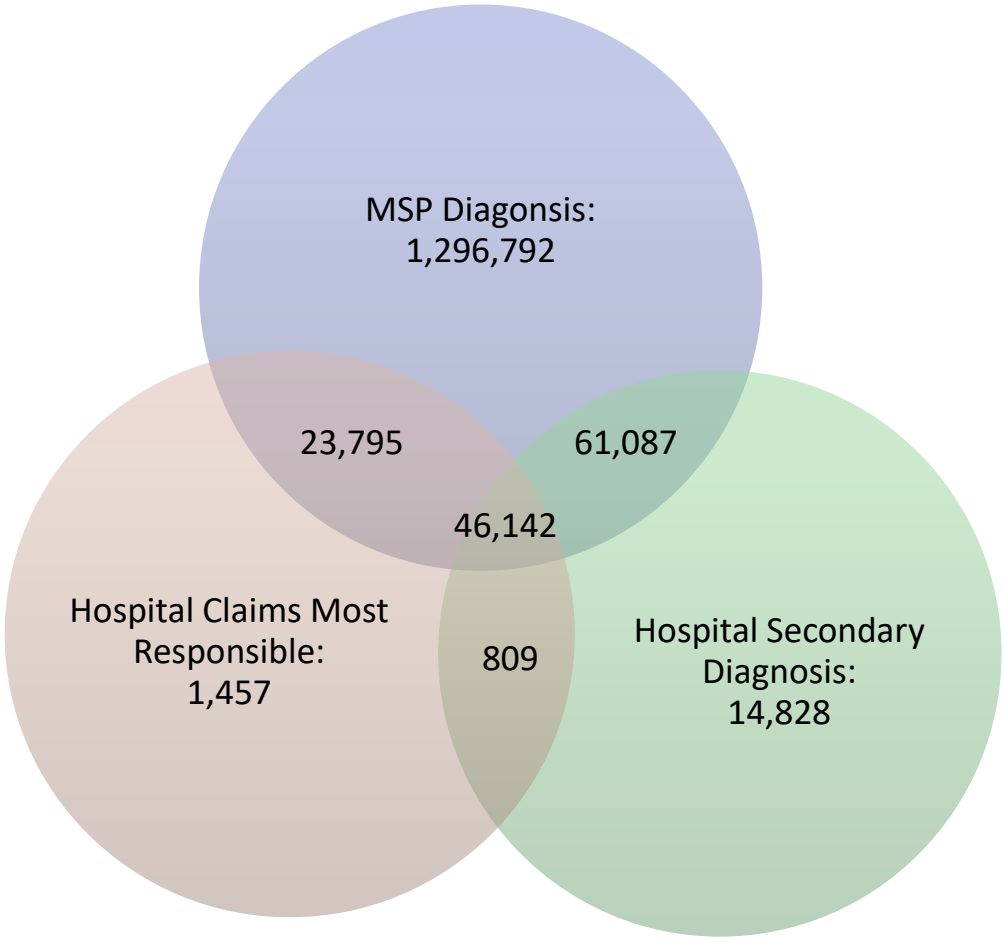
Hospital Claim	*n*	%
Individuals with at least one hospital contact during the study period	773,730	45.6%
Individuals with at least one hospital contact during the study period with an MSU disorder as a most responsible diagnosis	72,203	4.3%
Individuals with at least one hospital contact during the study period where a secondary diagnosis was psychiatric	122,866	7.2%
Individuals with at least one hospital contact during the study period where a secondary diagnosis was psychiatric but without a hospitalization with a most responsible diagnosis being psychiatric	75,915	4.5%
Individuals with ***only*** a secondary psychiatric diagnosis in hospital data (i.e., no most responsible psychiatric diagnosis in hospital data or MSP psychiatric diagnosis)	14,828	0.87%

Table 5 presents details on the MSP claims during the study period. Except for 356 cases, all individuals in the study cohort had at least one MSP claim during the study period . Among them, 84% had at least one MSP claim for an MSU disorder. Figure 2 illustrates the relationships between the different types of MSU disorder claims during the study period.

Table 5 MSP Claims between FY 2012/13 and 2015/16

MSP Claim	*n*	%
Individuals with at least one MSP claim during the study period	1,696,709	100.0%
Individuals without an MSP claim during the study period	356	0.0%
Individuals with at least one MSP claim during the study period with a psychiatric diagnosis	1,427,816	84.1%

Figure 2 MSP and Hospital Claims for MSU Diagnoses between FY 2012/13 and 2015/16



OBJECTIVE I: DISORDER-SPECIFIC CASE ALGORITHMS

As mentioned above, this project aimed to develop a set of 13 MSU disorder group-specific algorithms (collapsed into 11 groups herein) defining a case within the administrative data for a given disorder.

METHODOLOGY

The administrative case definitions were built on the work done by the PWG in Phase 1. The PWG thought it beneficial to start each case algorithm analysis with a "baseline definition" for estimating yearly prevalence. Specifically, this included any StudyIDs with one hospital discharge with the disorder-specific code(s) or a single MSP claim with a disorder-specific code(s) that corresponded to the disorder groups of interest. This yielded the maximum number of cases that could be ascertained from the administrative data. Although hospital records were expected to be accurate, a single MSP claim within one year was thought to potentially capture false-positives. Specifically, one visit might be insufficient to adequately diagnose a disorder and that subsequent visits might corroborate a diagnosis. Therefore, a case was defined as having at least one hospital discharge claim or two MSP claims.

The PWG developed the case definitions used to identify individuals with disorders in each disorder group of interest. These definitions were used as a starting point for a refined algorithm to capture the treated prevalence of a given disorder group.

Thus, to qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- at least one hospital discharge with a diagnosis (according to disorder-specific ICD-10 coding) in any diagnostic position, or
- at least two MSP claims within 365 days.

If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year. The following two-step rule was used to assign a case to a given fiscal year in the absence of a hospital discharge record:

- Step 1: If the individual had two or more MSP claims for the same diagnosis within a given fiscal year (e.g., April 1st, 2014 to March 31st, 2015), they were counted as a case for that fiscal year (i.e., FY 2014/15); if so, there was no need to proceed to Step 2.
- Step 2: If the individual only had one MSP claim for a certain diagnosis within a given fiscal year (e.g., on June 1st, 2014), then the previous fiscal year was searched for another MSP claim for the same diagnosis that fell within 365 days of the first claim. If one such case was found within 365 days of June 1st, 2014 (e.g., August 1st, 2013), the individual was counted as a case for FY 2014/15 because the June 1st, 2014 MSP claim belongs to FY 2014/15.

This case definition was adjusted for a specific disorder group on the basis of alternative case definitions depending on the nature of the disorder-related codes and observed utilization patterns. For case definitions that captured considerably more cases than the expected number of cases, a more restrictive case definition was tested.

Table 6 presents the complete list of ICD-9 and ICD-10 codes used herein. Both the broader baseline definition and the more conservative case definition were compared to determine which better identified MSU disorder cases in the population. For each disorder group, the expected age and gender distributions were obtained from the Phase 1 epidemiological results and compared to the distributions of both the baseline definition (i.e., at least one hospital discharge or one MSP claim) and case definition (i.e., at least one hospital discharge or two MSP claims) for adults (age ≥15 years).

Table 6 ICD-9 and ICD-10 Codes Used in This Report

Disorder Group	ICD-10 Code (Hospital Discharge Data)		ICD-9 Code (MSP Claims)	
Depressive disorders	F32	Depressive episode	311	Depressive disorder, not elsewhere Classified
	F33	Recurrent depressive disorder	50B	Anxiety/depression (311 required too)
	F34.1	Dysthymia		
Anxiety disorders	F40	Phobic anxiety disorders	300	Neurotic disorders
	F41	Other anxiety disorders	50B	Anxiety/depression
Alcohol-related disorders	F10	Mental and behavioural disorders due to use of alcohol	291	Alcoholic psychoses
			303	Alcohol dependence syndrome
Opioid-related disorders	F11	Mental and behavioural disorders due to use of opioids	292	Drug psychoses
			304	Drug dependence
			305	Nondependent abuse of drugs
Cannabis-related disorders	F12	Mental and behavioural disorders due to use of cannabinoids	292	Drug psychoses
			304	Drug dependence
			305	Nondependent abuse of drugs
Stimulant-related disorders	F14	Mental and behavioural disorders due to use of cocaine	292	Drug psychoses
	F15	Mental and behavioural disorders due to use of other stimulants, including caffeine	304	Drug dependence
			305	Nondependent abuse of drugs
Schizophrenia spectrum and other psychotic disorders	F20	Schizophrenia	295	Schizophrenic psychoses
	F21	Schizotypal disorder	297	Paranoid states
	F22	Persistent delusional disorders	298	Other nonorganic psychoses
	F23	Acute and transient psychotic disorders		
	F24	Induced delusional disorder		
	F25	Schizoaffective disorders		
	F28	Other nonorganic psychotic disorders		
	F29	Unspecified nonorganic psychosis		

Bipolar and related disorders	F30	Manic episode	296	Affective psychoses
	F31	Bipolar affective disorder		
	F34	Persistent mood [affective] disorders (not F34.1)		
	F38	Other mood [affective] disorders		
	F39	Unspecified mood [affective] disorder		
ADHD	F90	Hyperkinetic disorders	314	Hyperkinetic syndrome of childhood
Eating disorders	F50	Eating disorders	307.1	Anorexia nervosa
			307.5	Other and unspecified disorders of eating
Intellectual disabilities	F70	Mild mental retardation	317	Mild mental retardation
	F71	Moderate mental retardation	318	Other specified mental retardation
	F72	Severe mental retardation	319	Unspecified mental retardation
	F73	Profound mental retardation		
	F78	Other mental retardation		
	F79	Unspecified mental retardation		
Neurocognitive disorders	F01	Vascular dementia	290	Senile and presenile organic psychotic conditions
	F03	Unspecified dementia	293	Transient organic psychotic conditions
	F04	Organic amnesic syndrome, not induced by alcohol and other psychoactive substances	294	Other organic psychotic conditions (chronic)
	F05	Delirium, not induced by alcohol and other psychoactive substances		
	F06	Other mental disorders due to brain damage and dysfunction and to physical disease		
	F09	Unspecified organic or symptomatic mental disorder		
Personality disorders	F60	Specific personality disorders	301	Personality disorders
	F61	Mixed and other personality disorders		
	F62	Enduring personality changes, not attributable to brain damage and disease		

RESULTS

This report presents the results for each of the 11 MSU disorder groups in their respective sections below. Each section presents the Phase 1 epidemiological results, the baseline and case definitions as defined by ICD-9 and ICD-10 codes, and a comparison of the baseline and case definition results with the epidemiological results followed by a brief discussion.

DEPRESSIVE DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 estimate included separate measures for dysthymia and major depressive disorder (MDD) as well as a combined measure of dysthymia and MDD ("MDDplus"). Here, MDDplus was used for comparison owing to its concordance with the definition of ICD-9 code 311 covering both MDD and dysthymia. Phase 1 epidemiological results for depressive disorders in adults (aged ≥15 years) are presented in Table 7.

Table 7 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – All Depressive Disorders (MDDplus)

	Female	Male
Age Group	MDDplus	MDDplus
15–19	9.9	6.3
20–24	9.6	6.3
25–29	9.3	6.2
30–34	9.0	6.1
35–39	8.6	5.9
40–44	8.3	5.7
45–49	7.8	5.4
50–54	7.3	5.1
55–59	6.6	4.6
60–64	5.9	4.1
65–69	5.6	3.8
70–74	5.4	3.6
75–79	5.3	3.6
80–84	5.4	3.7
85–89	5.5	3.9
≥90	5.8	4.2

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline depressive disorder if they met the following requirements:

- at least one MSP claim with an ICD-9 diagnostic code of 311; or
- at least one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F32, F33, or F34.1.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge (ICD-10 F32, F33, or F34.1) in any diagnostic position; or
- an initial MSP claim with a 311 diagnosis and a second MSP claim with a 311 diagnosis or a 50B diagnosis within 365 days of the date of the initial claim; or
- an initial MSP claim with a 50B diagnosis and a second MSP claim with a 311 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 8.

Table 8 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Depressive Disorders

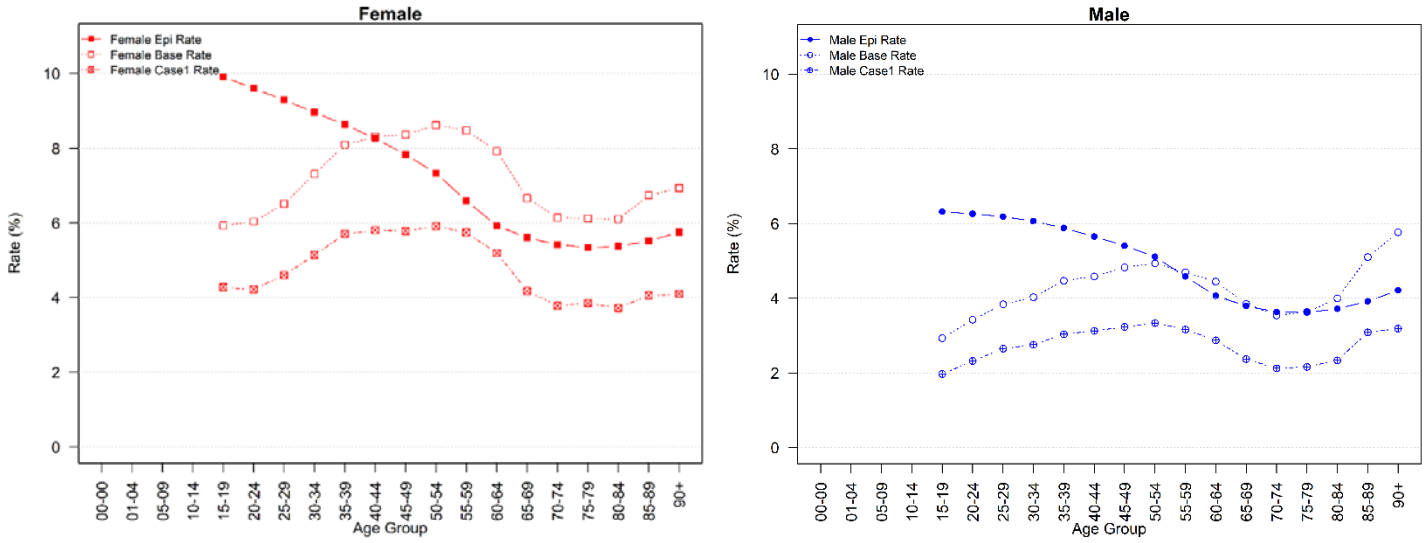
Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1
5–9	0.2	0.2	0.1	0.1	0.3	0.3	0.2	0.2
10–14	1.6	1.8	1.7	1.7	0.9	0.9	0.8	0.8
15–19	5.6	5.9	5.8	5.9	2.9	3.0	2.9	2.9
20–24	6.3	6.3	5.9	6.0	3.6	3.5	3.5	3.4
25–29	7.3	7.2	6.6	6.5	4.0	3.9	3.8	3.8
30–34	8.7	8.3	7.6	7.3	4.6	4.4	4.2	4.0
35–39	9.4	9.1	8.5	8.1	4.9	4.8	4.5	4.5
40–44	9.5	9.3	8.7	8.3	5.2	5.0	4.9	4.6
45–49	9.7	9.4	8.8	8.4	5.4	5.2	5.0	4.8
50–54	9.9	9.7	9.2	8.6	5.4	5.4	5.2	4.9
55–59	9.9	9.5	9.2	8.5	5.2	5.1	4.9	4.7
60–64	8.7	8.6	8.4	7.9	4.8	4.8	4.6	4.4
65–69	7.4	7.3	7.1	6.7	4.1	4.0	4.0	3.8
70–74	6.6	6.7	6.5	6.1	3.8	3.7	3.7	3.5
75–79	6.6	6.7	6.5	6.1	4.1	4.0	3.7	3.6
80–84	7.3	7.0	6.6	6.1	4.7	4.5	4.3	4.0
85–89	8.0	7.6	7.4	6.7	6.0	5.5	5.3	5.1
≥90	8.0	7.8	7.6	6.9	6.6	6.3	5.8	5.8
Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
10–14	0.9	1.2	1.1	1.1	0.4	0.5	0.4	0.4
15–19	3.6	4.2	4.1	4.3	1.7	1.9	1.9	2.0
20–24	3.9	4.3	4.2	4.2	2.2	2.4	2.4	2.3
25–29	4.5	5.0	4.7	4.6	2.4	2.6	2.6	2.6
30–34	5.5	5.8	5.4	5.1	2.8	3.0	2.8	2.8
35–39	6.0	6.4	6.0	5.7	3.0	3.3	3.1	3.0
40–44	6.0	6.5	6.1	5.8	3.2	3.4	3.4	3.1

45–49	6.1	6.6	6.1	5.8	3.3	3.6	3.3	3.2
50–54	6.1	6.6	6.3	5.9	3.3	3.6	3.4	3.3
55–59	5.9	6.4	6.2	5.7	3.0	3.4	3.3	3.2
60–64	5.0	5.6	5.5	5.2	2.8	3.1	2.9	2.9
65–69	4.1	4.5	4.4	4.2	2.2	2.4	2.4	2.4
70–74	3.7	4.1	4.1	3.8	2.1	2.2	2.2	2.1
75–79	3.7	4.2	4.0	3.9	2.2	2.4	2.2	2.2
80–84	4.0	4.3	4.2	3.7	2.5	2.7	2.5	2.3
85–89	4.3	4.6	4.5	4.1	3.3	3.2	3.1	3.1
≥90	4.2	4.5	4.4	4.1	3.2	3.5	3.2	3.2

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 3 shows the age- and gender-specific prevalence based on the epidemiological data (i.e., MDDplus), baseline case definition, and initial case definition for the most recent FY 2015/16 in the study dataset. The prevalence in all three measures was slightly higher for females than males, but the age distribution patterns were similar for both genders. In addition, depressive disorders peaked in the middle age groups (age 40–64 years) and then again in older adults (age ≥80 years) for both males and females. The treated prevalence estimates using the baseline definition were higher than the expected prevalence in older adults, particularly in females, but lower in younger adults. Conversely, the treated prevalence with the initial case definition was consistently lower than the expected prevalence across all age groups.

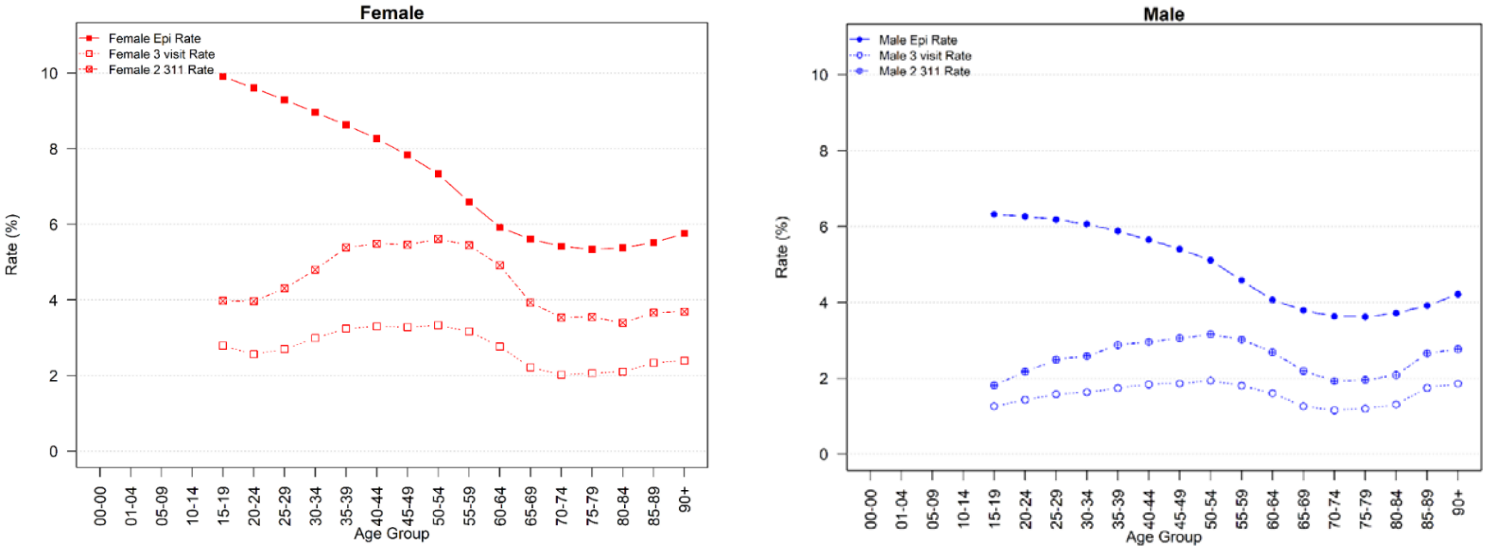
Figure 3 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Depressive Disorders



ALTERNATIVE CASE DEFINITIONS

More-conservative case definitions were tested by including individuals who had three MSP claims or one hospitalization within a given year (see Jones & Tallon, 2018a for details), which reduced the treated prevalence by approximately 40% compared to those with the initial case definition. Alternatively, the use of two 311 diagnoses instead of one 311 diagnosis plus one 50B diagnosis reduced the treated prevalence by 7% compared to that with the initial case definition. Thus, the initial case definition appears to be a better fit for depressive disorders as the alternative case definitions increased the discrepancy between the treated prevalence estimates and expected prevalence.

Figure 4 Prevalence based on Epidemiology and Administrative Alternative Case Definitions – Comparison for Depressive Disorders



DISCUSSION

Of the three definitions tested and compared with the expected prevalence, the initial case definition of two MSP claims or one hospital claim within a given year yielded the best measure of the treated prevalence of depression in the BC population.

The prevalence estimates based on both epidemiological and administrative data were consistently higher among females across all age groups. However, the curves for both genders exhibited similar patterns.

The expected prevalence gradually declined with increasing age until 80 years, after which it increased again. The treated prevalence estimates also gradually increased with age until 50 years, decreasing thereafter, and increasing again at the 80–84 year group. While the treated prevalence was lower than the expected prevalence estimates across all age groups, the discrepancy was substantial among the younger age groups. Kessler, Bennewith, Lewis, and Sharp (2002) report that only half of individuals with depression or anxiety received a diagnosis by general practitioners, and that the individuals who were followed-up to receive a diagnosis tended to be older. In addition, Gulliver, Griffiths, and Christensen

(2010) found that young individuals face several barriers when seeking professional help for mental disorders, including self-stigmatizing attitudes to mental disorders and fear of embarrassment, poor mental health literacy, and a preference for self-reliance rather than relying on professionals to manage their mental health issues (Gulliver et al., 2010).

CONCLUSION

The initial case definition provides a good measure of the treated prevalence of depressive disorders. However, it greatly underpredicts prevalence estimates in younger age groups. Therefore, the initial case definition could serve as an ongoing surveillance measure, particularly for middle-to-older age groups.

ANXIETY DISORDERS

EPIDEMIOLOGICAL RESULTS

Table 9 presents the overall estimates for anxiety disorders derived in Phase 1.

Table 9 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Any Anxiety Disorder

	Female	Male
Age Group	All	All
15–19	6.4	4.0
20–24	7.2	4.6
25–29	8.0	5.2
30–34	8.5	5.6
35–39	8.9	5.9
40–44	9.2	6.1
45–49	9.1	6.2
50–54	8.9	6.2
55–59	8.5	6.1
60–64	8.0	5.9
65–69	7.8	6.0
70–74	7.6	6.0
75–79	7.2	5.9
80–84	6.8	5.7
85–89	6.2	5.5
≥90	5.6	5.1

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline anxiety disorder if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnostic code of 300 or 50B, or

- at least one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F40 or F41.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge with an anxiety diagnosis (i.e., ICD-10 F40, F41) in any diagnostic position; or
- an initial MSP claim with a 300 or 50B diagnosis and a second MSP claim with a 300 diagnosis or a 50B diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender- specific prevalence distributions are presented in Table 10.

Table 10 Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Anxiety Disorders

Baseline Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.7
5–9	1.6	1.7	1.7	2.0	2.0	2.1	2.2	2.3
10–14	3.5	4.0	4.4	4.6	2.8	3.0	3.3	3.4
15–19	8.2	8.8	9.4	10.5	4.4	4.8	5.1	5.5
20–24	10.4	10.6	10.8	11.3	5.8	6.0	6.0	6.3
25–29	12.1	12.6	12.6	12.9	6.6	6.8	6.9	7.2
30–34	14.0	14.0	13.9	14.0	7.4	7.3	7.3	7.6
35–39	14.1	14.5	14.4	14.2	7.5	7.6	7.7	7.8
40–44	13.9	14.0	14.0	14.1	7.6	7.7	7.8	7.8
45–49	13.5	13.6	13.6	13.6	7.6	7.8	7.7	7.8
50–54	13.4	13.7	13.6	13.4	7.6	7.6	7.7	7.7
55–59	13.3	13.3	13.1	13.1	7.4	7.5	7.5	7.3
60–64	12.0	12.3	12.5	12.2	7.0	7.0	7.2	6.9
65–69	11.4	11.4	11.5	11.3	6.5	6.7	6.7	6.4
70–74	10.8	11.2	11.3	10.8	6.5	6.6	6.6	6.3

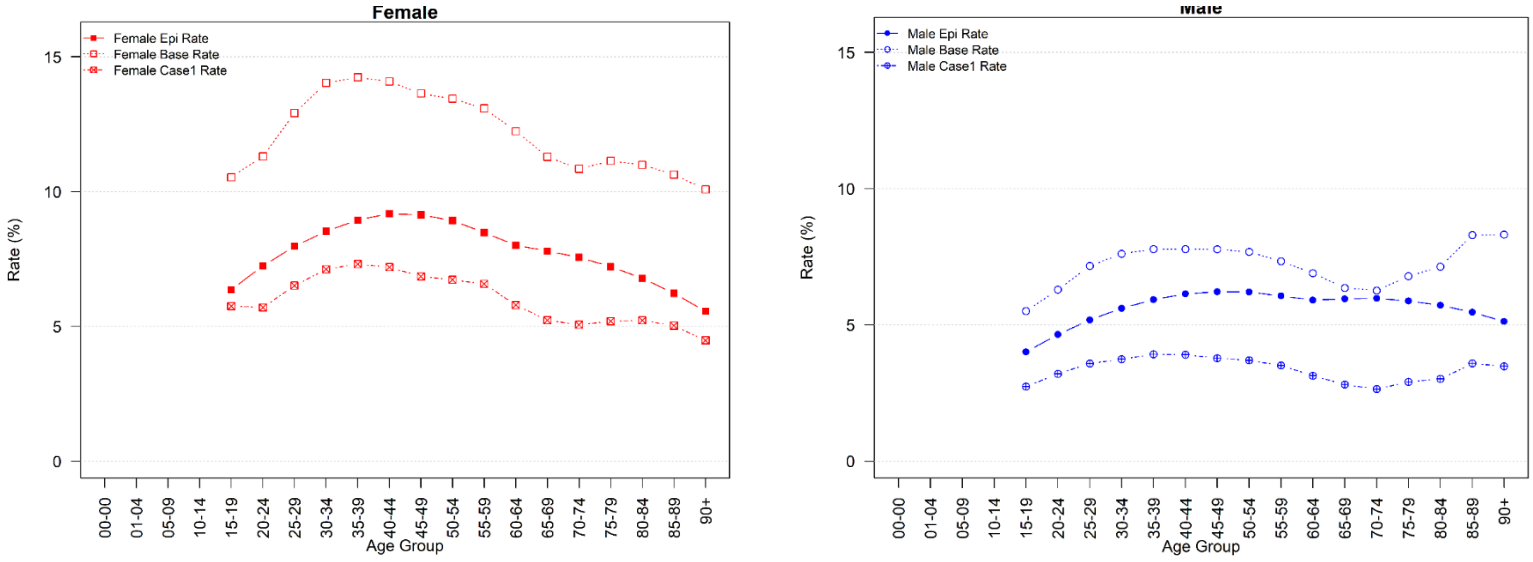
75–79	11.2	11.4	11.4	11.1	7.2	7.3	6.8	6.8
80–84	11.4	11.2	11.2	11.0	7.9	7.8	7.6	7.1
85–89	11.3	11.1	11.1	10.6	9.0	8.7	8.5	8.3
≥90	9.8	9.8	10.6	10.1	8.6	8.3	8.4	8.3
Initial Case Definition								
			Female				Male	
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
5–9	0.5	0.6	0.6	0.7	0.6	0.7	0.8	0.9
10–14	1.4	1.9	2.1	2.3	1.1	1.2	1.4	1.5
15–19	3.5	4.4	4.9	5.8	1.9	2.2	2.4	2.7
20–24	4.2	5.1	5.4	5.7	2.5	2.8	3.0	3.2
25–29	5.1	6.0	6.1	6.5	2.7	3.2	3.4	3.6
30–34	5.9	6.9	6.8	7.1	3.1	3.5	3.6	3.7
35–39	6.0	7.1	7.2	7.3	3.2	3.7	3.8	3.9
40–44	5.9	7.0	7.1	7.2	3.3	3.7	3.8	3.9
45–49	5.9	6.7	6.8	6.9	3.2	3.8	3.7	3.8
50–54	5.7	6.7	6.7	6.7	3.1	3.6	3.7	3.7
55–59	5.6	6.4	6.5	6.6	3.1	3.5	3.6	3.5
60–64	4.8	5.8	6.0	5.8	2.7	3.2	3.3	3.1
65–69	4.4	5.2	5.2	5.2	2.3	2.8	2.8	2.8
70–74	4.3	5.0	5.2	5.1	2.3	2.7	2.8	2.6
75–79	4.6	5.3	5.3	5.2	2.5	3.0	2.8	2.9
80–84	4.7	5.2	5.3	5.2	3.0	3.3	3.2	3.0
85–89	4.5	5.1	5.3	5.0	3.4	3.8	3.8	3.6
≥90	3.7	4.3	4.5	4.5	3.1	3.2	3.7	3.5

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 5 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for FY 2015/16 in the study dataset. Prevalence estimates for females were higher than males for all three measures. The treated prevalence estimates based on the baseline definition were higher than the expected prevalence across all age groups, while those based on the case

definition were consistently lower than the expected prevalence across all age groups and exhibited the same patterns as those with the baseline definition.

