Understanding the effects of Housing First for homeless people with mental illness on patterns of service use over time: An application of latent class growth analysis

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Abstract

Background: Previous studies have established the efficacy of Housing First (HF), a recovery-oriented housing intervention, in reducing utilization of other services in homeless individuals with mental illness. Less is known about how HF affects patterns of service use over time and characteristics associated with various trajectories of utilization. This study explores trajectories of shelter utilization and ambulatory visits in a randomized controlled trial of HF conducted across five Canadian cities.

Methods: Data from the At Home/Chez Soi trial was used. Homeless Canadians with mental illness were recruited from October 2009 to July 2011 and randomized to HF or treatment-as-usual (TAU). Latent class growth analysis was used to identify trajectories of the utilization of two costly services over 24 months: shelters (n=2058) and ambulatory visits (n=2127). Specific ambulatory visits of interest were addiction/mental health services excluding, and including, visits provided as part of the intervention, as well as physical health services. Types of addiction, mental health, and physical health service providers used by participants were also assessed. Shelter use was ascertained for the past month with trajectories modelled across 24 time points. Ambulatory visits were estimated for the previous 6-month period with trajectories mapped across 5 time points, of which the first preceded entry at baseline. Multinomial logistic regression was used to determine which baseline variables, including treatment group, could predict class membership.

Results: Four classes of trajectories were identified for shelter use: *consistently low* (n=1631, 79.3%)*, mostly low* (n=120, 5.8%)*, early increase* (n=179, 8.7%)*,* and *late increase* (n=128, 6.2%). Treatment group was a significant predictor of class membership - those enrolled in HF had higher odds of experiencing trajectories of low shelter use. Other variables associated with lower shelter use included younger age, less time homeless, alcohol abuse or dependence, and moderate/high suicide risk. Four classes of trajectories of addiction and mental health ambulatory visits (excluding intervention visits) were identified: *decreasing-then-increasing* (n=831, 39.1%), *increasing* (n=198, 9.3%), *decreasing* (n=776, 36.5%), and *consistently low* (n=322, 15.1%). When intervention visits were included, the resulting classes became: *mostly decline* (n=1108, 52.1%), *increase until midway then gradual decline* (n=285, 13.4%), *sharp*

drop then constantly low (n=499, 23.5%), and *consistently low* (n=235, 11.0%). Four trajectories were also identified for physical health visits: *mostly decline* (n=688, 32.4%), *rise until midway then decline* (n=313, 14.7%), *sharp drop then constantly low* (n=545, 25.6%), and *consistently low* (n=581, 27.3%). Treatment group was a significant predictor of class membership in addiction/mental health service use (excluding intervention visits) and physical health service use, as HF participants were more likely to experience a trajectory of low or decreasing visit rates compared to those provided usual services. Including intervention visits to trajectories of addiction/mental health visits led to a weakened effect of HF on trajectory prediction. Other variables associated with lower addiction/mental health ambulatory visits included not having Indigenous or minority background, no psychiatric hospitalization history, no psychotic disorder at baseline, and lower level of functioning. Variables associated with less physical health visits included being male, not having Indigenous or minority background, lower education, no drug abuse or dependence, lower level of functioning, less family social support, and less physical comorbidities. Among addiction/mental health visits outside of the intervention, nurse visits were the most common for all classes. Social workers were also one of most used providers in classes exhibiting higher use trajectories. When including intervention visits, classes with the greatest use now showed case managers to be the top used provider. TAU participants reported nurses to be the most contacted provider for addiction and mental health visits. Outside of the intervention, HF participants had the most pharmacist visits, but reported case manager visits to be the most frequent when intervention services were accounted for. For physical health visits, the class with the highest trajectory of use showed the most contacts with family doctors. The most contacted provider for physical health reasons was nurses for the TAU group, and family doctors for the HF group.

Conclusion: This study describes the effects of HF and other baseline characteristics on the likelihood of following particular trajectories of shelter utilization and ambulatory visits. Results indicate heterogeneity in not only the patterns of service use, but also in service user characteristics, as the profiles of individuals experiencing distinct trajectories appear to differ as well. Increased understanding of service use trajectories and characteristics of individuals with costly patterns of use can help to inform service planning and contribute to modelling efforts for homelessness.

Resumé

Contexte: Des études antérieures ont établi l'efficacité du Logement d'abord, ou *Housing First* (HF), une intervention de logement axée sur le rétablissement, dans la réduction de l'utilisation d'autres services chez les personnes sans abri atteintes de maladie mentale. On en sait moins sur la façon dont HF affecte les modes d'utilisation des services au fil du temps et les caractéristiques associées aux diverses trajectoires d'utilisation. Cette étude explore les trajectoires d'utilisation des refuges d'urgence et des visites ambulatoires dans le cadre d'un essai contrôlé randomisé de HF mené dans cinq villes canadiennes.

Méthodes: Les données de l'étude expérimentale At Home / Chez Soi ont été utilisées. Des Canadiens en situation d'itinérance atteints de maladie mentale ont été recrutés entre octobre 2009 et juillet 2011 et ont été répartis au hasard en groupes HF ou traitement habituel (*Treatment as usual* - TAU). L'analyse de la croissance des classes latentes (*latent class growth analysis*) a été utilisée pour identifier les trajectoires de classes de l'utilisation de deux services coûteux sur 24 mois: les refuges (n = 2058) et les visites ambulatoires (n = 2127). Les visites ambulatoires spécifiques d'intérêt étaient les services de toxicomanie / santé mentale excluant, et incluant, les visites fournies dans le cadre de l'intervention, ainsi que les services de santé physique. Les types de fournisseurs de services de toxicomanie, de santé mentale et de santé physique utilisés par les participants ont également été évalués. L'utilisation des refuges, mois par mois, a été obtenue par questionnaire, et les trajectoires modélisées avec 24 intervalles de temps. Les nombres de visites ambulatoires ont été estimés au cours de chaque période de six mois précédente et les trajectoires ont été réparties sur cinq intervalles temporels, dont le premier précédait le moment de l'entrée dans l'étude. La régression logistique multinomiale a été utilisée pour déterminer quelles variables mesurées au moment de l'entrée dans l'étude, y compris le groupe de traitement, pouvaient prédire l'appartenance à une classe.

Résultats: Quatre catégories de trajectoires ont été identifiées pour l'utilisation des refuges: *toujours faible* (n = 1631, 79,3%), *généralement faible* (n = 120, 5,8%), *augmentation précoce* (n = 179, 8,7%) et *augmentation tardive* (n = 128 , 6,2%). Ceux qui étaient inscrits dans HF, de même que ceux d'âge plus jeune, qui avaient passé moins de temps en itinérance, qui abusaient ou étaient dépendants à l'alcool et avaient un risque modéré ou élevé de suicide, avaient des

chances plus élevées de connaître des trajectoires de faible utilisation des refuges. Quatre classes de trajectoires de toxicomanie et de visites ambulatoires en santé mentale (excluant les visites d'intervention) ont été identifiées: *décroissante-puis-croissante* (n = 831, 39,1%), *croissante* (n = 198, 9,3%), *décroissante* (n = 776, 36,5 %), et *toujours faible* (n = 322, 15,1%). Lorsque les visites d'intervention ont été incluses, les classes résultantes sont devenues: *principalement décroissantes* (n = 1108, 52,1%), *augmentées jusqu'à mi-chemin puis déclin graduel* (n = 285, 13,4%), *forte baisse puis constamment faible* (n = 499, 23,5%) et *toujours faible* (n = 235, 11,0%). Quatre trajectoires ont également été identifiées pour les visites de santé physique: *déclin général* (n = 688, 32,4%), *montée jusqu'à mi-chemin puis diminution* (n = 313, 14,7%), *chute brutale puis constamment faible* (n = 545, 25,6%) et enfin *toujours faible* (n = 581, 27,3%). Les participants à HF étaient plus susceptibles de connaître une trajectoire de visites faible ou décroissante par rapport aux services habituels, pour les visites de toxicomanie/de santé mentale (à l'exclusion des visites d'intervention) et de santé physique. L'inclusion de visites d'intervention à des trajectoires de toxicomanie / de santé mentale a entraîné un affaiblissement de l'effet HF sur la prévision de la trajectoire. D'autres variables associées à des visites ambulatoires de moindre dépendance ou de santé mentale comprenaient le fait de ne pas avoir d'antécédents autochtones ou minoritaires, pas d'antécédents d'hospitalisation psychiatrique, pas de trouble psychotique au départ et un niveau de fonctionnement inférieur. Les variables associées à avoir moins de visites de santé incluaient le fait d'être un homme, de ne pas avoir d'origine autochtone ou minoritaire, un niveau de scolarité inférieur, un abus de drogue ou une dépendance, un fonctionnement inférieur, moins de soutien social familial et moins de comorbidités physiques. Parmi les visites de toxicomanie / santé mentale à part de l'intervention, les visites d'infirmières étaient les plus fréquentes dans toutes les classes. Les travailleurs sociaux étaient également l'un des fournisseurs les plus utilisés dans les classes présentant des trajectoires d'utilisation plus élevée. Lorsque les visites d'intervention étaient incluses, les gestionnaires de cas devenaient les fournisseurs les plus utlisés dans les classes démontrant des plus hauts taux d'utilisation. Les participants TAU ont rapporté que les infirmières étaient le fournisseur le plus contacté pour les visites de toxicomanie et de santé mentale. Excluant l'intervention, les visites de pharmaciens étaient les plus fréquentes chez les participants HF, mais les visites des gestionnaires de cas étaient les plus fréquentes lorsque les services d'intervention étaient pris en compte. Pour les visites de santé physique, dans la classe ayant la trajectoire d'utilisation la plus

élevée, les médecins de famille étaient le type de fournisseur le plus courant. Le fournisseur le plus contacté pour des raisons de santé physique était le personnel infirmier pour le groupe TAU, et les médecins de famille pour le groupe HF.

Conclusion: Cette étude décrit les effets de HF et d'autres caractéristiques à l'entrée dans l'étude sur la probabilité de suivre des trajectoires particulières d'utilisation des refuges et de visites ambulatoires. Les résultats indiquent une hétérogénéité non seulement dans les profils d'utilisation des services, mais aussi dans les caractéristiques des utilisateurs de services, car les profils des personnes ayant des trajectoires distinctes semblent également différer. Une meilleure compréhension des trajectoires d'utilisation des services et des caractéristiques des personnes ayant des profils d'utilisation coûteux peut aider à informer la planification des services et contribuer aux efforts de modélisation de l'itinérance.

Preface

This thesis explores the trajectories of service utilization and characteristics that may predict service use in a Canada-wide randomized controlled trial of Housing First. Chapter 1 introduces the topic of homelessness and the utilization of health, social, and justice services by individuals experiencing homelessness. In Chapter 2, an overview of homelessness in Canada is presented, along with a summary of current literature pertaining to the complications encountered by homeless individuals and their utilization of services. The effectiveness of Housing First as a homelessness intervention and applications of latent growth modelling methods are also summarized. Chapter 3 states the objectives of this thesis. Chapter 4 summarizes the study methodology, including details of the randomized controlled trial from which data were drawn and statistical approaches used. In Chapter 5, the results of the study are presented. Chapter 6 discusses the findings along with their implications. Concluding statements and directions for future research are presented in Chapter 7.

This thesis has been prepared in accordance with the guidelines for a "Traditional Monograph Thesis."

A description of the contribution of authors is provided on page ix.

Contribution of Authors

The idea for this thesis topic as well as specific study objectives were developed by Dr. Eric Latimer. This thesis consists of a secondary analysis of data collected from a completed randomized controlled trial of Housing First. Dr. Eric Latimer was the lead investigator for the Montreal site of that study, as well as its lead economist nationally.

The literature review presented in this thesis was conducted by Cherry Chu. The methodology used in the analysis was established jointly by Cherry Chu and Dr. Erica Moodie. Available literature was reviewed by Cherry Chu for inspiration on potential approaches, with the analysis plan carefully refined by Dr. Erica Moodie.

All data manipulations and statistical analyses were performed by Cherry Chu. Statistical guidance was provided by Dr. Erica Moodie in several aspects of analysis such as model selection and data interpretation.

All sections of this thesis were written by Cherry Chu, with revisions by Dr. Eric Latimer, Dr. Erica Moodie, and Dr. David Streiner.

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List of Abbreviations/Acronyms

ACE: Adverse Childhood Experience

ACT: Assertive Community Treatment

AHCS: At Home/Chez Soi

BIC: Bayesian Information Criterion

CFS: Child and Family Services

CI: Confidence Interval

CTI: Critical Time Intervention

COH: Canadian Observatory on Homelessness

DSM-IV: Diagnostic and Statistical Manual of Mental Disorders – 4th edition

ED or ER: Emergency Department or Emergency Room

FIML: Full Information Maximum Likelihood

HIV: Human Immunodeficiency Virus

HF: Housing First

HN: High Needs

HSJSU: Health, Social, and Justice Service Use

ICD-10: International Classification of Diseases – 10th revision

ICM: Intensive Case Management

IPS: Individual Placement and Support

LCGA: Latent Class Growth Analysis

MCMC: Markov Chain Monte Carlo

MCAS: Multnomah Community Ability Scale

MINI: Mini-International Neuropsychiatric Interview

MLR: Multinomial Logistic Regression

MN: Moderate Needs

OR: Odds Ratio

QOLI-20: Quality of Life Index – 20 item

RTLFB: Residential Time Line Follow-Back

TAU: Treatment as Usual

VIF: Variance Inflation Factor

1. INTRODUCTION

Homelessness is a serious social challenge that continues to be widespread in Canada. Homeless individuals are vulnerable to many complications due to factors such as poor living conditions, histories of trauma, and lack of social support. Psychiatric illnesses, poor physical health, substance abuse or dependence, and involvement with the criminal justice system are all familiar issues within the homeless population.[1] As a result, homeless individuals are among the most frequent users of services including hospitalizations, ambulatory visits, shelters, and incarcerations. Utilization of services also places a large economic burden on society - costs have been estimated to approach $60,000 per year for homeless people with mental illness in large Canadian cities.[2] It is therefore of great interest to be able to understand the dynamics behind how homeless Canadians use services, and whether specific homelessness interventions are effective in reducing service use in this population.

Emergency responses to homelessness have been implemented for years with no significant improvements to the situation. Consequently, many jurisdictions in developed nations, including Canada, are now reforming their service systems to end, rather than manage, homelessness.[3] Housing First (HF), an intervention model which incorporates the provision of immediate access to permanent housing with individualized support services, plays a crucial role in ending homelessness.[4] In part by adopting the HF approach on a sufficient scale, some jurisdictions in Canada, USA, and Europe have virtually eliminated homelessness.[5-7]

The At Home/Chez Soi (AHCS) study, a large randomized controlled trial of the HF intervention conducted in five Canadian cities (Vancouver, Winnipeg, Toronto, Montreal, and Moncton), has demonstrated that HF is effective in increasing housing stability and improving quality of life for homeless people with mental illness. It was also found that, for all high need and moderate need participants across all sites, over 50% of the costs of the intervention were recovered from reductions in social, health, and justice service use such as shelters, emergency department visits, and incarcerations.[8 9]

This thesis explores the utilization of health and social services in a broad sample of homeless Canadians participating in AHCS. The main objective was to model and classify trajectories of two important and costly services used by homeless people, namely shelters, and ambulatory services (in particular, addiction and mental health service visits, and physical health service visits).

