

**Alcohol use among Older Adults in Inpatient
Psychiatry in Ontario: Individual and Community
Factors Related to Problematic Use**

by

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A thesis

presented to the University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Science

in

Public Health and Health Systems

Waterloo, Ontario, Canada, 2018

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Background: Alcohol use among older adults is usually not identifiable and could be mistaken for other medical or psychiatric conditions. As sometimes an underlying cause, problematic alcohol use (PAU) continues to impact older adults with mental health issues who are admitted to inpatient psychiatry care. About 60% of older adults with undiagnosed alcohol related problems are found to have depression, repeated falls, delirium, heart failure, or chest infections when admitted to acute care (2). The associations between PAU and poor health outcomes is concerning as it could exacerbate the health conditions of older adults. Current predictions indicate an increase in the older adult population in Canada. Therefore, using the behavioural model of health care use, this study sought to investigate the prevalence of PAU among older adults, the characteristics of older adults who use alcohol, and the types of community support systems available.

Methods: Two data sources were used for this study. First, data from the Ontario Mental Health Reporting System (OMHRS) with inpatient information on mental and physical health, social support and service use, based on the Resident Assessment Instrument-Mental Health (RAI-MH) was used to conduct a multiple logistic regression analysis. OMHRS sample data included all older adults discharged from an inpatient mental health hospital between January 1, 2011, and December 31, 2016. Second, data from ConnexOntario was used to conduct a geographic analysis of psychiatric admission rates in relation to health service locations and PAU in the Waterloo-Wellington region of Ontario.

Results: Study results from the OMHRS data indicated that of the total number of older adults admitted to inpatient psychiatric care ($n = 21,577$), about 10% ($n = 2,107$) had PAU. Older adult men were twice as likely to have PAU compared to women. Older adults had an increased the odds of having PAU if they were educated (1.4), employed (1.5), or living in their own residence (1.3).

However, living with someone (0.8) and being 65 years or older (0.6) decreased the odds of an older adult having PAU. Contextual results for the Waterloo-Wellington region of Ontario showed that the clustering of psychiatry admissions for older adults were higher in areas with a cluster of services such as Guelph and Cambridge. However, in areas such as rural Wellington, there were high psychiatry admission rates for older adults but fewer mental health and addictions services. The study findings indicate that more seniors programs were needed to support older adults with mental health and addiction problems. In addition, older adults with PAU were likely to face the challenge of traveling further to utilize current available mental health and addictions support services in other cities.

Conclusion: This study identified the prevalence and characteristics of PAU among older adults admitted to psychiatric inpatient treatment; and highlighted some of the individual and contextual factors that are associated with the increased odds of PAU among this population. On an individual level, understanding the associated mental health and addictions service needs of older adults could contribute to providing better support before, during, and after psychiatry admissions. Contextually, factors such as the availability and accessibility of these mental health support services for older adults need to be further investigated to identify its role in service utilization.

Acknowledgements

I would like to thank my supervisor Dr. Christopher Perlman for his patience, guidance, and support through the entire course of my studies. It has been a privilege to learn a lot about mental health from your wealth of knowledge. Thank you to my committee members, Drs. Jean Costello and George Heckman for your constructive feedback. I feel truly blessed and grateful to you all.

Special thanks to the Network in Aging Research (NAR) for the Catalyst grant used to fund this project, and to the Marilyn White-Campbell (CMHA) and Dr. David Conn (Baycrest Health Centre) for the practicum opportunity that informed this thesis.

Thank you to my friend and colleague, Sebastian Rios for your support and encouragement throughout my study period. It was good to have such a knowledgeable mind that challenged me at every stage.

To my dad and mum (in heaven), thanks for pushing me always to soar to great heights and believing in me always.

Most of all thank you to my wonderful husband Kwesi for being my strength during the challenging times, and caring for our boys during those long nights of studies; and to my boys for being patient with me through what has no doubt been an interesting journey. I love you all.

To other friends, colleagues, and mentors, too many to mention, I say a big thank you.

Thank you Lord for all your mercies and grace.

Dedication

To my boys, you give me strength to keep going. This is to show that anything is possible when you set your mind to it.

To my hubby, thanks for being my rock.

To my mum up in heaven, I know you continue to watch over me through it all.

To my dad and brother, thanks for loving me.

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List of Abbreviations

ACTT	Assertive Community Treatment Team
ADL	Activities of Daily Living
AUD	Alcohol Use Disorder
CAGE	Cutting down, Annoyance at criticism, Guilty feelings and use of Eye-openers
CAMH	Centre for Addictions and Mental Health
CCSA	Canadian Centre on Substance Use
CCSMH	Canadian Coalition on Seniors' Mental Health
CIHI	Canadian Institute for Health Information
CMHA	Canadian Mental Health Association
CPA	Canadian Psychological Association
DSM-5	Diagnostic and Statistical Manual of Mental Disorders fifth edition
FSA	Forward Sortation Area
GIS	Geographic Information System
LRDG	Low-Risk Drinking Guidelines
MDS-MH	Minimum Data Set for Mental Health
MLRA	Multiple Logistic Regression Analysis
MHCC	Mental Health Commission of Canada
NIAAA	National Institute on Alcohol Abuse and Alcoholism
OMHRS	Ontario Mental Health Reporting System
PAU	Problematic Alcohol Use
RAI-MH	Residential Assessment Instrument-Mental Health
WW	Waterloo-Wellington region of Ontario
WWCCAC	Waterloo-Wellington Community Care Access Centre
WWLHIN	Waterloo-Wellington Local Health Integration Network

CHAPTER 1: INTRODUCTION AND OVERVIEW

Alcohol use among older adults poses a significant health risk, coupled with other comorbid disorders such as mental health problems. The problematic use of alcohol among older adults or the elderly¹ population, could be mistaken for other medical or psychiatric conditions (1). This is because problematic alcohol use (PAU) is often not identified as the underlying problem when older adults are admitted into care. About 60% of older adults with undiagnosed alcohol issues are found to have repeated falls, delirium, heart failure, or chest infections when admitted to acute care (2). The associations between PAU and poor health outcomes is concerning as it could exacerbate the health conditions of older adults.

Literature indicates that older adult drinkers who are classified as at-risk drinkers tend to be the most responsive to treatment in general practice or primary care (3). However, most patients with alcohol use disorder (AUD) usually exhibit other substance use and psychiatric disorders and may receive treatment at various inpatient and outpatient care facilities for other health complications instead of alcoholism (4, 5). In addition, some patients prefer to accept long-term help and care for at-risk alcohol use when integrated with other treatment programs (6). Visits to care facilities provide an opportunity for doctors to detect the signs of AUD, however, evidence suggests that this may not always be the case (5). Current efforts include an integration of screening processes for AUD into treatment facilities such as mental health clinics (6). Better screening processes are key to identifying the issues of PAU, especially for older adults with mental health issues. With predictions of an increase in the older adult population in Canada, there is a need to identify the

¹ For this thesis, seniors, older adults or the elderly are classified as being 55 years or older.

prevalence of problematic use of alcohol in older adults, the characteristics of older adults who use alcohol, and the types of community support services data available to examine contextual factors that affect healthcare utilization related to PAU among older adults with mental health issues.

1.1 Behavioural Model of Healthcare Utilization

The Behavioural Model of Healthcare Utilization is used to outline the individual and contextual characteristics that influence health behaviors such as the types of mental health and alcohol recovery community support services that older adults utilize within their communities. This model is used because it provides a better understanding of how factors affecting older adults with mental health and PAU could relate to the need for and access to healthcare service utilization. Figure 1 shows the sixth revised framework of this model.

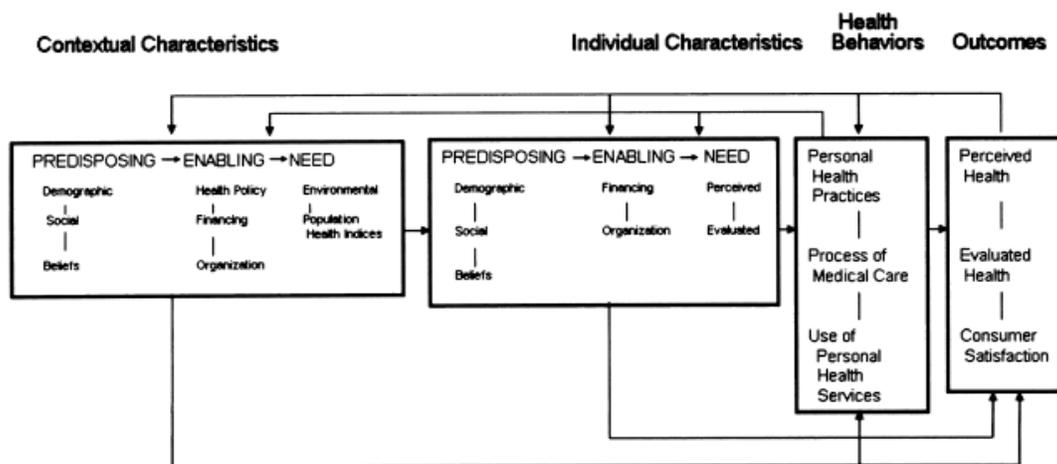


Figure 1: Behavioral model of healthcare use (Source: Andersen & Davidson, 2001)

At the core of the model are the three individual and contextual characteristics used to determine if a service is utilized.

- Predisposing individual characteristics include demographics (such as age and gender), social structure (such as family status, and how the community impacts an individual's

health and access to health services), and belief (such as an individual's knowledge about health and health services) could influence a patient's health care service use (58, 63). For example, an older adult with a predisposed alcohol use problem could experience a worsened effect in mental health disorders, therefore increasing their chance of utilizing psychiatric care. On the contextual level, similar predisposing factors include a broader-based perspective on the composition of demographics, social norms, and general beliefs within the community (58, 63). For example, a community with the demography of older adults is more likely to have different health care services compared to a community with young families (63). The environmental influences that affect the organization and provision of healthcare access may also differ in each case.

- Enabling resources are financial conditions that promote health service utilization. Individual enabling characteristics may include a patient's income level, type/extent of health insurance coverage, and the type/source/availability of care (62, 63). In addition, the characteristics of the patient's residential neighborhood such as accessibility and availability of health care services can increase or decrease service utilization (62). Contextual enabling characteristics focus more on the health care policies made at the local or federal level. For example, decisions on health care costs made at the federal level could affect the type and frequency with which an older adult may seek these health services. The organizational structure includes the number of health care facilities within a community, the number of healthcare workers delivering the services, as well as the structure of the health service delivery (63). For example, a health care facility that is close to residents, open for long hours with a mix of recovery service programs, and shorter wait

times, is likely to be utilized more frequently compared to one that is further away with longer wait times and shorter hours of operation.

- The patient must have a need for the healthcare service to facilitate utilization. At the individual level need could be perceived or evaluated (63). Perceived need is based on the individual's idea of how serious an illness might be, due to their views about health. An evaluated need is usually determined based on an examination of the patient by a health care professional (63). For instance, an older adult who presents with mental health issues during a visit to a general practitioner may need specialized care and be referred to a psychiatric facility. On the contextual level, the need may be environmental or population health indices. Environmentally, factors such as the water, air, or housing quality, and the level of neighborhood safety such as the rate of injuries and deaths are indicators. Population health indices are measured by mortality, morbidity and disability rates (63).

Though this theoretical framework is widely used for interpreting health care utilization behaviors (58), health behaviors are a lot more dependent on the types of services the patient requires and therefore individual and contextual characteristics cannot be easily generalized. However, the model provides a better understanding of interrelating factors that affect a patient at the individual and contextual levels. For older adults with alcohol use and mental health issues, the predisposing factors, enabling factors, and needs factors can be better categorized and analyzed so the appropriate health care services can be identified and recommended. This will be discussed further in Chapter 3 (section 3.3.2).

1.2 Seniors' Mental Health and Addictions in Ontario

In Ontario, Assertive Community Treatment Team (ACTT), Counselling and Treatment, Inpatient, Social Rehabilitation/Recreation are just a few of the many types of mental health and addictions

services available (66). Other specialized addictions treatment programs in the province are community and residential-based and are meant to provide continuous care after the patient is discharged (66). However, gaps have been identified in the availability and accessibility of senior-specific programs that cater to the needs of older adults with mental health and addictions problems (67). Particularly, the Canadian Psychological Association (CPA) notes that most of the mental health services in Ontario are provided by the private sector which allows those with the income and health insurance coverage to access the services while patients who are unable to afford the service end up competing for the few publicly funded services (69).

According to the Canadian Mental Health Association (CMHA), 17-30% of older adults (65+) are estimated to live with mental health disorders that include suicidal ideations, depression, anxiety disorders, dementia, delusional disorders, and concurrent disorders such as AUD (67). Even more alarming is the fact that seniors with depression have four times the likelihood of having alcohol-related problems compared to those without depression (68). In 2009, the Ministry of Health and Long-Term Care (MOHLTC) developed a 10-year strategy for mental health and addictions for the general population. Several institutions such as Canadian Coalition on Seniors' Mental Health (CCSMH), Centre for Addictions and Mental Health (CAMH), Mental Health Commission of Canada (MHCC), and CMHA have since released various frameworks that address senior-specific mental health and addictions issues (70, 71). The core basis of these frameworks could be related to behavioral model that advocates for the prevention, early identification, and early intervention of predisposing factors that include more family involvement and community support services. For example, mental illness could be identified and possibly prevented in early life while intervention during late-life changes could also help manage addictions (67). In addition, more government-funded medical and mental health support service programs, workers, and centers are

needed in or close to senior living communities to address enabling factors; education of older adults and/or family members, and to identify some of the individual and community triggers of poor mental health issues and addictions. Accessibility and availability of mental health and addictions services remain a major issue for older adults. Advocates continue to call for the promotion and integration of geriatric mental health services across Ontario, particularly through inpatient and outpatient programs, home care services, hospital and emergency services, and community health services; as well as promoting an integrated mental health and addictions platform for both health professionals and patients.

1.3 Thesis Overview

This thesis will include 5 chapters. The current chapter gives a brief overview of why this study is important, and what this study will add to the current body of knowledge in the field of geriatric substance abuse (particularly alcohol use) and mental health. Chapter 2 forms the literature review section. This chapter discusses some previous works that highlight the role of diagnostic and screening tools currently used in geriatric alcohol use assessment, problematic and characteristic alcohol use indicators in older adults, and types of support services available. The chapter concludes with a summary of the discussion. Chapter 3 describes the methods of data analysis. Chapter 4 forms the study results section, while Chapter 5 is the discussions and conclusion chapter. Chapter 5 also includes some recommendations for future research, as well as the implications of this study on health services use.

CHAPTER 2: LITERATURE REVIEW

The National Institute on Alcohol Abuse and Alcoholism (NIAAA), defines low-risk drinking as under a limit of one standard drink per day (that is, 12 ounces domestic beer, 5 ounces of wine, or 1.5 ounces 80 proof liquor), or seven drinks per week, for men and women age 65 and older (6). The Canadian low-risk drinking guidelines (LRDG) suggests a higher low-risk limit of up to two standard drinks a day, with nine and fourteen drinks a week for women and men respectively (72). This chapter discusses what constitutes PAU in older adults, some diagnostic and screening tools used for older adults with AUD, characteristics of older adults who use alcohol, and some types of community support services available to address mental health and addictions problems.

2.1 Problematic Alcohol Use in Older Adults

2.1.1 What Constitutes At-Risk Drinking for Older Adults?

To understand the magnitude of PAU in older adults, AUD needs to be classified. AUD afflicts 1–3% of older adults and is more prevalent in men than women (16). In Canada, at-risk drinking is defined as nine or more drinks per week for women and 12 or more for men, which is higher than the current NIAAA guidelines of seven drinks per week (1 per day) for men and women over the age of 65 (6). These differences in drinking limits are set based on population health indices such as mortality and morbidity. For instance, some countries such as the UK, New Zealand, and Australia measure health loss, the lifetime risk of death, and risk of injury due to alcohol use (87). Table 1 outlines the differences between the at-risk and alcohol dependence classifications.

Table 1: At-risk drinking vs. alcohol dependence

Characteristics	At-risk drinker	Alcohol-dependent
Withdrawal symptoms	No	Often
Amount consumed	More than 14/week	40-60/week or more
Drinking pattern	Variable; depends on the situation	Tends to drink a set amount in the same circumstances
Social consequences	Nil or mild	Often severe
Physical consequences	Nil or mild	Often severe
Socially stable	Usually	Often not
Neglect of major responsibilities	No	Yes

Source: NICE, 2013

While at-risk drinkers and problem drinkers are classified as heavy drinkers, those classified as alcohol dependent practice excessive drinking. From Table 1, it is evident that identifying older adults at the at-risk stage would be better than at the alcohol-dependent stage where the older adult is unable to function without assistance. This classification is important during the AUD diagnosis and screening stages for older adults to identify the level of alcohol consumption and the kind of support services required. It would be extremely beneficial for older adults to be identified before the at-risk drinking stage, however, as other comorbidities often mask the underlying issue of alcohol use, it is important to have tools in place for early screening and diagnosis of AUD. Section 2.2 discusses a diagnostic tool and some screening tools currently used to identify older adults who are at-risk drinkers or alcohol-dependent.

2.1.2 Early and Late-Onset Drinkers

The duration of drinking pattern for older adults gives an insight into some of the long-term effects, and aids in the types of support services that may be required for recovery. This means that the AUD impacts and response to recovery for early and late-onset drinkers may vary.

Older adult drinkers can be classified as early or late-onset drinkers. Early-onset drinkers usually begin alcohol use as young adults and progress well into older adulthood. Approximately one-third of AUDs among older adults do not develop until later in life (15). Late-onset drinkers are usually found to take up drinking after a major life event such as retirement; bereavement; and losses in a social network, education, or income (10). However, both early and late-onset older adult drinkers could be influenced by enabling attitudes and behaviors, family and personal history, and chronic stress (10), to cause at-risk drinking and AUD.

Adverse effects of AUD on the physiology of the elderly include chronic heart disease, falls, alcohol-related brain damage, cirrhosis, gastrointestinal disease, nutritional deficiencies, infections, and insomnia (11). Excessive drinking increases an older adult's susceptibility to falls and impairs balance and judgment when their reserve in postural support mechanisms are lost. This can cause an increased risk of osteoporosis on gait and balance, ultimately resulting in higher rates of hip fractures among older adults (11). To better identify some of the factors associated with older adult PAU, the socio-environmental factors within their areas of residence plays a major role in the care and recovery process, particularly for older adults who use alcohol.

2.1.3 Socio-Environmental Factors

The characteristics of areas where older adults reside may also affect the risk of alcohol use, as well as the alcohol recovery process. For example, older adults need the support of family through the alcohol recovery process, and to advocate for the best treatment approach. These include seeking medical attention for the decline in patient's cognition or self-care, provide information on recent and lifetime drinking problems, provide support during detoxification and treatment, coordinate with community services at home if needed, and make decisions for AUD in older adults with impaired cognition who are unable to process information, weigh consequences or

communicate decisions (11). Family members of elderly patients with comorbidities and cognitive impairments who need help with daily care, need to have access to support and education about alcoholism (11). For example, while relatively healthy older adults may need support to attend day, outpatient or community-based treatment programs, frail elderly patients may require medically supported withdrawal prior to admission to long-term care facilities. These support services are needed within the community where the older adults reside. However, the ability of older adults to access these support services is as important as the availability of the services.

2.2 Screening and Diagnostic Tools

Screening for AUD involves the use of guiding questions that provides indicators to help clinicians identify PAU or persons at-risk of PAU. AUD screening tools identified for older adults include CAGE², SMAST-G³, SAMI⁴, AUDIT⁵, ARPS⁶, and ASSIST⁷. These screening tools present various strengths and limitations that determine how appropriate they are for screening older adults. For older adults, the level of a screening sensitivity is important to identify PAU as an underlying diagnoses. For instance, SMAST-G identifies individuals experiencing harmful alcohol use or alcohol dependence but does not identify individuals who are at risk of experiencing alcohol-related harm (72). Similarly, AUDIT also identifies the various levels of AUD as hazardous alcohol use, dependence symptoms, and harmful alcohol use (73), but it has low sensitivity in screening older adults for medications, medical history, and functional status (74), which are important factors to consider when an intervention is required. On the other hand, ARPS (with sensitivity of 93%) is particularly useful as it combines classifying alcohol consumption as

² The four-item test with questions on Cutting down, Annoyance at criticism, Guilty feelings and use of Eye-openers (CAGE),

³ Short Michigan Alcoholism Screening Test (Geriatric Version)

⁴ Senior Alcohol Misuse Indicator (SAMI)

⁵ Alcohol Use Disorders Identification Test (AUDIT)

⁶ Alcohol-Related Problems Survey (ARPS)

⁷ Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)

non-hazardous, hazardous, or harmful with the patient's medical history, current medication use, physical/psychiatric conditions, gender and functional status, binge drinking, and drink-driving (75, 76). A tool like SAMI adopts an interactive approach by asking leading screening questions that inquire about substance use, which helps the elderly patient in identifying the link between their health problem and alcohol use, in a sensitive and non-judgemental manner (77). This is particularly useful when looking to obtain information on the patient's alcohol use and their plans to reduce or quit alcohol use. It also creates the opportunity for health professionals to educate patients on the role of small amounts of alcohol on the body as they get older, and the consequences of combining alcohol with medication (76). For older adults, prevention or early intervention is associated with identifying alcohol problems as the underlying issue during the initial screening process as AUD often interferes with other comorbidities, medications, psychiatric conditions, and daily function.