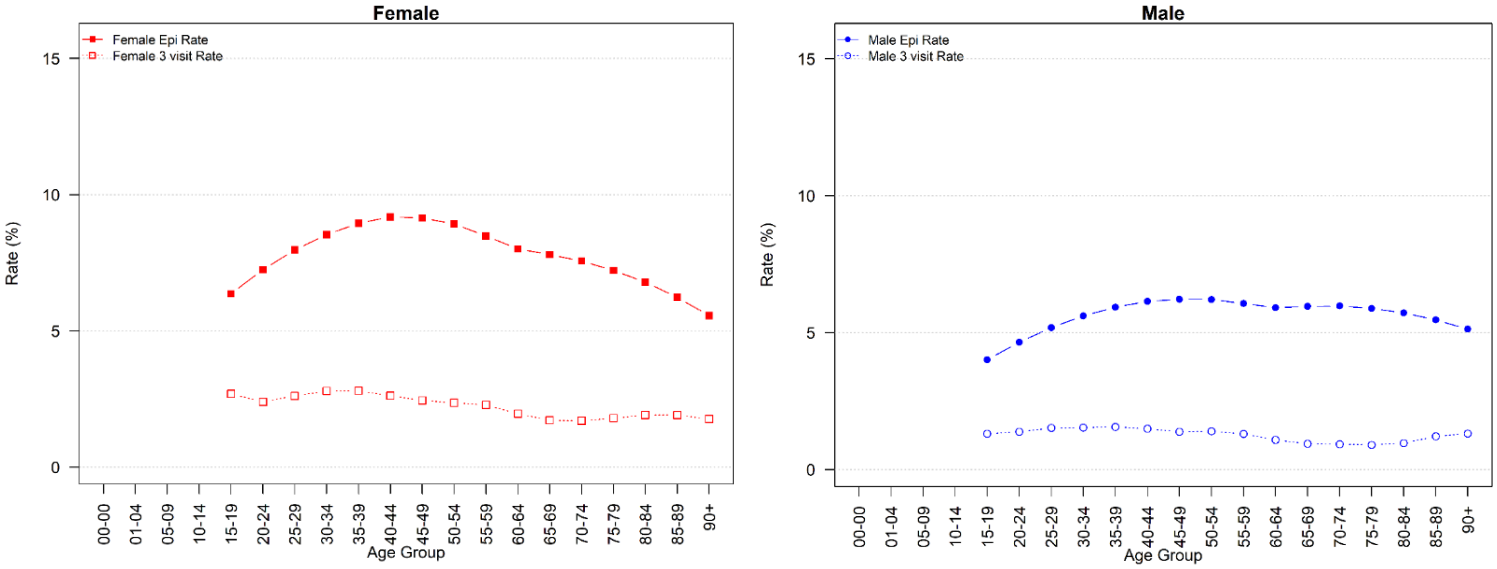
Figure 5 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Anxiety Disorders



ALTERNATIVE CASE DEFINITION

Applying a more-conservative case definition—three MSP claims or one hospitalization within a year—approximately halved the prevalence estimates compared to the initial case definition (see Jones, 2019a for details). Therefore, the initial case definition appears to be a better fit for anxiety disorders, because the more restrictive definition increased the discrepancy relative to the expected prevalence.

Figure 6 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Anxiety Disorders



DISCUSSION

The initial case definition provided a better measure of the treated population for anxiety disorders in BC than the baseline or alternative case definition. Although the prevalence estimates based on the initial case definition were consistently lower than the expected prevalence, the difference was similar across age groups. The baseline definition substantially overpredicted prevalence estimates compared to the expected prevalence, primarily in females. One possibility is that one MSP claim within a one-year period might have captured false-positives. Therefore, two MSP claims provide a more valid measure of anxiety disorders in this population.

For all three measures, prevalence estimates for females were consistently higher than those for males. This pattern is consistent with the general observation that mood and anxiety disorders appear to be more common in females than males in both administrative data (O'Donnell et al., 2016) and epidemiological studies (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012; McEvoy, Grove, & Slade, 2011).

Although the overall prevalence estimates were higher in females, the patterns across age groups were similar in both genders. The prevalence estimates based on both case definition and epidemiological data increased steadily with age until age 40–44, gradually declining thereafter. Only the treated prevalence based on administrative data increased slightly in the older age groups (i.e., age ≥75 years).

The gap between the epidemiological- and case definition-based prevalence estimates was slightly greater in males than females, mainly between age 65–79 years. This is consistent with previous studies indicating that older women with anxiety disorders are more likely to seek treatment than older men with anxiety disorders (Mackenzie, Reynolds, Cairney, Streiner, & Sareen, 2012; Andrews, Henderson, & Hall, 2001).

CONCLUSION

Using the initial case definition yields treated prevalence and patterns closest to the epidemiological data. As expected, the treated prevalence estimates were consistently lower than the expected prevalence. The gap was similar for both genders and across all age groups, with the greatest disparity in males aged 65–79 years. Thus, the initial case definition could serve as an ongoing surveillance measure.

SCHIZOPHRENIA SPECTRUM DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for schizophrenia spectrum disorders are presented in Table 11.

Table 11 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Schizophrenia Spectrum Disorders

	Female	Male
Age Group	All	All
15–19	0.4	0.4
20–24	0.6	0.6
25–29	0.7	0.8
30–34	0.8	0.9
35–39	0.8	0.9
40–44	0.8	0.9
45–49	0.8	0.8
50–54	0.7	0.7
55–59	0.7	0.6
60–64	0.6	0.5
65–69	0.6	0.5
70–74	0.5	0.4
75–79	0.4	0.3
80–84	0.4	0.2
85–89	0.3	0.1
≥90	0.2	0.1

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline schizophrenia spectrum disorder if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnostic code of 295; or
- one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F20, F21, F22, F23, F24, F25, F28, or F29.

To qualify as a case, an individual had to meet the following minimum requirements in any FY:

- either one hospital discharge claim (ICD-10 F20, F21, F22, F23, F24, F25, F28, or F29) in any diagnostic position; or
- an initial MSP claim with a 295[7] diagnosis and a second MSP claim with a 295 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 12.

Table 12 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Schizophrenia Spectrum and Other Psychotic Disorders

Baseline Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	NA	0.0	0.0	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
15–19	0.2	0.3	0.2	0.3	0.4	0.4	0.4	0.4
20–24	0.3	0.3	0.4	0.4	0.8	0.8	0.8	0.9
25–29	0.3	0.4	0.4	0.4	0.9	1.0	1.0	1.0
30–34	0.5	0.5	0.5	0.5	0.9	1.0	1.0	1.0
35–39	0.5	0.5	0.6	0.5	0.9	1.0	1.0	1.0

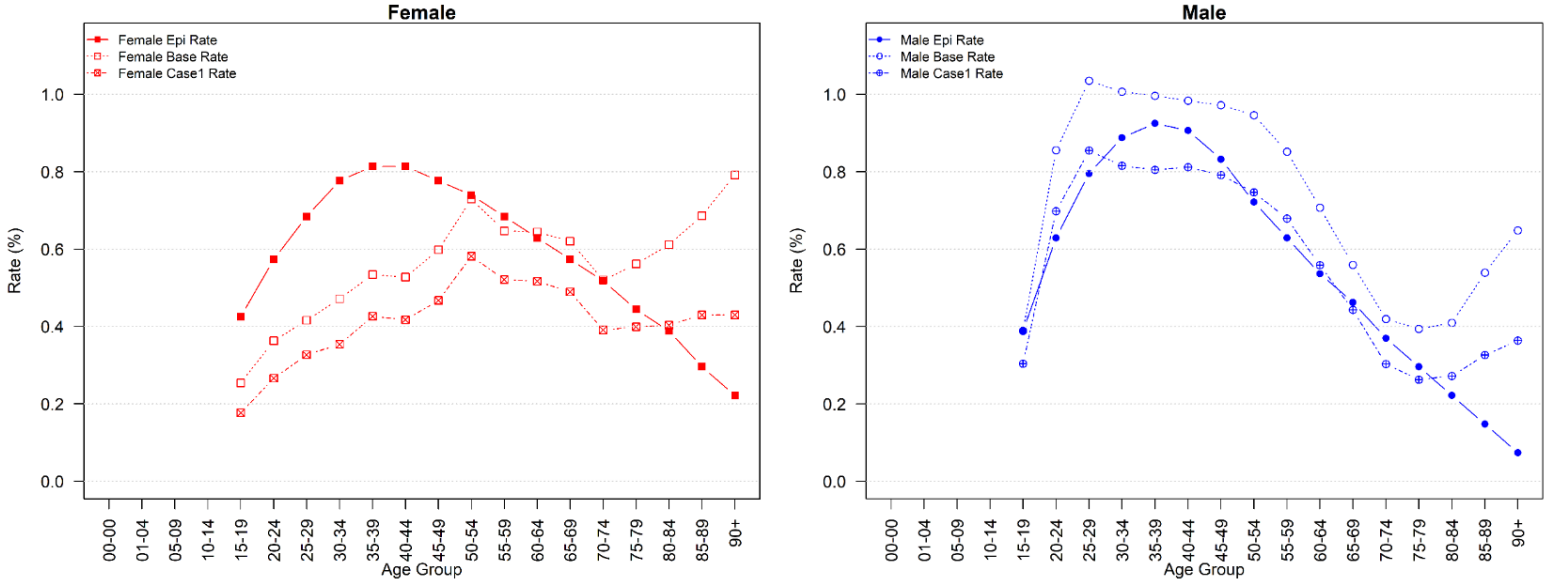
[7] Decision was made to include ICD-9 code 295 for the initial case definition as previous work in CARMHA indicated that most schizophrenia spectrum disorders were captured by 295.

40–44	0.5	0.5	0.5	0.5	0.9	1.0	1.0	1.0
45–49	0.6	0.6	0.6	0.6	0.9	1.0	1.0	1.0
50–54	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9
55–59	0.6	0.7	0.7	0.6	0.7	0.8	0.8	0.9
60–64	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
65–69	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.6
70–74	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
75–79	0.5	0.6	0.5	0.6	0.4	0.4	0.4	0.4
80–84	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4
85–89	0.6	0.6	0.6	0.7	0.5	0.5	0.5	0.5
≥90	0.7	0.7	0.7	0.8	0.5	0.5	0.5	0.6
Initial Case Definition								
		Female				Male		
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	NA	0.0	NA	NA	0.0	0.0	NA	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15–19	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
20–24	0.2	0.2	0.3	0.3	0.7	0.7	0.7	0.7
25–29	0.3	0.3	0.3	0.3	0.7	0.8	0.8	0.9
30–34	0.4	0.3	0.4	0.4	0.7	0.8	0.8	0.8
35–39	0.4	0.4	0.4	0.4	0.7	0.8	0.8	0.8
40–44	0.4	0.4	0.4	0.4	0.7	0.8	0.8	0.8
45–49	0.5	0.5	0.5	0.5	0.7	0.8	0.8	0.8
50–54	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.7
55–59	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7
60–64	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
65–69	0.4	0.4	0.4	0.5	0.3	0.4	0.4	0.4
70–74	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
75–79	0.4	0.4	0.4	0.4	0.2	0.2	0.3	0.3
80–84	0.3	0.4	0.4	0.4	0.2	0.2	0.2	0.3
85–89	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
≥90	0.4	0.4	0.4	0.4	0.2	0.3	0.3	0.4

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 7 shows the age- and gender-specific prevalence based on the epidemiological data as well as the baseline and initial case definitions for the most recent FY 2015/16 in the study dataset. The prevalence was higher in males than females in the younger age groups. For females, both baseline- and case definition-based prevalence estimates were consistently lower than the expected prevalence until age 50–60 years. Meanwhile, in males, the prevalence estimates for all three measures were similar across all age groups. However, the treated prevalence estimate increased sharply after age 75 years for both genders, while the expected prevalence decreased steadily with age.

Figure 7 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders



ALTERNATIVE CASE DEFINITIONS

Given that schizophrenia spectrum disorders are often misdiagnosed as other types of psychotic disorders (Kurdyak, Lin, Green, & Vigod, 2015; Veen et al., 2004), alternative case definitions that included codes for other psychotic disorders were tested. Specifically,

delusional disorder (ICD-9 code 297) and other nonorganic psychoses (or DSM-5 psychotic disorders not otherwise specified; ICD-9 code 298) were added to the initial case definition to determine whether these diagnoses can be distinguished from schizophrenia spectrum disorders in the administrative data. Figure 8 shows the results obtained with the addition of ICD-9 code 297 in comparison with the expected prevalence for schizophrenia spectrum disorders; similarly, Figure 9 shows the results with the additions of both ICD-9 codes 297 and 298. The addition of code 297 alone to the case and baseline definitions further increased the treated prevalence estimates for older age groups (age ≥75 years). No other changes were observed with the addition of code 297. However, the addition of both codes 298 and 297 to the baseline and case definitions slightly increased the prevalence estimates between the 20–25 and 50–54 age groups and substantially increased the prevalence estimates in older adults. Among males, the addition of codes 297 and 298 consistently overpredicted prevalence estimates for schizophrenia spectrum disorders compared to the expected prevalence. Among females, both alternative case definitions yielded prevalence estimates higher than the expected prevalence among those aged ≥60 years (see Shirmaleki & Jones, 2019a).

Figure 8 Prevalence based on Epidemiology and Alternative Case Definitions (ICD-9 295 and 297) – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders

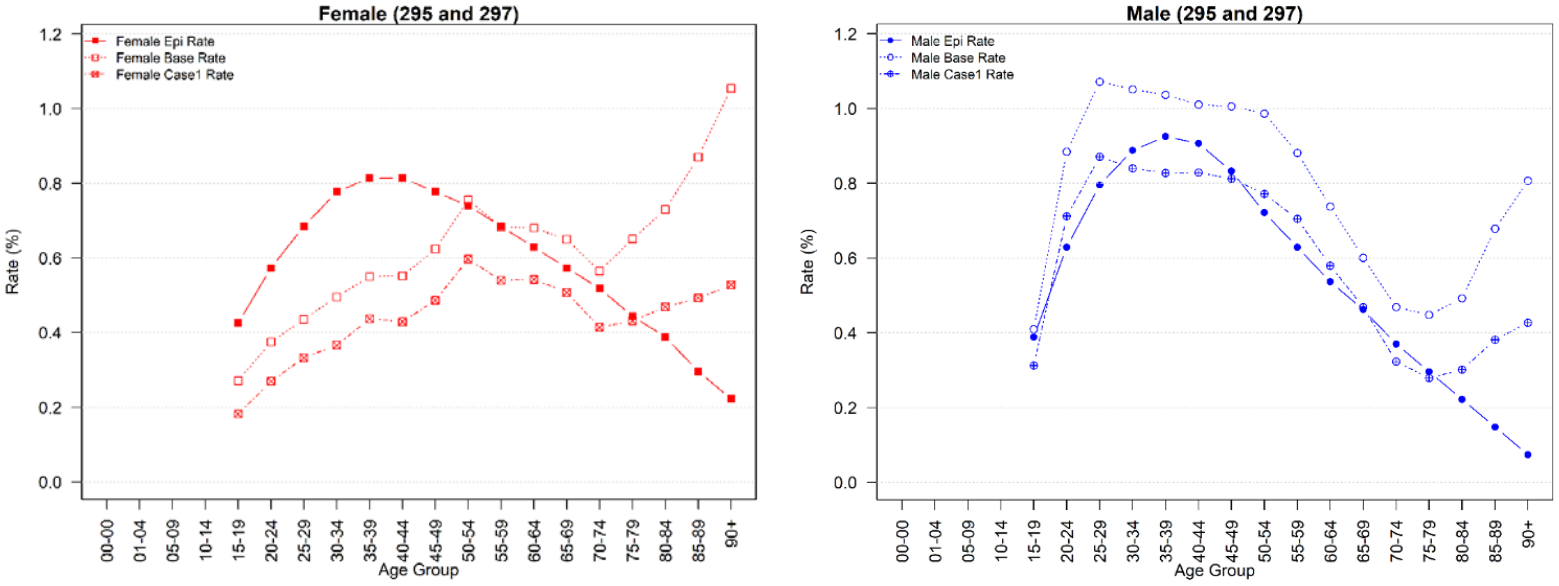
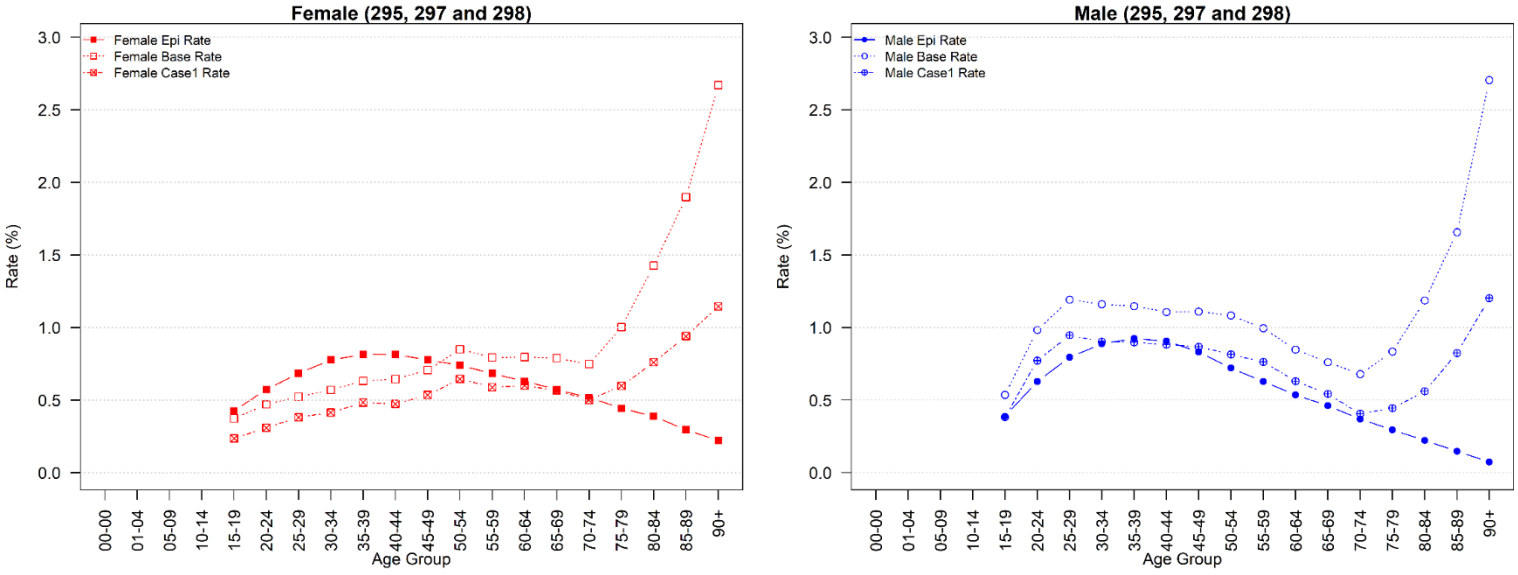


Figure 9 Prevalence based on Epidemiology and Alternative Case Definitions (ICD-9 295, 297, and 298) – Comparison for Schizophrenia Spectrum and Other Psychotic Disorders



DISCUSSION

Among the four definitions tested, the initial case definition (i.e., only ICD-9 code 295) yielded the best measure of the treated prevalence of depression in the BC population, as the baseline and alternative case definitions yielded treated prevalence estimates higher than the expected prevalence. Nonetheless, compared to the expected prevalence, the initial case definition fit better for males than females. The treated prevalence estimates based on the initial case definition tended to underpredict prevalence in younger age groups among females. Moreover, both the treated and expected prevalence estimates were higher for males than females across most age groups, although this pattern switched after age 50 years (i.e., the prevalence estimates for females were much higher than those for males). Despite these gender differences, the expected prevalence for both genders peak in adults aged 30–40 years, decreasing gradually thereafter.

To examine whether similar disorders can be distinguished on the basis of the administrative data, alternative case definitions using the addition of ICD-9 code 297

(delusional disorder) and 298 (other nonorganic psychoses or DSM-5 psychotic disorders not otherwise specified) were compared to the expected prevalence for schizophrenia spectrum disorders. Adding delusional disorder to the initial case definition did not bring the treated prevalence estimates closer to the expected prevalence among individuals younger than 65 years. However, it did yield treated prevalence estimates that were substantially higher than the expected prevalence in the older age groups. Given that delusional disorder has a late onset and occurs in older adults (Suvisaari et al., 2008), these results suggest that schizophrenia spectrum disorders and delusional disorder are distinguishable on the basis of the administrative data.

The second alternative case definition added both codes 297 and 298, which consistently increased the treated prevalence estimates across younger and adult groups, and substantially increased the treated prevalence estimates in older adults. Given that psychotic disorders not otherwise specified affect individuals of all ages including children (Nicholson et al., 2001), such results are unsurprising.

Regardless of the definition used, the treated prevalence estimates consistently indicated a sharp increase in the older adult population, in contrast to the steady decline with increasing age observed in the expected prevalence. One possible explanation for this disparity is that older adults are underrepresented in epidemiological studies, as they are less likely to participate in research than young populations (Vivrette, Martin, & Kramer, 2008; Gao et al., 2015). Furthermore, older adults who do participate in research tend to be healthier and more active than their peers (Golomb et al., 2012). Moreover, an analysis of survey data revealed that older adults incapable of participating or those who are institutionalized are often excluded from surveys (Kelfve, Thorslund, & Lennartsson, 2013). Therefore, these results suggest that older adults with a schizophrenia spectrum disorder are underrepresented in the expected prevalence.

CONCLUSION

The initial case definition (i.e., two or more MSP claims with ICD-9 code 295, or one or more of the following ICD-10 codes: F20, F21, F22, F23, F24, F25, F28, or F29) provides a good measure of schizophrenia spectrum disorders, although it underpredicts prevalence estimates in younger age groups among females. However, there are substantial disparities between the prevalence estimated based on case definition and the expected prevalence in older adults. Therefore, further studies are needed to investigate whether epidemiological studies fail to capture older adults with schizophrenia spectrum or other psychotic disorders, or if there is a coding issue that is overestimating cases in the administrative data. As such, the initial case definition could serve as an ongoing surveillance measure, particularly for the younger-to-middle-age groups.

BIPOLAR DISORDER AND RELATED DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for bipolar disorders are presented in Table 13.

Table 13 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Bipolar Disorders and Related Disorders

	Female	Male
Age Group	All	All
15–19	1.6	1.4
20–24	1.4	1.4
25–29	1.3	1.4
30–34	1.2	1.4
35–39	1.1	1.4
40–44	1.0	1.3
45–49	1.0	1.2
50–54	1.0	1.0
55–59	0.8	0.7
60–64	0.7	0.5
65–69	0.5	0.3
70–74	0.3	0.2
75–79	0.2	0.1
80–84	0.1	0.0
85–89	0.0	0.0
≥90	0.0	0.1

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline bipolar disorder or related disorders if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 296; or
- at least one hospital discharge diagnosis (any discharge type) with an ICD-10 diagnostic code of F30, F31, F34 (excluding F34.1), F38, or F39.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge claim (ICD-10 F30, F31, F34 [excluding F34.1], F38, or F39) in any diagnostic position; or
- an initial MSP claim with a 296 diagnosis and a second MSP claim with a 296 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 14.

Table 14 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Bipolar and Related Disorders

Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
10–14	0.5	0.5	0.6	0.6	0.3	0.3	0.3	0.3
15–19	1.5	1.7	1.7	1.8	0.9	0.9	1.0	1.0
20–24	1.4	1.5	1.5	1.6	1.1	1.2	1.2	1.3
25–29	1.6	1.6	1.6	1.6	1.2	1.2	1.3	1.3
30–34	1.9	1.8	1.8	1.8	1.2	1.3	1.3	1.4
35–39	2.0	2.1	2.0	1.9	1.4	1.4	1.4	1.4
40–44	2.0	2.0	2.0	2.0	1.4	1.5	1.5	1.5
45–49	2.0	2.1	2.0	2.0	1.5	1.5	1.5	1.4
50–54	2.1	2.2	2.2	2.2	1.5	1.5	1.5	1.5
55–59	2.0	2.0	2.1	2.0	1.5	1.5	1.5	1.5
60–64	1.8	1.8	1.9	1.8	1.3	1.4	1.4	1.4
65–69	1.6	1.6	1.6	1.6	1.1	1.1	1.1	1.1
70–74	1.3	1.4	1.5	1.4	1.0	1.0	1.0	1.1
75–79	1.4	1.5	1.5	1.5	1.1	1.1	1.1	1.1

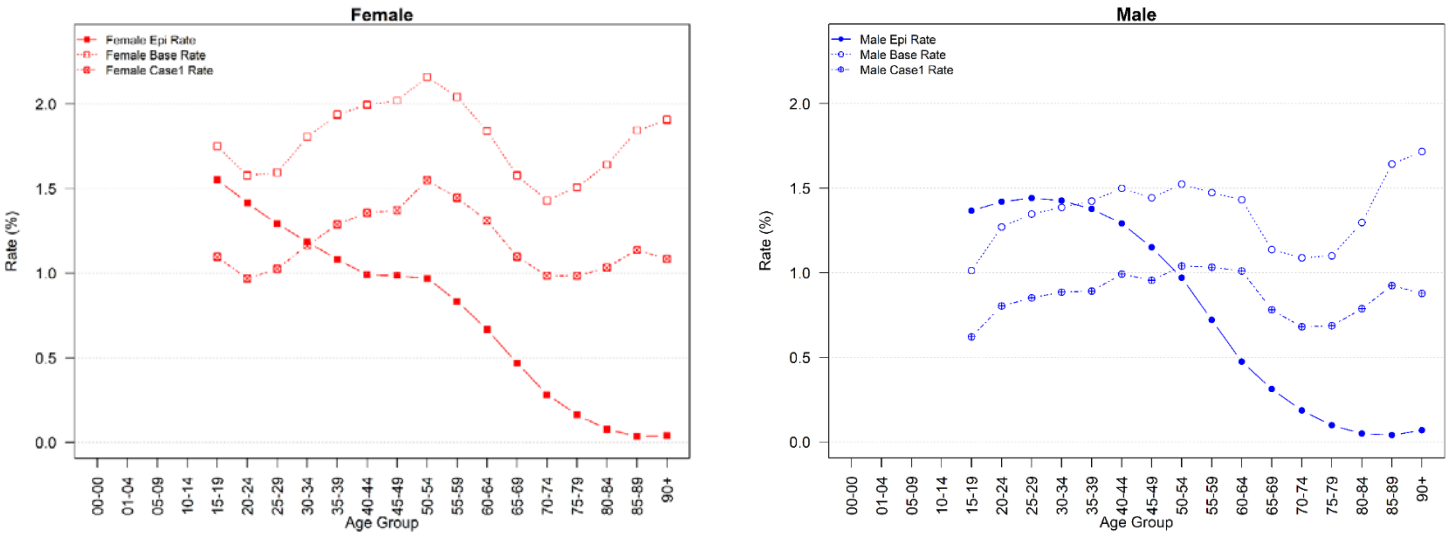
80–84	1.6	1.7	1.8	1.6	1.3	1.3	1.3	1.3
85–89	1.9	1.9	1.9	1.8	1.6	1.6	1.7	1.6
≥90	2.1	2.0	2.2	1.9	1.7	1.9	1.9	1.7
Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	NA	NA	NA	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.3	0.3	0.3	0.3	0.1	0.2	0.2	0.2
15–19	0.9	1.0	1.1	1.1	0.6	0.6	0.6	0.6
20–24	0.8	0.9	0.9	1.0	0.7	0.8	0.8	0.8
25–29	0.9	1.1	1.0	1.0	0.7	0.8	0.8	0.9
30–34	1.2	1.2	1.2	1.2	0.8	0.8	0.8	0.9
35–39	1.3	1.4	1.4	1.3	0.9	0.9	0.9	0.9
40–44	1.3	1.4	1.3	1.4	0.9	1.0	1.0	1.0
45–49	1.4	1.4	1.4	1.4	1.0	1.0	1.0	1.0
50–54	1.5	1.5	1.6	1.5	1.0	1.1	1.1	1.0
55–59	1.4	1.4	1.5	1.4	1.0	1.0	1.1	1.0
60–64	1.2	1.3	1.3	1.3	0.9	1.0	1.0	1.0
65–69	1.1	1.1	1.1	1.1	0.7	0.7	0.8	0.8
70–74	0.9	0.9	0.9	1.0	0.6	0.7	0.7	0.7
75–79	0.8	1.0	1.0	1.0	0.7	0.7	0.6	0.7
80–84	1.0	1.1	1.1	1.0	0.7	0.8	0.8	0.8
85–89	1.0	1.1	1.0	1.1	0.8	0.9	1.0	0.9
≥90	1.0	1.0	1.1	1.1	0.9	1.1	1.0	0.9

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 10 shows the age- and gender-specific prevalence based on the epidemiological data as well as the baseline and initial case definitions for the most recent FY 2015/16 in the study dataset. There were gender differences across all three measures. For females, the treated prevalence using the baseline definition was higher than the expected prevalence across all age groups. The treated prevalence using the initial case definition was lower than the expected prevalence among younger age groups (age ≤30 years) but higher in all

age groups beyond 30 years. The treated prevalence according to both the baseline and case definitions was generally higher than the expected prevalence, peaking from age 50–59 years and again after age 75 years.