Modelling trajectories provides insight into not only the cumulative or average frequency/duration of homeless service utilization, but also the specific patterns of utilization over time. As a result, trajectory analyses take full advantage of the data collected from longitudinal studies. Such analyses are also of great interest as there are direct economic implications associated with different trajectories of homeless service utilization. Furthermore, understanding predictors of specific high-use trajectories may serve to generate hypotheses about interventions targeted to those most at risk.

With the goal of improving planning to end homelessness, some Canadian research teams have been investigating various forms of systems modelling.[10-12] Such models must be calibrated using real-world data that realistically portray the dynamics of homelessness to prove fruitful. By developing trajectory models of shelter and ambulatory service utilization, we gain insight into how homeless Canadians use health and social services over time, what individual characteristics are associated with certain classes of utilization trajectories, and how utilization is affected by the provision of HF. This information can then be incorporated into simulation models of homelessness, and can also contribute to the knowledge base underlying the transformation of homeless services in Canada.

2. LITERATURE REVIEW

2.1 Preface

A literature review was conducted to evaluate the current knowledge of homelessness and service utilization in individuals experiencing homelessness. The focus of this review was to briefly describe homelessness, and to identify what types of services are frequently used by homeless individuals, to what extent these services are used by homeless persons in comparison to the general population, the risk factors associated with increased homeless service use, and whether specific interventions have been shown to be effective at reducing service utilization in this population. Emphasis was placed on identifying studies that have analyzed trajectories of homeless service utilization using a time-patterned approach, in line with the methodology of this thesis. Housing First (HF) studies were reviewed to investigate the efficacy of HF in improving outcomes, especially service utilization, among people experiencing homelessness. This review also incorporated literature pertaining to latent growth modelling and applications of methods such as latent class growth analysis. Relevant articles were selected from the MEDLINE database, and included studies conducted in North America and published from 2000 to 2017.

Articles referenced in Section 2.2, Background on Homelessness, were analyzed for the following information: causes of homelessness, characteristics of homeless individuals, and health outcomes. Findings pertaining to the use of shelters or housing, psychiatric or general hospitals, emergency departments, substance use treatment, and the justice system were extracted from studies included in Section 2.3, Service Use in Homeless Populations. Studies referenced in Section 2.4, Housing First, were examined for results concerning the effects of HF on the following outcomes: housing, health, substance use, service use, and employment. Publications cited in Section 2.5, Latent Class Growth Analysis, were reviewed for information relevant to latent class growth analysis (LCGA) and other forms of latent variable modelling, including their applications, with a focus on studies applying such methods to homelessness research.

It is noted that the aim of this chapter was not a systematic review, but rather a summary of the relevant literature currently available.

2.2 Background on Homelessness

The Canadian definition of homelessness, proposed by the Canadian Observatory on Homelessness (COH), describes as homeless an individual or family who does not possess "stable, permanent, appropriate housing, or the immediate prospect, means, and ability of acquiring it." A typology was developed by the COH to describe the various accommodations, or lack thereof, that are accessed by the unstably housed population. The first class is *unsheltered*, which characterizes people without housing but are not staying in emergency shelters nor other types of accommodation. The *emergency sheltered* describes those unable to secure permanent housing and therefore must access supports such as emergency shelters. *Provisionally accommodated* homeless people are accessing accommodation currently, but this accommodation is temporary. Lastly, the *at risk of homelessness* group refers to people who are currently housed, but their housing is unstable and therefore may be at risk of becoming homeless.[13] Table 1 describes in further detail the typology for homelessness, as reported by the COH.

Table 1: COH Typology of Homelessness[13]

CATEGORY	ATTRIBUTES
Unsheltered	1.1 People living in public or private spaces without consent or contract • Public space, such as sidewalks, squares, parks, forests, etc. • Private space and vacant buildings (squatting) 1.2 People living in places not intended for permanent human habitation • Living in cars or other vehicles • Living in garages, attics, closets or buildings not designed for habitation • People in makeshift shelters, shacks, or tents
Emergency Sheltered	2.1 Emergency overnight shelters for people who are homeless • May be oriented towards specific subpopulations such as women, families, youth, or Indigenous persons • Stays may be short-term (eg. in response to extreme weather conditions) or on an ongoing basis 2.2 Shelters for individuals/families impacted by family violence • Residents are not required to leave during the day • Private rooms are offered to families with a range of supports to help residents rebuild their lives 2.3 Emergency shelter for people fleeing a natural disaster or destruction of accommodation due to fires, floods, etc.
Provisionally Accommodated	3.1 Interim housing for people who are homeless • Sometimes referred to as "transitional housing" • Used as temporary accommodation between a period of unsheltered homelessness or emergency accommodation, to permanent housing • Time limitations on residency, but allows for longer stays than emergency shelters 3.2 People living temporarily with others, but without guarantee of continued residency or immediate prospects for accessing permanent housing • Often referred to as "couch surfers" or the "hidden homeless" • Stays with friends, family, or strangers as a temporary means of accommodation, without plans of acquiring permanent housing in the future 3.3 People accessing short term, temporary rental accommodations without security of tenure • Stays in non-permanent accommodations such as motels, hostels, rooming houses, etc. 3.4 People in institutional care who lack permanent housing arrangements • No arrangements in place to ensure a move into safe, permanent housing upon release from institutional care • Includes persons who: o were homeless prior to admittance and have no plan for permanent accommodation after release o had housing prior to admittance, but lost their housing while in institutional care o had housing prior to admittance, but cannot go back due to changes in their needs

	• Institutional care includes: penal institutions, medical/mental health institutions, residential treatment programs or withdrawal management centers, children's institutions/group homes 3.5 Accommodation/reception centers for recently arrived immigrants and refugees • Temporarily housed prior to securing their own housing • If no prospects of securing permanent housing, then they are considered homeless
At Risk of Homelessness	4.1 People at imminent risk of homelessness • Factors that may contribute to this stage include: o Precarious employment o Sudden unemployment o Supported housing with supports that are about to be discontinued o Households facing eviction o Severe and persistent mental illness, active addictions, substance use and/or behavioural issues o Division of household o Violence/abuse (or direct fear of) in current housing situations o Institutional care that is inadequate or unsuited 4.2 Individuals and families who are precariously housed • Experiences of severe housing affordability problems due to income, local economy, and/or lack of availability of affordable housing that meet their needs • May or may not become homeless in the immediate or near future, but those who manage to retain their housing in such circumstances often do so at the expense of meeting other important needs

In Canada, an estimated 14 400 people stay in shelters nightly, 150 000 people annually, and approximately 150-300 000 individuals are homeless in a given year.[14] *The State of Homelessness in Canada 2016* report estimated that 35 000 Canadians are homeless on any given night. Furthermore, the homeless population in Canada consists of a diverse range of individuals, including 27.3% women and 18.7% youth. Within the shelter population, 28-34% are Indigenous persons, and approximately 2950 veterans are homeless. In addition, the number of homeless adults and seniors over age 50 is increasing, accounting for 24.4% of shelter users.[15]

Numerous factors and causes may precipitate homelessness. Commonly reported personal reasons include unemployment or loss of income, substance use problems, physical and medical health problems, mental health and emotional problems, family conflicts and divorce/breakup, contacts with the criminal justice system, poverty, traumatic early childhood experiences and victimization, domestic violence, veteran or refugee status, and sexual orientation.[14] [16-23]

Environmental precipitants of homelessness include lack of affordable housing, lack of employment opportunities, absence of income support, eviction, release from institutional care, and income inequality within the country.[14 18 19 21 22]

Homelessness is also associated with many health complications, including higher rates of mental illness, substance use problems, and physical health issues in this population compared to non-homeless individuals.[24-28] Common psychiatric problems faced by homeless people include psychosis, major depressive disorders, post-traumatic stress disorder, suicidal ideation, cognitive impairment, and alcohol or drug dependence, while common medical problems include sexually transmitted illnesses (eg. HIV, gonorrhea), communicable diseases (eg. hepatitis), respiratory disorders (eg. asthma, tuberculosis), and dental problems.[14 18 21 24 25 28-31] Higher rates of mortality are also reported among homeless people[14], and this is due not only to the increased presence of morbidities in this population, but also due to the risk of homelessness itself.[32 33]

2.3 Service Use in Homeless Populations

As homeless individuals often live in distressing conditions and have numerous comorbidities, their rates of health and social service use (e.g., treatment for medical, surgical, and psychiatric purposes, substance abuse programs, shelters and housing, incarcerations) are high compared to those of the general population.[34-39] It is generally the case that most service use in the homeless population is by a small proportion of frequent users, and is often not limited to one service.[36 40] Some factors associated with increased service use or use of a greater variety of services in homeless populations include substance use problems, diagnosis or symptoms of mental illness, poorer physical health, criminal or delinquent behaviour, and less stable housing.[41-44]

Service utilization among homeless individuals generates a significant economic impact to society as well. Several studies reporting outcomes of health and social service use among the homeless population have also delved into the costs associated with the provision of services relating to behavioural or mental health, medical care, homelessness amelioration, shelters, and incarcerations. These costs are generally much higher among homeless individuals than among those who are stably or consistently housed.[45-48]

An observational study by Lim et al., one which did not employ an intervention, identified six different incarceration and shelter stay trajectories among their sample over 3 years: temporary, transition to homelessness, transition to incarceration, transition from incarceration, transition from homelessness, and continuously homeless. The majority showed a temporary pattern, with occasional brief incarcerations and shelter stays. Conversely, members of the continuously homeless group were characterized by prolonged shelter stays, and this group was much more likely to consist of older participants. The transitional trajectories were categorized depending on their change in incarceration or shelter use rates - for example, transition to homelessness represented an increasing use of shelters, while transition from incarceration meant decreasing incarceration rates over time. These contrasting trajectories also highlighted differing outcomes for their class members, such as those demonstrating a temporary pattern reporting almost twice the all-cause mortality risk and drug-related death than those continuously homeless.[49]

Much of the current literature has examined whether providing a housing intervention would influence service utilization among homeless people, and mixed results have been reported. A retrospective cohort study by Kessell et al. that compared supportive housing to usual care found that there was a slight increase in service contact rates post-intervention compared to the pre-intervention period, and there was no significant difference in the average or change in service utilization between the supportive housing group and the usual care group.[40] A 26-month longitudinal study by Pollio et al. found that homeless participants who achieved 24 months of stable housing at baseline exhibited a significantly different service use trajectory compared to those who were unhoused at baseline and throughout the study. In particular, the housed group showed the greatest service use in the time shortly before and after housing was achieved, with service use declining sharply in the first couple of months after becoming housed, while the unhoused group saw a linear decline in use of services over time. From these results, the authors concluded that a multiphase intervention would be ideal, where the level of service intensity varies according to the participants' current stage of needs.[50]

On the other hand, Hwang et al. reported that overall service use including medical hospitalizations, emergency department (ED) visits, and psychiatric treatment did not change

over time within individual subjects or between groups, where one group received supportive housing and the other group, usual care.[51]

The next few sections will focus in greater detail on studies concerning patterns of use of significant services commonly accessed by homeless people: public shelters, justice-related services, psychiatric or medical hospitalizations, ambulatory care, emergency departments, mental health services, and substance abuse or dependence programs.

2.3.1 Public Shelters

Many studies have described shelter utilization in homeless populations.[52-55] Using administrative data, Kuhn and Culhane defined a typology of homelessness based on the frequency and duration of public shelter use in NYC and Philadelphia. Three groups were identified: transitionally, episodically, and chronically homeless. Results indicated that the largest proportion of shelter users was transitionally homeless, and were more likely to be younger and Caucasian, but less likely to have psychiatric or medical complications. The episodically homeless were also young, but more likely to be of non-Caucasian origins and to present with health complications. The chronically homeless were responsible for half of the total shelter days, and tended to be older, non-Caucasian, and have high levels of health problems.[56] A typology for homeless persons was further investigated by Culhane et al., where they examined public shelter utilization in homeless families, and again established three clusters of shelter users: transitional, chronic, and episodic. The transitionally or temporarily sheltered group typically reported a single, relatively short episode of shelter use, and accounted for most of the sample. The chronically sheltered reported fewer than 1.5 episodes of somewhat long shelter use, and claimed half the total bed days despite being a small group. The episodically sheltered group showed repeated shelter use episodes that were quite short, yet demonstrated the highest rates in the utilization of other services, including inpatient psychiatric and substance abuse treatments. Surprisingly, this group reported the highest rates of disability, unemployment, and foster care involvement, whereas the chronically sheltered group reported the lowest rates.[57]

In contrast to the previous studies, which used a time-aggregated approach to describe shelter utilization and homelessness, McAllister et al. used a time-patterned approach. As noted by the authors, cumulative frequency and duration measures fail to represent the unique patterns of shelter stays that individuals experience over time. To accurately depict these trajectories, McAllister et al. used a time-patterned approach which captured the timing, duration, and sequence of homelessness. Their results suggested a typology consisting of ten subgroups, which were further divided into four sets based on their patterns of shelter utilization: temporary, structured-continuous, structured-intermittent, and unstructured-intermittent. The temporary set was comprised of groups who often exit shelters within a month without further re-entry. The structured-continuous set continuously stayed in shelters each month until exit. Length of time spent in shelters varied among the groups in this set, but re-entry was often limited to only once or twice and for a short time. The structured-intermittent set of groups showed sequences of shelter and non-shelter use, with stays lasting at least a month. Lastly, the unstructured-intermittent set exhibited significant variations in sequences of shelter and non-shelter use.[58]

A more recently published study by Gleason et al. also employed a temporal approach to analyzing homeless shelter utilization. Results were reported on the use of emergency shelters, transitional shelters, and outreach services in homeless people in Hawaii, where four distinct trajectories were found: “low service use”, “typical transitional shelter use”, “atypical transitional service use”, and “potential chronic service use”. The low service use group demonstrated low use of all three services, and included most of the sample. Those in the typical transitional shelter use class reported high transitional shelter use initially, followed by a steady decline to near-zero levels by 36 months, and was associated with being female, having employment, and absence of mental illness. The atypical transitional service use group reported increasing levels of transitional shelter use by the end of the observation period, in addition to high levels of outreach service and emergency shelter use. This class was associated with employment, lower education levels, and physical disability. Finally, members of the potential chronic service use class had high but inconsistent use of emergency shelter and outreach service use. This subgroup was described by the authors as showing a trajectory similar to that seen in chronically homeless people. Predictors of this trajectory included male sex, older age, and physical disability.[59]