This study uses the Ontario mental health reporting system (OMHRS) data which includes patterns of alcohol use, the CAGE screening tool, the DSM-V diagnostic tool, and other indicators to measure the severity of AUD in older adults. Therefore, subsequent sections only discuss these tools as an aid to informing health care providers of a patient's alcohol use problem and treatment option.

2.2.1 CAGE

The CAGE screening tool is made up of four simple questions that are meant to identify a drinking problem in older adults. The screen is positive for men if they answer 'yes' to any two questions and one 'yes' for women. Table 2 shows the CAGE screening questions.

Table 2: CAGE screening questions

• Have you ever felt you ought to CUT DOWN on your drinking?	Yes/No
• Have people ANNOYED you by criticizing your drinking?	Yes/No
• Have you felt bad or GUILTY about your drinking?	Yes/No
• Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover (EYE OPENER)?	Yes/No

Source: NICE, 2013

Although CAGE is currently adapted to include drugs screening and dependence, it is less useful for detecting problematic or risky substance use in nondependent persons (19). CAGE may be deemed inaccurate in screening the general elderly population, as it works better in care structure-based populations (20). For this study, CAGE is the appropriate tool because inpatients in psychiatric care are the focus.

2.2.2 The DSM-V

DSM-5 is an updated version of DSM-IV (fourth edition). According to the NIAAA's Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5), anyone that meets any two of the eleven criteria (Table 3) during a 12-month period is diagnosed with AUD (18). The DSM-5 integrates the two DSM-IV disorders of alcohol abuse and alcohol dependence into a single disorder called *alcohol use disorder (AUD)* with mild (2-3 symptoms), moderate (4-5 symptoms) and severe (6 or more symptoms) sub-classifications (18). This means that an elderly person with any of the symptoms in Table 3, will likely need intervention for alcohol abuse or alcohol dependence. The InterRAI team updated the RAI-MH instrument used in this study to DSM-V criteria questions that reflect the changes made to DSM-IV.

Table 3: DSM-V eleven criteria questions used to diagnose AUD

DSM-5	
In the past year, have you:	
1	Had times when you ended up drinking more, or longer, than you intended?
2	More than once wanted to cut down or stop drinking, or tried to, but couldn't?
3	Spent a lot of time drinking? Or being sick or getting over other aftereffects?
4	Wanted a drink so badly you couldn't think of anything else? **This is new to DSM-5**
5	Found that drinking—or being sick from drinking—often interfered with taking care of your home or family? Or caused job troubles? Or school problems?
6	Continued to drink even though it was causing trouble with your family or friends?
7	Given up or cut back on activities that were important or interesting to you, or gave you pleasure, in order to drink?
8	More than once gotten into situations while or after drinking that increased your chances of getting hurt (such as driving, swimming, using machinery, walking in a dangerous area, or having unsafe sex)?
9	Continued to drink even though it was making you feel depressed or anxious or adding to another health problem? Or after having had a memory blackout?
10	Had to drink much more than you once did to get the effect you want? Or found that your usual number of drinks had much less effect than before?
11	Found that when the effects of alcohol were wearing off, you had withdrawal symptoms, such as trouble sleeping, shakiness, restlessness, nausea, sweating, a racing heart, or a seizure? Or sensed things that were not there?

The presence of at least 2 of these symptoms indicates an **Alcohol Use Disorder (AUD)**.

The severity of the AUD is defined as:

Mild:
The presence of 2 to 3 symptoms

Moderate:
The presence of 4 to 5 symptoms

Severe:
The presence of 6 or more symptoms

Source: NIAAA, 2016

The use of alcohol in older adults could be due to grief because of losing a spouse, adult children moving away, retirement, chronic pain, depression, insomnia, loneliness and isolation, and shame especially among women due to the stigma of drinking and seeking help (17). To identify patients in need of help for at-risk drinking, doctors are advised to ask all elderly patients at every annual physical about their drinking habits. For example, using a diagnostic tool such as the DSM-V to identify a specific amount of alcohol consumed daily, weekly, or monthly; to determine how that compares to the standard drinking guidelines (16). A physical exam should also be conducted to identify any possible comorbid medical disorders (16). The collection of an elderly patient's alcohol consumption history is a crucial stage of the diagnosis process during screening for AUD. The next section highlights some characteristics of older adults who use alcohol and common health conditions identified in the literature reviewed on AUD effects on the elderly.

2.3 Characteristics of Older Adults Who Use Alcohol

This section discusses some of the characteristics of older adults who use alcohol, to highlight some factors of PAU among older adults in inpatient psychiatry. Older adults with AUD tend to exhibit psychiatric conditions, use numerous medications, have other drug or substance use addictions, affect more men than women, and show several significant physiological impacts. AUDs often occur concurrently with mental health, comorbidities, medication use, drug, and other substance use.

2.3.1 Psychiatric Conditions

Older adults (65+) experience psychiatric conditions such as suicide, depression, mood and anxiety disorders, neuro-cognitive disorders (including dementia and delirium), substance misuse (including prescription drugs and alcohol), psychotic disorders, and delusional disorders (67, 70).

For instance, in a study of persons age 65 and older, 13.3% of those with major lifetime depression also meet criteria for a lifetime of AUD, whereas only 4.5% had a lifetime AUD without a history of depression (8, 21). Amongst the elderly, it is still unclear if depression causes AUD or vice versa. However, AUD, depression, and anxiety disorders were associated with more than 70% of elderly suicides, domestic violence, separation/divorce, and social and economic decline (9). The co-occurrence of AUDs and depression heightens late-life suicide risk, as does 'at-risk' and problem drinking among older adults (8, 22). Depression is more prevalent in elderly men with AUD compared to women, because men are more likely to use alcohol to cope with depressive moods, while women with depression were less likely to misuse alcohol (23, 24).

Older adults also have increased odds of a psychiatric diagnosis for mood, anxiety or personality disorders with a combined use of both alcohol and tobacco over extended periods of time (12 months or more) (7). This indicates that the combination of AUD with other substances further worsens psychiatric conditions that are not concurrently diagnosed and treated. It is suggested that the screening and treatment for psychiatric conditions such as depression in older adults should include alcohol screening (23).

Some studies indicate that the psychiatric effects of alcohol may not be initially identifiable in older adults, as evidence suggests AUD could worsen pre-existing conditions and increase the length of stay for the elderly in psychiatric care facilities (4, 5). This is problematic as data shown in Table 4 indicates that alcohol was responsible for the highest percentages of hospitalizations associated with mental health conditions such as chronic AUD (24%), alcohol withdrawal (23%), and harmful alcohol use (18%) compared to physical conditions such as cirrhosis and pancreatitis (64).

Table 4: Top conditions entirely caused by alcohol, Canada, 2015–2016

Mental health conditions (percentage of hospitalizations)	Physical conditions (percentage of hospitalizations)
Chronic alcohol use disorder (24%)	Alcohol-induced cirrhosis of the liver (13%)
Alcohol withdrawal (23%)	Alcohol-induced acute pancreatitis (6%)
Harmful alcohol use (18%)	Alcohol-induced hepatitis (4%)
Alcohol intoxication (9%)	Alcohol-induced hepatic failure (4%)
Alcohol withdrawal delirium (5%)	Toxic effects of alcohol (3%)

Source: CIHI, 2017

2.3.2 Medications

The combined use of alcohol with certain medications (prescribed and non-prescribed) in older adults could be potentially fatal as its prevalent use could affect the liver, pancreas, gastrointestinal tract, respiratory tract, muscle, bone density, brain and the immune system (9). The association between alcohol and medications use among older adults are said to be common with about 6-10% of older adults with AUD also using medication (70). While some older adults rely on certain medications for treating age-related physical changes, its interaction with alcohol may pose a greater threat causing cognitive, emotional, and physical health problems (70).

The reasons for alcohol use among the elderly may vary based on gender and life experiences, for example, widowed women use alcohol while dealing with the grief of losing a loved one and receiving inadequate support to cope (26). However, there was also a significant link between grief and increased intake of alcohol, sleeping pills, and sedatives (26). For older adults, the side effects of alcohol and medications may not be initially identified but rather mistaken for other medical conditions or co-morbidities. For example, older adults prescribed Benzodiazepine for the treatment of AUD may become addicted but the medication is not identified as the cause of the

alcohol withdrawal symptoms (29). Table 5 shows a list of some medications commonly used in combination with alcohol among older adults.

Table 5: List of medications commonly used with alcohol

Medication group	Medication type
Analgesics	–Aspirin, acetaminophen
•Antibiotics	–Erythromycin, isoniazid
•Anticonvulsants	–Phenytoin
•Antihistamines	–Diphenhydramine, chlorpheniramine, clemastine, hydroxyzine, promethazine, cyproheptadine
•Anticoagulants	–Warfarin
•Antidiabetic agents	–Chlorpropamide, glipizide, glyburide, tolbutamide, metformin
•Barbiturates	–Phenobarbital
•Benzodiazepines	–Alprazolam, chlordiazepoxide, clonazepam, chlorazepate, diazepam, lorazepam, midazolam, oxazepam, temazepam, triazolam
•Histamine H2 receptor antagonists	–Cimetidine, nizatidine, ranitidine
•NSAIDS	–Ibuprofen, flurbiprofen, fenoprofen, ketoprofen, naproxen, diclofenac
•Opioids	–Codeine, hydromorphone, fentanyl, morphine, meperidine, propoxyphene
•Sedatives, hypnotics	–Chloral hydrate, meprobamate
•Tricyclic antidepressant	–Amitriptyline, clomipramine, desipramine, doxepin, imipramine, nortriptyline, trimipramine

Modified from source: Purcell, 2014

2.3.3 Drug or Substance Use

Older adults sometimes use alcohol in combination with drugs or other substances, especially those not medically prescribed for use or used for longer than the prescribed period. Common drugs and substances (both prescribed and recreational) include tobacco, sedatives, tranquilizers, opioids, amphetamines, cannabis, crack cocaine, hallucinogens, inhalants, and heroin (27). For instance, studies indicate that older adult men (65-74 years) were more likely to have a concurrent AUD and tobacco use disorder compared to those 75 years and older, who were more likely to have existing health problems (7, 27). Individuals with concurrent drug use and AUDs face challenging

complications that affect remission as they tend to be more susceptible to alcohol withdrawal symptoms due to a higher blood alcohol concentration that metabolizes slowly, creating a longer exposed effect (28, 30). For example, in a French study conducted on hospitalized geriatric inpatients, more than half (54%) alcohol-dependent patients (especially male) with AUD showed signs of addiction to benzodiazepine, after it was systematically used as a therapeutic treatment measure for alcohol withdrawal symptoms (29). Therefore, older adults who show these symptoms during the alcohol treatment process may also need to be treated for drug and other substance use problems.

2.3.4 Gender-Based Alcohol Limit Variations

Most countries including Canada use the LRDG to set the gender-based alcohol limits based on population health indices that measure health loss, injury, and death. Alcohol standard drink limits variations could make the diagnosis of AUD difficult, as gender plays an important role in determining the set limits for alcohol consumption in older adults. Generally, the alcohol limits for women are lower because women are believed to be more susceptible to the effects of alcohol, and particularly older women are at additional risk due to changes in metabolism that occurs through aging (33). The alcohol limits set for older males and females vary, for example in the US, the consumption of 4 or more drinks for men and 3 or more drinks for women per drinking day is classified as heavy/binge drinking (32). A low-to-moderate level of drinking is classified as up to 3 drinks for men and up to 2 drinks for women per drinking day (32). In a United States (US) community-dwelling study of older adults (60 to 94 years), 62 percent of the subjects were found to drink alcohol, of which 13% of men and 2% of women were heavy drinkers (31).

Depending on the social environment, gender alcohol limits may be combined with acceptable cultural and societal norms, which unintentionally promotes the use of alcohol in older adult men

compared to women. The quantity of alcohol consumed in a social context is dependent on how the society perceives gender. For example, a Korean study found that Koreans permitted social drinking and drunkenness in older adult men in their 60s or older, and they had a higher risk of excessive and heavy drinking than those in their 20s (34). On the other hand, drinking for women is prohibited in the Korean society and therefore higher prevalence of AUD in elderly men than women.

Other factors such as socioeconomic status, marital status, and education also affected the gender differences and alcohol use. For example, older adult women who had never used alcohol were more likely to live alone, and have a lower educational level compared to alcohol users (35). Most literature reviewed indicated that older adult men were more likely to develop AUDs compared to women, and the set gender-based alcohol limits may encourage men to drink more alcohol than women (31, 32, 33, 34).

2.3.5 Physiological Impacts of Excessive Drinking

Alcohol has a significant impact on the physiology of the elderly. Falls, alcohol-related brain damage, cirrhosis, gastrointestinal disease, nutritional deficiencies, infections, and insomnia are just a few of the impacts of excessive drinking. Table 6 shows a summary of some physiologic impacts of excessive alcohol use in older adults, based on prior known medical history.

Table 6: Medical history findings related to excessive alcohol intake

Alcohol-related illnesses	Poor nutrition, seizure activity, esophageal/gastrointestinal bleeding, aspiration pneumonia, anxiety, depression, neuropathies, pancreatitis, liver disease
Alcohol-related conditions misinterpreted	Depression, insomnia, nutritional deficiencies, falls as expected problems of aging
Age-related conditions exacerbated by excessive alcohol	Urinary incontinence, gait disturbances, depression, insomnia, delirium

Social history related to excessive alcohol use	Inability to fulfill major obligations, family dysfunction, difficulties with the law
Surgical history: alcohol-related injuries	Motor vehicle collisions, falls, and fractures

Source: Letizia & Reinbolz, 2005

Though older adults may be susceptible to some of these physiological impacts due to aging, alcohol consumption could further exacerbate a situation such as a fall with intoxication and loss of balance. Alcoholism often impairs brain function causing slurred speech and confusion in older adults, for example, older adults who drink excessively could become cognitively impaired and develop alcohol-related dementia (30). Though abstinence often reduces the confused state experienced, the effects of alcohol on memory and judgment could be irreparable (36).

Older adults with cirrhosis have the risk of developing liver cancer, with half of the elderly patients dying within one year of diagnosis (36). Excessive alcohol consumption also suppresses the optimal function of the immune system to fight off infections, for instance, there is an increased risk of contracting pneumonia and tuberculosis (36), which could be difficult to treat with medication if there is continuous alcohol use. Other physiologic impacts of excessive drinking such as nutritional deficiencies and insomnia could be resolved through abstinence. However, where abstinence is not possible, care providers might suggest other support services be utilized in the alcohol recovery process.

2.4 Support Services for Older Adults

This section discusses some types of support services available to examine contextual factors related to alcohol use among older adults. These are grouped into individual and community levels of support. Individual levels of support are usually direct, offered on a case-by-case basis, and one-on-one interaction with the elderly patient. Community levels of support focus on integration,

confidence building, and independence of older adults within their community. These are often facilitated by family/carer support to utilize group-based programs that offer indirect support services to elderly patients in the community.

2.4.1 Individual Level Support Services

The alcohol screening process involves the collection of basic patient information that may include the age, gender, duration of alcohol use (early or late-onset drinker), alcohol consumption rates, and details about the general well-being of the older adult. Once an older adult is identified as having AUD, a clinician plans and implements a treatment/management program. It is advised that delays from the time of diagnosis or detoxification to enrollment in a treatment program be avoided (37). Studies indicate that treatment duration is highly dependent on whether the older adult is an early or late-onset alcoholic. For example, patients with late-onset alcoholism were generally found to have greater resources and family support, were more likely to complete treatment with somewhat better outcomes compared to patients with early-onset alcoholism (10, 38, 39). A longitudinal study of prognosis for older adults with AUD found an overall 21% stable remission of late-life drinking at four years, with late-onset alcohol users almost twice as likely as early-onset alcohol users to have stable remission from treatment (39).

2.4.2 Community Level Support Services

Community-level support such as treatment options is encouraged after elderly patients have undergone detoxification. The availability or lack thereof of support services within an elderly patient's area of residence could be the difference in how the services are utilized. Other barriers to treatment amongst older adults include transportation to programs (due to intoxication causing a loss of license or inability to drive), misdiagnosis, denial, social stigma, fear of failure, enabling attitudes and behaviors, and attitudes of health professionals (8, 10, 25). Treatment components

should be accessible and flexible, client and family-centered, goal-oriented, and senior-specific; and include group counseling or recreational activities, harm reduction, comprehensive and holistic approach, and case management (8, 10, 25). To achieve an effective treatment program, barriers and components need to be addressed. Treatment options include but should not be limited to senior-specific programs, brief intervention, pharmacological intervention, psychosocial approaches (10, 25), as older adults will have to be treated on a case-by-case basis, to identify the appropriate treatment option.

2.4.3 Types of Support Services

This section discusses some types of common support services usually available to older adults with AUD during the treatment and recovery process. These include clinical management, senior-specific programs, brief intervention, pharmacological intervention, psychosocial approaches

2.4.3.1 Clinical Management

Clinical management seeks to manage alcohol withdrawal symptoms and effects on the elderly. Some alcohol withdrawal symptoms include autonomic hyperactivity, increased tremor, insomnia, nausea or vomiting, transient visual, tactile or auditory hallucinations, psychomotor agitation, anxiety, and grand mal seizures (11, 40). Older hospitalized patients with alcohol withdrawal have an increased risk of delirium, falls, prolonged confusion and dependency in daily activities, which results in a longer hospital stay and a higher risk for discharge to an extended care setting (11, 41). This process of detoxification can be done through hospitalization or outpatient programs, depending on the medical stability of the older adults (11, 37). Close supervision is advised as detoxification can have severe withdrawal effects on the health of the elderly.

Benzodiazepines are generally used on a short-term basis to manage alcohol withdrawal. Several studies agree that longer-term benzodiazepine use in the elderly may increase the risk of cognitive impairment, falls that cause hip and femur fractures, and an increased likelihood of motor vehicle crashes (42, 43, 44, 45). Although cognitive deterioration is an aging process, it can be worsened with benzodiazepine use. For instance, older adults are more likely to be hospitalized for alcohol withdrawal symptoms such as cognitive dysfunction due to benzodiazepine (42, 45). Shorter-acting benzodiazepine is recommended for the elderly, as longer-acting benzodiazepine can cause prolonged and excessive sedation because of pharmacologic changes related to aging (46).

2.4.3.2 Senior-Specific Programs

Options for senior-specific programs include inpatient programs, day treatment, outpatient therapy or community-based groups. Though treatment options may vary, some studies indicate that older adults respond better to mixed-age treatment and brief intervention protocols designed for the primary care clinic (11, 47, 48, 49). However, other studies suggest that senior-specific programs are as effective if not better than mixed-age programs when the focus is on building self-esteem, developing peer relationships and setting short-term goals, as this tends to promote higher alcohol abstinence at six and twelve-month follow-ups (10, 15, 50, 51). The type of support an older adult will need for a treatment program will depend on their health, for example, while relatively healthy elderly patients may be best suited to attend day treatment programs, patients with AUD needing psychiatric care may be better suited for inpatient treatment programs.

Overall, treatment should consider other age-related factors such as stigma in seeking treatment for alcohol abuse, avoiding treatments that take a confrontational approach, and creating age-specific groups where older adults are more comfortable with peers who share similar experiences (10, 52).

2.4.3.3 Brief Alcohol Use Intervention

The brief alcohol use intervention technique is used as an initial stage of addressing the issues of at-risk drinking or PAU. Of the vast number of literature on brief intervention, only a few are specific to older adults. The brief intervention approach for the elderly is dependent on whether they are early or late-onset alcohol user. The reason being that the brief intervention method is shown to be especially effective for late-onset clients who are at-risk drinkers (53). Studies on the effectiveness of brief interventions for alcohol use in seniors have shown positive results (54, 55, 56). However, depending on the level of alcohol risk, the older adult may be referred to a brief intervention program or to full treatment programs, to facilitate a reduction in alcohol use or abstinence. Figure 2 outlines a brief alcohol use intervention process for the elderly based on the US LRDG.

1. Identify patient's future goals: physical and emotional health; activities and hobbies; relationships and social life; financial stability.
2. Give feedback about patient's responses to screening questions.
3. Review where patient's drinking fits into population norms for age group.
4. Introduce the concept of standard drinks and advise on safe amounts of drinking (men: < 2 drinks/day, < 7 drinks/week, < 4 drinks/occasion; women: < 1 drink/day, < 5 drinks/week, < 3 drinks/occasion)
5. Weigh the pros and cons: reasons for drinking versus reasons to cut down or quit.
6. Consider change: quitting or cutting down on drinking.
7. Discuss sensible drinking limits and strategies for cutting down/quitting.
8. Create a drinking agreement in form of a prescription.
9. Discuss coping with risky situations, develop relapse prevention strategies.
10. Summarize discussion.