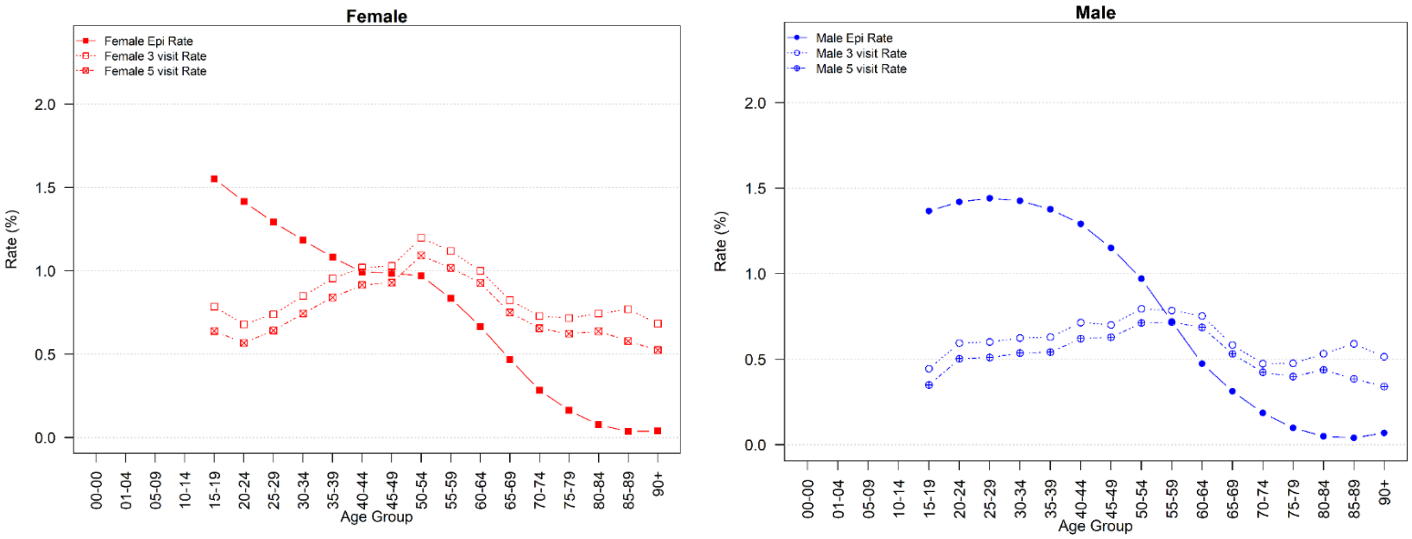
Figure 10 Prevalence based on Epidemiological and Administrative Case Definitions – Comparison for Bipolar and Related Disorders



ALTERNATIVE CASE DEFINITIONS

Alternative case definitions were tested to determine if the prevalence in older age groups could be aligned towards the expected prevalence. Two conservative definitions were tested: (1) three MSP claims within 365 days; and (2) five MSP claims over 365 days (Figure 11). Both alternative case definitions lowered the distribution of the prevalence across all age groups. While this decrease brought the treated prevalence estimates for older adults closer to the expected prevalence, it also significantly increased the gap for the younger age groups (Shirmaleki & Jones, 2019b). Thus, these results favour the initial case definition.

Figure 11 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Bipolar and Related Disorders



DISCUSSION

Four case definitions were tested for their ability to capture individuals receiving care for bipolar and related disorders. The baseline and initial case definitions yielded prevalence estimates that were substantially higher than the expected prevalence estimates for individuals age ≥40 years, whereas the more-conservative definition yielded a prevalence that was considerably lower than the expected prevalence among younger age groups and a higher-than-expected prevalence among older age groups.

There were several differences between the treated and expected prevalence. Regarding gender, the expected prevalence suggests that there are more males with bipolar and related disorders than females among younger age groups, while the opposite trend is apparent regarding treated prevalence. Moreover, in the administrative data, the treated prevalence for females was consistently higher than that of males across all age groups. The age distribution between the expected and treated prevalence was also markedly different: the expected prevalence decreased with increasing age, while the treated prevalence peaked in individuals age 50–64 years and in adults age ≥85 years.

The cause of this large discrepancy between the treated and expected prevalence for bipolar and related disorders is unclear. Nevertheless, broadening the diagnostic criteria for bipolar disorders might lead to overdiagnosis (Mitchell, 2012). Zimmerman et al. (2008) report that among individuals who were previously diagnosed with a bipolar disorder, less than half met the criteria for a bipolar disorder when using the Structured Clinical Interview guide for Axis I disorders.

Furthermore, it is unclear whether the overprediction observed for older age groups reflects a limitation of the epidemiological data to capture this population or if the codes are being used to capture disorders other than bipolar disorders that are specific to older adults. There is evidence in the literature to suggest late-onset bipolar disorder in older adults (Sajatovik et al., 2005; Almeida & Fenner, 2002). For example, Almeida and Fenner (2005) found that 8% of older adults with a bipolar disorder made their first contact with mental health services after age 65 years. Moreover, older adults with early onset of bipolar disorders have more severe outcomes and utilize more health services than those with late-onset bipolar disorders (Sajatovik et al., 2005). Conversely, other studies suggest that disorders with similar symptoms and neuropathology, such as Alzheimer's disorder, schizophrenia, and other neurological illnesses, are misdiagnosed as bipolar disorder (Azorin et al., 2012; Besga et al., 2015).

Another possible explanation for the low prevalence of bipolar disorders in the epidemiological data for older adults is that older adults with bipolar disorders are likely institutionalized and are therefore not captured by epidemiological studies (Sajatovik et al., 2005). The age distributions of the expected prevalence for the other disorder groups included in this report support this assumption.

CONCLUSION

The tested case definitions yield overall prevalence estimates close to the expected prevalence but are poor measures of bipolar and related disorders compared to the

expected prevalence when age- and gender-specific patterns are examined in detail. Therefore, it is unclear which definition best reflects the true prevalence and age distribution of bipolar and related disorders. As such, further research is needed to explain the observed discrepancies.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for ADHD are presented in Table 15.

Table 15 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – ADHD

	Female	Male
Age Group	All	All
15–19	4.2	6.3
20–24	3.5	6.0
25–29	3.0	5.7
30–34	2.7	5.3
35–39	2.5	4.8
40–44	2.5	4.2
45–49	2.7	3.7
50–54	2.8	3.1
55–59	2.6	2.5
60–64	2.2	1.9
65–69	1.7	1.5
70–74	1.2	1.2
75–79	0.8	0.9
80–84	0.4	0.6
85–89	0.1	0.3
≥90	0.0	0.1

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having baseline ADHD if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 314; or
- at least one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F90.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge with an ADHD diagnosis (ICD-10 F90) in any diagnostic position; or
- an initial MSP claim with a 314 diagnosis and a second MSP claim with a 314 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender- specific prevalence distributions are presented in Table 16.

Table 16 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – ADHD

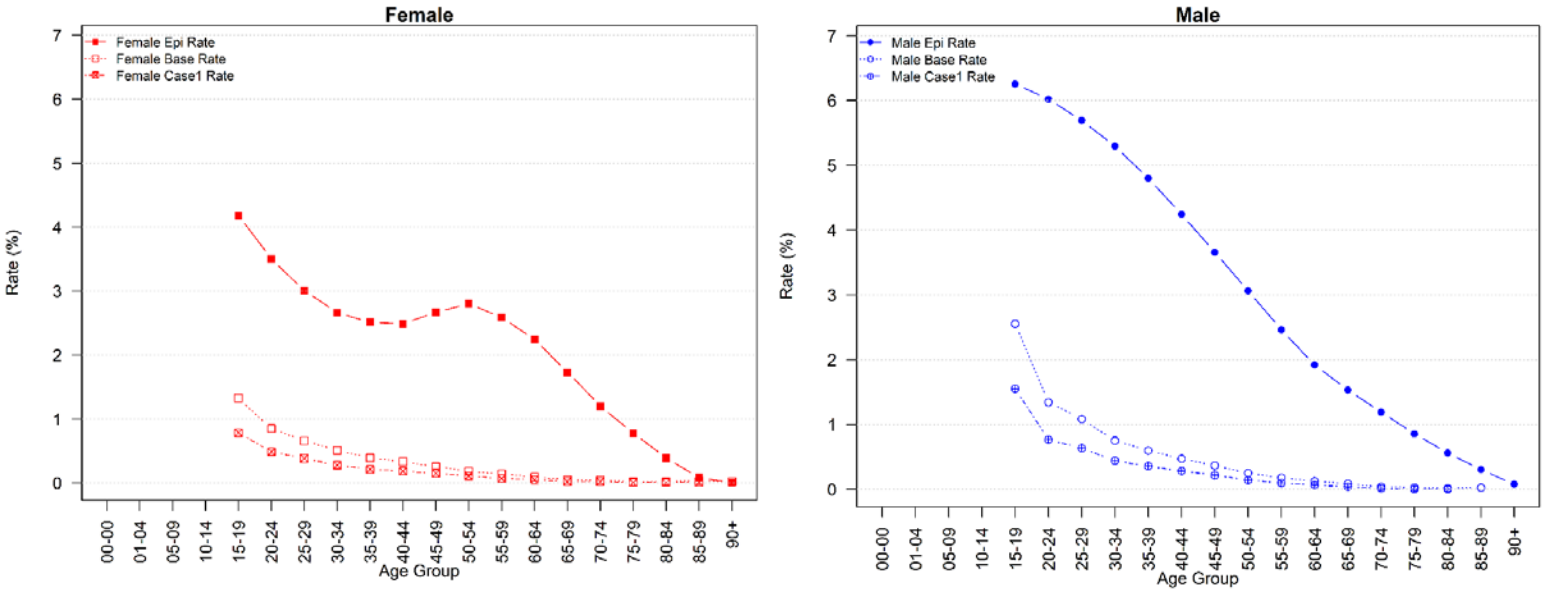
Baseline Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.3	0.2	0.2	0.2	0.7	0.6	0.6	0.7
5–9	1.7	1.8	1.8	2.0	5.1	5.2	5.3	5.7
10–14	1.7	1.8	1.9	2.0	4.9	5.0	4.9	5.3
15–19	1.1	1.1	1.2	1.3	2.1	2.2	2.5	2.6
20–24	0.7	0.7	0.8	0.8	1.1	1.1	1.2	1.3
25–29	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.1
30–34	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.8
35–39	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6
40–44	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.5
45–49	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4
50–54	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
55–59	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
60–64	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
65–69	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
70–74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75–79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

80–84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85–89	0.0	0.0	0.0	0.0	NA	NA	NA	0.0
≥90	0.0	NA	NA	0.0	NA	NA	NA	NA
Initial Case Definition								
			Female				Male	
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3
5–9	1.0	1.1	1.1	1.3	3.2	3.4	3.5	3.8
10–14	1.0	1.2	1.2	1.3	3.1	3.5	3.4	3.6
15–19	0.6	0.7	0.7	0.8	1.1	1.3	1.5	1.6
20–24	0.4	0.4	0.4	0.5	0.6	0.7	0.7	0.8
25–29	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6
30–34	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4
35–39	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4
40–44	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3
45–49	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
50–54	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
55–59	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
60–64	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
65–69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70–74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75–79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80–84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85–89	0.0	0.0	0.0	0.0	NA	NA	0.0	NA
≥90	NA	NA	NA	NA	NA	NA	NA	NA

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 12 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for FY 2015/16 in the study dataset. While there were no observable gender differences in the treated prevalence estimates, the expected prevalence was higher for males than females among the younger age groups. Moreover, the treated prevalence estimates were substantially lower than the expected prevalence.

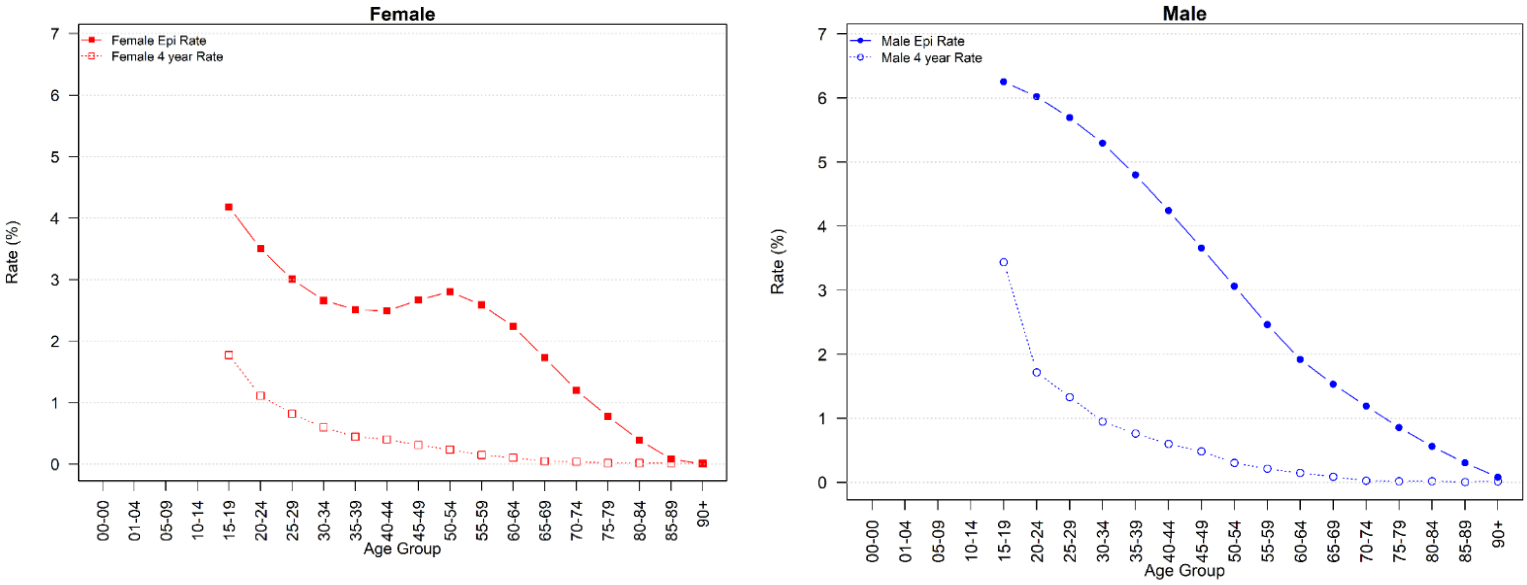
Figure 12 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for ADHD



ALTERNATIVE CASE DEFINITION

A more relaxed case definition was tested to determine if the treated prevalence estimate could be aligned towards the expected prevalence estimates. Specifically, the dataset was searched for one occurrence of a diagnosis across all four years (rather than within one year) using the baseline definition (see Shirmaleki & Jones, 2019c for details). Figure 13 shows the treated and expected prevalence estimates by age and gender. Although prevalence estimates increased slightly when using the alternative case definition, they remained substantially lower than the expected prevalence estimates.

Figure 13 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for ADHD



DISCUSSION

The three case definitions tested yielded similar treated prevalence estimates across age groups, except for older age groups for which the expected prevalence was less than 1%. All three definitions, including the relaxed alternative definition, produced considerably lower treated prevalence estimates than the expected prevalence.

The expected prevalence was higher in males than females until age 50–54 years, decreasing thereafter and exhibiting higher congruency between genders. Similarly, the treated prevalence was higher in males than females, particularly in the younger age groups, and gradually declined with increasing age. Some age and gender interactions were apparent where the expected prevalence estimates peaked in females around age 45–59 years, whereas the prevalence steadily declined with age in males.

A critical limitation of our approach to identifying the treated population with ADHD is that the prevalence for children aged <15 years was excluded from the graphs, because this is outside the scope of this project. While some individuals with ADHD are not diagnosed until adulthood, most are indeed diagnosed and begin treatment during their school years

(American Psychiatric Association, 2013). When individuals age <15 years were included in the analysis using the initial case definition (Table 17), the prevalence estimates for children aged 5–14 years were much higher than those for the older age groups and more closely aligned with the expected prevalence. Therefore, the initial case definition provides a better fit for capturing the younger population with ADHD owing to the early recognition and treatment of the disorder.

Nevertheless, further research is needed to explain the large gap between the expected and treated prevalence estimates in the adult population. Adults with ADHD are not well captured in the administrative data when using MSP claims and hospital discharge databases. However, it is possible that the vast majority of adults with ADHD are not seeking treatment and will therefore be overlooked in the administrative data.

CONCLUSION

Using the administrative data considerably underpredicts the treated prevalence estimates for the adult population (age ≥15 years). However, using the initial case definition for children aged <15 years, treated prevalence estimates approximated expected prevalence estimates. As such, the initial case definition provides a good measure for children aged <15 years but might be unsuitable for monitoring adults with ADHD unless the treated prevalence accurately reflects adults neither seeking nor requiring treatment for ADHD. Alternatively, measuring lifetime prevalence might be a better approach when using an administrative case definition.

EATING DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results are presented in Table 17.

Table 17 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Eating Disorders

	Female	Male
Age Group	All	All
15–19	1.1	0.3
20–24	1.0	0.3
25–29	0.9	0.3
30–34	0.8	0.3
35–39	0.6	0.2
40–44	0.5	0.2
45–49	0.4	0.1
50–54	0.3	0.1
55–59	0.2	0.1
60–64	0.2	0.1
65–69	0.2	0.1
70–74	0.2	0.1
75–79	0.2	0.1
80–84	0.2	0.1
85–89	0.3	0.1
≥90	0.3	0.1

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline eating disorder if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 307.1, 307.5 or 783; or

- at least one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F50.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge with an eating disorder diagnosis (ICD-10 F50) in any diagnostic position; or
- an initial MSP claim with a 307.1, 307.5, or 783 diagnosis and a second MSP claim with a 307.1, 307.5, or 783 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 18.

Table 18 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Eating Disorders

Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
15–19	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0
20–24	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
25–29	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
30–34	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
35–39	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
40–44	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
45–49	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
50–54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55–59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60–64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

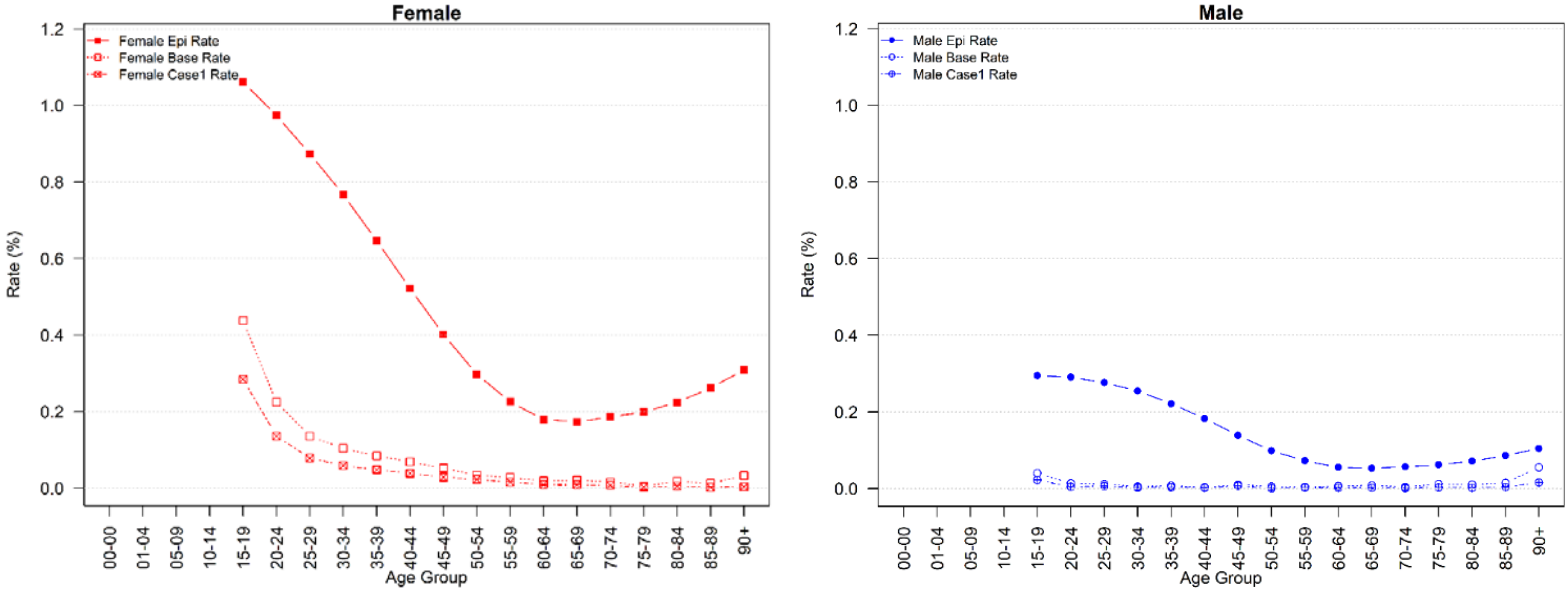
65–69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70–74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75–79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80–84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85–89	0.0	0.0	0.0	0.0	NA	NA	0.0	0.0
≥90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Initial Case Definition								
	Females				Males			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
15–19	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0
20–24	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
25–29	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
30–34	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
35–39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40–44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45–49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50–54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55–59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60–64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65–69	0.0	0.0	0.0	0.0	0.0	NA	0.0	0.0
70–74	0.0	0.0	0.0	0.0	0.0	NA	0.0	0.0
75–79	0.0	0.0	0.0	0.0	0.0	NA	0.0	0.0
80–84	0.0	0.0	0.0	0.0	NA	0.0	NA	0.0
85–89	0.0	0.0	0.0	0.0	NA	NA	0.0	0.0
≥90	0.0	0.0	0.0	0.0	NA	0.0	0.0	0.0

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 14 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for FY 2015/16 in the dataset. There were minimal differences between the treated prevalence estimates derived from the baseline and case definitions. Compared to the epidemiological data, the

treated prevalence estimates were substantially lower than the expected prevalence estimates. This discrepancy was greater among younger age groups than older age groups. Moreover, while the treated prevalence estimates for individuals aged ≥35 years was null, the expected prevalence increased in females aged ≥70 years. A very slight increase was observed in male older adults. The observed increase in the expected prevalence in older age groups is due to the collating and averaging of two data sources, one of which is missing prevalence for older adults. Age- and gender-specific prevalence based on the individual data sources used for eating disorders decreased continuously with increasing age.

Figure 14 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Eating Disorders

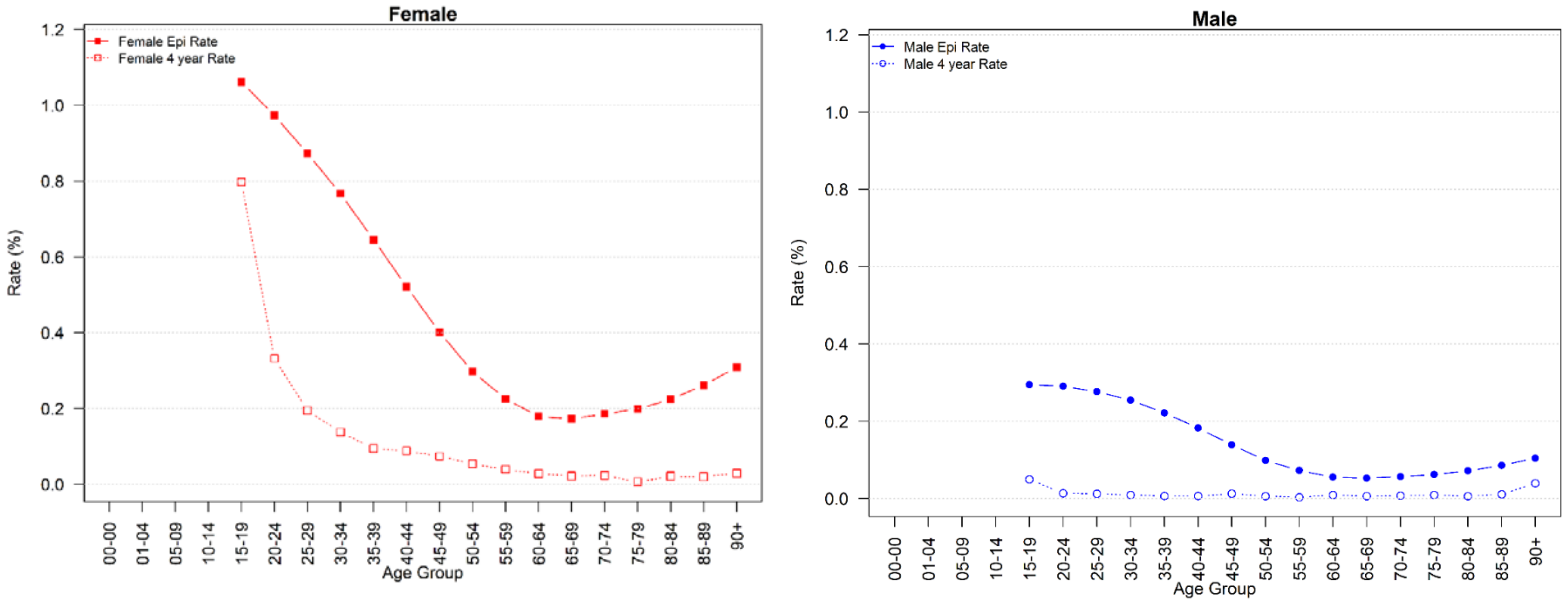


ALTERNATIVE CASE DEFINITION

An alternative case definition was tested to determine if it could provide a better measure of the treated population and bring the distribution closer to the expected prevalence. Rather than using a one-year timeframe, the dataset was searched for one occurrence

across four years using the baseline definition (see Shirmaleki & Jones, 2019d for details). The alternative case definition brought the treated prevalence estimates for females aged 15–19 and 20–24 years closer to the expected prevalence estimates (Figure 15). No other differences were observed in the other age groups or the male population when using the alternative case definition.

Figure 15 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Eating Disorders



DISCUSSION

The initial case definition, baseline definitions, and an alternative case definition with more-relaxed criteria were assessed for their ability to capture the estimated treated prevalence for eating disorders. The treated prevalence estimates derived from the initial case definition were substantially lower than the expected prevalence estimates. Moreover, there were no differences between the baseline and initial case definitions. Therefore, an alternative case definition was tested using broader criteria (i.e., one claim for eating disorders within four years rather than one year). However, the alternative case definition

only brought the estimated treated prevalence closer to the expected estimates for females aged 15–19 and 20–24 years.

Regarding gender differences, the expected prevalence estimates were markedly higher for females than males. This is consistent with the understanding that eating disorders are more prevalent in females than males. In addition, among those with bulimia nervosa, males are less likely than females to seek treatment (APA, 2013).

The high prevalence estimates of eating disorders in younger age groups is well recognized (Preti et al., 2009; Oakley Browne et al., 2006; APA, 2013). The treated prevalence estimates resulting from our case definitions are also reflective of this pattern.

