Hospital Readmissions among Patients who are Homeless in Toronto

by

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ABSTRACT

Despite high interest in examining hospital readmissions, few studies have focused on readmissions among individuals experiencing homelessness, a population with complex health challenges.

A cohort of 1,165 homeless adults recruited from homeless shelters and meal programs in Toronto were observed from December 6\textsuperscript{th}, 2004 to March 31\textsuperscript{st}, 2009 using administrative health care databases. Multivariate analyses were used to i) compare the 30-day readmission rate between the homeless participants and a cohort of low-income controls; ii) to compare the readmission rate between \textit{hospitalized} homeless participants and \textit{hospitalized} low-income controls, matched on age, sex and case mix group; and iii) to determine risk factors associated with readmission among the homeless participants.

Homeless participants were substantially more likely to be readmitted within 30-days as compared to low-income controls, even after accounting for the primary reason for admission. Further research is needed to assess practices and interventions to reduce readmissions in this patient population.
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ETHICS APPROVAL

The analyses described in this paper will build on the Health Care Utilization in Homeless People (HCUH) study, which has received ongoing ethics approval by the Research Ethics Board (REB) at St. Michael’s Hospital (REB 03-223C).
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<td>Canadian Institute for Health Information Discharge Abstract Database</td>
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<tr>
<td>CMG</td>
<td>Case Mix Group</td>
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<tr>
<td>CRICH</td>
<td>Centre for Research on Inner City Health</td>
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<tr>
<td>DCARE</td>
<td>Discharged to care</td>
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<tr>
<td>GEE</td>
<td>Generalized estimating equation</td>
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<td>HCUH</td>
<td>Health Care Utilization in Homeless People Study</td>
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<tr>
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<td>Institute for Clinical Evaluative Sciences</td>
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Chapter 1

INTRODUCTION
1.0 INTRODUCTION

Hospital readmission rates are a widely-used performance indicator. Readmissions are considered possible markers of poor or incomplete treatment of an underlying condition, and may also reflect inadequate discharge planning and care coordination (Halfon et al, 2006; Kripalani et al., 2007). Addressing these deficits could offer opportunities to improve patient outcomes and reduce health care costs (Friedman & Basu, 2004).

Despite interest among decision-makers and health services researchers in examining hospital readmissions, few studies have focused on readmissions among individuals experiencing homelessness. People who are homeless face disproportionately high levels of illness and tend to be high users of acute care services (Hwang et al., 2013). To our knowledge, there have been no Canadian studies of hospital readmission among patients who are homeless. In the context of a single-payer universal health care system, an opportunity exists to explore readmission rates among this population.

This thesis is composed of three inter-related analyses that examine a cohort of 1,165 homeless adults recruited from homeless shelters and meal programs in Toronto between December 6th, 2004 and December 20th, 2005. The first objective was to compare the 30-day readmission rate between the homeless cohort and a cohort of low-income controls.

The second objective examined the same homeless cohort but a different comparison group in order to compare the 30-day readmission rate between hospitalized homeless participants and hospitalized low-income controls in Toronto, matched on age, sex and case mix group at the time of first admission.
The third objective was to assess risk factors associated with hospital readmission among the homeless cohort. The results of these analyses can inform practice and policies to improve discharge planning and care coordination for patients experiencing homelessness.
Chapter 2

LITERATURE REVIEW
2.0 LITERATURE REVIEW

2.1 Homelessness in Toronto

“Homelessness describes the situation of an individual or family without stable, permanent, appropriate housing, or the immediate prospect, means and ability of acquiring it. It is the result of systemic or societal barriers, a lack of affordable and appropriate housing, the individual/household’s financial, mental, cognitive, behavioural or physical challenges, and/or racism and discrimination. Most people do not choose to be homeless, and the experience is generally negative, unpleasant, stressful and distressing.” (CHRN, 2012: 1)

This ‘Canadian definition of homelessness’, developed by the Canadian Homelessness Research Network, describes the estimated 30,000 Canadians who are affected by homelessness on any given night (CHRN, 2013). It has been estimated that upwards of 1.3 million individuals in Canada have experienced extreme housing instability or homelessness during the past five years (Gaetz et al., 2013). Each year, approximately 200,000 unique individuals access the shelter system (Homeless Hub, 2013). An additional 50,000 Canadians experience ‘hidden homelessness’ each night, forced to ‘couch surf’ with friends or relatives for lack of alternative options, and having no foreseeable access to permanent housing (CHRN, 2013).

In Toronto, upwards of 5,000 people experience homelessness each night (City of Toronto, 2013). Men comprise the majority of the city’s homeless population (65%), women comprise one third, and the remaining 1% self-identify as transgender or transsexual (City of Toronto, 2013). Moreover, approximately 14% of the homeless population in Toronto are parents with dependent children (City of Toronto, 2013).

Between 2006 and 2011, there was a 51% decline in street homelessness in the City of Toronto (City of Toronto, 2011). Many attribute this success to the city’s Street to Homes program, a Housing First initiative that houses approximately 600 individuals annually, with the
vast majority (90%) maintaining their housing (Falvo, 2009). In addition, Toronto’s 10 Year Affordable Housing Action Plan, adopted by City Council in 2009, seeks to increase the stock of rental housing, and reduce wait times for rent-geared-to-income units (City of Toronto, 2009). Recognizing the importance of housing stability in addressing homelessness in the city, a key objective of the Action Plan is to improve access to affordable housing, and to intensify Housing First initiatives for individuals experiencing homelessness.

2.2 Costs Associated with Homelessness

Homelessness costs the Canadian economy an estimated $7.05 billion annually, when accounting for the costs of running shelters and providing health, social and correctional services (Gaetz et al., 2013). The average annual cost to the public of an individual experiencing homelessness is estimated at $42,484 per person (Gaetz et al., 2013).

Meanwhile, it is estimated that a $3.5 billion investment could ‘eliminate’ homelessness to the greatest extent possible (Power, 2008). Notwithstanding, readers are cautioned against over-estimating the savings associated with housing provision, given that many individuals will remain high users of social and health services once they are housed (Gaetz et al., 2013).

Even still, there is evidence to suggest that housing provision for homeless individuals can result in cost-savings to the health care, criminal justice and social services sectors. Eberle and colleagues (2001) posit that the provision of housing generates savings that exceed the cost of providing the housing (by approximately 30%), particularly when considering savings to the criminal justice system. Similarly, Culhane and colleagues (2002) argue that the savings accrued from housing a homeless individual are sufficient to pay for most, if not all, of the cost of
providing the housing.

Studies examining cost-savings to the health care system following housing provision to homeless individuals have drawn similar conclusions. A demonstration project in Connecticut that housed 430 homeless individuals found a US$ 72 million decline in acute health care costs over a 30 month period (University of Pennsylvania, 2002). In particular, homeless individuals with high mental and physical health care needs who received housing required less costly support services than those who were not housed (Proscio, 2002; University of Pennsylvania, 2002). In a pre-post study, Proscio (2002) found a 57% decline in inpatient days among individuals provided with supportive housing, corresponding to cost savings of US$ 53,400. In Canada, Hwang and colleagues (2011) demonstrated that admissions by homeless patients cost $2,559 more than admissions by comparable non-homeless patients after controlling for differences in patient characteristics such as age, gender, and resource intensity weight. For patients receiving medical and surgical services, the authors attribute the differential costs to more frequent alternate level of care (ALC) days\(^1\) among the homeless cohort. With regards to psychiatric services, homeless patients cost $1,058 more on average per admission than housed patients, even after controlling for differences in length of stay between the two groups (Hwang et al., 2011).

Recognizing the potential for cost-savings to the health care system, the Affordable Care Act in the United States has expanded Medicaid coverage for supportive housing for homeless individuals. In 2014, the majority of chronically ill homeless adults will become eligible for Medicaid and for supportive housing (Nardone et al., 2012). Given the anticipated increase in

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\(^1\) ALC patients are those who no longer require acute care services yet remain in hospital awaiting discharge to more appropriate community settings such as long-term care institutions or rehabilitation facilities (CIHI, 2009)
demand for health services among this subset of the Medicaid population, states have a strong incentive to reduce the need for costly acute care utilization by improving housing stability and health outcomes of homeless individuals (Nardone et al., 2012). In the United Kingdom, readmissions among individuals experiencing homelessness have been recognized as a substantial challenge and cost to the government, as demonstrated by a recent £10 million investment by the Department of Health to reduce readmissions among this population (Government of UK, 2013).

Similarly, the provincial government of Ontario has acknowledged the cost-saving potential of providing housing and additional supports as needed, as reflected in a recent media statement by Health Minister and Deputy Premier, Deb Matthews: “Providing a home first is, in fact, the right thing to do from a moral and human standpoint ... but now we know it is also the right thing to do from a cold dollars-and-cents perspective” (Boyle, 2013). Ontario’s Ministry of Municipal Affairs and Housing echoes this statement by suggesting that it is a more efficient use of tax dollars to provide stable housing and additional supports as needed (Ministry of Municipal Affairs and Housing, 2012).

2.3 Entry into Homelessness: Policy Environment & Additional Risk Factors

Homelessness in Toronto, as elsewhere in Canada, is precipitated by a variety of complex and interrelated factors. Many attribute the increase in homelessness to declining investments and supply of affordable housing units, and in particular, to the “dismantling” of the national housing strategy (Gaetz et al. 2013; Hulchanski, 2003).

While the federal government had been chiefly responsible for shaping Canada’s housing
system, the mid-twentieth century saw a shift of responsibility away from the federal government towards municipalities (Hulchanski, 2003). The shift continued into the late twentieth century when in 1996, the federal government transferred the administration of social housing to the provinces, ending half a century of federal involvement in this sector (Department of Finance, 1996). Throughout the 1990s, the federal government continued to reduce provincial transfer payments and to decrease direct expenditure on social housing, amounting to federal treasury savings of approximately $1.5 billion annually (Department of Finance, 2000). Eliminating the federal supply of social housing required that the provinces and municipalities assume the incidental costs of inadequate housing, namely the costs of providing medical and social services, emergency housing and policing (Hulchanski, 2003). In many cases, the provinces have further downloaded the responsibility to municipalities. A decade ago, the Government of Ontario transferred the management and administration of public social housing and emergency shelters to the municipal level (Hulchanski, 2003). Many municipalities within the province continue to face shortages of affordable housing and growing repair bills for existing public units (Shapcott, 2012).

The disassembling of the national housing strategy was followed by the economic decline leading to the 2008 global economic downturn, which contributed to wage and benefit reductions, increases in part time and precarious employment, and higher rates of unemployment among lower income households in Canada (Gaetz et al., 2013). Between 1980 and 2005, the average earnings of Canada’s lowest income quintile dropped by 20%, and with limited access to subsidized units, low-income households were spending an increasing proportion of their earnings on housing (Statistics Canada, 2008).
In Toronto and across the province, a substantial number of households both at risk of homelessness or currently experiencing homelessness await access to subsidized housing. An estimated 156,358 households are on the waiting list for affordable housing in Ontario, with 86,892 residing in Toronto (ONPHA, 2012; City of Toronto, 2013). Though Toronto residents comprise 20.3% of Ontario’s population, they represent 44.3% of the total active waiting list in Ontario (ONPHA, 2012). Low vacancy rates for rental housing in the city (1.7% as of Fall 2012) have contributed to higher costs of rental units. In October 2012, 38% of households in Toronto were spending in excess of 30% of their earnings on rent (City of Toronto, 2013). To illustrate, a single adult receives an Ontario Works monthly payment of $599 (November 2012), while the average market rent for a bachelor apartment in Toronto is $808 (City of Toronto, 2013).

The social and economic factors contributing to the surge in homelessness in the late 20th century were exacerbated by the deinstitutionalization of individuals with mental health illness (Dear & Wolch, 1987). Additionally, increases in crack and cocaine use in the 1980s and heroin in the 1990s, in combination with considerable declines in the availability of affordable housing and single-room occupancy hotels, further compounded urban homelessness (City of Toronto, 1999).

Personal life experiences and childhood circumstances introduce another layer of complexity to the homelessness discourse. Roos and colleagues (2013) investigated the associations between serious mental illness, homelessness, and adverse childhood experiences. Their study revealed that homeless adults in the United States had high rates, between 17% and 60%, of various childhood adversities. Adverse childhood events (neglect, abuse or general household dysfunction) were both indirectly and directly associated with homelessness. The authors conclude that while serious mental disorders may partially mediate the association
between childhood adversity and homelessness, there remains a strong direct relationship (Roos et al., 2013).

In addition, studies have cited sex and gender differences in self-reported reasons for entry into homelessness. Males are more likely to cite job loss, mental health illness, institutional discharge, and alcohol or drug dependency as primary reasons. In contrast, females cited eviction, interpersonal conflict, and lack of social supports as main reasons for entry into homelessness (Tessler, Rosenheck, & Gamache, 2001). Among women, intimate partner violence is strongly associated with housing instability and homelessness (Champion et al., 2009; Davies, Lyon, & Monti-Catania, 1998; Shinn et al., 1998; Hirst, 2003; Wesely & Wright, 2005). Inadequate housing and lack of access to affordable housing have also been shown to force women back into the abusive relationships from which they had fled (McNaughton & Sanders, 2007).