Figure 2: Brief alcohol use intervention for geriatric patients (Source: Barry et al, 2006)

Brief interventions usually include assessment, goal setting, behavior modification techniques, and self-help literature. Interventions begin by asking questions about substance use and assessing medical, behavioral, or legal problems that may be related to substance use (10). Brief

interventions work better with at-risk or problem drinkers, but a full treatment program is suggested for alcohol-dependent patients who want to quit drinking (10). Though brief interventions can be effective for older adults, they must be willing to accept the help, especially in cases where there is a denial of alcohol abuse.

2.4.3.4 Pharmacological Intervention

The literature on pharmacological interventions suggests two commonly used drugs; Disulfiram and Naltrexone. Several studies indicate that though Disulfiram has been used to treat younger patients with a joint cocaine and alcohol dependence, it is not recommended for use in older adults, particularly those that are cognitively impaired, due to serious adverse effects (10, 11, 37, 46, 57). Naltrexone; an opioid antagonist, reduces the craving for alcohol and assists in relapse prevention. However, several studies agree that it was not as effective in achieving abstinence as it was in preventing relapses to heavy drinking amongst older adults (50-70 years) (10, 11, 57). Acamprosate (Campral) was also identified as a drug used to reduce cravings for alcohol. It is taken after the patient has undergone detoxification and has abstained from alcohol use. Though it is comparatively less harmful to the liver especially in heavy drinkers, this drug's efficacy and safety in elderly patients has not be established due to lack of information (10, 57).

2.4.3.5 Psychosocial Approaches

Psychosocial risk factors such as retirement; bereavement; losses in a social network, education, or income; enabling attitudes and behaviors; family and personal history; and chronic stress (10) could cause at-risk drinking and AUD in older adults. Older adults may start drinking to "fill the gap" of their loss. Most psychosocial treatments aim to provide empathy, develop coping skills

and confidence to address the risk factors (10). This approach builds self-confidence in dealing with alcohol use problems and broadens social networks with other older adults.

Older adults also need the support of family through the alcohol recovery process, to advocate for their best treatment approach. These include seeking medical attention for decline in patient's cognition or self-care, provide information on recent and lifetime drinking problems, provide support during detoxification and treatment, coordinate with community services at home if needed, and make decisions for older adults with impaired cognition who are unable to process information, weigh consequences or communicate decisions (11). Families should also have access to support and education about alcoholism, especially for the families of elderly patients with comorbidities and cognitive impairments, who need help with daily care (11). While relatively healthy older adults may need support to attend day, outpatient or community-based treatment programs; frail elderly patients with psychiatric disorders may require medically supported alcohol withdrawal prior to admission to long-term care facilities.

2.5 Summary

A number of terms have been used to identify persons who problematically consume alcohol, including alcohol abusers (moderate drinkers) or heavy/excessive drinkers (alcohol dependent), that may be considered at risk of or indicative of alcohol use disorder (AUD). Among those suspected of being at risk, comprehensive alcohol screening processes are important to identify the type of treatment needed for older adults, particularly those with psychiatric disorders. Through the various screening tools outlined, clinicians can assess the duration and rate of alcohol consumed by older adults, as well consequence of use. There is no doubt that the impacts of alcohol on older adults create adverse effects that may be irreparable. Depression, cognitive impairment,

and other psychiatric disorders are just a few conditions identified in older adults with AUD. Older adults with mental health issues and other comorbidities are at a higher risk of worsening their conditions with alcohol. AUD creates a domino health effect that causes a series of other health conditions such as insomnia and falls that become difficult to treat, especially in elderly heavy drinkers. Problematic alcohol use tends to be more common among men than women, indicating that gender plays a major role in alcohol consumption patterns, sometimes promoting increased alcohol consumption for men. The current Canadian LRDG standard drink limits for the general population also apply to older adults as there are no specific limits for older adults. However, these limits appear to be high for older adults.

Detoxification and treatment programs are proven effective ways of promoting abstinence or reducing alcohol abuse and dependence. However, the aging process and existing health conditions may affect the effectiveness of the detoxification and treatment programs for older adults because severe withdrawal symptoms could occur. As discussed, several factors such as stigma, enabling attitudes, and lack of self-confidence may prevent elderly patients from receiving the required support to abstain or reduce their alcohol consumption. The predictors of alcohol use are numerous, and the type of intervention for recovery will depend on availability and accessibility to local support services.

Family support is important in the recovery process particularly, when advocacy and intervention are required. Older adults who are in remission for alcohol use may need continuous support, especially after hospitalization. Though abstinence will be the best outcome of detoxification and treatment, it may not always be the outcome especially if relapse occurs due to lack of adequate service utilization. Some studies also indicate that though there are obvious adverse effects of alcohol on the elderly, there is limited data to support such findings. This study will use inpatient

psychiatric data to highlight some factors related to the problematic use of alcohol, as well as identify some available contextual support services or lack thereof for older adults in their areas of residence.

2.6 Study Rationale

The literature reviewed in this study highlights some gaps in screening for PAU and diagnosing AUD among older adults. For older adults with mental health issues, PAU often complicates the recovery process, and ultimately affects healthcare service utilization. Although screening tools detect PAU, several other factors may help clinicians identify older adults who are at-risk of or have PAU. Individual and geographic factors may provide a better understanding of important factors to consider. This study used data from inpatient psychiatry care, so results may not be generalizable to other older adult population with mental health and PAU. However, this study may be replicated to identify indicators that may apply to older adult population in other health care settings with varying health conditions.

Therefore, the main purpose of this study was to examine the prevalence, characteristics, and geographic factors associated with PAU among older adults admitted to inpatient psychiatry in Ontario, Canada. Inpatient psychiatric services in Ontario are an important resource for individuals, including older adults that are experiencing crises related to mental health and substance use issues. Older adults admitted to inpatient psychiatry who use alcohol represent a segment of the older adult population who are experiencing severe difficulty and disruptions in their lives.

This study answered the following questions:

- 1) What is the prevalence of problematic alcohol use among older adults in inpatient psychiatry?
- 2) What are the characteristics of older adults admitted to inpatient psychiatry who use alcohol?

3) Are psychiatric admissions for alcohol among senior's geographically clustered in the Wellington-Waterloo Region?

- What types of community support services data are available to examine contextual factors related to alcohol use among older adults?

CHAPTER 3: METHODS AND ANALYSIS

3.1 Data

Two data sources were used for this study namely; Ontario Mental Health Reporting System (OMHRS) and ConnexOntario and these are explained further in subsequent sections.

3.1.1 OMHRS

The Canadian Institute for Health Information (CIHI) uses OMHRS to collect, analyze and report inpatient psychiatry information of all hospitalized admissions (81 facilities with mental health beds) in Ontario (78). The OMHRS inpatient information collected include details of mental and physical health, social support and service use, based on the Resident Assessment Instrument-Mental Health (RAI-MH). The RAI-MH is completed for inpatients that are admitted and discharged from psychiatry care (90). This study included all data for inpatients admitted for more than 72 hours representing complete assessments with the RAI-MH (78), which has a 100% completion rate for routine care in Ontario (90). The OMHRS team at CIHI checks and reports on data quality that is subsequently communicated to other facilities. Data quality checks are conducted on issues such as non-response items, data accuracy, and coding errors. Data found with errors are usually returned to the hospitals for errors to be rectified (90). The clinical staff takes about an hour to complete the RAI-MH for the average person. Hospitals that use the RAI-MH instrument are assigned a 'RAI coordinator' that supports and trains clinicians. CIHI also delivers training sessions, teleconferences, webcast and other ongoing support modes (90). The OMHRS data includes over 300 elements in the Minimum Data Set for Mental Health (MDS-MH) and is de-identified for use in various research projects (78). Some MDS-MH elements relevant to this study include demography, mental state indicators, substance use, self-care, and service utilization.

These are discussed in further detail in the variables section (3.2.3). The OMHRS dataset is available through a data sharing agreement between CIHI and interRAI Canada at the University of Waterloo.

3.1.2 Inventory of Geographic Service Variables

The geographic context for this alcohol use study was the Waterloo-Wellington (WW) region of Ontario, made up of Kitchener, Waterloo, Cambridge, Guelph, and rural Wellington areas. Study data included regional services offered by the Waterloo-Wellington Local Health Integration Networks (WWLHIN) and the Waterloo-Wellington community care access centre (WWCCAC). The WW regional services provide various levels of assistance with activities of daily living (ADL), mental health and addictions support. Institutions such as the CMHA, the Cambridge Memorial and Grand River hospitals, and Homewood Health Centre offer clinical and community mental health and addictions senior services such as geriatric addictions support, supportive housing, nursing and physician care.

To identify the geographic locations of these senior support services within the WW region, this study used data from ConnexOntario. ConnexOntario provides health services information on mental health, addictions, and gambling services through a health service providers' database. They also provide a helpline and basic educational support for mental health and addictions to those in need. ConnexOntario provided the research team with a database of the service providers in Ontario, including the admission criteria for providers (e.g., age limits) and the addresses of each provider. In addition, location information for social rehabilitation (e.g., Alcoholics Anonymous) and recreation programs (e.g., senior's community centers, seniors' programming at pools) for seniors in the WW region were collected through website searches.

3.2 Sample

The OMHRS data included over 1000 variables describing the clinical and functional needs of every person admitted to an inpatient mental health bed in Ontario since 2005. Annually, there are about 100,000 episodes of care registered in OMHRS where about 10% of episodes represent older adults (adults aged 55 and older). This study sample involved older adults discharged from an inpatient mental health hospital between January 1, 2011, and December 31, 2016. The purpose was to identify any differences between older adults admitted with mental health conditions and no alcohol addictions and those admitted with mental health and alcohol addiction.

3.3 Variables

A multiple logistic regression analysis (MLRA) was conducted using the Statistical Analysis Software (SAS) 9.4. The total number of older adults (55+) were categorized into three sections. Each category represented one of the three sections of the behavioral model (predisposing, enabling, and needs factors). All independent variables in each category were assigned a binary response outcome, except for age groups which were nominal. Problematic alcohol use was the dependent variable.

- For the predisposing factors, the variables included in the MLRA were age, gender, marital status, education, employment status, living arrangement, and usual residence
- For enabling factors, variables included recent psychiatric admissions, lifetime psychiatric admissions, time of last discharge, duration of admission, contact with a mental health professional, and the reason for admission
- The needs factors were analyzed in two subsections. First, the mental health scales subsection included in the MLRA were social withdrawal scale, cognitive performance scale, aggressive behavior scale, depression rating scale, activities of daily living hierarchy

scale, and pain. A detailed table explaining the mental health scales is found in Appendix 1 (Table 11). The second subsection addressed physical health and social relationships with variables such as falls, disturbed relationships with family, interpersonal conflicts, social relations, loss due to death, loss due to income, intentional medicine misuse, and the use of other substances such as inhalants, hallucinogens, cocaine and crack, opiates, stimulants, and cannabis.

The next two sections discuss how the dependent and independent variables are operationalized by defining how they are measured in this study. In addition, the independent variables are categorized using the behavioral model discussed in section 1.1. Variables outlined are based on data from the RAI-MH assessment used to populate the OMHRS data.

3.3.1 Dependent Variable

Problematic alcohol was ascertained using several items in the OMHRS data. Alcohol use is assessed based on the number of drinks the person has had in a single sitting in the prior 2 weeks. Instances, where the person has consumed 5 or more drinks in a single sitting, is commonly used as an indicator of PAU, although 2-4 drinks may also be problematic for older adults (7, 8). To determine the primary outcome, PAU was operationalized by combining the alcohol use item with items on whether the person was admitted due to problematic substance use, scores on the "CAGE" scale (a scale in the OMHRS data measuring the degree of a problem the person's alcohol use has on their life), and the presence of a DSM-V diagnosis. The InterRAI team updated the RAI-MH instrument used in this study to DSM-V criteria questions that reflect the changes made to DSM-IV. The process of defining PAU and results is shown in Chapter 4 (section 4.1.1).

3.3.2 Independent Variables

Independent variables related to PAU were chosen based on several items in the RAI-MH assessment instrument for inpatient mental health and they were categorized using behavioral model. Table 10 gives a description of all the independent variables listed in this section.

- Predisposing factors include demographics such as age (55+ based on year of birth), gender (male or female), marital status (married, single, divorced, widowed), education (no schooling, graduate degree, or unknown) and employment status (employed, or unemployed), and living arrangements (living with family or with others, or living alone), and those whose usual residence was their private home/apartment/rented room. Establishing the demographics of older adults provides some personal background information to identify some characteristics of those admitted to inpatient psychiatry that uses alcohol, and it can be used to identify possible triggers for alcohol use.
- The enabling factor identified is prior health service utilization associated with the number of recent and lifetime inpatient psychiatric admissions, time of last discharge, duration of hospitalization, the reason for admission, and patient's last contact with a mental health professional within their community. This information offers an insight into an older adult's treatment history and service support needs.
- Needs factors are categorized into 2 sections. First, the mental health scales include independent variables such as cognition, aggressive behavior, depression, ADL, CAGE (substance use screener), social withdrawal, and pain in older adults at the time of admission into psychiatric care. Table 11 (Appendix 1) outlines the details of the mental health scales. In addition, the DSM-V psychiatric diagnostic information categorized these mental health conditions based on the level of importance with 1 (most important

condition), 2 (second most important), and 3 (third most important). Second, physical health status attributed to falls, medication misuse, and other substance use; and social relationships such as disturbed relations with family, interpersonal conflicts, loss due to death, loss of income was also be included. Establishing the kind of social support and physical health condition of older adults at the time of admission will aid health care professionals to determine recovery or treatment options available to the older adult.

3.3.3 Contextual Variables

The data on health service providers of mental health and addictions (mainly alcohol) recovery programs and services for seniors was matched with geographic data from OMHRS data using the Forward Sortation Area (FSA). The FSA is the first 3 digits of the postal code, representing geographic areas within the Waterloo-Wellington LHIN. Senior services were categorized into mental health and addiction services in a clinical care setting, for example, nursing and physician care through hospitals and general practitioners; general community support services such as mental health and addictions housing, ACTT, counselling; and social and recreational facilities/centres and organizations such as community health centres that facilitate social support meetings/groups for seniors.

3.4 Analyses

3.4.1 Prevalence of Problematic Alcohol Use

To answer question 1, prevalence of PAU was assessed by defining PAU. Problematic alcohol use was categorised into 5 or more drinks, 2-4 drinks, and 0-1 drink in a single sitting in the two weeks prior to admission. For this analysis, the dataset included all older adults admitted to psychiatric care for 3 days or more who were assessed using the DSM-V diagnostic codes for AUD (F10.10

and F10.20) and alcohol intoxication (F10.129, F10.229, and F10.929). Older adults who were screened with the CAGE tool to identify PAU were also included in the analysis. The CAGE scores rate older adults with PAU based on whether they scored 2 or greater or < 2. Those who scored 2 or more were identified as having PAU and those with a score less than 2 were associated with not having PAU. The CAGE and DSM-V scores were used to assess older adults based on the number of drinks (5 or more drinks, 2-4 drinks, and 0-1 drink consumed).

3.4.2 Characteristics Associated with Problematic Alcohol Use

To answer question 2, a MLRA was used to identify the characteristics associated with other older adults admitted into inpatient psychiatry care with PAU. Age was a categorical variable. Age groups were split into four categories namely; 55-64 (reference group), 65-74, 75-84, and 85+ years. Each age group category was compared to the reference age group to determine its statistical significance. A bivariate analysis of the OMHRS dataset was initially conducted to identify all the variables significant to PAU. After an initial analysis to determine the frequency and percentage for older adults with or without PAU in each category (based on chi-square and p-values), a stepwise selection procedure in a multivariate logistic regression model was used to validate the statistical significance of all the independent variables. Independent variables were analysed using the 3 blocks of the behavioral model of healthcare use (predisposing, enabling and needs factors). Tables 8 and 10 outline all the variables that were used in this study.

Variables were initially selected based on those identified as significant to PAU in the literature reviewed. Regression modelling followed to identify variables that were statistically significant to PAU. Variables were grouped into blocks based on demographics, social factors, and mental health diagnosis among others. Each block of variables was entered into a logistic regression model predicting PAU, starting with demographic factors. Variables that were identified as statistically

insignificant were manually excluded from the models one at a time to identify changes in the c-statistics, odds ratio and 95% confidence interval and to eliminate collinearity that results from deleting some variables. Variables were deemed statistically significant based on the p-value ($p < 0.001$), effect sizes for the odds ratios, and 95% confidence intervals. The c-statistics (0.70 or higher) was used to determine the strength of the model at discriminating PAU from those without PAU. The final table with statistically significant results is presented in Table 9.

3.4.3 Geographic Analysis

Geographic Information Systems (GIS) is a spatial analysis tool that uses digital maps to provide information on geographic locations, links and it analyzes attribute data of health information acquired for a geographic reference (59). GIS is useful in assessing the geographical accessibility of places such as healthcare services and residential locations. For instance, it was used to determine if the geographical accessibility from home to hospital, care home, and hospice affected the type of palliative and end of life care patients received (60). GIS also allows for current trends to be assessed over time to identify changes that may occur. For instance, GIS was used to assess the overall impact of a neighborhood's built environment design on the walking patterns of Canadian adult residents over a two-year period (61).

For this study, GIS (ArcGIS software 10.5.1) was used to address question 3, with the purpose of understanding how the characteristics of areas where older adults reside relate to their risk of having PAU. Particularly, the types of community support services and its availability and accessibility to older adults. Literature indicates that neighborhood characteristics such as distance to bars, Alcoholics Anonymous (AA) meetings, and density of drug-related crime are related to appropriate follow-up and readmission among persons with mental health conditions (13). In the mapping of service providers and social support services within the WWLHIN, this study

determined where older adults resided in relation to the clusters of mental health and addiction services; optimal distances to these services; and the types of mental health and alcohol recovery programs provided. Also, GIS can be used to examine whether the number of recreational centers for seniors in a geographic area is related to the clustering of alcohol abuse among older adults. Spatial analysis is gradually being accepted as a method of geographic analysis for health studies, therefore this study demonstrated its use in understanding the availability and accessibility of services among older adults with psychiatric and alcohol disorders.

3.5 Ethics and funding

The Office of Research Ethics at the University of Waterloo provided ethics clearance for this research on October 17, 2017, under ORE file number 22546. This study forms part of a major research project funded by the Network in Aging Research (NAR) Catalyst grant from September 2017 to August 2018.

CHAPTER 4: STUDY RESULTS

To address questions 1 and 2 descriptive analyses of the OMHRS data was performed to examine the prevalence of potentially PAU and other characteristics associated with this use. A multiple logistic regression analysis examined the relationship between PAU (dependent variable) and independent variables such as demographics (for example, age, marital status, education and employment, and living arrangements), mental health status, activities of daily living (ADL) functioning, cognition, physical health status and falls, and prior health service utilization. GIS mapping was used to present the results for question 3.

4.1 Research Question 1

What is the prevalence of problematic alcohol use among older adults in inpatient psychiatry?

4.1.1 Results

From the OMHRS dataset, PAU (dependent variable) was defined using the number of drinks per sitting in the last 14 days, CAGE scores, and DSM-V diagnostic codes used to assess inpatients admitted for alcohol use disorder (AUD). Figure 3 provides a summary tree for the number of drinks categories and the number of older adults with or without PAU assessed in each category using the CAGE and DSM-V codes in RAI-MH. The total older adult population (55+) admitted to inpatient psychiatric care in Ontario between January 2011 and December 2016 was 21,577. Based on Figure 3, the MLRA results indicated that of the total population (n=21,577), about 10% of older adults had PAU (n=2,107), with the remaining 19,470 older adult inpatients admitted to psychiatric care without PAU. The majority of those with PAU were identified based on having 5 or more drinks and CAGE scores above the cut-off (5.8%) or an AUD (1.8%). About 2% of those with PAU were identified among those with 2-4 drinks in the prior 2 weeks. More than half of the

older adults who had 5 or more drinks and assessed with the CAGE score were identified as having PAU.

