Exploring the prevalence of serious mental illness among Albertans living with peripheral arterial disease who have undergone a lower limb amputation

by

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ABSTRACT

Peripheral arterial disease (PAD) is a chronic disease that may lead to severe consequences including loss of lower limb. With a known relationship between chronic disease and mental illness, it is paramount to establish the prevalence of mental illness to guide the development of strategies that support individuals living with concurrent mental illness and chronic disease. This thesis examines the prevalence of serious mental illness (SMI) among Albertans living with PAD who have undergone a lower limb amputation (LLA), with the consideration of various other variables of interest. A retrospective cohort design was used whereby existing health data records were analyzed from the years 2017 through to 2019 to determine the study group, which included anyone who had a primary diagnosis of, and hospitalization with PAD, and was over the age of 18. Demographics of the study group are discussed and the following independent variables were reviewed; age, sex, geography, housing, diabetes, length of stay, and discharge disposition. Excel software and R software version 4.3.2 were used to perform descriptive statistics (mean, median, mode and standard deviation), and inferential statistics (correlation analysis, chi-square test of independence, and logistic regression). Correlation analysis revealed no correlation between SMI and LLA, and a moderate correlation between diabetes and LLA. The chi-square test of independence revealed that there was a statistical significance between SMI and those with an LLA, SMI and those without an LLA, as well as PAD and SMI. Logistic regression revealed a statistical significance between diabetes and LLA, and no statistical significance between LLA and SMI. A higher percentage, or prevalence, of SMI was noted in the group of people with LLA compared with those who did not have an LLA, although this was not deemed statistically significant. Key recommendations after completion of this study include the

following: 1) further mental health assessment, starting with depression screening, in individuals who present to acute or primary care settings with symptoms of PAD, 2) increased screening of females who present with symptoms of PAD or risk factors as well as further research on females living with PAD and SMI, 3) further research in understanding mental illness reporting in younger and older adults, 4) repeating this study across every Canadian province and territory, and 5) further research to understand rates of SMI pre and post operatively from an LLA to understand more about a potential causative relationship. This work provides the foundation for further research to be carried out amongst this population, specifically the lived experiences of individuals who live with PAD and a mental illness.

PREFACE

This thesis is an original work by Danielle Jasmine Cray. The research project, of which this thesis is part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name “Exploring the prevalence of serious mental illness among Albertans living with peripheral arterial disease who have undergone a lower limb amputation”, Pro00124131_AME2, November 2nd, 2023. Study data was collected by AbSPORU and a data creation plan was made in consultation with AbSPORU analytical experts. The data was received unidentified and was stored using a secure, password protected, research drive within the University of Alberta firewall. Data analysis was conducted remotely, and thereby accessed with a password via Citrix Workspace. The data was analyzed using Excel software and R software version 4.3.2. The data will be destroyed within the limits applicable at the time of the project, according to the University of Alberta policy. The data used in this thesis is owned by Alberta Health Services (AHS).

DEDICATION

I would like to dedicate this thesis to all of the people who are suffering with vascular disease and a mental illness. You are the reason for my passion for this project and my hope to help improve mental health support for those living with a chronic disease.

ACKNOWLEDGEMENTS

I would like to thank my thesis supervisor, Dr. Edith Pituskin, for her continued support, encouragement, as well as her confidence in me and the meaning and value behind this project. Her excitement for, and involvement in, nursing research has inspired me to consider conducting further research in my career. I am grateful to have had the opportunity to work with her and learn from her over the duration of my program. Thank you, Dr. Pituskin.

I would like to thank my thesis committee members and arms length examiner, Dr. Carmel Montgomery, Dr. Mark Haykowsky and Dr. Tanya Park, for their dedication to this project. Their knowledge, suggestions and expertise was greatly appreciated during this process and I am grateful for their involvement.

I would like to thank my husband, David, my parents, Larry and Muriel, my husband's family and my friends for their unwavering support throughout this process. Having these people in my life to uplift me and believe in my abilities was pivotal in my ability to complete the program.

I would like to thank my colleagues in Vascular Surgery at the Peter Lougheed Center for their support during completion of my project. They have always shown great interest in my progress and have been reassuring and encouraging. I learned a great deal from them as a new Registered Nurse and my interest in pursuance of research affecting those with vascular disease started there.

I would like to acknowledge the financial support I received from the Alberta Registered Nurses Educational Trust, University of Alberta, and Alberta Health Services. Thank you for supporting me throughout this educational journey, and helping make this project possible.

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GLOSSARY OF TERMS

Key terms used within this thesis report are outlined and defined below.

Peripheral Arterial Disease is defined by the Centers for Disease Control and Prevention (2022) as "in the legs or lower extremities…the narrowing or blockage of the vessels that carry blood from the heart to the legs…primarily caused by the buildup of fatty plaque in the arteries..." (para. 1).

Lower limb amputation is defined as "the removal of a part, or multiple parts, of the lower limb" (Esquenazi & Kwasniewski, 2021, para. 1) and "performed to remove ischemic, infected, necrotic tissue or locally unresectable tumor and, at times, is a life-saving procedure" (Kalapatapu, 2022, para. 1).

Multimorbidity is defined by The World Health Organization (WHO), 2016, as "the coexistence of two or more chronic conditions in the same individual" (p. 3).

Serious mental illness is defined by the National Institute of Mental Health (2023) as "a mental, behavioral, or emotional disorder resulting in serious functional impairment, which substantially interferes with or limits one or more major life activities" (para. 4). It is acknowledged that this may not be the most acceptable term as all mental illness can be recognized as serious. For the purposes of this thesis, this term will be used as it is currently found in the literature. However, consideration should be made to change this terminology in the future. The following mental illnesses were investigated: depression, generalized anxiety disorder, anxiety with depressive disorder, and bipolar disorder. While anxiety is often not listed as a serious mental illness, it was included in this project as it is closely linked with depression and is likely debilitating and serious for many individuals.

Depressive disorders are defined in the DSM-5-TR (2022) by the American Psychiatric Association as all having the common feature of "the presence of sad, empty, or irritable mood, accompanied by related changes that significantly affect the individual's capacity to function" (para. 1).

Generalized anxiety disorder is defined in the DSM-5-TR (2022) by the American Psychiatric Association as "persistent and excessive anxiety and worry about various domains, including work and school performance that the individual finds difficult to control…experiences physical symptoms, including restlessness or feeling keyed up or on edge, being easily fatigued, difficulty concentrating or mind going blank, irritability, muscle tension and sleep disturbance" (para.10).

Bipolar and related disorders including Bipolar I, Bipolar II, and cyclothymic disorder, and are defined in the DSM-5-TR (2022) by the American Psychiatric Association as "classic manic-depressive disorder or affective psychosis" (para.2), "requiring the lifetime experience of at least one major depressive episode and at least one hypomanic episode" (para. 3), and "experience at least 2 years or both hypomanic and depressive periods without ever fulfilling the criteria for an episode for mania, hypomania, or major depression" (para. 4), respectively.

International Statistical Classification of Diseases and Related Health Problems, (ICD) is defined by the WHO (2023) as being used as "the basis for comparable statistics on causes of mortality and morbidity between places and over time" (para. 2) and "serves a broad range of uses globally and provides critical knowledge on the extent, causes and consequences of human disease and death worldwide via data that is reported and coded with the ICD" (para. 1).

Canadian Classification of Health Interventions (CCI) is defined as "a multi-axial classification of health-related interventions developed and maintained by the Canadian Institute of Health Interventions (CIHI) to facilitate the capture of health care interventions (CIHI, 2022b, p. 8).

CHAPTER ONE

Introduction

This thesis project represents the concluding portion of my Master of Nursing degree in the Nurse Practitioner, adult stream. My Registered Nurse (RN) career to date has been heavily focused in the area of Vascular Surgery. With my passion for improving mental health care in acute care settings and my dedication to this patient population, it seemed fitting to complete a project that incorporated these two areas. My goal is to improve the care of individuals living with chronic disease and mental illness, and hope that my project provides foundational knowledge, within Alberta, to build on future research in this area.

Background

Holistic health care involves caring for an individual through all aspects of their health journey which includes not only physical health but mental health as well. There is an established relationship between living with chronic physical illness and mental illness, and often these co-occur (National Institute of Mental Health, 2021). Through both firsthand experience and supportive literature, acute care and/or surgical care environments often fail to fully encompass mental health care into the hospital encounter. Qualitative work by McBride et al (2021b) found that among individuals living with serious mental illness (SMI) noted their mental health was not as recognized or acknowledged in the health visit as much as physical concerns, despite the established mental illness diagnoses. SMI and chronic disease have a bidirectional relationship whereby one may significantly impact the other, leading to lowered quality of life and worsening health outcomes (Canadian Mental Health Association, Ontario, 2023). Therefore, it is of significant importance to ensure mental health is supported and maintained throughout acute care encounters.

Peripheral arterial disease (PAD) is a chronic illness that often requires repeat hospitalization. Peripheral vascular disease (PVD) and PAD are terms that are often used interchangeably, but the American Heart Association (2021) recommends the term PAD as this encompasses both venous and arterial disorders. It is manifested by partial or complete blockages of the peripheral vessels of the limbs (Soyoye et al., 2021), particularly of the lower extremities (Song et al., 2019). With advancing PAD, inadequate blood flow and oxygenation results in pain at rest, numbness, coldness and non-healing ulcers (Topfer & Spry, 2018). Risk factors involved in the development of PAD include several chronic diseases such as diabetes mellitus, smoking, dyslipidemia, hypertension, coronary heart disease and cerebrovascular disease, with diabetes and smoking being of greatest risk (Soyoye et al., 2021). PAD is estimated to affect over 200 million people throughout the world, with prevalence significantly increasing with age (Song et al., 2019). Advancing PAD and progressive tissue death may ultimately necessitate surgical amputation of lower limbs. The increase in rates of chronic diseases such as diabetes and kidney disease means that PAD will likely increase in coming years. Limb amputation is a costly health system expense (~$284,000 for major amputation hospitalization) and is also costly for the individual (Zivot Limb Preservation Clinic, n.d.). Fifty-five percent of people who undergo amputation are permanently disabled and among those who undergo above-knee amputation, they never return to ambulatory status (Barnes et al., 2020). Although males have twice the rates of LLA, (Alberta Health & Alberta First Nations Information Governance Center, 2017) those reporting mental health concerns are more often female, younger, have more financial strain and less social support, (Thomas et al., 2020). Potentially, there is a silent mental health crisis among men (Affleck et al., 2018). For individuals who are living with diabetes, rates of LLA amongst First Nations individuals are triple those of non-First Nations individuals (Alberta Health &

Alberta First Nations Information Governance Center, 2017). Understanding groups of individuals who are at risk can help us guide screening and clinical interventions in practice.

LLA results in significant and difficult changes to activities of daily living, alongside often serious mental health symptoms including depression, despair, anxiety, loss of self-esteem, stigma and isolation (Roșca et al., 2021). Such progressively debilitating diseases may cause a cycle of mood disturbance and decreasing physical functioning. With this understanding, it is imperative to engage in research that allows us to gain an increased understanding of the connections between mental and physical health, and how best to serve individuals suffering with both.

Literature Review

Living with chronic disease and mental illness

Individuals who live with a chronic disease can often also live with a mental illness, and living with a chronic disease could predispose an individual to developing a mental health condition (National Institute of Mental Health, 2021). The same is true for living with an SMI and developing a chronic illness as people with SMI often have more comorbidities related to their physical health which can lead to poorer health outcomes (Launders et al., 2022). The Canadian Mental Health Association (CMHA) Alberta Division notes that just over 21% of Canadians will live with a mental health condition at some point during their life (CMHA Alberta, 2023). While living with a mental illness or a chronic physical illness can be challenging as a single illness, multimorbidity can be exhausting. The World Health Organization (2016) identifies multimorbidity as a growing issue that requires attention to improve both patient care and safety. Panagioti et al., (2015) conclude in their systematic review

and meta-analysis that individuals with multimorbidities, which include a mental health concern, are at higher risk for safety issues within primary care settings. Furthermore, individuals living with SMI have been found to have poorer surgical outcomes and increased associated cost which emphasizes the need for preoperative improvement of care for these patients (McBride et al., 2018), as well as increased postoperative complications, longer duration of hospital stay, greater cost and higher readmission rates as well as worse surgical outcomes (McBride et al., 2021a). Individuals with any mental health condition have been noted to have a decreased life expectancy when compared with those who do not live with a mental illness, and other aspects of a person's life can be impacted such as financial and social implications (Firth et al., 2019). Additionally, individuals who are homeless are at a three times greater risk of cardiovascular disease and have higher mortality than those who are housed (Al-Shakarchi et al., 2020) and older adults have especially been shown to have a relationship between their physical and mental health (Luo et al., 2020). The literature supports not only the importance of improving mental health care of individuals living with chronic disease but how critically this can impact an individual's overall healthcare journey and potentially prolong their life.

Peripheral Arterial Disease and Mental Health

Depression is observed more frequently in those with PAD versus those without PAD, which is linked to higher mortality rates (McDermott et al., 2016). Literature notes that one in five individuals who have PAD also live with depression (Smolderen et al., 2023). Other studies have specifically looked at women having a higher risk of depression with PAD versus without PAD as well (Grenon et al., 2014). Grenon et al (2012) looked at the relationship between depression and PAD from data from the Heart and Soul Study (Ruo et al., 2003) and found that

symptoms of depression were also related to a higher risk of developing PAD. Patients who have PAD, such as the cohort identified for this study, have been shown to be more likely than the general population to develop symptoms of depression (Ramirez et al., 2018). Given the multitude of literature that supports this relationship, depression was important to investigate in this study and one of the SMI's included. Depression and anxiety disorders frequently coexist and are associated with more serious physical illnesses and worse treatment outcomes than with either alone (Bobo et al., 2022), therefore, anxiety was included in this study. Small studies suggest that the presence of depression is associated with worse patency and recurrent leg symptoms after lower extremity revascularization (Cherr et al., 2007). Additionally, being diagnosed with depression or anxiety has been shown to be associated with higher rates of amputations and loss of lower limbs and mortality rates are about 24% higher in those who have PAD with depression (Smolderen et al., 2023). Goldstein et al. (2020) reviewed literature on the connections between bipolar disorder and vascular disease, identifying associations with higher mortality rates and noting the significant connection between the two diseases amongst various studies. This same study concluded that more research is needed to focus on this relationship between bipolar disorder and vascular disease. It is possible that consistent and comprehensive mental health screening of individuals living with progressive PAD could identify those at higher risk of rapid advancement or worse treatment outcomes, ultimately leading to improved quality of life and health outcomes.

Rates of lower limb amputation in Canada

LLA can result from numerous illnesses such as diabetes, vascular disease, congenital issues, cancer, or trauma; however, the main cause in western countries is related to diabetes

(Imam et al., 2017). Diabetes is closely linked with incidence of PAD and is one of the greatest risk factors for this chronic illness (Soyoye et al., 2021). In Canada, rates of diabetes-associated LLA have increased in recent years (Imam et al., 2017) as well as LLA related to PAD (Hussain et al., 2019). Essien et al. (2022) analyzed data from Imam et al.'s study and determined that the province of Alberta had a 1.3% increase noted in rates of LLAs. Given Alberta's increased rates of LLA, it was important to specifically look at LLA in this study alone and in relation to SMI.

Gap in Knowledge

To our knowledge, there is no research within the province of Alberta that investigates the relationship between SMI and those living with PAD, with or without an LLA. Sex, age, geography, diabetes, housing, length of stay, and discharge disposition were also examined aiming to compare and identify any differences noted amongst these variables. Examining these variables revealed potential gaps and disparities in care. Understanding prevalence may ultimately lead to improved mental health screening and overall care of these individuals undergoing invasive intervention.