A recurring topic of investigation is the change in shelter utilization in homeless individuals following an intervention. The two-year NY/NY supportive housing intervention was found to significantly reduce shelter use when comparing participants pre and post-housing, as well as when comparing these housed participants to matched controls not provided the intervention.[52] A study on participants receiving Assertive Community Treatment as part of the ACCESS program reported that the use of vocational assistance and other supportive services was reported to decrease the risk of shelter utilization. Surprisingly, participants with increased use of housing services within the program had a higher risk of shelter use. Authors noted that this may be due to two reasons: the confounding effect of housing need, as individuals receiving housing assistance may have increased housing needs, and the fact that case managers occasionally placed street-dwelling clients into shelters due to restraints in resources for residential placements. This same study also found that shelter utilization was predicted by younger age, fewer years of schooling, and a prior history of shelter use.[54]

2.3.2 Criminal Justice System

Elevated levels and durations of incarceration are often associated with homelessness.[38 44 53 60-62] Commonly reported reasons for incarcerations include drug related crimes, court order misconducts, property violations or vandalism, violence, and deception or forgery.[44 60] Studies have emphasized a higher likelihood of incarcerations in homeless persons, particularly among those with mental illness and/or substance abuse or dependence. Homeless individuals with alcohol and/or drug use disorders were more likely to be involved with the criminal justice system than those without, and among those without a substance use disorder, mental health services utilization was associated with criminal justice system involvement.[63] Increased odds of arrest were also reported in individuals with referral to treatment from the criminal justice system.[60] Significant factors associated with arrest behaviour among homeless youth include longer history of homelessness, previous juvenile detention or incarceration experience, using theft as sole income source, alcohol and/or drug dependency or abuse, and major depressive or manic episodes.[44] Higher levels of incarcerations have also been reported in homeless males than females[64], and in homeless adult women than adolescent women.[65] Furthermore, it was found that homeless inmates had longer durations of incarceration than non-homeless ones, and the

durations were significantly longer among homeless individuals with a dual diagnosis of severe mental illness and substance use disorder than those without.[61] A systematic review investigating the correlates of criminal justice system contacts have reported similar results.[66] Another study revealed that among the homeless individuals who were re-arrested during a two-year period, the vast majority exhibited an episodic re-arrest pattern, while the remaining showed a continuous trajectory of re-arrest. Significant predictors of episodic re-arrest included Indigenous ethnicity and history of victimization, while a continuous re-arrest trajectory was associated with frequent involvement with the criminal justice system for non-violent offenses, and history of a single theft arrest.[67]

Certain housing interventions have shown evidence of improving criminal justice system involvement among homeless people. As part of the study on the NY/NY supportive housing intervention, significant reductions in the number of incarcerations and days incarcerated were reported in the post-intervention period for the experimental group (compared to pre-intervention), and also when comparing this housed group to a matched control group.[52]

2.3.3 Health Services

Medical and psychiatric hospitalizations, ambulatory care (e.g., hospital outpatient clinics, community health clinics, physician offices), emergency department visits, and mental health services are among the most costly services regularly used by homeless people.[38 47 68-76] Homeless patients have more frequent admissions to inpatient care and EDs for both medical and psychiatric reasons, longer lengths of stay, higher likelihood of readmissions, higher total charges per patient, and more ambulatory care contacts than non-homeless patients.[33 36 77-80] One study reported that single men, women, and adults in families were much more likely to have had psychiatric hospitalizations if they were homeless, compared to their age and gender-matched, low-income controls.[36]

Culhane et al. obtained results that were somewhat unconventional compared to previously published findings, in that service use in homeless families decreased during periods of residential instability. The authors characterized three different classes of utilization in a study

using three-year longitudinal data. The "temporarily homeless" group saw a sharp drop in inpatient psychiatric treatment from before shelter entry to during shelter stay, but increased to even higher numbers post-discharge. The "episodically homeless" class saw a slight decline from before to during shelter stay, but again escalated post shelter discharge. The "chronically homeless" group reported lower rates of inpatient use but demonstrated no significant change in trajectory during the three years. This same study investigated service use depending on the type of housing exit, and found that the use of inpatient behavioural services increased significantly after entry into permanent housing or other housing arrangements, but was especially pronounced for non-subsidized housing.[48]

Predictors correlated with increased utilization rates of health services among the homeless population include food insufficiency, chronic physical illnesses and comorbidities, poor physical health, psychiatric illnesses and use of mental health services, substance use problems, dual diagnosis of mental illness and substance abuse/dependence, sensory impairments, disability, barriers to primary care, female sex, older age, single adult status (as opposed to family status), family conflicts or abuse, less family support, victimization, history of criminal activity or violence, less education, and lower income.[33 42 63 68 70-72 74 75 78 81-90] However, other studies have found conflicting results. For example, higher education was reported to be associated with an increased likelihood of outpatient visits.[91] Among homeless veterans, males were found to have fewer than half as many outpatient visits as females, but many more ED visits.[92] Some studies have shown that younger age was associated with ED use or re-admission[37 39 79] and older age was linked to ambulatory visits[39], while others have reported more ambulatory visits among adolescents or younger adults than older adults.[65 93] For psychiatric hospitalizations, sources have reported that older age and previous incarcerations were associated with a lower likelihood of psychiatric service use[72 75], or that variables such as age, education and substance use were not related to service use.[55 94] A study on sheltered youth found that they were more likely to use outpatient clinics than street youth, while more street youth reported ED visits, and it was more likely that their stay was related to drug or alcohol problems. Among the sheltered youth, the following findings were reported: being younger or male was associated with an ED visit due to drug or alcohol use, females were more likely to report inpatient

hospitalization, and older youth were more likely to have used the ED and have an inpatient stay.[95]

Reasons for hospitalizations, outpatient contacts, and ED visits for physical health purposes include communicable diseases (e.g., hepatitis C, HIV), alcohol and drug related problems, injuries, dental diseases, respiratory or cardiovascular conditions, endocrine problems (e.g., diabetes), gastrointestinal disorders, and poisonings.[69 82 84 96-99] Examples of diagnoses or conditions leading to psychiatric hospitalizations or use of mental health services include psychotic disorders (e.g., schizophrenia), mood disorders (e.g., bipolar disorder, depression), post-traumatic stress disorder, personality disorder, and high suicide risk.[55 82 84 90]

Studies have investigated whether available housing interventions may reduce health service utilization in homeless individuals. In general, supportive housing has shown positive results. Authors of the NY/NY supportive housing study have indicated significant declines from baseline for the experimental group in the use of hospitals (general and psychiatric), total users, number of hospital episodes, and total or average hospital days. Among the controls, this decline was less profound, with some outcomes even showing non-significance or an increase in utilization.[52] Kessell et al. compared supportive housing to usual care and found service-specific effects: no significant pre or post intervention differences nor any group differences in the use of non-emergency ambulatory care, emergency ambulance services, and outpatient mental health services, whereas significant reductions in ED visits and inpatient medical hospitalizations were reported in the post-intervention period (but this was reported in both treatment groups similarly). This same study also found that a small proportion of the participants, the high users, accounted for more than half the total access of ambulance services seen in the sample.[40] Similar findings have been reported for high users of ED visits and hospitalizations.[14 39 84] Service-specific effects of supportive housing were also found in a study which showed that the number of inpatient and outpatient hospital admissions for behavioural health problems increased post-intervention compared to before housing placement, whereas the number of behavioural health-related ED visits decreased.[100] One source reported significant reductions in ED visits and inpatient admissions from the six or 12-month period before move-in compared to after move-in for permanent supportive housing, but with no significant changes beyond the 12-month mark. In

comparison, the waitlisted control participants did not see any notable changes in their service use.[101] A pre-post study of supportive housing showed a reduction in the number of ED, inpatient, and outpatient admissions for physical health diagnoses post-housing compared to 12 months before housing.[100]

Interventions other than supportive housing have been considered as well. A prominent reduction in psychiatric inpatient bed-days was reported in transitional housing clients compared to those in the control group.[102] In a study where homeless patients in respite care were compared to waitlisted controls, it was found that in the 12 months following hospital discharge, the respite care group reported significantly fewer inpatient days and hospital admissions, albeit no change in the use of ED and outpatient clinics.[103] Rothbard et al. reported on clients enrolled in Assertive Community Treatment as part of the ACCESS program. They found that, despite a non-significant difference in the number of hospitalized psychiatric inpatients across the pre-intervention, intervention, and post-intervention periods, the average length of stay in hospital annually was significantly reduced during the intervention period, but increased again post-intervention. On the contrary, significant increases were found in the number of participants and visits related to outpatient psychiatric treatment across time: the number of outpatient service users rose during the intervention period from pre-intervention, and fell only slightly post-intervention, while the number of visits jumped up significantly from pre-intervention to during the intervention, and continued to rise post-intervention. This study also reported that ED utilization for psychiatric or substance abuse problems was relatively constant over the 3-year observation period.[104]

2.3.4 Treatment for Substance Abuse or Dependence

Another category of services commonly accessed by homeless people is treatment for substance abuse or dependence.[42 47 55 72 76] Some predictors found to be associated with the use of alcohol or drug abuse treatment include substance abuse or dependence, psychosis, having had high school education, history of incarcerations, and use of medical care.[33 42 62 72 87] Interestingly, a study reported that some factors inversely associated with length of stay in inpatient or residential substance use treatment included recent substance use, number of binge-drinking days, and

substance use severity index scores.[62] There appears to be a gender and age difference in the use of substance treatment services as well, as homeless male veterans were significantly more likely to use substance abuse outpatient services than their female counterparts[92], and higher utilization of outpatient services was reported among older homeless adults than younger, but no difference was found in inpatient use.[88]

In examining the relationship between housing interventions and use of substance treatment programs, mixed results have been found. One study reported that following the provision of supportive housing, there was a marginally significant increase in use of outpatient substance abuse services.[40] Rothbard et al. assessed the trajectories of substance abuse service utilization in homeless clients receiving Assertive Community Treatment as part of the ACCESS program, and found that the number of days hospitalized for inpatient substance use treatment decreased from pre-intervention to during the intervention, and remained stagnant post-intervention. Similarly, the annual inpatient days per individual significantly decreased when comparing baseline values to values during the intervention. However, use of outpatient services did not seem to differ significantly over time.[104]

2.4 Housing First

Over the years, many interventions have been developed to help ameliorate and end homelessness. One of the most prominent is known as Housing First. The Housing First model was popularized by Sam Tsemberis through the Pathways to Housing supported housing program, a variant of the HF model.[105] The main underlying principle of HF is to provide immediate housing to homeless clients. HF is often targeted towards homeless individuals with severe mental illness and/or addiction disorders. However, unlike traditional homelessness interventions, clients of HF are offered housing immediately without needing to meet preconditions such as sobriety. The program also entails delivery of clinical services tailored towards mental health and substance abuse. An emphasis is placed on consumer preference for the selection of housing and participation in services.[105] Services are generally administered through Assertive Community Treatment (ACT) or Intensive Case Management (ICM) teams.[106]

Housing First is one of the most studied interventions in the homelessness literature. Programs applying the HF model have consistently demonstrated improvements in residential stability among homeless clients with severe mental illness and/or substance use disorders, in comparison to participants given standard care or the traditional "Treatment First" or "Continuum of Care" approach, where clients must be deemed ready (e.g., demonstrate sobriety) prior to being provided housing. Particularly, many studies have reported that significantly more HF than control participants achieved stable housing. They reached residential stability more rapidly, and maintained independent housing for a longer period of time.[8 105 107-109]

However, weaker findings have been reported for outcomes such as mental health and substance use. Several studies have reported similar improvements between HF and control groups in reductions in substance use problems over time[8 108 109], while others have reported better substance use outcomes among HF clients.[110 111] Authors have also reported no significant improvements compared to control conditions in psychiatric outcomes.[8 108 109] Other outcomes such as employment and income have not been examined as frequently, but some findings have indicated no significant improvements nor group differences in employment or income when comparing HF to controls[112 113], or that the odds of obtaining employment over time was actually lower among those in HF, at least initially.[114]

Nonetheless, studies have consistently found a reduction for HF clients in overall use of health, social, and justice services such as shelters, physical/psychiatric hospitalizations, emergency department visits, substance abuse treatment, and arrests or incarcerations.[8 108 109 111 112 115-118] For example, one study revealed that the number of emergency medical service contacts significantly declined two years after HF placement, and this translated to 3% fewer contacts for each additional month of HF.[119] Another study examining incarceration outcomes indicated that the number of jail bookings and days in jail were significantly reduced from two years prior to receipt of housing to two years post-housing. This translated into 5% fewer bookings and 7% fewer jail days for each additional month of enrollment in HF.[116] Although several authors have reported a more enhanced reduction in service use in HF participants compared to usual care or treatment first approaches[108 109 111 118], others have documented similar reductions in the control group as well.[8]

Edens et al. identified trajectories of service utilization in high frequency substance users compared to abstainers, both of which were enrolled in a HF and ICM intervention. It was found that both groups exhibited a differing trajectory of decline of mental health outpatient visits over time: high-frequency users reduced visits by 50% at six months, then showed a slight increase followed by a plateau by the end of 24 months, while abstainers reported a low and steady number of visits throughout the study.[112] Bean et al. reported substantial reductions in incarcerations from time of receiving housing to six months after, and significant declines in the number of arrests from 12 months before move-in to six months after, with no significant changes in the period between 6 and 12 months post-move-in.[115] Tsemberis et al. found that the Continuum of Care group reported significantly higher use of substance abuse treatment than the HF group at all time points (6,12,18, and 24 months post-baseline), and that the HF group saw a decline in service use while the Continuum group reported a rise in use over time.[109]

2.5 Latent Class Growth Analysis

Latent class growth analysis is a technique used in longitudinal data analysis to identify unique and relatively homogeneous subpopulations of individuals within a larger heterogeneous sample. LCGA makes it possible to track longitudinal changes in outcome and to distinguish trajectories among unobserved, or latent, classes of subjects, where each latent class may exhibit a unique growth curve with respect to the outcome and possess certain characteristics that differentiate it from other classes.[120 121]

Latent growth modelling techniques, such as LCGA, have been applied in many areas of research including, but not limited to, psychology and mental health[122-124], substance use[125 126], criminal involvement[127], developmental learning and cognition[128-130], and physical injuries.[131]

Such approaches have been adopted in a homelessness context as well, particularly to model trajectories of housing stability and their predictors. Using LCGA, Tevendale et al. identified housing trajectories and predictors of these trajectories in a sample of 426 homeless youth in Los Angeles County over two years. The resulting model grouped participants into three classes of trajectories: consistently sheltered, inconsistently sheltered short-term, and inconsistently

sheltered long-term. Predictors associated with class membership included age, length of time homeless, affiliation with family home, use of particular drug types, and involvement in formal sector activities.[132] Lennon et al. applied LCGA to track housing trajectories in a sample of 96 mentally ill homeless men in New York City over the course of 18 months, with part of the sample being randomized to critical time intervention (CTI). Results identified four latent classes in the control group and three in the CTI group, but did not include an analysis of predictors.[133] Adair et al. used growth mixture modelling, another type of latent growth modelling, in their analysis of the At Home/Chez Soi data and reported on trajectories of housing stability. Six latent classes were found in both the HF group and the TAU group. The classes were: almost no time housed, rapid and sustained housing, gradual gains sustained, divergence by treatment arm, early housing gradually lost, and rapid gain then steep decline. More positive trajectories of residential stability were identified for HF participants than for those in the TAU group. Characteristics associated with class membership included gender, ethnicity (particularly Indigenous background), number of prior hospitalizations, severity of psychiatric symptoms, general health, income, and previous time homeless.[134]

However, to our knowledge, only one study has assessed trajectories of homeless service use as an outcome using latent growth modelling. Gleason et al. used LCGA to model emergency shelter, transitional shelter, and outreach services use among 4655 homeless individuals in Hawaii over three years. The best model suggested four latent classes of service use: low use, typical transitional shelter use, atypical transitional shelter use, and potential chronic use. Using multinomial logistic regression (MLR), predictors of class membership were identified as gender, age, ethnicity, household size, employment status, education, presence of a physical disability, and presence of a mental illness.[59] No study has attempted to characterize the longitudinal patterns of use of other services in homeless populations, such as healthcare usage. Furthermore, there remains a limited understanding of homeless service use patterns in general within Canada, where the service and support systems available to homeless individuals are very different from those in the US.