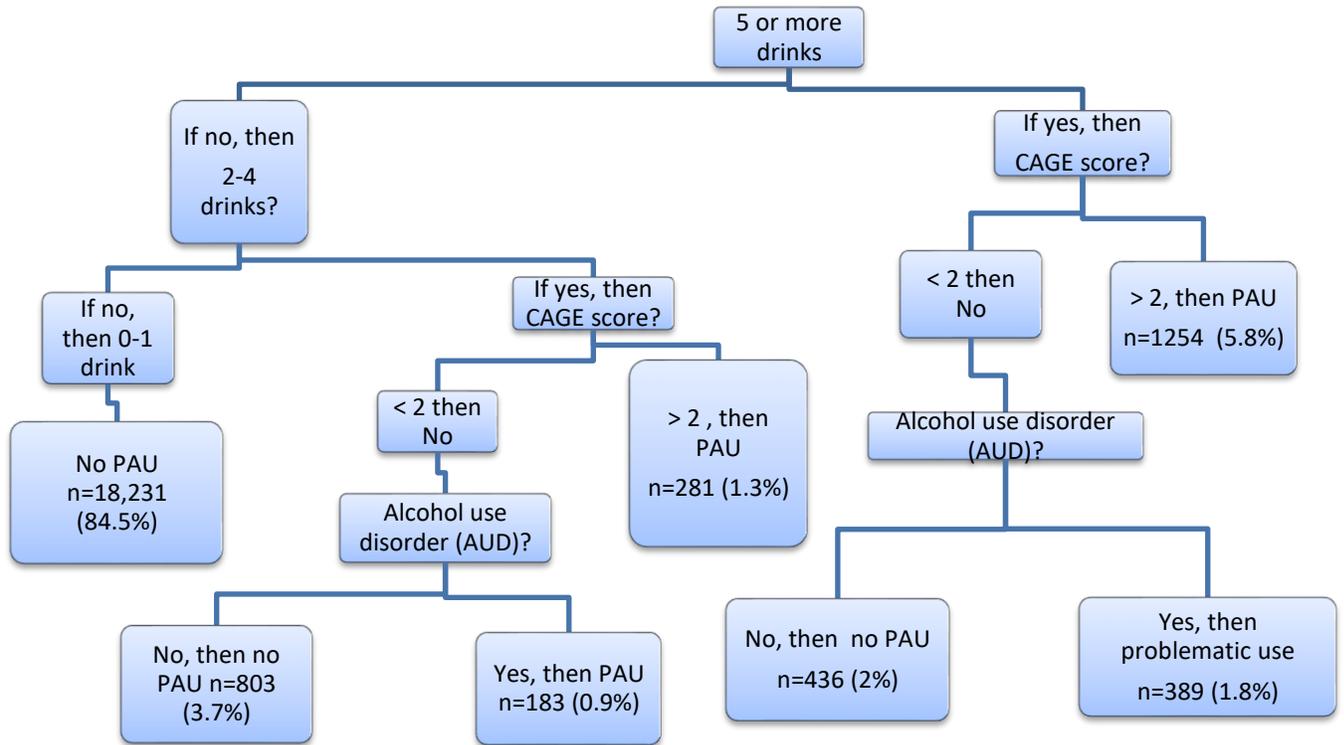


Figure 3: Defining problematic alcohol use

The total older adult population was assessed on whether they had 2-4 drinks or 5 or more drinks per sitting in the last 14 days. Those who had were further assessed based on their CAGE score, which identified anyone with a score equal to or greater than 2 as having PAU. If they had a CAGE score of less than 2, they were assessed based on whether they had been admitted to inpatient psychiatric care for AUD using the DSM-V scores. A positive response meant they were identified as having PAU. Otherwise, they did not have a PAU. Those who had 0-1 drink per sitting in the

last 14 days were not classified as having PAU. The bivariate results for PAU (n=2,107) are presented in Table 7.

Table 7: Problematic alcohol use for all variables

Predisposing factors (Personal items)	Total % (n)	Chi-Square	p-value
Variables	Problematic alcohol use	value	
Gender: Males	13.22 (1333)	255.87	<0.0001
Females	6.74 (774)		
Age: 55-64	15.72 (1496)	774.66	<0.0001
65-74	7.57 (447)		
75-84	3.26 (146)		
85+	1.07 (18)		
Marital Status: Married (includes common-law partners)	9.52 (959)	1.28	0.25
Not married (includes widowed, separated or divorced)	9.98 (1148)		
Education: No Schooling	5.64 (252)	108.90	<0.0001
Schooling (8 grades to graduate degree)	10.84 (1855)		
Employment status: Employed	19.16 (558)	337.35	<0.0001
Unemployed	8.30 (1549)		
Living arrangement: Lives alone	11.53 (883)	42.17	<0.0001
Lives with someone (includes spouse, children, others or in a group setting)	8.79 (1224)		
Usual residence: Private home	10.79 (1976)	145.17	0.0001
Other group care facilities	4.00 (131)		
Enabling factors (Mental Health Service History)	Total % (n)	Chi-Square	p-value
Variables	Problematic alcohol use	value	
# Psychiatric admissions (recent): None	9.55 (1796)	8.03	0.0046
One or more in the last 2 years	11.26 (311)		
# psych admissions lifetime: None	9.98 (1356)	1.97	0.15
One or more	9.39 (751)		
Time since last discharge: More than 1 year	8.57 (532)	14.06	0.0002
Up to a year	10.25 (1575)		
Amount of time hospitalized: None/30 days or less	9.82 (2042)	1.88	0.17
31 days up to a year in the last 2 years	8.33 (65)		
Contact with Community MH: None	10.37 (1335)	13.24	0.0003
Up to one year	8.87 (772)		
Reason for admission: Other reasons	3.35 (86)	136.14	<0.0001
Inability to care for self due to MH, problem with addiction/dependency, and specific psychiatric symptoms (e.g. depression hallucinations, medication side effects)	10.63 (2021)		
Needs factors (MH scales)	Total % (n)	Chi-Square	p-value
Variables	Problematic alcohol use	value	
Social withdrawal scale: < 3	10.36 (1185)	9.89	0.0017
Greater or equal 3	9.09 (922)		
Cognitive performance scale: < 3	11.50 (1948)	268.82	<0.0001
Greater or equal 3 (moderate to severe impairment)	3.43(159)		
Aggressive behaviour scale: < 3	10.95 (1907)	143.62	<0.0001
Greater or equal 3 (moderate to severe aggression)	4.81 (200)		

Depression rating scale: < 3 Greater or equal 3 (possible to severe depression)	9.02 (842) 10.33 (1265)	10.42	0.0012
Activities of Daily Living (ADL) Hierarchy Scale: Independent Need supervision to total dependence	12.29 (1812) 4.31 (295)	337.55	<0.0001
Pain: No pain Less than daily to daily excruciating pain	9.08 (1391) 11.44 (716)	27.94	<0.0001
Needs factors (physical health including falls and social relationships)	Total % (n)	Chi-Square value	p-value
Variables	Problematic alcohol use		
Falls: No falls in the last 90 days One or more falls in the last 30-90 days	9.26 (1733) 13.08 (374)	41.04	<0.0001
Disturbed relationship with family: No Yes	8.72 (1361) 13.02 (746)	83.46	<0.0001
Interpersonal Conflict: No Yes	8.33 (925) 11.29 (1182)	53.90	<0.0001
Social relationships: No Yes	9.82 (1931) 9.24 (176)	0.64	0.42
Loss due to death (close family or friend): No Yes	7.92 (728) 11.14 (1379)	62.01	<0.0001
Loss of income: No Yes	8.64 (1567) 15.68 (540)	162.68	<0.0001
Intentional medication misuse: No Yes	9.00 (1760) 17.22 (347)	140.21	<0.0001
Other substance use: Within the last year			
Inhalants: No Yes	9.70 (2087) 33.90 (20)	39.10	<0.0001
Hallucinogens: No Yes	9.69 (2086) 35.00 (21)	43.48	<0.0001
Cocaine and Crack: No Yes	9.39 (2002) 39.62 (105)	271.44	<0.0001
Stimulants: No Yes	9.60 (2059) 34.53 (48)	97.39	<0.0001
Opiates: No Yes	9.37 (1970) 24.95 (137)	147.50	<0.0001
Cannabis: No Yes	8.66 (1766) 29.05 (341)	523.81	<0.0001

Several demographic and clinical factors were associated with PAU. The proportion of males (13%) who had problematic use was almost double that of females (7%). The prevalence of PAU decreased as age increased, from 16% among the 55-64 age group to 1% among those 85 or more. Other notable differences in the prevalence of problematic use were among those who were employed (19%), living alone (12%), and living in a private home (11%).

Inpatients mental health history showed older adults with PAU had been recently admitted to psychiatric care (11%), with stays of 30 days or less (10%). In addition, those with PAU had no

contact with a mental health professional within their community (10%), with a significant number admitted because of their inability to care for themselves due to mental health issues, problems with addiction/dependency, and specific psychiatric symptoms (11%).

The mental health scales indicated that PAU resulted in some form of social withdrawal (10%), aggression (11%), and cognitive impairment (12%) among older adults, however, possible to severe depression (10%) was the most significant mental health symptom of older adults who had problems with alcohol.

Physical health and social relationships were also impacted by PAU. Older adults with prevalent PAU admitted to having fallen in the last 90 days (13%) and intentional misuse of medication (17%). A combined use of alcohol and other substances such as cocaine and crack (40%), hallucinogens (35%), stimulants (35%), and inhalants (34%), cannabis (29%), and opiates (25%) was also reported. Major indicators of problems with social relationships among older adults with prevalent alcohol use problems included a loss of contact with family members in the last month or more (13%), interpersonal conflict (11%), loss of income (16%), and the loss of a close family member or friend (11%). Table 8 shows the summary of the prevalence of older adults with PAU (n=2,107) and without PAU (n=19,470).

Table 8: Summary on prevalence of problematic alcohol use

Predisposing factors (Personal items)	Total (%)		Total (n)		Chi-Square value	p-value
	No	Yes	No	Yes		
Gender: Males	44.04	63.27	9294	1333	255.87	<0.0001
Females	55.96	36.73	10176	774		
Age: 55-64	41.18	71	8018	1496	774.66	<0.0001
65-74	28.05	21.21	5461	447		
75-84	22.24	6.93	4331	146		
85+	8.53	0.85	1660	18		
Marital Status: Married (includes common-law partners)	46.91	45.51	9114	959	1.28	0.2575

Not married (includes widowed, separated or divorced)	53.19	54.49	10356	1148		
Education: No Schooling	21.66	11.96	4217	252	108.90	<0.0001
Schooling (8 grades to graduate degree)	78.34	88.04	15253	1855		
Employment status: Employed	12.09	26.48	2354	558	337.35	<0.0001
Unemployed	87.91	73.52	17116	1549		
Living arrangement: Lives alone	34.98	41.91	6772	883	42.17	<0.0001
Lives with someone (includes spouse, children, others or in group setting)	65.22	58.09	12698	1224		
Usual residence: Private home	83.67	93.78	16330	1976	145.17	0.0001
Other group care facilities	16.13	6.22	3140	131		
Enabling factors (Mental Health Service History)			Total (n)			
Variables	No	Yes	No	Yes	Chi-Square value	p-value
# Psychiatric admissions (recent): None	87.41	85.24	17019	1796	8.03	0.0046
One or more in the last 2 years	12.59	14.76	2451	311		
# psych admissions lifetime: None	62.80	64.36	12227	1356	1.97	0.1596
One or more	37.20	35.64	7243	751		
Time since last discharge: More than 1 year	29.14	25.25	5674	532	14.06	0.0002
Up to a year	70.86	74.75	13796	1575		
Amount of time hospitalized: None/30 days or less	96.33	96.92	18755	2042	1.88	0.17
31 days up to a year in the last 2 years	3.67	3.08	715	65		
Contact with Community MH: None	59.27	63.36	11539	1335	13.24	0.0003
Up to one year	40.73	36.64	7931	772		
Reason for admission: Other reasons	12.76	4.08	2484	86	136.14	<0.0001
Inability to care for self due to MH, problem with addiction/dependency, and specific psychiatric symptoms (e.g. depression, hallucinations, medication side effects)	87.24	95.92	16986	2021		
Needs factors (MH scales)			Total (n)			
Variables	No	Yes	No	Yes	Chi-Square value	p-value
Social withdrawal scale: < 3	52.64	56.24	10249	1185	9.89	0.0017
Greater or equal 3	47.36	43.76	9221	922		
Cognitive performance scale: < 3	77.01	92.45	14994	1948	268.82	<0.0001
Greater or equal 3 (moderate to severe impairment)	22.99	7.55	4476	159		
Aggressive behaviour scale: < 3	79.67	90.51	15511	1907	143.62	<0.0001
Greater or equal 3 (moderate to severe aggression)	20.33	9.49	3959	200		
Depression rating scale: < 3	43.63	39.96	8495	842	10.42	0.0012
	56.37	60.04	10975	1265		

Greater or equal 3 (possible to severe depression)						
Activities of Daily Living (ADL) Hierarchy Scale: Independent Need supervision to total dependence	66.39 33.61	86 14	12927 6543	1812 295	337.55	<0.0001
Pain: No pain Less than daily to daily excruciating pain	1.52 28.48	66.02 33.98	13925 5545	1391 716	27.94	<0.0001
Needs factors (physical health including falls and social relationships)			Total (n)			
Variables	No	Yes	No	Yes	Chi-Square value	p-value
Falls: No falls in the last 90 days One or more falls in the last 30-90 days	87.23 12.77	82.25 17.75	16984 2486	1733 374	41.04	<0.0001
Disturbed relationship with family: No Yes	76.49 23.51	67.49 32.51	14892 4578	1422 658	83.46	<0.0001
Interpersonal Conflict: No Yes	52.32 47.68	43.90 56.10	10186 9284	925 1182	53.90	<0.0001
Social relationships: No Yes	91.12 8.88	91.65 8.35	17742 1728	1931 176	0.64	0.4222
Loss due to death (close family or friend): No Yes	43.48 56.52	34.55 65.45	8466 11004	728 1379	62.01	<0.0001
Loss of income: No Yes	85.08 14.92	74.37 25.63	16566 2904	1567 540	162.68	<0.0001
Intentional medication misuse: No Yes	91.43 8.57	83.53 16.47	17802 1668	1760 347	140.21	<0.0001
Other substance use: Within the last year Inhalants: No Yes	99.80 0.20	99.05 0.95	19431 39	2087 20	39.10	<0.0001
Hallucinogens: No Yes	99.80 0.20	99.00 1.00	19431 39	2086 21	43.48	<0.0001
Cocaine and Crack	99.18 0.82	95.02 4.98	19310 160	2002 105	271.44	<0.0001
Stimulants: No Yes	99.53 0.47	97.72 2.28	19379 91	2059 48	97.39	<0.0001
Opiates: No Yes	97.88 2.12	93.50 6.50	19058 412	1970 137	147.50	<0.0001
Cannabis: No Yes	95.72 4.28	83.82 16.18	18637 833	1766 341	523.8108	<0.0001

4.2 Research Question 2

What are the characteristics of older adults admitted to inpatient psychiatry who use alcohol?

4.2.1 Results

The results for the MLRA are presented for each category and shows all independent variables that were statistically significant and insignificant. These are presented using the odds ratio, 95% confidence limits, and p-values in Table 10. The overall results show the independent variables that were statistically significant ($p < 0.0001$) in Table 9. Based on the OMHRS dataset over the 5-year period, the results represent the main characteristics of older adults admitted to inpatient psychiatry with PAU.

Table 9: Final results for statistically significant independent variables

Predisposing factors (Personal items)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Gender	2.11	1.90	2.32	<0.0001	Male
Age: 55-64 (ref)					Age groups of all older adults admitted to inpatient psychiatric care from January 2011 to December 2016
65-74	0.59	0.53	0.67	<0.0001	
75-84	0.28	0.23	0.34	<0.0001	
85+	0.10	0.06	0.16	<0.0001	
Education:	1.36	1.18	1.58	<0.0001	Has 8 grades or more
Employment status	1.51	1.34	1.71	<0.0001	Has current employment
Enabling factors (Mental Health Service History)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Contact with Community MH	0.79	0.71	0.87	<0.0001	Up to 30 days or more since last contact with a community mental health agency or mental health professional (e.g., psychiatrist, social worker) in the last year
Reason for admission	3.75	2.99	4.70	<0.0001	Inability to care for self due to MH, problem with addiction/dependency, and specific psychiatric symptoms (e.g. depression, hallucinations, medication side effects)
Needs factors (MH scales)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Social withdrawal symptoms	0.75	0.68	0.83	<0.0001	Includes decreased energy, flat or blunted affect, Anhedonia, loss of interest, lack of motivation, and reduced interaction
Cognitively impaired	0.64	0.53	0.78	<0.0001	Refer to summary of scales table
Aggressive behaviour	0.65	0.55	0.77	<0.0001	Refer to summary of scales table

Activities of Daily Living (ADL) Hierarchy Scale	0.69	0.59	0.80	<0.0001	Refer to summary of scales table
Needs factors (physical health including falls and social relationships)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Falls	2.26	1.97	2.59	<0.0001	Any falls in the last 90 days
Interpersonal Conflict	1.47	1.33	1.62	<0.0001	Presence of potential problems with social relations
Loss due to death (close family or friend)	1.50	1.36	1.66	<0.0001	Death of close family member or friend in the last 3 days to a year or more
Intentional medication misuse	1.71	1.49	1.96	<0.0001	Misuse of prescription or over-the-counter medication in the last 3 months (e.g., uses medication for a purpose other than intended)
Cocaine and Crack	2.39	1.80	3.16	<0.0001	Up to a year of using Cocaine and crack
Cannabis	2.10	1.80	2.44	<0.0001	Up to a year of using Cannabis
c-statistics = 0.789					

4.2.1.1 Predisposing Factors

In Table 9, the results for the predisposing factors indicated that gender, age, education, and employment status were all statistically significant ($p < 0.0001$) variables that influence PAU among older adults. However, men were 2.1 times more likely to have PAU compared to women. Older adults who were educated (1.4 times), employed (1.5 times), and lived in a private home/apartment/rented room (1.3 times) were more likely to have alcohol use problems; but the odds were decreased (0.8) if older adult lived with someone at the time of psychiatric admission.

All age groups older than 55-64 years of age were less likely to have PAU. This meant that the younger the older adult, the higher the risk of having PAU. Those in the age group 85+ had the least odds (0.1) of having PAU possibly due to the presence of other comorbidities such as dementia.

4.2.1.2 Enabling Factors

For this category (Table 9), the MLRA results indicated that only two variables were statistically significant ($p < 0.0001$). Older adults who had contact with a mental health professional within their community over the last 30 days or more had a decreased odd (0.7) of alcohol problems. For older adults, this could be quite significant as other comorbidities may be present.

4.2.1.3 Needs Factors

While all mental health scales were significantly associated with PAU ($p < 0.0001$), older adults with social withdrawal symptoms (0.7), cognitive impairment (0.6), aggressive behavior (0.6), and ADL (0.6) had a decrease in odds of having PAU. However, some aspects of the older adult's physical health and social relationships were associated with an increased odds of PAU. Particularly, there was an increase in the odds of PAU among those with falls (2.2) and those using cocaine and crack (2.3), cannabis (2.1), and intentional medication misuse (1.7). Social relationship problems attributable to interpersonal conflict (1.4) and the loss of a close family or friend (1.5) also increased the odds of having PAU. Table 10 shows the summary of odds ratios, confidence limits and p-values results for all the independent variables analyzed.

Table 10: Summary of odds ratios, confidence limits, and p-values for independent variables

Predisposing factors (Personal items)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Gender	2.060	1.863	2.278	<0.0001	Male
Age: 55-64 (ref)	-	-	-	-	Age groups of all older adults admitted to inpatient psychiatric care from January 2011 to December 2016
65-74	0.615	0.544	0.695	<0.0001	
75-84	0.292	0.241	0.353	<0.0001	
85+	0.103	0.064	0.166	<0.0001	
Marital Status:	1.016	0.899	1.148	0.80	Married or has a partner or significant other
Education:	1.371	1.186	1.586	<0.0001	Has 8 grades or more
Employment status	1.531	1.357	1.727	<0.0001	Has current employment
Living arrangement	0.800	0.708	0.904	<0.0004	Lived with someone at the time of admission

Usual residence	1.315	1.070	1.616	0.0093	Had their usual residence as a private home/apartment/rented room
Enabling factors (Mental Health Service History)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
# Psychiatric admissions (recent)	1.372	1.076	1.751	0.01	Had 1 or more recent (last 2 years) psychiatric admissions
# Psych admissions lifetime	0.893	0.678	1.178	0.42	Had 1 or more lifetime mental health admissions
Time since last discharge	1.290	1.002	1.661	0.04	Had 30 days to a year since time discharge of last mental health admission
Amount of time hospitalized	0.836	0.615	1.136	0.25	Spent 30 days to more than a year in a psychiatric hospital/unit in the last 2 years
Contact with Community MH	0.799	0.721	0.886	<0.0001	Up to 30 days or more since the last contact with a community mental health agency or mental health professional (e.g., psychiatrist, social worker) in the last year
Reason for admission	3.797	3.026	4.763	<0.0001	Inability to care for self due to MH, problem with addiction/dependency, and specific psychiatric symptoms (e.g. depression, hallucinations, medication side effects)
Needs factors (MH scales)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Social withdrawal symptoms	0.746	0.672	0.828	<0.0001	Includes decreased energy, flat or blunted affect, Anhedonia, loss of interest, lack of motivation, and reduced interaction
Cognitively impaired	0.629	0.516	0.767	<0.0001	Refer to summary of scales table
Aggressive behaviour	0.646	0.545	0.765	<0.0001	Refer to summary of scales table
Depressed	1.003	0.901	1.116	0.96	Refer to summary of scales table
Activities of Daily Living (ADL) Hierarchy Scale	0.682	0.583	0.797	<0.0001	Refer to summary of scales table
Pain	1.106	0.992	1.232	0.06	Refer to summary of scales table
Needs factors (physical health including falls and social relationships)					
Variables	Odds Ratio	95% Wald Confidence Limits		p-value	Description
Falls	2.179	1.898	2.502	<0.0001	Any falls in the last 90 days
Disturbed relationship with family	1.208	1.081	1.350	0.0008	The belief that relationship(s) with immediate family members is disturbed or dysfunctional.
Interpersonal Conflict	1.394	1.257	1.545	<0.0001	Presence of potential problems with social relations
Social relationships	0.985	0.825	1.177	0.86	Has not had any social relations or contact with family members in the last month or more
Loss due to death (close family or friend)	1.477	1.333	1.637	<0.0001	Death of close family member or friend in the last 3 days to a year or more

Loss of income	1.157	1.028	1.303	0.01	Major loss of income in the last 3 days to a year or more
Intentional medication misuse	1.641	1.425	1.889	<0.0001	Misuse of prescription or over-the-counter medication in the last 3 months (e.g., uses medication for purpose other than intended)
Other substance use: Inhalants	1.966	1.008	3.836	0.04	Up to a year of using Inhalants (e.g., glue, gasoline, paint thinners, solvents)
Hallucinogens	1.627	0.849	3.116	0.14	Up to a year of using Hallucinogens (e.g., phencyclidine or “angel dust,” LSD or “acid,” “magic mushrooms,” ecstasy)
Cocaine and Crack	1.950	1.442	2.635	<0.0001	Up to a year of using Cocaine and crack
Stimulants	1.502	0.977	2.307	0.06	Up to a year of using Stimulants (e.g., amphetamines such as “uppers,” “speed,” methamphetamine)
Opiates	1.126	0.889	1.426	0.32	Up to a year of using Opiates (e.g., heroin)
Cannabis	2.015	1.728	2.349	<0.0001	Up to a year of using Cannabis
c-statistics = 0.794					

4.3 Research Question 3

Are psychiatric admissions for alcohol among seniors geographically clustered in the Wellington-Waterloo Region?