Purpose Statement

The purpose of this thesis was to evaluate the prevalence of SMI amongst individuals living with PAD who have undergone a LLA compared with those who have not undergone an LLA, within the province of Alberta. By knowing the prevalence amongst groups and variables we can consider upstream approaches in PAD care and surgical care to support mental health and help prevent potential exacerbations. If we can improve the mental health of these individuals, as poorer outcomes are noted in the literature for this population, and provide holistic preoperative

services, we could even help prevent or delay loss of limb.

Research Question

In individuals living with PAD in Alberta, is there a difference in prevalence of SMI among those who have undergone a LLA compared with those who have not?

Hypothesis

The literature confirms a known correlation between chronic illness and mental illness (Luo et al., 2020). It is possible that progressively debilitating and severe chronic disease may influence the burden of mental illness for these individuals or mental illness may impact chronic disease management and progression. Therefore, we hypothesized that we would observe a higher prevalence of SMI amongst the group of individuals who have had a LLA versus those who have not had a LLA.

CHAPTER TWO

Methodology

Study Design

This research is a retrospective cohort study whereby administrative health data records within the province of Alberta have been analyzed. This study involves both descriptive and inferential statistical analysis of prevalence of SMI amongst individuals with PAD who have undergone an LLA compared with those who have not undergone an LLA. Other variables of interest were explored as it is important to take other factors into consideration when evaluating

relationships amongst two health conditions. Health records between January 1st, 2017, through to December 31st, 2019 were used to identify a recent admission with a most responsible diagnosis of PAD to determine the study group. While individuals can be admitted to hospital with multiple diagnoses, the most responsible diagnosis is the main diagnoses for admission. Those who met the inclusion criteria for this study were then reviewed again, looking back to April 2002, to identify if they had had a previous hospitalization with a most responsible diagnosis of PAD and LLA. This was reviewed to analyze prevalence of SMI if the group had undergone a previous LLA prior to recent hospitalization compared with no previous LLA and this encounter being the first. The time from 2017-2019 was chosen specifically to exclude the potential impacts of the COVID-19 pandemic on study findings, which may have involved restricted access to health care, and to understand the prevalence of suffering in this population before we suffered together, globally. A retrospective cohort study design was chosen as it met the objectives of the study outcomes and due to the time constraints of a Master of Nursing Thesis program.

Ethics approval was obtained for this project from the Health Research Ethics board at the University of Alberta via Alberta Research Information Services (ARISE) System. Ethics was initially obtained and then two amendments were made to the initial approval reflecting adjustments in data collection strategies. A data disclosure agreement (DDA) was signed with Alberta Health Services to obtain data, and Alberta Strategy for Patient Oriented Research Support Unit (AbSPORU) analytical experts obtained the data based on the data creation plan. This research was conducted remotely in Calgary on a home computer. To ensure secure data storage and analysis, a secure data folder was created through the University of Alberta, with access obtained via Citrix Workspace with a login password.

Setting

The setting of this study took place within the province of Alberta, Canada. As of January 2023, the province of Alberta had a population of 4,647,178 with the highest growth rate in the country of 3.68% as of January 2022 (Government of Alberta, 2023b). Through the Alberta Health Care Insurance Plan (AHCIP), eligible Alberta residents are able to obtain full coverage for many medical services and health care costs once registered through the plan with their personal health care card. These services include, but are not limited to, psychiatrist visits and surgical care. Alberta residents are also able to receive full coverage of services from podiatric surgeons in a hospital within Alberta or another facility under AHS. A medical service that is not covered is any prescription medication outside of the hospital (Government of Alberta, 2023a).

Data Sources

The data sources used for this research study were health administrative provincial data sets from AHS. These data sets were requested through AbSPORU via a data request form that was obtained on their website (AbSPORU, 2023). The request form was sent to gather data and a copy of ethics approval was provided. AbSPORU analytical experts identified the appropriate databases to locate the metrics of interest.

The Discharge Abstract Database (DAD) was used for all data collection for this project. DAD "contains demographic, administrative, and clinical data on all separations (with the exception of stillbirths and cadaveric donors) from acute inpatient facilities in all provinces and territories except Quebec" (CIHI, 2023b, para. 5).

Study Population

The study population for this research included individuals who met the following criteria:

1) Adults, 18 years of age and above

2) Must have a most responsible diagnosis of PAD on an inpatient hospital encounter between January 1st, 2017 through to December 31st, 2019

3) Resides within the province of Alberta

Individuals were excluded from this study if they were below the age of 18, did not have a most responsible diagnosis of PAD on the hospital encounter investigated, or did not reside in Alberta at the time of their inpatient hospital encounter.

Data Collection

Data was collected by AbSPORU analytical experts from AHS data records based on the data creation plan developed with members of the AbSPORU team. The data was collected from January 1st, 2017 through to December 31st, 2019 to determine the cohort. Subsequently, based on individuals who met the inclusion criteria, their data records were then reviewed retrospectively back to April 1st, 2002 to identify if they had undergone a previous LLA prior to the current inpatient hospitalization of focus.

Variables

The following independent and dependent variables were identified during data collection.

Independent Variables

Sex. Sex has been examined in this study by using demographic information provided from the accessed datasets. We understand that gender identity may not correlate with assigned sex at birth, but for the purposes of this study, sex will be examined using male and female identifiers. Given the noted sex differences in individuals with PAD (Pabon et al., 2022), this variable is discussed and quantified.

Age. Age has been examined in this study by using demographic information provided from the accessed data sets. Age groups were subcategorized based on the Canadian Institute for Health Information (CIHI) Age Stratifier into groups of 10 years, as this was expected to help identify variations (CIHI, 2022a). The following age groups were used (18-28, 29-39, 40-50, 51-61, 62-72, 73-83, 84-94, and 95 years and above). Of note, the age group of 95 and above contained only four years as the oldest individual in the study was age 98.

Geography. Geographic location was examined and discussed as urban versus rural using postal codes provided in the demographic information from health data sets. The postal codes were determined as urban versus rural by the AbSPORU team upon data retrieval and this is outlined in the methods section.

Housing. Individuals who are not housed have higher rates of cardiovascular disease with higher mortality rates, (Al-Shakarchi et al., 2020), therefore it was important to identify this high risk group within the data analysis and identify if there is a higher risk of SMI with LLA. Homelessness is coded in the hospital based on the code Z59.0 (CIHI, 2023a) and was included as such in our data creation plan as identification.

Diabetes. Rates of lower limb amputation, related to either PAD, diabetes or both, have increased in Canada in the last 10 years (Hussain et al., 2019), therefore of particular interest in this study. During the data creation plan process, PAD codes identified for this study also had some diabetes codes embedded in them, as outlined in Appendix A, Table 1. Additionally, diabetes codes unrelated to PAD (for example, diabetes with kidney disease) were also reviewed to identify how many individuals had a code associated with diabetes overall.

Length of Stay. The admission information obtained from the DAD records provided information about each individual's length of stay (LOS). This was reviewed to understand if LOS was impacted by the variables of interest.

Discharge Disposition. Discharge locations were provided within the data set and the most frequent discharge dispositions for each group were identified. This has provided information regarding if patients were, for example, discharged home, died in hospital, or sent to another health care facility.

Dependent Variable

SMI. SMI was examined in relation to the independent variables. Each variable was reviewed in relation to SMI amongst two groups, those who had an LLA and SMI and those who did not have an LLA but had an SMI.

Dataset Creation Plan

The dataset creation plan was created with AbSPORU analytical experts. The earliest date of the data extraction was April 1st, 2002 and the latest date was December 31st, 2019. The reason for reviewing data for LLA prior to the current hospitalization was to identify if SMI was higher amongst those who had had a previous LLA. The data was all de-identified and received

from the DAD database. The list of ICD-10 codes and CCI codes used to identify PAD and LLA for this sample population were used based on work by Hussain et al., 2019. This was a Canadian study that looked at trends of LLA for diabetes and PAD. Each code was reviewed and agreed that they were appropriate for this study. Both PAD and LLA codes are listed in Appendix A Table 1 and Table 2 respectively. Based on hospitalization during 2017-2019 with a most responsible diagnostic code of PAD, trauma codes were not identified in this cohort to exclude this cause of LLA as it was considered likely that if the person had PAD and LLA they were linked. Codes for mental illnesses were chosen based on the ICD-10-CA Tabular List (CIHI, 2022c) and chosen based on the pre-decided illnesses to investigate.

Data Analysis

Data analysis began once the health records and datasets were obtained and secured safely. ICD-10 and CCI codes associated with PAD were obtained to identify the sample population. Exploration of prevalence began with creating three groups of interest to describe; entire sample population, those with PAD and LLA and SMI, and those with PAD without LLA with SMI. Descriptive statistical analysis of each group was discussed, referencing age, sex, geography, housing, diabetes, LOS, and discharge location (independent variables) and the dependent variable (SMI). The number of males and females in each group were identified and age groups were created in spans of 10 years, with the exception of the last group which was 95 years and above and only had four years in total. These were subcategorized based on the Canadian Institute for Health Information (CIHI) Age Stratifier into groups of 10 (CIHI, 2022a). Measures of central tendency (mean, median, mode and standard deviation) were identified for each age group. SMI was discussed and reviewed for each group. Inferential statistics was used by performing a correlation analysis amongst diabetes, LLA and SMI, chi-square test to

determine if there was a statistical significance between SMI and LLA, as well as logistic regression which used rural location, SMI, diabetes, age and sex, and evaluated impact on LLA. Information has been presented using a collection of tables, pie charts, graphs and charts. As a first time researcher, to augment validity and reliability of the inferential statistical analysis results, a member of the AbSPORU analytical team, who obtained the data for this project, reviewed the initial analytical work and assisted with the statistics using R Studio version 4.3.2 to ensure they were correctly performed and interpreted. Additionally, a member of the thesis committee also reviewed the logistic regression analysis and assisted with this analysis.

CHAPTER THREE

Results

Sample Population Demographics

The sample population has been described and then divided into two groups: those who have had an LLA with SMI and those who have not had an LLA with SMI.

During the timeframe of January 1st, 2017 through to December 31st, 2019, a total of 3524 individuals ages 18 years and older were identified as being admitted to hospital as an inpatient with PAD. The independent variables of interest for this study include age, sex, geography, housing, diabetes, LOS, and discharge disposition. The dependent variable of interest is SMI, which has been previously defined for the purposes of this thesis work to include those of interest based on literature review, and for this reason is not comprehensive. Of this total

cohort, 2297 individuals were male (65.2%) and 1227 were female (34.8%) (Figure 1.1 below). The sample population characteristics are outlined below in Table 1 and discussed in more depth.

Figure 1.1
Population Sex

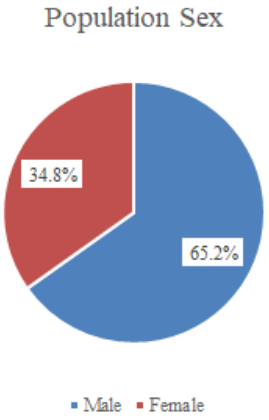


Table 1
Sample Population Characteristics

Sample Characteristics	Number of individuals from sample (n) & % of total population
Age (years) mean	67, SD= 13.07
Sex, Male	n=2297 (65.2%)
Rural Residence	n=817 (23.2%)
Homeless	n=24 (0.7%)
Diabetes	n=2208 (62.6%)
LLA	n= 1068 (30.3%)
SMI	n=69 (1.96%)

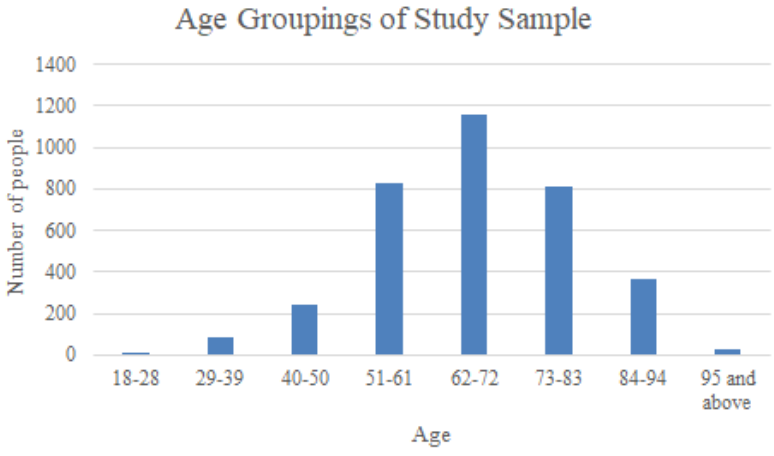
Note: SMI= serious mental illness, LLA= lower limb amputation, n= number, SD= standard deviation

Age of the entire sample ranged from the youngest being 23 years old and oldest being 98

years old. Age was categorized into groups of 10 years with the following: 18-28, 29-39, 40-50, 51-61, 62-72, 73-83, 84-94, 95 and above. Ten individuals were between the ages 18-28, 86 between the ages 29-39, 244 between the ages of 40-50, 828 between the ages of 51-61, 1156 between the ages of 62-72, 811 between the ages of 73-83, 362 between the ages of 84-94, and 27 who were 95 years and above (see Figure 1.2 below). Of note, the age bracket 95 years and above consisted of only four ages as the oldest individual was 98. This group spanned over four years rather than 10 years like the rest of the groups. The greatest number of individuals in the study sample were between the ages of 62-72 years old.

The mode, median, mean and standard deviation (SD) were calculated for each individual age grouping as well as the entire sample of individuals, (see Figure 1.3 in Appendix B). In years, the overall age mode was 71, median 67, and mean 67 with a SD of the entire sample population of 13.07.

Figure 1.2
Age Groupings of Study Sample

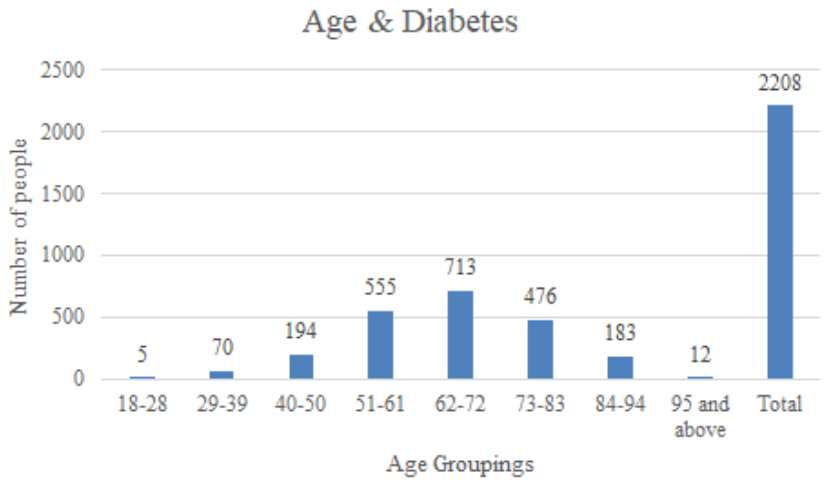


Geography was categorized into urban versus rural locations. This was determined by

AbSPORU analytical experts upon data retrieval. Postal codes beginning with T0 were coded as rural and any other postal code was coded as urban. Of the entire sample population, 817 individuals were living in a rural location (23.2%), and 2707 were living in an urban area (76.8%). Homelessness was evaluated and 24 individuals were coded as being homeless and 3500 individuals were not homeless.

Given the high incidence of diabetes and PAD noted in the literature, this was the comorbidity of interest in this study. Diabetes was identified using codes E10-E14 (Government of Canada & Statistics Canada, 2015). Some of these codes were used to identify PAD in the determination of the cohort, while other diabetes codes were unrelated to PAD but still accounted for. Of the 3524 individuals, 2208 had a diagnostic code associated with diabetes (62.6%). A total of 1433 unique diagnostic codes were identified amongst this entire group, with 60 of these codes involving diabetes. Outlined below in Figure 1.4 are the number of individuals in each age grouping with a code associated with diabetes.