2.6 Summary

This literature review has summarized the definition and characteristics of homelessness, as well findings related to: health, social, and justice service utilization in people experiencing homelessness, Housing First and its effects as a homelessness intervention, and latent class growth analysis in homelessness research. The inclusion criteria of this literature review could, however, have led to some potentially relevant studies being excluded. Although the search for literature was not as formal as a rigorous systematic review, this summary should have identified most recently published Canadian and US studies that were relevant to the topics addressed.

It has been validated repeatedly that being homeless is associated with not only higher service utilization, but also increased diversity in the services used, including public shelters, arrests and incarcerations, psychiatric and medical treatments, and addiction programs. Such high rates of use may be attributed to the numerous challenges homeless people face while living in sub-par conditions, including complications in mental and physical health, substance addictions, food insecurity and poverty, absence of social support, and tendencies to be involved in criminal activities. Furthermore, several homelessness interventions, such as Housing First, have been shown to be effective in reducing service utilization in the homeless population.

Despite compelling evidence demonstrating a link between high service utilization and homelessness, the use of cross-sectional data or time-averaged measurements remains predominant among relevant studies. Cross-sectional data is vulnerable to overestimating chronic service use and underestimating short durations of use.[135] Basing analyses on time-averaged measures fails to consider the changes in service utilization over time, which can have very different implications from a service planning perspective. As McAllister et al. explained, a time-patterned approach can reveal much more information than a time-aggregated method of analysis.[58] That is, two individuals with identical measures of cumulative service use can exhibit remarkable differences in how their service use changes over time, each indicating a distinct pattern of homelessness. Tracking patterns of utilization is also useful for identifying subcategories of individuals based on their longitudinal trajectories of service utilization. As previously mentioned, some researchers have turned to computer modelling to better describe the

dynamics of homeless populations.[10] It is of interest, for modelling and service planning purposes, to identify trajectories of utilization and classifications of individuals at risk of continued or increased use of services. Such findings can also allow us to predict which individuals may require greater attention and care, since high use may reflect underlying issues such as mental health or substance addiction problems. However, relatively few studies have evaluated homeless service utilization based on identifying temporal trends, classifying these trends, or recognizing the characteristics of the individuals demonstrating these various trends.

The objectives of this study are to identify trajectories of several types of services among homeless individuals (shelters, addiction/mental health ambulatory services, and physical health ambulatory services), as well as potential baseline variables, including treatment group, that may be associated with subgroups of homeless users. Findings may increase our understanding of how homeless Canadians use health and social services over time, and which characteristics, including participation in HF, are associated with particular trajectories of use. As the patterns of service utilization over time can have significant economic implications, these findings may prove useful in developing more accurate models to characterize homelessness, and to inform policy and decision makers for homeless services transformation.

3. STUDY OBJECTIVES

This study has three objectives:

1. To identify latent classes of utilization trajectories of three costly services over the span of two years by homeless individuals with mental illness: a) shelters, b) addiction and mental health ambulatory visits, and c) physical health ambulatory visits.
2. To evaluate how the receipt of Housing First (compared to usual services) and the baseline characteristics of participants influence the probability of belonging to certain classes of trajectories.
3. To understand participants' use of various service providers for addiction, mental health, and physical health ambulatory visits.

4. METHODS

4.1 The At Home/Chez Soi Trial

4.1.1 Study Design and Sample Selection

The AHCS trial was a set of randomized controlled trials conducted nationally in five Canadian cities: Vancouver, Winnipeg, Toronto, Montreal, and Moncton. The full protocol is available in a previously published article.[136] The following is a simplified description of the trial's methods.

A total of 2255 participants were enrolled from October 2009 to July 2011, with ongoing data collection until spring of 2013. Potential participants were recruited through referrals from a variety of health and social service agencies serving homeless people, such as shelters, clinics and hospitals, drop-in centres, criminal justice programs, mental health teams, and outreach teams. Individuals were eligible if they were legal adults in their respective provinces, were absolutely homeless or precariously housed, and had a mental disorder (including concurrent substance use disorders) as indicated by the Mini-International Neuropsychiatric Interview (MINI).[137] Exclusion criteria included being a current client of an ACT or ICM program and having no legal residency status in Canada (such as Canadian citizenship, landed immigrant status, refugee or refugee claimant status). The trial obtained Research Ethics Board approval from all participating institutions.[8 9 136]

Participants in all cities (except Moncton) were classified into High Needs (HN) and Moderate Needs (MN) groups prior to randomization.[136] Individuals categorized as HN must have had a current diagnosis of a bipolar disorder or psychotic disorder as indicated by the MINI, a score of less than 62 on the Multnomah Community Ability Scale (MCAS)[138 139], and met at least one of the following criteria: hospitalized twice in any 1-year period within the past five years, had substance abuse or dependence as indicated by the MINI or a referral source, or any arrest or incarceration within the past six months.[8] All other participants were classified as having MN.

HN participants were randomized into either Housing First and Assertive Community Treatment (HF+ACT) or treatment as usual (TAU), and those in MN were randomized into Housing First

and Intensive Case Management (HF+ICM) or TAU. Due to a small sample size in Moncton, participants were not stratified based on need level, and all individuals were randomized into either HF+ACT or TAU. Additionally, Vancouver, Winnipeg, Toronto, and Montreal incorporated congregate housing, ICM with Indigenous peer support, ICM for ethnoracial minorities, and ICM with a community-based provider, respectively.[136]

Participants were followed for two years after being enrolled into the study, with in-person interviews conducted every six months and telephone interviews every three months (except on months when in-person interviews were conducted).[136]

4.1.2 Intervention

The intervention for all participants, Housing First, was based on a recovery-oriented, harm-reduction model with no prior requirements for housing readiness (e.g., sobriety), with the only conditions being that participants must pay up to 30% of their income or the shelter portion of their welfare directly as rent, and there must be visits from staff at least once a week for follow-up supports. All services provided to participants were individualized and centered on consumer choice. Service providers and medical staff were based off-site, and there was no mandatory requirement for participants to engage in treatment for the duration of the intervention. Housing provided to participants was in the form of independent, scattered-site apartments. High Needs individuals randomized to HF+ACT had access to a special ACT team whose features included a 10:1 participant to staff ratio, presence of a psychiatrist and nurse, daily team meetings with at least one peer specialist, and services available seven days a week, 24 hours per day (on-call basis during late evening and night hours). Moderate Needs individuals in the HF+ICM group were provided ICM for at least one year when housed. This program featured a participant to staff ratio of at most 20:1, monthly case conferences among staff, and working hours covering all seven days per week for 12 hours each day. Participants randomized to the control group were provided “usual care”; that is, they did not receive the intervention, but were free to seek out services and supports normally available to them.[136]

Fidelity was assessed across all sites during both the early and later implementation periods, corresponding to the first and third year of operation, respectively. The following domains were included in the evaluation: housing choice and structure, separation of housing and services, service array, and program structure. High fidelity ratings were received during early implementation (3.47 out of 4) and later implementation (3.62 out of 4).[140]

4.1.3 Sample Characteristics in Original Study

Briefly, the sample in the original study had a mean age of 40.9 years (SD = 11.2). Approximately 67% of the sample was male (females were over-sampled to ensure adequate numbers for analysis). Twenty-one percent were Indigenous, and 70% were single or never married. Forty-one percent were classified as HN. Fifty-five percent did not graduate from high school and 92% were unemployed at baseline. The average time homeless in one's lifetime was 75.2 (SD = 138.2) months. Thirty-six percent of the sample identified as being at moderate or high risk for suicide at baseline. Thirty-four percent were diagnosed with a psychotic disorder and 67% had substance abuse or dependence.

4.2 Study Measures

The primary outcomes of interest in this secondary analysis were use of shelters, characterized by total days of stay in the past 1-month period, and use of addiction/mental health and physical health ambulatory services, characterized by total number of visits in the past 6-month period.

Use of shelters consisted of stays in shelters with or without dormitories. All outcome stays were measured using the Residential Time-Line Follow-Back (RTLFB) Calendar, an instrument used to measure housing histories of participants as an indicator of housing stability, with high test-retest reliability and concurrent validity.[141] The outcome was ascertained every month during the 24-month study, and frequencies pertained to the past month at the time of ascertainment. Hence trajectories were mapped across all 24 time points.

Ambulatory visits pertained to services used for addiction, mental health, and physical health purposes, and consisted of visits to a health or social services provider at his/her office, and visits by a health or social services provider at the participant's home or anywhere else. Visits with the following service providers were classified under addictions and mental health: mental health worker, housing worker, case manager, therapist or counselor, outreach worker, social worker, welfare worker, nurse, addictions counselor, work/vocational counselor, individual placement & support (IPS) counselor, pharmacist, peer support worker, community worker, follow-up worker, street worker, spiritual advisor/counselor/healer, Indigenous elder, clergy, psychoeducator, life skills worker, occupational therapist, psychiatrist, psychologist, art therapist, and child & family services (CFS) worker. Service providers categorized under physical health services included: nurse, family doctor, specialist doctor (not psychiatrist or psychologist), dentist/prothesist, pharmacist, optometrist, physiotherapist, nutritionist/dietitian, occupational therapist, chiropractor, natural healer, radiologist, and midwife. Frequencies were recorded using the Health, Social, Justice Service Use (HSJSU) questionnaire, a tool created specifically for the AHCS study. The HSJSU was developed based on seven existing instruments used to measure the utilization of a variety of services.[142] The outcome was ascertained every six months of the 24-month study. At each time of interview, participants were asked to report visit counts in the past month only, to ensure greater accuracy of recall. Frequencies were then multiplied by six to approximate service use in the past 6-month period. Adjustments were also applied to all visit frequencies to account for misreporting.[2] As the follow-up period was two years, trajectories in the following analyses were mapped across five time points.

The following baseline covariates were ascertained through self-report items on a questionnaire assessing demographics, service, and housing history, as well as a screener questionnaire: age at enrollment, gender, ethnicity, level of education, income for the month prior to baseline, presence of alcohol abuse or dependence, presence of drug abuse or dependence, past psychiatric hospitalization (identified as "yes" if at least one of the following questions were answered "yes": *"In the past 5 years, have you been hospitalized for a mental illness at any time for longer than 6 months?"* and *"In the past 5 years, have you been hospitalized 2 or more times in any one year period for a mental illness?"*), history of criminal justice involvement (*"In the past 6 months, have you been arrested for criminal activity more than once, or been imprisoned at least*

once, or served probation or other community sanction?"), inadequate access to health care ("*In the past 6 months, was there ever a time when you felt that you needed health care but you didn't receive it?"),* total amount of time homeless, and suicide risk (no, low, moderate, or high).

Childhood trauma was identified by the Adverse Childhood Experience (ACE) questionnaire, with questions related to events experienced in the first 18 years of life. A total score was calculated based on seven types of experiences: childhood abuse (psychological, physical, sexual) and household dysfunction (substance abuse, mental illness, domestic violence, criminal involvement).[143]

Level of functioning was assessed using the Multnomah Community Ability Scale, an instrument developed for individuals with chronic mental illness.[138 139] The MCAS consists of 17 items that assess functioning in many aspects of life, including physical health, intellectual functioning, and social effectiveness.

Baseline psychiatric diagnosis was evaluated using the Mini-International Neuropsychiatric Interview, a short structured interview developed for diagnosing DSM-IV and ICD-10 psychiatric disorders.[137] Baseline psychiatric diagnosis was recoded into a binary variable with the following two categories: less severe conditions with no symptoms of psychosis, consisting of current major depressive episode, current manic episode or hypomanic episode, current post-traumatic stress disorder, and current panic disorder, as well as severe conditions with psychotic features, consisting of current mood disorder with psychotic features, and current psychotic disorder.

Family social support was measured by the Quality of Life Index - 20 item (QOLI-20), family subscale score. The QOLI-20 is an abbreviated version of the larger QOLI, a structured self-report interview capturing eight domains of life satisfaction: living situation, daily activities and functioning, family relations, social relations, finances, work and school, legal and safety issues, and health, as well as a global life satisfaction score.[144] Participants were asked to rate each item on the QOLI-20 on a 7-point scale, with higher scores indicating greater life satisfaction in that domain.

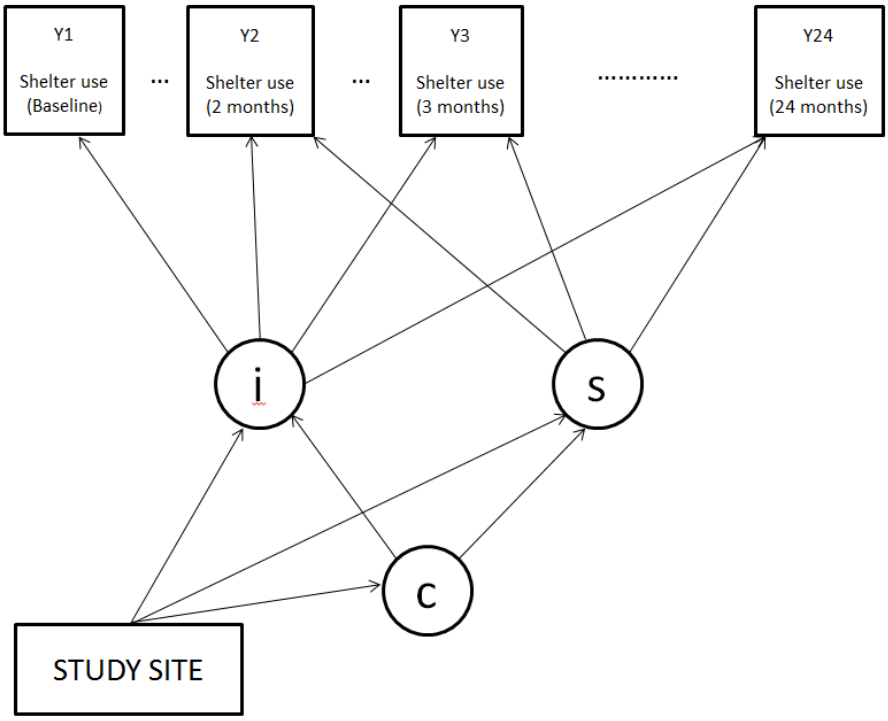
As an indicator of physical health, the number of comorbidities was also included into the model. This was measured using the Comorbid Conditions List, a comprehensive list of physical health disorders developed for the original study with sources from the Canadian Community Health Survey and the National Population Health Survey of Statistics Canada.[142]

All independent variables incorporated into the analysis as covariates were measured at enrollment or baseline. Predictors were selected if they were suspected to be associated with shelter and ambulatory service use, as directed by the literature review and the available data in the original study. An effort was made to select predictors with the least missing data. Variables demonstrating multicollinearity, as indicated by a Variance Inflation Factor (VIF)[145] of over 4, and correlation coefficients above +0.5 or below -0.5, were excluded from analysis.