4.3.1 Results

The WWLHIN region OMHRS January 2011 to December 2016 inpatient psychiatry data for seniors (55+) admitted to psychiatric care (n=1,459), and the seniors with PAU admitted to psychiatric care (n=170) per FSA was initially obtained. For a comparative analysis, the OMHRS data was standardized per 100,000 population using the 2011 census data for 55+ older adults per each FSA in the region, for psychiatric inpatients without or with PAU (n=22,917 and n=3,951) respectively. The standardized population figures are used for the GIS analysis unless otherwise stated.

To determine if clustering was likely to occur for older adults admitted to psychiatric care with or without alcohol use in the WWLHIN region, a cluster analysis was performed. The spatial autocorrelation analysis (Global Moran's I) was initially used to confirm the presence of clustering of psychiatric admissions with or without alcohol use when mapped with services data. Data on the cluster analysis included the p-values, z-scores, as well as the Moran's index for the services and rates of admission. Appendix 2 shows the summary results of the spatial autocorrelation analysis.

Second, the Anselin local Moran's I was used to depict areas where cluster and outlier related to services and psychiatric admissions occurred. Cluster and outlier areas are identified on the results maps discussed in section 4.3.1.2.

Geographical clustering results are presented for the older adults admitted to inpatient psychiatric care with and without PAU in relation to the location of addiction, community support, and mental health services within the community.

4.3.1.1 Spatial Autocorrelation Analysis (Global Moran's I)

The results for psychiatric admissions with (right) or without (left) PAU indicates that clusters for admissions occurred close to addiction services, were statistically significant (p -value < 0.01) and could not have happened by chance or at random. The positive Moran's I index value (0.53 and 1.0) indicates a likelihood of clustering while a negative value could mean a dispersed pattern is more likely. The z-score (>2.58) in both cases also confirms the fact that the null hypothesis that states that "the spatial patterns realized were just a result of spatial randomness" can be rejected. Figures 4 and 5 show the evidence of spatial autocorrelation including the values obtained. This means that the clustering of individuals who were admitted to psychiatric inpatient treatment

tended to occur in areas that were also close to the locations of addiction services. A summary results table is also found in Appendix 2.

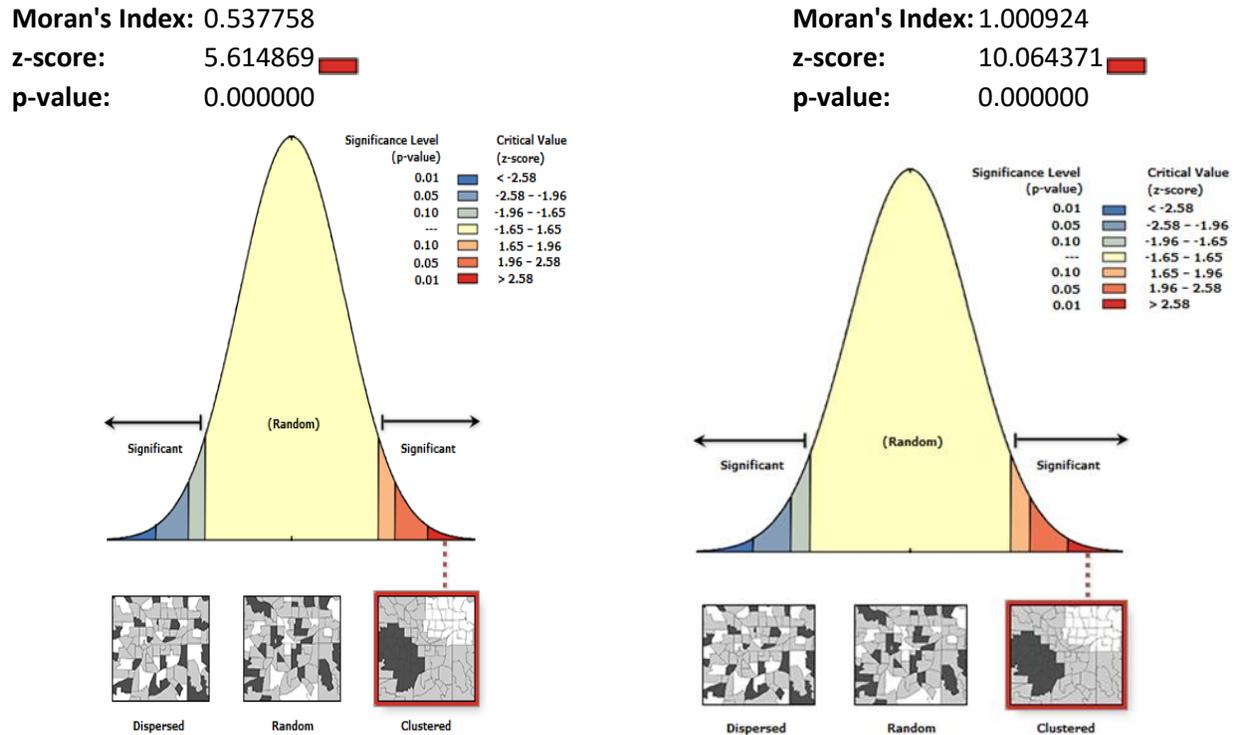


Figure 4 (left): Psychiatric admissions cluster for addiction services

Figure 5 (right): Psychiatric admissions cluster involving problematic alcohol use for addiction services

Left figure: Given the z-score of 5.61486944402, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Right figure: Given the z-score of 10.0643709092, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Similarly, the analysis was conducted for psychiatric admissions and community support services data. However, in this instance, the results (Figure 6) indicate that there was a likelihood of randomness (z-score=1.25) in the spatial pattern for psychiatric admissions compared to the psychiatric admissions for inpatients with alcohol use problems (Figure 7), which showed a likelihood of clustering (2.63). This means for those without PAU, there was no significant

psychiatric admissions clustering in areas near community support services but there was clustering of psychiatric admissions for those with alcohol use problems in areas with community support services. The random pattern could be attributed to the location of the community support services in relation to psychiatric admissions. This is explained further in the cluster and outlier analysis mapping section (4.3.1.2).

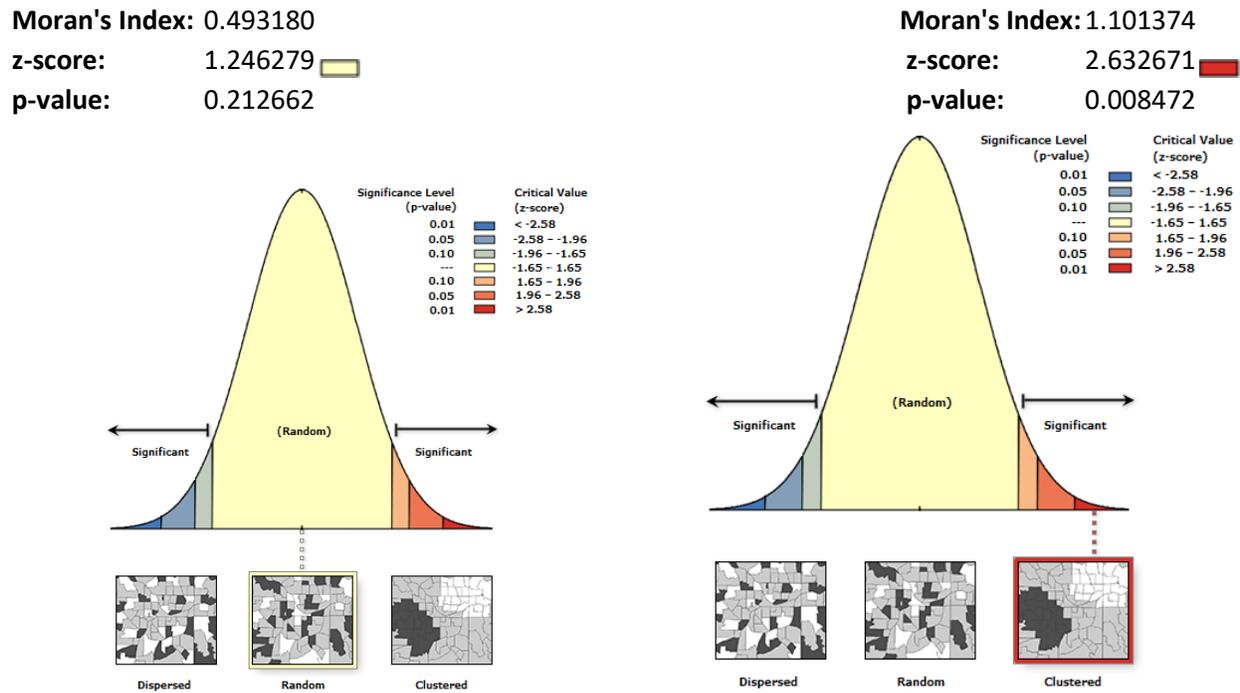


Figure 6 (left): Psychiatric admissions cluster for community support services

Figure 7 (right): Psychiatric admissions cluster involving problematic alcohol use for community support services

Left figure: Given the z-score of 1.24627881821, the pattern does not appear to be significantly different than random.

Right figure: Given the z-score of 2.63267131316, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Like the results for addictions services, the mental health services results (Figures 8 and 9) also indicates a clustering with high z-scores for both psychiatric admissions with (18.45) or without (15.52) alcohol use. With a p-value of less than 0.01, it is unlikely that the spatial pattern of

clustering occurred at random, and the null hypothesis can be rejected. This means that there might be other causes for the statistically significant results and this is explored further in the next section.

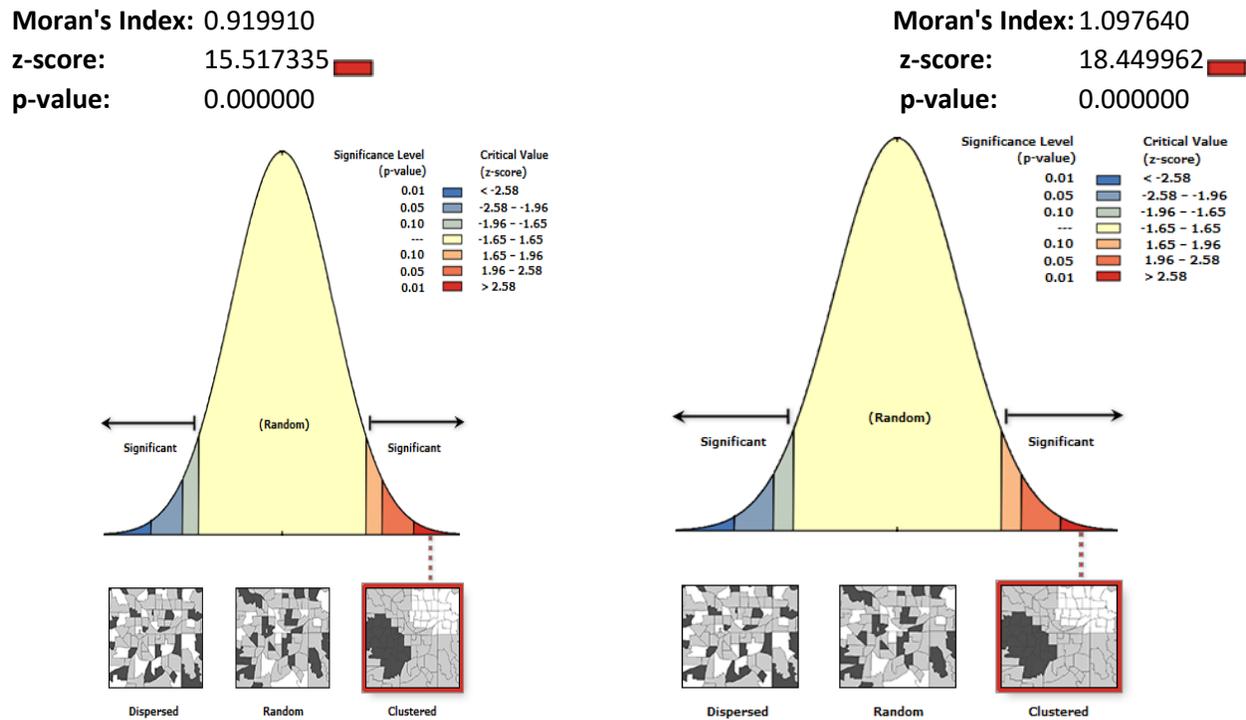


Figure 8 (left): Psychiatric admissions cluster for mental health services

Figure 9 (right): Psychiatric admissions cluster involving problematic alcohol use for mental health services

Left figure: Given the z-score of 15.5173346227, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Right figure: Given the z-score of 18.4499623072, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

4.3.1.2 Cluster and Outlier Analysis (Anselin Local Moran's I)

This section shows the results maps of where the cluster and outlier areas occur and how they relate to the services. 36 FSAs in the WWLHIN were mapped. Each map contains a color-coded legend for all three categories of service locations and 5 classes of quantile classification indicating the rates of psychiatric admissions. The results of the cluster and outlier analysis are presented in three parts.

First, an initial comparison of the crude data for psychiatric admissions with or without PAU as obtained from the OMHRS dataset is presented in map form. It is important to note that location overlaps occurred for mental health and addictions service points, particularly where the clustering was quite significant. This was because both services were often offered at the same locations. The output tables for these maps are presented in Appendix 3.

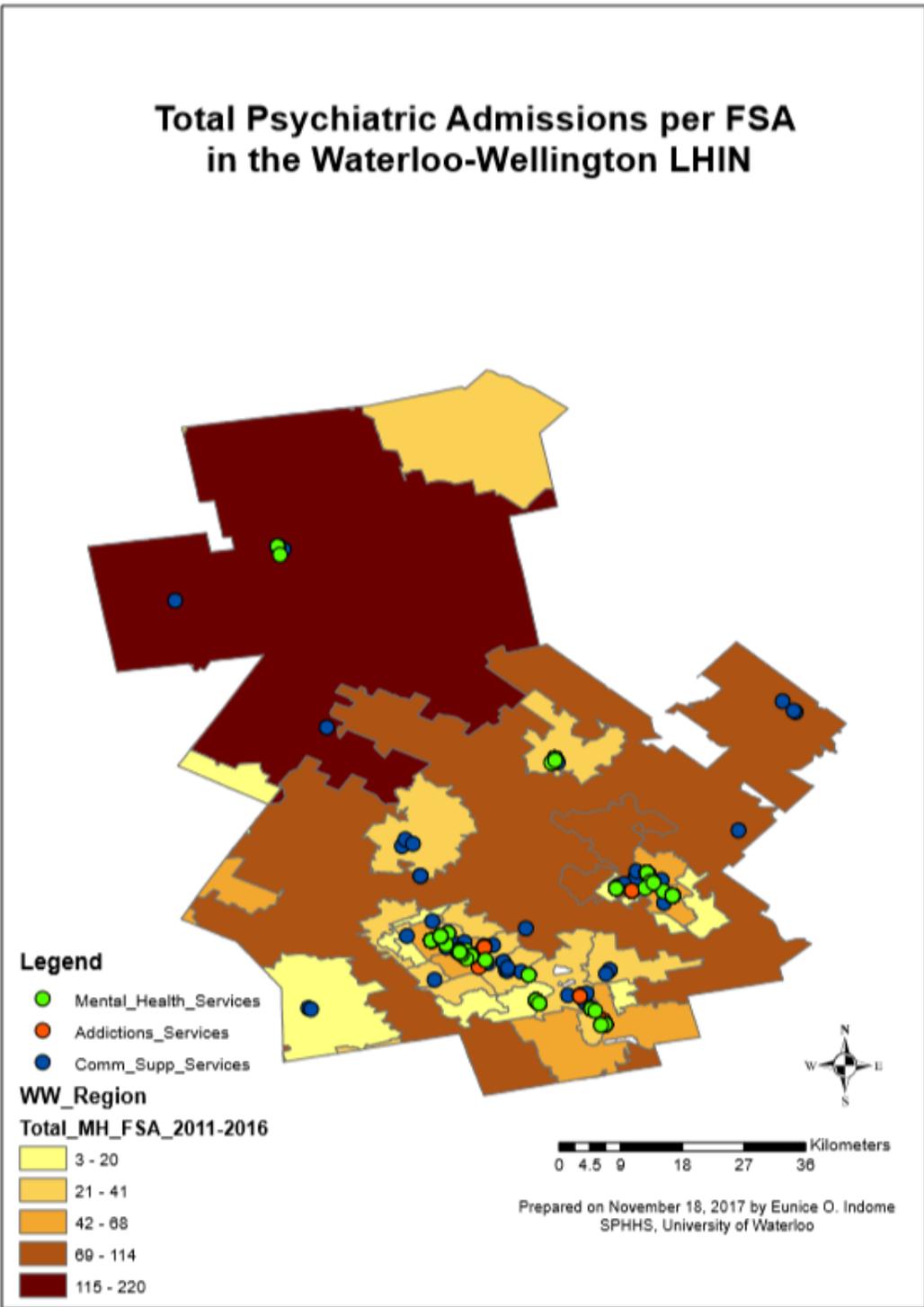


Figure 10: Total 2011-2016 Psychiatric admissions in WWLHIN (crude data)

In Figure 10, the highest crude rates of admissions (fifth quantile, 115-220) occurred in the upper section of the map where only a couple of mental health and community support services were found. However, areas with service clusters were within the first (3-20) to third (42-68) quantile classes. This pattern indicates an inverse relationship where an increase in the actual number of services can be attributed to a decrease in admission rates. Also, community support service locations are the most dispersed and this could explain why it appeared to have a random distribution in the spatial autocorrelation results (Figure 6). On the lower half of the map, areas with fourth quantile (69-114) were found to have the second highest rates of psychiatric admissions with few to no services.

In Figure 11, a similar pattern occurs for psychiatric admissions involving PAU, meaning that both admissions with or without PAU were likely to occur within similar locations. However, the number of older adults admitted into psychiatric care was significantly higher for psychiatric admission only, compared to those admitted to psychiatric care with PAU. Again, areas of service clusters showed a lower count within the first (0-3) to third (4-6) quantile for admissions, compared to areas with high admission counts (fifth quantile, 18-28) which showed few to no services were available.