Reasons for entry into homelessness are multifaceted, and are mediated by a variety of interrelated factors that are embedded within a complex policy and economic environment. Yet central to the issue is the affordable housing market. Gaetz and colleagues (2013) note that while “affordable housing is not the only solution to homelessness,” strategies to end homelessness cannot succeed in the absence of affordable housing units.
2.4 Homelessness and Health

2.4.1 Health Challenges among Individuals Experiencing Homelessness

There is extensive evidence of poorer health outcomes among homeless adults, as compared to the general population. This relationship between homelessness and health outcomes is complex and mediated by a range of factors, including the physical environment and social, psychological and economic processes such as competing priorities and neighbourhood-level effects (Dunn & Hayes, 2000; Dunn, 2000; Dunn et al., 2004; Dunn et al., 2006; Hwang et al., 1999; Shaw, 2004; Hwang, 2001).

Physical abuse is a strong risk factor associated with adult homelessness (Herman et al., 1997). In turn, individuals experiencing homelessness face high levels of injuries and assault (Hwang, Colantonio, Chiu, Tolomiczenko, Kiss, Cowan et al., 2008). It has also been suggested that childhood physical abuse that contributes to traumatic brain injury increases the risk of homelessness in adulthood (Herman, Susser, Struening, Link, 1997). Traumatic brain injury is common among individuals experiencing homelessness, and is associated with poorer physical and mental health status (Hwang et al., 2008). A survey of 904 homeless adults in Toronto found a lifetime prevalence of 53% for any traumatic brain injury among this population (Hwang, Colantonio, Chiu, Tolomiczenko, Kiss, Cowan et al., 2008).

Individuals experiencing homelessness face a higher burden of illness than comparable housed individuals (Hwang et al., 2013). Many homeless individuals have experiences of physical and sexual assault, both prior to and since becoming homeless, with sexually transmitted infections being a particularly pertinent problem among homeless youth (Hwang & Dunn, 2005). Tuberculosis, HIV and hepatitis B and C are also common in the homeless
population. Among homeless adults in Toronto, there is a 67% lifetime prevalence of mental illness, and a 68% lifetime prevalence of substance abuse (Goering, Tolomiczenko, Sheldon, Boydel et al., 2002). Homeless adults face a high prevalence of chronic diseases such as diabetes, hypertension, chronic obstructive pulmonary disease, seizures, and musculoskeletal disorders (Hwang & Dunn, 2005). Foot problems, ranging from fungal infections to frostbite, are also common experiences among homeless individuals, as are dental problems (Hwang & Dunn, 2005).

Given these myriad health challenges, it is not surprising that homeless individuals experience significantly higher rates of mortality than their housed counterparts. Men living in homeless shelters in Toronto are between 2 and 8 times more likely to die compared to men of the same age in the general population (Hwang, 2000). A review of mortality rates among homeless women revealed rates that are 5 to 31 times higher for those in a younger age bracket (18 to 44 years old) compared to younger women in the general population (Cheung & Hwang, 2004). Common causes of mortality for homeless individuals are cancer and heart disease among older adults, while overdose, suicide, homicide and AIDS are more common causes among individuals ages 45 and under (Hwang, 2000; Cheung & Hwang, 2004). In recent years, drug overdose has emerged as one of the leading causes of mortality among the younger homeless population, accounting for a third of deaths among those 45 years of age and younger (Baggett, O’Connell, Porneala, Stringfellow et al., 2013).

To complicate matters, serious health conditions are frequently undiagnosed or insufficiently treated among individuals experiencing homelessness owing in part to real and perceived barriers to health care (such as discrimination by health professionals and
transportation costs), even in the context of universal health insurance coverage (Hwang et al., 2013).

2.4.2 Health Care Utilization among Individuals Experiencing Homelessness

Individuals experiencing homelessness have substantially higher rates of both outpatient and acute care utilization than non-homeless low-income individuals of the same age and sex. In Toronto, a report from the Health Care Utilization in Homeless People (HCUH) study shows that ambulatory care use was 1.7 to 1.9 times higher in individuals experiencing homelessness than among age- and sex-matched low-income controls. Homeless single men and women, respectively, visited the emergency department at a rate 9 and 12 times higher than controls (Hwang et al., 2013). Hospitalization rates were 8.5 times higher than controls among men and 4.6 times higher among women. Moreover, among the homeless cohort, the maximum annual number of emergency department visits (108) and that of hospitalizations (14.9) was substantially higher than among controls (14 and 2.5, respectively) (Hwang et al., 2013). According to the authors, these differences are largely driven by a small subset of the homeless cohort with very high rates of health care utilization (Hwang et al., 2013). Implications emerging from such studies suggest that the early identification of high need individuals could inform practices and interventions that better cater to their complex health conditions.
2.5 Interventions for Homeless Populations

2.5.1 Interventions to Improve Housing Stability and Health

The past decade has seen calls for more targeted efforts to ‘end’ rather than manage homelessness in Canada (CWP, 2012). Strategies to manage homelessness have emphasized temporary assistance for acute food and shelter needs, such as emergency shelter services and charitable meal programs. Yet studies have found that this focus on temporary emergency assistance has negative effects on the health outcomes, safety and wellbeing of individuals experiencing homelessness and the communities in which they live, and can be more costly to the public sector than providing housing (Pauly, Carlson & Perkin, 2012).

On the other hand, plans to end homelessness have centered on the Housing First model, which seeks to permanently house individuals who are homeless or at risk of homelessness by providing subsidized housing alongside social and medical services, as needed. Unlike many shelter providers, the Housing First model does not impose pre-conditions on clients (eg. control of substance use problems or medication compliance) before moving the individuals into permanent housing (Goering et al., 2011). The central premise of the Housing First model is that individuals who are homeless or vulnerably housed are more receptive to medical and social services once they are permanently housed than when they are homeless, owing to fewer competing priorities and a more conducive environment in which to engage with and benefit from support services.

Based on this philosophy, Toronto City Council established the Streets to Homes program in 2005, as part of a broader strategy to address homelessness in the city (Raine & Marcellin, 2007). Since the program’s inception, 3,881 individuals have been housed
through the Streets to Homes initiative (City of Toronto, 2013). Streets to Homes provides subsidized intensive case management to clients with and without mental illness. While the Streets to Homes program has not been directly evaluated, there is a growing evidence-base in support of the Housing First model at large (Hwang, Latimer, Aubry, Tsemberis & Goering, 2013; Larimer et al., 2009; Forchuk et al., 2008; Gulcur et al., 2003).

In 2008, the Canadian government provided funding of $110 million to the Mental Health Commission of Canada for the At Home/Chez Soi study, a multi-site randomized controlled trial of a complex Housing First intervention for individuals with severe and moderate mental health illness. Early results of evaluations of the At Home/Chez Soi study to date have been mixed, yet promising. At 12 months, participants in the Housing First intervention with Intensive Case Management had remained stably housed for 73% of the time, compared to 30% in the ‘treatment as usual’ arm of the study (MHCC, 2012). Among individuals with moderate unmet mental health care needs, two-thirds of participants in the intervention arm remained stably housed for more than 100 days at the 12 month follow-up, compared to 25% in the control group. The median duration for those stably housed among the treatment group was 251 days, compared to zero days stably housed among the controls (Hwang, Latimer, Aubry, Tsemberis, Goering, 2013).

Different subgroups within the homeless population have been shown to benefit from a diverse range of interventions that cater to their specific needs. Central to many of these interventions is a housing component. The provision of housing to homeless individuals with mental illness (with first and last month’s rent) at the time of hospital discharge improved sustained housing stability among this subgroup of the homeless population, all of whom remained housed at 6 months following discharge (Forchuk et al., 2008). In contrast, among
participants who received usual care (a referral to a social worker), all but one remained homeless at 6 months following discharge (Forchuk et al.). Additionally, homeless individuals with severe alcohol problems were found to benefit from a Housing First intervention (with on-site case management), which significantly reduced their alcohol consumption over the 12 month period (Larimer et al., 2009).

Among homeless individuals with substance abuse challenges or concurrent disorders, stable housing was associated with improved housing tenure, and declines in substance use, relapses, and health care utilization (Fitzpatrick-Lewis, Ganann, Krishnaratne, Ciliska, Kouyoumdjian, Hwang, 2011). Over a two year period, individuals with concurrent mental illness and substance abuse involved in a Housing First program spent 66% fewer days homeless than at baseline, and had reduced need for substance abuse programs at 36 months (Gulcur, Stefanic et al., 2003; Padgett et al., 2006). Abstinence-dependent housing was also found to be an effective intervention to improve drug abstinence and housing tenure among this subgroup of the homeless population (Fitzpatrick-Lewis et al.). However, housing not conditional on abstinence was most beneficial for long-term housing stability, substance abstinence and mental health outcomes (Fitzpatrick-Lewis et al.). Overall, studies among homeless individuals with substance use challenges suggest that housing provision is an effective strategy for decreasing substance use and health care utilization (Larimer et al., 2009; Milby, Schumacher et al., 2000; Milby, Schumacher et al., 2004; Milby, Schumacher et al., 2003; Milby, Schumacher et al., 2005; Kertesz, Mullins et al., 2007).

Among homeless individuals with HIV, housing provision was found to improve survival rates even after controlling for many potential confounders (Schwarz et al., 2009). A randomized controlled trial of a housing intervention (rental assistance with case management
versus usual care) for homeless individuals with HIV/AIDS found greater improvements in housing status in the intervention arm, and significant improvements in self-reported mental and physical health among these individuals (Wolitski et al., 2010).

Alongside housing provision, case management targeting the specific needs of clients was found to be an effective intervention among many subgroups of the homeless population. Benefits of case management include completion of substance abuse treatment, reduced need for inpatient care, and improved housing status and quality of life (Fitzpatrick-Lewis et al., 2011).

Despite variations across interventions that cater to the specific needs of different subsets of the homeless population, there is growing evidence in support of housing provision as a means of improving housing stability and health among the homeless population, particularly when accompanied by on-site supportive services (Fitzpatrick-Lewis et al., 2011). As previously discussed, economic evaluations of such interventions have provided further arguments in their favour, particularly when considering the substantial societal costs associated with homelessness.

### 2.5.2 Housing Interventions and Health Care Utilization

Numerous studies have reported improvements in health status and reductions in acute health care utilization following housing provision. A randomized trial by Sadowski and colleagues (2009) found a 29% reduction in hospitalizations in chronically ill homeless adults offered transitional housing upon discharge compared to those who received standard discharge care from hospital-based social workers, even after adjusting for covariates. Similarly, during a one-year follow-up period, individuals in a Chicago respite care program experienced fewer days hospitalized than those in the usual care group (Buchanan, Doblin, Sai, & Garcia, 2006). This
trend was strongest among individuals with HIV/AIDS, although the authors found no difference in outpatient clinic or emergency department visits between the two groups (Buchanan, Doblin, Sai, & Garcia, 2006; Buchanan et al., 2006).

A study focusing on homeless adults with psychiatric and substance use disorders in San Francisco found that individuals who received permanent supportive housing had 56% fewer visits to the emergency department and reduced likelihood of hospitalization than during the two years prior to the intervention (Martinez & Burt, 2006). This supports an earlier finding that homelessness is a stronger predictor of repeat psychiatric emergency department visits than having a diagnosis of schizophrenia (Dhossche & Ghani, 1998). Similar results were found in a recent pre-post study evaluating a Housing First pilot program, which resulted in significantly lower rates of emergency department use, hospital admission and jail bookings among the intervention group (Srebnik, Connor & Sylla, 2013).

A study evaluating whether a supportive housing intervention is associated with increased ambulatory care use and decreased acute care utilization found no difference between the intervention cohort and those who were eligible but were not enrolled in the housing program (Kessell, Bhatia, Bamberger & Kushel, 2006). This finding points to the high level of illness and health care needs in this population, many of whom will remain high users of health care after becoming housed. In turn, high acute care utilization among homeless individuals is likely to translate into high readmission rates among this population.
2.6 Hospital Readmissions

2.6.1 Hospital Readmissions as Performance Indicator

Hospital readmission rates may point to gaps in quality of care that if addressed, could offer an opportunity for improving patient outcomes and reducing costs to the health care system (Friedman & Basu, 2004). Readmissions are considered possible markers of poor or incomplete treatment of an underlying condition, and may also reflect inadequate discharge planning and lack of care coordination (Halfon et al, 2006; Kripalani et al., 2007).

Some studies have found a relationship between hospital readmissions rates and quality of care. A seminal study on the topic found that individuals who were readmitted were approximately 55% more likely to have experienced a quality of care problem while an inpatient (Ashton et al., 1997). A study of coronary bypass surgery patients revealed that 85 percent of readmissions were directly attributable to quality of care-related surgical complications (Hannan et al., 2003).

Studies examining the relationship between discharge readiness and readmissions found that patients discharged without a necessary prescription were at greater risk of readmission, as were individuals who did not receive (or refused) a referral for post-discharge community supports and services such as housing (Craig et al., 2000; Craig & Bracken, 1995). An influential study of hospital readmissions among Medicare beneficiaries reported a 30-day medical readmission rate of 21.1%, and in half of these events, the patient did not have an outpatient visit between their initial discharge and their readmission (Jencks et al, 2009). The study was also instrumental in documenting the substantial costs associated with these readmissions, estimated at US $17.4 billion in 2004 (Jencks et al, 2009).
Despite some support for the relationship between readmission rates and quality of hospital and post-discharge care, the use of global readmission rates as an indicator of quality of care remains contentious. The authors of a systematic review concluded that there is insufficient evidence to validate the use of readmission rates as a marker of quality of care (Benbassat & Taragin, 2000). Nevertheless, they argue that the uncertainty surrounding the use of readmission rates as a marker of quality of care “does not preclude efforts for their reduction” (Benbassat & Taragin, 2000). After all, hospital readmissions are undesirable both from a patient and health system perspective.