While both the treated and expected prevalence decreased with age, the expected prevalence increased in older adults aged ≥65 years due to the data triangulation process described in *Methodology.* However, recent evidence suggests that older adults with eating disorders, particularly males, are often overlooked in the health care system (Mangweth-Matzek & Hoek, 2017). As such, treated prevalence estimates should not be used to estimate the true prevalence as they underestimate individuals with eating disorders across all age groups, particularly older adults, as eating disorders are often missed in this age group.

CONCLUSIONS

Compared to the epidemiological data, the case definitions greatly underestimate the treated population with eating disorders. In addition, according to the three case definitions tested, the administrative data fail to capture eating disorders in older adults. Therefore, the interpretation of treated prevalence estimates should be made with these limitations in mind.

INTELLECTUAL DISABILITIES

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for intellectual disabilities are presented in Table 19.

Table 19 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Intellectual Disabilities

	Female	Male
Age Group	All	All
15–19	0.6	0.7
20–24	0.5	0.6
25–29	0.5	0.5
30–34	0.4	0.5
35–39	0.4	0.4
40–44	0.3	0.3
45–49	0.3	0.3
50–54	0.2	0.2
55–59	0.2	0.2
60–64	0.1	0.1
65–69	0.1	0.1
70–74	0.1	0.1
75–79	0.1	0.2
80–84	0.2	0.2
85–89	0.2	0.2
≥90	0.2	0.3

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline intellectual disability if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 317, 318 or 319; or

- at least one hospital discharge (any discharge type) with ICD-10 diagnostic codes of F70, F71, F72, F73, F78, or F79.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge claim (ICD-10 F70, F71, F72, F73, F78, F79) in any diagnostic position; or
- an initial MSP claim with a 317, 318 or 319 diagnosis and a second MSP claim with a 317, 318, or 319 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender- specific prevalence distributions are presented in Table 20.

Table 20 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Intellectual Disabilities

Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.02	0.01	0.02	0.02	0.04	0.02	0.04	0.04
5–9	0.04	0.05	0.07	0.10	0.08	0.07	0.12	0.20
10–14	0.07	0.07	0.07	0.10	0.09	0.10	0.12	0.13
15–19	0.10	0.09	0.09	0.10	0.13	0.13	0.10	0.14
20–24	0.06	0.06	0.06	0.06	0.08	0.09	0.08	0.07
25–29	0.05	0.05	0.04	0.04	0.06	0.07	0.06	0.06
30–34	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04
35–39	0.03	0.03	0.04	0.03	0.05	0.05	0.04	0.03
40–44	0.03	0.03	0.03	0.04	0.04	0.05	0.04	0.04
45–49	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04
50–54	0.04	0.04	0.04	0.03	0.06	0.05	0.05	0.05
55–59	0.04	0.04	0.03	0.03	0.05	0.05	0.05	0.04
60–64	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04
65–69	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03

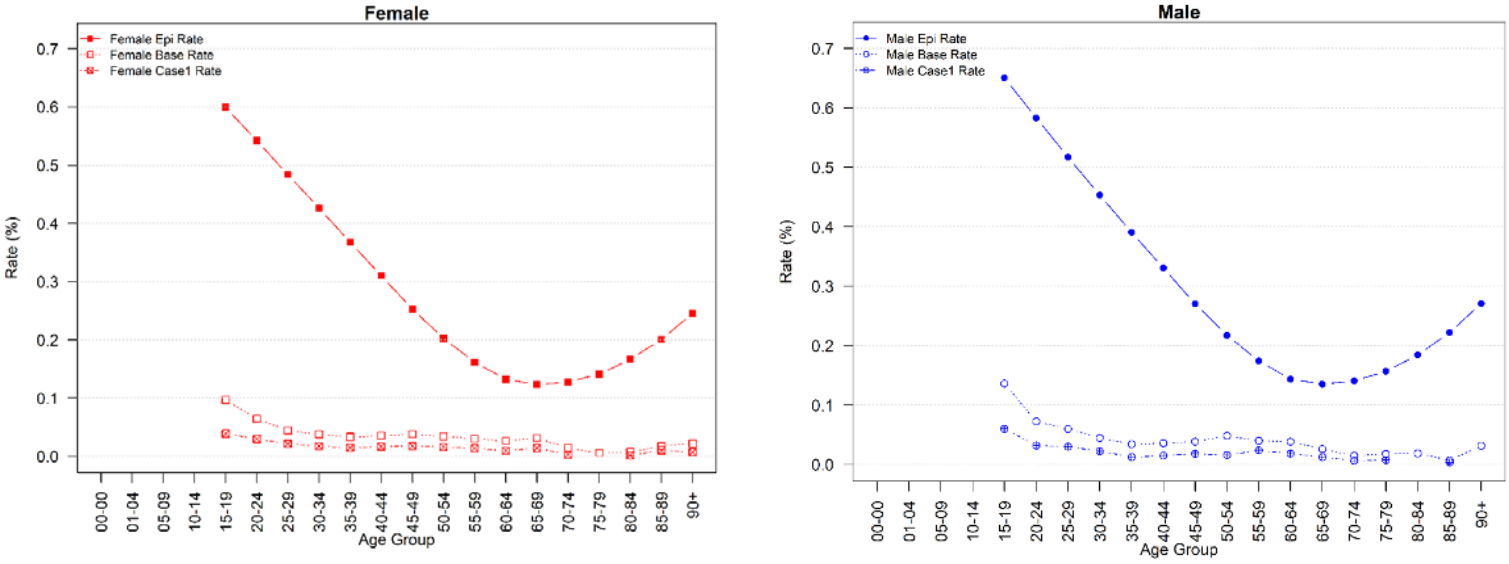
70–74	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01
75–79	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.02
80–84	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02
85–89	0.01	0.02	0.01	0.02	0.03	0.02	0.02	0.01
≥90	0.01	0.02	0.02	0.02	0.03	0.02	0.01	0.03
Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
5–9	0.01	0.01	0.01	0.04	0.02	0.03	0.04	0.06
10–14	0.02	0.03	0.02	0.04	0.03	0.04	0.04	0.05
15–19	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.06
20–24	0.03	0.03	0.03	0.03	0.04	0.05	0.04	0.03
25–29	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.03
30–34	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02
35–39	0.01	0.02	0.01	0.01	0.02	0.03	0.01	0.01
40–44	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
45–49	0.02	0.01	0.01	0.02	0.02	0.02	0.03	0.02
50–54	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.02
55–59	0.02	0.02	0.02	0.01	0.02	0.03	0.02	0.02
60–64	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02
65–69	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
70–74	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
75–79	0.00	0.00	0.01	NA	0.00	0.00	0.01	0.01
80–84	0.00	0.00	0.00	0.00	0.01	NA	0.01	NA
85–89	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
≥90	0.01	0.01	0.00	0.01	NA	NA	NA	NA

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 16 shows the age- and gender-specific prevalence based on the epidemiological data as well as the baseline and initial case definitions for FY 2015/16 in the study dataset. The distribution patterns of all three measures were the same for both males and females. Both baseline and case definitions produced prevalence estimates substantially lower than the expected prevalence. This discrepancy was greater among younger age groups than older

age groups. The observed increase in older age groups is due to the collating and averaging of two data sources, one of which was missing prevalence data for older adults. Age- and gender-specific estimates of expected prevalence based on the individual data sources used for intellectual disabilities decreased continuously with increasing age.

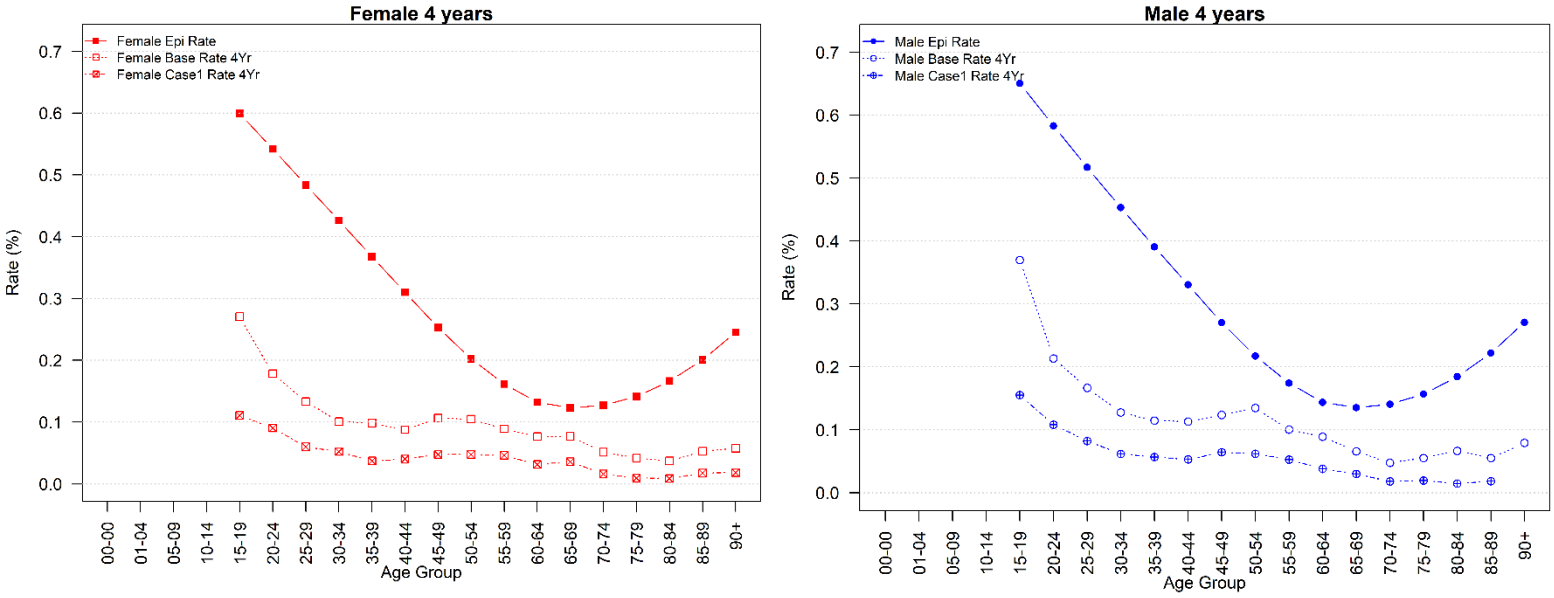
Figure 16 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Intellectual Disabilities



ALTERNATIVE CASE DEFINITION

An alternative case definition was tested to determine if the treated prevalence estimates could be aligned towards the expected prevalence. As a more-relaxed criterion than the initial case definition, rather than using a one-year timeframe, the dataset was searched for one occurrence across four years using the baseline definition (see Shirmaleki & Jones, 2019e for details). In Figure 17, the treated prevalence increased when using the alternative case definition but remained substantially lower than the expected prevalence.

Figure 17 Prevalence based on Epidemiology and Alternative Case Definitions (Four-year timespan) – Comparison for Intellectual Disabilities



DISCUSSION

The initial case definition yielded treated prevalence estimates that were much lower than the expected prevalence across all age groups. One explanation for this is that treatment for individuals with intellectual disabilities often involves the management of physical health conditions and provisions of services to improve function and quality of life (Sullivan et al., 2018). Consequently, the ICD-9 or ICD-10 codes for intellectual disabilities might not be used to record physical health-related medical visits.

The alternative case definition, which captured individuals who had one claim within four years, improved the correspondence between the treated and expected prevalence; however, a large gap remained between the treated prevalence and expected prevalence.

All three measures using the administrative data showed that the treated prevalence decreased with increasing age, while the increase in the expected prevalence among older age groups is due to the data triangulation process described in the *Methodology.* The decrease in treated prevalence with increasing age is consistent with findings from other

studies (Lin et al., 2013; Ouellette-Kuntz et al., 2009 Maulik, Mascarenhas, Mathers, Dua, & Sazena, 2011). These results also reflect previous findings that intellectual disabilities have early onset (APA, 2013) and early identification (Maulik et al., 2011).

No gender differences were observed among individuals with intellectual disabilities, although both expected and treated prevalence were slightly higher for males than females.

CONCLUSION

The initial case definition provides a measure of the treated population with intellectual disabilities that is much lower than that expected based on the epidemiological data. Extending the timeframe to four years can somewhat improve the correspondence, although the gap remains sizeable. One explanation for this is that specific treatment for some chronic disorders, such as intellectual disabilities might decrease with increasing age. Furthermore, ongoing medical visits might focus on physical illness and would therefore not be coded with intellectual disability diagnoses.

NEUROCOGNITIVE DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for NCDs due to traumatic brain injury (TBI) or substance/medication use are presented in Table 21.

Table 21 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Neurocognitive Disorders due to TBI or Substance/Medication Use

	Female	Male
Age Group	All	All
15–19	0.0	0.0
20–24	0.0	0.0
25–29	0.0	0.0
30–34	0.0	0.0
35–39	0.0	0.0
40–44	0.0	0.0
45–49	0.0	0.0
50–54	0.1	0.1
55–59	0.1	0.1
60–64	0.2	0.3
65–69	0.3	0.5
70–74	0.5	0.7
75–79	1.2	1.4
80–84	2.2	2.4
85–89	3.6	4.0
≥90	5.7	5.5

ADMINISTRATIVE CASE DEFINITION

A case definition was developed for the NCD group that would capture major NCDs including dementia, delirium, and vascular NCD rather than NCDs due to TBI or substance/medication use. The data were limited to ICD-9 Chapter V (codes 290–319) and

ICD-10 Chapter V (codes F00–F99), while the codes for TBI, concussions, and head injuries are included in ICD-9 Chapter XVII and ICD-10 Chapter XIX. Similarly, because of the dataset's limited range, Alzheimer's disease, which uses ICD-9 and ICD-10 codes 331.0 and G30.9, respectively, could not be included. While the group of disorders in our case definition deviates from the group of disorders included in Phase 1, the expected prevalence for NCDs due to TBI or substance/medication use was still compared with the treated prevalence of the major NCDs.

ADMINISTRATIVE CASE DEFINITION FOR NEUROCOGNITIVE DISORDERS

An individual was classified as having a baseline NCD if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 290, 293, or 294; or
- one hospital discharge (any discharge type) with an ICD-10 diagnostic code F01, F03, F04, F05, F06, or F09.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge with a neurocognitive diagnosis (ICD-10 F01, F03, F04, F05, F06, F09) in any diagnostic position; or
- an initial MSP claim with a 290, 293, or 294 diagnosis and a second MSP claim with a 290, 293, or 294 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions for NCDs are presented in Table 22.

Table 22 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Neurocognitive Disorders

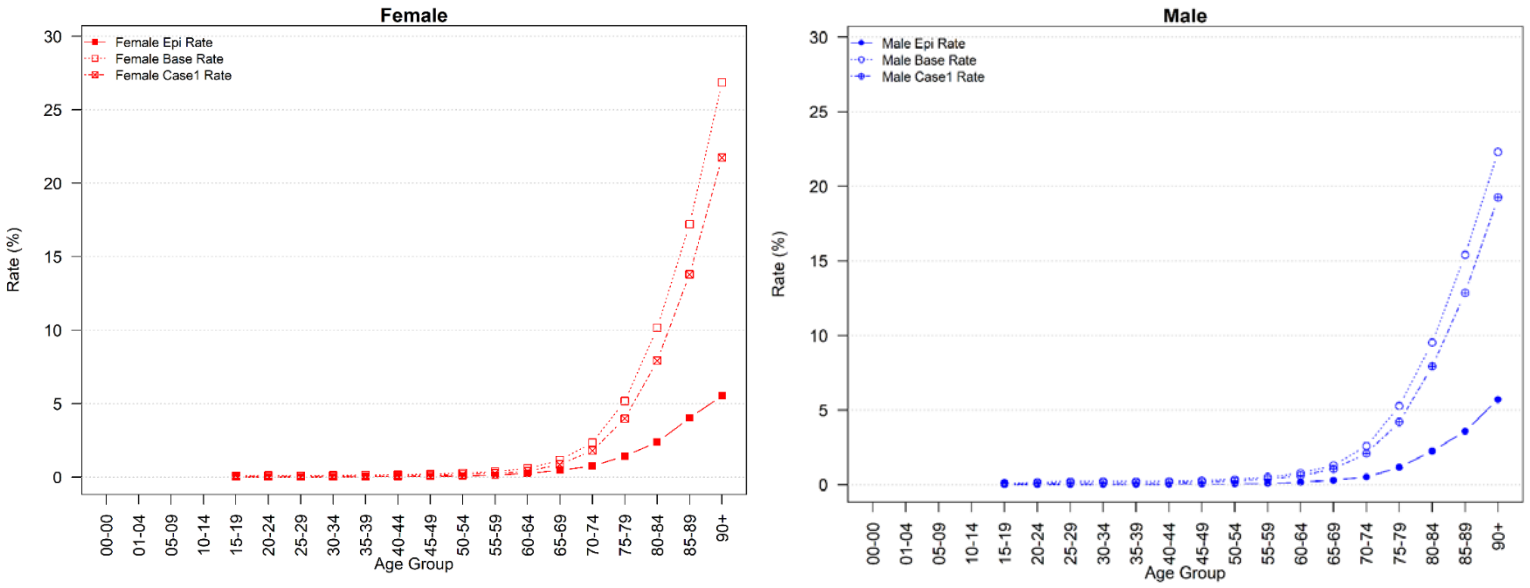
Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01
5–9	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.02
10–14	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
15–19	0.06	0.09	0.10	0.09	0.08	0.10	0.09	0.10
20–24	0.08	0.10	0.11	0.11	0.16	0.17	0.17	0.16
25–29	0.10	0.10	0.11	0.11	0.19	0.22	0.19	0.21
30–34	0.12	0.13	0.12	0.13	0.21	0.22	0.20	0.22
35–39	0.10	0.12	0.15	0.14	0.20	0.21	0.21	0.21
40–44	0.14	0.16	0.16	0.16	0.22	0.22	0.23	0.22
45–49	0.20	0.18	0.20	0.20	0.26	0.29	0.28	0.28
50–54	0.25	0.28	0.29	0.28	0.33	0.34	0.35	0.35
55–59	0.39	0.40	0.40	0.39	0.48	0.53	0.48	0.51
60–64	0.58	0.61	0.60	0.59	0.72	0.75	0.79	0.78
65–69	1.09	1.08	1.11	1.16	1.26	1.27	1.32	1.30
70–74	2.21	2.30	2.42	2.35	2.59	2.61	2.59	2.59
75–79	5.06	5.10	5.09	5.17	5.22	5.32	5.26	5.27
80–84	10.39	10.60	10.45	10.16	9.44	9.36	9.55	9.53
85–89	17.02	17.09	17.29	17.22	15.34	15.15	15.60	15.40
≥90	25.18	25.69	26.06	26.85	21.12	22.62	22.21	22.30
Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.00	0.00	0.00	NA	NA	0.00	0.00	0.00
5–9	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01
10–14	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
15–19	0.03	0.04	0.04	0.04	0.03	0.05	0.04	0.04
20–24	0.03	0.05	0.05	0.04	0.08	0.09	0.08	0.07
25–29	0.04	0.05	0.04	0.05	0.09	0.10	0.10	0.10
30–34	0.05	0.05	0.06	0.06	0.09	0.11	0.10	0.12

35–39	0.05	0.06	0.06	0.06	0.10	0.12	0.11	0.12
40–44	0.07	0.09	0.09	0.08	0.11	0.12	0.13	0.12
45–49	0.12	0.11	0.10	0.11	0.17	0.19	0.19	0.17
50–54	0.16	0.17	0.17	0.18	0.22	0.24	0.24	0.25
55–59	0.25	0.27	0.27	0.26	0.35	0.38	0.36	0.37
60–64	0.37	0.41	0.41	0.41	0.56	0.60	0.63	0.61
65–69	0.77	0.80	0.78	0.86	0.99	1.04	1.07	1.05
70–74	1.56	1.72	1.79	1.80	2.00	2.15	2.20	2.10
75–79	3.73	3.86	3.88	3.98	4.14	4.38	4.25	4.21
80–84	7.80	8.38	8.27	7.92	7.41	7.73	7.85	7.93
85–89	13.19	13.78	14.10	13.79	12.17	12.49	13.02	12.86
≥90	19.62	20.80	21.33	21.74	17.50	18.46	19.33	19.25

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 18 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for FY 2015/16 in the study dataset. The graphs show the same distribution curve pattern for both males and females. Both baseline and case definitions produced higher prevalence estimates than the expected prevalence, with the greatest discrepancy among older age groups. This was expected, as the epidemiological data only included NCDs due to TBI or substance/medication use. Of note, this case definition did not include codes for NCDs due to substance/medication use. The three distribution curves exhibited a similar shape until age 65 years, after which the treated prevalence was substantially higher than the expected prevalence. Although the treated prevalence skewed toward in the older age groups, Table 22 shows the presence of NCDs across all age groups including children. Given that this case definition included almost all NCDs, the specific NCDs occurring among younger age groups could not be identified.

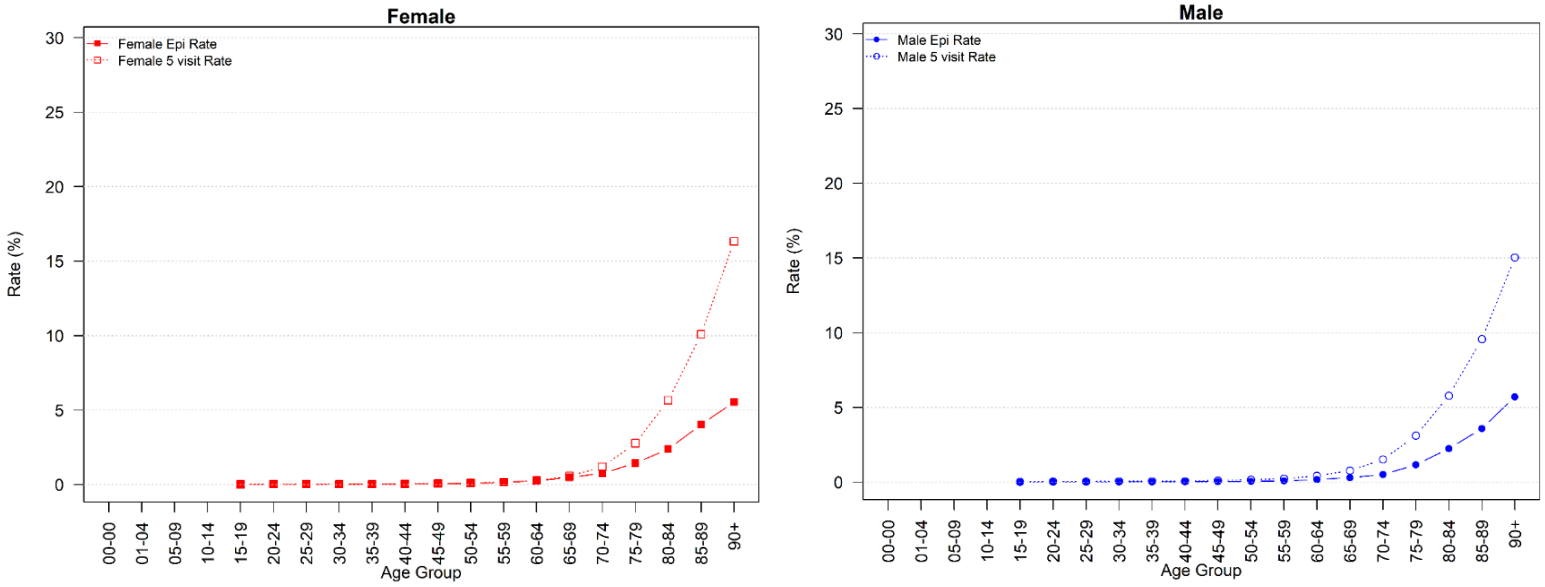
Figure 18 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for All Neurocognitive Disorders



ALTERNATIVE CASE DEFINITION

A conservative case definition was tested to determine if the treated prevalence could be aligned towards the expected prevalence. The required number of MSP claims was increased to five within 365 days (see Shirmaleki and Jones, 2019f for details). Figure 19 shows that this increase in the required number of claims slightly reduced the prevalence, resulting in the administrative data predicting substantially higher treated prevalence than the expected prevalence.

Figure 19 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Neurocognitive Disorders



DISCUSSION

The NCDs included in the case definition differed from those in the Phase 1 epidemiological data owing to the limited range of ICD-9 and ICD-10 codes included in our dataset. Nevertheless, the treated prevalence determined using our case definition was compared with the expected prevalence determined in Phase 1. The treated prevalence estimates for dementia, delirium, and vascular NCD were substantially higher than the expected prevalence of NCDs due to TBI and substance/medication use. This disparity was anticipated given that the expected prevalence does not cover major NCDs.

The alternative case definition was designed to reduce the discrepancy between the expected and treated prevalence by using a more conservative criterion. Nevertheless, the treated prevalence determined using the alternative case definition still surpassed the expected prevalence.

Despite the difference between the groups of NCDs compared, both the expected and treated prevalence increased with age, particularly in older age groups. The presence of NCDs in younger age groups as determined by treated prevalence might reflect

neurocognitive deficits associated with bipolar disorders (Doyle et al., 2009), schizophrenia disorder (Agnew-Blais & Seidman, 2013), substance use (Brown, et al., 2000), or sports-related head injuries (Karlin, 2011).

Because of data limitations, it was not possible to meaningfully compare the epidemiological and administrative data. Accordingly, previous studies report the challenges of conducting ongoing surveillance and analysis of TBIs. The addition of ICD-9 code 959.01 for "head injury unspecified" shifted the TBI coding from the initial ICD-9 code 850 for concussion (Centers for Disease Control and Prevention, 2003). According to the DSM-5, NCDs due to TBI should be coded in the following manner: ICD-9-CM 907.0 followed by 294.10 or 294.11; ICD-10-CM S06.2X9S followed by F02.80 or F02.81; or ICD-9-CM 331.83 or ICD-10-CM G31.84 (APA, 2013). Therefore, future research should examine the treated prevalence for NCDs due to TBI or substance/medication use with the relevant ICD-9 and ICD-10 codes. However, the three-digit-level of coding might hinder researcher owing to the lack of specificity required to adequately capture NCDs due to TBI or substance/medication use.

CONCLUSIONS

The initial case definition used for NCDs provides a measure of the treated population that is much higher than expected from the epidemiological data. This is expected, because the Phase 1 epidemiological data only capture NCDs due to TBI or substance/medication. However, the prevalence estimates for older adults are substantially underpredicted using the baseline definition for NCDs due to TBI or substance/medication use, because most MSP claims are not coded at the specificity required to capture such disorders. Therefore, the current coding system lacks the specificity required to differentiate various types of NCDs.

EPIDEMIOLOGICAL RESULTS

Personality disorders are characterized as having a lifelong course unlike many Axis I disorders included herein. As such, lifetime prevalence estimates for personality disorders were obtained during Phase 1 of the project. However, the prevalence was adjusted to a one-year estimate to align with the one-year service-planning analyses conducted for the NBP project. The adjusted annual age- and gender-specific prevalence estimates from Phase 1 are presented in Table 23.

Table 23 Epidemiological Age and Gender Distributions (Cases Per 100 Population; Adjusted to One Year) – Personality Disorders

	Female	Male
Age Group	All	All
15–19	3.8	2.5
20–24	4.2	2.7
25–29	4.4	2.8
30–34	4.4	2.8
35–39	4.2	2.6
40–44	3.9	2.3
45–49	3.2	2.0
50–54	2.5	1.6
55–59	1.8	1.2
60–64	1.2	0.9
65–69	0.9	0.8
70–74	0.7	0.8
75–79	0.6	0.8
80–84	0.5	0.8
85–89	0.5	0.8
≥90	0.6	0.9

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline personality disorder if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 301; or
- at least one hospital discharge (any discharge type) with an ICD-10 diagnostic code of F60, F61, or F62.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge claim (ICD-10 F60, F61, F62) in any diagnostic position; or
- an initial MSP claim with a 301 diagnosis and a second MSP claim with a 301 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 24.