Figure 1.4
Age & Diabetes



Length of stay ranged from one day to 778 days, with a mean LOS of 66.9 days overall with a SD of 35.9. Discharge location varied with private home being the most frequent discharge disposition and home with support/referral being second most frequent, (see Figure 1.5 in Appendix B).

The prevalence of SMI overall was 1.96% in the entire cohort; 69 out of the 3524 individuals. The totals for each category of mental illness are outlined below in Table 2 with depression being the most frequently occurring SMI at 76.8%. Of the total number of individuals in the study, there was a higher percentage of SMI amongst females than males, 2.4% and 1.7% respectively.

Age groupings and percentage of SMI amongst each group are outlined below in Table 3. The highest prevalence of SMI was noted in the youngest age bracket at 10%. The next highest percentage of SMI was noted in the next youngest age group at 4.6%. Figure 1.6 below shows a scatterplot that depicts a negative relationship between age and percentage of SMI, indicated by the downward slope pattern; as age increases, SMI decreases.

Table 2
Sex and SMI

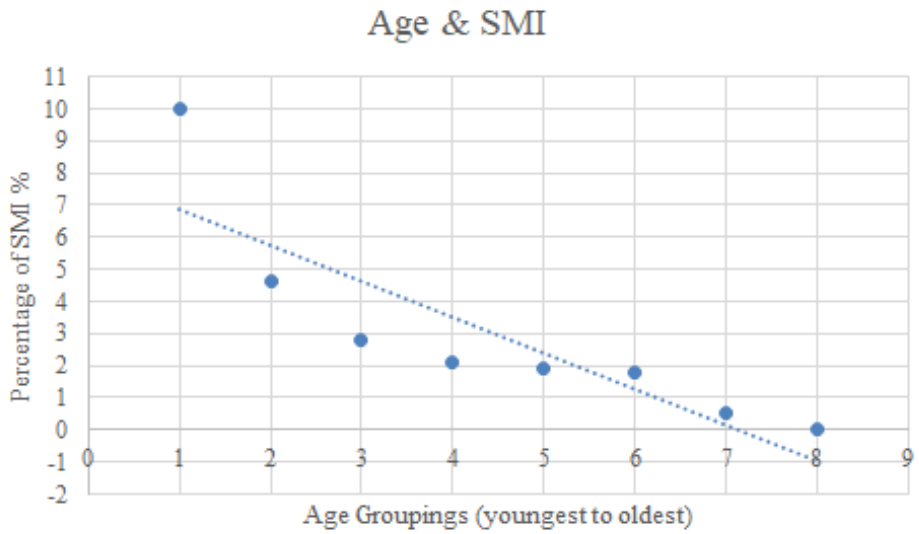
	Total SMI	**Anxiety and depressive disorder**	**Generalized Anxiety Disorder**	**Depression**	**Bipolar Disorder**
Female	29	4	1	23	1
Male	40	5	5	30	0
Total	69	9	6	53	1

Table 3
Age and SMI

Age Grouping (years)	Number of people	Number with SMI
18-28	n=10	n=1, 10%
29-39	n=86	n=4, 4.6%
40-50	n=244	n=7, 2.8%
51-61	n=828	n=18, 2.1%
62-72	n=1156	n=22, 1.9%
73-83	n=811	n=15, 1.8%
84-94	n=362	n=2, 0.5%
95 and above	n=27	n=0, 0%

n= number of people, %= percentage of individuals

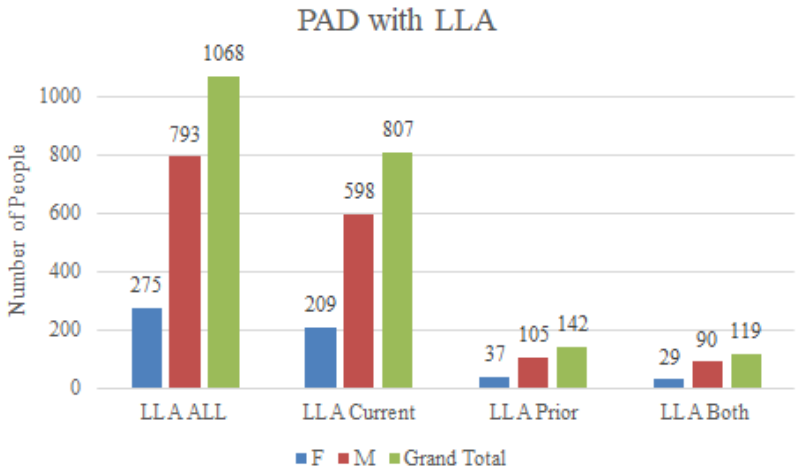
Figure 1.6
Age & SMI scatter plot and trendline



PAD with LLA

Reviewing LLA amongst the sample population involved looking at current LLA (during the hospitalization of 2017-2019), prior LLA (prior to this hospitalization as far back as April 1, 2002), and if any patients had a combination of the two. LLA ranged from minor to major limb amputations and the codes used to identify these procedures are outlined in Appendix A: Table 2. The data was received with an LLA count and no associated codes were provided to identify the degree of amputation (for example, toe amputation vs. below knee amputation). Figure 1.7 outlines a total of 807 patients who only had a current hospitalization LLA, 142 patients who had only a prior LLA with no current LLA, and a total of 119 patients who had both a prior and a current LLA at the time of this admission. More males than females, 90 people vs. 29 people, had 2 amputations (past and present). In total, 1068 patients out of the entire cohort had some form of LLA (past, present, or both). Of the total 1227 females in the cohort, 275 had an LLA (22.4%), while out of the 2297 male patients, 793 had an LLA (34.5%).

Figure 1.7
PAD with LLA



PAD, LLA and SMI

Individuals were further subcategorized into those with PAD and LLA with SMI, and those with PAD without LLA with SMI. Tables 4 and 5 below provide an overview of these categories. The group of individuals who had any type of LLA (current, prior, or both) totalled 1068 people (30.3%) of the sample population. Thirty individuals out of the total 69 with SMI in the overall sample group had a concurrent LLA, a total of 2.8% of the LLA group. Of these 30 people, 10 were female and 20 were male. These sex differences are in keeping with the total sample population as about a third of the total population were female and ⅔ male. Age mode, median, mean and SD were calculated for this group and are outlined in Figure 1.8 in Appendix A, with a mean age of 64 and SD of 11.4. The mode, median, and mean did not differ significantly between the two groups.

Table 4
PAD with LLA +/- SMI

PAD with LLA	With SMI	Without SMI
n= 1068	n= 30, 2.8%	n= 1038, 97.2%

Note: n= number of people, %= percentage of individuals

Table 5
PAD without LLA +/- SMI

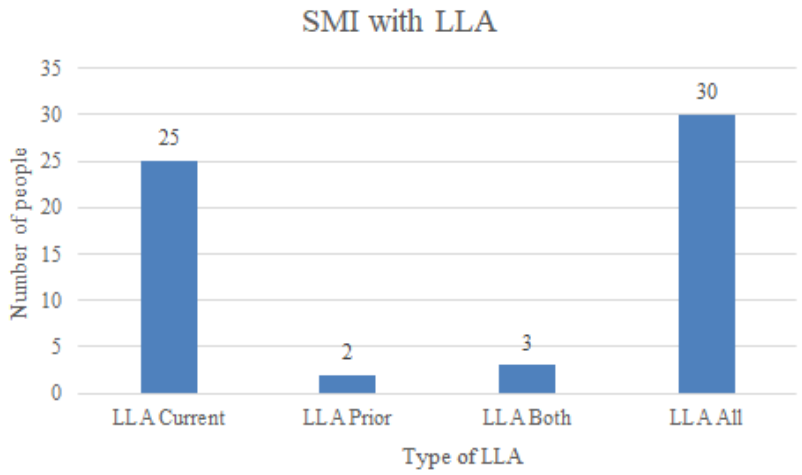
PAD without LLA	With SMI	Without SMI
n= 2456	n= 39, 1.6%	n= 2417, 98.4%

Note: n= number of people, %= percentage of individuals

None of the individuals in the LLA with SMI group were coded as being homeless and none lived in a rural area. Twenty-seven out of the 30 people in this group had a code associated

with diabetes (90%). LOS ranged from two days to 486 days with an average LOS of 89.5 days and a SD of 101.6. The LOS with those who had an LLA and SMI was approximately 22.6 days higher than the sample size. The majority of individuals in this group had a current LLA during the 2017-2019 hospitalization, with prior and both being much lower (see Figure 1.9 below).

Figure 1.9
SMI with LLA



No individuals in the LLA group had bipolar disorder, 24 had depression, three had GAD, and three had anxiety and depressive disorder. Three individuals in the cohort had an SMI (depression) with both a current and prior LLA. None of the three individuals with both types of amputations were homeless, none lived in a rural area, and each person went to a different discharge location; all individuals were male. Two individuals in the LLA group had only a prior LLA and SMI. Twenty-five individuals had only a current LLA on hospitalization with a concurrent SMI. Of these individuals, none were homeless and none lived in a rural setting. SMI's were depression, GAD and mixed anxiety and depressive disorder with the majority being depression (80%). Nine were female and 16 were male. The majority of individuals in the SMI

with LLA group were male. Most individuals with an LLA and SMI were discharged to acute care or to continuing care (see Figure 2.0, Appendix A).

In the group without an LLA, a total of 2456 individuals had a diagnosis of PAD without any form of LLA (69.6%) in the cohort. There were 952 females and 1504 males in this group. Of this total, 609 people lived in a rural area and 1847 were in an urban area. Nineteen people were coded as being homeless with three of these individuals living in a rural area. A total of 1295 people without an LLA had a code associated with diabetes with 610 of these people having two or more diabetes codes. Of this total, 39 people had an SMI with 29 people having depression which was most prevalent (74%). Age groupings of those with an SMI and no LLA are outlined in Figure 2.1 (see Appendix A). The age group of 95 years and above did not have any individuals with an SMI, therefore there are no values listed in the figure.

Of the 39 individuals without an LLA with SMI, 31 (79.5%) of them had diabetes. LOS for individuals who had an SMI with no LLA ranged from two days to 221 days, with an average LOS of 54.2 days and a SD of 56.8. Individuals with an LLA without an SMI had an average LOS of 30 days with a SD of 49.6. One individual was coded as being homeless with an SMI, and 13 lived in a rural area. Most individuals were discharged home with or without support or to a private home (Figure 2.1).

The total percentage of individuals who had an LLA and SMI was 2.8% (30 individuals out of a total of 1068). The total percentage of individuals who did not have an LLA but had an SMI was 1.6% (39 individuals out of a total of 2456). The grand total percentage of people with PAD with an SMI irrespective of an LLA was approximately 2% (69 individuals out of 3524).

Inferential Data Analysis

Correlation analysis is used to identify if there is a relationship present between two variables, with the correlation coefficient indicating the strength of the relationship (QuestionPro, 2024). Correlation analysis was first performed in excel to determine if there was any relationship noted amongst the chosen variables of diabetes, LLA and SMI. Diabetes was included as literature indicates it being one of the greatest risk factors for PAD (Soyoye et al., 2021). As there were a high number of individuals with diabetes in this study, this variable was included to identify the relationship with LLA as well for this group of individuals. The correlation coefficient noted by r and the coefficient of determination (r^2) were determined between diabetes and LLA, and SMI and LLA. To ensure validity and reliability of the results, the test was repeated using R software version 4.3.2 (R Core Team, 2013), yielding the same results. Diabetes and any form of LLA (current, past or both) yielded an r value of 0.31 and r^2 value of 0.09. SMI and any LLA (past, present or both) yielded an r value of 0.04 and r^2 of 0.0001. Thus, the correlation between diabetes and LLA was noted to be moderate or typical ($r>0.30$) and the correlation between SMI and LLA was noted to be weak or non-existent ($r=<0.10$) (Chan, 2003). Figure 2.3 outlines the results of conducting this correlation analysis using R version 4.3.2 (R Core Team, 2013). Spearman was the method used for the correlation analysis and was compared with the Kendall method which both yielded the same results.

A chi-square test of independence is used to look at observed values in the data and compare them to expected values (Hayes, 2024), on the premise that our hypothesis, that increased prevalence of SMI will be noted in the group who have had an LLA compared with those who have not had an LLA, is true. In this data analysis, SMI with and without an LLA were evaluated using contingency tables, along with SMI and PAD (irrespective of an LLA). Initially, this test was conducted using excel software comparing SMI with or without LLA, and

guided by creating an observed and expected values table (Indeed, 2023) in comparing these variables. The p value yielded from the analysis in excel was 0.76. With an alpha value of 0.05, the p value is > alpha, indicating that the result is not statistically significant (Minitab, 2023). To ensure validity and reliability of the results, the chi-square test was performed using R software version 4.3.2 (R Core Team, 2013). Coding was performed with a member of the AbSPORU Health Research Methods and Analytics team who obtained the data for this project. R software was downloaded on the Citrix workspace that is password protected, and analysis was carried out using a chi-square test and the creation of contingency tables. A chi-square test of independence showed that there was significant association between SMI and LLA , (x^2 = 951.37, df=1, p-value =<2.2e-16), there was significant association between SMI and no LLA (x^2= 2302.5, df=1, p-value <2.2e-16), and there was a significant association between SMI and PAD (x^2 = 3253.4, df=1, p-value=<2.2e-16). These results indicate the differences between the observed and expected values are statistically significant, on the premise that our hypothesis is true (SMI greater in those with LLA compared with those without LLA).

Regression analysis is used to determine if there are associations present between variables in a data set and can be used to understand strength of relationships and predict outcomes (Beers, 2023). Logistic regression was used in this research as binary outcomes were being evaluated (Lawton et al., 2022). Logistic regression was performed using R software version 4.3.2. (R Core Team, 2013). Coding was performed with a member of the AbSPORU Health Research Methods and Analytics team who obtained the data for this project. Coding evaluated rural location, SMI, diabetes, age and sex as the independent variables and LLA being the dependent variable in this test. The results are outlined below in Table 6. Logistic regression analysis used adjusted odds ratios (aOR) to account for all variables listed in Table 6. Odds ratios

were used to identify how strongly each of the variables were associated with LLA, and confidence intervals were used to determine statistical significance (Tenny & Hoffman, 2023). A larger odds ratio is associated with a higher likelihood of the event occurring based on the variable investigated, and the confidence interval determines how significant the findings are (Tenny & Hoffman, 2023). Based on this, the following conclusions and inferences were made based on the data analysis. The odds ratio codes were completed using coding from UC REGENTS, 2021. Among individuals who were coded with a rural address (p-value= 2.63e-16), the aOR for LLA was 0.64 (95% CI, 0.53 to 0.77). An aOR of less than 1 with a statistically significant CI indicates that it is less likely that living in a rural area will be associated with having an LLA. Among individuals with an SMI (p-value=0.182), the aOR for LLA was 1.41 (95% CI, 0.85 to 2.33). An aOR of 1.41 with a CI that is not statistically significant indicates that it is less likely that having an SMI is associated with LLA. Among individuals with diabetes (p-value= <2e-16), the aOR for LLA was 5.28 (95% CI, 4.37 to 6.41). An aOR that is higher than 1 and a statistically significant CI indicates that there is a higher likelihood that having diabetes is associated with an LLA. Among individuals of male sex (p-value= 1.79e-09), the aOR for LLA was 1.67 (95% CI, 1.42 to 1.98). An aOR greater than 1 with a statistically significant CI indicates that being of male sex is more likely to be associated with having an LLA. Age (p-value= 0.899) had an aOR for LLA of 1.00 (95% CI, 0. 99 to 1.00) and is not considered statistically significant.