Readmission rates have become accepted as a hospital performance indicator, particularly with the establishment of the Hospital Readmissions Reduction Program (HRRP) by the Patient Protection and Affordable Care Act (U.S), which ties compensation levels to the hospital’s readmission rate. As of October 2012, hospitals performing worse than the national risk-adjusted average for 30-day readmission (for heart failure, heart attack or pneumonia) will be penalized. In 2013, the penalty was capped at 1 percent of the hospital’s total Medicare revenue for that year, and is set to increase to 3 percent in 2015 (Commonwealth Fund, 2012). Thus, hospitals have a strong incentive to identify modifiable risk factors for readmission and to implement interventions that target patient populations at high risk of readmission (Mitchell et al., 2012)
2.6.2 ‘Avoidable’ Readmissions

The use of hospital readmission rates as a marker of quality of care remains contentious given that not all readmissions will be preventable, even in the presence of optimal care (Goldfield et al., 2008). Only a subset of readmissions (those that are clinically related to the index admission) can be deemed ‘potentially preventable’ (Goldfield et al., 2008). The authors of a recent meta-analysis estimated that avoidable readmissions comprise only 23.1% of all readmissions (van Walraven, Jennings, Forster, 2012). They caution against interpreting readmission rates as a measure of quality of care given that the “true proportion” of avoidable readmissions remains unclear (van Walraven et al., 2012; van Walraven, Bennett & Jennings, 2011).

This elusive concept of ‘avoidable readmissions’ complicates the study of readmission rates, particularly when the intent is to evaluate and draw comparisons between hospitals. In the context of performance-based compensation systems, it is imperative that strong methodology be used to define ‘excess’ readmission rates so as to not penalize hospitals with sicker patient populations (Goldfield et al., 2008).

The analyses presented in this thesis do not attempt to draw conclusions related to hospital performance or quality of care. Rather, the objective is to deepen our understanding of hospital readmissions among the homeless population in Toronto given the dearth of research in this area and the known high levels of mortality, morbidity, and acute care use among this population.
2.6.3 Predictive Modeling of Hospital Readmissions

Numerous studies have sought to develop predictive models of factors associated with hospital readmission. Such studies have tended to focus on patient populations with a common health condition, rather on more heterogeneous groups of patients (Hasan, 2010). In addition, these studies tend to emphasize comorbid conditions and hospitalization characteristics (e.g. length of stay) as potential predictors of readmission.

In a systematic review of predictive models for hospital readmission, Kansagara and colleagues (2011) note that while comorbid conditions account for much of the risk among some patient populations, the social determinants of health are important factors to consider, particularly among “socioeconomically disadvantaged” groups (Kansagara et al., 2011). However, they found few studies have integrated these broader social factors into their predictive models (Kansagara et al., 2011). Because few studies have included social determinants in their predictive indexes, these unidentified predictors do not factor into the triage of individuals (e.g. those who are unstably housed) to interventions that cater to their specific health and social needs (Kansagara et al., 2011).

Similarly, a recent systematic review of social factors associated with hospital readmission among pneumonia and heart failure patients recommended the incorporation of “higher level social factors” in models predicting readmissions (Calvillo–King et al., 2013). When social factors such as low income and unemployment are examined, they are often, albeit inconsistently, associated with hospital readmission among patients admitted for community-acquired pneumonia (Calvillo–King et al., 2013). When variables such as low socioeconomic status, housing instability, and lack of social support were integrated into readmission models of
patients with heart failure, they were often found to be associated with an increased risk of readmission (Calvillo–King et al., 2013). While the authors suggest that these social factors are “outside a hospital’s control” (Calvillo–King et al., 2013), there is a case to be made for hospitals to engage more strongly in addressing the social determinants of health. Speaking to members of Health Quality Ontario and the broader research community, Dr. Nirav Shah, the Commissioner of Health for New York State, argued that the social determinants (including unstable housing) are within the purview of hospital responsibility (Shah, 2013). Given the expansion of Medicaid to include potentially greater numbers of individuals with poor health status, there is a strong incentive for American institutions to address the variables once considered “outside a hospital’s control”.

### 2.6.4 Hospital Readmissions among Individuals Experiencing Homelessness

Despite a substantial body of literature on readmissions, few studies have explored the issue of hospital readmissions among individuals experiencing homelessness, a population with unique health care challenges and needs, and high levels of acute care use.

A matched cohort study investigating hospital readmissions among patients discharged against medical advice found that these individuals were more likely to be homeless, more likely to be readmitted within 14 days, and were at greater risk of experiencing multiple readmissions throughout the course of a year (Choi, Kim & Palepu, 2011). Additional studies have reported an increased risk of readmission among patients discharged against medical advice (Southern, Nahvi, & Arnsten, 2012; Hwang, Li, Gupta, Chien, Martin, 2003). While these studies highlight an important risk factor for readmission that is relevant to the homeless population, they do not focus specifically on patients who are homeless.
Moore and colleagues (2011) conducted a retrospective cohort study to predict risk factors associated with re-presentation to the emergency department among homeless patients, and determined that leaving against medical advice; treatment in another hospital; involvement in a community case management program; and being a recipient of a pension were associated with increased odds of re-presentation. This predictive model of emergency department representation among the homeless was subsequently validated and found to be highly sensitive (Moore et al., 2012). However, there are few similar studies that have examined hospital readmission rates and risk factors associated with readmission among patients who are homeless.

Kertesz and colleagues (2009) reported a 90-day unplanned readmission rate of 21.2% among homeless patients discharged from a single Boston hospital. Patients were identified through administrative health data and deemed homeless if they had accessed outpatient care at Boston’s Health Care for the Homeless Program at least once within a year of their hospitalization. This study design may have excluded homeless individuals with poorer access to outpatient care. Furthermore, given this method for identifying homeless participants, it is possible that patients were not homeless at the time of their hospitalizations.

Buck and colleagues (2012) compared the mean number of readmissions during a one year observation period between homeless patients and a random sample of housed patients from the same hospital district in Harris County, Texas. The mean number of readmissions among the housed patients was 0.21, compared to an average of 1.84 readmissions per year among the homeless. Patients who were homeless were at twice the odds of being readmitted as compared to housed individuals. The authors do not report whether readmissions were planned or unplanned. Furthermore, as with Kertesz et al. (2009), Buck et al. (2012) only include the first readmission event in their analysis.
Doran et al. (2013) conducted a study of readmissions among patients at a single large hospital in a mid-sized northeastern city in the U.S. Patients were identified as homeless if there was documentation in the chart that they were living on the street, in a shelter, in unstable or temporary housing (eg. couch-surfing), or another location not meant for human habitation. The study found a very high readmission rate within 30 days of discharge (50.8%) among patients who were homeless. This rate was much higher than the 21.2% readmission rate within 90 days reported by Kertesz and colleagues (2009), despite the fact that Doran et al. used a shorter observation window of 30 days. The difference in rates could be partially credited to Boston’s medical respite program for the homeless, which has been found to be an effective intervention for reducing readmissions among this group of patients (Kertesz et al.). While Doran and colleagues report as a point of comparison the readmission rate (18.7%) among general Medicaid patients at the study hospital, they did not account for differences between the homeless and control cohorts through either matching or regression analyses.

A further limitation of these studies is that they do not capture readmissions to other institutions. Only Buck and colleagues (2012) use administrative health data (albeit from only two public hospitals in Texas) to compare readmission rates between homeless and housed patients.
2.6.5 Interventions to Reduce Hospital Readmissions among Homeless Patients

A systematic review of respite programs for homeless patients found evidence for improved housing outcomes, reduced future inpatient days and fewer hospital admissions among individuals discharged to respite care (Doran, Ragins, Gross & Zerger, 2013).

In Canada, there are three established medical respite programs for the homeless, two of which are in Toronto (the Rotary Club of Toronto Infirmary at Seaton House and the Sherbourne Infirmary) (Edgington, 2011). Canada’s third respite program is the Booth Centre Special Care Unit located in Ottawa. To our knowledge, there have been no published evaluations of these programs or their influence on acute care utilization or readmission rates.

In the U.S., Kertesz and colleagues (2009) compared 90-day readmission rates between homeless patients discharged to Boston’s medical respite care program for the homeless to those discharged to ‘other planned care’ or to ‘own care’. Boston’s respite care services include 24-hour nursing care, nurse practitioner and physician services, a dental team, and caseworkers. Overall, readmissions within 90 days of discharge occurred among 21.2% of homeless study participants, and were significantly less common among respite patients, even after adjusting for differences between the groups using propensity scores (Kertesz et al., 2009). These promising results suggest that respite programs for the homeless could serve as an intermediary between hospitals and more permanent housing placements for individuals experiencing homelessness.
Chapter Three

RESEARCH OBJECTIVES
3.0 RESEARCH OBJECTIVES

This study seeks to fill knowledge gaps regarding hospital readmissions among individuals experiencing homelessness by studying the readmission rates of a representative sample of homeless adults in Toronto. These individuals tend to face higher levels of mortality and morbidity than their housed counterparts.

In the context of a single-payer universal health care system with comprehensive administrative health data, Ontario offers an ideal environment in which to study patterns of health care utilization among individuals experiencing homelessness. The thesis will also benefit from access to comprehensive survey data from the Health Care Utilization in Homeless People (HCUH) study.

Moreover, in the provincial context of fiscal restraint, mounting pressure to control health care costs, and the Ontario Ministry of Health and Long-Term Care’s interest in identifying groups of patients with high readmission rates, this study will shed light on one such population who tend to rely disproportionately on acute care services. More specifically, the thesis objectives are:

**Objective 1:** To compare the 30-day medical/surgical readmission rate between homeless adults and low-income adults of the same age and sex in Toronto

**Objective 2:** To compare the 30-day medical/surgical readmission rate between hospitalized homeless patients and hospitalized low-income controls in Toronto, matched for age, sex and case mix group at the time of first admission
**Objective 3:** To identify factors associated with an increased risk of 30-day medical/surgical readmission among homeless adults in Toronto

Objective 1 and Objective 2 both compare readmission rates between the homeless cohort and a control group. In the first instance, controls of the same age and sex as the homeless participants were selected from low-income neighbourhoods in Toronto. Controls were not required to have been hospitalized during the study period. In Objective 2, controls were matched to the homeless participants based on age-, sex- and case mix group (primary reason for admission). Thus, only controls with at least one hospitalization during the observation period were selected for this cohort. We undertook this second analysis to determine whether the observed difference in readmission rates between the homeless cohort and the low-income controls remained even after selecting for controls who had been hospitalized for the same conditions as the homeless participants.
Chapter Four

OBJECTIVE 1: 30-DAY READMISSION RATES AMONG HOMELESS ADULTS AND LOW-INCOME CONTROLS
4.0 OBJECTIVE 1: 30-DAY READMISSION RATES AMONG HOMELESS ADULTS AND LOW-INCOME CONTROLS

4.1 ABSTRACT

Despite high interest among decision-makers and hospital administrators in examining hospital readmissions, few studies have focused on readmissions among individuals experiencing homelessness. A cohort of 1,165 homeless adults recruited from homeless shelters and meal programs in Toronto were matched by age and sex to low-income controls in Toronto, and observed through administrative health data (CIHI-DAD) from December 6th, 2004 to March 31st, 2009 to determine their rate of unplanned 30-day medical/surgical hospital readmission. There was a higher rate of 30-day readmission among individuals with a history of homelessness (21.4%) than among the controls (8.2%). Individuals with a history of homelessness (N=220) contributed 504 hospitalizations during the study period and 108 readmissions, compared to 122 hospitalizations and 10 readmissions among the controls (N=82). Individuals with a history of homelessness are significantly more likely to be readmitted within 30 days as compared to low-income controls (OR= 3.05, p=0.015, 95% CI 1.24-7.53).
4.2 INTRODUCTION

Readmission rates may serve as markers of incomplete treatment of an underlying condition and may reflect inadequate coordination of health services (Friedman & Basu, 2004; Halfon et al, 2006; Kripalani et al., 2007 in Goldfield et al., 2008). Though decision-makers have taken an interest in addressing hospital readmissions among high risk groups, there have been few studies examining readmissions among homeless patients, who face high levels of morbidity and who tend to rely heavily on acute care services (Hwang et al, 2013).

Kertesz and colleagues (2009) report a 90-day readmission rate of 21.2% among homeless patients at a single Boston hospital. They determine that individuals discharged to a respite care program for the homeless are at reduced risk of readmission (Kertesz et al., 2009). More recently, Doran et al. (2013) revealed a 30-day readmission rate of 50.8% among patients who are homeless, compared to 18.7% among general Medicaid patients at the study hospital.

Buck and colleagues (2012) compared the number of readmissions during a one year observation period between homeless patients and a random sample of housed patients. The mean number of readmissions per year among the housed patients was 0.21, compared to 1.84 among the homeless.