Table 24 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Personality Disorders

Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.01	0.01	0.01	0.00	0.02	0.02	0.01	0.02
5–9	0.02	0.03	0.02	0.01	0.05	0.04	0.04	0.03
10–14	0.08	0.10	0.09	0.11	0.05	0.06	0.06	0.06
15–19	0.33	0.43	0.44	0.46	0.18	0.19	0.17	0.19
20–24	0.42	0.43	0.49	0.56	0.33	0.31	0.32	0.32

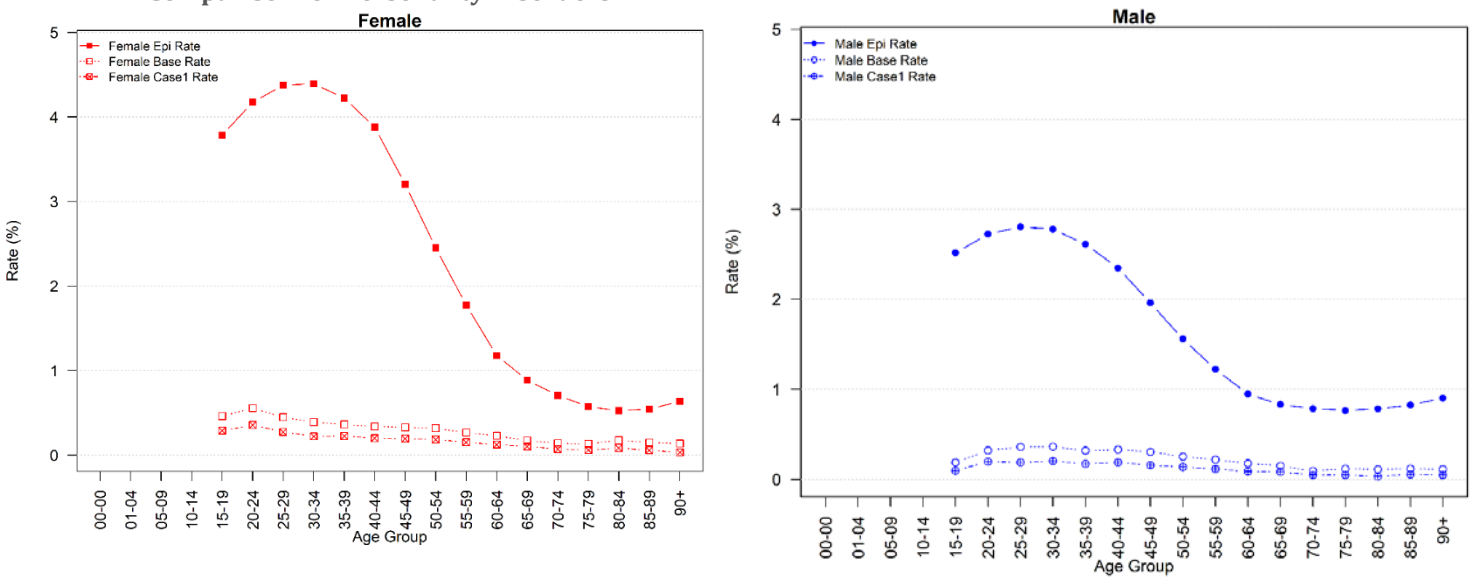
25–29	0.38	0.41	0.39	0.45	0.41	0.39	0.36	0.36
30–34	0.38	0.40	0.37	0.39	0.43	0.43	0.38	0.37
35–39	0.37	0.36	0.35	0.36	0.43	0.41	0.36	0.32
40–44	0.36	0.35	0.35	0.34	0.41	0.39	0.34	0.33
45–49	0.36	0.35	0.33	0.33	0.38	0.37	0.32	0.31
50–54	0.33	0.34	0.33	0.32	0.31	0.30	0.24	0.25
55–59	0.28	0.31	0.28	0.27	0.24	0.24	0.23	0.22
60–64	0.20	0.25	0.24	0.23	0.21	0.20	0.18	0.18
65–69	0.18	0.19	0.16	0.17	0.17	0.15	0.16	0.15
70–74	0.15	0.16	0.13	0.14	0.12	0.13	0.11	0.09
75–79	0.15	0.15	0.15	0.13	0.13	0.11	0.11	0.12
80–84	0.14	0.16	0.16	0.18	0.11	0.11	0.09	0.11
85–89	0.18	0.15	0.15	0.15	0.20	0.16	0.15	0.12
≥90	0.17	0.22	0.18	0.14	0.16	0.16	0.13	0.11
Initial Case Definition								
			Female				Male	
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	NA	NA	0.00	NA	0.01	0.00	NA	0.00
5–9	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
10–14	0.03	0.04	0.04	0.05	0.01	0.01	0.02	0.02
15–19	0.18	0.25	0.27	0.29	0.08	0.08	0.07	0.10
20–24	0.23	0.25	0.30	0.36	0.15	0.15	0.18	0.20
25–29	0.20	0.22	0.24	0.28	0.18	0.21	0.19	0.19
30–34	0.21	0.22	0.22	0.22	0.18	0.22	0.21	0.20
35–39	0.21	0.22	0.20	0.22	0.19	0.21	0.19	0.17
40–44	0.20	0.21	0.21	0.20	0.20	0.20	0.19	0.19
45–49	0.18	0.20	0.20	0.19	0.19	0.20	0.18	0.16
50–54	0.18	0.19	0.18	0.19	0.14	0.15	0.13	0.14
55–59	0.15	0.17	0.17	0.15	0.12	0.12	0.13	0.11
60–64	0.10	0.13	0.13	0.12	0.09	0.09	0.09	0.09
65–69	0.09	0.10	0.08	0.10	0.07	0.08	0.07	0.08
70–74	0.07	0.07	0.07	0.07	0.05	0.05	0.05	0.05
75–79	0.06	0.07	0.08	0.06	0.05	0.04	0.04	0.05
80–84	0.07	0.07	0.05	0.08	0.03	0.05	0.04	0.03
85–89	0.08	0.07	0.07	0.06	0.08	0.08	0.07	0.05
≥90	0.06	0.10	0.09	0.03	0.05	0.09	0.06	0.05

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 20 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for the most recent FY 2015/16 in the study dataset. Both baseline and case definitions produced prevalence estimates lower than the expected prevalence adjusted for annual representation. The expected prevalence was slightly higher for females than males. Unsurprisingly, this discrepancy was substantially greater in younger age groups, as older age groups were expected to have fewer cases.

The distribution of cases was generally the same among measures, whereby prevalence decreased with increasing age (of note, the slight increase in expected prevalence among older adults is due to the triangulation of data from different sources).

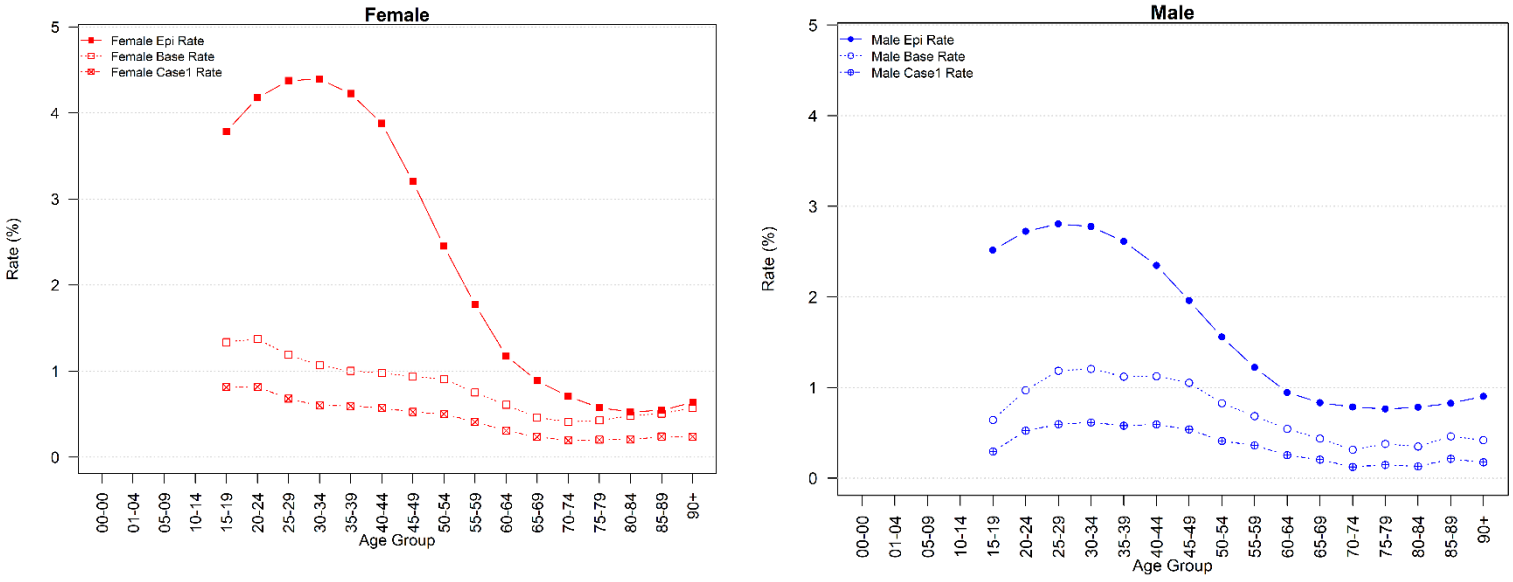
Figure 20 Prevalence based on Epidemiology (Adjusted) and Administrative Case Definitions – Comparison for Personality Disorders



ALTERNATIVE CASE DEFINITION

Given the substantial disparities observed between the expected and treated prevalence using the initial case definition, an alternative case definition was tested to determine if the treated prevalence could be aligned towards the expected prevalence. As a more relaxed criterion than the initial case definition, rather than within one year, the dataset was searched for one occurrence across four years using the baseline definition (Figure 21) (see Shirmaleki & Jones, 2019i for details). The distribution increased slightly using the alternative case definition compared to the initial case definition but the gap remained significant. No meaningful differences were observed between males and females.

Figure 21 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Personality Disorders



DISCUSSION

The initial case definition, the baseline definitions, and an alternative case definition with more-relaxed criteria were assessed for their ability to capture the estimated treated prevalence for personality disorders. The treated prevalence estimates derived from the initial case definition were substantially lower than the adjusted annual expected

prevalence. The expected prevalence was higher for females than males, while the treated prevalence showed no gender differences. Moreover, there were no differences between the baseline and initial case definitions.

The alternative case definition using a broader criterion (i.e., one claim for a personality disorder within four years) only slightly increased the treated prevalence. Figure 21 shows that the treated prevalence using the alternative case definition was slightly higher in females than males aged 15–24 years but the overall treated prevalence remained substantially lower than the adjusted annual expected prevalence.

The discrepancy between the expected and treated prevalence is unsurprising, as individuals with personality disorders often go undetected in clinical settings. This is partly because of the egosyntonic nature of personality disorders, whereby an individual fails to perceive their behaviours and thought patterns to be dysfunctional or problematic. Therefore, up to 80% of individuals meeting the criteria for personality disorders do not seek treatment (Andrews et al., 2006). Similarly, Tyrer et al. (2003) report that 75% of individuals with personality disorders rejected treatment.

Furthermore, prevalence increased in individuals aged 30–34 years using all four measures (i.e., expected, baseline, initial, and alternative case definitions), declining thereafter. Despite the lifelong duration of personality disorders, symptom severity reduces with age (Lenzenweger et al., 2004; Balsis et al., 2007; Hopwood & Bleidorn, 2018). The higher attrition rate of older adults in studies could also explain the observed decline in the expected prevalence in older adults (Costa et al., 1986).

CONCLUSION

Using the administrative data greatly underpredicts the expected prevalence of personality disorders regardless of which case definition is used, as most individuals with personality disorders remain untreated. Therefore, for surveillance purposes, the administrative data

could be used with the understanding that it greatly underestimates the presence of personality disorders in the population.

ALCOHOL-RELATED DISORDERS

EPIDEMIOLOGICAL RESULTS

The Phase 1 epidemiological results for alcohol-related disorders are presented in Table 25.

Table 25 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Alcohol-Related Disorders

	Female	Male
Age Group	All	All
15–19	7.3	14.0
20–24	6.0	11.7
25–29	4.8	9.8
30–34	3.9	8.1
35–39	3.2	6.7
40–44	2.7	5.5
45–49	2.4	4.9
50–54	2.3	4.5
55–59	2.1	4.1
60–64	1.9	3.9
65–69	1.8	3.7
70–74	1.7	3.6
75–79	1.7	3.5
80–84	1.8	3.4
85–89	1.9	3.4
≥90	2.1	3.4

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline alcohol-related disorder if they met the following criteria:

- at least one MSP claim with an ICD-9 diagnosis of 291 or 303; or
- at least one hospital discharge (any discharge type) with the ICD-10 code F10.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge with claim (ICD-10 F10) in any diagnostic position; or
- an initial MSP claim with a 291 or 303 diagnosis and a second MSP claim with a 291 diagnosis or a 303 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in the latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 26.

Table 26 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Alcohol-Related Disorders

Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
15–19	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3
20–24	0.4	0.4	0.4	0.4	0.6	0.6	0.6	0.6
25–29	0.4	0.4	0.4	0.5	0.8	0.8	0.8	0.7
30–34	0.5	0.4	0.4	0.4	0.9	0.9	0.8	0.9
35–39	0.5	0.5	0.4	0.4	0.9	0.9	0.9	1.0
40–44	0.5	0.5	0.5	0.5	1.1	1.1	1.1	1.0
45–49	0.6	0.6	0.5	0.6	1.2	1.2	1.1	1.1
50–54	0.6	0.6	0.6	0.6	1.2	1.2	1.2	1.3
55–59	0.5	0.5	0.5	0.5	1.1	1.1	1.2	1.2
60–64	0.4	0.4	0.4	0.5	1.0	1.0	1.1	1.1
65–69	0.4	0.4	0.4	0.4	1.0	1.0	1.0	1.0

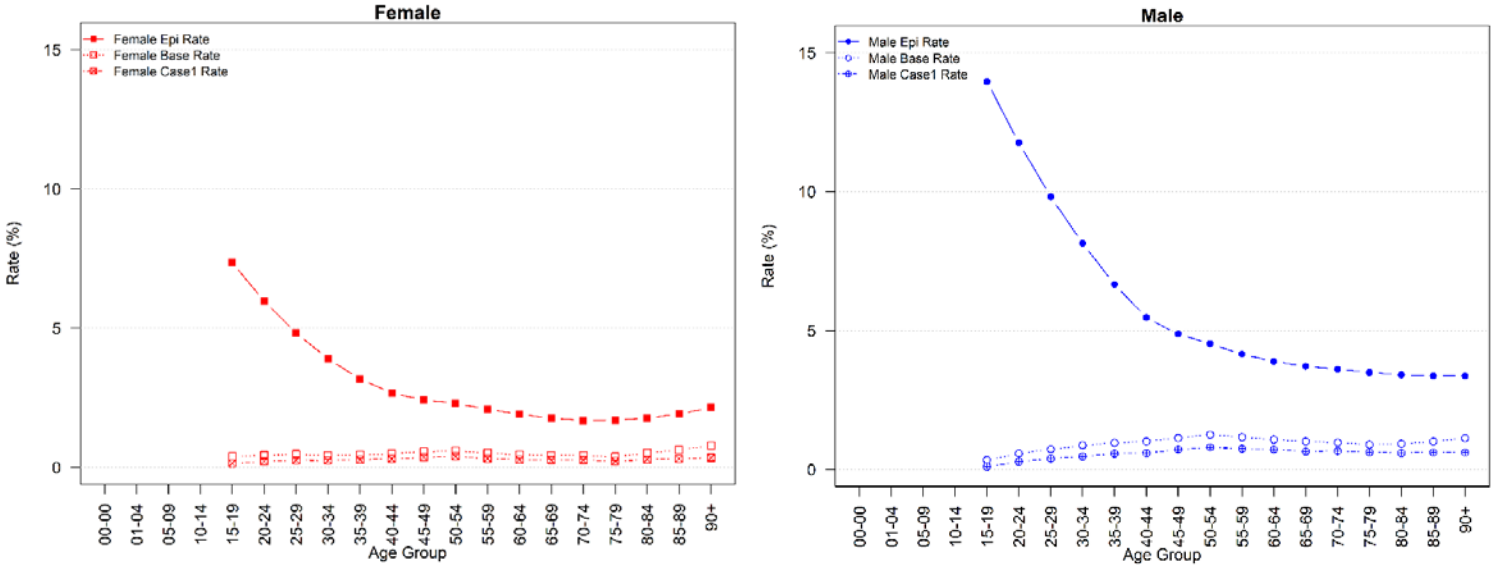
70–74	0.4	0.4	0.4	0.4	0.9	1.0	1.0	1.0
75–79	0.4	0.4	0.4	0.4	0.9	0.9	0.9	0.9
80–84	0.5	0.5	0.4	0.5	0.9	0.8	0.9	0.9
85–89	0.5	0.6	0.6	0.6	1.0	1.0	0.9	1.0
≥90	0.7	0.8	0.8	0.8	0.8	1.1	1.1	1.1
Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	NA	NA	NA	NA	NA	0.0	NA	0.0
5–9	0.0	0.0	NA	NA	0.0	0.0	0.0	NA
10–14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15–19	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
20–24	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
25–29	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4
30–34	0.3	0.3	0.3	0.2	0.4	0.5	0.5	0.5
35–39	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.6
40–44	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.6
45–49	0.4	0.4	0.3	0.4	0.7	0.7	0.7	0.7
50–54	0.4	0.4	0.4	0.4	0.7	0.8	0.8	0.8
55–59	0.3	0.3	0.3	0.3	0.7	0.7	0.8	0.7
60–64	0.2	0.2	0.3	0.3	0.6	0.6	0.7	0.7
65–69	0.2	0.3	0.2	0.3	0.6	0.6	0.7	0.7
70–74	0.2	0.2	0.3	0.3	0.6	0.6	0.7	0.7
75–79	0.2	0.3	0.2	0.2	0.6	0.6	0.6	0.6
80–84	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.6
85–89	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.6
≥90	0.4	0.4	0.4	0.4	0.5	0.6	0.7	0.6

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITION

Figure 22 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for the most recent FY 2015/16 in the study dataset. There were gender differences in the expected prevalence; specifically, prevalence was generally higher in males than females, especially in younger age groups. Both baseline and case definitions, produced treated prevalence

estimates that were lower than expected. Unsurprisingly, this discrepancy was greater among younger age groups, as older age groups are expected to have fewer cases.

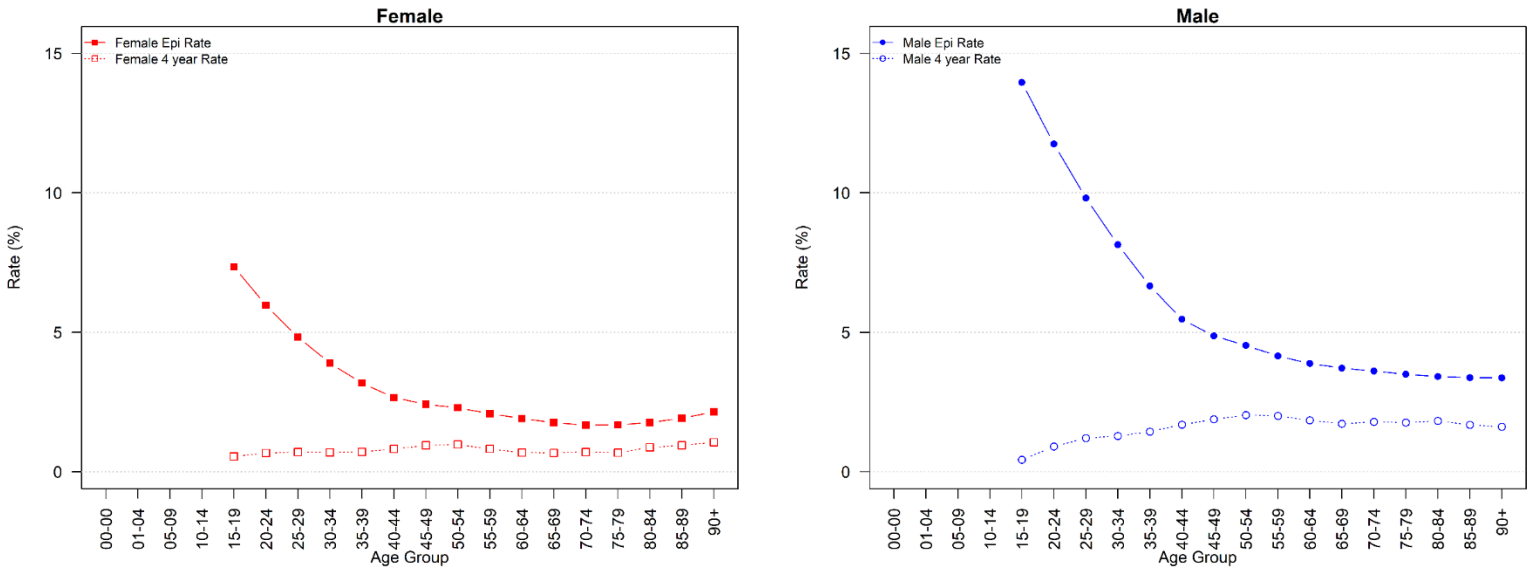
Figure 22 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Alcohol-Related Disorders



ALTERNATIVE CASE DEFINITION

An alternative case definition was tested to determine if the treated prevalence estimates could be aligned towards the expected prevalence. As a more relaxed criterion than in the initial case definition, the dataset was searched for one occurrence across four years (rather than within one year) using the baseline definition (see Jones, 2019b for details). Figure 23 shows that the treated prevalence increased when using the alternative case definition. However, the treated prevalence for both genders remained substantially lower than the expected prevalence for younger age groups.

Figure 23 Prevalence based on Epidemiology and Alternative Case Definitions – Comparison for Alcohol-Related Disorders



DISCUSSION

Using administrative data, three case definitions were tested for their ability to capture individuals with alcohol-related disorders. All three definitions yielded treated prevalence estimates that were substantially lower than the expected prevalence in individuals aged 15–39 years. For individuals aged ≥40 years, the difference between the expected and treated prevalence was consistently small.

While the age distribution was consistent between genders, the expected and treated prevalence were both higher in males than females. The gender difference became more pronounced when using the alternative case definition with a more-relaxed criterion of one MSP claim across four years or one hospital discharge claim. These results are concordant with research suggesting that females generally consume less alcohol than males (Substance Abuse and Mental Health Services Administration, 2002, as cited in Nolen-Hoeksema, 2004) and are less likely to develop alcohol use disorders (Erol & Karpyak, 2015).

The observed age differences are also consistent with studies showing that alcohol consumption is highest among young adults (Jackson, William, & Gomberg, 1998). However, despite the high expected prevalence among younger adults, the treated prevalence was lowest among this age group. Accordingly, one study reports that help-seeking behaviour is lowest among individuals aged 16–24 years who have substance use disorders, particularly males with alcohol-related disorders (Reavley, Cvetkovski, Jorm, & Lubman, 2010).

CONCLUSION

The treated prevalence estimates determined using the case definitions are substantially lower for individuals aged 15–39 years than other age groups. There was greater correspondence between the expected and treated prevalence for individuals aged ≥40 years. Therefore, the case definition may be better suited for monitoring alcohol-related disorders in middle-to-older age groups.

SUBSTANCE-RELATED DISORDERS

EPIDEMIOLOGICAL RESULTS

Case definitions for specific substance use disorders could not be used because of the lack of specificity in the administrative data. The first three digits of ICD-9 code 304 include all types of drug dependence other than alcohol-related disorders, while specific substance use disorders are identified at the fourth digit level. For example, cannabis-related disorders are identified as ICD-9 code 304.3, while opioid-related disorders are identified as ICD-9 code 304.0. In the current dataset, 96% of all drug dependence claims were only coded at the three-digit level (i.e., 304). Consequently, a case definition that captures all substance use disorders in MSP claims as well as cannabis-, opioid-, and stimulant-related disorders in hospital discharge claims was developed (Jones & Shirmaleki, 2019a).

Phase 1 age- and gender-specific prevalence estimates for cannabis-, opioid-, and stimulant-related disorders were combined to present an overall substance use disorder distribution in order to compare the treated prevalence estimates with the expected prevalence (Table 27).

Table 27 Epidemiological Age and Gender Distributions (Cases Per 100 Population) – Substance Use Disorders

	Female	Male
Age Group	All	All
15–19	3.8	6.2
20–24	3.0	5.5
25–29	2.4	4.8
30–34	1.9	4.2
35–39	1.6	3.5
40–44	1.4	2.9
45–49	1.2	2.5
50–54	1.1	2.1
55–59	0.9	1.7
60–64	0.8	1.2
65–69	0.8	0.9
70–74	0.7	0.8
75–79	0.6	0.6
80–84	0.5	0.4
85–89	0.4	0.3
≥90	0.2	0.2

ADMINISTRATIVE CASE DEFINITION

An individual was classified as having a baseline substance use disorder if they met the following criteria:

- either one MSP claim with an ICD-9 code of 292, 304, or 305; or
- one hospital discharge (any discharge type) with an ICD-10 code of F11, F12, F14, F15, or F19.

To qualify as a case, an individual had to meet the following minimum requirements in any fiscal year:

- either one hospital discharge claim (ICD-10 F11, F12, F14, F15, or F19) in any diagnostic position; or
- an initial MSP claim with a 292, 304, or 305 diagnosis and a second MSP claim with a 290, 304, or 305 diagnosis within 365 days of the date of the initial claim.
- If the claim period spanned a fiscal year boundary, the individual would be counted as a case in latter fiscal year.

Age- and gender-specific prevalence distributions are presented in Table 28.

Table 28 Observed Age and Gender Distributions (Cases Per 100 Population) based on Baseline and Initial Case Definitions – Substance Use Disorders

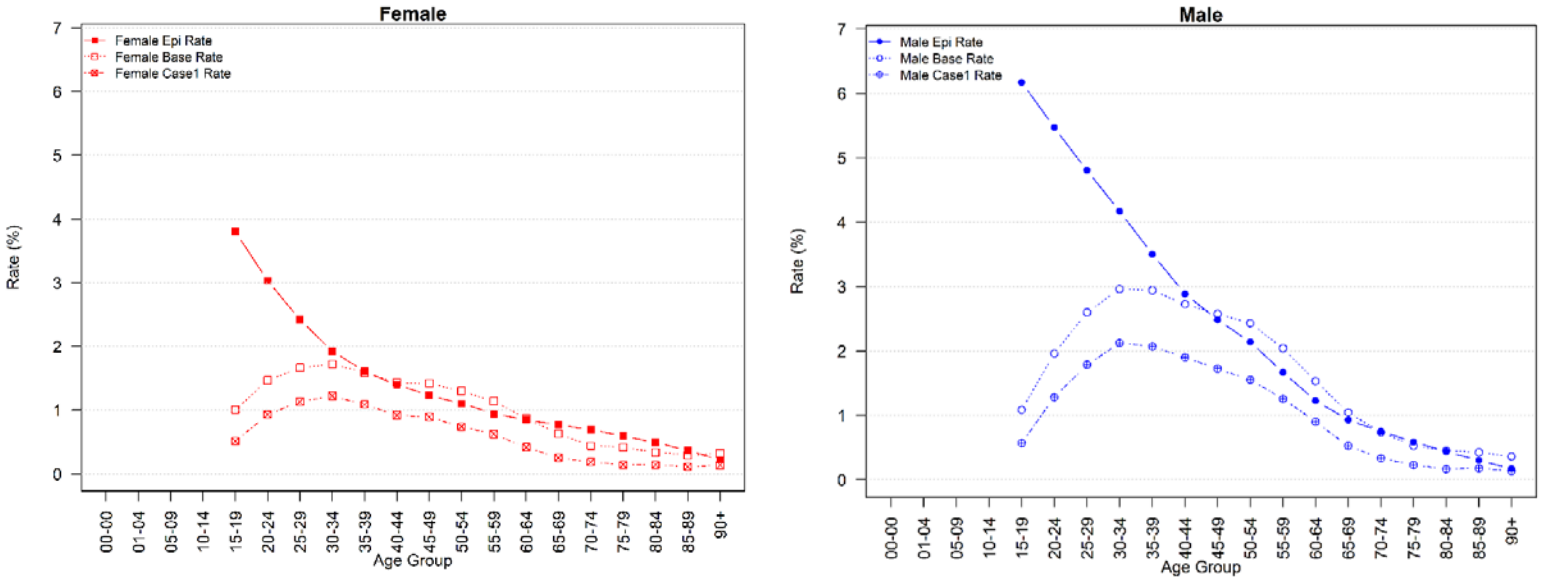
Baseline Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
5–9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10–14	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
15–19	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.1
20–24	1.3	1.3	1.4	1.5	1.7	1.8	1.8	2.0
25–29	1.5	1.5	1.5	1.7	2.3	2.3	2.4	2.6
30–34	1.7	1.6	1.7	1.7	2.8	2.8	2.8	3.0
35–39	1.4	1.5	1.5	1.6	2.6	2.7	2.7	2.9
40–44	1.3	1.4	1.4	1.4	2.6	2.6	2.6	2.7
45–49	1.3	1.3	1.3	1.4	2.3	2.4	2.4	2.6
50–54	1.2	1.3	1.3	1.3	2.1	2.2	2.2	2.4
55–59	1.0	1.0	1.1	1.1	1.7	1.9	1.9	2.0
60–64	0.7	0.7	0.8	0.9	1.2	1.3	1.4	1.5
65–69	0.5	0.5	0.6	0.6	0.8	0.9	0.9	1.0
70–74	0.4	0.4	0.5	0.4	0.6	0.6	0.7	0.7
75–79	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
80–84	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.5
85–89	0.3	0.4	0.3	0.3	0.3	0.4	0.4	0.4
≥90	0.3	0.2	0.3	0.3	0.3	0.3	0.5	0.4

Initial Case Definition								
	Female				Male			
Age Group	2012/13	2013/14	2014/15	2015/16	2012/13	2013/14	2014/15	2015/16
0–4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–9	0.0	NA	0.0	NA	0.0	0.0	NA	0.0
10–14	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
15–19	0.4	0.5	0.5	0.5	0.4	0.5	0.6	0.6
20–24	0.7	0.9	0.9	0.9	1.0	1.1	1.2	1.3
25–29	1.0	1.0	1.1	1.1	1.4	1.5	1.6	1.8
30–34	1.1	1.1	1.1	1.2	1.8	1.9	2.0	2.1
35–39	0.9	1.0	1.0	1.1	1.7	1.8	2.0	2.1
40–44	0.8	0.9	0.9	0.9	1.6	1.8	1.8	1.9
45–49	0.7	0.8	0.8	0.9	1.4	1.6	1.6	1.7
50–54	0.6	0.7	0.7	0.7	1.2	1.4	1.4	1.6
55–59	0.5	0.5	0.6	0.6	1.0	1.1	1.1	1.3
60–64	0.3	0.3	0.4	0.4	0.6	0.7	0.8	0.9
65–69	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5
70–74	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3
75–79	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2
80–84	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2
85–89	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2
≥90	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1

CORRESPONDENCE BETWEEN EPIDEMIOLOGY AND CASE DEFINITIONS

Figure 24 shows the age- and gender-specific prevalence estimates based on the epidemiological data as well as the baseline and initial case definitions for the most recent FY 2015/16 in the study dataset. The relationship between the three distributions was similar among both genders. Using all three measures, the prevalence estimates were slightly higher among males than females. Overall, both the baseline and case definitions produced treated prevalence estimates that were considerably lower than the expected prevalence in younger age groups. Nevertheless, all three measures yielded closely aligned prevalence estimates among individuals aged ≥30 years.