Table 6
Logistic Regression Analysis with LLA

		95% CI	
	aOR	**2.5%**	**97.5%**
Rural	0.64	0.53	0.77
SMI	1.41	0.85	2.33
Diabetes	5.28	4.37	6.41
SEXM	1.67	1.42	1.98
Age	1.00	0.99	1.00

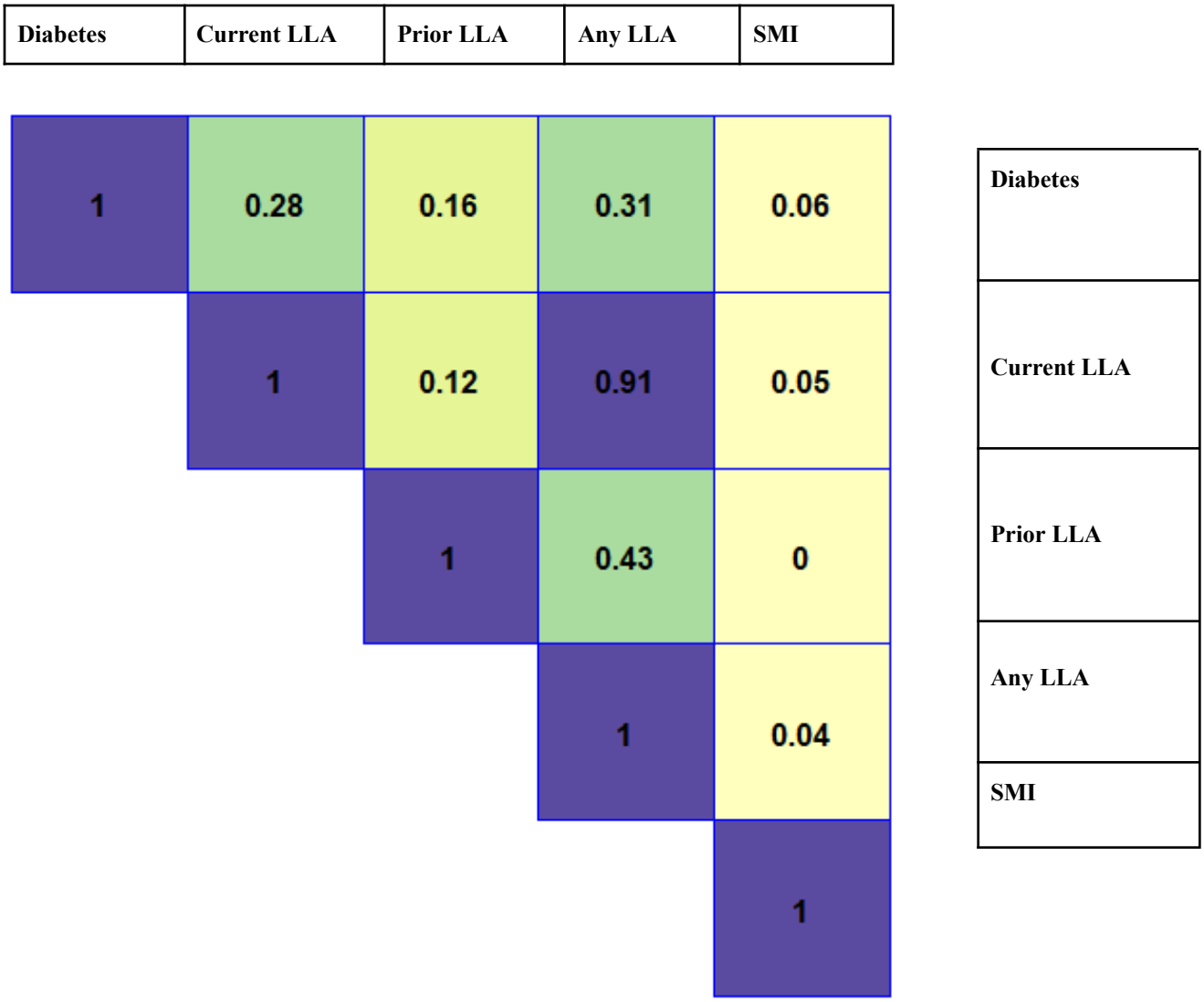
Note: Rounded to the nearest 2 decimals; aOR= adjusted odds ratio, CI= confidence interval, SEXM= male sex

Discussion

PAD is estimated to affect approximately 2 million Canadians (Gouda et al., 2023), with associated LLA (Hussain et al., 2019) and diabetes- associated LLA (Imam et al., 2017) on the rise. The province of Alberta was noted to have a 23% increase in LLA's from the year 2006-2011 (Imam et al., 2017). Additionally, it is known in the literature that often individuals live with chronic disease and mental illness concurrently (National Institute of Mental Health, 2021) and individuals living with an SMI are found to have poorer surgical outcomes (McBride et al., 2018) and decreased life expectancy (Firth et al., 2019). Given the lack of evidence available within the province of Alberta regarding PAD and SMI, this study was warranted in order to plan strategies to implement to protect the mental health of these individuals and to gain a better understanding of factors that may impact SMI overall.

Figure 2.3

Correlation Analysis Results- Diabetes, LLA, SMI



Sex

Overall, more males than females were identified in this cohort as having a hospitalization with a most responsible diagnosis of PAD. Similarly, the subsequent subcategorization of those with and without LLA and SMI showed results that had a higher male to female ratio of individuals. Given findings in the literature that identify women as often presenting with more atypical symptoms of PAD in comparison to men (Pabon et al., 2022) it is

possible that women are not as easily identified as having PAD or may be living with asymptomatic PAD, and potentially may be underdiagnosed in the total PAD population. Moreover, those who have asymptomatic PAD have an increased risk of cardiovascular disease (Gouda et al., 2023), therefore likely putting women at a heightened risk of morbidity and mortality associated with PAD. Interestingly, there was a higher percentage of females with SMI when compared with males, 2.4% and 1.7%, respectively. This supports the literature that it is possible that men's mental illness may go undertreated based on less research and understanding in this group and overlooking of male mental illness by health care professionals (Smith et al., 2018).

Male sex was identified in logistic regression to be a predictor of LLA, and this correlates with literature regarding higher incidence of LLA amongst males in comparison to females (Alberta Health & Alberta First Nations Information Governance Center, 2017), however, given the higher number of males in this cohort, this result is not unexpected.

Age

The mean age of the entire cohort was 67 years of age. The mean age did not differ significantly across groupings with the mean age amongst those with LLA and SMI being 64 years of age and the mean age amongst individuals without LLA and with SMI being 69 years of age. These are expected given incidence of PAD increases with age and roughly doubles with each decade (Pabon et al., 2022). It was decided to include anyone over the age of 18 (all adults) in this study given the literature supporting increasing chronic disease development in younger adults, such as with diabetes (Xie et al., 2022), which is closely linked with PAD (Soyoye et al., 2021). Interestingly, it was noted that 2 individuals in the cohort had 7 diabetes codes associated with their stay, the age of one of the individuals who had the highest number of diabetes codes

associated with their hospital stay was 33 years. Additionally, 12% of the cohort who had diabetes were 50 years or less. While PAD prevalence may be higher in those over the age of 50 (Abramson et al., 2022), we can see that diabetes may become more prevalent in younger ages, and therefore impact development of PAD at an increasingly younger age. This is important for health care providers to be aware of when treating individuals who present at a younger age to hospital. They may show signs of PAD that may ultimately necessitate a limb amputation if not promptly investigated and treated.

Another important finding regarding age in this cohort was that the highest percentage of SMI was in the age group 18-28 years at 10%. The next highest percentage was in the following age group of 29-30 years at 4.6%. Noted through a scatter plot was a negative relationship between age and SMI; as age increased, SMI percentages decreased. It is challenging to generalize some of these findings based on the small portion of the cohort that had an SMI and some groups only having one individual in the age bracket. However, it remains of interest that the two youngest age groupings had the highest percentages of SMI, regardless of how many people this entailed. It would be important to highlight this in future studies to identify if younger adults with PAD are at higher risk of having an SMI, or vice versa. It may be possible that younger adults report their mental illness more often than older adults. In fact, literature notes that older adults often do not recognize mental illness and contribute symptoms of mental illness to normal aging processes (Malkin et al., 2019). Therefore, it is crucial to implement increased awareness amongst health care providers in educating older adults about mental health and recognition of the signs and symptoms of an illness. Based on literature review that indicates a known correctional relationship between mental and physical health, it is possible that education for older adults in understanding mental health and mental illness, could impact

overall physical health outcomes. There may be older adults in this study who have never been diagnosed by a healthcare professional with a mental illness and who remain unaware of why they are suffering.

Geography

A total of 23.2% of the population were located in a rural area while 76.8% of the population were deemed urban. Similarly, this trend was seen when the cohort was subcategorized into those with and without LLA and an SMI. No individuals in the LLA with SMI group were coded as being in a rural location and only three individuals in the SMI without LLA group were living in a rural area. Literature proposes that people living in a rural area may be less likely than those in an urban area to pursue mental health support for reasons that may be associated with stigma, understanding of mental health, lack of transport, and various other social factors (Morales et al., 2020). Therefore, it is possible that individuals are living with mental illness in rural areas and are not reporting their symptoms or concerns to health care providers, and subsequently not being diagnosed by a health care provider or coded in the DAD as having an SMI. Furthermore, the results of logistic regression indicated that living in a rural area was a protective factor against LLA. This could be impacted by the lesser number of individuals in the study overall living in a rural setting, and could be influenced by lack of healthcare resources in rural settings compared with urban.

The Mental Health Commission of Canada (2020) notes that rural areas encounter challenges when it comes to accessing mental health support which includes lengthy wait lists for care and limitations to communication, while also facing the stigma associated with mental health and living in a small place. Speaking from a health care lens, one of the suggestions they

mention includes supporting primary care providers which is important in protecting the mental health of those in rural areas. It is possible that with implementation of specialized mental health training in all rural areas of Alberta that more individuals may be recognized as living with a mental illness in rural communities, which could have substantial impacts on overall care and health of these individuals.

While this study focused on rural vs. urban settings in the context of geography, another recommendation following completion of this research is to repeat this study across Canada in all provinces and territories. This will help understand PAD and SMI across the country and identify areas of increased and decreased risk, and potentially share useful health strategies across health authorities in the country to support improved health outcomes.

Housing

Of the total cohort, only 24 individuals had been coded as being homeless, with one person also having an SMI. Homeless individuals are noted to access health care less frequently than housed individuals and have worse health outcomes as well (Siersbaek et al., 2021). It is possible that individuals who are homeless are not seeking medical help at the onset of mental illness symptoms or during a mental health crisis, and therefore, not identified in the cohort for this study.

CIHI (2023a) noted that coding for homelessness (Z59.0) was made a mandatory requirement for hospital visits in the year 2018-2019. Given this study focused on a cohort during the time from 2017-2019, there may have been individuals in the group who were not appropriately coded as being homeless as it was not yet a requirement to be sent to DAD. Moreover, it is possible that individuals who were not housed, but living with friends or between

places for a period of time, were coded as being housed with a postal code, when in reality they did not have any form of secure housing. Housing and homelessness should continue to be evaluated in future studies, specifically those including and after the year 2018 when data coding was required, as those who are without housing face many challenges in health care access and therefore are at risk of worsened health outcomes.

Diabetes

Diabetes was the comorbidity of interest for this study given the high correlation with PAD that is noted throughout the literature. Diabetes is a major risk factor for PAD and people incur twice the risk of developing PAD with diabetes (Soyoye et al., 2021). 62.6% of the entire cohort had at least one diagnostic code associated with diabetes. Of those who had both an LLA and SMI, 90% of that group had a code associated with diabetes. Of those who had no LLA but had an SMI, 79% had a code associated with diabetes. These are high percentages and are undoubtedly contributing to the literature on PAD and diabetes. This supports how critical diabetes management and care is in the potential development of PAD and ultimately LLA. Diabetes was moderately correlated with LLA as indicated by the correlation analysis results, and is in keeping with literature on this topic. Additionally, those who had an LLA with SMI had a higher percentage of diabetes than those without an LLA and SMI, which, given current literature on diabetes and limb amputations, is not surprising. Furthermore, logistic regression supported the correlation between diabetes and LLA as it was noted to be a predictive factor for LLA with an aOR and CI of significance.

Given the literature on higher rates of diabetes amongst younger adults, and the results of this study showing that some of the highest number of diabetes codes were in younger adults,

more research is warranted in this area to ensure that appropriate preventative care is provided to younger individuals presenting with symptoms related to diabetes. Furthermore, as increased rates of chronic disease are occuring in younger adults, it could be possible that rates of mental illness may also increase; this requires more research in this area.

Length of Stay

Overall length of hospital stay had a wide range from one day to 778 days. This large data point may have skewed the results related to LOS, and it is possible that it could even be a coding error or typo. The individual who had this associated LOS also had a long list of additional comorbidities indicated by extensive coding, which also could have contributed to a complex hospital stay. The mean hospital stay of the entire cohort was 66.9 days. When evaluating LOS and comparing between those with LLA without SMI and those with LLA with SMI, the LOS varied. Those with an LLA and an SMI, average LOS was 89.5 days with a high SD of 101.6. Those with an LLA without any SMI had an average LOS of 30 days with a lower SD of 49.6. The average LOS increased with SMI. Given the variation in number of days in hospital, and the SMI with LLA group being considerably smaller than LLA without SMI, it is possible this explains these differences. It is not clear in this study if SMI directly impacted LOS. However, research suggests that patients who have mental illness and comorbidities sustain a longer hospital stay when compared with those who do not have a mental illness (Siddiqui et al., 2018). More research is needed to understand the impact of SMI on hospital stay of those with PAD. The AHS Calgary Zone has an acute care pathway for treatment of lower limb vascular amputations (see Appendix C). The pathway indicates that individuals who have had an LLA may be in hospital up to 3 weeks or longer. The LLA and SMI group had an increased number of

days of LOS of 22.6 when compared with the overall cohort group. This may be related to prolonged rehabilitation required in another acute care facility or continuing care facility (as indicated by the discharge dispositions) or related to other comorbidities requiring hospitalization and attention prior to discharge.

Discharge Disposition

The discharge disposition did not change significantly amongst the cohort group and the sub group of those without an LLA with SMI. Both groups had a majority of individuals discharged home with or without support or to a private home. However, the group who had an LLA with SMI were more frequently discharged to an acute care area or to continuing care. These differences are not unexpected given the context of further rehabilitation required post operatively from an LLA.

SMI

In answering our main research question for this study, it was noted that there was a higher prevalence of SMI amongst the group with an LLA than without an LLA (2.8% vs 1.6% respectively). Through inferential statistical analysis, chi-square tests revealed a statistical significance between both SMI and LLA and SMI without LLA. Correlation analysis did not reveal a relationship between the two. Upon reflection after data analysis was completed, it is possible that correlation analysis was not the most appropriate tool to use as it is typically used for quantitative variables, whereas chi-square tests of independence are used for categorical variables (Scribbr, n.d.). In this study, SMI and LLA were used which are categorical variables. Thus, it is likely that the chi-square test results accurately depict that there is a statistical

significance between expected vs actual outcomes. Of note, however, given the small numbers of SMI in this population, and due to statistically significant findings from each group in the chi-square test, SMI with LLA, SMI without LLA and SMI with PAD, it is likely that LLA itself does not have a direct impact on SMI, given the similarities in findings. Logistic regression was also performed using R software version 4.3.2 which shows that SMI is not statistically related or predictive of an LLA. It is possible that the low numbers of SMI could reflect the actual numbers in the PAD population, or it could be possible that SMI's are underdiagnosed and/or underreported. Given that the majority of the cohort were over the age of 65 years (57%), there is a possibility that mental illness has not been unrecognized through this population of individuals, based on previous outlined literature.