Psychiatric Admissions involving Alcohol Use per FSA in the Waterloo-Wellington LHIN

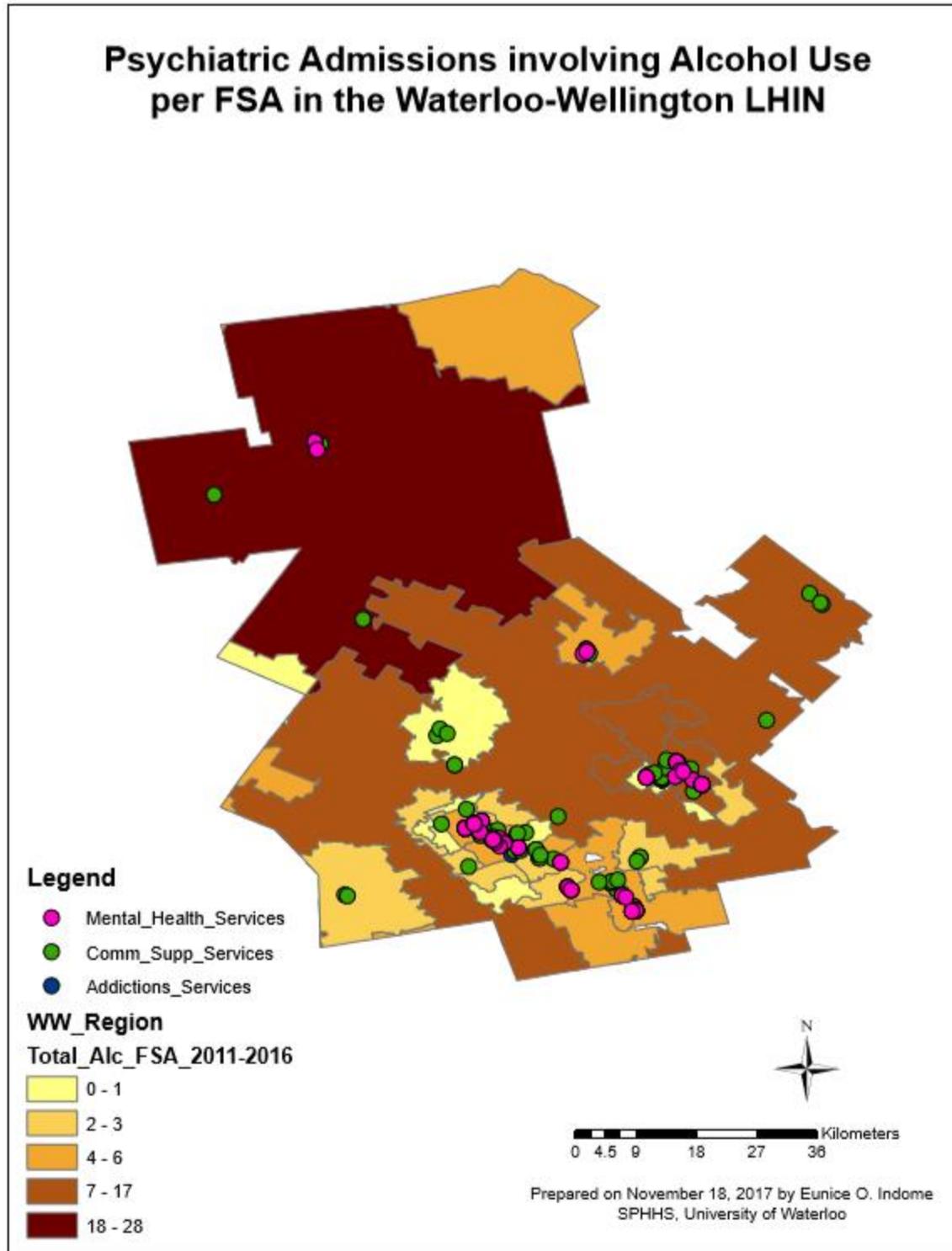


Figure 11: Total 2011-2016 Psychiatric admissions involving problematic alcohol use in WWLHIN (crude data)

Second, a comparison of the maps using standardized admissions rates per FSA for both rates of psychiatric admissions was analyzed.

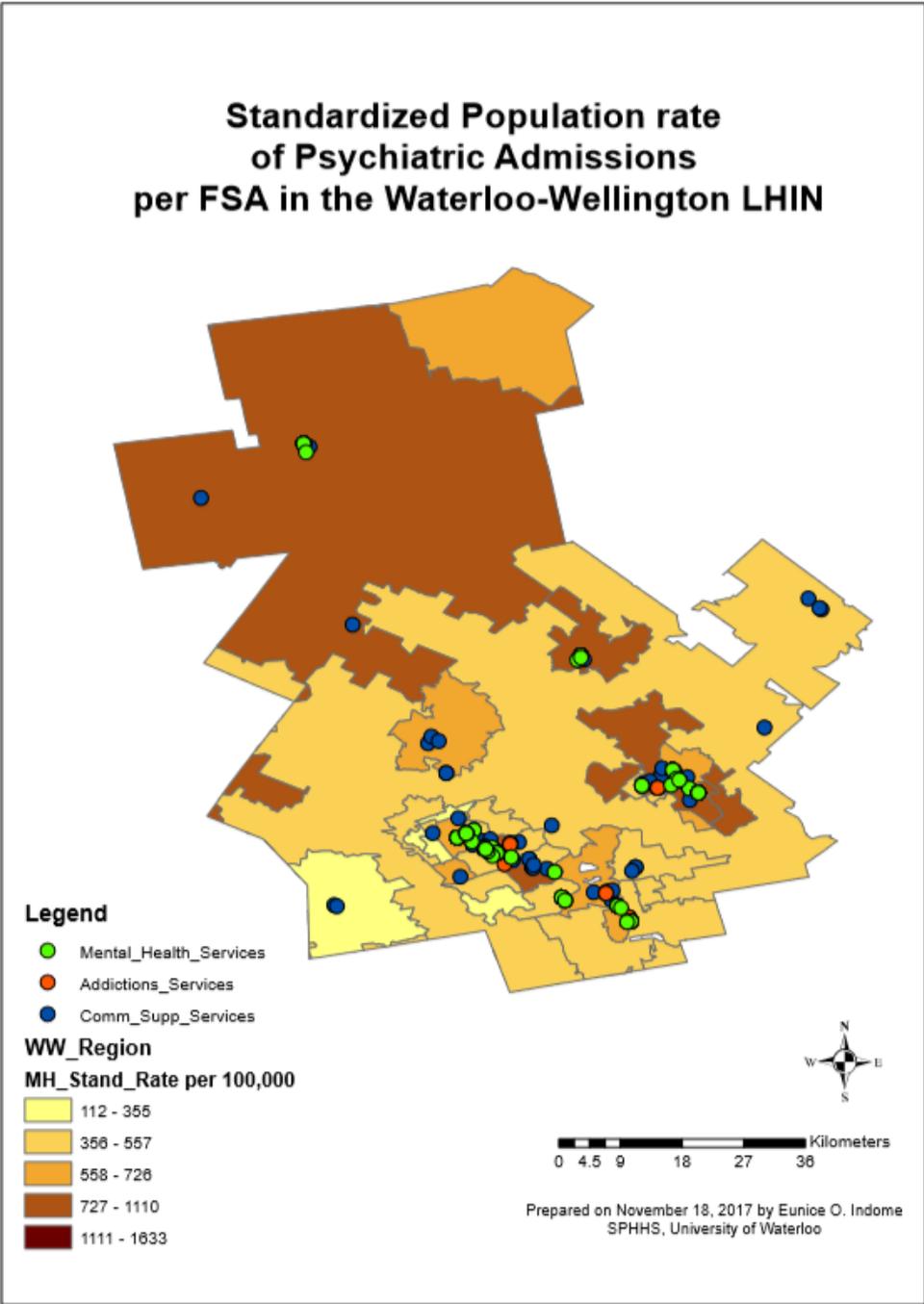


Figure 12: Standardized rates of psychiatric admissions per FSA in WWLHIN

In Figures 12 and 13, the standardized rates for both admissions show that some areas with a cluster of services had higher rates of admissions compared to areas that had lower rates of admissions when crude rates were used in Figures 10 and 11. For seniors with PAU, this means that they might be close to the services needed.

Although the upper section of Figure 12 still shows that the high rates of psychiatric admission rates in the fourth quantile (727-1110) remained unchanged after rate standardization, changes were realized in the lower sections of the map to include where admission rates were clustered in service areas. The lower section of the map shows that admission rates were mainly centered in the third quantile (558-726), especially where services were clustered. A vast area of the map's lower section fell within the second quantile (356-557), which had few to no services available. The map indicates that the services were likely to be in areas where mental health and addictions problems were prevalent and created a high demand for services.

In Figure 13, a similar trend occurs for psychiatric admission involving PAU. The upper section of the map shows that high admission rates fell within the fourth quantile (90-162), however, this does not match the lack of available services within that area. The lower half of the map shows areas within the third quantile (57-89) also had few to no services. This could mean that those in the third quantile areas are likely to travel a fair distance to utilize the services clustered in other areas. Apart from an area on the south-east where service clusters occurred in the fourth and fifth (163-1556) quantile, most of the service clusters occurred in the areas that fell within the first (0-19) and second (20-56) quantiles. Again, this map indicated that the rate of psychiatric admissions involving alcohol use were found in areas of need. Overall, the high rates of admissions realized in the northern section of both maps may be attributed to lack of services within the FSAs in the area.

Standardized Population rate of Psychiatric Admissions involving Alcohol use per FSA in the Waterloo-Wellington LHIN

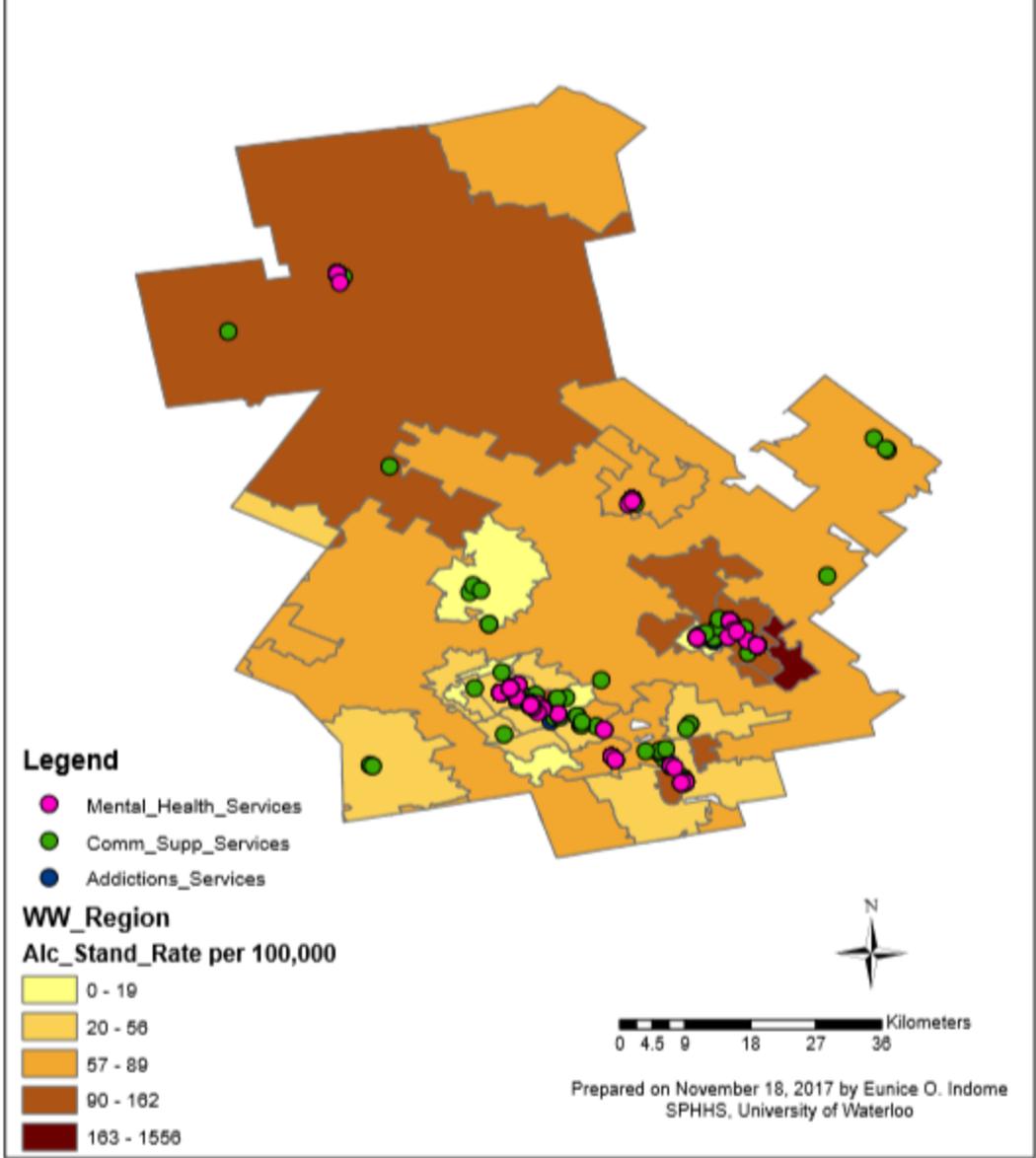


Figure 13: Standardized rates of psychiatric admissions involving problematic alcohol use per FSA in WWLHIN

Finally, Figures 14 and 15 show where the cluster and outlier outcomes are identified for both admissions. The cluster and outlier results can be interpreted as follows:

- High-High cluster: Statistically significant ($p\text{-value} < 0.05$) high values clustered with other high values
- High-Low outlier: Statistically significant high value outlier with neighboring low values
- Low-High outlier: Statistically significant low value outlier with neighboring high values
- Low-Low cluster: Statistically significant low values clustered with other low values

The corresponding Moran's I index, p-values and z-scores for the cluster and outlier results showing the high and low values are presented in Appendix 3.

In Figure 14, the upper section of the map which initially indicated there were high rates of psychiatric admissions was non-significant (white). This does not eliminate the significance of high admission rates but rather that there was no spatial autocorrelation between those areas and their neighbors. This means that the high rates of admission did not correlate with the number of services available for older adults in these areas. Similarly, there were some FSAs with no spatial autocorrelation on the lower section of the map. The high-low outlier (red) FSAs shown on the map correlates with the areas initially identified in Figure 12 with few to no services and relatively high rates of psychiatric admissions. The area represents a spatial outlier with statistically significant high values surrounded by neighboring low values. This implies that the high psychiatric admission rates were found close to neighboring areas with low admission rates, perhaps due to the clustering of services within these areas (in white). Also, the lower portion of the map shows a low-low cluster (light blue), which in this instance was evidence of spatial autocorrelation because statistically significant low values were clustered with other neighboring

low values. The clustering could be attributed to the number of available services to support older adults admitted with mental health disorders.

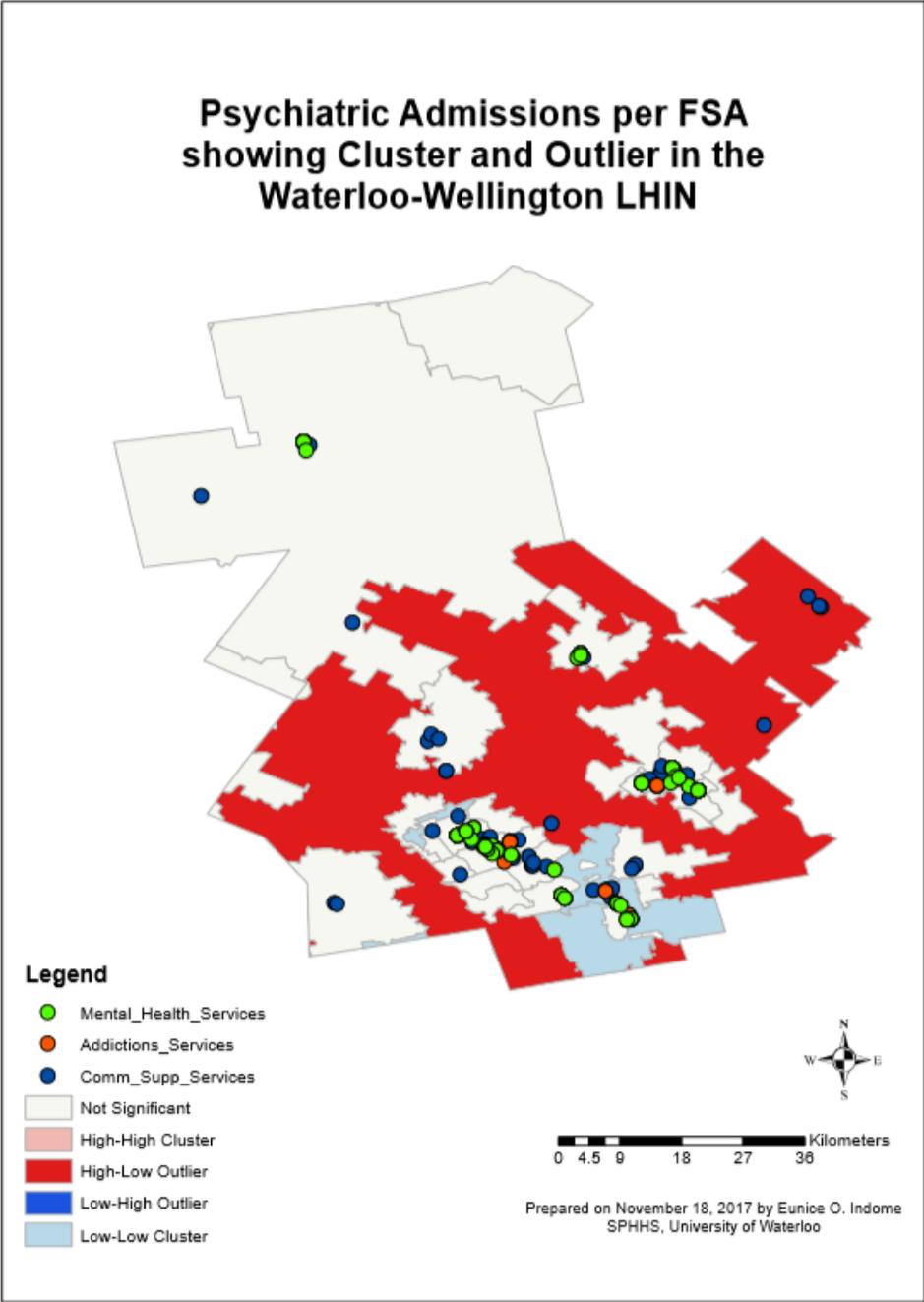


Figure 14: Clusters and Outliers for Psychiatric admissions in WWLHIN

In Figure 15, the map shows a high-high cluster (pink), meaning that there were statistically significant high values clustered around other neighboring high values. This provides evidence that FSAs with relatively high admission rates for alcohol problems were clustered with other areas of high rate of psychiatric admissions related to PAU. Some FSAs close to the cluster of services were also found to have a low-low cluster (light blue), indicating that the availability of the support services was likely to be responsible for lowering the number of psychiatric admissions involving PAU.

Overall, the results indicate an inverse relationship between the clustering of seniors with psychiatric admissions, PAU, and location of the services. Areas with available support services were found to have fewer or no clusters of older adults admitted to inpatient psychiatric care compared to areas with high admission rates that had fewer support services. Most services were clustered within the downtown core of the major cities like Kitchener/Waterloo, Cambridge, and Guelph, while the rural Wellington area (upper section of map), which had the highest admission rates had fewer to no services available. This also means that seniors admitted from the rural Wellington areas were likely to travel further for services. To access areas with service clusters, the distance to travel ranged from 1-19 kilometers depending on where the older adult lived in relation to the service(s) needed.

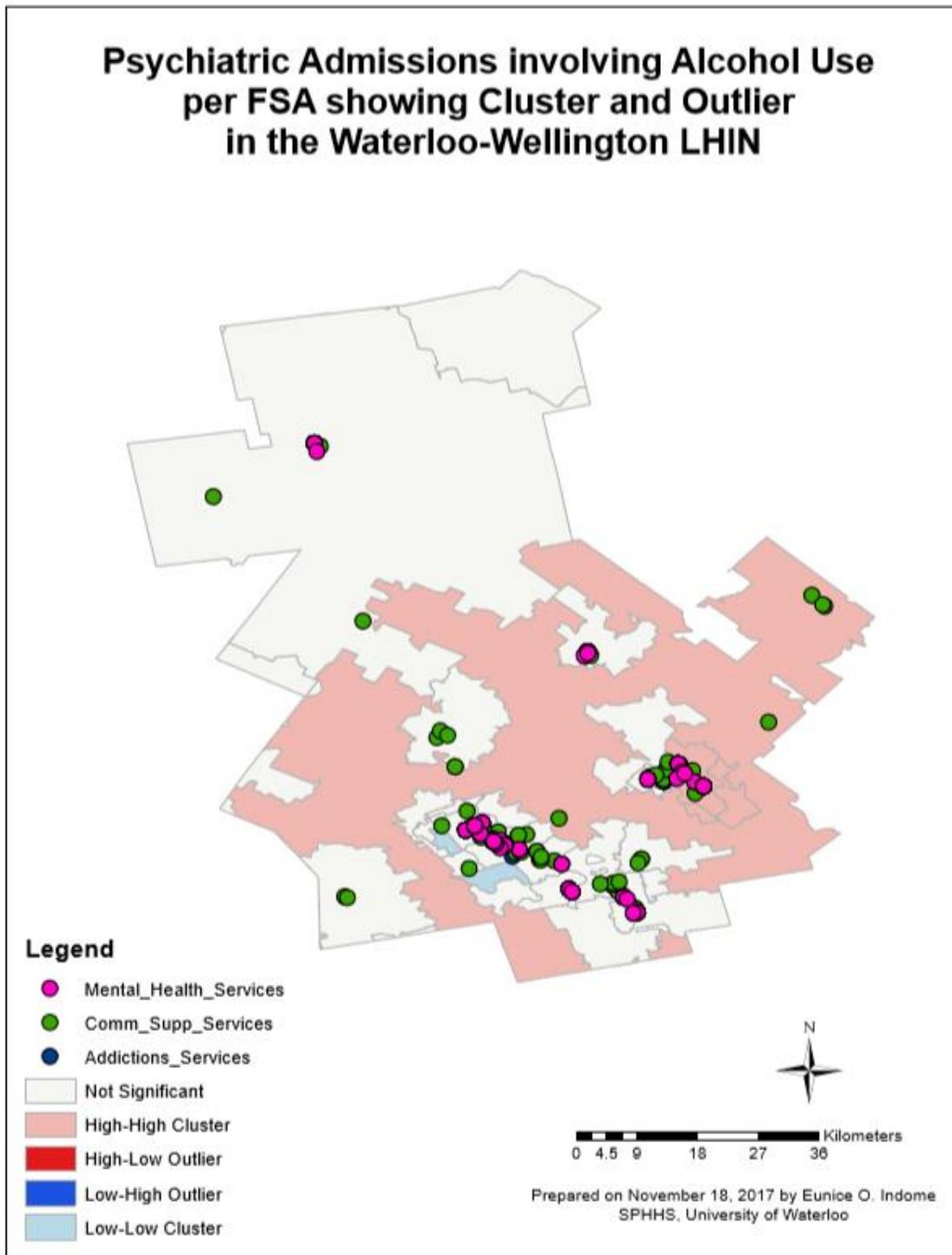


Figure 15: Clusters and Outliers for Psychiatric admissions involving problematic alcohol use in WWLHIN

4.4 Research Question 3a

What types of community support services data are available to examine contextual factors related to alcohol use among older adults?