No Canadian studies of hospital readmissions among patients who are homeless could be found in the literature. This study sought to document the 30-day readmission rate of a representative sample of homeless adults in Toronto, compared to age- and sex-matched low-income controls.
4.3 METHODOLOGY

4.3.1 Health Care Utilization in Homeless People (HCUH) Study

This analysis utilized data from the HCUH study, a cross-sectional study that recruited 1,165 homeless adults from homeless shelters and meal programs between December 6th, 2004 and December 20th, 2005. Enrollment was stratified to obtain a 2:1:1 ratio of single men, single women, and family adults (i.e. adults with a partner and/or dependent children) to reflect the demographics of Toronto’s homeless population. A HCUH pilot study determined that the majority of Toronto’s homeless population (90%) use shelters, while the remaining 10% access meal programs but not shelters (Hwang, Chiu & Kiss, 2005). As such, 90% of participants were recruited from shelters and 10% from meal programs. Participants were recruited at random from shelter lists and meal lines, and were screened to determine whether they met the inclusion criteria and were interested in participating in the study. Homelessness was defined as residing in a shelter, public place, abandoned building, vehicle or ‘couch-surfing’ (with no alternative) within the previous seven days. Individuals who did not meet this definition of homelessness were excluded, as were those unable to provide consent or unable to communicate in English. Individuals who had never been issued a provincial health card were also excluded given that this was necessary for linkage to administrative health data.

In instances where there were two adults belonging to the same family, only one of the individuals was randomly selected for the study. Of the 2,516 adults who were screened, 882 (35.1%) were excluded from the study based on the following criteria: 229 (9%) were not homeless based on our definition; 104 (4.1%) were unable to communicate in English; 54 (2.1%) were meal program users who had accessed shelter services in the previous week; 53 (2.1%)
could not provide informed consent; and, 442 (17.6%) did not possess valid health card numbers. In addition, 443 (17.6%) of the individuals screened for the study declined to participate, and 2 records were found to be duplicates. The final sample size (prior to linkage with administrative health data) was 1,189 individuals.

Study participants were administered a comprehensive survey instrument focusing on factors related to health care utilization, such as demographic factors, history of homelessness, physical and mental health status, alcohol or drug use challenges, and health care need. We used validated instruments, including the physical (PCS-12) and mental health (MCS-12) composite scores of the Short Form Health Survey (SF-12), to assess health status.

4.3.2 Administrative Health Data

The 1189 HCUH study participants consented to having their Ontario Health Insurance Plan health card numbers linked to administrative health data at the Institute for Clinical Evaluative Sciences (ICES). An exact match was achieved for 94% of participants, and an additional 4% of participants were matched by probabilistic linkage based on first name, last name, date of birth and sex. As a result, administrative health data was obtained for 1,165 (98%) of the HCUH study participants.

The Canadian Institute for Health Information’s Discharge Abstract Database (CIHI-DAD) was used to identify hospital admissions and readmissions. CIHI-DAD contains patient-level demographic data (eg. gender, date of birth, postal code); clinical data (eg. diagnoses, procedures) for acute, chronic, rehabilitation, and day surgery institutions in Ontario; administrative data (eg. hospital number, admission category, length of stay and discharge
disposition) and measures of resource consumption (eg. case mix group, resource intensity weight).

4.3.3 Cohort of Low-Income Controls

A cohort of low-income controls residing in Toronto was identified using the Registered Persons Database (RPDB), a registry of all individuals with a valid provincial health insurance number. We excluded controls whose death occurred prior to the start of the observation period (December 6, 2004), as indicated in the RPDB. Using Statistics Canada’s Postal Code Conversion File, 3-digit forward sortation areas were converted into census tracts. Controls were selected from census tracts belonging to Toronto’s lowest income quintile (based on 2006 census data) (Statistics Canada, 2006). These census tracts encompass one fifth of Toronto’s population (upwards of 500,000 individuals) where 40.9% of residents have incomes below the low-income cutoff (as compared to 24.4% for the City of Toronto at large) (McKeown et al., 2008). The average annual income of Toronto residents belonging to the lowest income quintile is $43,480 (range of $25,084 to $78,279), and the unemployment rate is 10.4% (McKeown et al., 2008).

We randomly assigned a low-income control of the same age and sex to each of the 1,165 homeless participants for whom we had administrative health data.
4.3.4 Outcome

Participants and low-income controls were observed from the participant’s recruitment date (between December 6\textsuperscript{th}, 2004 and December 20\textsuperscript{th}, 2005) until the end of the observation period (March 31\textsuperscript{st}, 2009). The outcome for this analysis was a binary indicator for the presence or absence of an unplanned 30-day medical/surgical readmission after each hospitalization. As per Figure 1, admissions that occurred within 30 days of discharge from any hospitalization were considered readmissions, meaning that the 30-day observation window was ‘reset’ at the time of each discharge. For the hypothetical patient illustrated in Figure 1, hospitalization ‘A’ resulted in a 30-day readmission (hospitalization ‘B’). Upon discharge from hospitalization ‘B’, a new 30-day observation window began, and the same patient experienced another readmission within the 30-days (hospitalization ‘C’). In contrast, hospitalizations ‘C’ and ‘D’ did not result in a readmission within 30 days.

**Figure 1. Defining a 30-day readmission event.**

![Diagram showing hospitalizations A, B, C, and D with readmissions within 30 days](image)

We excluded both psychiatric and pregnancy-related hospitalizations from our analytic dataset (Figure 2), as we hypothesized that the mechanisms underlying these types of readmissions would differ from those underlying medical/surgical readmissions. Furthermore,
these exclusions allow for comparability with previous studies of hospital readmissions among patients who are homeless. Given our interest in unplanned readmissions, hospitalizations within 30-days of discharge where the admission category was coded as ‘elective’ were excluded (n=13) (Figure 2).

To avoid considering transfers between hospitals as readmissions, we used CIHI methodology to identify ‘episodes of care’. These ‘episodes of care’ refer to a series of admissions to acute care hospitals that include an initial hospitalization event (i.e., first record in an episode) and all subsequent transfers (CIHI, 2013). In particular, admissions that met either of the following criteria were considered transfers and not readmissions: i) admissions within 6 hours of discharge to another acute care institution, whether or not the transfer was coded by either institution; and, ii) admissions within 6 to 12 hours of discharge from another acute care institution whereby at least one of the institutions coded the transfer (CIHI, 2013).

Episodes of care were identified using the ICES-derived epi, epivisit, and epiflag variables (Table 1). The admission date (admdate) from the first record within an episode defined the start of the episode, and the discharge date (ddate) from the last record within an episode defined the end of the episode.

Table 1. CIHI-DAD Variables used to Derive the Episodes of Care and Readmissions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPI</td>
<td>Unique episode number</td>
</tr>
<tr>
<td>EPIVISIT</td>
<td>Visit number within an episode</td>
</tr>
<tr>
<td>ADMDATE</td>
<td>Admission date</td>
</tr>
<tr>
<td>ADMCAT</td>
<td>Admission category</td>
</tr>
<tr>
<td>DDATE</td>
<td>Discharge date</td>
</tr>
<tr>
<td>IKN</td>
<td>ICES key number</td>
</tr>
<tr>
<td>DISCHDISP</td>
<td>Discharge disposition</td>
</tr>
</tbody>
</table>
Figure 2. Flowchart of study design

- **All CIHI-DAD records** (January 1 2002 – March 31 2009)
  
  - **Excluded mental health records** (i.e., services provided by psychiatric providers, where PRVSERVc=00064)

  - **Step 1. Constructed episodes of care**
    - Selected first and last record within an episode
    - Used admission date (admdat) from first record and discharge date (ddate) from last record to define start and end of episode
    - Retained discharge disposition (dischdisp) from last record

  - **Analytic Dataset**
    - All non-psychiatric and non-pregnancy-related episodes of care that occurred during the observation period (DATEMAIN to March 31, 2009)

  - **Step 2. Derived outcome variable**
    - Assigned outcome variable (30-day readmission) to each episode of care

* DATEMAIN refers to the homeless participant’s enrollment date (participants were recruited between December 6th, 2004 and December 20th, 2005)
4.3.5 CIHI-DAD Derived Process of Care Variables

We characterized hospitalizations based on a set of ‘process of care’ variables, including length of stay and discharge disposition. Type of discharge (i.e. discharge against medical advice, discharge to care, death) was defined based on the CIHI-DAD discharge disposition code for the last record within an episode of care. The length of stay (days) was derived from the admission date of the first event and the discharge date of the last event in the episode of care, and was categorized based on clinically meaningful groups. For simplicity, episodes of care will henceforth be referred to as “hospitalizations”.

4.3.6 Statistical Analysis

The 30-day medical/surgical readmission rate was calculated as the proportion of non-psychiatric, non-pregnancy related hospitalizations during the observation period that resulted in an unplanned 30-day medical/surgical readmission to any acute care hospital in Ontario (Figure 2), as per the following formula:

\[
\text{Readmission rate} = \frac{\text{Total number of hospitalizations that resulted in a readmission}}{\text{Total number of hospitalizations}}
\]

In addition, the mean readmission rate per person was calculated as the sum of all readmission rates per person over the total number of individuals in the cohort. Differences in the overall readmission rate as compared to the per-person rate indicate that the frequency distribution of readmissions is skewed.

In determining the total number of non-psychiatric, non-pregnancy related medical/surgical hospitalizations that occurred during the observation period (i.e. the denominator of the formula above), hospitalizations with discharge dates between March 1st and
March 31st, 2009 (the final 30-days of the observation window) were excluded, as well as hospitalizations where the discharge disposition was coded as death (Figure 2).

We used the PROC GENMOD procedure in SAS version 9.3 with a logit link function (for logistic regression) to estimate an odds ratio for the association between homelessness and 30-day readmission. Homelessness was represented by a binary variable that distinguishes homeless participants from matched controls.

The GENMOD procedure uses generalized estimating equations (GEEs) to account for within-patient correlations (from repeat hospitalizations) by setting study ID as the cluster variable. GEE models first estimate a naïve linear regression that assumes independence across observations (Twisk, 2013). An iterative process is then used to refit the regression coefficients and to correct for the within-patient correlations. This correction is achieved by specifying a priori the correlation structure for the repeated observations. A strength of the GEE methodology is that it is robust even when the correlation structure has been misspecified (Twisk, 2013).

We attempted to use an exchangeable correlation structure to derive an odds ratio for the association between homelessness and hospital readmission. The exchangeable correlation structure assumes that all observations within an individual are equally correlated. We chose an exchangeable correlation structure since we expected dependence across observations for the same individual. However, given sparse data and the different distribution of readmissions among the homeless cohort compared to the low-income cohort (Table 4), it was not possible to estimate an exchangeable correlation model. As such, we reverted to the simplest correlation structure (independence) to achieve model convergence. The independence correlation structure assumes no correlation across individuals, thus the parameter estimates it produces are identical.
to those from a standard logistic regression. However, the use of the GENMOD procedure with a REPEATED statement (even when an independence correlation structure is specified) results in the reporting of robust standard errors that are higher than the standard errors calculated using maximum likelihood with traditional logistic regression (Twisk, 2013).

In our analyses, we distinguish between single adults and family adults (e.g. adults with dependent children) given that family adults are a unique subgroup of the homeless population who tend to have fewer health care needs (Chambers et al., 2013b).

Table 2. Variable Specifications for Demographic and Process of Care Variables

<table>
<thead>
<tr>
<th>Label</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group</td>
<td>1=&lt;&lt;25 years</td>
</tr>
<tr>
<td></td>
<td>2=25-39 years</td>
</tr>
<tr>
<td></td>
<td>3=40-49 years</td>
</tr>
<tr>
<td></td>
<td>4=≥50 years</td>
</tr>
<tr>
<td>Demographic group</td>
<td>1=Single adult male</td>
</tr>
<tr>
<td></td>
<td>2=Single adult female</td>
</tr>
<tr>
<td></td>
<td>3=Family adult</td>
</tr>
<tr>
<td>Length of stay</td>
<td>0= &lt;2 days</td>
</tr>
<tr>
<td></td>
<td>1= 2-4 days</td>
</tr>
<tr>
<td></td>
<td>2= 5-9 days</td>
</tr>
<tr>
<td></td>
<td>3= ≥ 10 days</td>
</tr>
<tr>
<td>Left against medical advice (AMA)</td>
<td>1= Left AMA</td>
</tr>
<tr>
<td></td>
<td>0= Did not leave AMA</td>
</tr>
<tr>
<td>Discharged to a long-term or continuing care facility or another type of institution with supports (e.g., palliative care/hospice, addiction treatment centre, jail)</td>
<td>1= Discharged to care</td>
</tr>
<tr>
<td></td>
<td>0= Not discharged to care</td>
</tr>
</tbody>
</table>

4.4 RESULTS

The homeless cohort (N=1,165) consisted of 587 (50.4%) single adult males, 296 (24.4%) single adult females and 282 (24.2%) family adults (71.3% of whom were women). During the observation period (December 6th, 2004 to March 31st, 2009), 220 homeless participants contributed a total of 504 hospitalizations, compared to 122 hospitalizations among
82 low-income controls. Table 3 reports the characteristics of the hospitalizations of homeless participants compared to those of controls.

The majority of hospitalizations among the homeless (57.3%) and a large proportion of those of controls (44.3%) occurred among single adult males. Among the low-income controls, there was a greater proportion of hospitalizations by individuals ages 40 and above (73.8%) than among the homeless cohort (55.9%). A greater proportion of homeless participants left against medical advice (9.3%) than controls. The most frequent length of stay among the low-income controls was one day (37.7%), compared to two to four days among the homeless participants (36.9%). Among the homeless cohort, 13% of discharges were discharges “to care”, meaning that the remaining 87% were presumably discharges to a shelter or to the street.