4.3 Statistical Analysis

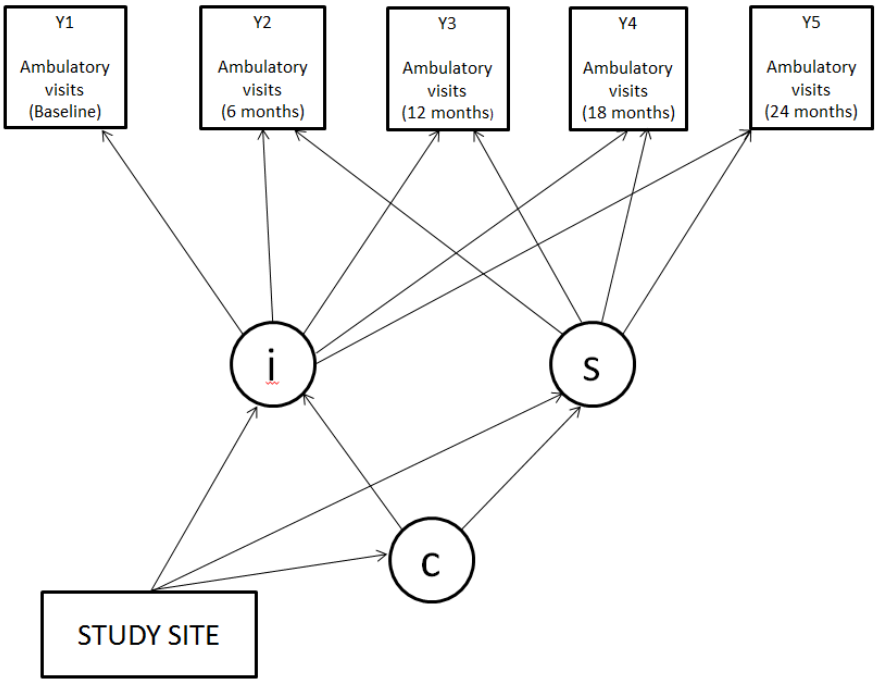
LCGA was used to model unique classes of service utilization trajectories (Figures 1 and 2).

Figure 1: Theoretical LCGA model for shelter utilization.



Note: Linear model is shown here. Y1-Y24 represent the outcome (days of shelter use in the past month) at each of the 24 months. i and s represent the intercept and slope growth factors, respectively. c represents the latent class variable. Study site is included as a covariate, with the following levels: Toronto, Montreal, Vancouver, Winnipeg, Moncton.

Figure 2: Theoretical LCGA model for ambulatory visits.



Note: Linear model is shown here. Model framework is applied to separate analyses for three different outcomes: a) addiction and mental health service visits excluding intervention visits, b) addiction and mental health service visits including intervention visits, and c) physical health service visits. Y1-Y5 represent the outcome (number of visits in the past six months) at baseline and months 6, 12, 18, and 24. i and s represent the intercept and slope growth factors, respectively. c represents the latent class variable. Study site is included as a covariate, with the following levels: Toronto, Montreal, Vancouver, Winnipeg, Moncton.

Inspired by the methods used by Gleason et al.[59], multinomial logistic regression was used to assess which baseline covariates could predict class membership once trajectories were identified and individuals were grouped into their respective classes. This approach was applied individually to four separate outcomes: a) shelter use, b) addiction and mental health service visits excluding intervention visits, c) addiction and mental health service visits including intervention visits, and d) physical health service visits. As shelters and physical health services were not features of the HF intervention, all shelter use and physical health visits analyzed were external to the intervention. The types of service providers reported for addiction, mental health, and physical health visits were also examined to identify the providers most commonly accessed by participants.

As the variables for days of shelter use and number of ambulatory visits had a preponderance of zeros, a small constant of 0.01 was added to all observations, which helped to prevent inaccurate estimation of trajectory classes due to the floor effect. Models considered in the trajectory analyses included linear, quadratic, cubic, and piecewise growth curves over all time points (24 for shelters analysis, 5 for all ambulatory visits analyses), for two and up to six latent classes. To narrow down the options for identifying a correct type of growth curve, average outcome trajectories were plotted and assessed for general shapes, and the curves deemed most suitable for the data were subsequently explored. The best model was then selected based on several criteria: the Schwarz-Bayesian Information Criterion (BIC)[146], with lower values indicating a better fit; entropy[147], with values closer to one indicating better model prediction; and substantive interpretation of estimated class trajectories, with key factors including reasonable class sizes and sufficiently distinct trajectories. In situations where the BIC and entropy disagreed, the substantive interpretation of classes played a larger role in the model selection process.

For the shelter utilization analysis, the quadratic, cubic, and piecewise models were chosen for investigation based on exploratory plots. For the ambulatory visits analysis, only the linear and quadratic models were considered, as the number of time points were too limited (five, compared to 24 in the shelters analysis) for a cubic model[148], and exploratory plots did not suggest a piecewise fit. As the outcomes (days of use or number of visits) could only take on values equal to or greater than zero, all outcomes were log-transformed to ensure the modelling respected the

boundaries of the data and only generated estimations in the positive range when back-transformed onto the original scale.

Multiple imputation was conducted for all predictor variables with missing data using a Markov Chain Monte Carlo (MCMC) approach. The imputation procedure utilized the variance-covariance method under the unrestricted H1 model.[149] This technique of handling missing data has been well documented in the literature.[150 151] Data for the independent variables was imputed for approximately 0% to 13% of the total observations for the shelter use analysis, and 0% to 15% for the ambulatory visits analyses. Subsequent analyses were performed across 20 imputed datasets.

For the shelters analysis, list-wise deletion was used on the dependent variable because fewer than 10% of the participants were missing outcome data, and therefore only participants with complete observations for the outcome were included in the analysis. For the ambulatory visits analyses, missing outcome data (1%-19%) were estimated in the LCGA model using full-information maximum likelihood (FIML).

As a low number of participants identified as transgender, transsexual, and other, only participants who identified as male or female were included in both shelter and ambulatory visit LCGAs to avoid model estimation issues.

Altogether, this resulted in a sample size of 2058 individuals in the shelter use analysis (1133 participants in HF and 925 in TAU), and 2127 individuals in the ambulatory visits analyses (1150 participants in HF and 977 in TAU), from the 2255 total participants in the original study. Information on excluded participants and comparisons of the analyzed and original samples are reported (available in Appendix). The demographics and other characteristics of interest were similar in the analyzed and original samples.

All variables included for analysis with missing data were assumed to be missing at random. Subsequent analyses carried out across all imputed datasets used the maximum likelihood estimator with robust standard errors.[152]

The HF and TAU groups were combined and analyzed together in the LCGA to allow for clear identification of classes that were common to both groups. Since a main objective of this analysis was to compare trajectories between HF and TAU clients, a variable for assigned treatment group was included in the MLR models as a covariate. In addition, because the number of sites in this study (five cities) was not high enough to incorporate into the LCGA as a cluster variable[153], it was brought into the model as a series of binary variables (with the reference group being Toronto) to account for non-independence of individual observations within the same city.

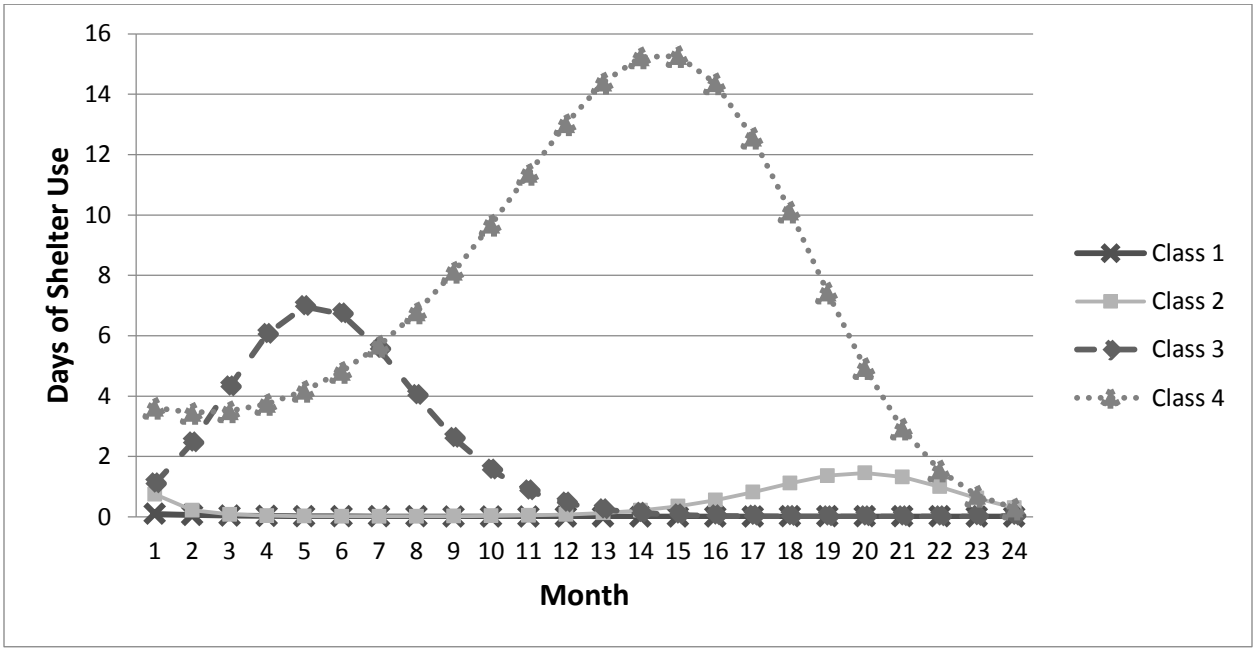
All analyses were performed using Mplus Version 8.[152]

5. RESULTS

5.1 Shelter Utilization

The selected model was the 4-class cubic model (Figure 3). The log-transformed outcome used for the LGCA was then back-transformed onto the original scale for ease of interpretability.

Figure 3: Estimated trajectories of shelter use days.



Potential predictors of class membership and their distributions are outlined in Table 2.

Class 1, the *consistently low* group, was the largest class, consisting of 79.3% of the sample. This class demonstrated near-zero days of shelter use throughout the study. Class 2, the *mostly low* group, was the smallest class (5.8% of the sample). This included participants who started off with slightly higher shelter use than class 1, but generally showed a low shelter use pattern throughout. Class 3 was the *early increase* class (8.7% of the sample), which consisted of individuals who started off with an increasing number of days in shelter, but declined to almost

zero days at month 14 and remained low until the end of the study. Class 4, the *late increase* group (6.2% of the sample), was the class with the highest shelter use of all four classes. This group was composed of participants who started off with moderate shelter use, and who then experienced a notable increase in use which peaked at month 15 before declining in use to almost zero at the end of 24 months. The number of days of shelter use per month was as much as 15 days higher in class 4 as compared to class 1 over the course of the 24 months of follow-up.

Class 1 was used as the reference group in the MLR (Table 3). Odds ratios (OR) for site based on the LCGA are also reported. Compared to class 1, members of class 2 were significantly less likely to be female, but more likely to have a higher income, or drug abuse or dependence. Members of class 3 were more likely to be older. Participants in class 4 were less likely to have alcohol abuse or dependence, or to be at moderate or high risk of suicide, but were marginally more likely to have had a longer time homeless. Members of classes 2, 3 and 4 all had lower odds of being enrolled in HF, suggesting that enrolment in HF is protective against higher shelter use – whether that higher use occurs early or later on. More than three-fifths (61.9%) of members of class 1 had been assigned to the HF group.

Table 2: Shelter use - Distribution of baseline characteristics by class membership[a]

Variable	Class 1: Consistently low N=1631 (79.3%)	Class 2: Mostly low N=120 (5.8%)	Class 3: Early increase N=179 (8.7%)	Class 4: Late increase N=128 (6.2%)
Treatment group (%)				
Treatment as usual	622 (38.1)	66 (55.0)	133 (74.3)	104 (81.3)
Housing First	1009 (61.9)	54 (45.0)	46 (25.7)	24 (18.8)
Age (years)	40.7	39.9	43.0	41.8
Gender (% female)	544 (33.4)	27 (22.5)	58 (32.4)	34 (26.6)
Ethnicity (%)				
Caucasian	802 (49.2)	60 (50.0)	86 (48.0)	64 (50.0)
Indigenous	357 (21.9)	35 (29.2)	33 (18.4)	20 (15.6)
Other minority	472 (28.9)	25 (20.8)	60 (33.5)	44 (34.4)
Education (%)				
Less than high school	910 (55.8)	73 (60.8)	91 (50.8)	71 (55.5)
Completed high school/some higher education	510 (31.3)	39 (32.5)	64 (35.8)	42 (32.8)
Completed higher education	204 (12.5)	7 (5.8)	23 (12.9)	15 (11.7)
Missing	7 (0.4)	1 (0.8)	1 (0.6)	-
Income (mean $ / prior month)	667.50	825.39	655.27	746.32
Missing (%)	11 (0.7)	-	3 (1.7)	2 (1.6)
Alcohol abuse or dependence (%)	739 (45.3)	61 (50.8)	86 (48.0)	34 (26.6)
Drug abuse or dependence (%)	852 (52.2)	81 (67.5)	97 (54.2)	59 (46.1)
Past psychiatric hospitalization (%)	603 (37.0)	38 (31.7)	81 (45.3)	58 (45.3)
Missing	38 (2.3)	1 (0.8)	3 (1.7)	5 (3.9)
Past criminal involvement (%)	571 (35.0)	47 (39.2)	64 (35.8)	42 (32.8)
Missing	7 (0.4)	1 (0.8)	1 (0.6)	5 (3.9)
Total time homeless (years)	4.6	5.7	5.5	5.7
Missing (%)	29 (1.8)	2 (1.7)	4 (2.2)	3 (2.3)
Childhood trauma (ACE score)	4.6	4.6	4.2	3.5
Missing (%)	233 (14.3)	3 (2.5)	27 (15.1)	8 (6.3)
Suicide risk (% moderate/high)	611 (37.5)	43 (35.8)	62 (34.6)	29 (22.7)
Baseline psychiatric diagnosis (% psychotic)	728 (44.6)	53 (44.2)	102 (57.0)	76 (59.4)
Missing	12 (0.7)	3 (2.5)	-	-
Inadequate access to health care (%)	756 (46.4)	65 (54.2)	78 (43.6)	51 (39.8)
Missing	16 (1.0)	1 (0.8)	5 (2.8)	2 (1.6)
Level of functioning (MCAS score)	60.5	59.3	58.6	58.4
Family social support (QOLI-20 Family score)	13.8	14.3	14.1	14.1
Missing (%)	40 (2.5)	3 (2.5)	7 (3.9)	7 (5.5)
Number of comorbidities	4.8	5.4	4.4	4.3
Missing (%)	1 (0.1)	-	-	-