4.4.1 Results

Community support services data within the WWLHIN was obtained from various websites searches. 65 community support service organizations were identified, and services were categorized into 7 sections as follows:

- Alcoholics Anonymous (AA) groups (5) – Provides alcohol recovery support services
- Adult day programs (30) – This includes all day programs such as senior-specific day programs, adult day services, acquired brain injury programs/services, Alzheimer’s day programs, senior outing programs, and day support programs/services
- Recreational services (12) – This includes all recreational programs in community centers for seniors
- Community care access (3) – Includes home and community care support for older adults
- Exercise and falls prevention (3) – Includes exercise and falls support groups, and meals on wheels programs for seniors
- Respite care for seniors (2) – Provides temporal respite support for seniors, and palliative care consultations
- Seniors’ centres (10) – Programs include parks and recreation services, outreach services, and seniors social peer support groups

GIS mapping was used to show the locational distribution of all 65 community support services. There were some overlaps in service provisions, for example, some recreational services were provided at seniors' centers and community centers.

Figure 16 shows the 7 categories of the community support services in a color-coded legend. The distribution of the service locations is mainly concentrated in and around the three city centers of Kitchener-Waterloo, Cambridge, and Guelph. The rural Wellington area (upper section of the map) only had 3 adult day programs for older adults living in the area. This result is consistent with those of previous map results that indicated there was a high rate of psychiatric admissions with or without alcohol use. The lack of community support services and increased rates of admission could be an indicator that older adults require additional support services after discharge from care. In addition, this also means that older adults will need to travel to the three major city centers to access their support service needs. For older adults in the rural Wellington area with PAU, programs such as AA groups, exercise and falls prevention, respite care, and community care access could be the most needed services for the area.

Again, on the lower half of the map, areas with few to no community support services were those previously identified with relatively high rates of admission and few adult programs and seniors' centers in neighboring FSAs. Older adults in these areas may lack the support services they need after discharge from psychiatry care, leading to further travel to access the services.

Though the clustering of community support services in city centers may provide an all round availability and accessibility to care, it also means that service access is limited for older adults who are unable to travel to these locations for care.

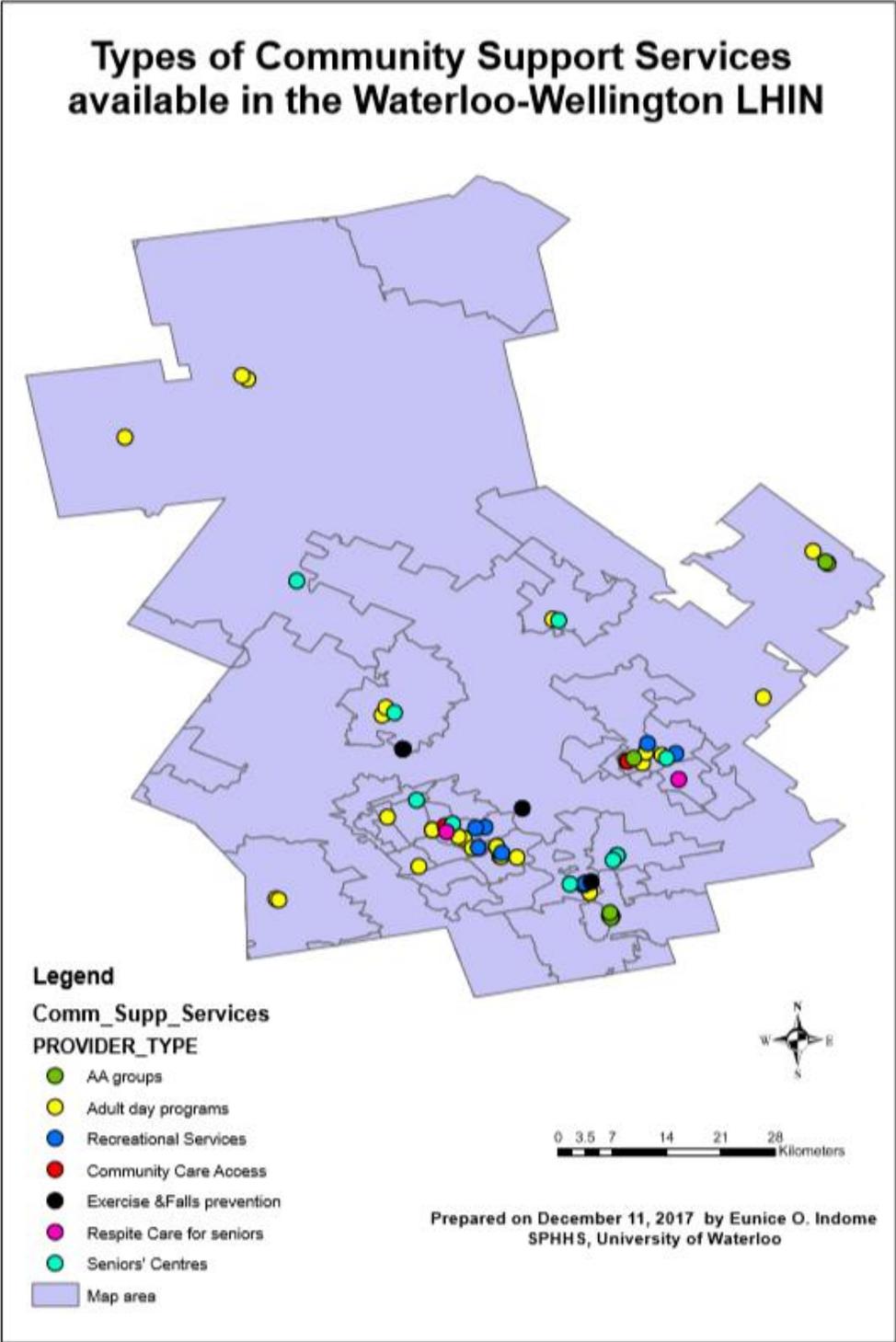


Figure 16: Types of community support services available in the Waterloo-Wellington LHIN

CHAPTER 5: DISCUSSION AND CONCLUSION

This chapter discusses the implications of results on health service use among older adults with PAU, based on the individual and contextual factors of the Andersen behavioral model on health care utilization.

5.1 Identifying Problematic Alcohol Use

The NIAAA clinician's guide for at-risk drinking recommends consuming less than four drinks per day and less than 14 drinks per week for healthy men under 65 years of age, and less than three drinks per day and less than 7 drinks per week for healthy women and healthy men over 65 years of age (6, 91). The Canadian low-risk drinking guidelines (LRDG) suggests a limit of up to two standard drinks a day, with nine drinks a week for women and fourteen drinks a week for men (72) with at least two alcohol free days a week. The current Canadian LRDG is found to be a high limit for older adults. Some literature indicate that older adults (60 years and over) identified in healthcare settings such as community-based clinics (61.9%) and assisted living facilities (69%) were found to be drinking more than the recommended limits (82, 91). These results are clearly high for older adults but self-reporting could sometimes affect a study's sample. Although there is the belief that alcohol use declines with age, there is the need for caution when interpreting these figures (92). Such interpretation should take into account how age, existing comorbidities, and the type of healthcare setting determines how much information older adults are able to share with their clinicians about their alcohol consumption rates. For example, inpatient psychiatry care data in this study included patients such as those with dementia that could have skewed the PAU prevalence sample of older adults in the higher age range (65 years and over), and subsequently contributed to the low figures for PAU realized in these older group of older adults. Irrespective,

clinicians could still address PAU through the process of screening for AUD, diagnosis, and implementing harm reduction strategies.

Based on this study's definition of PAU using the CAGE score, and the number of drinks (in a single sitting over a 14-day period), older adults who consumed 5 or more drinks were more than half of the entire population identified as having PAU. The high trend of PAU was also found among those diagnosed with the DSM-V assessment for older adults who consumed 5 or more drinks and those who consumed 2-4 drinks. These results indicated that some older adults drank well above the recommendation of the LRDG. While advocates continue to call for a lower LRDG for older adults, lessons on low-risk drinking could be learned from countries like Italy with guidelines that specify about 25% less drinking for older adults compared to younger adults (89). Promoting harm reduction is key to lessening the impacts of PAU on older adults.

Screening for PAU is an important factor for identifying AUD in older adults. This study utilized content from a comprehensive assessment tool to screen for PAU, particularly the CAGE, recent alcohol use, and DSM-V for AUD. Other screening tools have been used for older adults, including CAGE⁸, SMAST-G⁹, SAMI¹⁰, AUDIT¹¹, ARPS¹², and ASSIST¹³ but in many instances these tools are used as stand-alone instruments. Instead, the algorithm from this study is derived from a comprehensive tool that can also be used to assess other aspects of a person's health and well-being. Therefore, screening is implemented into a more comprehensive assessment. While this integrated screening approach is useful for the initial identification of PAU in hospital, there is also the need for ongoing screening and management. Since the items on the PAU screen used in

⁸ The four-item test with questions on Cutting down, Annoyance at criticism, Guilty feelings and use of Eye-openers (CAGE),

⁹ Short Michigan Alcoholism Screening Test (Geriatric Version)

¹⁰ Senior Alcohol Misuse Indicator (SAMI)

¹¹ Alcohol Use Disorders Identification Test (AUDIT)

¹² Alcohol-Related Problems Survey (ARPS)

¹³ Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)

this study are also available on other interRAI tools, such as the interRAI Community Mental Health (CMH), there is the opportunity for continually monitoring a person's use of alcohol as they transition between care settings in jurisdictions using both the RAI-MH and interRAI-CMH. This would be in line with recommendations for regular screening for all older adults, and more frequently for older adults with mental health and addiction issues not only in inpatient psychiatry but also within a community setting.

In addition to the use of tools for screening, it is also important to consider the process of screening for PAU among older adults. In particular, issues of stigma may arise in the form of self-stigma on the part of the older adult or stigma on the part of the assessor. (e.g., approaching the screening process in a non-judgemental manner). The RAI-MH is a unique tool in that it does not prescribe the way information is obtained; it acts more like a guide of content areas and collects observations about the frequency of health status and substance use. Therefore, clinicians should still use best practices in ascertaining the information from a client in a way that is appropriate.

5.2 Individual and Contextual Characteristics

The results of the regression analyses presented a number of findings that were consistent with what would be expected in literature as well as some emerging findings. Key findings are discussed in the following sections in relation to the themes outlined in the Behavioural Model of Health Service Use.

5.2.1 Predisposing Factors

This study found that individual characteristics that predispose older adults to PAU included demographic factors (age and gender), and social factors (employment status, education, living arrangement, and usual residence). Older adults in the 55-64 age group, men, those who were

educated, employed, or lived alone in their private residence had a greater risk of PAU and an increased likelihood of psychiatric admission. Although this study's findings bares similarities to other studies that found variations in older adult age, gender, and social factors increased the likelihood of alcohol use problems significantly (31, 32, 33, 34, 80, 82, 91), older adults admitted to inpatient psychiatry face the additional challenge of other concurrent mental health issues. For gender, older adult men with PAU have been identified as likely to have social relationship issues (88) similar to this study's findings that indicated that living alone was associated with PAU among older adults with mental health issues. Compared to men, women are noted to have better social relationships and are likely to avoid the negative consequences including the stigma associated with PAU (88). The fear of being stigmatized may contribute to the social isolation issues among older adults who live alone.

Employment status, and being employed, was associated with PAU and is consistent with previous findings in the literature that earning an income was a major predictor of PAU among those employed (86). However, this cannot be generalised for all older adults especially those 65 years and older with mental health and addiction issues. Retirement and loss of income could better explain the association with PAU among this group. Countries such as the UK, promote alcohol awareness for older adults (50-64 years) in the workplace so they are aware of their alcohol consumption, and how it affects their work and the aging process (79). Since the older adult working population is predicted to have increased with older adults working past the age of 64 (79), the education of older adults is important to somewhat prepare them for life after retirement where harm reduction or abstinence could be encouraged. Perhaps, if trends continue to gradually shift towards older adults working past retirement age, old age could become a risk factor rather than a protective factor.

Other studies indicate that older adults who lived in older adult communities such as public housing were at a heightened risk for mental health disorders, prevalent alcohol abuse, and lack of access to treatment (84, 85, 86). Though this study identifies that older adults admitted to inpatient psychiatry care who lived on their own in their usual residence were more likely to have PAU, other factors such as living with someone decreased the odds of PAU. It could be because older adults who live with others in homes such as long-term care facilities may be subject to alcohol use regulations, and this might have contributed to the low figures realized in Table 7. While living with someone could be a protective factor for care and treatment advocacy (11), older adults could be influenced to drink in a social setting with their spouse, children, or friends increasing the risk of PAU. This is consistent with studies that found alcohol use to be most significant in older adults who socialized, particularly with family and friends (34, 80, 83).

Contextually, the demographic and social composition of a community could promote the use of health services. The map results shown in Chapter 4 indicated that the rural Wellington area (upper section of the map) had the highest rate of admissions with few to no support services. This also means that there was likely to be a concentration of an older adult population in this area without adequate access and available mental health and addictions support services. Except for Guelph and Cambridge that had a cluster of support services in areas with high admission rates, areas such as Kitchener had fewer admission rates for older adults likely due to accessibility to the available services. It is worth noting that areas with specialised mental health and addictions services such as Guelph could be the reason for some of the high admissions rates realized in this study. Meaning, these services may be privately funded and not available in all the areas of need.

The GIS mapping results indicated that the largest area with high rates of admission was further away from the city centers, highlighting the bigger issue of service availability and accessibility in

the rural areas. This could also indicate that older adults are more likely to retire away from city centers, highlighting the need to have an appropriate distribution of mental health and addiction support services within these remote older adult communities. The demographics and social compositions of these older adult neighborhoods should drive the provision of services and healthcare use.

5.2.2 Enabling Factors

Enabling characteristics for this study addressed older adults' mental health admissions history in inpatient psychiatry care. Older adults with PAU had been recently admitted to psychiatric care but had slightly fewer lifetime psychiatric admissions. In addition, most did not have any contact with a mental health professional in the last year or more. This could mean that older adults could not access publicly funded mental health and addictions services, the person experienced an emergent condition requiring hospitalization, or that the person could not afford private community-based services. For instance, Canadian Psychological Association (CPA) mentions that most of the mental health services in Ontario were provided by the private sector and allowed those with the income and health insurance coverage to access the services (69). Patients who are unable to afford the service end up competing for the few publicly funded services (67, 69). While this study did not have access to health coverage information, private health coverage could be one of the reasons why older adults in this study did not seek care with a mental health professional in their community.

On a contextual level, patients with mental health and PAU may require more specialized services that may be available in only a few locations such as Guelph. This could explain the high rates of psychiatric admissions found within that area. The GIS mapping results also showed the other area with high admissions rates (rural Wellington) occurred away from the cluster of service areas,

hence, travel time to services for older adults in these areas could be longer, and even more challenging for those who have concurrent mental health and addiction issues. Previous studies identified transportation to programs, enabling attitudes and behaviors as barriers to treatment of older adults (8, 10, 25). Similarly, the global Moran's I results indicated that the distance at which clustering of services could be maximized was between 1 and 19 km (up to 20-minute drive). While this may not seem like a long distance, older adults with psychiatric conditions and PAU may find this as a major limitation to accessing the required health services needed. Therefore, health policies that centre on healthcare cost decisions on health care costs made at the federal level could affect the type and frequency with which an older adult may seek these health service. Also, a critical look at organizational structures such as the number of health care facilities within a community, the number of healthcare workers delivering the services, as well as the structure of the health service delivery (63) is needed.

5.2.3 Needs Factors

The needs characteristics focused on the perceived and evaluated mental health and addictions need of older adults. Like other study results, this study identified that depression, and pain was heightened by PAU (8, 21, 22). Numerous literature sources continue to make the link between mortality risk, cognitive function, depression, heart disease and AUD (7, 8, 21, 22, 23, 24). Although this study's findings cannot be generalised for all older adults with PAU, the results surprisingly indicated that the odds of an older adult in inpatient psychiatry having PAU was decreased if they were cognitively impaired, had aggressive behaviour, had social withdrawal issues, or difficulties performing activities of daily living. This could mean that PAU was less likely to occur, or be identified, when there were other mental health issues present. Age and other predisposing factors may be to blame in such cases.

While mental health disorders are known to influence the development of substance addictions such as alcohol (27, 81), the older adult's perception of the symptoms may vary, and they may have difficulty with self-evaluation. In addition, older adults with the perception of being stigmatized for having PAU or diagnosed with AUD might not seek help. This could explain why a high number of older adults in this study indicated they had no contact with a mental health professional in the year prior to admission. Though the RAI-MH assesses for AUD in older adults who come into psychiatry care, other older adults with mental health issues who do not come into care may go undiagnosed. Needs that are not reported during inpatient or outpatient care are less likely to be appropriately evaluated by a health professional. Characteristics associated with PAU centred on issues of physical health and social relationships. Older adults with PAU reported falls in the last 90 days, had intentionally misused medication, and used other substances such as cocaine and crack (40%). This was similar to findings from the literature that relates PAU to increase in falls and medication misuse (25, 26, 30, 70). In such instances, some impacts of physical health such as falls could be identified and evaluated by health professionals, but the impact of medications misuse and substance use could sometimes be less obvious, and difficult to identify and evaluate without further tests. Social relationship issues attributed to PAU among older adults include interpersonal conflicts, loss of income, and a loss of a close family or friends. While PAU was associated with social relationship problems between older adults and their families and friends, the loss of such relationships due to death could initiate PAU (26), similar to this study. Not surprising, about 1.1 to 2.3 million American older adults use alcohol to deal with grief and the loss of a loved one (26, 81). Older adults that lose family and friends due to interpersonal conflicts could be at a greater risk of losing the support systems required to assist and advocate for their treatment and care. For older adults with mental health and addictions issues

and PAU, having this support could promote harm reduction or even abstinence through health service use. It is recommended that delays from diagnosis to treatment periods for alcohol problems in older adults be avoided (37). Family/friends support may be required to help older adults access the needed care (11), and for those with social relationships issues, this could be problematic as it could lengthen the access period to the treatment and recovery. Other barriers to treatment amongst older adults include misdiagnosis, denial, social stigma, fear of failure, and attitudes of health professionals (8, 10, 25).

Contextually, the need may be environmental or related to population health indices. Although this was outside the scope of this study, the rates of psychiatric admissions could have an impact on the rates of morbidity, mortality, and disability rates in high admissions areas. Older adults who live in these high admission areas with fewer services could be more susceptible to having mental health and alcohol addiction problems that go untreated without the essential health support services. For older adults, the availability of fewer services could influence their perception of their service need and use, rather than what has been evaluated by a clinician. Perhaps, this study highlights the need to investigate other environmental factors such as the level of neighborhood safety (i.e. the rate of injuries and deaths) as possible indicators for predicting PAU.

5.3 Implication of Study on Health Service Use

This study has direct clinical and public health policy relevance for the prevention and care of alcohol use among older adults. Results from this study may provide health professionals with a better understanding of some of the factors that influence alcohol use. By understanding the magnitude and risk factors of alcohol issues among older adults, early intervention programs can be designed to target those at the highest risk (9). Prevention of AUD among this population may

lead to a reduction in the need for hospitalization (leading to lower health care costs) or better treatment outcomes among those who are hospitalized.

To drive future research, this project developed the data infrastructure needed to better understand how community factors related to alcohol use. This is important for supporting better public health policies for creating healthier communities to support seniors who are at risk of or recovering from alcohol use as well as mental health conditions. We know that the characteristics of areas where persons reside relate to health and well-being. Access to health care services is influenced by the interaction between geographic proximity to services, socioeconomic conditions in local communities, service provision, and pathways of care (12). This is particularly important for individuals at risk for addictions. Neighborhood characteristics such as distance to bars, Alcoholics Anonymous (AA) meetings, and density of drug-related crime is related to appropriate follow-up and readmission among persons with mental health conditions (13). No studies have examined such factors in relation to addictions among older adults.

These are not only important areas of inquiry from the perspective of gaps in the scientific and clinical literature; they are important priorities for healthcare system planning. The Canadian Coalition for Seniors Mental Health is currently developing guidelines for the care of older adults with addictions (the researcher of this study is currently a member of the alcohol guidelines working group). The proposed research would be able to inform such guidelines by helping to identify key risk factors and approaches to improving community support for older adults recovering from alcohol abuse. Locally, the Waterloo-Wellington LHIN is developing a keen interest in the use of geographical analysis of health issues and service use. Their aim is to use the analysis to drive better service planning and implementation for the community (14)

5.4 Strengths and Limitations

The strengths of this study include the availability of population-level hospital data that provided the opportunity to identify variations at individual and geographic levels. The comprehensive nature of these data allowed for a detailed analysis that also pushed how PAU is defined. In addition, the use of GIS mapping visually aided in the identification of locations of services in relation to inpatient psychiatric admission involving PAU. The versatility of using GIS allows for the combination of various geographical features that interact on the map to provide a visual representation that is easily interpreted. Nonetheless, this study was not without limitations.