### Table 3. Characteristics of hospitalizations among 1,165 homeless participants and 1,165 low-income controls; no. (%)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Homeless Hospitalizations (n=504)</th>
<th>Low-Income Control hospitalizations (n=122)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single adult male</td>
<td>289 (57.3)</td>
<td>54 (44.3)</td>
</tr>
<tr>
<td>Single adult female</td>
<td>153 (30.4)</td>
<td>32 (26.2)</td>
</tr>
<tr>
<td>Family adult</td>
<td>62 (12.3)</td>
<td>36 (29.5)</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 years</td>
<td>80 (15.9)</td>
<td>10 (8.2)</td>
</tr>
<tr>
<td>25-39 years</td>
<td>142 (28.2)</td>
<td>22 (18.0)</td>
</tr>
<tr>
<td>40-49 years</td>
<td>110 (21.8)</td>
<td>54 (44.3)</td>
</tr>
<tr>
<td>≥50 years</td>
<td>172 (34.1)</td>
<td>36 (29.5)</td>
</tr>
<tr>
<td><strong>Hospital length of stay (days)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>117 (23.2)</td>
<td>46 (37.7)</td>
</tr>
<tr>
<td>2 to 4</td>
<td>186 (36.9)</td>
<td>37 (30.3)</td>
</tr>
<tr>
<td>5 to 9</td>
<td>106 (21.0)</td>
<td>27 (22.1)</td>
</tr>
<tr>
<td>≥10</td>
<td>95 (18.9)</td>
<td>12 (9.8)</td>
</tr>
<tr>
<td><strong>Left against medical advice</strong></td>
<td>47 (9.3)</td>
<td>***</td>
</tr>
<tr>
<td><strong>Discharge to care</strong></td>
<td>67 (13.3)</td>
<td>6 (4.9)</td>
</tr>
</tbody>
</table>

*** As per ICES’ privacy policy, this cell has been suppressed due to insufficient cell count
Of the 504 hospitalizations among the homeless participants, 108 resulted in readmissions within 30-days (Figure 3). Among the low-income cohort, only 10 of the 122 hospitalizations were followed by a readmission within 30 days. Among the homeless cohort, there was a small subgroup of individuals who contributed a disproportionate number of readmissions during the study period (Table 4).

<table>
<thead>
<tr>
<th>No. of readmissions during observation period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>≥7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeless (N=44)</td>
<td>24</td>
<td>12</td>
<td>***</td>
<td>-</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Low-income residents (N= 6)</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*** As per ICES’ privacy policy, cells have been suppressed due to insufficient cell counts
The majority of homeless participants with at least one 30-day readmission were single adult males (50.9%). Older adults (ages 50 and over) were most frequently readmitted (41.7%) among the homeless cohort. The majority of the homeless patients (38.0%) had a length of stay of two to four days. Among the low-income controls, none of the readmissions were associated with leaving against medical advice, whereas among the homeless patients, 14.8% of the hospitalizations that resulted in a readmission were ones in which the patient left against medical advice (Table 5).

Table 5. Characteristics of hospitalizations that were followed by a 30-day readmission among homeless and controls; no. (%)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Homeless Readmissions (n=108)</th>
<th>Low-income resident readmissions (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single adult male</td>
<td>55 (50.9)</td>
<td>***</td>
</tr>
<tr>
<td>Single adult female</td>
<td>41 (38.0)</td>
<td></td>
</tr>
<tr>
<td>Family adult</td>
<td>12 (11.1)</td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 years</td>
<td>24 (22.2)</td>
<td>***</td>
</tr>
<tr>
<td>25-39 years</td>
<td>22 (20.4)</td>
<td></td>
</tr>
<tr>
<td>40-49 years</td>
<td>17 (15.7)</td>
<td></td>
</tr>
<tr>
<td>≥50 years</td>
<td>45 (41.7)</td>
<td></td>
</tr>
<tr>
<td>Hospital length of stay (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>21 (19.4)</td>
<td>***</td>
</tr>
<tr>
<td>2 to 4</td>
<td>41 (38.0)</td>
<td></td>
</tr>
<tr>
<td>5 to 9</td>
<td>26 (24.1)</td>
<td></td>
</tr>
<tr>
<td>≥10</td>
<td>20 (18.5)</td>
<td></td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>16 (14.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Discharge to care</td>
<td>11 (10.2)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

*** As per ICES’ privacy policy, cells have been suppressed due to insufficient cell counts

There was a higher readmission rate (21.4%) among individuals with a history of homelessness than among the low-income controls (8.2%) (Table 6). The average readmission rate per person was 8.6% among the homeless and 3.7% among the controls. That the overall readmission rate among the homeless cohort (21.4%) is substantially higher than the per-person readmission rate (8.6%) suggests the distribution of readmissions is right-skewed, and that there
is a subset of homeless participants contributing a disproportionate number of readmission events. Individuals with a history of homelessness were significantly more likely to be readmitted within 30 days as compared to the low-income controls (OR= 3.05, p=0.015, 95% CI 1.24-7.53).

Table 6. Proportion of hospitalizations among the homeless and controls that resulted in an unplanned 30-day medical/surgical readmission

<table>
<thead>
<tr>
<th></th>
<th>Homeless</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day readmission rate (%)</td>
<td>21.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Mean readmission rate per person (%), SD</td>
<td>8.6 (18.9)</td>
<td>3.7 (14.7)</td>
</tr>
</tbody>
</table>

4.5 DISCUSSION

This study was the first to quantify and characterize the occurrence of hospital readmissions among individuals who are homeless in Canada. An estimated 30,000 Canadians are affected by homelessness on any given night with approximately 200,000 unique individuals accessing the shelter system each year (CHRN, 2013; Gaetz et al., 2013). Individuals experiencing homelessness face a disproportionately higher burden of illness than comparable housed individuals, and tend to be high users of acute care services (Hwang et al., 2013).

In this study, readmission rates among a representative sample of 1,165 homeless adults in Toronto were compared to readmission rates among a cohort of low-income controls of the same age and sex. Homeless participants contributed 504 hospitalizations during the study period and 108 unplanned medical/surgical readmissions, compared to 122 hospitalizations and 10 readmissions among the cohort of low-income controls. Homeless participants were more than three times as likely to be readmitted within 30 days as compared to low-income controls.
Our readmission rates are similar to those found by Kertesz and colleagues (2009) (21.2%), but lower than those reported by Doran et al. (50.8%) (2013). There may be several methodological and contextual reasons for this difference. Doran and colleagues do not exclude planned readmissions as was done in our analysis, and they do not report the percentage of planned readmissions. Furthermore, their study was conducted in a city with no medical respite programs targeting the needs of patients who are homeless, whereas there are two such programs in Toronto (the Rotary Club of Toronto Infirmary at Seaton House and the Sherbourne Infirmary) (Edgington, 2011). Other possible explanations are higher severity of illness among homeless individuals in the U.S. compared to Canada, due to lack of universal health insurance and poorer access to care for low-income individuals.

Our study has several limitations. There is a potential for selection bias given that individuals without a valid health card number (and with no possibility of probabilistic linkage with administrative health data) were excluded from this analysis. Such individuals may represent a subset of the homeless population with higher unmet need for health care. In addition, 18% of individuals who were screened for the HCUH study refused to participate.

Given the observational design of the study, there is likely residual confounding from unobserved differences between the homeless cohort and the controls. For example, though controls were selected from low-income neighbourhoods based on postal code, this might not reflect the income level of each individual control. Moreover, the study is only generalizable to individuals with a history of homelessness given that participants recruited as part of the cross-sectional HCUH study cannot be assumed to be homeless throughout the observation period.

Readmissions that occurred outside of Ontario were not captured in the administrative health data. Furthermore, given a limited number of readmission events, it was not possible to
control for data clustering at the level of the physician or institution. Notwithstanding these limitations, our study examined hospital readmissions among an important patient population that has been largely neglected in the literature on hospital readmissions.
Chapter Five

OBJECTIVE 2: 30-DAY MEDICAL/SURGICAL READMISSION RATES AMONG HOMELESS PATIENTS AND AGE-, SEX-, AND CMG-MATCHED LOW-INCOME CONTROLS: A MATCHED-COHORT STUDY
5.0 OBJECTIVE 2: 30-day medical/surgical readmission rates among homeless patients and age-, sex-, and CMG-matched low-income controls in Toronto: a matched-cohort study

5.1 ABSTRACT

The objective of this study was to compare 30-day unplanned medical/surgical readmission rates between hospitalized homeless patients in Toronto and age- and sex-matched low-income controls belonging to the same Case Mix Group (CMG) at the time of their first admission. A cohort of 1,165 homeless adults recruited from homeless shelters and meal programs in Toronto were observed from December 6th, 2004 to March 31st, 2009. Homeless participants who were hospitalized at least once during the study period (n=203) were matched to hospitalized low-income controls in Toronto (n=203) based on age-, sex- and CMG of the first hospitalization. Homeless participants contributed 478 hospitalizations and 106 readmissions during the study period, as compared to 300 hospitalizations and 21 readmissions among the controls. Homeless participants had nearly four times the odds of being readmitted within 30-days as compared to low-income controls (OR= 3.79, p=<0.0001, 95% CI 1.93-7.39).
5.2 INTRODUCTION

An estimated 30,000 Canadians experience homelessness on any given day, with approximately 200,000 unique individuals accessing the shelter system annually (CHRN, 2013; Homeless Hub, 2013). In Toronto, upwards of 5,000 people experience homelessness each night (City of Toronto, 2013).

Individuals experiencing homelessness face a high burden of illness, and tend to be high users of both outpatient and acute care (Hwang et al., 2013; Hwang, Colantonio, Chiu, Tolomiczenko, Kiss, Cowan et al., 2008). A report from the Health Care Utilization in Homeless People (HCUH) study found that ambulatory care use was 1.7 to 1.9 times higher in individuals experiencing homelessness than among age- and sex-matched low-income controls (Hwang et al., 2013). Yet little is known about hospital readmission rates among this patient population.

In recent years, readmission rates have become an accepted performance indicator for hospital performance (Halfon et al, 2006; Kripalani et al., 2007 in Goldfield et al., 2008). Given the transition towards performance-based hospital compensation, particularly in the United States, there is a growing interest in identifying patient populations at high risk of readmission. This study shed light on one such patient population that has received scant attention in the health services research literature.
5.3 METHODOLOGY

5.3.1 Health Care Utilization in Homeless People (HCUH) Study

As with Objective 1, this analysis utilized data from the HCUH study, a cross-sectional study that recruited 1,165 homeless adults from homeless shelters and meal programs in Toronto between December 6\textsuperscript{th}, 2004 and December 20\textsuperscript{th}, 2005.

5.3.2 Administrative Health Data

HCUH survey data was linked to the Canadian Institute for Health Information’s Discharge Abstract Database (CIHI-DAD), as described in Chapter 4.

5.3.3 Control Cohort

This analysis followed the same homeless cohort as described in the previous chapter, but used a different comparison group. In contrast to Objective 1, which did not require that controls have been hospitalized, the control cohort in this analysis is comprised of a new sample of low-income controls who were hospitalized at least once during the observation period. As per a matched-cohort design, we matched hospitalized low-income controls residing in Toronto to hospitalized homeless participants based on age, sex and case mix group (CMG) at the time of their first hospitalization. The CMG classification system, developed by the Canadian Institute for Health Information (CIHI), groups patients based on primary reason for admission to an acute-care hospital. Patients are first assigned to one of 25 major clinical categories according to the body system involved in the most responsible diagnosis (e.g. respiratory, circulatory). These
categories are further classified as either medical or surgical, and subsequently, as typical or atypical. Lastly, the typical cases are subdivided based on age group and complexity level, resulting in 472 distinct groups of patients who are expected to have similar resource requirements (Finlayson et al., 2009).

5.3.4 Outcome

The outcome for this analysis was a binary indicator for the presence or absence of an unplanned 30-day medical/surgical readmission after each hospitalization (as previously described in Objective 1). We matched a low-income Toronto resident to the first hospitalization of each homeless participant and assessed for differences in readmission rates between the two cohorts, allowing for repeated hospitalizations. Unplanned hospitalizations that occurred within 30 days of discharge from any hospitalization were considered readmissions (Figure 4 illustrates this concept).

For simplicity, the hypothetical homeless participant in Figure 4 is the same as that illustrated in Figure 1. In contrast, Figure 4 also portrays the hospitalization pattern of the age-, sex- and CMG-matched low-income resident. As illustrated, the low-income resident was matched to the homeless participant’s first hospitalization only. The hypothetical low-income resident in Figure 4 was hospitalized twice during the observation period (hospitalization ‘E’ and ‘F’), neither of which resulted in a 30-day readmission.
5.3.5 Statistical Analysis

The readmission rate was calculated as the proportion of medical/surgical hospitalizations that resulted in an unplanned 30-day medical/surgical readmission to an acute care hospital, as described in Objective 1. The association between homelessness and 30-day readmission was assessed using a logistic regression model using generalized estimating equations and setting study ID as the cluster variable (PROC GENMOD with an independence correlation structure in SAS version 9.3).

Contrary to many studies of hospital readmissions that censor the data after the first readmission event, we elected to include all hospitalizations that occurred during the study period. We felt that a repeated measures design would better reflect the reality of homeless patients and would provide a more nuanced understanding of their health care utilization patterns.
Given the matched-cohort design of the study (whereby participants are matched to controls who do not have the ‘exposure’ of homelessness), and given that no further covariate adjustments were made, it was not essential to adjust for the matching variables (i.e. age, sex, case-mix group) in the logistic regression analysis (Sjölander & Greenland, 2013).