As age increased, SMI was noted to decrease which could be related to recognition of mental illness amongst younger adults or the possibility of under-recognition amongst older adults. This requires further research to understand the differences between SMI amongst various age groups.

Of the total number of individuals in the study, there was a higher percentage amongst females with SMI rather than males, 2.4% and 1.7% respectively. As discussed in the literature review, studies show that women are at a higher risk of depression with PAD versus without PAD (Grenon et al., 2014). This could be reflected in these study results. To be considered, however, is that literature also recognizes that younger females are more likely to report mental health concerns (Thomas et al., 2020). Research has shown that men are less likely to report mental illness symptoms such as those of depression and do not recognize these symptoms as severe as women do (Affleck et al., 2018). It is possible that men are underreporting and contributing to these differences in percentages noted above. Future research should be aimed at understanding

SMI in males and females to identify if SMI is more frequently occurring in females and if strategies can be implemented specifically for females, as well as understanding if males under report and why. This could be accomplished with qualitative work in males with PAD or other chronic disease. Additionally, future research should also aim to understand PAD and SMI of all gender identities, rather than sex alone. This may reveal disparities of care amongst the 2SLGBTQIA+ community and allow for interventions and opportunities to improve health care of this marginalized population.

The number of individuals who had a prior LLA with an SMI, before this current hospitalization having an LLA was 3. Due to the small number of individuals it is difficult to generalize findings and no further statistical analysis was performed in this group. However, it does not appear that having a previous LLA impacted rates of SMI during current hospitalization. It is recommended that repeat studies be performed whereby it is identified when the SMI was diagnosed, if it was pre or post amputation, to understand more clearly if there is a causative relationship present amongst these variables.

People who live with an SMI have poorer surgical outcomes and increased incurred cost, which emphasizes the need for preoperative improvement of care for these patients (McBride et al., 2018). This study could be repeated with an exhaustive list of mental illness codes to understand the full extent of mental illness, as opposed to focusing on certain disorders specifically. This may provide a more accurate depiction of complete SMI amongst this group. Furthermore, ensuring that healthcare providers in rural areas as well as urban areas have the resources, knowledge, and training to be able to appropriately diagnose individuals will lead to improved outcomes. It is possible that people within this cohort live with a mental illness but have not ever been diagnosed.

CHAPTER FOUR:

Clinical Implications

Numerous clinical implications have been identified from this study that reflect initiation of strategies to protect mental health, as well as other areas of future research based on the variables explored in this study.

As identified from our cohort, there are less females than males across all groupings and this may or may not be related to underrecognition of PAD in the female sex (Pabon et al., 2022). Increased screening of females in primary care settings for PAD (if they present with risk factors such as smoking and diabetes, or symptoms) is key in early diagnosis and treatment in this population. Individuals who have asymptomatic PAD have an increased risk of cardiovascular disease (Gouda et al., 2023), therefore females may be at a greater risk of chronic disease. Given that it was not until 1993 when the National Institute of Health policy for inclusion of women in research was made a Federal law (National Institute of Health Office of Research on Women's Health, n.d.), it is imperative that we advocate for continued research on women to understand the discrepancies that exist between female and male health.

Furthermore, females were noted in this study to have a higher percentage of SMI than males (2.4% vs. 1.7%). Given that depression has been noted in the literature to have higher incidence in those with PAD versus those without, and linked to higher mortality rates (McDermott et al., 2016) as well as being potentially associated with worse potency in those who have been revascularized in the lower extremities (Cherr et al., 2007), it is critical that emphasis is placed on understanding more on this topic. Males were identified in this study as having PAD more frequently than females, as indicated by the higher percentage of the sample population

being male. Further research is warranted to understand men's mental health and identify if males within this PAD population are underreporting mental illness.

Males in this study were noted to have higher rates of LLA (34.5% versus 22.4%) and more males than females had two amputations (90 versus 29). This is an interesting statistic and is congruent with literature that supports higher rates of LLA amongst males versus females (Alberta Health & Alberta First Nations Information Governance Center, 2017). Qualitative work with males may help understand some of the factors that may influence higher rates of LLA in this group.

Another clinical implication that should be pursued and investigated more in future research and initiatives is the awareness of mental health and illness amongst the older adult population. Literature supports this need as older adults reportedly often associate mental illness symptoms with normal aging processes (Malkin et al., 2019). Increased education and awareness amongst all health care providers is key to communicate that older adults are noted to associate mental illness with aging processes and how best to communicate the difference during regular routine health visits. Healthcare providers should initiate conversations with older adults during routine follow up and consultative care regarding mental health to ensure early and accurate diagnoses are being made for all individuals. Additionally, information should be provided in primary care settings on what constitutes "normal aging", to ensure older adults are aware of this and to decrease mental suffering in this group. Additionally, further research in younger adults and their perceptions and understanding of mental illness may help guide strategies for implementation in the older adults population. Is stigma less prominent in the younger adult population? Are older adults stigmatized more frequently for having a mental illness? These are

questions that could be helped answered by qualitative work with both younger and older adults living with a chronic disease and mental illness.

This study indicated that there were less individuals living in rural areas with PAD, SMI and LLA in comparison to urban areas. This could be due to lack of mental health services in rural areas and lack of transportation or access to urban centers across Alberta that provide these health services. This could also be reflected by lack of primary care in rural areas or lack of mental health training amongst health care professionals to accurately diagnose these illnesses. Increased mental health training in rural areas is recommended to ensure that all individuals are being screened for mental illness and/or treated, or appropriately referred to a provider in this field.

Housing was a challenging variable to understand in this study. Because the data was collected before coding of homelessness was made a requirement by the CIHI, it would be important to repeat this study in the years including and following 2018 to have a truer understanding of this issue for individuals in Alberta.

Diabetes has been shown to be highly prevalent amongst the PAD population in this study with 62.6% of the cohort having a diagnostic code associated with diabetes. Moreover, diabetes, along with other chronic diseases, has been shown in the literature to be increasing at younger ages (Xie et al., 2022), and given diabetes being a major risk factor for PAD (Soyoye et al., 2021), we can expect to see higher rates of diabetes in younger adults in the coming years. Therefore, preventative screening of diabetes in younger adults on routine health visits may allow early lifestyle or medical management that could potentially delay or prevent devastating consequences such as loss of limb. It is important to provide education to health care professionals on the evidence leading to higher rates of diabetes in younger adults.

LOS in this study was identified using admission data, and varied across groups. The highest LOS was amongst those with SMI and LLA at an average LOS of 89.5 days, when compared with LLA with no SMI (31.7 days) and the overall cohort group of 66.9 days. It is possible that this increase in LOS in the SMI group was directly related to having an SMI given literature that supports an increased LOS with having an SMI (Siddiqui et al., 2018). Further studies should be conducted with individuals living with PAD and understanding if SMI causes a longer hospital stay.

The overall goal of this thesis was to look at prevalence of SMI amongst individuals with PAD who have or have not had a LLA, and determine if there was higher prevalence as chronic disease progressed. While inferential statistical analysis indicated a non statistically significant correlation, the study identified that there was a higher percentage of SMI amongst the group with LLA compared with no LLA. Furthermore, this study identified depression being the most frequently occurring SMI overall for individuals with PAD, regardless of limb amputation. This aligns with literature review and provides evidence to support implementation of depression screening in individuals admitted to hospital with PAD, especially given that higher rates of depression and anxiety have been associated with higher rates of amputation and loss of limb (Smolderen et al., 2023). This could be implemented using various depression screening tools. It is important to take into consideration when implementing a new initiative the environment and uptake for change. It is possible that patients with PAD will often encounter the emergency department as an initial visit which is often quite busy. Therefore, short assessment tools should be used in these environments to aid in implementation of the strategy such as the PHQ-2 or PHQ-9 screening tool. The PHQ-2 screening tool is made up of the first two questions of the PHQ-9 questionnaire (American Psychological Association, 2020). Health care providers could

start by screening with the PHQ-2 and if screened positive, could continue with the remainder of the questions to implement the PHQ-9. If screened positive for depression, a discussion should be had with the patient and consent to be seen by a psychiatric provider in hospital. If patients are seen in primary care for possible PAD, primary care providers could engage in this initiative as well and refer to the most appropriate provider if screened positive. Additionally, this process of screening for depression could be integrated into the current Provincial Lower Limb Ischemia Primary Care Pathway (outlined in Appendix D), as there are no current recommendations or management of mental health incorporated into this pathway. This could be instrumental in identifying those with depression and PAD and aid in early treatment options prior to devastating consequences such as loss of limb, that could only exacerbate mental illness if pre-existing.

Finally, while this was an Alberta study only, this study could be replicated within each Canadian province and territory to help understand PAD and SMI across the country and identify areas of increased and decreased risk. This could lead to the shared and collaborative work across Canada in determining useful health strategies amongst health authorities that have shown to improve health outcomes of this population.

Study Limitations

Limitations of this study must be considered and acknowledged. This was a retrospective cohort study whereby results could be influenced by bias of the researcher in that all investigated variables were chosen specifically to review. Additional factors that could have been considered for this study to review include ethnicity of each individual in the cohort, prescription records to identify current medication usage, other comorbid conditions that could influence development of PAD such as coronary artery disease, smoking history, dyslipidemia and chronic kidney disease. It is possible that a more comprehensive review of variables and other factors of

consideration in this study may have yielded different results or provided more information and implications to be discussed.

This study was heavily dependent on correct coding of each hospitalization of the individuals in the cohort. It must be acknowledged that it is possible that codes were not all encompassing of the individual's diagnoses and for that reason some individuals may have unintentionally been missed. This may be especially true with regards to underreporting and underdiagnosing of SMI. Limitations with the datasets have been recognized through the Government of Alberta (2017), as it states on their website that occasionally only partial data that has been collected is submitted to Alberta Health and data elements that are collected can vary and change with time. It is possible that further research with qualitative data may yield a higher accuracy and understanding of mental illness in this population.

SMI was defined in this study by only a small portion of mental illness. While the number of illnesses and codes reviewed was in keeping with the literature's noted associations of mental illness and vascular disease, and with the breadth of a masters level project and deliverables, it is possible that reproducing this project with a complete list of mental illness diagnostic codes may yield different results. We were also unable to determine when the SMI was diagnosed in this cohort, we simply had data to indicate that an SMI was part of the diagnostic codes during that hospitalization. Future research could be aimed at repeating this study with identification if an SMI was present prior to the amputation or not to determine if SMI was impacted by having a LLA.

We were unable to make an inferences on the degree of amputation in this study or if this had an impact on SMI. We did not have access to the specific type of procedural codes

associated with LLA given the outlined criteria in the data creation plan. Therefore, data was received with a binary answer to if the patient had had a LLA. If the degree of amputation was known, it is possible that further inferences or correlations could have been made.

The most responsible diagnosis of individuals in this study was PAD. Through discussion with AbSPORU analytical experts, it was determined that if the most responsible diagnosis was PAD and the patient had a code associated with LLA, it was likely the two were related. Trauma codes were not used to identify or exclude anyone who may have had an LLA related to trauma, and therefore should be considered a limitation.

The data for this study involved looking at individual hospitalizations from 2017-2019, and then reviewing if the person had a previous amputation from this hospitalization as far back as 2002. Therefore, those who had an amputation prior to 2002 would not be captured in this study. This may have impacted the overall numbers and would not have been all encompassing unless we had reviewed as far back as the oldest individual in the data set. Furthermore, if an individual had an amputation outside of the province of Alberta, but resided here, that information would have not been available or included in this data set.

Finally, homelessness may not have been accurately reflected in this study given that the CIHI only made coding of homelessness mandatory starting in 2018. Therefore, one year of the findings may not have depicted homelessness and individuals may not be adequately coded for the time frame used.

Conclusion

This thesis project identified a cohort of individuals living in Alberta, Canada who had a diagnosis of PAD during the years 2017-2019. While this thesis had a focus on SMI and LLA, it

yielded results through exploration of numerous variables that may impact both. Through this exploration, several recommendations were able to be made to be implemented in practice or to support the need for future research in this area. The following key recommendations are made based on this work; 1) further mental health assessment and management should be considered for patients living with PAD as depression seems to be the most frequently occurring SMI in this cohort. Recommendations for screening for depression amongst people admitted with PAD is warranted in acute care and primary care settings to be able to implement better strategies for mental health care. Additionally, implementing pre- and post operative care of individuals undergoing or have undergone an LLA is recommended given the higher percentage of individuals in the LLA group having an SMI. It is possible that our smaller cohort group and limited SMI's investigated may have impacted the results of this study, therefore, warranting further investigation of this topic in future research and a replication of this study with a complete list of mental illnesses. 2) Increased screening of females who present with symptoms of PAD or risk factors such as diabetes and smoking, to ensure atypical presentations or asymptomatic individuals are not missed which could lead to worsened health outcomes. 3) Future research in understanding mental illness reporting and understanding in younger adults versus older adults and strategies that can be implemented to educate older adults on normal aging processes compared with disease processes. 4) Repeating this study in every Canadian province and territory would be important to understand differences across the country in treatment of this group of individuals. This may highlight areas that have higher rates of LLA and SMI and suggest ways to intervene. 4) While our hypothesis is true, we cannot determine that LLA causes SMI, or SMI contributes to LLA. Therefore, further research is needed to understand the rates of SMI pre and post operatively following an LLA and further statistical

analysis in this area. This would help contribute to the body of knowledge on mental illness and chronic disease and further assist in the implementation of strategies for protection of mental health in individuals living with PAD and SMI.

This project is significant in that our findings inform future patient-centered care and personalized health interventions, in ultimately helping reduce both psychological and physiological suffering in this high risk population. This project helped uncover information surrounding the prevalence of SMI in this patient population, with future work aiming to reduce suffering and improve overall mental health care in acute care settings. Based on inferential statistical analysis, our findings were variable regarding statistical significance, but our hypothesis was correct in that a higher percentage of SMI was noted within the group who had an LLA compared with the group who did not have an LLA. However, this project still leaves room for future research and study replication, not only in Alberta, but across the country of Canada, to understand more on this group of individuals and understand how mental health is being managed in the acute care setting as well as the primary care setting. A proactive approach in engaging routine involvement of multidisciplinary teams and mental health screening is envisioned for the future to address all aspects of health for these individuals, and target specific clinical interventions both pre and post operatively.

Ultimately, there is much work to be done in this field of research and my hope is that this project has given foundational data to continue this work within Alberta and across Canada. The goal is to reduce suffering in this patient population and improve the lives of Canadians living with chronic disease and mental illness.