Data analyzed was limited to inpatient psychiatric admission of older adults in the OMHRS database. Hence, it did not account for those who use other mental health services but are not admitted to inpatient psychiatric care nor did it include older adults in the general population or those receiving home care services, though some of the study findings may apply to this group of older adults. Outpatient mental health service use history could contribute to the provision of ongoing support for older adults after they leave care, as well as those who do not come into care. However, the results in this study cannot be generalized for all older adults with mental health and PAU issues especially since other factors such as genetic risk, physiological effects of alcohol, societal expectations, personality traits, and gender roles (88) were not assessed.

This study only showed the distribution of support services locations and its relation to inpatient psychiatry admissions in the WWLHIN, for example, the locations of some churches that provide community support services were mapped but data on the number of seniors that use the service was not obtained. The independent variable for seniors who had prior contact with mental health professionals within their communities was the only variable to provide some insight into outpatient service use history. However, the definition of PAU based on the OMRHS data in this

study may be applicable to other interRAI instruments, such as the Community Mental Health (CMH). The CMH is being used by a growing number of jurisdictions and may provide further insights about PAU among seniors in the community.

While GIS mapping is useful in depicting changes over time, data from OMHRS captures information on the condition of the patient at the time of admission and discharge, therefore changes overtime following discharge from hospital may not be known. For example, the results indicated that in-patients in the 55-64 age group were the most likely to have PAU based on the information captured at the time of admission. Over time, it is unknown if these older adults limit or increase their alcohol use as they age or following an interaction with the mental health system. A study that includes follow-up data for this group of older adults will provide a better picture of changes over time.

Lastly, additional geographic data is needed to conduct a detailed mapping of various other features that may influence mental health and addictions service delivery and use within the study area. Such geographic data will help to understand why the clustering of these services occurred in the areas identified compared to other areas with no clustering. For instance, while this study only mapped geographical support service locations to the rates of psychiatric admissions, other features such as roads, transportation, parks, bars, and casinos within older adult communities could provide more insight into why the differences in psychiatric admission rates occurred. This, however, was outside the scope of this study

5.5 Future Research

This study highlights some major factors that influence PAU among older adults with mental health disorders and the related factors that drives this problem within older adult communities.

Future research could do the following:

- ***Emphasize the need to support better public health policies to create healthier communities that support seniors who are at risk of or recovering from alcohol use as well as mental health conditions.*** The patterns of psychiatric admissions rates involving alcohol use and the location of services shown in this study could serve as a guide for formulating policies that address the distribution of services within older adult communities. Further, proximity to support services should be a priority as frailty and comorbidities due to aging could affect accessibility to these services.
- ***Conduct this research on a broader scale to identify areas of support service needs for older adults living with mental health and addiction problems within their communities.*** While the focus of this research was on the geographical location of support services in WWLHIN, future research could explore the impacts of support service distribution on various other communities within other LHINs or the province of Ontario, to determine the patterns of services provision and how they affect older adults or other populations. The patterns of older adult psychiatric admissions concentrated away from the major cities provides an insight into the distribution of the older adult population within various living communities and creates an opportunity for senior-specific support programs to be fairly distributed within the areas of need.
- ***Compare census data for older adults with patterns of mental health and addictions problems to identify if these clusters of services and admissions occur at random.***

Although service clustering was shown to have occurred in this study, future research could use census data for older adult communities to investigate if this service cluster patterns happened at random or forms part of a more widespread issue of service distribution in other LHINs or province(s). This will provide insight into how mental health and addictions affect older adults, and if aging has more to do with these effects or service availability, accessibility, and use plays a more crucial role.

5.6 Conclusion

This study clearly identified individual and contextual factors associated with PAU, and how service distribution could impact mental health and addictions problems and service utilization. On an individual level, the results for independent variables obtained from OMHRS dataset gave a clear indication of some of the triggers for PAU among older adults with mental health issues. While some of the limitations outlined did not allow for further information to be obtained, this study identified an interaction between services distribution in older adults communities and its impacts on mental health and alcohol addictions issues. Contextually, this research provided an insight into possibilities for further research using GIS mapping tools to explore geographical indicators that are used to inform future health policies on mental health and addictions service provision.

APPENDICES

APPENDIX 1: Mental Health Scale Summary Table

Table 11: SUMMARY of Scales embedded in the interRAI-MH

SCALE	Description	INTERPRETATION OF SCORES	Validation Measure
Aggressive Behaviour Scale (ABS)	Measure of aggressive behaviours, including physical and verbal abuse.	Scores range from 0 to 12. Higher scores indicate higher levels of aggressive behaviour. 0 = no signs of aggression 1-4 = mild to moderate aggression 5+ = more severe aggression	Cohen Mansfield Agitation Inventory
Activities of Daily Living (ADL) Hierarchy Scale	Measure of functional performance, reflecting a person's ability to carry out activities of everyday living such as personal hygiene and locomotion.	Scores range from 0 to 6: 0 = independent 1 = supervision required 2 = limited impairment 3 = extensive assistance required; level 1 4 = extensive assistance required; level 2 5 = dependent 6 = total dependence	Amount of nursing time required for care.
CAGE – Substance use screener	Assesses the patient's: Need to Cut down on substance use; Angered by criticisms from others; Guilt about substance use; need for an "Eye-opener" (drinking/using substances in the morning)	Scores range from 0 to 4. A score of 2 or more is considered to indicate a potential problem with substance addiction	
Cognitive Performance Scale (CPS)	Describes the person's cognitive status including performance in daily decision-making, short-term memory, expression.	Scores range from 0 to 6: 0 = intact 1 = borderline intact 2 = mild impairment 3 = moderate impairment 4 = moderate to severe impairment 5 = severe impairment 6 = very severe impairment	Mini Mental State Examination Montreal Cognitive Assessment.
Depression Rating Scale (DRS)	Describes the mood status of an individual including presence of negative statements, persistent anger, unrealistic fears, repetitive health complaints, repetitive anxious complaints	Scores may vary between 0 and 21. 3+ = indicative of possible depression 7+ = indicative of more severe depression.	Hamilton Depression Inventory Cornell Depression Scale Beck Depression Inventory
PAIN	Summarizes the presence and intensity of pain.	Scores may range between 0 and 4: 0 = No pain 1 = Less than daily pain 2 = Daily pain but not severe 3 = Daily severe pain 4 = Daily excruciating pain	McGill Pain Questionnaire

APPENDIX 2: Spatial Analysis Results (Global Moran's I)

Table 12: Global Moran's I Summary for addiction services

Psychiatric admissions		Psychiatric admissions involving PAU	
Moran's Index:	0.537758	Moran's Index:	1.000924
Expected Index:	-0.016129	Expected Index:	-0.016129
Variance:	0.009731	Variance:	0.010212
z-score:	5.614869	z-score:	10.064371
p-value:	0.000000	p-value:	0.000000

Table 13: Global Moran's I Summary for Community Support Services

Psychiatric admissions		Psychiatric admissions involving PAU	
Moran's Index:	0.493180	Moran's Index:	1.101374
Expected Index:	-0.018519	Expected Index:	-0.018519
Variance:	0.168577	Variance:	0.180950
z-score:	1.246279	z-score:	2.632671
p-value:	0.212662	p-value:	0.008472

Table 14: Global Moran's I Summary

Psychiatric admissions		Psychiatric admissions involving PAU	
Moran's Index:	0.919910	Moran's Index:	1.097640
Expected Index:	-0.008621	Expected Index:	-0.008621
Variance:	0.003581	Variance:	0.003595
z-score:	15.517335	z-score:	18.449962
p-value:	0.000000	p-value:	0.000000

APPENDIX 3: Spatial Analysis Results (Anselin Local Moran's I)

Table 15 shows the map table and population data from OMHRS that was used for the cluster and outlier analysis. Although the map had 38 FSAs (FSA_NAME) in the WWLHIN, only 36 FSAs were matched and used based on the data that was available from the OMHRS dataset. The Cities column show the 4 WWLHIN location of the FSAs in Kitchener/Waterloo (KW), rural Wellington (RW), Guelph (G), and Cambridge (C). Table 15 also includes the census data for older adults (55+) per FSA for 2011 (Tot_POP_FSA), the total admission rates with and without PAU (Total_Alc_FSA and Total_MH_FSA respectively), and the standardized rates with and without PAU (Alc_Stand_Rate and MH_Stand_Rate respectively).

Table 15: WWLHIN shapefile data joint to population data

WW_Region															
FID	Shape *	OBJECTID_1	OBJECTID	FSA	PROV	Shape_Leng	Shape_Area	Cities	Object ID	FSA_Name	Total_POP_FSA	Total_MH_FSA	MH_Stand_Rate	Total_Alc_FSA	Alc_Stand_Rate
0	Polygon	9	9	N0B	ON	9.078038	0.198362	KW	9	N0B	20540	92	448	17	83
1	Polygon	10	10	N0C	ON	0.92131	0.028438	RW	10	N0C	5325	38	714	4	75
2	Polygon	11	11	N0G	ON	3.342817	0.183468	RW	11	N0G	24770	220	888	28	113
3	Polygon	12	12	N0J	ON	0.223431	0.000436	RW	12	N0J	8110	41	506	5	62
4	Polygon	13	13	N0K	ON	0.496141	0.003838	KW	13	N0K	6370	53	832	5	78
5	Polygon	14	14	N1C	ON	0.128582	0.00061	G	14	N1C	700	4	571	1	143
6	Polygon	15	15	N1E	ON	0.25982	0.002382	G	15	N1E	9090	66	726	10	110
7	Polygon	16	16	N1G	ON	0.262354	0.002211	G	16	N1G	7145	68	952	11	154
8	Polygon	17	17	N1H	ON	1.016561	0.010783	G	17	N1H	11815	114	965	13	110
9	Polygon	18	18	N1K	ON	0.242916	0.00079	G	18	N1K	1460	6	411	0	0
10	Polygon	19	19	N1L	ON	0.411746	0.002638	G	19	N1L	1925	18	935	3	1556
11	Polygon	20	20	N1M	ON	0.767583	0.008046	RW	20	N1M	4470	36	805	4	89
12	Polygon	21	21	N1P	ON	0.114793	0.000245	C	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
13	Polygon	22	22	N1R	ON	1.143962	0.014688	C	22	N1R	11450	52	454	4	35
14	Polygon	23	23	N1S	ON	0.1854	0.001122	C	23	N1S	5465	31	567	6	110
15	Polygon	24	24	N1T	ON	0.222081	0.001099	C	24	N1T	2615	13	497	3	115
16	Polygon	25	25	N2A	ON	0.20038	0.001603	KW	25	N2A	7220	39	540	5	69
17	Polygon	26	26	N2B	ON	0.163097	0.001205	KW	26	N2B	5275	26	493	1	19
18	Polygon	27	27	N2C	ON	0.188694	0.001329	KW	27	N2C	3595	31	862	2	56
19	Polygon	28	28	N2E	ON	0.28041	0.001899	KW	28	N2E	6730	34	505	2	30
20	Polygon	29	29	N2G	ON	0.16525	0.000605	KW	29	N2G	3490	57	1633	5	143
21	Polygon	30	30	N2H	ON	0.172286	0.000876	KW	30	N2H	5680	48	845	6	106
22	Polygon	31	31	N2J	ON	0.741101	0.003847	KW	31	N2J	5745	32	557	3	52
23	Polygon	32	32	N2K	ON	0.305929	0.002042	KW	32	N2K	5335	24	450	3	56
24	Polygon	33	33	N2L	ON	0.231492	0.001907	KW	33	N2L	7145	45	630	4	56
25	Polygon	34	34	N2M	ON	0.181889	0.001182	KW	34	N2M	8420	45	534	4	48
26	Polygon	35	35	N2N	ON	0.165614	0.001178	KW	35	N2N	5975	34	569	2	33
27	Polygon	36	36	N2P	ON	0.315299	0.002583	KW	36	N2P	3765	20	531	3	80
28	Polygon	37	37	N2R	ON	0.334455	0.00222	KW	37	N2R	845	3	355	0	0
29	Polygon	38	38	N2T	ON	0.156635	0.000806	KW	38	N2T	3860	13	337	1	26
30	Polygon	39	39	N2V	ON	0.36055	0.001225	KW	39	N2V	2680	3	112	0	0
31	Polygon	40	40	N3A	ON	0.74614	0.015661	KW	40	N3A	4150	14	337	2	48
32	Polygon	41	41	N3B	ON	0.803223	0.011912	KW	41	N3B	3150	22	698	0	0
33	Polygon	42	42	N3C	ON	0.531122	0.005296	C	42	N3C	5250	22	419	2	38
34	Polygon	43	43	N3E	ON	0.129617	0.000311	C	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
35	Polygon	44	44	N3H	ON	0.696209	0.005803	C	44	N3H	6450	38	589	4	62
36	Polygon	45	45	N4N	ON	0.029806	0.000039		45	N4N	3695	41	1110	6	162
37	Polygon	46	46	N4W	ON	0.404549	0.003931		46	N4W	2965	16	540	1	34

Cluster and Outlier Tables

Table 16 shows the results for psychiatric admissions. The Column for the cluster outlier type (COType RS) shows where statistically significant clustering occurred (p-value < 0.05) in the high-low outlier and low-low cluster areas. The results also showed the Moran's I index (LMiIndex RS), z-scores (LMiZScore RS) and corresponding nearest neighbors (NNeighbors RS) on the map.

Similarly, Table 17 shows the results for psychiatric admissions with alcohol use. The column for the cluster outlier type (COType RS) shows where statistically significant clustering occurred (p-value < 0.05) in the high-high and low-low cluster areas.

Table 16: Clusters and outliers results table for psychiatric admissions

OBJECTID *	Shape *	SOURCE_ID	MH_Stand_Rate	Shape_Length	Shape_Area	LMIndex RS	LMIZScore RS	LMPValue RS	COType RS	NNeighbors RS
1	Polygon	0	448	9.078038	0.198362	0	<Null>	0.002	HL	27
2	Polygon	1	714	0.92131	0.028438	0.438181	0.9067	0.184		1
3	Polygon	2	888	3.342617	0.183468	0.458592	0.904126	0.198		6
4	Polygon	3	506	0.223431	0.000436	0.283436	1.352625	0.046	LL	2
5	Polygon	4	832	0.496141	0.003838	-0.492214	-0.625013	0.206		1
6	Polygon	5	571	0.128582	0.00061	-0.077948	-1.015131	0.128		3
7	Polygon	6	726	0.25982	0.002382	0.378216	1.572046	0.066		4
8	Polygon	7	952	0.262354	0.002211	0.609173	1.026584	0.164		5
9	Polygon	8	965	1.016561	0.010783	0.156416	0.111737	0.372		4
10	Polygon	9	411	0.242916	0.00079	-0.275425	-0.343625	0.318		2
11	Polygon	10	935	0.411746	0.002638	0.327532	0.406154	0.308		4
12	Polygon	11	805	0.767583	0.008046	0.181753	0.165584	0.368		2
13	Polygon	13	454	1.143962	0.014688	0.213355	1.583284	0.038	LL	7
14	Polygon	14	567	0.1654	0.001122	0.040808	0.596907	0.288		2
15	Polygon	15	497	0.222081	0.001099	0.239361	1.338224	0.07		3
16	Polygon	16	540	0.20038	0.001603	-0.14736	-1.336357	0.104		7
17	Polygon	17	493	0.163097	0.001205	0.049341	0.534973	0.32		4
18	Polygon	18	862	0.188694	0.001329	0.286909	0.469193	0.314		6
19	Polygon	19	505	0.28041	0.001899	0.067284	0.671148	0.254		5
20	Polygon	20	1633	0.16525	0.000605	0.831855	0.660434	0.248		6
21	Polygon	21	845	0.172286	0.000876	0.441148	1.070578	0.158		5
22	Polygon	22	557	0.741101	0.003847	-0.015922	-0.00954	0.48		8
23	Polygon	23	450	0.305929	0.002042	0.188709	1.243976	0.088		6
24	Polygon	24	630	0.231492	0.001907	-0.001576	-0.395293	0.37		7
25	Polygon	25	534	0.181889	0.001182	-0.226724	-1.769938	0.064		5
26	Polygon	26	569	0.165614	0.001178	0.047839	1.317154	0.074		6
27	Polygon	27	531	0.315299	0.002583	0.061706	0.950477	0.16		6
28	Polygon	28	355	0.334455	0.00222	0.057025	0.442862	0.354		4
29	Polygon	29	337	0.156635	0.000806	0.502015	1.443893	0.052		4
30	Polygon	30	112	0.36055	0.001225	0.808054	1.495584	0.034	LL	5
31	Polygon	31	337	0.74614	0.015661	0.465124	0.926238	0.15		2
32	Polygon	32	698	0.803223	0.011912	0.08544	0.189406	0.398		2
33	Polygon	33	419	0.531122	0.005296	0.270738	1.207497	0.09		4
34	Polygon	35	589	0.696209	0.005803	0.022715	1.555947	0.038	LL	7
35	Polygon	36	1110	0.029806	0.000039	2.002535	1.071415	0.136		1
36	Polygon	37	540	0.404549	0.003931	-0.056779	-0.15853	0.38		2

Table 17: Clusters and outliers results table for psychiatric admissions involving alcohol

OBJECTID *	Shape *	SOURCE_ID	Alc_Stand_Rate	Shape_Length	Shape_Area	LMilIndex RS	LMiZScore RS	LMIPValue RS	COType RS	NNeighbors RS
1	Polygon	0	83	9.078038	0.198362	0	<Null>	0.002	HH	27
2	Polygon	1	75	0.92131	0.028438	-0.004355	-0.020453	0.152		1
3	Polygon	2	113	3.342617	0.183468	-0.00453	-0.361293	0.486		6
4	Polygon	3	62	0.223431	0.000436	0.02689	0.247583	0.422		2
5	Polygon	4	78	0.496141	0.003838	0.009071	0.080789	0.386		1
6	Polygon	5	143	0.128582	0.00061	0.320822	3.67454	0.008	HH	3
7	Polygon	6	110	0.25982	0.002382	0.037306	2.938563	0.004	HH	4
8	Polygon	7	154	0.262354	0.002211	0.246925	2.735784	0.008	HH	5
9	Polygon	8	110	1.016561	0.010783	-0.001728	-0.153273	0.282		4
10	Polygon	9	0	0.242916	0.00079	0.012939	0.070569	0.266		2
11	Polygon	10	1556	0.411746	0.002638	0.447933	2.337356	0.016	HH	4
12	Polygon	11	89	0.767583	0.008046	0.001489	0.110448	0.252		2
13	Polygon	13	35	1.143962	0.014688	0.025729	0.313288	0.382		7
14	Polygon	14	110	0.1654	0.001122	-0.005567	-0.382644	0.236		2
15	Polygon	15	115	0.222081	0.001099	-0.009543	-0.383015	0.24		3
16	Polygon	16	69	0.20038	0.001603	0.014876	0.411887	0.456		7
17	Polygon	17	19	0.163097	0.001205	0.036043	0.274729	0.434		4
18	Polygon	18	56	0.188694	0.001329	0.033796	0.527577	0.248		6
19	Polygon	19	30	0.28041	0.001899	0.073873	0.692867	0.05	LL	5
20	Polygon	20	143	0.16525	0.000605	-0.025652	-0.43737	0.358		6
21	Polygon	21	106	0.172286	0.000876	-0.001221	-0.422869	0.394		5
22	Polygon	22	52	0.741101	0.003847	0.035568	0.572903	0.24		8
23	Polygon	23	56	0.305929	0.002042	0.040985	0.6219	0.122		6
24	Polygon	24	56	0.231492	0.001907	0.042203	0.746151	0.068		7
25	Polygon	25	48	0.181889	0.001182	0.03763	0.461368	0.3		5
26	Polygon	26	33	0.165614	0.001178	0.064771	0.685934	0.066		6
27	Polygon	27	80	0.315299	0.002583	0.021213	0.642946	0.126		6
28	Polygon	28	0	0.334455	0.00222	0.072236	0.45223	0.284		4
29	Polygon	29	26	0.156635	0.000806	0.089229	0.663955	0.042	LL	4
30	Polygon	30	0	0.36055	0.001225	0.085481	0.50601	0.166		5
31	Polygon	31	48	0.74614	0.015661	0.029335	0.209287	0.486		2
32	Polygon	32	0	0.803223	0.011912	0.010342	0.092491	0.234		2
33	Polygon	33	38	0.531122	0.005296	0.033202	0.369549	0.478		4
34	Polygon	35	62	0.696209	0.005803	0.022946	0.479895	0.404		7
35	Polygon	36	162	0.029806	0.000039	0.008721	-0.04563	0.172		1
36	Polygon	37	34	0.404549	0.003931	0.00696	0.060729	0.248		2

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