To address the concern that study participants may not have remained homeless throughout the observation period (2005-2009), we conducted a secondary analysis with a reduced observation period (only one year from the first hospitalization).

5.4 RESULTS

Of the 1,165 homeless participants, 220 were hospitalized at least once during the observation period. We attempted to match each of these 220 individuals to a low-income resident, but found no match for 17 of the homeless participants. The CMGs of these 17 excluded participants were not rare. Rather, no age and sex-matched control could be found for these participants during the observation period. Our matched-cohort was thus reduced to 203 homeless participants and 203 low-income controls. The 203 homeless participants contributed 478 hospitalizations and 106 readmissions during the study period, corresponding to a readmission rate of 22.2%. Among the 203 low-income controls, there were 300 hospitalizations and 21 readmissions, corresponding to a readmission rate of 7.0% (Figure 5).
Individuals with a history of homelessness were significantly more likely to be readmitted within 30 days as compared to the age-, sex- and CMG-matched low-income controls (OR= 3.79, p=<0.0001, 95% CI 1.94-7.39).

As a secondary analysis, we reduced the observation period to only one year from the first hospitalization, because not all homeless participants necessarily remained homeless throughout the observation period. Though the magnitude of the odds ratio associated with homelessness was similar to that found in the primary analysis, it did not meet the standard significance threshold of p≤0.05 (OR= 3.51, p=.0556, 95% CI 0.97-12.70). This could be a result of inadequate statistical power, given that when the observation period was reduced to 1 year only, the total number of hospitalizations dropped from 778 to 213, with 126 hospitalizations and 26 readmissions among the homeless and 87 hospitalizations and 6 readmissions among the low-income controls.
The most common reasons for admission among the homeless participants and controls were poisoning/toxic effect of drug and pneumonia (Table 8). Table 9 reports the distribution of readmissions among the homeless cohort and the low-income cohort. Of the 203 hospitalized homeless participants, 42 individuals were readmitted during the study period, the majority of whom experienced only one readmission (52.4%). However, there were 6 homeless participants who were readmitted 5 or more times during the observation period, one of whom was readmitted 23 times. Among the 203 low-income controls, only 17 individuals experienced a 30-day readmission, and most experienced only one readmission (82.4%).

The highest proportion of readmissions among the homeless cohort occurred within 7 days of discharge (45.3%), though a substantial proportion of readmissions among this cohort (32.1%) took place between 15 and 30 days post-discharge. Among the low-income controls, the highest proportion of readmissions occurred between 7 and 14 days of discharge (38.1%).

Table 7. Characteristics of homeless participants’ and controls’ first hospitalization, no. (%)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Homeless Participants (n= 203)</th>
<th>Low-Income Controls (n= 203)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) (mean, SD)</td>
<td>40.9 (13.3)</td>
<td>40.9 (13.2)</td>
<td>1.00</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>122 (60.1)</td>
<td>122 (60.1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Females</td>
<td>81 (39.9)</td>
<td>81 (39.9)</td>
<td></td>
</tr>
<tr>
<td>Hospital length of stay (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>55 (27.1)</td>
<td>62 (30.5)</td>
<td>0.13</td>
</tr>
<tr>
<td>2 to 4</td>
<td>77 (37.9)</td>
<td>79 (38.9)</td>
<td></td>
</tr>
<tr>
<td>5 to 9</td>
<td>35 (17.2)</td>
<td>42 (20.7)</td>
<td></td>
</tr>
<tr>
<td>≥ 10</td>
<td>36 (17.7)</td>
<td>20 (9.9)</td>
<td></td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>15 (7.39)</td>
<td>8 (3.94)</td>
<td>0.20</td>
</tr>
<tr>
<td>Discharge to care</td>
<td>19 (9.36)</td>
<td>10 (4.93)</td>
<td>0.12</td>
</tr>
</tbody>
</table>

*P*-values were computed using Chi-square tests for categorical variables and Independent t-tests for continuous variables.
Table 8. Most common Case Mix Groups (CMG) at the time of first hospitalization among the Matched Cohort (N=203)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Case Mix Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Poisoning/ Toxic Effect of Drug</td>
</tr>
<tr>
<td>9</td>
<td>Viral/ Unspecified Pneumonia</td>
</tr>
</tbody>
</table>
| 6         | Inflammatory Disorder of Female Reproductive System  
            Chronic Obstructive Pulmonary Disease  
            Laparoscopic Cholecystectomy with/without Common Bile Duct Exploration |
| 4         | Gastrointestinal Hemorrhage  
            Seizure Disorder, except Status Epilepticus  
            Symptom/Sign of Digestive System  
            HIV with Major Respiratory Complication/ Manifestation  
            Cellulitis |
| 3         | Ischemic Event of Central Nervous System  
            Arrhythmia without Cardiac Catheter  
            Syncope  
            Complex Hernia Repair  
            Fixation of Lower Limb except Ankle/Foot  
            Thyroid/Parathyroid/ Thymus Gland Intervention  
            Intracranial Intervention with Trauma/Complication of Treatment |

Table 9. Distribution of 30-day hospital readmissions among homeless participants and low-income controls

<table>
<thead>
<tr>
<th>No. of readmissions during observation period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>≥7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeless (n=42)</td>
<td>22 (52.3)</td>
<td>12 (28.6)</td>
<td>***</td>
<td>-</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Low-income residents (n=17)</td>
<td>14 (82.4)</td>
<td>***</td>
<td>***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*** As per ICES’ privacy policy, cells have been suppressed due to insufficient cell counts

Table 10. Distribution of 7, 14, and 30-day readmissions among homeless participants and low-income controls

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Within 7 days</th>
<th>Within 14 days</th>
<th>Within 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of readmissions (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeless (n=106)</td>
<td>48 (45.3)</td>
<td>24 (22.6)</td>
<td>34 (32.1)</td>
</tr>
<tr>
<td>Low-income controls (n= 21)</td>
<td>6 (28.6)</td>
<td>8 (38.1)</td>
<td>7 (33.3)</td>
</tr>
</tbody>
</table>
5.5 DISCUSSION

We compared 30-day medical/surgical readmission rates between homeless patients in Toronto and low-income controls in Toronto matched on age, sex and case mix group. Even after selecting for controls who had been hospitalized for the same conditions as the homeless participants, homeless patients still had nearly four times the odds of being readmitted within 30-days as compared to the low-income controls.

Based on our descriptive analysis, individuals who are homeless more commonly experience a ‘revolving door’ pattern of readmissions than do low-income individuals in Toronto. While the majority of patients experienced only one readmission during the study period, a small subset of the homeless cohort contributed a disproportionate number of readmissions (5 or more). From a health system perspective, being able to identify these individuals at high risk of repeat readmissions is essential for directing interventions to mitigate their risk.

Given the very high levels of morbidity among a subset of the homeless population, it is possible that a number of individuals will remain high users of acute care services and at high risk of readmission even after becoming housed. The readmission rates of these individuals are unlikely to improve markedly from interventions that target overall hospital quality of care, for example. These patients will likely require more tailored interventions and care coordination that extends well beyond the hospital walls. Yet little is known about which interventions are effective for patients who are homeless. In particular, further research is needed to evaluate interventions to reduce readmissions among this subset of the homeless population with very complex health care needs.
Chapter Six

OBJECTIVE 3: RISK FACTORS ASSOCIATED WITH READMISSION AMONG INDIVIDUALS WHO ARE HOMELESS IN TORONTO
6.0 OBJECTIVE 3: RISK FACTORS ASSOCIATED WITH READMISSION AMONG INDIVIDUALS WHO ARE HOMELESS IN TORONTO

6.1 Abstract

The objective of this study was to identify risk factors associated with 30-day medical/surgical readmission among a representative sample of homeless adults in Toronto. We used data from the HCUH study, a cross-sectional study that recruited 1,165 homeless adults from homeless shelters and meal programs in 2004-2005. HCUH survey data was linked to Ontario administrative health data and participants were observed from December 6th, 2004 to March 31st, 2009 to identify all unplanned medical/surgical readmissions within 30 days of discharge. Multivariate analyses were conducted using generalized estimating equations to assess risk factors associated with readmission. Having a primary care physician and leaving against medical advice were associated with an increased risk of 30-day readmission among patients who are homeless.
6.2 Introduction

Identifying individuals at risk of readmission is the first step in developing strategies to improve care and health outcomes for these patients (Billings, Steventon, Georghiou, Lewis, Bardsley, 2012). Yet few studies have sought to define readmission rates among patients who are homeless, or to describe factors associated with readmission among this population.

Doran and colleagues (2013) found a higher risk of readmission among patients discharged to a shelter or to the streets versus those discharged home. In addition, the risk of readmission increased with each additional hospitalization during the 12 months prior to the start of the study (Doran et al., 2013). Kertesz and colleagues (2009) compared 90-day readmission rates between homeless patients discharged to Boston’s medical respite care program for the homeless and those discharged to ‘other planned care’ or to ‘own care’. Patients discharged to a respite care program for the homeless were significantly less likely to be readmitted, even after adjusting for differences between the groups using propensity scores (Kertesz et al., 2009).

Respite programs for the homeless could serve as the intermediary between hospitals and more permanent housing placements for homeless patients who are newly discharged. Yet there is a dearth of studies evaluating the efficacy of respite programs among different subgroups of the homeless population and in different contexts. Few studies have sought to describe factors associated with a higher risk of readmission among patients who are homeless, which could help identify patients who are most likely to benefit from a medical respite program or other such intervention.
6.3 Methodology

6.3.1 Study Design

For this analysis, we focused on risk factors associated with 30-day medical/surgical hospital readmissions among the homeless cohort. As previously described, the outcome of interest was a binary indicator for the presence or absence of an unplanned 30-day medical/surgical readmission after each hospitalization.

We used administrative health data linked to survey data from the Health Care Utilization in Homeless People (HCUH) study. Once again, we used CIHI’s Discharge Abstract Database to identify all hospitalizations and unplanned 30-day medical/surgical readmissions that occurred within the observation period. A more detailed description of this methodology can be found in Chapter 4.

6.3.2 Conceptual Framework

The Behavioral Model for Vulnerable Populations, which understands health care utilization as a function of predisposing, enabling and need factors, informed the selection of variables for our initial model (Figure 6).

Predisposing Characteristics

Predisposing characteristics influence an individual’s propensity to use health services. The age variable was categorized into clinically meaningful groups (<25, 26-39, 40-49, ≥50) to account for the variable’s skewed distribution. Our demographic variable was comprised of three categories: single male, single female and family adult. This distinction between single adults
and family adults (e.g. adults with dependent children) has been made in the homelessness literature given that family adults tend to be a unique subgroup of the homeless population with fewer health care needs (Chambers et al., 2013b).

Lifetime duration of homelessness was categorized into two groups: less than 2 years homeless versus 2 or more years homeless. Individuals with a history of traumatic brain injury were those who have had at least one injury to the head that left them “dazed, confused or disoriented”. We used the Addiction Severity Index, which has been validated with homeless individuals, to assess for alcohol, drug or mental health problems (Zanis, McLellan, Canaan et al., 1994; Joyner, Wright & Devine, 1996; Drake, McHugo & Biesanz, 1995; McGahan, Griffith, Parente et al., 1986; McLellan, Kushner, Metzger et al., 1992). We used pre-established cut-off scores that are specific to the homeless population to dichotomize the problems into either absent or present (Burt, Aron & Douglas, 1999).

*Enabling Factors*

Enabling factors are those that impede or support the use of services, such as having a primary care physician or encountering barriers that contribute to unmet need for health care. The following enabling factors were dichotomized as absent or present: having a primary care physician; having unmet need for health care; and, having unmet need for mental health care.

*Need Factors*

Need factors are those that precipitate the use of health services. Physical and mental health status were assessed using the physical component summary (PCS-12) and mental
component summary (MCS-12) of the Short Form Health Survey (SF-12), which has been validated in homeless populations (Larson, 2002). Higher scores represent better health status.

Chronic health conditions were categorized into four groups (0, 1, 2, and 3 or more conditions). The National Survey of Homeless Assistance Providers and Clients informed the selection of chronic health conditions, which included diabetes, anemia, high blood pressure, heart disease, stroke, cancer, liver problems (including hepatitis), HIV infection or AIDS, arthritis (or other joint problems), mobility problems and handicap (Chambers et al., 2013b).

‘Process of Care’ Factors

We adapted the Behavioural Model for Vulnerable Populations to include characteristics of the hospitalization (‘process of care’ factors) that are likely to influence readmission rates, such as length of stay, discharges against medical advice, and discharges to care. Using the CIHI-DAD discharge disposition code for the last record within an episode of care, we identified whether an individual left hospital against medical advice or was discharged to care. The latter includes individuals who were discharged to a continuing or long-term facility, or another location with supports (such as a hospice, an addiction treatment centre, or a jail). The length of stay (days) was derived from the admission date of the first event and the discharge date of the last event in the episode of care and was categorized into clinically meaningful groups. Length of stay was also assessed as a continuous variable, but was found to be non-significant.
6.3.3 Statistical Analysis

Our analytic dataset included all hospitalizations (n=504) and all readmissions (n=108) that occurred among the homeless cohort (N=220) during the observation period. We conducted multivariate analyses using generalized estimating equations (PROC GENMOD with a logit link function and an independence correlation structure) to assess risk factors associated with readmission among the homeless cohort.