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Appendix A

Codes used to define PAD, LLA and SMI

Table 1: ICD-10 PAD Codes

I70.0 - Atherosclerosis of aorta
I70.2 - Atherosclerosis of arteries of extremities
I70.20 - Atherosclerosis of arteries of extremities without gangrene
I70.21 - Atherosclerosis of arteries of extremities with gangrene
I70.8 - Atherosclerosis of other arteries
I70.9 - Generalized and unspecified atherosclerosis
I73.9 - Peripheral vascular disease, unspecified (includes intermittent claudication)
I74.0 - Embolism and thrombosis of abdominal aorta
I74.3 - Embolism and thrombosis of arteries of lower extremities
I74.4 - Embolism and thrombosis of arteries of extremities, unspecified (Peripheral arterial embolism)
I74.5 - Embolism and thrombosis of iliac artery
I74.8 - Embolism and thrombosis of other arteries
I74.9 - Embolism and thrombosis of unspecified artery
I79.2 Peripheral angiopathy in diseases classified elsewhere
E10.50x - Type 1 diabetes mellitus with peripheral angiopathy
E10.51x - Type 1 diabetes mellitus with peripheral angiopathy with gangrene
E10.70x - Type 1 diabetes mellitus with peripheral angiopathy foot ulcer (angiopathic) (neuropathic)
E10.71x - Type 1 diabetes mellitus with foot ulcer (angiopathic) (neuropathic) with gangrene
E11.50x - Type 2 diabetes mellitus with peripheral angiopathy
E11.51x - Type 2 diabetes mellitus with peripheral angiopathy with gangrene
E11.70x - Type 2 diabetes mellitus with foot ulcer (angiopathic)(neuropathic)
E11.71x - Type 2 diabetes mellitus with foot ulcer (angiopathic) (neuropathic) with gangrene
E13.50x – Other specified diabetes mellitus with peripheral angiopathy
E13.51x - Other specified diabetes mellitus with peripheral angiopathy with gangrene
E13.70x - Other specified diabetes mellitus with foot ulcer (angiopathic) (neuropathic)
E13.71x - Other specified diabetes mellitus with foot ulcer (angiopathic) (neuropathic) with gangrene
E14.50x - Unspecified diabetes mellitus with peripheral angiopathy
E14.51x - Unspecified diabetes mellitus with peripheral angiopathy with gangrene
E14.70x - Unspecified diabetes mellitus with foot ulcer (angiopathic) (neuropathic)
E14.71x - Unspecified diabetes mellitus with foot ulcer (angiopathic) (neuropathic) with gangrene

Appendix A

Codes used to define PAD, LLA and SMI

Table 2: CCI codes to identify Lower Limb Amputation

1VC93 (include Above knee amputation)
1VG93 (amputation through knee joint)
1VQ93 (amputation below knee)
1WA93 (amputation ankle joint)
1WE93 (amputation tarsal bones, and intertarsal joints, hindfoot, midfoot)
1WI 93 (amputation first metatarsal bone and first metatarsophalangeal joint)
1WJ93 (amputation, tarsometatarsal joints, other metatarsal bones and other metatarsophalangeal joints-forefoot)
1WK93 (amputation first phalanx of foot),
1WL93 (amputation other phalanx of foot)
1WM93 (amputation other interphalangeal joints of toe)
1WN93 (amputation first interphalangeal joint of toe)

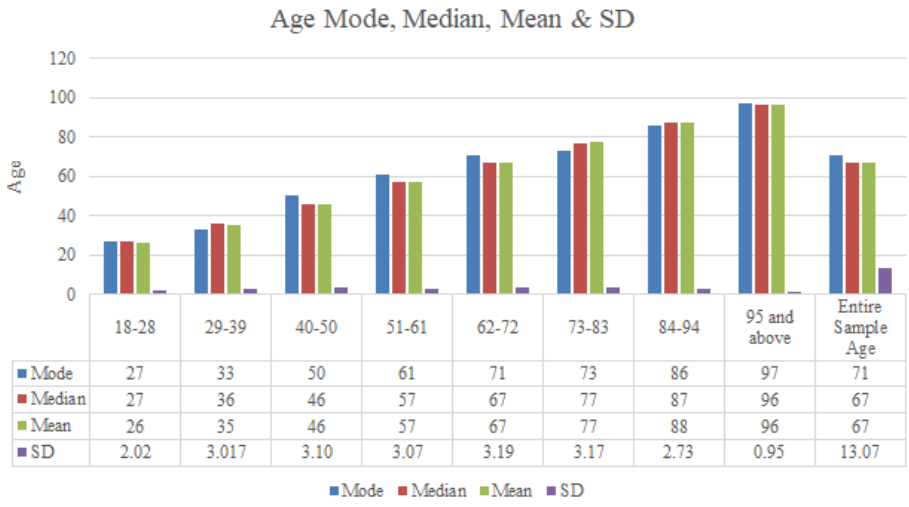
Table 3: ICD-10 SMI Codes

F31.x - Bipolar Disorder
F32.x, F33.x- Depression
F41.1 - Generalized Anxiety Disorder
F41.2- Mixed Anxiety and depressive disorder

Appendix B

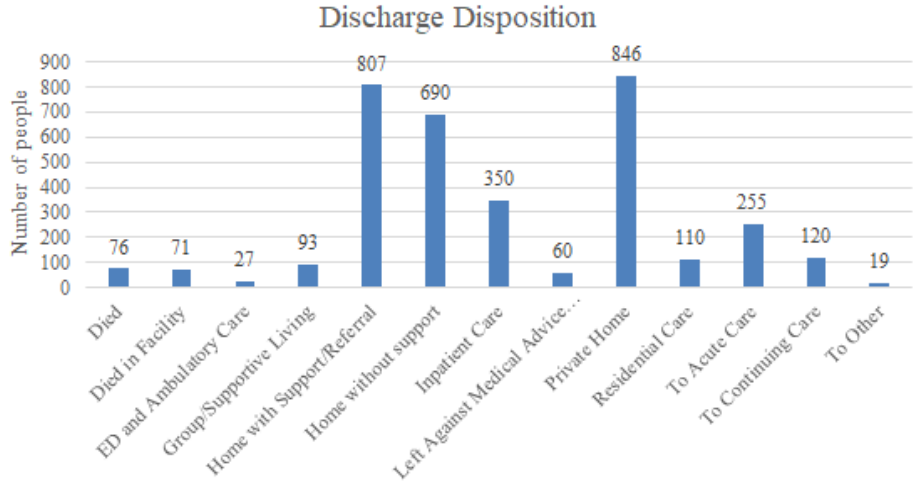
Additional Figures

Figure 1.3
Age Mode, Median, Mean & SD



	18-28	29-39	40-50	51-61	62-72	73-83	84-94	95 and above	Entire Sample Age
Mode	27	33	50	61	71	73	86	97	71
Median	27	36	46	57	67	77	87	96	67
Mean	26	35	46	57	67	77	88	96	67
SD	2.02	3.017	3.10	3.07	3.19	3.17	2.73	0.95	13.07

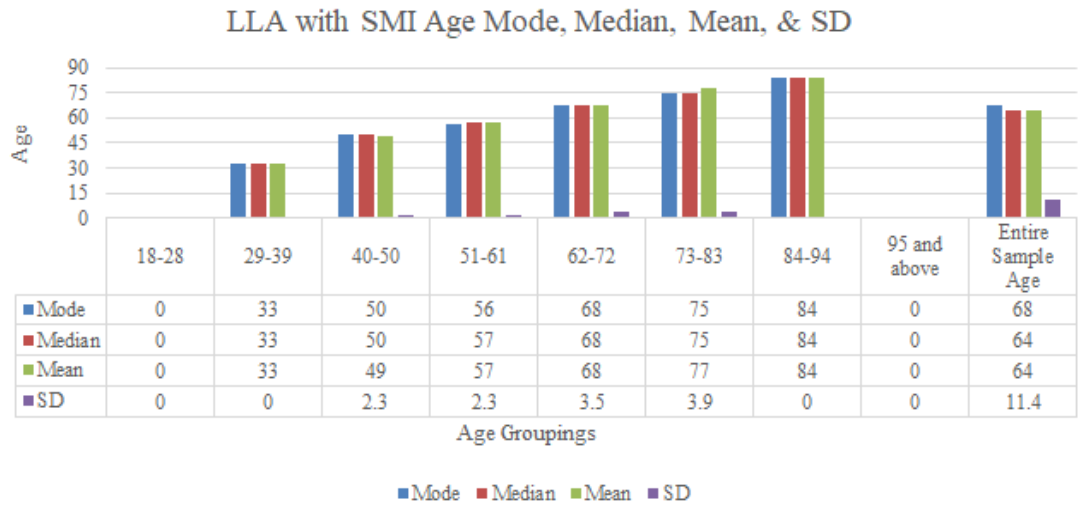
Figure 1.5
Discharge Disposition



Appendix B

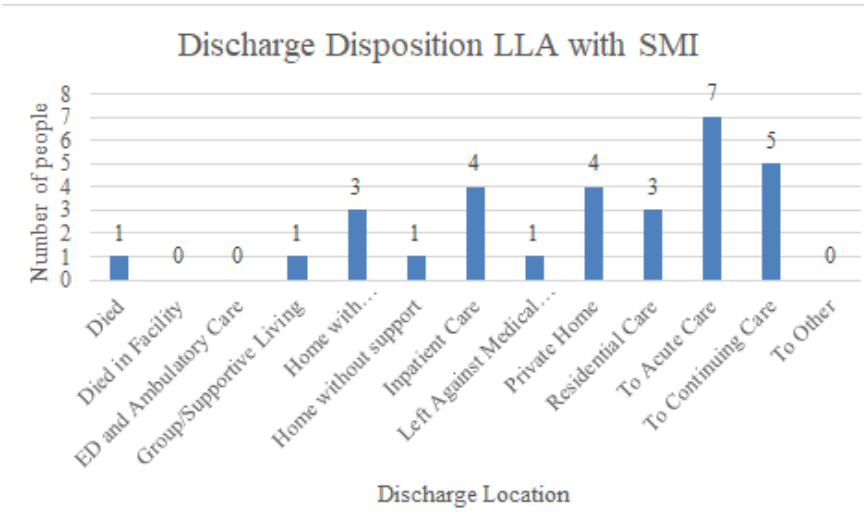
Additional Figures

Figure 1.8
LLA with SMI Age Mode, Median, Mean & SD



	18-28	29-39	40-50	51-61	62-72	73-83	84-94	95 and above	Entire Sample Age
Mode	0	33	50	56	68	75	84	0	68
Median	0	33	50	57	68	75	84	0	64
Mean	0	33	49	57	68	77	84	0	64
SD	0	0	2.3	2.3	3.5	3.9	0	0	11.4

Figure 2.0
Discharge Disposition LLA with SMI



Appendix B

Additional Figures

Figure 2.1
SMI no LLA Mode, Median, Mean & SD

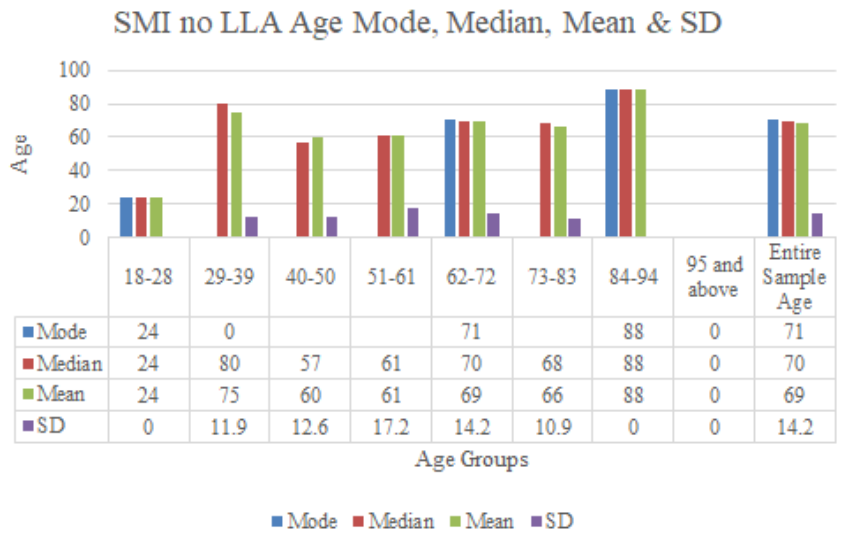
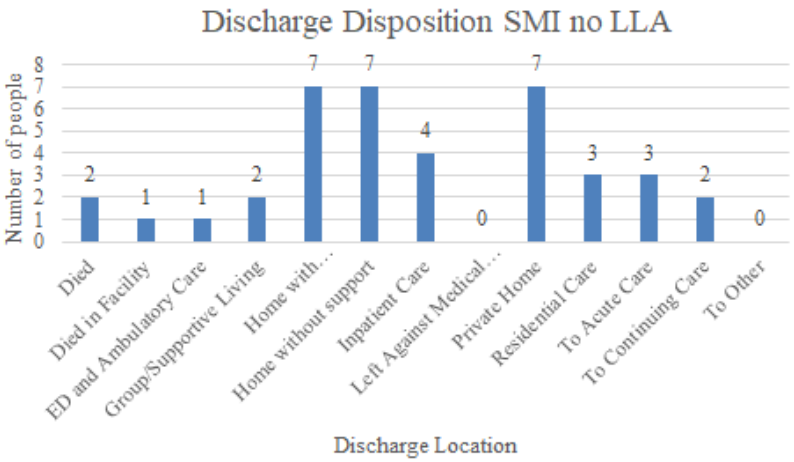
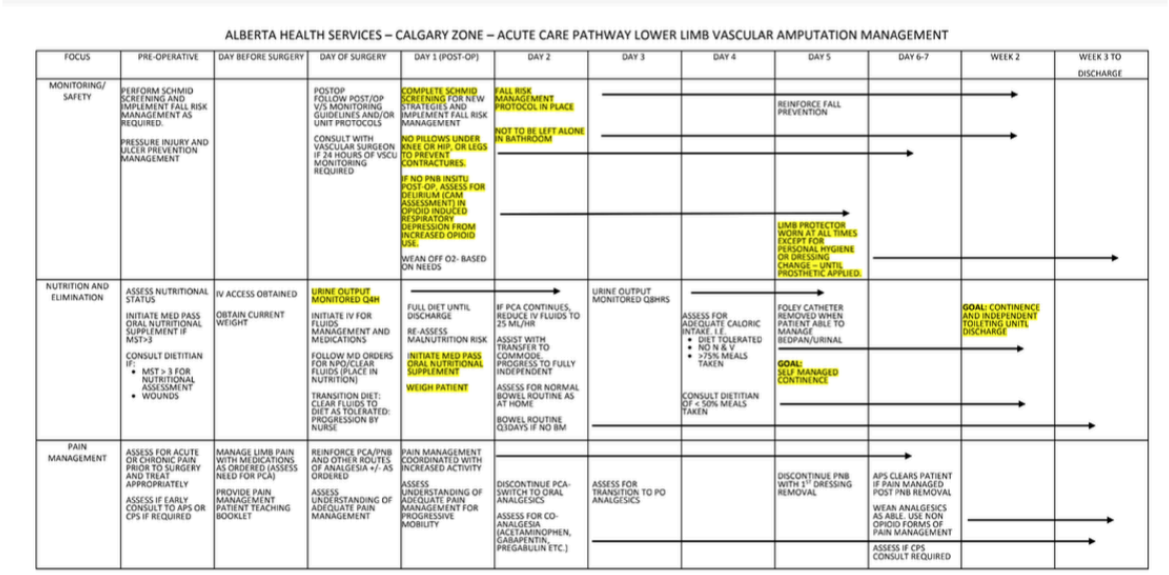