[a] *Table reports data before multiple imputation*

Table 3: Shelter use - Odds ratios and their 95% confidence intervals for predictors of class membership[a]

Variable	Class 2: Mostly low	Class 3: Early increase	Class 4: Late increase
Treatment group			
Treatment as usual (reference)			
Housing First	**0.50 (0.34-0.72)**	**0.21 (0.15-0.31)**	**0.14 (0.09-0.22)**
Age (years)	0.99 (0.97-1.01)	**1.03 (1.01-1.04)**	1.00 (0.99-1.02)
Gender			
Male (reference)			
Female	**0.57 (0.35-0.92)**	1.23 (0.85-1.78)	0.82 (0.52-1.28)
Ethnicity			
Caucasian (reference)			
Indigenous	1.24 (0.74-2.07)	1.10 (0.67-1.79)	1.27 (0.71-2.26)
Other minority	0.73 (0.43-1.22)	1.22 (0.84-1.76)	1.12 (0.73-1.74)
Education			
Less than high school (reference)			
Completed high school/some higher education	1.15 (0.75-1.78)	1.25 (0.87-1.80)	0.97 (0.63-1.49)
Completed higher education	0.55 (0.24-1.25)	1.12 (0.66-1.89)	0.87 (0.46-1.64)
Income ($ / prior month)[b]	**1.22 (1.01-1.46)**	0.92 (0.57-1.48)	1.13 (0.91-1.42)
Alcohol abuse or dependence	0.91 (0.60-1.39)	1.24 (0.87-1.76)	**0.47 (0.30-0.72)**
Drug abuse or dependence	**1.65 (1.04-2.62)**	1.27 (0.87-1.85)	0.96 (0.64-1.44)
Past psychiatric hospitalization	0.72 (0.47-1.10)	1.24 (0.87-1.76)	1.34 (0.89-2.03)
Past criminal involvement	0.97 (0.63-1.48)	1.02 (0.72-1.44)	0.92 (0.60-1.43)
Total time homeless (years)	1.01 (0.98-1.04)	1.02 (0.99-1.04)	**1.03 (1.01-1.06)**
Childhood trauma (ACE score)	0.98 (0.91-1.05)	0.98 (0.91-1.05)	0.92 (0.85-1.00)
Suicide risk			
No/low (reference)			
Moderate/high	0.81 (0.53-1.23)	0.99 (0.69-1.42)	**0.54 (0.34-0.88)**
Baseline psychiatric diagnosis			
Not psychotic (reference)			
Psychotic	1.03 (0.67-1.60)	1.41 (0.98-2.04)	1.09 (0.69-1.75)
Inadequate access to health care	1.29 (0.84-1.96)	0.98 (0.69-1.39)	0.95 (0.63-1.44)
Level of functioning (MCAS score)	0.99 (0.97-1.02)	0.99 (0.96-1.01)	0.99 (0.97-1.02)
Family social support (QOLI-20 Family score)	1.02 (0.99-1.06)	1.00 (0.97-1.03)	0.98 (0.95-1.02)
Number of comorbidities	1.06 (0.99-1.13)	0.95 (0.90-1.01)	0.99 (0.93-1.06)
Site[c]			
Toronto (reference)			
Montreal	1.47 (0.79-2.74)	1.00 (0.66-1.51)	1.34 (0.82-2.17)
Vancouver	**3.28 (1.83-5.88)**	0.98(0.63-1.53)	**1.94 (1.19-3.17)**
Winnipeg	1.47 (0.80-2.69)	**0.51 (0.32-0.81)**	**0.41 (0.22-0.78)**
Moncton	0.45 (0.15-1.33)	**0.15 (0.05-0.43)**	**0.07 (0.01-0.49)**

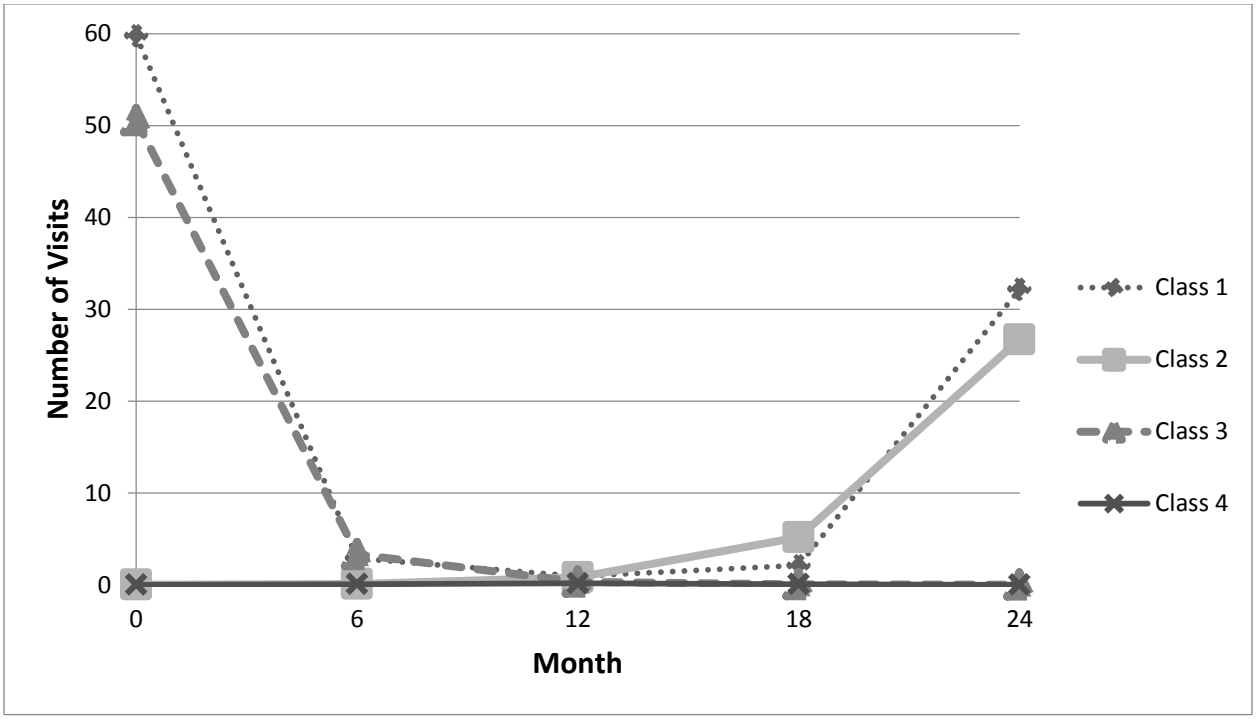
[a] *Reference class is class 1 ("consistently low" group)*
[b] *Odds ratios for income reflect a $1000 difference*
[c] *Odds ratios for site are based on the LCGA model*

5.2 Addiction and Mental Health Ambulatory Visits

5.2.1 Addiction Programs and Mental Health Service Visits (excluding intervention visits)

The selected model was the 4-class quadratic model (Figure 4). The log-transformed outcome used for the LCGA was then back-transformed onto the original scale for ease of interpretability.

Figure 4: Estimated trajectories of addiction and mental health service visit counts (excluding intervention visits).



Distributions of predictors by class membership are shown in Table 4.

Class 1, the *decreasing-then-increasing* group, was the largest class, comprising 39.1% of the sample. Participants started off with the highest service use at baseline, followed by a sharp decline to near-zero levels at six months. This persisted until month 18, when visit counts began

to increase from then onwards. Class 2, the *increasing* group, was the smallest class (9.3% of the sample). Members of this class had near-zero visit counts at baseline but exhibited an increasing trajectory of use throughout the study. Class 3, the *decreasing* group, included 36.5% of the sample. Class 3 participants reported service use that was relatively high at baseline, but declined rapidly to low values at month 6, which was followed by low and stable service use until the end. Class 4 was the *consistently low* group (15.1% of the sample). Members of class 4 displayed low and stable visits rates for the entire study.

Class 1 was used as the reference group in the MLR (Table 5). Odds ratios (OR) for site based on the LCGA are also reported. Compared to class 1, class 2 participants tended to be older, and less likely to be of "other" minority background, to have a history of psychiatric hospitalization, or to have a higher level of functioning at baseline. Class 3 participants were less likely to be of Indigenous ethnicity, to have completed higher education, or to have a mental disorder with psychotic features. Class 4 participants were less likely to be of Indigenous or other minority status, to have a history of psychiatric hospitalization, to have a psychotic disorder, or to have a higher level of baseline functioning. Treatment group was a significant predictor of class 3 and 4 membership, as participants in these two classes were more likely to be enrolled in HF than class 1.

Table 4: Addiction and mental health visits (excluding intervention visits) - Distribution of baseline characteristics by class membership[a]

Variable	Class 1: Decreasing-then-increasing N = 831 (39.1%)	Class 2: Increasing N = 198 (9.3%)	Class 3: Decreasing N = 776 (36.5%)	Class 4: Consistently low N = 322 (15.1%)
Treatment group (%)				
Treatment as usual	431 (51.9)	92 (46.5)	322 (41.5)	132 (41.0)
Housing First	400 (48.1)	106 (53.5)	454 (58.5)	190 (59.0)
Age (years)	40.1	42.4	40.8	42.8
Gender (% female)	268 (32.3)	70 (35.4)	263 (33.9)	84 (26.1)
Ethnicity (%)				
Caucasian	358 (43.1)	108 (54.6)	389 (50.1)	193 (59.9)
Indigenous	208 (25.0)	44 (22.2)	152 (19.6)	54 (16.8)
Other minority	265 (31.9)	46 (23.2)	235 (30.3)	75 (23.3)
Education (%)				
Less than high school	445 (53.6)	102 (51.5)	442 (57.0)	184 (57.1)
Completed high school/some higher education	272 (32.7)	72 (36.4)	240 (30.9)	101 (31.4)
Completed higher education	111 (13.4)	23 (11.6)	92 (11.9)	34 (10.6)
Missing	3 (0.4)	1 (0.5)	2 (0.3)	3 (0.9)
Income (mean $ / prior month)	681.9	624.6	693.6	667.2
Missing (%)	9 (1.1)	1 (0.5)	4 (0.5)	3 (0.9)
Alcohol abuse or dependence (%)	398 (47.9)	88 (44.4)	327 (42.1)	135 (41.9)
Drug abuse or dependence (%)	441 (53.1)	104 (52.5)	419 (54.0)	154 (47.8)
Past psychiatric hospitalization (%)	346 (41.6)	63 (31.8)	297 (38.3)	103 (32.0)
Missing	16 (1.9)	3 (1.5)	19 (2.5)	9 (2.8)
Past criminal involvement (%)	307 (36.9)	74 (37.4)	260 (33.5)	107 (33.2)
Missing	8 (1.0)	4 (2.0)	3 (0.4)	-
Total time homeless (years)	4.7	4.8	5.0	5.0
Missing (%)	19 (2.3)	5 (2.5)	15 (1.9)	3 (0.9)
Childhood trauma (ACE score)	4.7	4.3	4.5	4.1
Missing (%)	154 (18.5)	15 (7.6)	105 (13.5)	66 (20.5)
Suicide risk (% moderate/high)	305 (36.7)	72 (36.4)	291 (37.5)	104 (32.3)
Baseline psychiatric diagnosis (% psychotic)	429 (51.6)	89 (45.0)	347 (44.7)	132 (41.0)
Missing	5 (0.6)	2 (1.0)	6 (0.8)	2 (0.6)
Inadequate access to health care (%)	394 (47.4)	93 (47.0)	363 (46.8)	130 (40.4)
Missing	7 (0.8)	6 (3.0)	7 (0.9)	5 (1.6)
Level of functioning (MCAS score)	60.3	59.4	60.9	58.4
Family social support (QOLI-20 Family score)	13.9	13.8	13.5	14.1
Missing (%)	19 (2.3)	8 (4.0)	21 (2.7)	12 (3.7)
Number of comorbidities	4.9	4.7	4.7	4.6
Missing (%)	1 (0.1)	-	-	-

[a] *Table reports data before multiple imputation*

Table 5: Addiction and mental health visits (excluding intervention visits) - Odds ratios and their 95% confidence intervals for predictors of class membership[a]

Variable	Class 2: Increasing	Class 3: Decreasing	Class 4: Consistently low
Treatment group			
Treatment as usual (reference)			
Housing First	1.26 (0.92-1.73)	**1.51 (1.23-1.84)**	**1.62 (1.24-2.12)**
Age (years)	**1.02 (1.00-1.03)**	1.00 (0.99-1.02)	1.01 (1.00-1.03)
Gender			
Male (reference)			
Female	1.32 (0.93-1.87)	1.10 (0.88-1.38)	0.81 (0.59-1.10)
Ethnicity			
Caucasian (reference)			
Indigenous	0.72 (0.46-1.13)	**0.70 (0.53-0.94)**	**0.47 (0.32-0.70)**
Other minority	**0.60 (0.40-0.90)**	0.87 (0.69-1.10)	**0.57 (0.41-0.79)**
Education			
Less than high school (reference)			
Completed high school/some higher education	1.16 (0.81-1.66)	0.82 (0.65-1.03)	0.86 (0.63-1.16)
Completed higher education	0.85 (0.50-1.45)	**0.72 (0.52-0.99)**	0.68 (0.43-1.07)
Income ($ / prior month)[b]	0.80 (0.62-1.02)	0.98 (0.85-1.14)	0.89 (0.74-1.06)
Alcohol abuse or dependence	0.86 (0.62-1.21)	0.81 (0.65-1.02)	0.83 (0.62-1.11)
Drug abuse or dependence	1.08 (0.75-1.56)	1.12 (0.90-1.39)	0.86 (0.63-1.17)
Past psychiatric hospitalization	**0.61 (0.43-0.86)**	0.94 (0.76-1.17)	**0.66 (0.49-0.90)**
Past criminal involvement	1.19 (0.84-1.68)	0.90 (0.72-1.12)	0.90 (0.67-1.20)
Total time homeless (years)	1.00 (0.98-1.03)	1.01 (0.99-1.02)	0.99 (0.97-1.01)
Childhood trauma (ACE score)	0.95 (0.90-1.02)	0.97 (0.93-1.01)	0.96 (0.91-1.02)
Suicide risk			
No/low (reference)			
Moderate/high	1.04 (0.72-1.51)	1.03 (0.82-1.28)	0.90 (0.66-1.23)
Baseline psychiatric diagnosis			
Other disorders (reference)			
With psychotic features	0.74 (0.52-1.06)	**0.74 (0.59-0.94)**	**0.46 (0.33-0.63)**
Inadequate access to health care	1.02 (0.73-1.44)	0.99 (0.80-1.23)	0.76 (0.57-1.02)
Level of functioning (MCAS score)	**0.97 (0.95-1.00)**	1.00 (0.99-1.02)	**0.95 (0.93-0.97)**
Family social support (QOLI-20 Family score)	1.00 (0.97-1.03)	0.99 (0.98-1.01)	1.00 (0.98-1.03)
Number of comorbidities	0.96 (0.91-1.02)	0.98 (0.94-1.01)	0.97 (0.93-1.02)
Site[c]			
Toronto (reference)			
Montreal	**3.64 (2.18-6.06)**	**1.58 (1.16-2.16)**	**8.96 (5.50-14.60)**
Vancouver	**2.93 (1.75-4.90)**	0.95 (0.69-1.32)	**3.79 (2.25-6.39)**
Winnipeg	**1.77 (1.06-2.94)**	0.83 (0.62-1.11)	**2.23 (1.33-3.73)**
Moncton	**5.72 (3.08-10.61)**	**1.80 (1.15-2.82)**	**9.20 (5.05-16.76)**