Figure 24 Prevalence based on Epidemiology and Administrative Case Definitions – Comparison for Substance-Related Disorders



ALTERNATIVE CASE DEFINITION

An alternative case definition was not required given the overall alignment between the initial case definition and the epidemiological data.

DISCUSSION

Case definitions for specific substance use disorders could not be tested because of the lack of specificity in the dataset. Therefore, a case definition was developed to capture all substance-related disorders, as 96% of all drug dependence claims were limited to the three-digit-level of coding and hence could not differentiate specific substance use disorders. Specifically, the ICD-10 codes used included individuals that met the criteria for cannabis-, stimulant-, and opioid-related disorders, while the ICD-9 codes included any substance use disorder including hallucinogen dependence, sedative dependence, and other unspecified drug dependence. Alcohol-related disorders were excluded from this group because they are identified using ICD-9 codes 291 and 303. Likewise, the

epidemiological data for cannabis-, stimulant-, and opioid-related disorders were combined to create a substance use disorder group that could be used to compare the treated and expected prevalence of substance-related disorders.

The baseline and case definitions adequately captured individuals aged ≥30 years with substance-related disorders. However, the baseline definition produced prevalence estimates that surpassed the expected prevalence among certain age groups. Given the high overall correspondence between the prevalence estimates determined using the case definition and epidemiological data, an alternative case definition for substance-related disorders was not required.

The expected and treated prevalence were higher among males than females until age 65–69 years, after which the prevalence was similar between genders. Prevalence decreased with increasing age among both genders, although there was a significant discrepancy between the expected and treated prevalence among both males and females aged <30 years. Younger adults had the highest expected prevalence but the lowest treated prevalence, suggesting that the case definition does not capture most individuals with a substance use disorder. One possible explanation for this is that younger adults with substance use disorders are less likely to seek treatment (Reavley et al., 2010). Compared to older adults, younger individuals tend to be more ambivalent about receiving treatment and have more difficulties perceiving the consequences of their substance use (Winters, 1999). Another possibility is that the definitions underpredicted the treated prevalence as they are limited to physician and hospital discharge claims. Accordingly, individuals receiving care in the community or picked up by the emergency department might not be captured. Therefore, to improve the detection of substance-related disorders in younger populations, further research could utilize case definitions that include administrative data from the emergency department and community mental health services.

CONCLUSION

The initial case definition provides a good measure for capturing adults aged ≥30 with substance-related disorders, yielding treated prevalence estimates similar to the expected prevalence. Unfortunately, the case definition greatly underpredicts young individuals with substance-related disorders. Therefore, our case definition could be used to monitor middle-to-older age groups with substance-related disorders.

PREVALENCE OF THE 11 MSU DISORDER GROUPS

Table 29 shows the correspondence between the Phase 1 prevalence estimates based on the meta-analysis results (i.e., expected prevalence) and the overall prevalence estimates derived from the administrative data using case definitions collapsed over age and gender (i.e., treated prevalence) over FY 2015/16. The treated prevalence estimates were consistently lower than the expected prevalence across all MSU disorder groups except for bipolar and related disorders. Correspondence between the two measures was highest for bipolar and related disorders, schizophrenia spectrum disorders, anxiety disorders, and depressive disorders. Conversely, NCDs, intellectual disabilities, and personality disorders had the lowest correspondence between the expected and treated prevalence. It is important to note that comparing overall prevalence estimates can potentially mask age- and gender-specific variations between the expected and treated prevalence. For instance, as shown in Table 29, there was high correspondence between the expected and treated prevalence for bipolar and related disorders, while the age- and gender-specific results (Table 10) exhibited large age- and gender-specific discrepancies between the expected and treated prevalence.

Table 29 Correspondence between Phase 1 Epidemiological and Administrative Data Prevalence Estimates (Cases per 100 Population)

MSU Disorder Group	Expected Prevalence	Treated Prevalence		Correspondence between Expected and Treated Prevalence
		One-year Prevalence (FY 2015/16)	Four-year Prevalence***	
Depressive Disorders	6.42	3.94	--	61%
Anxiety Disorders	6.90	4.86	--	70%
Schizophrenia Spectrum and Other Psychotic Disorders*	0.55	0.53	--	96%
Bipolar and Related Disorders*	0.93	0.99	--	106%
ADHD*	3.60	0.50	0.63	14%
Feeding and Eating Disorders	0.33	0.03	--	9%
Intellectual Disabilities*	0.60	0.02	0.06	3%
NCDs*	0.33	0.01	--	4%
Personality Disorders*	13.35	0.16	--	1%
Alcohol-Related Disorders	4.80	0.42	--	9%
Substance Use Disorders**	2.20	1.00	--	45%

* Lifetime disorders

** Derived from Phase 1 results.

*** Calculated for select MSU disorder groups, cases occurring at any time during the four-year study period.

SUMMARY OF RESULTS

Our objective was to test the feasibility of using administrative data to capture the treated prevalence of 11 MSU disorder groups as a means to monitor them in the BC population. We have compared the baseline definitions (i.e., minimum of one MSP claim or one DAD entry), case definitions (i.e., minimum of two MSP claims or one DAD entry), and alternative case definitions (as appropriate) were compared to the expected prevalence based on epidemiological data. The case definitions generally provide the best measure of these disorders relative to the expected prevalence.

The correspondence between the expected and treated prevalence varied among MSU disorder groups. Schizophrenia and other psychotic disorders, anxiety disorders, and substance use disorders exhibited the closest correspondence between the expected and treated prevalence. Meanwhile, the treated prevalence of personality disorders, eating disorders, ADHD, and NCDs was substantially lower than the expected prevalence. Accordingly, including community mental health and substance use service data might strengthen the treated prevalence estimates for these disorders.

Both treated and expected prevalence varied with respect to age and gender. Females tended to have higher prevalence estimates for mood disorders, whereas males tended to have higher prevalence estimates for alcohol and other substance use disorders. The prevalence of most MSU disorders declined with age. However, there were sharp increases in the treated prevalence of schizophrenia and other psychotic disorders, depressive disorders, bipolar and related disorders, and NCDs among older adults.

OBJECTIVE II: DISORDER-SPECIFIC SEVERITY ALGORITHMS

INTRODUCTION

The second objective of this project was to further refine the algorithms by developing a set of definitions for different levels of case severity for each disorder (e.g., "mild," "moderate," and "severe"). Severity distributions are important within the NBP framework because the services required for a disorder vary with respect to severity as indicated by the NBP panels. Including severity measures within the administrative data could aid the surveillance of service utilization by considering the severity level.

The feasibility of testing severity algorithms depends on the accuracy of the disorder-specific case definitions developed in Objective I. Indeed, the case definitions detailed in Objective I provided reasonable estimates of the treated populations of several disorder groups. However, the treated prevalence estimates of some disorder groups based on the case definitions were much lower than the expected prevalence. Nevertheless, severity algorithms were developed, as the treated prevalence appeared to conform to the expected age and gender distributions of most disorder groups.

Panelists from the NBP project consistently reported that the severity levels of MSU disorders are determined according to the extent of functional impairment and disruption in daily activities and wellbeing. As it was not possible to measure these variables using administrative data, the PWG developed severity algorithms based on service utilization patterns as a measure of symptom severity, whereby individuals with higher severity levels were assumed to have more visits within a year.

Building on the severity algorithms developed by the PWG, the PDAC aimed to explore additional measures to improve and further validate these algorithms. This chapter presents the measures of severity tested using the administrative data. Furthermore, the

results were compared with the existing epidemiological severity breakdowns developed in Phase 1 (Vigo et al., 2019).

METHODOLOGY

SEVERITY ALGORITHMS

The PWG defined severity separately for each data source (i.e., MSP, DAD, and PharmaNet[8]). The most severe level derived from either the MSP or DAD data sources was selected as the severity level for each individual for the disorder of interest. The PWG tested their severity algorithms for depressive disorders with the following definitions:

- Severe:
    - hospital diagnosis is the most responsible diagnosis; or
    - four MSP claims within 60 days.
- Moderate:
    - hospital diagnosis is *not* the most responsible diagnosis; or
    - at least three MSP claims in a year.
- Mild:
    - no hospital record with the diagnosis in a year; or
    - two MSP claims in a year.

When using the MSP data, mild depression was defined as having a maximum of two visits in a fiscal year. Severe depression was defined as having four or more visits within 60 days. Finally, moderate depression was defined as a case of depression not meeting the criteria for mild or severe depression.

When using DAD codes, severe depression was defined as having any hospital discharge with the most responsible diagnosis being depression. Moderate depression was defined as having one hospital diagnosis of depression other than the most responsible diagnosis.

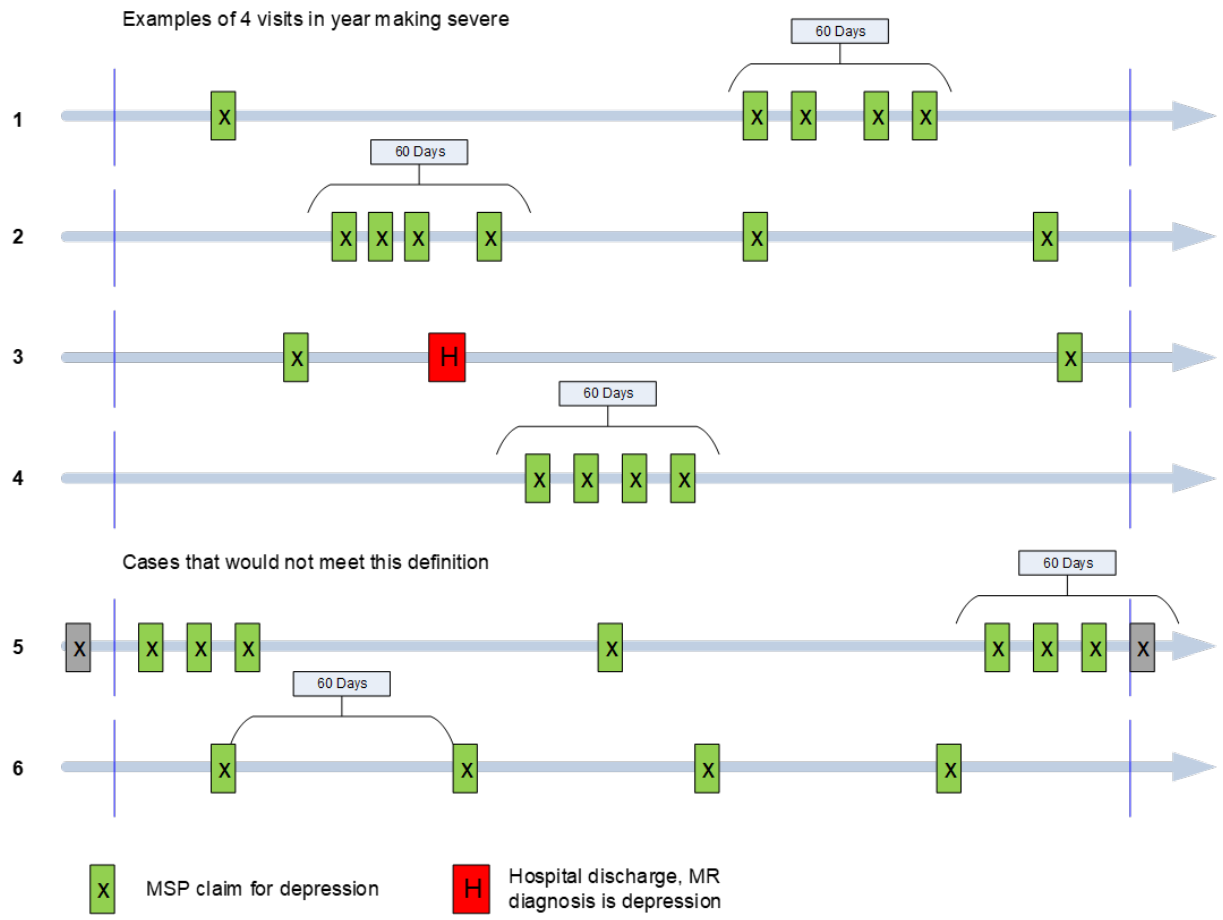
[8] Despite extensive analysis, the PWG was unable to incorporate PharmaNet data into the severity algorithms.

Meanwhile, an individual with any hospital discharge with depression as one of the discharge diagnoses means the individual cannot have a mild level of depression.

TIMEFRAME FOR SEVERITY LEVELS

The PWG members defined "severe" as having at least four claims within a 60-day period. This timeframe averaged out to one visit biweekly for the disorder of interest. Because of the lack of literature to guide the selection of these criteria, the PWG and PDAC examined the impacts of altering these criteria. In our analysis of depressive disorders, the maximum number of visits for moderate depressive disorders within a year was 18, which supports the use of the cut-off of four claims within a 60-day period for severe depressive disorders. Figure 25 illustrates how an individual would meet the criteria for severe depression according to this timeframe.

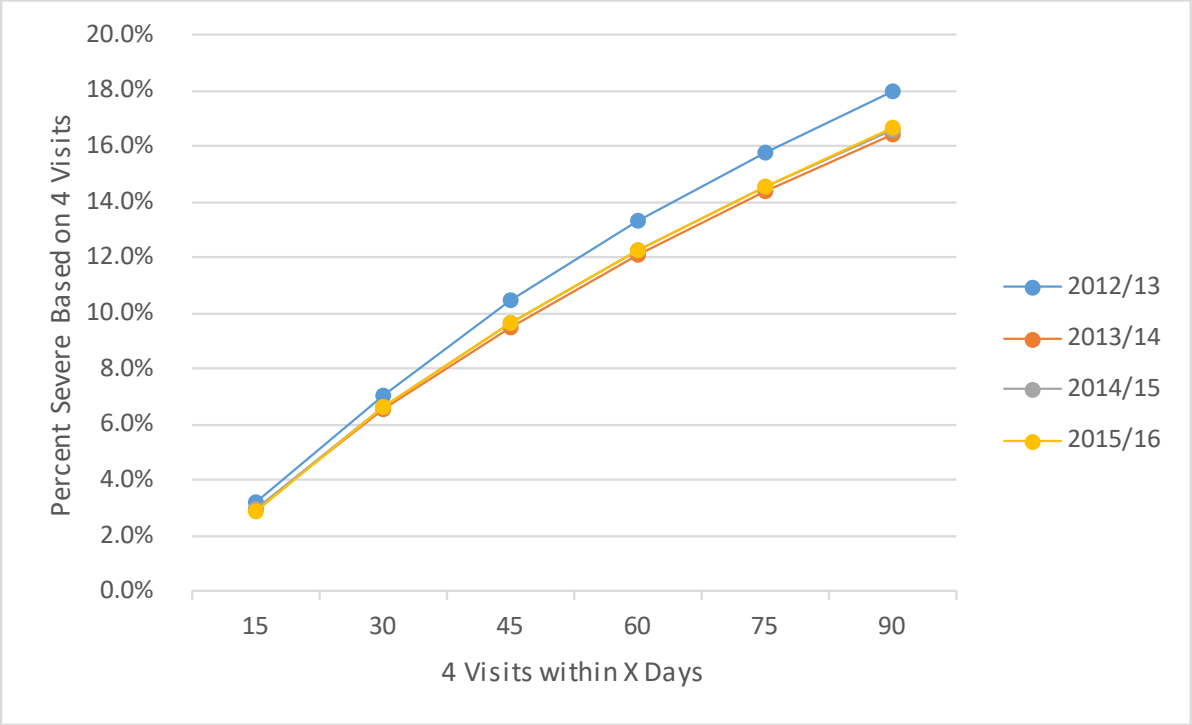
Figure 25 Timeframe for a Severe Case of Depression



Note: MR = most responsible

Four claims within timeframes other than 60 days were also examined (see Jones & Shirmaleki, 2019b for details). Using anxiety-related disorders as an example, Figure 26 illustrates the percentage of individuals meeting the criteria for severe anxiety-related disorders across different timeframes. As expected, the percentage of severe anxiety-related disorders increased with increasing timeframe; these results were consistent across all four years. Therefore, the PDAC concluded that the results did not indicate any reason *not* to use four visits within 60 days as a criterion for severe.

Figure 26 Percentages of Individuals Meeting the Criteria for Severe Anxiety-Related Disorders across Different Timeframes



LONGITUDINAL ANALYSIS

Severity patterns from FY 2012/13 to 2015/16 within the dataset were also examined to determine whether an individual remained at the same severity level for each disorder of interest over the study period.

OTHER MEASURES CONSIDERED PROXIES FOR SEVERITY

Building on the severity algorithms developed by the PWG, the PDAC examined the presence of other psychiatric disorders and psychiatrist visits as additional proxies for

severity.[9] However, none of these measures were found to be useful for improving the existing severity definitions. These measures were:

Presence of other psychiatric disorders: The presence of comorbid psychiatric disorders was tested as an indicator of severity. While the results were considered to possibly identify more-complex cases, the presence or absence of a comorbid disorder might not impact the severity of the disorder under consideration. For example, an individual can have severe depression regardless of whether they have a comorbid substance use disorder (see Jones & Tallon, 2018a for details). Therefore, this measure was excluded from the severity analysis.

Visits to a psychiatrist: Psychiatrist visits were also considered as an indicator of higher severity. However, our analysis revealed regional variations in the number of available psychiatrists across health authorities and health service delivery areas. Given that such variability in access to psychiatrists among regions would confound our results, this measure was also excluded from the severity analysis (See Jones & Shirmaleki, 2019g for details).

PHARMANET DATA

PHARMANET ALGORITHMS DEVELOPED BY THE PWG

The PWG also explored the utility of PharmaNet data to increase the validity of each severity algorithm. The initial PharmaNet analysis was tested on depressive disorders and was based on the counts of prescriptions associated with the American Hospital Formulary Service (AHFS) antidepressant classification of 28:16.04.xx. The preliminary results

[9] See *Attachment 3.1 Depressive_Disorders.docx* distributed with the 2018-12-07 PDAC meeting materials.

indicate that the number of prescriptions might be useful as a measure of severity levels with the following criteria:

- Severe: ≥18 filled prescription within a year.
- Moderate: 3–17 filled prescription within a year.
- Mild: ≤2 filled prescription within a year.

However, there were some methodological issues with the original PharmaNet data abstraction, and the revised data created uncertainty about the value of the PharmaNet data for assessing the severity of depression. No final decision was reached by the time the PWG was concluded.

PHARMANET ALGORITHMS USED IN THIS PROJECT

As part of the NBP project, the PDAC further examined the PharmaNet claims by examining the distribution of PharmaNet prescriptions by severity level (see Shirmaleki & Jones, 2019h for details). The sample comprised individuals who met the case definition for at least one of the 11 MSU disorder groups in FY 2014/15. Individuals in the sample were further stratified by severity level according to the severity algorithm and their PharmaNet claims for FY 2014/15. The PharmaNet Drug Identification Number (DIN) was used to determine the AHFS code for each drug provided in the claim.

The AHFS codes were grouped as follows:

- any AHFS code/drug;
- AHFS codes associated with all mental disorders (“28:”);
    - medications/AHFS codes for each disorder group were assigned using disorder-specific guidelines (Adams et al., 2017; Geller et al., 2017; Gorla & Mathews, 2005; Oldham et al., 2001; Katzman et al., 2014 Kennedy et al., 2016; Lehman et al., 2010; Sullivan et al., 2018; Yatham et al., 2018).

SEVERITY ALGORITHMS VERSUS EPIDEMIOLOGICAL SEVERITY DISTRIBUTION

Our severity algorithm was compared with the Global Burden of Disease (GBD) severity breakdown (Burstein et al., 2015; GBD 2015 Disease and Injury Incidence and Prevalence Collaborators, 2016) used in the Phase 1 analysis (Vigo et al., 2019). The GBD provides severity distributions for all disorder groups of interest except for ADHD, eating disorders, intellectual disabilities, and NCDs. Alternative approaches were developed and applied for these disorder groups in Phase 1 (Vigo et al., 2019).

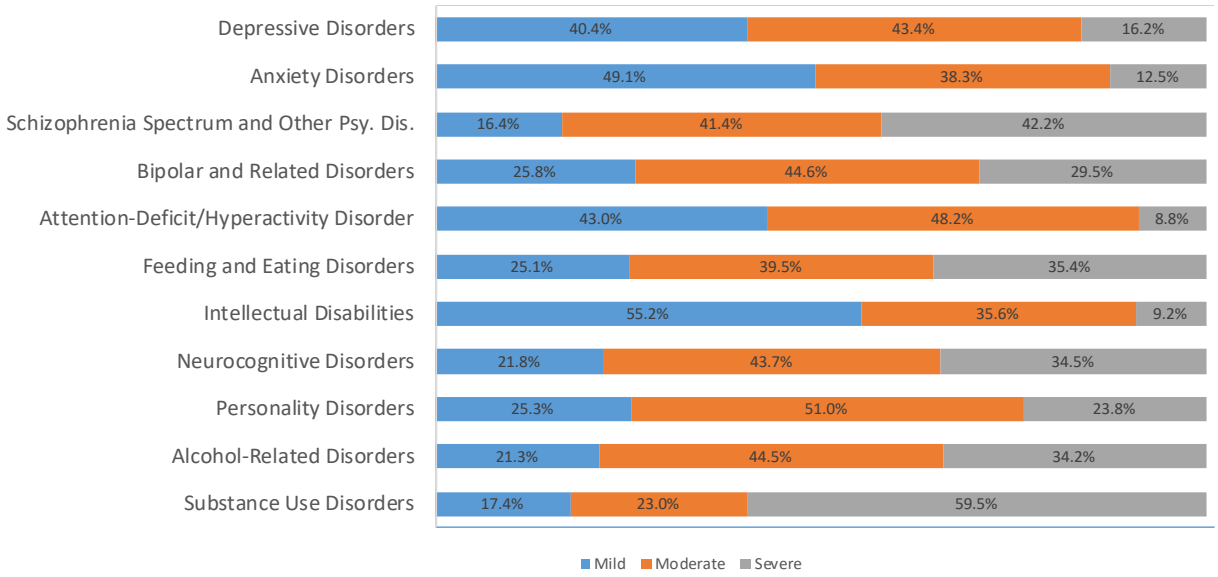
The GBD categorizes severity according to severity level (e.g., "asymptomatic," "mild," "moderate," or "severe") or health state (e.g., "manic," "depressive," or "psychosis"). The asymptomatic classification was difficult to apply to this project, because it represents individuals who are not experiencing any symptoms of their disorder and would therefore not be included in one-year prevalence estimates. Therefore, GBD severity was categorized with or without the asymptomatic category. It should also be noted that in Phase 1, asymptomatic and mild were combined for eating disorders and intellectual disabilities. Health states rather than severity levels were used for bipolar and related disorders as well as schizophrenia spectrum and other psychotic disorders to reflect distinct periods of episodes and residual states. To compare the severity algorithms with Phase 1 health states, the "residual" health state was compared to mild severity, the depressive episode was compared to moderate severity, and psychosis (i.e., manic or acute psychosis) was compared to severe.

RESULTS

SEVERITY BREAKDOWN BY MSU DISORDER GROUP

Figure 27 illustrates the severity breakdowns for FY 2014/15. Similar patterns were observed across all four years.

Figure 27 Severity Breakdown by Disorder Groups for FY 2015/16



The greatest proportion of schizophrenia spectrum and other psychotic disorders fell under the severe category, accounting for 42.2% of all cases within this group. In contrast, the greatest proportions of ADHD cases were mild and moderate, representing 43% and 48.2% of all cases within this group, respectively. Similarly, depressive and anxiety disorders had greater proportions of mild and moderate cases than severe cases.

LONGITUDINAL RESULTS

Although results for all disorder groups were analyzed, this report presents data for anxiety disorders; the results for all 11 MSU disorder groups are presented in Jones & Shirmaleki (2019b). Table 30 presents the patterns of severity for anxiety disorders during the study period from the highest to the lowest proportions. The results show that the most common severity pattern for anxiety disorders was mild for a single year followed by moderate for a single year. The cumulative percentage ("CumPercent") shows that individuals who only met the case definition in a single year for mild or moderate severity accounted for nearly 60% of all individuals who met the case definition for anxiety disorders.

Among the individuals who met the case definition for two consecutive years, the most common pattern was mild in both years, representing 2.4% of all combinations. Less than 25 individuals met the case definition during all four years with varying severity levels. The severity patterns were similar across the 11 MSU disorder groups.

Table 30 Severity Distribution Patterns for Anxiety Disorders during the Study Period

Fiscal Year						
1213	1314	1415	1516	Freq	Percent	CumPercent
			mild	55,332	11.4%	11.4%
	mild			49,976	10.3%	21.8%
		mild		49,229	10.2%	31.9%
mild				39,034	8.1%	40.0%
			modr	29,409	6.1%	46.1%
modr				23,366	4.8%	50.9%
		modr		20,688	4.3%	55.2%
	modr			19,774	4.1%	59.3%
			sevr	10,040	2.1%	61.4%
		mild	mild	6,541	1.4%	62.7%
sevr				6,107	1.3%	64.0%
		modr	**modr**	6,054	1.3%	65.2%
	mild	mild		5,995	1.2%	66.5%
		sevr		5,694	1.2%	67.7%
	sevr			5,197	1.1%	68.7%
		mild	**modr**	5,112	1.1%	69.8%
	mild		mild	5,068	1.0%	70.8%
modr	**modr**			4,395	0.9%	71.7%
		modr	mild	4,018	0.8%	72.6%
modr	**modr**	**modr**	**modr**	4,000	0.8%	73.4%
mild	mild			3,967	0.8%	74.2%
modr	mild			3,920	0.8%	75.0%
mild		mild		3,704	0.8%	75.8%
	mild	**modr**		3,564	0.7%	76.5%
	modr	**modr**		3,503	0.7%	77.3%
	modr	mild		3,219	0.7%	77.9%
mild			mild	2,954	0.6%	78.5%
mild	**modr**			2,913	0.6%	79.1%
modr		mild		2,857	0.6%	79.7%
	modr		mild	2,672	0.6%	80.3%
	mild		**modr**	2,483	0.5%	80.8%
	modr	**modr**	**modr**	2,331	0.5%	81.3%
		sevr	**modr**	2,310	0.5%	81.8%
modr			mild	2,184	0.5%	82.2%
modr	**modr**	**modr**		1,929	0.4%	82.6%
	mild	**modr**	**modr**	1,608	0.3%	82.9%
mild		**modr**		1,593	0.3%	83.3%
	modr		**modr**	1,556	0.3%	83.6%
		sevr	**sevr**	1,509	0.3%	83.9%
206 other combinations				77,683	16.1%	100.0%
sevr	**sevr**	mild	**sevr**	25	0.0%	99.9%
mild	**sevr**		**sevr**	24	0.0%	99.9%
modr	**sevr**	mild	**sevr**	24	0.0%	99.9%
sevr	mild	**sevr**	**sevr**	24	0.0%	99.9%
mild	**sevr**	mild	mild	22	0.0%	100.0%
mild	**sevr**	**sevr**	mild	22	0.0%	100.0%
mild	mild	**sevr**	mild	21	0.0%	100.0%
sevr	mild	**sevr**	mild	20	0.0%	100.0%
sevr	mild	mild	**sevr**	14	0.0%	100.0%
mild	**sevr**	mild	**sevr**	13	0.0%	100.0%
Total				483,697		

Note. The middle 206 rows are collapsed into one. CumPercent = cumulative percentage; Freq = Frequency; modr = moderate; sevr = severe.