Figure 2.2
Discharge Disposition SMI no LLA



Appendix C

Alberta Health Services Calgary Zone Clinical Pathway Amputation Management



ALBERTA HEALTH SERVICES – CALGARY ZONE – ACUTE CARE PATHWAY LOWER LIMB VASCULAR AMPUTATION MANAGEMENT

FOCUS	PRE-OPERATIVE	DAY BEFORE SURGERY	DAY OF SURGERY	DAY 1 (POST-OP)	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6-7	WEEK 2	WEEK 3 TO DISCHARGE
MONITORING/ SAFETY	PERFORM SCHMID SCREENING AND IMPLEMENT FALL RISK MANAGEMENT AS REQUIRED. PRESSURE INJURY AND ULCER PREVENTION MANAGEMENT		POSTOP FOLLOW POST/OP V/S MONITORING GUIDELINES AND/OR UNIT PROTOCOLS CONSULT WITH VASCULAR SURGEON IF 24 HOURS OF VSCU MONITORING REQUIRED	COMPLETE SCHMID SCREENING FOR NEW STRATEGIES AND IMPLEMENT FALL RISK MANAGEMENT NO PILLOWS UNDER KNEE OR HIP, OR LEGS TO PREVENT CONTRACTURES. IF NO PNB INSITU POST-OP, ASSESS FOR DELIRIUM (CAM ASSESSMENT) IN OPIOID INDUCED RESPIRATORY DEPRESSION FROM INCREASED OPIOID USE. WEAN OFF O2- BASED ON NEEDS	FALL RISK MANAGEMENT PROTOCOL IN PLACE NOT TO BE LEFT ALONE IN BATHROOM			REINFORCE FALL PREVENTION LIMB PROTECTOR WORN AT ALL TIMES EXCEPT FOR PERSONAL HYGIENE OR DRESSING CHANGE – UNTIL PROSTHETIC APPLIED.			
NUTRITION AND ELIMINATION	ASSESS NUTRITIONAL STATUS INITIATE MED PASS ORAL NUTRITIONAL SUPPLEMENT IF MST>3 CONSULT DIETITIAN IF: • MST > 3 FOR NUTRITIONAL ASSESSMENT • WOUNDS	IV ACCESS OBTAINED OBTAIN CURRENT WEIGHT	URINE OUTPUT MONITORED Q4H INITIATE IV FOR FLUIDS MANAGEMENT AND MEDICATIONS FOLLOW MD ORDERS FOR NPO/CLEAR FLUIDS (PLACE IN NUTRITION) TRANSITION DIET: CLEAR FLUIDS TO DIET AS TOLERATED: PROGRESSION BY NURSE	FULL DIET UNTIL DISCHARGE RE-ASSESS MALNUTRITION RISK INITIATE MED PASS ORAL NUTRITIONAL SUPPLEMENT WEIGH PATIENT	IF PCA CONTINUES, REDUCE IV FLUIDS TO 25 ML/HR ASSIST WITH TRANSFER TO COMMODE, PROGRESS TO FULLY INDEPENDENT ASSESS FOR NORMAL BOWEL ROUTINE AS AT HOME BOWEL ROUTINE Q3DAYS IF NO BM	URINE OUTPUT MONITORED Q8HRS	ASSESS FOR ADEQUATE CALORIC INTAKE, I.E • DIET TOLERATED • NO N & V • >75% MEALS TAKEN CONSULT DIETITIAN OF < 50% MEALS TAKEN	FOLEY CATHETER REMOVED WHEN PATIENT ABLE TO MANAGE BEDPAN/URINAL GOAL: SELF MANAGED CONTINENCE		GOAL: CONTINENCE AND INDEPENDENT TOILETING UNTIL DISCHARGE	
PAIN MANAGEMENT	ASSESS FOR ACUTE OR CHRONIC PAIN PRIOR TO SURGERY AND TREAT APPROPRIATELY ASSESS IF EARLY CONSULT TO APS OR CPS IF REQUIRED	MANAGE LIMB PAIN WITH MEDICATIONS AS ORDERED (ASSESS NEED FOR PCA) PROVIDE PAIN MANAGEMENT PATIENT TEACHING BOOKLET	REINFORCE PCA/PNB AND OTHER ROUTES OF ANALGESIA +/- AS ORDERED ASSESS UNDERSTANDING OF ADEQUATE PAIN MANAGEMENT	PAIN MANAGEMENT COORDINATED WITH INCREASED ACTIVITY ASSESS UNDERSTANDING OF ADEQUATE PAIN MANAGEMENT FOR PROGRESSIVE MOBILITY	DISCONTINUE PCA- SWITCH TO ORAL ANALGESICS ASSESS FOR CO-ANALGESIA (ACETAMINOPHEN, GABAPENTIN, PREGABULIN ETC.)	ASSESS FOR TRANSITION TO PO ANALGESICS		DISCONTINUE PNB WITH 1ST DRESSING REMOVAL	APS CLEARS PATIENT IF PAIN MANAGED POST PNB REMOVAL WEAN ANALGESICS AS ABLE. USE NON OPIOID FORMS OF PAIN MANAGEMENT ASSESS IF CPS CONSULT REQUIRED		

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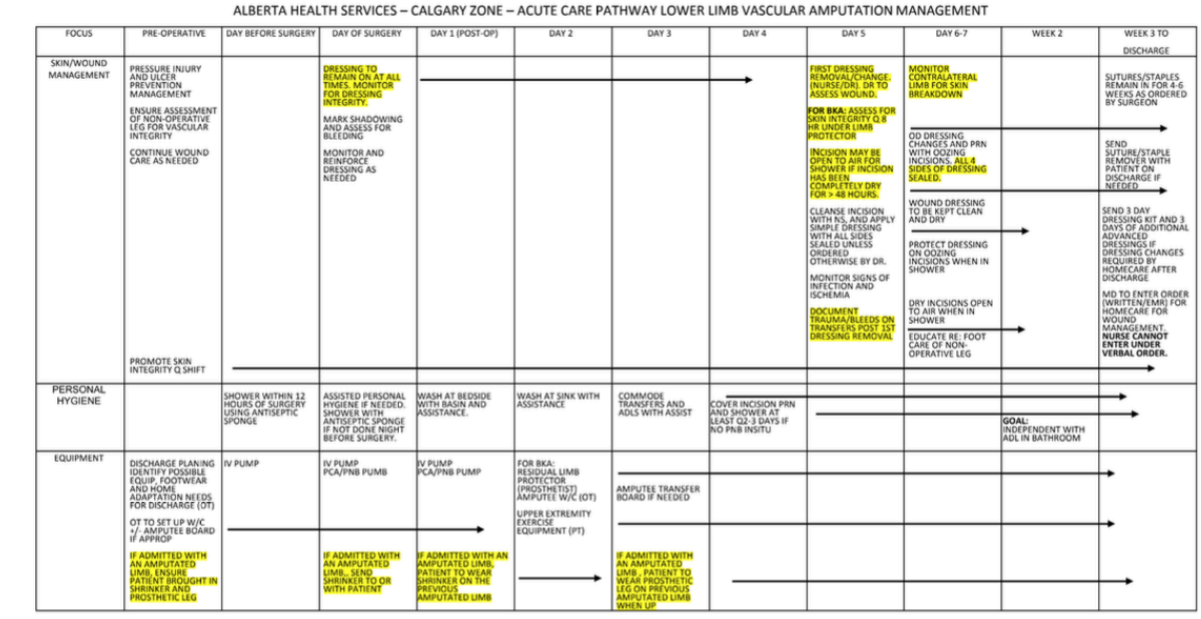

ALBERTA HEALTH SERVICES – CALGARY ZONE – ACUTE CARE PATHWAY LOWER LIMB VASCULAR AMPUTATION MANAGEMENT

FOCUS	PRE-OPERATIVE	DAY BEFORE SURGERY	DAY OF SURGERY	DAY 1 (POST-OP)	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6-7	WEEK 2	WEEK 3 TO DISCHARGE
SKIN/WOUND MANAGEMENT	PRESSURE INJURY AND ULCER PREVENTION MANAGEMENT ENSURE ASSESSMENT OF NON-OPERATIVE LEG FOR VASCULAR INTEGRITY CONTINUE WOUND CARE AS NEEDED PROMOTE SKIN INTEGRITY Q SHIFT		DRESSING TO REMAIN ON AT ALL TIMES. MONITOR FOR DRESSING INTEGRITY. MARK SHADOWING AND ASSESS FOR BLEEDING MONITOR AND REINFORCE DRESSING AS NEEDED					FIRST DRESSING REMOVAL/CHANGE: (NURSE/DR). DR TO ASSESS WOUND. FOR BKA: ASSESS FOR SKIN INTEGRITY Q 8 HR UNDER LIMB PROTECTOR INCISION MAY BE OPEN TO AIR FOR SHOWER IF INCISION HAS BEEN COMPLETELY DRY FOR > 48 HOURS. CLEANSE INCISION WITH NS, AND APPLY SIMPLE DRESSING WITH ALL SIDES SEALED UNLESS ORDERED OTHERWISE BY DR. MONITOR SIGNS OF INFECTION AND ISCHEMIA DOCUMENT TRAUMA/BLEEDS ON TRANSFERS POST 1ST DRESSING REMOVAL	MONITOR CONTRALATERAL LIMB FOR SKIN BREAKDOWN OD DRESSING CHANGES AND PRN WITH OOZING INCISIONS. ALL 4 SIDES OF DRESSING SEALED. WOUND DRESSING TO BE KEPT CLEAN AND DRY PROTECT DRESSING ON OOZING INCISIONS WHEN IN SHOWER DRY INCISIONS OPEN TO AIR WHEN IN SHOWER EDUCATE RE: FOOT CARE OF NON-OPERATIVE LEG		SUTURES/STAPLES REMAIN IN FOR 4-6 WEEKS AS ORDERED BY SURGEON SEND SUTURE/STAPLE REMOVER WITH PATIENT ON DISCHARGE IF NEEDED SEND 3 DAY DRESSING KIT AND 3 DAYS OF ADDITIONAL ADVANCED DRESSINGS IF DRESSING CHANGES REQUIRED BY HOMECARE AFTER DISCHARGE MD TO ENTER ORDER (WRITTEN/EMR) FOR HOMECARE FOR WOUND MANAGEMENT. NURSE CANNOT ENTER UNDER VERBAL ORDER.
PERSONAL HYGIENE		SHOWER WITHIN 12 HOURS OF SURGERY USING ANTISEPTIC SPONGE	ASSISTED PERSONAL HYGIENE IF NEEDED. SHOWER WITH ANTISEPTIC SPONGE IF NOT DONE NIGHT BEFORE SURGERY.	WASH AT BEDSIDE WITH BASIN AND ASSISTANCE.	WASH AT SINK WITH ASSISTANCE	COMMODE TRANSFERS AND ADLS WITH ASSIST	COVER INCISION PRN AND SHOWER AT LEAST Q2-3 DAYS IF NO PNB INSITU			GOAL: INDEPENDENT WITH ADL IN BATHROOM	
EQUIPMENT	DISCHARGE PLANING IDENTIFY POSSIBLE EQUIP, FOOTWEAR AND HOME ADAPTATION NEEDS FOR DISCHARGE (OT) OT TO SET UP W/C +/- AMPUTEE BOARD IF APPROP IF ADMITTED WITH AN AMPUTATED LIMB, ENSURE PATIENT BROUGHT IN SHRINKER AND PROSTHETIC LEG	IV PUMP	IV PUMP PCA/PNB PUMB IF ADMITTED WITH AN AMPUTATED LIMB., SEND SHRINKER TO OR WITH PATIENT	IV PUMP PCA/PNB PUMP IF ADMITTED WITH AN AMPUTATED LIMB, PATIENT TO WEAR SHRINKER ON THE PREVIOUS AMPUTATED LIMB	FOR BKA: RESIDUAL LIMB PROTECTOR (PROSTHETIST) AMPUTEE W/C (OT) UPPER EXTREMITY EXERCISE EQUIPMENT (PT)	AMPUTEE TRANSFER BOARD IF NEEDED IF ADMITTED WITH AN AMPUTATED LIMB., PATIENT TO WEAR PROSTHETIC LEG ON PREVIOUS AMPUTATED LIMB WHEN UP					

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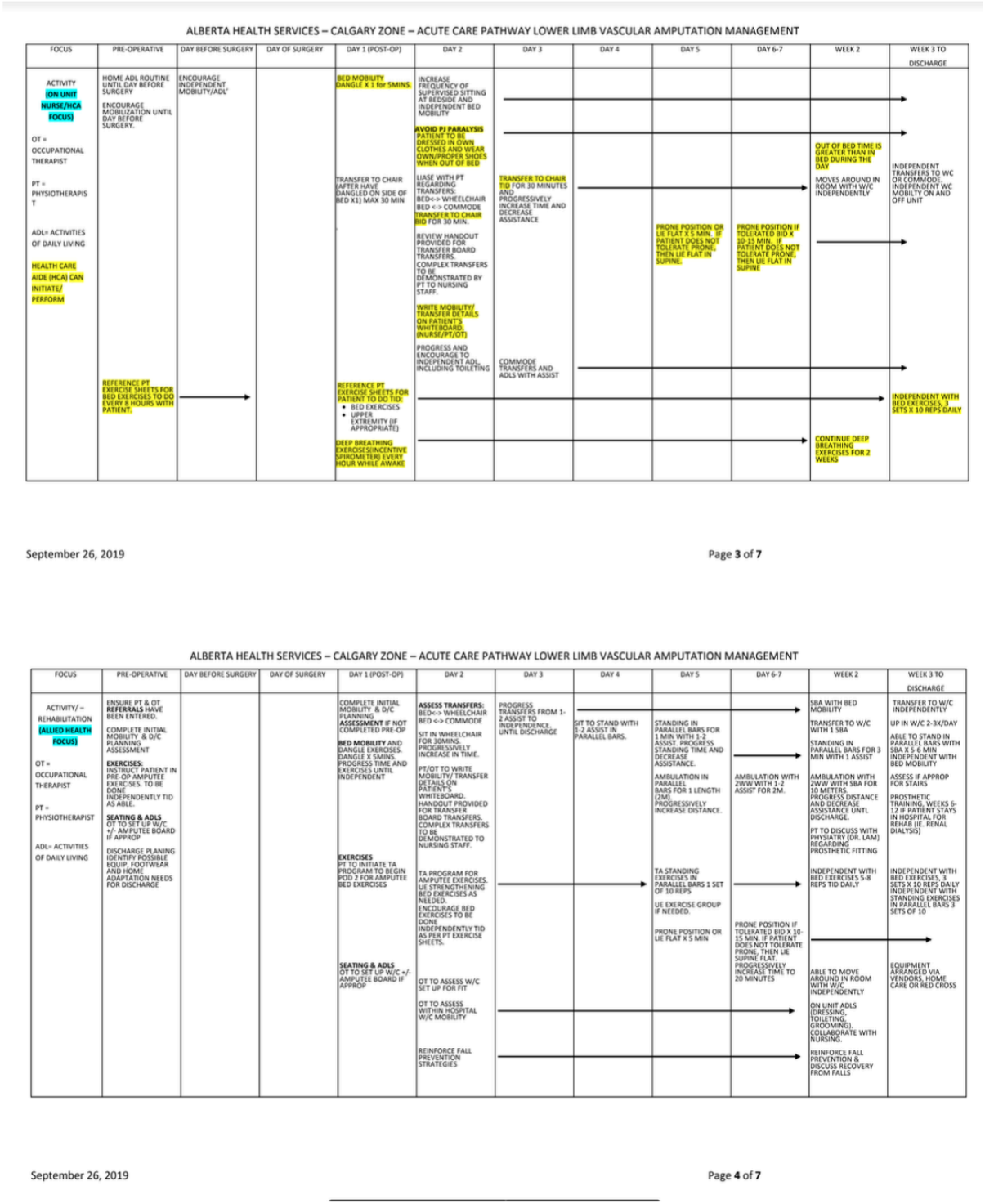
(Alberta Health Services Calgary Zone Clinical Pathway Amputation Management, 2019)