[a] *Reference class is class 1 ("decreasing-then-increasing" group)*
[b] *Odds ratios for income reflect a $1000 difference*
[c] *Odds ratios for site are based on LCGA model*

Tables 6 and 7 report the average number of addiction and mental health visits per person with each service provider (excluding intervention visits) by treatment group and class, respectively. Participants in the TAU group reported a higher number of total visits per person (37.7) than the HF group (26.2). The most frequently contacted service providers in the TAU group were nurses (6.8), social workers (4.8), and psychiatrists (3.7). The most commonly used service providers in the HF group were pharmacists (4.1), nurses (4.0), and psychiatrists (3.6). Of the four classes, class 1 reported the greatest number of visits per person (46.8), while class 4 reported the lowest (7.9). Nurses were the top service provider used by all four classes, ranging from 1.8 visits per person in class 4 to 8.1 visits per person in class 1. Pharmacists, social workers, and psychiatrists were also among the most commonly used service providers in classes 1, 2, and 3. Although use of pharmacists and psychiatrists remained high in class 4, addictions counselors were also among the top used providers in this class.

Table 6: Average number of addiction and mental health visits (excluding intervention visits) per person by service provider, by treatment group

	Treatment as Usual	Housing First
Mental health worker	2.2	1.0
Housing worker	2.3	0.9
Case manager	2.9	1.0
Therapist or counselor	1.6	1.1
Outreach worker	2.1	1.4
Social worker	4.8	2.5
Welfare worker	1.5	2.1
Nurse	6.8	4.0
Addictions Counselor	2.3	1.6
Work/vocational counselor	0.2	0.2
IPS counselor	0.0	0.1
Pharmacist	2.8	4.1
Peer support worker	0.3	0.1
Community worker	1.4	0.8
Follow-up worker	0.1	0.2
Street worker	0.3	0.2
Spiritual advisor/counselor/healer	0.3	0.2
Indigenous elder	0.2	0.0
Clergy	0.4	0.3
Psychoeducator	0.0	0.0
Life skills worker	0.6	0.2
Occupational therapist	0.2	0.1
Psychiatrist	3.7	3.6
Psychologist	0.3	0.2
Art therapist	0.0	0.0
CFS worker	0.3	0.1
TOTAL	37.7	26.2

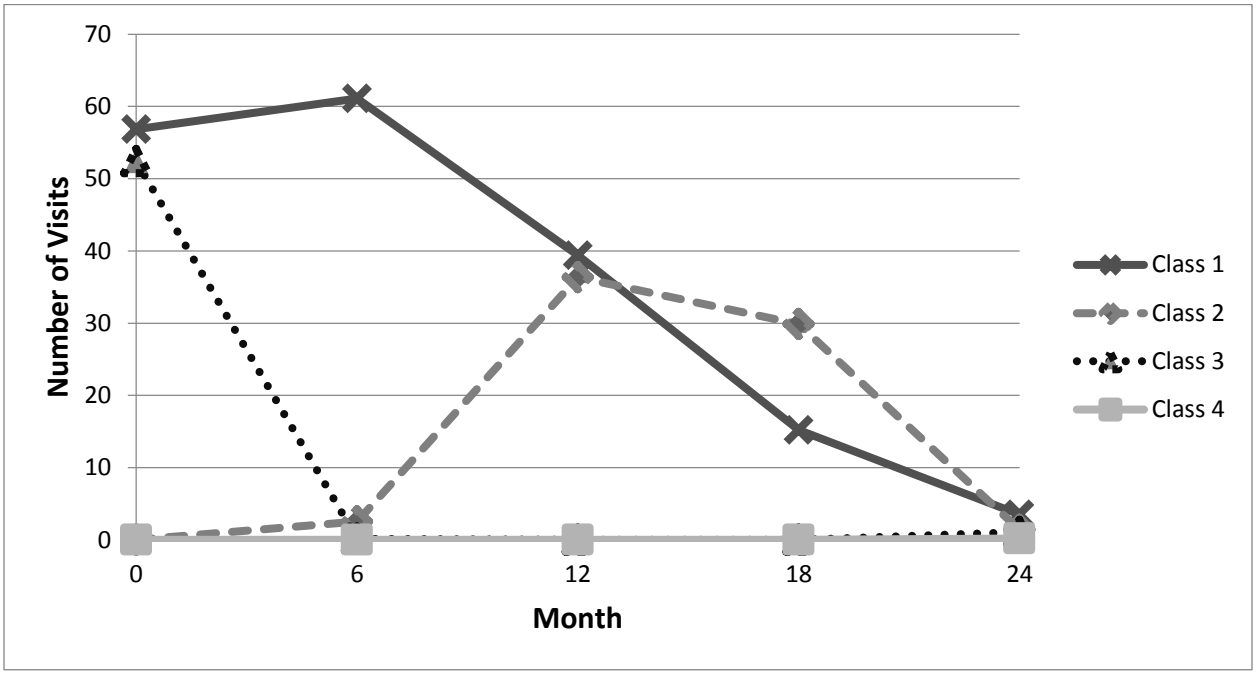
Table 7: Average number of addiction and mental health visits (excluding intervention visits) per person by service provider, by class

	Class 1	Class 2	Class 3	Class 4
Mental health worker	2.7	0.9	1.1	0.2
Housing worker	2.1	0.2	1.8	0.1
Case manager	2.9	1.2	1.4	0.6
Therapist or counselor	2.0	0.9	1.1	0.5
Outreach worker	2.2	0.4	2.2	0.3
Social worker	5.2	2.1	3.5	0.5
Welfare worker	2.8	1.3	1.5	0.5
Nurse	8.1	5.7	3.7	1.8
Addictions Counselor	2.5	1.6	1.9	0.9
Work/vocational counselor	0.5	0.0	0.1	0.0
IPS counselor	0.1	0.1	0.0	0.0
Pharmacist	5.4	4.2	2.5	0.8
Peer support worker	0.3	0.4	0.1	0.1
Community worker	1.2	1.4	1.1	0.3
Follow-up worker	0.3	0.0	0.0	0.0
Street worker	0.3	0.4	0.3	0.0
Spiritual advisor/counselor/healer	0.3	0.6	0.3	0.0
Indigenous elder	0.2	0.1	0.1	0.0
Clergy	0.5	0.0	0.4	0.1
Psychoeducator	0.1	0.0	0.0	0.0
Life skills worker	0.6	0.6	0.2	0.2
Occupational therapist	0.2	0.1	0.2	0.0
Psychiatrist	5.7	2.8	2.7	0.9
Psychologist	0.4	0.3	0.2	0.0
Art therapist	0.0	0.0	0.0	0.0
CFS worker	0.3	0.1	0.1	0.0
TOTAL	46.8	25.4	26.5	7.9

5.2.2 Addiction Programs and Mental Health Service Visits (including intervention visits)

The previous analysis was replicated to include addiction and mental health visits provided as part of the intervention to assess the effect of HF on trajectories of all visits that occurred throughout the study. The 4-class quadratic model was selected, with trajectories back-transformed onto the original scale (Figure 5).

Figure 5: Estimated trajectories of addiction and mental health service use (intervention visits included).



Distributions of predictors across classes are reported in Table 8.

Class 1, the *mostly decline* group, was the largest class (52.1% of the sample). Class 2 was the *increase until midway then gradual decline* class, consisting of 13.4% of the sample. Class 3 was

the *sharp drop then constantly low* group and included 23.5% of the sample. The smallest class was class 4 (11.0% of the sample), the *consistently low* class.

Using class 1 as the reference group, results of the MLR (Table 9) indicated that classes 2, 3, and 4 were all less likely to include participants of Indigenous or other ethnic background, or to have a psychotic disorder at baseline. Classes 2 and 4 were also less likely to have a history of psychiatric hospitalization, or to have a higher level of functioning. Class 4 was associated with a higher mean age, and less likely to have had a longer time homeless. Treatment group only predicted class 3 membership, with members less likely to be enrolled in HF than class 1.

Table 8: Addiction and mental health visits (intervention visits included) - Distribution of baseline characteristics by class membership[a]

Variable	Class 1: Mostly decline N= 1108(52.1%)	Class 2: Increase until midway then gradual decline N= 285 (13.4%)	Class 3: Sharp drop then constantly low N=499(23.5%)	Class 4: Consistently low N= 235(11.0%)
Treatment group (%)				
Treatment as usual	484 (43.7)	115 (40.4)	269 (53.9)	109 (46.4)
Housing First	624 (56.3)	170 (59.7)	230 (46.1)	126 (53.6)
Age (years)	39.9	40.9	41.6	44.7
Gender (% female)	366 (33.0)	94 (33.0)	165 (33.1)	60 (25.5)
Ethnicity (%)				
Caucasian	461 (41.6)	160 (56.1)	286 (57.3)	141 (60.0)
Indigenous	265 (23.9)	63 (22.1)	95 (19.0)	35 (14.9)
Other minority	382 (34.5)	62 (21.8)	118 (23.7)	59 (25.1)
Education (%)				
Less than high school	600 (54.2)	161 (56.5)	286 (57.3)	126 (53.6)
Completed high school/some higher education	358 (32.3)	98 (34.4)	155 (31.1)	74 (31.5)
Completed higher education	145 (13.1)	24 (8.4)	58 (11.6)	33 (14.0)
Missing	5 (0.5)	2 (0.7)	-	2 (0.9)
Income (mean $ / prior month)	670.5	627.2	725.0	680.3
Missing (%)	9 (0.8)	4 (1.4)	4 (0.8)	-
Alcohol abuse or dependence (%)	506 (45.7)	132 (46.3)	218 (43.7)	92 (39.2)
Drug abuse or dependence (%)	585 (52.8)	145 (50.9)	274 (54.9)	114 (48.5)
Past psychiatric hospitalization (%)	460 (41.5)	103 (36.1)	182 (36.5)	64 (27.2)
Missing	20 (1.8)	4 (1.4)	15 (3.0)	8 (3.4)
Past criminal involvement (%)	397 (35.8)	105 (36.8)	169 (33.9)	77 (32.8)
Missing	7 (0.6)	3 (1.1)	4 (0.8)	1 (0.4)
Total time homeless (years)	4.8	5.1	4.8	4.7
Missing (%)	26 (2.4)	7 (2.5)	8 (1.6)	1 (0.4)
Childhood trauma (ACE score)	4.6	4.4	4.6	3.9
Missing (%)	195 (17.6)	43 (15.1)	65 (13.0)	37 (15.7)
Suicide risk (% moderate/high)	390 (35.2)	110 (38.6)	205 (41.1)	67 (28.5)
Baseline psychiatric diagnosis (% psychotic)	568 (51.3)	122 (42.8)	208 (41.7)	99 (42.1)
Missing	8 (0.7)	3 (1.1)	3 (0.6)	1 (0.4)
Inadequate access to health care (%)	501 (45.2)	129 (45.3)	256 (51.3)	94 (40.0)
Missing	12 (1.1)	8 (2.8)	2 (0.4)	3 (1.3)
Level of functioning (MCAS score)	60.4	58.8	60.9	58.8
Family social support (QOLI-20 Family score)	14.0	14.0	13.1	13.9
Missing (%)	28 (2.5)	9 (3.2)	12 (2.4)	11 (4.7)
Number of comorbidities	4.7	4.8	5.0	4.4
Missing (%)	1 (0.1)	-	-	-

[a] *Table reports data before multiple imputation*

Table 9: Addiction and mental health visits (intervention visits included) - Odds ratios and their 95% confidence intervals for predictors of class membership[a]

Variable	Class 2: Increase until midway then gradual decline	Class 3: Sharp drop then constantly low	Class 4: Consistently low
Treatment group			
Treatment as usual (reference)			
Housing First	1.16 (0.88-1.52)	**0.64 (0.52-0.80)**	0.92 (0.69-1.23)
Age (years)	1.00 (0.99-1.02)	1.01 (1.00-1.02)	**1.03 (1.02-1.05)**
Gender			
Male (reference)			
Female	1.07 (0.80-1.44)	0.99 (0.77-1.27)	0.77 (0.55-1.08)
Ethnicity			
Caucasian (reference)			
Indigenous	**0.59 (0.41-0.86)**	**0.59 (0.43-0.81)**	**0.51 (0.33-0.81)**
Other minority	**0.48 (0.34-0.68)**	**0.55 (0.42-0.72)**	**0.56 (0.39-0.80)**
Education			
Less than high school (reference)			
Completed high school/some higher education	1.07 (0.79-1.45)	0.86 (0.67-1.10)	0.91 (0.65-1.29)
Completed higher education	0.63 (0.39-1.04)	0.72 (0.51-1.03)	0.96 (0.61-1.51)
Income ($ / prior month)[b]	0.85 (0.68-1.05)	1.06 (0.90-1.24)	0.91 (0.76-1.09)
Alcohol abuse or dependence	0.99 (0.74-1.32)	0.89 (0.70-1.13)	0.80 (0.58-1.11)
Drug abuse or dependence	0.81 (0.60-1.10)	1.05 (0.83-1.33)	1.05 (0.74-1.48)
Past psychiatric hospitalization	**0.72 (0.54-0.98)**	0.86 (0.68-1.10)	**0.53 (0.38-0.74)**
Past criminal involvement	1.11 (0.83-1.49)	0.97 (0.76-1.23)	1.01 (0.73-1.39)
Total time homeless (years)	1.00 (0.98-1.02)	0.99 (0.98-1.01)	**0.97 (0.95-1.00)**
Childhood trauma (ACE score)	0.97 (0.92-1.02)	0.99 (0.94-1.03)	0.96 (0.90-1.02)
Suicide risk			
No/low (reference)			
Moderate/high	1.16 (0.86-1.58)	1.15 (0.91-1.45)	0.79 (0.56-1.13)
Baseline psychiatric diagnosis			
Other disorders (reference)			
With psychotic features	**0.63 (0.46-0.86)**	**0.77 (0.60-0.99)**	**0.55 (0.39-0.77)**
Inadequate access to health care	0.94 (0.71-1.26)	1.14 (0.91-1.44)	0.83 (0.61-1.14)
Level of functioning (MCAS score)	**0.97 (0.95-0.98)**	1.00 (0.99-1.02)	**0.95 (0.94-0.97)**
Family social support (QOLI-20 Family score)	1.01 (0.99-1.03)	0.99 (0.97-1.01)	0.99 (0.97-1.02)
Number of comorbidities	1.00 (0.96-1.05)	1.01 (0.97-1.04)	0.97 (0.92-1.01)
Site[c]			
Toronto (reference)			
Montreal	**3.57 (2.29-5.58)**	**6.39 (4.57-8.95)**	**44.24 (21.13-95.62)**
Vancouver	**3.00 (2.00-4.50)**	**1.69 (1.18-2.44)**	**8.55 (3.92-18.63)**
Winnipeg	**1.82 (1.22-2.73)**	**1.55 (1.11-2.16)**	**5.61 (2.58-12.20)**
Moncton	**4.74 (2.88-7.79)**	**3.02 (1.89-4.82)**	**22.14 (9.83-49.86)**