PHARMANET RESULTS

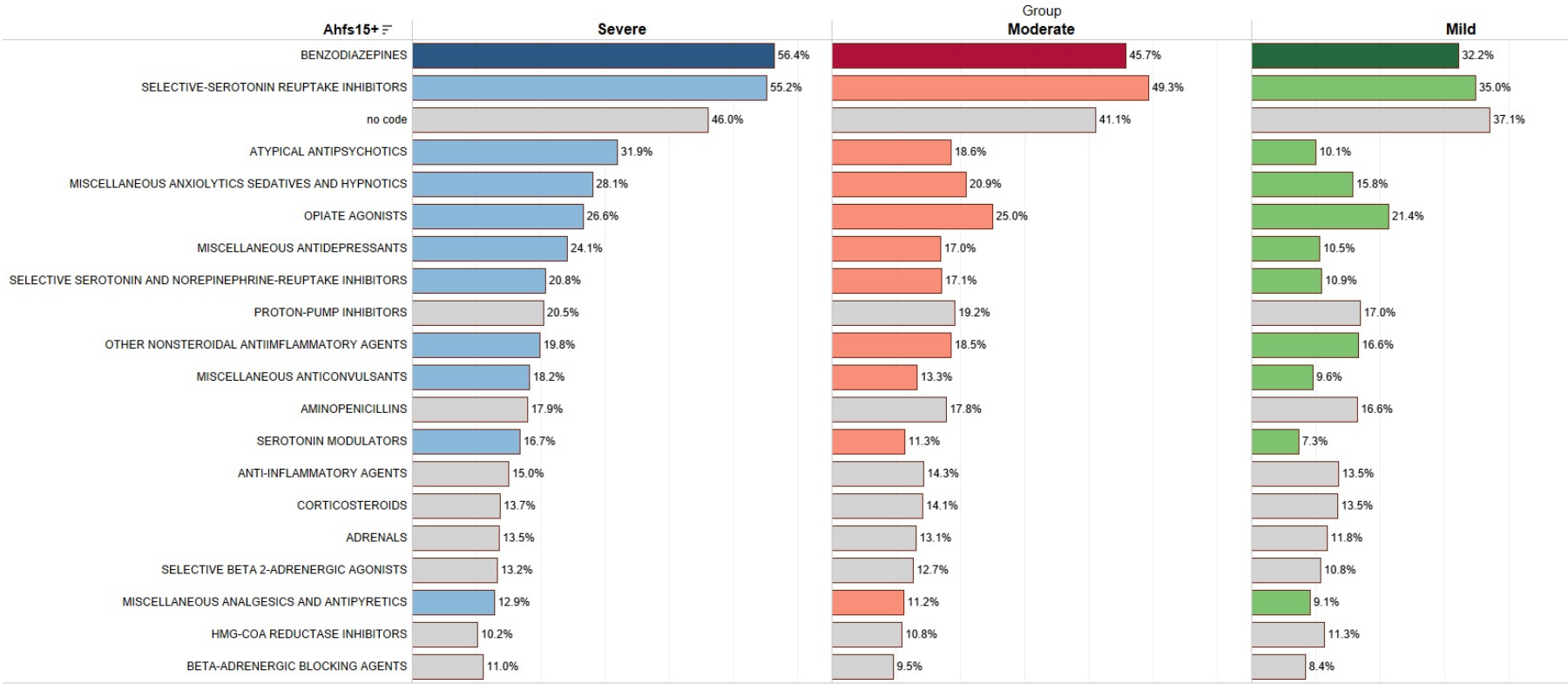
This report presents data for anxiety disorders as an example of the results (see Shirmaleki & Jones, 2019h for results on all 11 MSU disorder groups). Table 31 summarizes the results for individuals who met the case definition for anxiety disorders, stratified by severity level and type of medication prescribed. Almost all individuals with an anxiety disorder (96.2%) received a prescription for any type of drug ("Any Pharma"), while 85.4% received a prescription for a psychiatric drug. Some relationship was observed between prescriptions typically used to treat anxiety and severity level. For instance, the numbers of prescriptions for benzodiazepines alone and benzodiazepines with antidepressants increased with severity. Benzodiazepines, a type of tranquillizer often prescribed to treat anxiety or insomnia, are usually not readily available to individuals owing to their likelihood of abuse and addiction.

Figure 28 presents the top 20 drugs prescribed to individuals who met the case definition for an anxiety disorder. Drugs typically used to treat anxiety disorders are presented in the dark hue, while all other psychiatric drugs are presented in a light hue. As expected, the most commonly prescribed drugs were benzodiazepines and antidepressants (e.g., selective serotonin reuptake inhibitors). Of note, there was no apparent relationship between severity level and the prescription of drugs that are not typically prescribed to treat anxiety disorders (e.g., corticosteroids). Other disorder groups exhibited similar patterns (see Shirmaleki & Jones, 2019h).

Table 31 Prescriptions in Adults (aged ≥15 years) Meeting an Anxiety Disorder Case Definition by Severity Level in FY 2014/15

Adults in 2014/15	Cases			Severe			Moderate			Mild		
Cases	188,645	100.0%	of cases	23,532	12.5%	of cases	72,391	38.4%	of cases	92,722	49.2%	of cases
Any Pharma	181,556	96.2%	of cases	22,985	97.7%	of severe	70,729	97.7%	of moderate	87,842	94.7%	of mild
Any Mental Health Pharma	161,084	85.4%	of cases	21,767	92.5%	of severe	65,605	90.6%	of moderate	73,712	79.5%	of mild
Benzodiazepines	76,236	40.4%	of cases	13,262	56.4%	of severe	33,094	45.7%	of moderate	29,880	32.2%	of mild
Any Antidepressants + Benzodiazepines	141,225	74.9%	of cases	20,182	85.8%	of severe	59,718	82.5%	of moderate	61,325	66.1%	of mild

Figure 28 AHFS Prescriptions in Adults (aged ≥15 years) Meeting an Anxiety Disorder Case Definition by Severity Level in FY 2014/15

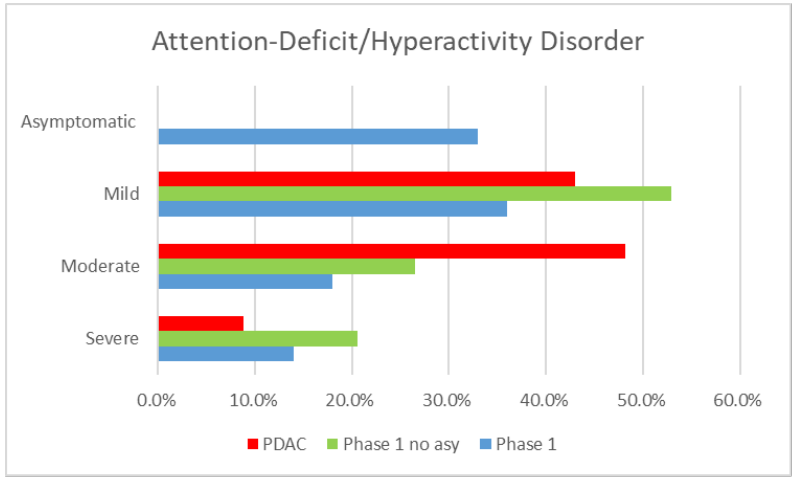


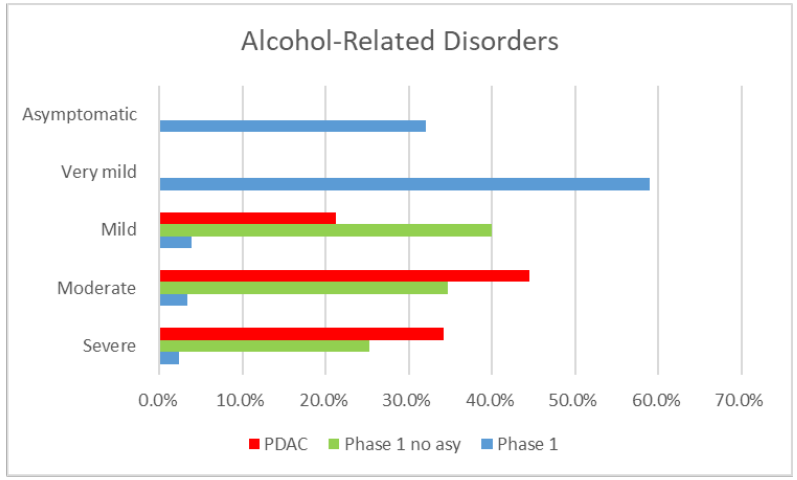
Note. Dark colours, light colours, and grey indicate drugs typically used for anxiety disorders, other psychiatric drugs, and non-psychiatric drugs, respectively.

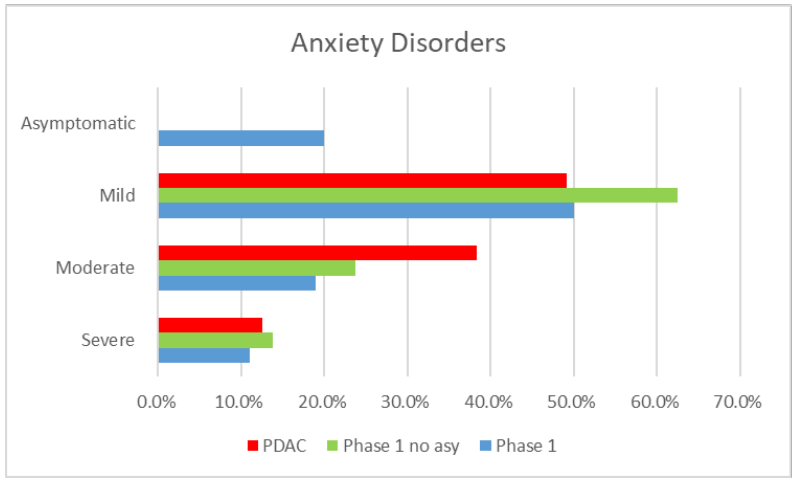
SEVERITY ALGORITHMS VERSUS EPIDEMIOLOGICAL SEVERITY DISTRIBUTIONS

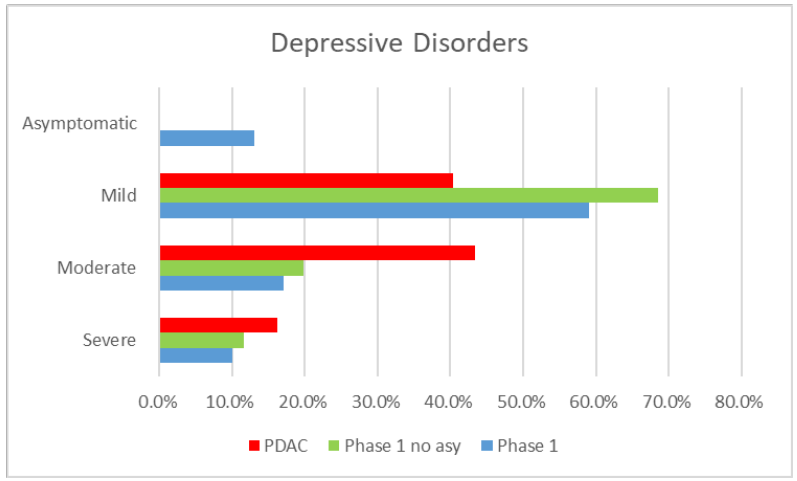
Figure 29 presents the results for all 11 MSU disorder groups using the severity algorithms versus the GBD severity and health state breakdown with and without asymptomatic cases. The results suggest that the correspondence between our severity algorithms and epidemiological severity distributions was low for most disorder groups. However, there were some similar patterns between the two measures for anxiety disorders, intellectual disabilities, and opioid-related disorders.

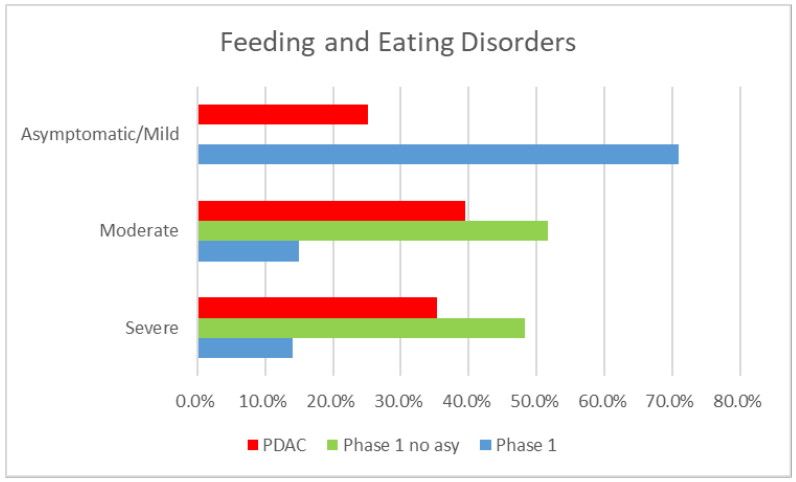
Figure 29 Comparison of Severity Algorithms and Phase 1 Severity Estimates

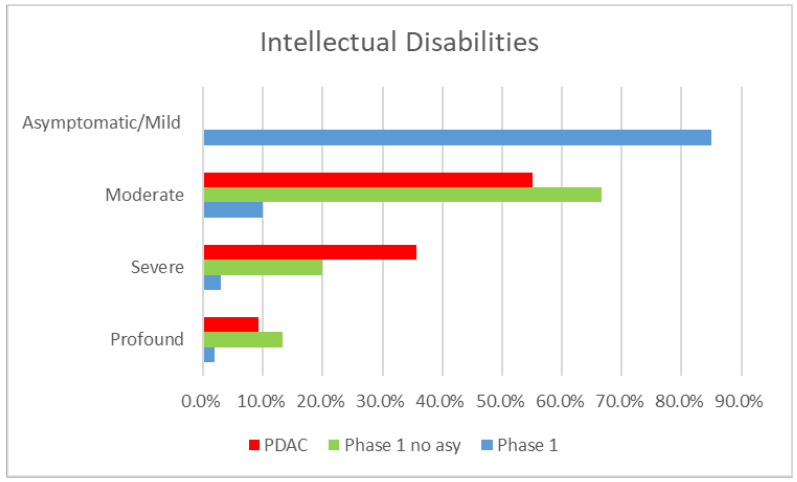


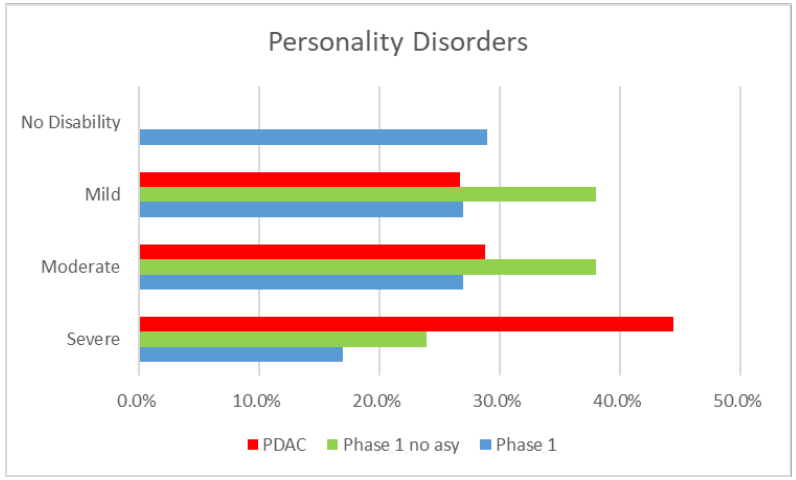


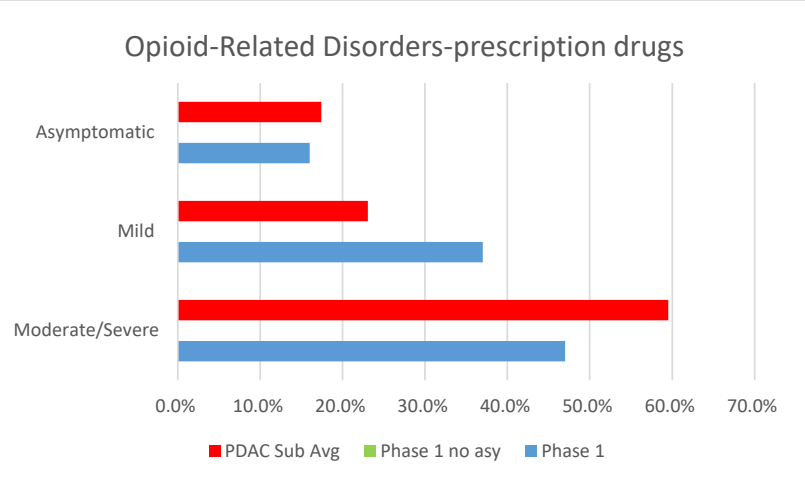


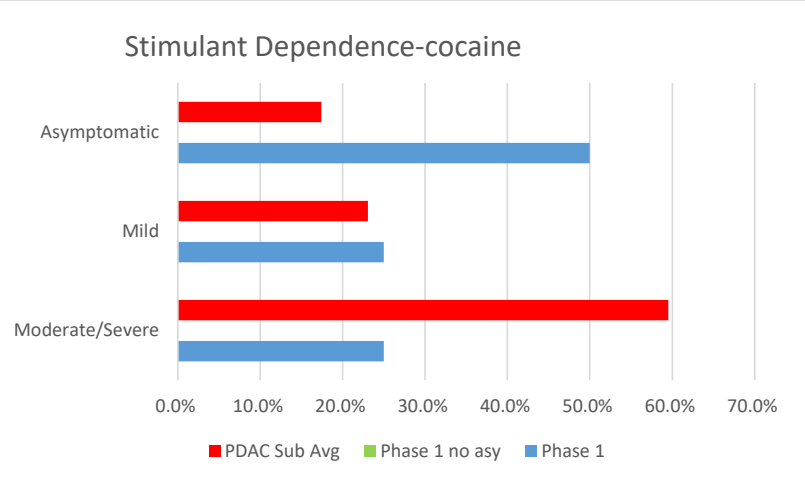


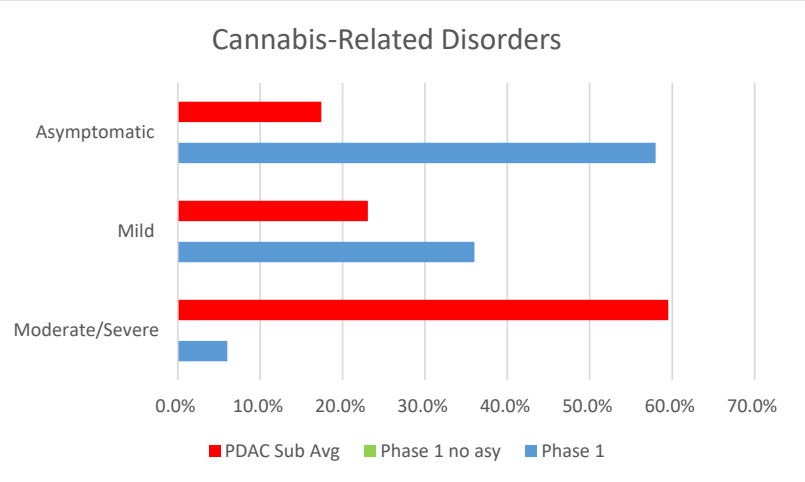

Feeding and Eating Disorders
Asymptomatic/Mild
Moderate
Severe
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0%
PDAC
Phase 1 no asy
Phase 1


Intellectual Disabilities
Asymptomatic/Mild
Moderate
Severe
Profound
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0%
PDAC
Phase 1 no asy
Phase 1

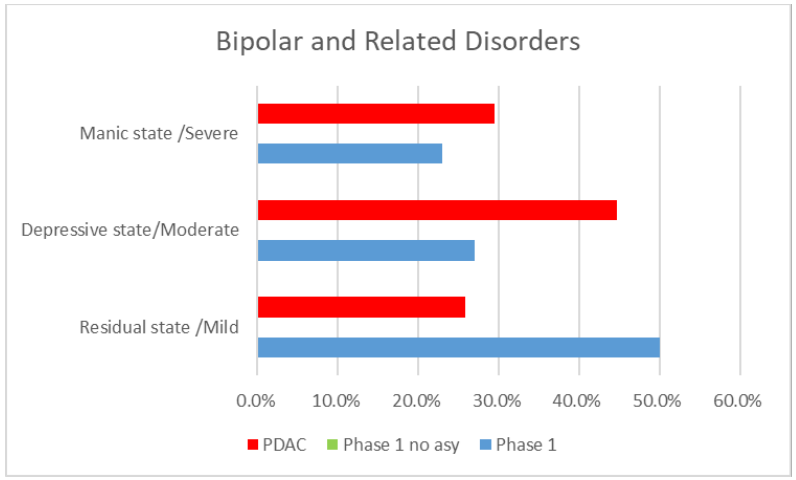

Personality Disorders
No Disability
Mild
Moderate
Severe
0.0% 10.0% 20.0% 30.0% 40.0% 50.0%
PDAC
Phase 1 no asy
Phase 1

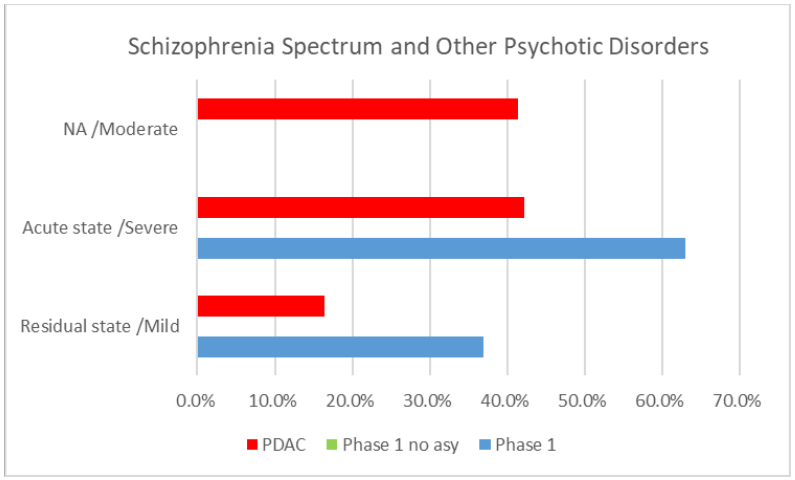






Note. The substance use results derived from the administrative data are repeated for comparison with Phase 1 opioid, stimulant, and cannabis results. For all three substance use disorders, the severity algorithm for *mild* was compared with *asymptomatic,* while the severity algorithm for *moderate* was compared with *mild.*





Note. Health states rather than severity levels are used for bipolar and related disorders as well as schizophrenia spectrum and other psychotic disorders. No asy = without asymptomatic cases.

SUMMARY OF RESULTS

The results stratified by severity show that mild was the most common severity level for ADHD, depressive disorders, anxiety disorders, and intellectual disabilities, while severe was the most common severity level for substance use disorders, and schizophrenia spectrum and other psychotic disorders.

Using anxiety disorders as an example, longitudinal analysis of severity patterns showed that almost 60% of individuals met the case definition for an anxiety disorder with either mild or moderate severity in one year only. Similar patterns were observed across all 11 MSU disorder groups.

The PharmaNet data were investigated as a proxy of severity levels for anxiety disorders. The results show that the prescription of benzodiazepines increased with severity. However, the use of PharmaNet data to distinguish severity levels is questionable, as 96.2% of all individuals who met our case definition were prescribed medications while 85.4% were prescribed psychiatric medications.

The Phase 1 expected severity distributions and our severity algorithms showed low correspondence, suggesting that our severity algorithms are likely capturing service utilization patterns rather than the severity of disorders.

Nevertheless, these results should be interpreted cautiously as data on community-based MSU services are lacking, making it difficult to determine whether these individuals have been receiving MSU services during the study period.

OBJECTIVE III: COMORBIDITY ANALYSIS

INTRODUCTION

As described in *Project Objectives*, this project aimed to establish comorbidity rates across the 11 MSU disorder groups using our case definitions. Given that our case definitions exhibited good correspondence with the epidemiological data, the comorbidity analysis was performed. However, comorbidity analysis at the severity level was not conducted as we were less confident in our severity algorithms.

METHODOLOGY

STUDY SAMPLE

The sample included for Objective III comprised 408,708 individuals who met the case definition for at least one of the 11 MSU disorder groups in FY 2014/15. Individuals were considered to have comorbid MSU disorders if they met case definitions for at least two disorder groups within FY 2014/15.

PAIRWISE COMORBIDITY MEASURES

Comorbidity was determined by calculating odds ratios (OR), correlations, and percentages, as each measure provides unique information about the relationship between two disorders. An OR of 1.0 implies that the presence of both disorders is due to chance. Meanwhile, an OR significantly less than 1.0 implies one disorder's presence leads to a decreased likelihood of having the other disorder, whereas an OR significantly greater than 1.0 implies one disorder's presence leads to an

increased likelihood of having the other disorder. The population estimate for adults (aged ≥15 years) in BC for 2014 from PEOPLE 2018 was used for odds ratio calculations.

The second method we used to measure comorbidity was correlations between disorders using the phi coefficient. As the phi coefficient is suitable for binary measures (Fleiss, Levin, & Paik, 2003)—that is, the presence or absence of a given disorder in this study—it can be interpreted in a manner similar to other measures of correlation and is useful for those unfamiliar with the interpretation of the OR.

Finally, comorbidity was investigated by calculating two sets of percentages for each comparison: (1) the percentage of individuals with the first disorder who also have the second disorder, and (2) the percentage of individuals with the second disorder who also have the first disorder. As the number of individuals with the first disorder will differ from those individuals with the second disorder, the percentages will differ and hence reflect how common the comorbid disorder is among those with the initial disorder.

COMORBIDITY PATTERNS

Comorbidity patterns were explored by calculating the number of case definitions a given individual met within a one-or four-year period.

RESULTS

PAIRWISE COMORBIDITY

There were 408,708 unique individuals who met the case definition for at least one of the 11 MSU disorder groups in FY 2014/15. Table 32 presents the number of individuals who met the case definition for each disorder group as well as the proportions of individuals who met the case definition for a single or comorbid MSU disorder(s). The most prevalent MSU disorder groups were anxiety disorders (*n* = 194,486) and depressive disorders (*n* = 157,087) followed by bipolar and related disorders (*n* = 42,508) and NCDs due to TBI or substance/medication use (*n* = 42,024).

Individuals with personality disorders (83.6%) had the highest proportion of comorbid disorders followed by those with alcohol-related disorders (64.5%) and bipolar and related disorders (61.5%). The proportion of individuals who met the case definition for a comorbid disorder within the same fiscal year exceeded 50% for most disorder groups except for ADHD (21.1%), NCD (28.9%), intellectual disabilities (41.3%), and depressive disorders (43.7%). Of note, these results only present the comorbid disorders treated within the same year and do not reflect patterns of comorbid disorders occurring or treated over a lifetime.

Table 32 Proportions of Single and Comorbid MSU Disorder(s) in FY 2014/15

Disorder Group	*n*	Single Diagnosis *n*	(%)	Comorbid Diagnosis *n*	(%)
DEP	157,087	88,440	(56.3%)	68,647	(43.7%)
ANX	194,486	125,443	(64.5%)	69,043	(35.5%)
ALC	16,705	5,930	(35.5%)	10,775	(64.5%)
SUD	37,192	17,480	(47.0%)	19,712	(53.0%)
ADHD	21,216	16,739	(78.9%)	4,477	(21.1%)
BP	42,508	16,366	(38.5%)	26,142	(61.5%)
SCZ	20,406	8,775	(43.0%)	11,631	(57.0%)
PD	6,417	1,052	(16.4%)	5,365	(83.6%)
ED	1,302	523	(40.2%)	779	(59.8%)
ID	910	534	(58.7%)	376	(41.3%)
NCD	42,024	29,879	(71.1%)	12,145	(28.9%)

Note. DEP = depressive disorders; ANX = anxiety disorders; ALC = alcohol-related disorders; SUD = substance use disorders; ADHD = attention deficit/hyperactivity disorder; BP = bipolar and related disorders; SCZ = schizophrenia spectrum and other psychotic disorders; PD = personality disorders; ED = eating disorders; ID = intellectual disabilities; NCD = neurocognitive disorders.

Table 33 presents the numbers (n) of individuals who met the case definition for each pairwise comorbid disorder in FY 2014/15. Anxiety and depressive disorders were the most common comorbid disorders across the 11 MSU disorder groups. The most prevalent pairwise comorbid disorders were depressive disorders with anxiety disorders (*n* = 51,793) followed by depressive disorders with bipolar and related disorders (*n* = 15,157) and anxiety-related disorders with bipolar and related disorders (*n* = 13,367). However, it should be noted that bipolar and depressive disorders are mutually exclusive, as any individual with a history of manic or hypomanic episodes should be diagnosed with a bipolar disorder. Thus, these results are corroborated by previous studies indicating that bipolar and unipolar depression are frequently misdiagnosed in clinical practice (Shen et al., 2018; Bowden, 2001).