Variables included in the multivariate model were selected through an iterative process known as purposeful selection (Hosmer & Lemeshow, 2000). Univariate logistic regressions with generalized estimating equations were conducted for each of the variables listed in Table 12. As illustrated in Figure 7, variables that met the inclusion criteria of \( p \leq 0.25 \) at the univariate stage were included in the multivariate model (alongside age and demographic group, which were forced into the model). Variables were removed or retained if a) the variable had a \( p \leq 0.10 \) or b) the parameter estimate of a remaining variable(s) changed by 15% or more upon its
removal. Variables dismissed at the univariate stage were reintroduced back into the model to assess whether they had an effect in the multivariate model. MCS-12 is the only variable originally dismissed at the univariate stage that was later retained in the multivariate model (given that it met the inclusion criterion of $p \leq 0.10$).

**Figure 7. Purposeful Selection of Variables** (adapted from Bursac, Williams & Hosmer, 2008 and Hosmer & Lemeshow, 2000)
6.4 RESULTS

The highest proportion of hospitalizations among the homeless cohort occurred among individuals 50 or older (34.1%), single adult males (57.3%), and Caucasians (61.9%). Most participants reported having a primary care physician (88.3%). Among this representative sample of hospitalized homeless adults in Toronto, there is a high prevalence of lifetime traumatic brain injury (57.5%) (Table 1).

As was found with hospitalizations, the highest proportion of readmissions was experienced by individuals 50 years or older (41.7%). Among individuals with a readmission, 44.4% reported having a mental health problem. There was a lower average PCS-12 score (indicating poorer physical health status) among individuals who were readmitted (mean= 34.3; SD= 11.6) compared to those who were not readmitted (mean= 39.3; SD=12.9). A higher proportion of individuals in the readmission group had spent two or more years homeless, as compared to less than 2 years homeless (66.7% vs. 55.0%). A higher proportion of readmitted patients left against medical advice at the time of their index admission compared to those who were not readmitted (14.8% vs. 7.9%). Among individuals with a readmission, 95.4% reported having a primary care physician, compared to 76.9% among those who were not readmitted.

Table 2 reports the final results of the multivariate analysis. In our multivariate model, individuals with a primary care physician were significantly more likely to be readmitted within 30 days as compared to those without a primary care physician (OR=2.65; 95% CI 1.05-6.73; p=0.04). Individuals who left hospital against medical advice were almost twice as likely to be readmitted compared to those who did not (OR=1.96; 95% CI 0.99-3.86; p=0.05).
Table 11. Characteristics of hospitalizations among homeless participants with and without an unplanned medical/surgical readmission within 30 days no. (%)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall n= 504</th>
<th>Yes n= 108</th>
<th>No n= 396</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predisposing Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>40.9 (13.3)</td>
<td>44.95 (13.2)</td>
<td>39.3 (13.2)</td>
</tr>
<tr>
<td>Demographic Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single adult male</td>
<td>289 (57.3)</td>
<td>55 (50.9)</td>
<td>234 (59.1)</td>
</tr>
<tr>
<td>Single adult female</td>
<td>153 (30.4)</td>
<td>41 (38.0)</td>
<td>112 (28.3)</td>
</tr>
<tr>
<td>Family adult</td>
<td>62 (12.3)</td>
<td>12 (11.1)</td>
<td>50 (12.6)</td>
</tr>
<tr>
<td>Lifetime duration of homelessness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 yrs</td>
<td>214 (42.5)</td>
<td>36 (33.3)</td>
<td>178 (45.0)</td>
</tr>
<tr>
<td>≥ 2 yrs</td>
<td>290 (57.5)</td>
<td>72 (66.7)</td>
<td>218 (55.0)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>White</td>
<td>312 (61.9)</td>
<td>65 (60.2)</td>
<td>247 (62.4)</td>
</tr>
<tr>
<td>Black</td>
<td>102 (20.2)</td>
<td>29 (26.9)</td>
<td>73 (18.4)</td>
</tr>
<tr>
<td>First Nations</td>
<td>49 (9.7)</td>
<td>8 (7.4)</td>
<td>41 (10.4)</td>
</tr>
<tr>
<td>Other</td>
<td>41 (8.1)</td>
<td>6 (5.6)</td>
<td>35 (8.8)</td>
</tr>
<tr>
<td>History of traumatic head injury</td>
<td>290 (57.5)</td>
<td>72 (66.7)</td>
<td>219 (55.3)</td>
</tr>
<tr>
<td>Alcohol problem in past 30 days</td>
<td>156 (31.0)</td>
<td>25 (23.2)</td>
<td>131 (33.1)</td>
</tr>
<tr>
<td>Drug problem in past 30 days</td>
<td>184 (36.5)</td>
<td>28 (25.9)</td>
<td>156 (39.4)</td>
</tr>
<tr>
<td>Mental health problem in past 30 days</td>
<td>199 (39.5)</td>
<td>48 (44.4)</td>
<td>151 (38.1)</td>
</tr>
<tr>
<td><strong>Enabling Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a primary care physician</td>
<td>445 (88.3)</td>
<td>103 (95.4)</td>
<td>342 (76.9)</td>
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<td>Unmet need for health care</td>
<td>75 (14.9)</td>
<td>22 (20.4)</td>
<td>53 (13.4)</td>
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<tr>
<td>Unmet need for mental health care</td>
<td>45 (9.0)</td>
<td>6 (5.6)</td>
<td>39 (9.9)</td>
</tr>
<tr>
<td><strong>Need Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCS-12 Score (mean, SD)</td>
<td>41.6 (12.5)</td>
<td>34.3 (11.6)</td>
<td>39.3 (12.9)</td>
</tr>
<tr>
<td>MCS-12 Score (mean, SD)</td>
<td>40.1 (12.8)</td>
<td>41.5 (10.8)</td>
<td>40.2 (12.5)</td>
</tr>
<tr>
<td>Number of chronic health conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>118 (23.4)</td>
<td>29 (26.9)</td>
<td>89 (22.5)</td>
</tr>
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<td>106 (21.0)</td>
<td>15 (13.9)</td>
<td>91 (23.0)</td>
</tr>
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<td>2</td>
<td>118 (23.4)</td>
<td>22 (20.4)</td>
<td>96 (24.2)</td>
</tr>
<tr>
<td>3 or more</td>
<td>162 (32.1)</td>
<td>42 (38.9)</td>
<td>120 (30.3)</td>
</tr>
<tr>
<td><strong>Process of Care</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Length of stay (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>117 (23.2)</td>
<td>21 (19.4)</td>
<td>96 (24.2)</td>
</tr>
<tr>
<td>2 to 4</td>
<td>186 (36.9)</td>
<td>41 (38.0)</td>
<td>145 (36.6)</td>
</tr>
<tr>
<td>5 to 9</td>
<td>106 (21.0)</td>
<td>26 (24.1)</td>
<td>80 (20.2)</td>
</tr>
<tr>
<td>≥ 10</td>
<td>95 (18.9)</td>
<td>20 (18.5)</td>
<td>75 (18.9)</td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>47 (9.3)</td>
<td>16 (14.8)</td>
<td>31 (7.8)</td>
</tr>
<tr>
<td>Discharged to care</td>
<td>67 (13.3)</td>
<td>11 (10.2)</td>
<td>56 (14.1)</td>
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</table>
Table 12. Univariate and multivariate regression model for risk of unplanned 30-day medical/surgical readmission in the homeless cohort

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Univariate Regressions</th>
<th>P-value</th>
<th>Multivariate Model</th>
<th>P-value</th>
</tr>
</thead>
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<tr>
<td></td>
<td>OR and 95% CI</td>
<td></td>
<td>OR and 95% CI</td>
<td></td>
</tr>
<tr>
<td>Predisposing Factors</td>
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</tr>
<tr>
<td>Age (years)</td>
<td>1.00</td>
<td>0.91</td>
<td>1.00</td>
<td>0.94</td>
</tr>
<tr>
<td>Demographic Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single adult male (ref)</td>
<td>1.00</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Single adult female</td>
<td>2.12 (1.28-3.53)</td>
<td>0.00</td>
<td>1.64 (0.66-4.04)</td>
<td>0.28</td>
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<tr>
<td>Family adult</td>
<td>0.81 (0.22-3.05)</td>
<td>0.76</td>
<td>1.11 (0.37-3.32)</td>
<td>0.84</td>
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<tr>
<td>Lifetime duration of homelessness</td>
<td>1.63 (0.72-3.69)</td>
<td>0.24</td>
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<td>Race/ethnicity</td>
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<td></td>
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<tr>
<td>White (ref)</td>
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<td></td>
<td>1.00</td>
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<tr>
<td>Black</td>
<td>1.51 (0.41-5.58)</td>
<td>0.54</td>
<td>1.64 (0.66-4.04)</td>
<td>0.28</td>
</tr>
<tr>
<td>Aboriginal</td>
<td>0.74 (0.31-1.76)</td>
<td>0.50</td>
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<tr>
<td>Other</td>
<td>0.65 (0.22-1.91)</td>
<td>0.43</td>
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<tr>
<td>Traumatic brain injury</td>
<td>1.62 (0.75-3.49)</td>
<td>0.22</td>
<td></td>
<td></td>
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<tr>
<td>Alcohol problem</td>
<td>0.61 (0.27-1.35)</td>
<td>0.22</td>
<td></td>
<td></td>
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<tr>
<td>Drug problem</td>
<td>0.54 (0.25-1.15)</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental health problem</td>
<td>1.30 (0.52-3.24)</td>
<td>0.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enabling Factors</td>
<td></td>
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</tr>
<tr>
<td>Has a primary care physician</td>
<td>3.25 (1.28-8.29)</td>
<td><strong>0.01</strong></td>
<td>2.65 (1.05-6.73)</td>
<td><strong>0.040</strong></td>
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<tr>
<td>Unmet need for health care</td>
<td>1.66 (0.67-4.11)</td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmet need for mental health care</td>
<td>0.54 (0.22-1.32)</td>
<td>0.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCS-12 Score</td>
<td>0.97 (0.94-1.00)</td>
<td><strong>0.03</strong></td>
<td>0.97 (0.94-1.00)</td>
<td>0.076</td>
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<td>MCS-12 Score</td>
<td>1.01 (0.99-1.03)</td>
<td>0.44</td>
<td>1.02 (1.00-1.04)</td>
<td>0.069</td>
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<td>No. chronic conditions</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None (ref)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.51 (0.10-2.52)</td>
<td>0.41</td>
<td></td>
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</tr>
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<td>2</td>
<td>0.70 (0.17-2.91)</td>
<td>0.63</td>
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<tr>
<td>3 or more</td>
<td>1.07 (0.27-4.22)</td>
<td>0.92</td>
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<tr>
<td>Process of Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 4</td>
<td>1.29 (0.77-2.18)</td>
<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 9</td>
<td>1.49 (0.72-3.05)</td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 10</td>
<td>1.22 (0.58-2.56)</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>2.05 (1.11-3.79)</td>
<td><strong>0.02</strong></td>
<td>1.96 (0.99-3.86)</td>
<td>0.052</td>
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<tr>
<td>Discharged to care</td>
<td>0.69 (0.34-1.38)</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Odds ratios were computed using logistic regression with generalized estimating equations to account for correlations from repeat hospitalizations; bolded items are significant at a p-value less than 0.05
We conducted Chi-square tests and Independent t-tests to assess whether individuals with a primary care physician differ from those without a primary care physician, and found that individuals with a primary care physician have significantly lower PCS-12 scores, a measure of poorer physical health status.

Table 13. Characteristics of 220 homeless participants with and without a primary care physician; no. (%)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Has a primary care physician</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 years</td>
<td>28 (15.3)</td>
<td>7 (18.9)</td>
</tr>
<tr>
<td>25-39 years</td>
<td>63 (34.4)</td>
<td>11 (29.7)</td>
</tr>
<tr>
<td>40-49 years</td>
<td>44 (24.0)</td>
<td>13 (35.1)</td>
</tr>
<tr>
<td>≥50 years</td>
<td>48 (26.2)</td>
<td>6 (16.2)</td>
</tr>
<tr>
<td>Unmet need for health care</td>
<td>27 (14.8)</td>
<td>7 (18.9)</td>
</tr>
<tr>
<td>PCS-12 Score; mean (SD)</td>
<td>40.49 (12.4)</td>
<td>47.24 (11.2)</td>
</tr>
<tr>
<td>MCS-12 Score; mean (SD)</td>
<td>39.49 (12.5)</td>
<td>43.32 (13.4)</td>
</tr>
<tr>
<td>No. chronic conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>40 (21.9)</td>
<td>14 (37.8)</td>
</tr>
<tr>
<td>1</td>
<td>48 (26.2)</td>
<td>10 (27.0)</td>
</tr>
<tr>
<td>2</td>
<td>44 (24.0)</td>
<td>7 (18.9)</td>
</tr>
<tr>
<td>3 or more</td>
<td>51 (27.9)</td>
<td>6 (16.2)</td>
</tr>
</tbody>
</table>

*P-values were computed using Chi-square tests for categorical variables and Independent t-tests for continuous variables

* Bolded items are significant at a p-value less than 0.05

6.5 Discussion

The objective of this study was to identify factors associated with an increased risk of unplanned 30-day medical/surgical readmission among homeless adults in Toronto. In our multivariate model, only two variables were identified as independent predictors of 30-day readmission.
Leaving hospital against medical advice has previously been found to be associated with an increased risk of readmission (Garland et al., 2013; Choi et al., 2011; Hwang et al., 2003). A recent study reported that 1.1% of index hospitalizations in Manitoba resulted in patients leaving against medical advice (Garland et al., 2013). We found a substantially higher prevalence of discharges against medical advice (9.3%) among homeless adults in Toronto. Individuals who left hospital against medical advice were almost twice as likely to be readmitted compared to those who did not.