Appendix C



ALBERTA HEALTH SERVICES – CALGARY ZONE – ACUTE CARE PATHWAY LOWER LIMB VASCULAR AMPUTATION MANAGEMENT

FOCUS	PRE-OPERATIVE	DAY BEFORE SURGERY	DAY OF SURGERY	DAY 1 (POST-OP)	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6-7	WEEK 2	WEEK 3 TO DISCHARGE
ACTIVITY (ON UNIT NURSE/HCA FOCUS) OT = OCCUPATIONAL THERAPIST PT = PHYSIOTHERAPIST ADL= ACTIVITIES OF DAILY LIVING HEALTH CARE AIDE (HCA) CAN INITIATE/ PERFORM	HOME ADL ROUTINE UNTIL DAY BEFORE SURGERY ENCOURAGE MOBILIZATION UNTIL DAY BEFORE SURGERY. REFERENCE PT EXERCISE SHEETS FOR BED EXERCISES TO DO EVERY 8 HOURS WITH PATIENT.	ENCOURAGE INDEPENDENT MOBILITY/ADL'		BED MOBILITY DANGLE X 1 for 5MINS. TRANSFER TO CHAIR (AFTER HAVE DANGLED ON SIDE OF BED X1) MAX 30 MIN REFERENCE PT EXERCISE SHEETS FOR PATIENT TO DO TID: • BED EXERCISES • UPPER EXTREMITY (IF APPROPRIATE) DEEP BREATHING EXERCISES(INCENTIVE SPIROMETER) EVERY HOUR WHILE AWAKE	INCREASE FREQUENCY OF SUPERVISED SITTING AT BEDSIDE AND INDEPENDENT BED MOBILITY AVOID PJ PARALYSIS PATIENT TO BE DRESSED IN OWN CLOTHES AND WEAR OWN/PROPER SHOES WHEN OUT OF BED LIASE WITH PT REGARDING TRANSFERS: BED<-> WHEELCHAIR BED <-> COMMODE TRANSFER TO CHAIR BID FOR 30 MIN. REVIEW HANDOUT PROVIDED FOR TRANSFER BOARD TRANSFERS. COMPLEX TRANSFERS TO BE DEMONSTRATED BY PT TO NURSING STAFF. WRITE MOBILITY/ TRANSFER DETAILS ON PATIENT'S WHITEBOARD. (NURSE/PT/OT) PROGRESS AND ENCOURAGE TO INDEPENDENT ADL, INCLUDING TOILETING	TRANSFER TO CHAIR TID FOR 30 MINUTES AND PROGRESSIVELY INCREASE TIME AND DECREASE ASSISTANCE COMMODE TRANSFERS AND ADLS WITH ASSIST		PRONE POSITION OR LIE FLAT X 5 MIN. IF PATIENT DOES NOT TOLERATE PRONE, THEN LIE FLAT IN SUPINE.	PRONE POSITION IF TOLERATED BID X 10-15 MIN. IF PATIENT DOES NOT TOLERATE PRONE, THEN LIE FLAT IN SUPINE	OUT OF BED TIME IS GREATER THAN IN BED DURING THE DAY MOVES AROUND IN ROOM WITH W/C INDEPENDENTLY CONTINUE DEEP BREATHING EXERCISES FOR 2 WEEKS	INDEPENDENT TRANSFERS TO WC OR COMMODE. INDEPENDENT WC MOBILITY ON AND OFF UNIT INDEPENDENT WITH BED EXERCISES, 3 SETS X 10 REPS DAILY

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ALBERTA HEALTH SERVICES – CALGARY ZONE – ACUTE CARE PATHWAY LOWER LIMB VASCULAR AMPUTATION MANAGEMENT

FOCUS	PRE-OPERATIVE	DAY BEFORE SURGERY	DAY OF SURGERY	DAY 1 (POST-OP)	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6-7	WEEK 2	WEEK 3 TO DISCHARGE
ACTIVITY/ – REHABILITATION (ALLIED HEALTH FOCUS) OT = OCCUPATIONAL THERAPIST PT = PHYSIOTHERAPIST ADL= ACTIVITIES OF DAILY LIVING	ENSURE PT & OT **REFERRALS** HAVE BEEN ENTERED. COMPLETE INITIAL MOBILITY & D/C PLANNING **ASSESSMENT** IF NOT COMPLETED PRE-OP **BED MOBILITY** AND DANGLE EXERCISES. DANGLE X 5MINS. PROGRESS TIME AND EXERCISES UNTIL INDEPENDENT **EXERCISES:** INSTRUCT PATIENT IN PRE-OP AMPUTEE EXERCISES. TO BE DONE INDEPENDENTLY TID AS ABLE. **SEATING & ADLS** OT TO SET UP W/C +/- AMPUTEE BOARD IF APPROP DISCHARGE PLANING IDENTIFY POSSIBLE EQUIP, FOOTWEAR AND HOME ADAPTATION NEEDS FOR DISCHARGE			COMPLETE INITIAL MOBILITY & D/C PLANNING **ASSESSMENT** IF NOT COMPLETED PRE-OP **BED MOBILITY** AND DANGLE EXERCISES. DANGLE X 5MINS. PROGRESS TIME AND EXERCISES UNTIL INDEPENDENT **EXERCISES** PT TO INITIATE TA PROGRAM TO BEGIN POD 2 FOR AMPUTEE BED EXERCISES **SEATING & ADLS** OT TO SET UP W/C +/- AMPUTEE BOARD IF APPROP	**ASSESS TRANSFERS:** BED<-> WHEELCHAIR BED <-> COMMODE SIT IN WHEELCHAIR FOR 30MINS. PROGRESSIVELY INCREASE IN TIME. PT/OT TO WRITE MOBILITY/ TRANSFER DETAILS ON PATIENT'S WHITEBOARD. HANDOUT PROVIDED FOR TRANSFER BOARD TRANSFERS. COMPLEX TRANSFERS TO BE DEMONSTRATED TO NURSING STAFF. TA PROGRAM FOR AMPUTEE EXERCISES. UE STRENGTHENING BED EXERCISES AS NEEDED. ENCOURAGE BED EXERCISES TO BE DONE INDEPENDENTLY TID AS PER PT EXERCISE SHEETS. OT TO ASSESS W/C SET UP FOR FIT OT TO ASSESS WITHIN HOSPITAL W/C MOBILITY REINFORCE FALL PREVENTION STRATEGIES	PROGRESS TRANSFERS FROM 1-2 ASSIST TO INDEPENDENCE, UNTIL DISCHARGE	SIT TO STAND WITH 1-2 ASSIST IN PARALLEL BARS.	STANDING IN PARALLEL BARS FOR 1 MIN WITH 1-2 ASSIST. PROGRESS STANDING TIME AND DECREASE ASSISTANCE. AMBULATION IN PARALLEL BARS FOR 1 LENGTH (2M). PROGRESSIVELY INCREASE DISTANCE. TA STANDING EXERCISES IN PARALLEL BARS 1 SET OF 10 REPS UE EXERCISE GROUP IF NEEDED. PRONE POSITION OR LIE FLAT X 5 MIN	AMBULATION WITH 2WW WITH 1-2 ASSIST FOR 2M. PRONE POSITION IF TOLERATED BID X 10-15 MIN. IF PATIENT DOES NOT TOLERATE PRONE, THEN LIE SUPINE FLAT. PROGRESSIVELY INCREASE TIME TO 20 MINUTES	SBA WITH BED MOBILITY TRANSFER TO W/C WITH 1 SBA STANDING IN PARALLEL BARS FOR 3 MIN WITH 1 ASSIST AMBULATION WITH 2WW WITH SBA FOR 10 METERS. PROGRESS DISTANCE AND DECREASE ASSISTANCE UNTL DISCHARGE. PT TO DISCUSS WITH PHYSIATRY (DR. LAM) REGARDING PROSTHETIC FITTING INDEPENDENT WITH BED EXERCISES 5-8 REPS TID DAILY ABLE TO MOVE AROUND IN ROOM WITH W/C INDEPENDENTLY ON UNIT ADLS (DRESSING, TOILETING, GROOMING). COLLABORATE WITH NURSING. REINFORCE FALL PREVENTION & DISCUSS RECOVERY FROM FALLS	TRANSFER TO W/C INDEPENDENTLY UP IN W/C 2-3X/DAY ABLE TO STAND IN PARALLEL BARS WITH SBA X 5-6 MIN INDEPENDENT WITH BED MOBILITY ASSESS IF APPROP FOR STAIRS PROSTHETIC TRAINING, WEEKS 6-12 IF PATIENT STAYS IN HOSPITAL FOR REHAB (IE. RENAL DIALYSIS) INDEPENDENT WITH BED EXERCISES, 3 SETS X 10 REPS DAILY INDEPENDENT WITH STANDING EXERCISES IN PARALLEL BARS 3 SETS OF 10 EQUIPMENT ARRANGED VIA VENDORS, HOME CARE OR RED CROSS

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Appendix C

ALBERTA HEALTH SERVICES – CALGARY ZONE – ACUTE CARE PATHWAY LOWER LIMB VASCULAR AMPUTATION MANAGEMENT

FOCUS	PRE-OPERATIVE	DAY BEFORE SURGERY	DAY OF SURGERY	DAY 1 (POST-OP)	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6-7	WEEK 2	MEDICATION LIST TO RECEIVING FACILITY WEEK 3 TO DISCHARGE
DISCHARGE PLANNING (cont.)									BEGIN TO IDENTIFY TIME FRAME FOR APPROPRIATE DISCHARGE LOCATION **PATIENT & FAMILY AWARE OF ADOD IS 15-22 DAYS FROM TODAY**		
CONSULTS/ REFERRALS	**CONSULT AS SOON AS POSSIBLE:** PT /OT PHYSIATRIST (DR. LAM) OR CALL OFFICE AT 403-944-4226. DR. LAM ON UNIT EVERY WEDNESDAY. **CONSULT AS REQUIRED:** ACUTE PAIN/CHRONIC PAIN SERVICE INTERNAL MEDICINE ANESTHESIA NEPHROLOGY DIABETIC NURSE EDUCATOR GERIATRICS TRANSITION SERVICE SOCIAL WORK SPIRITUAL CARE DIETITIAN PSYCHIATRY PROSTHETIST • (EXTERNAL TO AHS)	→	APS/ANESTHESIA CONSULT REFER TO IM CONSULT RECOMMENDATIONS FOR: • HOLDING AND RESTARTING MEDS • IF POST-OP IM CONSULT REQUIRED FOLLOW THRU WITH RECOMMENDATIONS FOR BKA: CONTACT PROSTHETIST FOR LIMB PROTECTOR FITTING ON APPROPRIATE DAY(POSTOP DAY 2 OR 5, DEPENDING ON POSTOP DRESSING)			IF RAAPID BACK TO HOME FACILITY, REFERRAL FOR LIMB PRESERVATION CLINIC AT THE PLC FOR FOLLOW-UP CARE IN 2-3 WEEKS FOR NON-OPERATIVE FOOT CONSULT SOCIAL WORK IF THERE ARE ANY FINANCIAL OR HOUSING ISSUES	CONSULT DIETITIAN OF < 50% MEALS TAKEN	CONSIDER AGU IF PATIENT IS • >65 Y OR FRAIL • STILL MEDICALLY ACTIVE AND • GOAL IS TO DISCHARGE HOME. CONSULT GERIATRICS IF PATIENT IS >65 OR FRAIL AND HAS AT LEAST ONE OF THE FOLLOWING: • CONSIDERED FOR AGU • UNRESOLVING DELIRIUM	ASSESS FOR NEED OF TRANSITIONS SERVICES INVOLVEMENT AND PLAN FOR SUPPORTIVE CARE BY HOME CARE REFERRAL TO APPROPRIATE PROGRAM: MSK, TRANSITION, AGU, OUTPATIENT THERAPY ACCESSIBLE TRANSPORTATION – **ACCESS** CALGARY AS NEEDED (OT/TS) RAAPID REFERRAL INITIATED & ACCEPTING PHYSICIAN CONTACTED BY SURGEON ASSESS IF CPS CONSULT NEEDED	CONSULT CPS FOR CHRONIC PAIN ISSUES DIABETIC NURSE EDUCATOR REFERRALS AS NEEDED FOR FOLLOW-UP REFER TO CAR IF DISCHARGE IS TO HOME IN CALGARY	CPS TO PROVIDE LIST OF DISCHARGE PAIN MEDICATIONS IF APPLICABLE TRANSITION SERVICES NOTIFIED OF DISCHARGE TIME ON DAY OF DISCHARGE PODIATRY FOR RESIDUAL FOOT CARE AT PLC ZIVOT LIMP PRESERVATION CENTRE OR WITH THE SHCMC ALTERNATIVE RELATIONSHIP PROGRAM(ARP)

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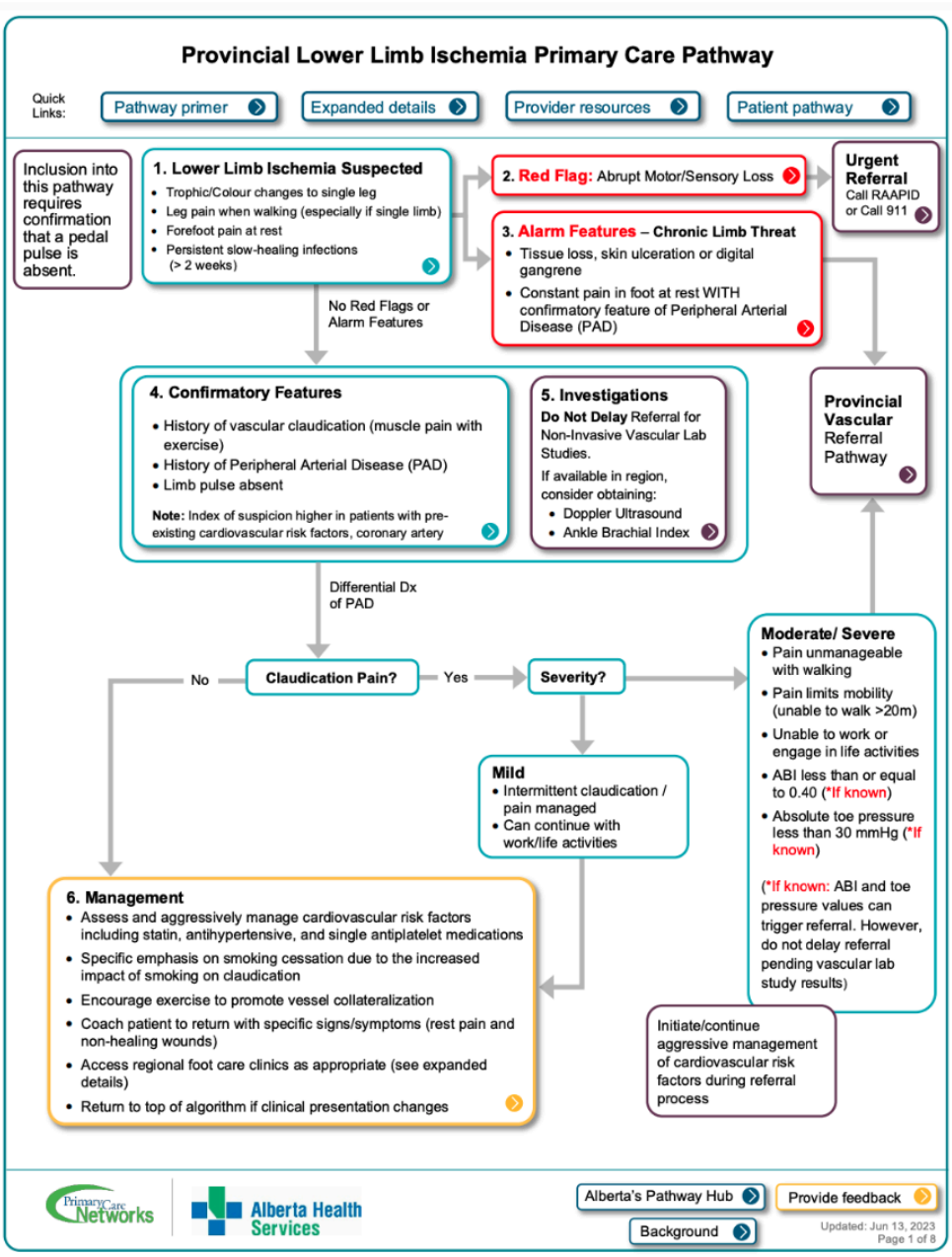
Appendix D

Provincial Lower Limb Ischemic Primary Care Pathway



Pathway copied directly from https://www.albertahealthservices.ca/assets/info/aph/if-aph-lower-limb-ischemia-primary-care-pathway.pdf