Table 33 Pairwise Comorbid Case Counts (*n*) in FY 2014/15

Disorder Group	DEP	ANX	ALC	SUD	ADHD	BD	SCZ	PD	ED	ID	NCD
DEP	**157,087**										
ANX	51,793	**194,486**									
ALC	4,614	4,389	**16,705**								
SUD	9,340	10,012	5,653	**37,192**							
ADHD	1,896	2,849	187	825	**21,216**						
BP	15,157	13,367	2,136	4,326	819	**42,508**					
SCZ	4,039	4,302	1,279	3,463	239	5,753	**20,406**				
PD	3,244	3,140	899	1,996	224	2,282	1,285	**6,417**			
ED	455	556	80	117	41	245	44	151	**1,302**		
ID	127	177	21	42	59	116	125	49	*	**910**	
NCD	5,229	5,110	2,306	1,488	59	2,853	1,861	462	27	54	**42,024**

Note. Bolded values represent the total number of individuals meeting the case definition for the indicated MSU disorder group. DEP = depressive disorders; ANX = anxiety disorders; ALC = alcohol-related disorders; SUD = substance use disorders; ADHD = attention deficit/hyperactivity disorder; BP = bipolar and related disorders; SCZ = schizophrenia spectrum and other psychotic disorders; PD = personality disorders; ED = eating disorders; ID = intellectual disabilities; NCD = neurocognitive disorders. * The number of cases is less than 5 and was therefore suppressed to preserve anonymity.

Table 34 presents the pairwise comorbid ORs for FY 2014/15.[10] All ORs were statistically significant, and all ORs were greater than 1, except that for NCDs with ADHD. The strongest association was observed between personality disorders with an eating disorder (OR = 97.0) followed by substance use disorders with concurrent alcohol-related disorders (OR = 74.6). Overall, comorbidity between personality disorders and other disorders was very high compared to other pairwise comorbidities.

[10] The adult (≥15 years old) population in 2014 from PEOPLE 2018.

Table 34 Pairwise Comorbid Odds Ratios in FY 2014/15

Disorder Group	DEP	ANX	ALC	SUD	ADHD	BD	SCZ	PD	ED	ID	NCD
DEP	—										
ANX	15.0	—									
ALC	11.2	8.3	—								
SUD	10.1	8.8	74.6	—							
ADHD	2.8	3.6	2.5	5.1	—						
BP	17.4	11.2	16.7	15.8	4.4	—					
SCZ	7.2	6.2	20.0	27.8	2.6	49.0	—				
PD	29.8	22.3	47.6	59.1	8.0	63.1	60.5	—			
ED	15.4	17.1	18.2	12.3	7.1	25.2	7.9	97.0	—		
ID	4.6	5.5	6.6	6.0	15.2	15.9	36.3	41.4	*	—	
NCD	4.2	3.2	18.5	4.7	0.3	8.4	11.5	8.6	2.3	6.9	—

Note. DEP = depressive disorders; ANX = anxiety disorders; ALC = alcohol-related disorders; SUD = substance use disorders; ADHD = attention deficit/hyperactivity disorder; BP = bipolar and related disorders; SCZ = schizophrenia spectrum and other psychotic disorders; PD = personality disorders; ED = eating disorders; ID = intellectual disabilities; NCD = neurocognitive disorders. * The number of cases is less than 5 and was therefore suppressed to preserve anonymity.

Phi coefficients between all pairwise comorbidities in FY 2014/15 are presented in Table 35. Most pairwise comorbid combinations had a positive relationship, indicating that the presence of one MSU disorder increases the likelihood of being treated for another MSU disorder. Meanwhile, a few pairwise comorbid combinations showed no relationships (e.g., NCD with ADHD and NCD with eating disorders). Higher correlations were observed for depressive with anxiety disorders (ϕ = 0.27), alcohol-related disorders with substance use disorders (ϕ = 0.22), and schizophrenia spectrum disorders with bipolar and related disorders (ϕ = 0.19).

Table 35 Phi Correlation Coefficients between All Pairs of Conditions in FY 2014/15

Disorder Group	DEP	ANX	ALC	SUD	ADHD	BD	SCZ	PD	ED	ID	NCD
DEP	—										
ANX	0.27	—									
ALC	0.08	0.07	—								
SUD	0.11	0.10	0.22	—							
ADHD	0.02	0.03	0.01	0.02	—						
BP	0.17	0.13	0.07	0.10	0.02	—					
SCZ	0.06	0.06	0.07	0.12	0.01	0.19	—				
PD	0.10	0.08	0.08	0.13	0.02	0.14	0.11	—			
ED	0.03	0.03	0.02	0.02	0.01	0.03	0.01	0.05	—		
ID	0.01	0.01	0.00	0.01	0.01	0.02	0.03	0.02	*	—	
NCD	0.05	0.04	0.08	0.03	0.00	0.06	0.06	0.02	0.00	0.01	—

Note. DEP = depressive disorders; ANX = anxiety disorders; ALC = alcohol-related disorders; SUD = substance use disorders; ADHD = attention deficit/hyperactivity disorder; BP = bipolar and related disorders; SCZ = schizophrenia spectrum and other psychotic disorders; PD = personality disorders; ED = eating disorders; ID = intellectual disabilities; NCD = neurocognitive disorders. * The number of cases is less than 5 and was therefore suppressed to preserve anonymity.

The percentages of pairwise comorbidities in FY 2014/15 are presented in Table 36. Individuals who met the case definition of personality disorders were the most frequently diagnosed with comorbid disorders, mainly with depressive disorders (50.6%), anxiety disorders (48.9%), and bipolar and related disorders (35.6%). Similarly, among individuals who met the case definition for an eating disorder, 34.9% and 42.7% also met the case definition for a depressive disorder or an anxiety disorder, respectively.

In the administrative data, alcohol and substance use disorders were often comorbid with other MSU disorders within the same year. For instance, 27.6% and 25.1% of individuals who met the case definition for an alcohol-related disorder or a substance use disorder, respectively, also met the case definition for a depressive

disorder. Likewise, 26.3% and 26.9% of those who met the case definition of an alcohol-related disorder or substance use disorder, respectively, also met the case definition for an anxiety disorder. However, only 2.9% and 2.3% of individuals who met the case definition for a depressive disorder or anxiety disorder, respectively, also met the case definition for an alcohol-related disorder.

While anxiety and depressive disorders were common comorbidities across all 11 MSU disorder groups within the same year, 64.5% and 56.3% of individuals who met the case definition for anxiety disorders or depressive disorders, respectively, did not meet the case definition for a comorbid MSU disorder group within the same year.

Table 36 Percentages of Pairwise Comorbidities in FY 2014/15

Disorder Group	DEP	ANX	ALC	SUD	ADHD	BD	SCZ	PD	ED	ID	NCD
DEP	**56.3%**	33.0%	2.9%	5.9%	1.2%	9.6%	2.6%	2.1%	0.3%	0.1%	3.3%
ANX	26.6%	**64.5%**	2.3%	5.1%	1.5%	6.9%	2.2%	1.6%	0.3%	0.1%	2.6%
ALC	27.6%	26.3%	**35.6%**	33.8%	1.1%	12.8%	7.7%	5.4%	0.5%	0.1%	13.8%
SUD	25.1%	26.9%	15.2%	**47.0%**	2.2%	11.6%	9.3%	5.4%	0.3%	0.1%	4.0%
ADHD	8.9%	13.4%	0.9%	3.9%	**78.9%**	3.9%	1.1%	1.1%	0.2%	0.3%	0.3%
BP	35.7%	31.4%	5.0%	10.2%	1.9%	**38.5%**	13.5%	5.4%	0.6%	0.3%	6.7%
SCZ	19.8%	21.1%	6.3%	17.0%	1.2%	28.2%	**43.0%**	6.3%	0.2%	0.6%	9.1%
PD	50.6%	48.9%	14.0%	31.1%	3.5%	35.6%	20.0%	**16.4%**	2.4%	0.8%	7.2%
ED	34.9%	42.7%	6.1%	9.0%	3.1%	18.8%	3.4%	11.6%	**40.2%**	*	2.1%
ID	14.0%	19.5%	2.3%	4.6%	6.5%	12.7%	13.7%	5.4%	*	**58.7%**	5.9%
NCD	12.4%	12.2%	5.5%	3.5%	0.1%	6.8%	4.4%	1.1%	0.1%	0.1%	**71.1%**

Note. Bolded values reflect the percentages of individuals who did not meet a comorbid case definition. DEP = depressive disorders; ANX = anxiety disorders; ALC = alcohol-related disorders; SUD = substance use disorders; ADHD = attention deficit/hyperactivity disorder; BP = bipolar and related disorders; SCZ = schizophrenia spectrum and other psychotic disorders; PD = personality disorders; ED = eating disorders; ID = intellectual disabilities; NCD = neurocognitive disorders. * The number of cases is less than 5 and was therefore suppressed to preserve anonymity.

COMORBIDITY PATTERNS

Comorbidity patterns within a single year and over four years are presented in Table 37 and Figure 30. Most individuals (~75%) met the case definition for a single MSU disorder within one year. The proportion of individuals who met the case definition for a single disorder decreased to 63.2% over four years, as the likelihood of meeting the case definition for another MSU disorder increases with a broader timeframe.

The second most common pattern observed was individuals who met the case definition for two MSU disorders within the same year, which ranged from 17.8–18.4% in a single year and up to 25% over four years. Although rare, the maximum number of MSU disorder case definitions an individual met within one year was nine. These comorbidity patterns were consistent across the four years of the study period.

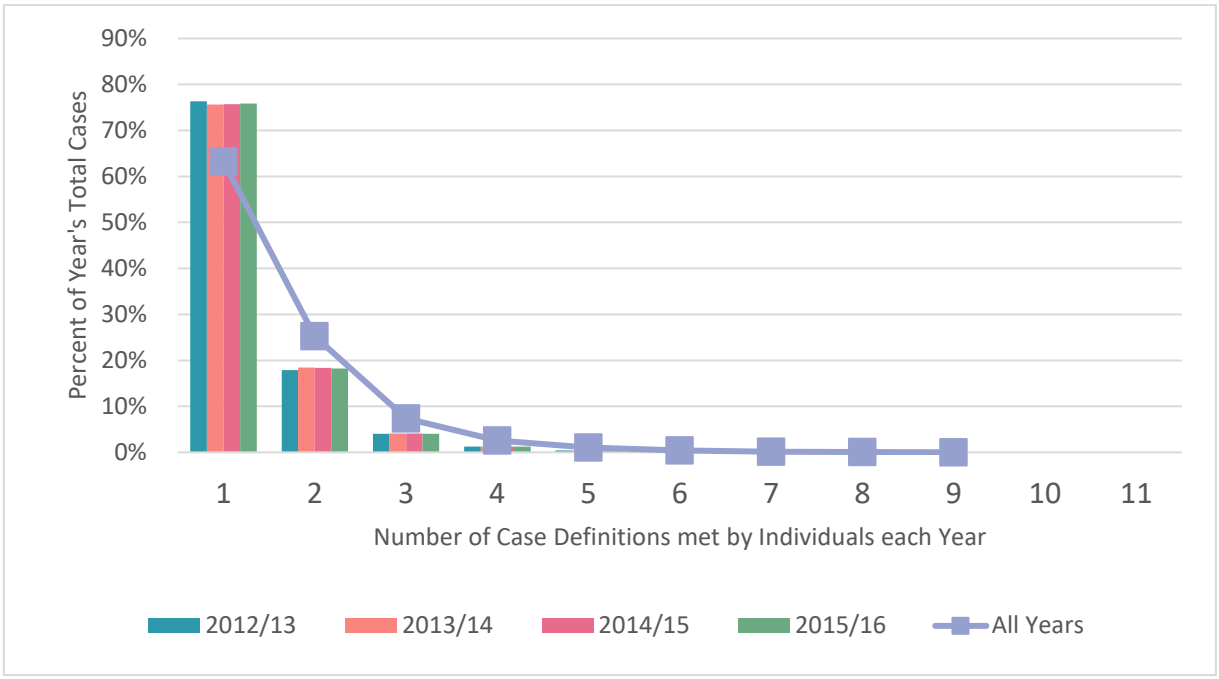
While the pairwise comorbidity results revealed that significant proportions of individuals within most MSU disorder groups met a comorbid case definition, the comorbidity patterns indicated that meeting the case definition of a single MSU disorder was the most common pattern. One possible explanation is that most of the population meeting a single case definition did so for common mental disorders (e.g., anxiety disorders and depressive disorders) or for disorders typically diagnosed in certain age groups (e.g., NCDs and ADHD). As such, the lowest comorbidity rates were observed in individuals with anxiety (35.5%), depression (43.7%), NCDs (21.1%), or ADHD (28.9%). These four mental disorders accounted for 64% of all individuals who met the case definitions of any of the 11 MSU disorder groups. Common age-specific disorders appeared to be diagnosed without comorbidities, whereas comorbidities appeared to be the norm for all other MSU disorders.

Table 37 Comorbidity Patterns of Unique Individuals between FY 2012/13 and 2015/16

# of Disorders	Unique Individuals with MSU Disorders				
	FY 2012/13	FY 2013/14	FY 2014/15	FY 2015/16	All Four Years
1	265,703 (76.4%)	290,184 (75.6%)	295,145 (75.7%)	301,069 (75.9%)	516,413 (63.2%)
2	62,089 (17.8%)	70,801 (18.4%)	71,686 (18.4%)	72,417 (18.2%)	206,289 (25.3%)
3	14,033 (4.0%)	15,783 (4.1%)	15,968 (4.1%)	16,111 (4.1%)	60,001 (7.3%)
4	4,257 (1.2%)	4,693 (1.2%)	4,845 (1.2%)	4,824 (1.2%)	21,011 (2.6%)
5	1,345 (0.4%)	1,670 (0.4%)	1,660 (0.4%)	1,721 (0.4%)	8,357 (1.0%)
6	403 (0.1%)	499 (0.1%)	545 (0.1%)	559 (0.1%)	3,212 (0.4%)
7	84 (0.0%)	155 (0.0%)	146 (0.0%)	151 (0.0%)	1,089 (0.1%)
8	16 (0.0%)	24 (0.0%)	27 (0.0%)	30 (0.0%)	276 (0.0%)
9	*	*	*	*	23 (0.0%)
With MSU Disorders	347,932 (22.6%)	383,809 (24.7%)	390,024 (24.9%)	396,885 (25.1%)	816,673 (51.7%)
Without MSU Disorders	1,189,135 (77.4%)	1,168,793 (75.3%)	1,176,555 (75.1%)	1,182,075 (74.9)	762,287 (48.3%)
N	1,537,067	1,552,602	1,566,579	1,578,960	1,578,960

* The number of cases is less than 5 and was therefore suppressed to preserve anonymity.

Figure 30 Comorbidity Patterns between FY 2012/13 and 2015/16



SUMMARY OF RESULTS

The comorbidity analysis included the 408,708 individuals who met the case definition for at least one of the 11 MSU disorder groups in FY 2014/15. The most prevalent MSU disorders were mood disorders including anxiety disorders (*n* = 194,486), depressive disorders (*n* = 157,087), and bipolar and related disorders (*n* = 42,508).

While personality disorders were one of the least prevalent MSU disorder groups captured in the administrative data (1.5%), they were the most likely to be complicated by a comorbid MSU disorder (83.6%) within the same year. These results were consistent across all three comorbidity measures used herein. However, pairwise comorbidity analysis based on number of individuals showed that anxiety disorders with depressive disorders was the most prevalent comorbidity pair in the study population (*n* = 51,793).

Comorbidity analysis based on odds ratio illustrated the increased likelihood of an individual experiencing at least two MSU disorders within the same year. All pairwise odd ratios were statistically significant and greater than 1, except for ADHD with NCDs. Meanwhile, the phi correlation coefficient showed a positive relationship between most pairwise combinations, indicating that having one MSU disorder increased the likelihood of having another comorbid MSU within the same year.

In addition, the percentages of pairwise comorbid MSU disorders revealed that comorbid anxiety and depressive disorders were common among individuals from all 11 MSU disorder groups. However, more than half of individuals with depressive disorders (56.3%) or anxiety disorders (64.5%) did not meet a case definition for a comorbid MSU disorder within the same year. Similarly, the comorbidity patterns illustrated that 75–76% of individuals met the case definition for only one MSU disorder, most of which were common mental disorders such as depressive and

anxiety disorders. However, most other MSU disorder groups were highly comorbid with other MSU disorders within one year.

DISCUSSION

There is growing interest in using administrative data for MSU disorder surveillance. Some studies have evaluated the case definitions for depression, anxiety (Kisely et al., 2009), bipolar, and schizophrenia disorders (Marrie et al., 2013). Accordingly, to assist in the efforts of developing a standardized approach for population surveillance, the present study (1) explored the feasibility of developing case definitions for 11 MSU disorder groups using physician, hospital, and prescription claims and compared these results with epidemiological data to test for agreeability; (2) further refined these algorithms by developing severity definitions; and (3) derived pairwise comorbidity rates using our case definitions across the 11 MSU disorder groups.

DEVELOPING CASE DEFINITIONS FOR THE 11 MSU DISORDER GROUPS

Objective I was to develop 11 MSU disorder-specific algorithms (from the original 13 groups) for defining cases from the administrative data. The administrative data for this project were limited to hospital discharge and MSP billing data, which cannot confirm the clinical diagnosis of a disorder. Therefore, it was only possible to confirm that our case definitions capture individuals who had at least two visits to a physician or a psychiatrist, or at least one visit to a hospital for a given MSU disorder.

The baseline definition (i.e., one MSP or one hospital claim) often produced prevalence estimates that were higher than the expected prevalence. Thus, it can be assumed that the higher prevalence estimates based on the baseline definition reflect false-positives. Therefore, to capture MSU disorders in the population with greater certainty, we recommend using the case definition (i.e., at least two MSP

claims or one hospital discharge claim). Alternative case definitions were also tested for disorders for which the treated prevalence estimates differed substantially from the expected prevalence of specific age groups. Nevertheless, using these alternative case definitions minimally impacted the overall results. Therefore, the initial case definition appears to exhibit the best correspondence with the epidemiological data.

There was high correspondence between the treated and expected prevalence for schizophrenia spectrum and other psychotic disorders, substance use disorders (as an aggregate disorder group), and anxiety disorders. However, compared to the expected prevalence, the treated prevalence substantially underpredicted alcohol-related disorders, personality disorders, ADHD, and intellectual disabilities. These results are not surprising given that intellectual disabilities and learning disorders are usually not the primary reason for a medical visit and are therefore less likely to be coded in the administrative data (Lin et al., 2013). In addition, intellectual disabilities and developmental disorders (e.g., ADHD) are more likely to be diagnosed in children. It was also assumed that the treated prevalence of personality disorders would be much lower than the expected prevalence given the discordance in the diagnostic criteria in clinical practice, egosyntonic nature of personality disorders (Tyrer et al., 2015), and lack of effective treatment for most personality disorders (Bateman et al., 2015).

Among older age groups, there were noticeable differences between the expected and treated prevalence of bipolar and related disorders as well as schizophrenia spectrum and other psychotic disorders. While the expected prevalence of such disorders gradually declined in older age groups, the treated prevalence based on the administrative data sharply increased with age. There are several possible reasons for this. Some studies suggest the possibility of late-onset bipolar disorder, where symptoms appear for the first time after the age of 65 (Almeida & Fenner, 2002; Sajatovic et al., 2005). Evidence also showed that schizophrenia spectrum disorders commonly co-occur with bipolar disorders (Azorin et al., 2012). There is a possibility that older adults with such severe mental disorders might be

institutionalized and missed by community health surveys (Sajatovic et al., 2005). Therefore, these results may have important implications when planning services for older adults. Specifically, administrative data could be used to supplement the data for institutionalized populations missed by community surveys. Thus, the demographic variability observed across the 11 MSU disorder groups supports the need to monitor MSU disorders separately and is informative for service planners working towards tailoring services to specific age groups.

Furthermore, our results suggest that administrative data can be used to develop disorder-specific case definitions for MSU disorders with varying degrees of success. As expected, our case definitions did not produce prevalence estimates that precisely matched the expected prevalence owing to the existing limitations of both administrative data and epidemiological data. Therefore, the success of the algorithms herein must be judged with this in mind.

SEVERITY ALGORITHMS

Objective II aimed to test the feasibility of developing severity algorithms using the administrative data for three severity levels: mild, moderate, and severe. Each severity level was determined on the basis of the frequency of visits using MSP claims within a given timeframe, the type of the DAD diagnosis (e.g., most responsible, primary, or secondary diagnosis). However, prescription drugs provided during the given 12-month period could not be meaningfully incorporated. Therefore, we decided to use frequency of visit as a measure of severity in accordance with the NBP project results, wherein panelists consistently assigned cases with more visits to higher severity levels.

We examined the severity patterns of anxiety disorders over time. Our results showed that most individuals met the case definition for an anxiety disorder for only a single 12-month period. Table 30 shows that 65% of individuals with an

anxiety disorder met the definition for either mild, moderate, or severe for a single year, and less than 2% of individuals met the case definition twice or more between FY 2012/13 and 2015/16. Most met the case definition for a mild followed by a moderate and severe anxiety disorder. The most common pattern for two consecutive years was mild in both years, representing only 2.4% of all individuals with an anxiety disorder during the study period.

Meanwhile, our PharmaNet data results showed that prescriptions for drugs associated with MSU disorder treatment were prescribed to nearly everyone who received an MSU disorder diagnosis, making it difficult to use PharmaNet data to differentiate severity levels. Nevertheless, further research are required to determine whether information on dosage or other measures of relative strength can be retrieved to distinguish severity levels, with the caveat that drug dosage depends on factors other than severity, such as weight, tolerance, level of response, and individual differences.

In addition, there were differences between the severity distributions determined by the severity algorithms and the epidemiological severity distribution. This incongruence potentially indicates that our severity algorithms are capturing service utilization patterns rather than severity levels based on symptomology. However, some patterns using our severity algorithms reflected the expected severity distribution observed in the GBD epidemiological distributions. For instance, substantial proportions of individuals fell within the mild and moderate severity categories for depressive and anxiety disorders, while a small proportion fell within the severe category.

COMORBIDITY AMONG THE 11 MSU DISORDER GROUPS

Objective III aimed to establish comorbidity figures from the administrative data using the 11 MSU case definitions. Pairwise comorbidity analysis was performed by

calculating odds ratios, ϕ correlation coefficients, and percentages, as each approach provides unique information about the relationship between two MSU disorders. The results confirm that comorbid diagnoses were common across all 11 MSU disorder groups, although the relationships vary by disorder group. Comorbidity patterns in the study cohort were also examined by calculating the number of disorders individuals met the case definition for within one year and across four years. Approximately 75% of individuals met the case definition for only one MSU disorder in one year, likely due to the large number of individuals who met a single case definition for a common mental disorder such as depressive or anxiety disorders.

Thus, these results collectively highlight the importance of examining both pairwise comorbidity and comorbidity patterns in unique individuals based on the administrative data. As shown in Table 37, most individuals were treated for one MSU disorder at a time, while pairwise comorbidity analysis revealed that these patterns vary by MSU disorder group.

Nevertheless, the comorbidity results should be interpreted with caution as they are limited to MSP and DAD claims data and leaving out data from community mental health services. It should be noted that comorbid disorders are not always diagnosed in clinical practice. Instead, individuals presenting with symptoms that overlap with multiple disorders might receive a single diagnosis of an all-encompassing disorder (Tew & Pincus, 2007). Evidence also suggests that comorbidities are reported to be underrepresented in medical records compared to research assessments conducted with structured diagnostic interviews (Zimmerman & Mattia, 2000; Basco et al., 2000).

STRENGTHS AND LIMITATIONS

STRENGTHS

The work presented herein was overseen and supported by two provincial advisory committees comprising members from five regional health authorities, the Provincial Health Services Authority, the BC MoH, and the BCCDC.

One strength of this study is that it is primarily based on the use of a large, population-based, health administrative dataset, namely MSP and hospital discharge data (i.e., DAD). These data sources are standardized across BC and are mandatorily reported, which enables comparison across the different Health Authorities, Health Service Delivery Areas, and Local Health Areas. Furthermore, there is no financial incentive tied to physicians providing MSP or DAD billing data that could impact the accuracy of the diagnostic data. Quality checks and audits are frequently performed on MSP billing data (Population Data BC, 2018). Moreover, ICD codes in health records have also been shown to be recorded accurately at the population level (Hu, 1996).

Our epidemiological annual prevalence and distributions of 13 MSU disorder groups (per the DSM-5) by age, gender, and severity were the result of robust systematic reviews and meta-analysis of the best available published epidemiological studies using population-level survey data. The accuracy of our case definitions was evaluated by comparing our results with the expected prevalence. Such comparisons will not only aid service planners and epidemiologists in identifying treatment gaps by MSU disorder, age, and gender, but will also provide insights into the differences in the treated and expected prevalence and how they need to be interpreted accordingly.

Another strength of this study is the longitudinal analysis using four years of data, which enabled the assessment of the stability of a given diagnosis over time. As

results from one year are essentially replicated in a different year, some statistical confidence can be placed in single-year results. Nevertheless, it is important to note that as the study period (FY 2012/13 to 2015/16) preceded the current opioid crisis and COVID-19 pandemic, the results do not capture the potential changes in MSU service utilization patterns since 2016.

Finally, the results of the comorbidity analysis provide a snapshot of how comorbid MSU disorders are captured in administrative data and confirm that having one psychiatric disorder increases the likelihood of having a comorbid MSU disorder. Thus, the comorbidity analysis results can be used to investigate how often two MSU disorders are treated within a given year or over multiple years as well as how having one specific MSU disorder increases the likelihood of having a second MSU disorder.

LIMITATIONS

Despite its strengths, this study also has some limitations. First, the lack of specificity at the decimal level in the ICD-9 codes limited our ability to distinguish specific NCDs and substance use disorders. Earlier studies on the use of administrative data for mental disorder surveillance highlight the challenges of being limited to the three-digit codes (Manitoba Centre for Health Policy & Martens, 2004; Kisely et al., 2009). Second, it was challenging to distinguish depression from anxiety because of the 50B code used in BC. Kisely et al. (2009) examined mood and anxiety disorders using administrative data across five provinces and found that BC is the only province where the prevalence of mood disorders are higher than those of anxiety disorders. That study revealed that 60% of mood and anxiety disorders in BC were coded with 50B, which likely impacted the individual prevalence of anxiety and mood disorders in the present study.

Although this study aimed to derive treated prevalence estimates based on case definitions, treated prevalence likely underestimates the true prevalence of an MSU disorder, because not everyone with a given MSU disorder will seek or receive treatment. In addition, some MSU disorders such as ADHD and intellectual disabilities are typically diagnosed at younger ages and were therefore less likely to be captured in the analysis of the adult (i.e., age ≥15 years) population in the present study.

Finally, the administrative data were limited to MSP billing and hospital discharge claims. Although including the Minimum Reporting Requirement data, which includes administrative data on mental health services received in the community by each Health Authority, would have strengthened treated prevalence estimates, they were unavailable at the time of this project.

RECOMMENDATIONS

Several recommendations have been made throughout this report and through discussions within the PDAC and the PWG before it. In addition, we recommend dropping the supplemental MSP billing code 50B, which covers both anxiety and depression, making it difficult to distinguish these disorders within the administrative data and for surveillance purposes. Most other jurisdictions in Canada have already dropped this code from their billing systems.

We also recommend that BC adopt a standardized approach to case definitions of MSU disorders and that the province should routinely report resource utilization for MSU disorders based on treatment data. Health Authorities do not have easy access to MSP billing data and have limited ability to identify treated MSU disorders in their respective regions. Therefore, we recommend that these analyses be provided to Health Authorities for surveillance purposes, which will allow them to monitor the treatment of MSU disorders among residents within their respective regions.

The results reported herein demonstrate that a case definition of one hospitalization or two physician visits within 12 months can be used to track several MSU disorders in the BC population. Nevertheless, we recommend adjusting the study population according to the common age of presentation for certain disorders. For instance, ADHD is most often diagnosed in children, and most diagnoses of intellectual disabilities are made during the early developmental years. Hence, ongoing lifelong treatment and services for intellectual disabilities delivered at the community level will not be captured by MSP or hospital discharge claims.

Furthermore, given the demographic variability observed in the treated and expected prevalence across the MSU disorder groups, we recommend monitoring MSU disorders separately, which will be more informative for service planners and providers working towards reducing treatment gaps. Thus, the present results will be useful for informing and supporting the planning of health resources, policies, and programs for MSU disorders.

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