Study participants who reported having a primary care physician were more likely to be readmitted within 30 days as compared to those without a primary care physician. Upon further investigation, we determined that individuals with a primary care physician have significantly lower PCS-12 scores than those without. It is thus possible that having a primary care physician is serving as a proxy for illness severity. That individuals with poorer health status would be more likely to be readmitted speaks to the high level of morbidity among this population, and suggests that the health care system is responding to need. Having a primary care physician has previously been shown to be associated with an increased risk of readmission (Hasan et al., 2009). One hypothesis is that having a physician may lead to earlier detection of a deteriorating condition (Hasan et al., 2009). Regardless of the mechanism, it may be considered promising that those individuals who are most likely to be readmitted are connected to the health care system by their primary care physician. As such, primary care physicians could serve as the vehicle for interventions to reduce readmissions among patients who are homeless.
Our study has a number of limitations. The predisposing, enabling and need factors used in this study were derived from HCUH survey data, thus there is a potential for self-report bias. However, a reliance on administrative health data to derive these variables (e.g. mental health problem) might have excluded individuals with poorer access to health care services.

Given the limited number of readmission events, the multivariate analysis presented in this study should be considered exploratory in nature. It is possible that certain variables that are important in explaining readmissions among this population were not found to be significant because of insufficient statistical power. In addition, given the limited sample size, it was not possible to pursue a split-sample design to internally validate our model. However, the primary intent of this exploratory study was not to develop a predictive algorithm of readmissions among patients who are homeless, but rather to identify risk factors associated with hospital readmission among this population. Further research would be needed to develop and validate a predictive algorithm for risk of readmission among patients who are homeless.
Chapter 7

DISCUSSION
7.0 DISCUSSION

7.1 General Discussion

This thesis explored readmission rates among adults with a history of homelessness in Toronto. The studies presented here benefited from the use of both survey data obtained from in-person interviews and linkage to administrative health data. In the context of a single-payer universal health care system, Ontario offers a unique environment in which to study patterns of health care utilization among individuals experiencing homelessness. Moreover, given mounting political pressure to control health care costs and to identify groups with high levels of acute care use, this thesis has shed light on one such population.

In recent years, readmission rates have become an accepted indicator of health system performance. In the U.S., the establishment of the Hospital Readmissions Reduction Program (HRRP) (which ties ‘avoidable’ readmission rates to hospital compensation), will further incentivize hospitals to adopt strategies to reduce readmissions among high risk patient populations (Mitchell et al., 2012). While the HRRP currently applies to Medicare patients only, the program could foreseeably be extended to penalize hospitals for readmissions among Medicaid patients as well (including those who are homeless) (Nardone et al., 2012). Thus there is a need to better understand hospital readmissions among this important subset of the Medicaid population. In Canada as well, there is high interest among decision-makers and hospital administrators in addressing high readmission rates among certain patient populations.

The objective of this thesis was to deepen our understanding of hospital readmissions among homeless individuals in Toronto. Despite a substantial body of literature on readmissions,
there are few studies of hospital readmissions among patients who are homeless, who tend to have unique and complex health care needs.

We found readmission rates that are similar to those reported by Kertesz et al. (21.1%), but substantially lower than the rate (50.8%) reported by Doran and colleagues (2013). There may be several methodological and contextual reasons for these differences. Unlike our analyses (which excluded elective admissions), Doran et al. include both planned and unplanned 30-day readmissions. In addition, it seems that their study hospital caters to a particularly complex patient population, given that they report a high readmission rate (18.7%) even among their control group (general Medicaid patients at the study hospital) (Doran et al., 2013). In contrast, our study found a readmission rate of only 7.0% among low-income controls matched on age, sex, and case mix group to the homeless participants (Objective 2). The high readmission rate reported by Doran et al. (2013) may also reflect fewer support services for homeless individuals residing in the study city, as compared to those that are available in Toronto and Boston.

Buck and colleagues (2012) compared readmission rates among homeless patients to a random sample of housed adults from the same hospital district, and determined that patients who are homeless are at twice the odds of being readmitted. They do not report whether readmissions were planned or unplanned. Furthermore, as with Kertesz et al. (2009), Buck et al. (2012) only include the first readmission event in their analysis. To more accurately reflect the health care utilization patterns of patients who are homeless, we did not censor our data after the first readmission. Rather, we included all readmissions that occurred during the study period and used generalized estimating equations to adjust for some of the dependence across observations. In addition, given our use of administrative health data, we were able to capture readmissions to all other institutions in the province, which was not the case for the aforementioned studies. An
additional strength of our study is that homeless participants were identified through face-to-face interviews, thus we did not have to rely on administrative health data or chart reviews to identify our homeless cohort.

To date, there are no Canadian studies of hospital readmissions among patients who are homeless. This thesis used Ontario administrative health data to address this knowledge gap and to determine hospital readmission rates among a subset of the homeless population in Toronto. In **Objective 1**, we found a substantially higher readmission rate among homeless participants as compared to age- and sex-matched low-income controls in Toronto. Individuals with a history of homelessness were more than three times as likely to be readmitted within 30 days as compared to controls (OR = 3.05, p = 0.015, 95% CI 1.24-7.53).

In **Objective 2**, homeless participants with at least one hospitalization during the study period were matched to low-income controls in Toronto based on age-, sex- and case mix group (CMG) at the time of the first hospitalization. Individuals with a history of homelessness were significantly more likely to be readmitted within 30 days as compared to the age-, sex- and CMG-matched low-income controls (OR = 3.79, p = <0.0001, 95% CI 1.93-7.39).

Objective 1 and 2 of this thesis both compare readmission rates between the homeless cohort and a control group. In the first instance, controls of the same age and sex were selected from low-income neighbourhoods in Toronto. Controls were not required to have been hospitalized during the study period. In contrast, in Objective 2, low-income controls residing in Toronto were matched to the first hospitalization of each homeless participant based on age-, sex- and CMG. Thus, only controls with at least one hospitalization were selected for this cohort.
Objective 1 reported the readmission rate among the homeless cohort and, as a point of reference, the readmission rate of low-income controls in Toronto. This control cohort is expected to be more representative of Toronto’s low-income population given that controls were not required to have been hospitalized for the same conditions as the homeless participants. Thus Objective 1 provides a more generalizable rate of readmission among low-income individuals residing in Toronto. Objective 2 is preferable for reporting the odds ratio of the relationship between homelessness and 30-day readmission given the strong matching criteria and, in particular, the selection of low-income controls who were hospitalized for the same conditions as the homeless participants.

We expected the odds ratio for Objective 2 to be smaller than that found in Objective 1, given that the participants and controls were matched on an additional variable (case-mix group) that would presumably reduce some of the unobserved differences between the two cohorts. That the odds ratios associated with being homeless did not differ significantly between Objective 1 and 2 suggests that the risk of readmission among low-income individuals residing in Toronto is not strongly dependent on the CMG of the person’s initial hospitalization. An alternative explanation is that low-income individuals in Toronto are being admitted for the same types of conditions as homeless individuals, regardless of whether or not they are explicitly matched on CMG. Yet even after accounting for the primary reason for admission, homeless participants continue to be at substantially greater risk of readmission than low-income controls in Toronto. Their poorer health status, in combination with potentially inadequate discharge policies may contribute to their higher propensity for readmission. Furthermore, even when discharge planners do secure a shelter bed for discharged patients, shelter clients are required to vacate the premises during the day, a practice that is likely not conducive to patient recovery. In addition, shelters
are not typically able to provide the follow-up medical care required by newly discharged patients.

Objective 3 focused on risk factors associated with readmission among individuals experiencing homelessness. As part of continuing efforts to improve quality of care and hospital performance, numerous studies have sought to develop predictive models to better understand factors associated with hospital readmissions. Such studies have mainly focused on specific patient groups with a given condition, rather than on more diverse and heterogeneous patient populations (Hasan, 2010). In general, there are few studies that incorporate social determinants of health into their predictive models, which tend to be important risk factors for readmission, particularly among socioeconomically disadvantaged groups (Kansagara et al., 2011). Accordingly, Objective 3 explored both clinical and social variables as potential risk factors for readmission among individuals experiencing homelessness.

Only two variables were found to be independently associated with hospital readmissions among adults who are homeless in Toronto. First, individuals who left against medical advice were almost twice as likely to be readmitted compared to those who did not (OR=1.96; p=0.05, 95% CI 0.99-3.86). Second, individuals who reported having a primary care physician have more than two and a half times the odds of being readmitted within 30 days as compared to those without a primary care physician (OR=2.65, p=0.04, 95% CI 1.05-6.73) (Table 12). Additional analyses suggest that it is possible that having a primary care physician is serving as a proxy for illness severity, a relationship that has been observed elsewhere (Hasan et al., 2009). In addition, Hasan and colleagues (2009) hypothesize that having a primary care physician may contribute to earlier detection of a deteriorating condition, hence a “lower threshold for readmission” (Hasan
et al., 2009). Given limitations in our data, we are unable to determine whether either of these hypotheses is correct.

7.2 Limitations

The analyses presented as part of this thesis have their limitations. Individuals without a valid health card (and with no possibility of probabilistic linkage with administrative health data) were excluded from this analysis, which may contribute to selection bias. Furthermore, 18% of individuals who were screened for the HCUH study refused to participate.

Given the observational design, there remains the possibility of residual confounding from unobserved differences between the homeless cohort and the low-income cohort of Objectives 1 and 2. For example, though controls in Objective 1 and 2 were selected from low-income neighbourhoods in Toronto based on their postal code, this might not reflect the income level of each individual control. It is also possible that some of the low-income controls who were identified through the Registered Persons Database may themselves have been homeless at the time of the study. Using HCUH study survey data, we were able to assess a number of variables (e.g. unmet need for health care) as potential risk factors for readmission among the homeless cohort only. Since low-income controls were identified in administrative databases and not via in-person surveys, we were not able to account for these variables among the control cohort.

The predisposing, enabling and need factors used in Objective 3 were derived from HCUH survey data, thus there is a potential for self-report and recall bias. However, a reliance on administrative health data to derive these variables (e.g. presence of mental health problems)
might have only captured individuals who have better access to health care (and who are thus more likely to receive a mental health diagnosis that is identifiable in administrative health data).

The patient-level risk factors used in Objective 3 were measured at the time of HCUH survey administration, and may not have remained constant throughout the study period. Similarly, the study is only generalizable to individuals with a history of homelessness, given that participants were homeless at the time of recruitment, but their homeless status was not known for the remainder of the observation period.

Though we were able to capture hospitalizations at all institutions in Ontario, readmissions that occurred outside of the province were not captured in our administrative health data. Furthermore, given a limited number of readmission events, it was not possible to control for data clustering at the level of the physician or institution.

Notwithstanding these limitations, which we largely expect to have a conservative bias, the analyses presented here have examined hospital readmissions among an important patient population that has been largely neglected in the literature on hospital readmissions.

7.3 Future Directions

Further research is needed to estimate the proportion of potentially preventable readmissions among the homeless cohort (for example, the extent to which the primary reason for readmission is related to the initial diagnosis).

A future direction for research is to examine psychiatric admissions and readmissions among the homeless population, who tend to experience high levels of mental health illness. To
our knowledge, there are no previous studies of psychiatric readmissions among patients who are homeless.

Identifying individuals at risk of readmission through predictive modeling is the first step in developing strategies to improve care and health outcomes of high-risk patients (Billings, Steventon, Georghiou, Lewis, Bardsley, 2012). However, the fundamental objective is to couple predictive indexes with evidence-based interventions that reduce the risk of readmission and that invest the ensuing savings back into funding the intervention (Billings et al., 2012). Yet Billings and colleagues (2012) acknowledge that “unfortunately, only a modest amount is known about what works, and for whom, in reducing re-admissions”. This knowledge gap is particularly true of individuals experiencing homelessness, particularly in the Canadian context. In Canada, there are three established medical respite programs for the homeless, two of which are in Toronto (the Rotary Club of Toronto Infirmary at Seaton House and the Sherbourne Infirmary) (Edgington, 2011). Canada’s third respite program is the Booth Centre Special Care Unit located in Ottawa. Further research is needed to evaluate the influence of these programs and other such interventions on readmission rates among this population.

### 7.4 Conclusions

In recent years, hospital readmission rates have become a widely used performance indicator as they are considered markers of potentially poor quality of care or inadequate discharge planning. This thesis examined hospital readmissions among a ‘high risk’ patient population. We found substantially higher rates of hospital readmission among homeless individuals as compared to age and sex matched low-income controls. Even after accounting for the primary reason for admission, readmission rates remained substantially higher among
patients who are homeless. Among the homeless cohort, leaving against medical advice was associated with an increased risk of readmission, as was having a primary care physician.

While the use of hospital readmission rates as a performance indicator remains controversial, particularly when applied to performance-based compensation, there is increased recognition of the substantial costs associated with hospital readmissions. Accordingly, the United Kingdom’s Department of Health recently announced a £10 billion initiative to reduce readmissions among patients who are homeless (Weakley, 2013). What is yet to be seen is whether additional jurisdictions will adopt such sizeable, targeted efforts to address hospital readmissions among this patient population.
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