[a] *Reference class is class 1 ("mostly decline" group)*
[b] *Odds ratios for income reflect a $1000 difference*
[c] *Odds ratios for site are based on LCGA model*

Tables 10 and 11 report the average number of addiction and mental health visits per person with each service provider (intervention visits included) by treatment group and class, respectively. Participants in the HF group reported a greater number of total visits per person (42.6) than the TAU group (37.7). The most frequently contacted service providers in the HF group were case managers (10.3), nurses (5.5), and mental health workers (4.8). The most commonly used service providers in the TAU group were nurses (6.8), social workers (4.8), and psychiatrists (3.7). Of the four classes, class 1 reported the greatest number of visits per person (54.2), while class 4 reported the lowest (10.0). Classes 1 and 2 reported case managers as the top used service provider (9.6 in class 1, 8.5 in class 2), followed by nurses and mental health workers. For classes 3 and 4, nurse visits were the most common (4.8 in class 3, 2.8 in class 4). The next most common providers were social workers and pharmacists for class 3, and pharmacists and case managers for class 4.

Table 10: Average number of addiction and mental health visits (intervention visits included) per person by service provider, by treatment group

	Treatment as Usual	Housing First
Mental health worker	2.2	4.8
Housing worker	2.3	1.5
Case manager	2.9	10.3
Therapist or counselor	1.6	1.1
Outreach worker	2.1	1.7
Social worker	4.8	2.8
Welfare worker	1.5	2.1
Nurse	6.8	5.5
Addictions Counselor	2.3	1.6
Work/vocational counselor	0.2	0.3
IPS counselor	0.0	0.1
Pharmacist	2.8	4.1
Peer support worker	0.3	0.4
Community worker	1.4	0.8
Follow-up worker	0.1	0.2
Street worker	0.3	0.2
Spiritual advisor/counselor/healer	0.3	0.2
Indigenous elder	0.2	0.2
Clergy	0.4	0.3
Psychoeducator	0.0	0.0
Life skills worker	0.6	0.2
Occupational therapist	0.2	0.2
Psychiatrist	3.7	3.6
Psychologist	0.3	0.3
Art therapist	0.0	0.0
CFS worker	0.3	0.1
TOTAL	37.7	42.6

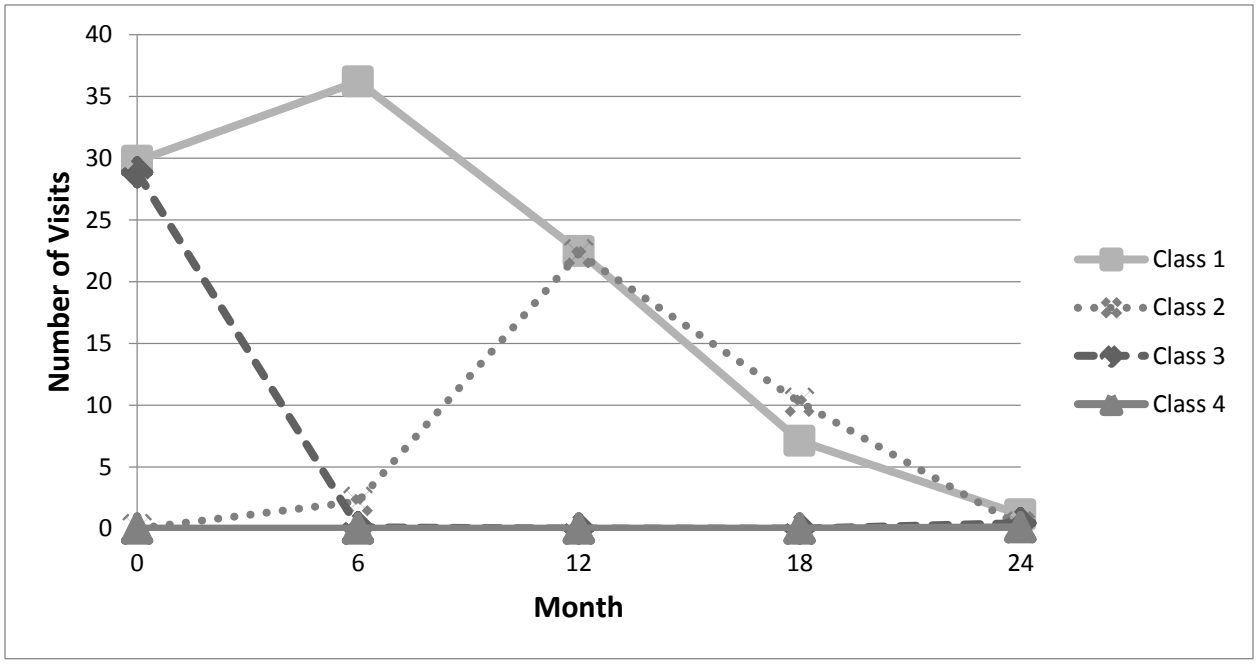
Table 11: Average number of addiction and mental health visits (intervention visits included) per person by service provider, by class

	Class 1	Class 2	Class 3	Class 4
Mental health worker	5.3	2.8	1.8	0.3
Housing worker	2.7	0.7	1.3	0.2
Case manager	9.6	8.5	2.6	0.9
Therapist or counselor	1.9	1.0	0.8	0.1
Outreach worker	2.9	0.7	1.2	0.5
Social worker	4.9	1.7	3.6	0.7
Welfare worker	2.5	1.3	1.5	0.3
Nurse	7.5	5.5	4.8	2.8
Addictions Counselor	2.2	1.8	2.2	0.4
Work/vocational counselor	0.4	0.1	0.2	0.1
IPS counselor	0.1	0.0	0.1	0.0
Pharmacist	4.5	2.3	2.8	1.9
Peer support worker	0.4	0.6	0.0	0.2
Community worker	1.0	1.0	1.5	0.3
Follow-up worker	0.2	0.0	0.1	0.0
Street worker	0.4	0.2	0.2	0.0
Spiritual advisor/counselor/healer	0.3	0.4	0.3	0.1
Indigenous elder	0.3	0.1	0.2	0.0
Clergy	0.5	0.0	0.2	0.2
Psychoeducator	0.0	0.0	0.0	0.0
Life skills worker	0.5	0.5	0.3	0.2
Occupational therapist	0.3	0.2	0.2	0.0
Psychiatrist	5.2	2.5	2.2	0.6
Psychologist	0.3	0.1	0.4	0.1
Art therapist	0.0	0.0	0.0	0.0
CFS worker	0.2	0.1	0.2	0.0
TOTAL	54.2	32.2	28.7	10.0

5.3 Physical Health Ambulatory Visits

The chosen model was the 4-class quadratic model, with the log-transformed outcome back-transformed onto the original scale (Figure 6).

Figure 6: Estimated trajectories of physical health service visit counts.



Predictors of interest and their distributions by class are outlined in Table 12.

Class 1, the *mostly decline* group, was the largest class (32.4% of the sample). Members exhibited high visit rates at baseline followed by a small peak in use at six months. Service use then declined continuously, approaching zero visits at 24 months. Class 2 was the *rise until midway then decline* group, and was the smallest class identified (14.7% of the sample). Participants in this class had low visit counts at baseline, a small increase at six months, then a sharper rise in visit counts until month 12. This was followed by a decline in visit rates until the end. Class 3, the *sharp drop then constantly low* group, included 25.6% of the sample. Members of class 3 started off with high service use at baseline, but saw an immediate drop in visit rates at

month six of the follow-up, before reaching stable, near-zero rates until the study's end. Class 4 was the *consistently low* group, comprising 27.3% of the sample. This class had low and stable use of services throughout the study.

Results of the MLR (including ORs for site based on the LCGA) are reported in Table 13. Class 1 served as the reference group for the MLR. Compared to the reference class, class 2 members were less likely to be of Indigenous ethnicity, to have completed higher education, to have a higher level of functioning at baseline, or to have a higher number of physical comorbidities. Class 3 participants were less likely to be of Indigenous or other minority background, to have a higher level of functioning, or to have more physical comorbidities. Members of class 4 were less likely to be female, to be Indigenous, to have completed higher education, to have drug abuse or dependence, to have a higher level of baseline functioning, to have more family social support, or to have more physical comorbidities. Treatment group was a significant predictor of class membership, as class 3 and 4 participants were more likely to be enrolled in HF than those in class 1.

Table 12: Physical health visits - Distribution of baseline characteristics by class membership[a]

Variable	Class 1: Mostly decline N = 688 (32.4%)	Class 2: Rise until midway then decline N = 313 (14.7%)	Class 3: Sharp drop then constantly low N = 545 (25.6%)	Class 4: Consistently low N = 581 (27.3%)
Treatment group (%)				
Treatment as usual	351 (51.0)	143 (45.7)	234 (42.9)	249 (42.9)
Housing First	337 (49.0)	170 (54.3)	311 (57.1)	332 (57.1)
Age (years)	41.6	40.5	40.7	40.7
Gender (% female)	258 (37.5)	103 (32.9)	171 (31.4)	153 (26.3)
Ethnicity (%)				
Caucasian	295 (42.9)	153 (48.9)	293 (53.8)	307 (52.8)
Indigenous	197 (28.6)	70 (22.4)	99 (18.2)	92 (15.8)
Other minority	196 (28.5)	90 (28.8)	153 (28.1)	182 (31.3)
Education (%)				
Less than high school	361 (52.5)	182 (58.2)	304 (55.8)	326 (56.1)
Completed high school/some higher education	226 (32.9)	102 (32.6)	165 (30.3)	192 (33.1)
Completed higher education	98 (14.2)	29 (9.3)	75 (13.8)	58 (10.0)
Missing	3 (0.4)	-	1 (0.2)	5 (0.9)
Income (mean $ / prior month)	670.8	733.6	680.6	656.4
Missing (%)	5 (0.7)	1 (0.3)	8 (1.5)	3 (0.5)
Alcohol abuse or dependence (%)	332 (48.3)	143 (45.7)	243 (44.6)	230 (39.6)
Drug abuse or dependence (%)	378 (54.9)	169 (54.0)	304 (55.8)	267 (46.0)
Past psychiatric hospitalization (%)	242 (35.2)	113 (36.1)	216 (39.6)	238 (41.0)
Missing	11 (1.6)	10 (3.2)	12 (2.2)	14 (2.4)
Past criminal involvement (%)	231 (33.6)	113 (36.1)	206 (37.8)	198 (34.1)
Missing	4 (0.6)	4 (1.3)	1 (0.2)	6 (1.0)
Total time homeless (years)	4.6	5.0	4.6	5.3
Missing (%)	12 (1.7)	5 (1.6)	11 (2.0)	14 (2.4)
Childhood trauma (ACE score)	4.8	4.4	4.4	4.1
Missing (%)	112 (16.3)	28 (8.9)	69 (12.7)	131 (22.5)
Suicide risk (% moderate/high)	267 (38.8)	103 (32.9)	215 (39.5)	187 (32.2)
Baseline psychiatric diagnosis (% psychotic)	281 (40.8)	137 (43.8)	270 (49.5)	309 (53.2)
Missing	3 (0.4)	1 (0.3)	4 (0.7)	7 (1.2)
Inadequate access to health care (%)	344 (50.0)	150 (47.9)	251 (46.1)	235 (40.5)
Missing	4 (0.6)	4 (1.3)	7 (1.3)	10 (1.7)
Level of functioning (MCAS score)	61.9	60.0	60.2	58.2
Family social support (QOLI-20 Family score)	13.8	14.0	13.8	13.7
Missing (%)	12 (1.7)	11 (3.5)	21 (3.9)	16 (2.8)
Number of comorbidities	5.5	4.7	4.7	3.9
Missing (%)	-	-	1 (0.2)	-

[a] *Table reports data before multiple imputation*

Table 13: Physical health visits - Odds ratios and their 95% confidence intervals for predictors of class membership[a]

Variable	Class 2: Rise until midway then decline	Class 3: Sharp drop then constantly low	Class 4: Consistently low
Treatment group			
Treatment as usual (reference)			
Housing First	1.27 (0.97-1.67)	**1.46 (1.16-1.84)**	**1.51 (1.20-1.91)**
Age (years)	0.99 (0.98-1.01)	0.99 (0.98- 1.01)	0.99 (0.98-1.00)
Gender			
Male (reference)			
Female	0.93 (0.69-1.26)	0.86 (0.67-1.11)	**0.74 (0.57-0.97)**
Ethnicity			
Caucasian (reference)			
Indigenous	**0.66 (0.45-0.97)**	**0.50 (0.36-0.69)**	**0.49 (0.34-0.69)**
Other minority	0.86 (0.61-1.19)	**0.73 (0.55-0.96)**	0.81 (0.61-1.08)
Education			
Less than high school (reference)			
Completed high school/some higher education	0.87 (0.64-1.19)	0.84 (0.64-1.10)	0.86 (0.66-1.12)
Completed higher education	**0.58 (0.36-0.93)**	0.92 (0.64-1.31)	**0.67 (0.45-0.99)**
Income ($ / prior month)[b]	1.12 (0.93-1.35)	0.97 (0.81-1.17)	0.95 (0.78-1.16)
Alcohol abuse or dependence	0.98 (0.72-1.33)	0.97 (0.75-1.24)	0.89 (0.69-1.16)
Drug abuse or dependence	0.84 (0.62-1.14)	0.95 (0.73-1.23)	**0.64 (0.49-0.83)**
Past psychiatric hospitalization	0.97 (0.72-1.31)	0.99 (0.77-1.27)	0.97 (0.75-1.26)
Past criminal involvement	1.01 (0.75-1.37)	1.08 (0.84-1.39)	0.90 (0.69-1.16)
Total time homeless (years)	1.01 (0.99-1.03)	1.00 (0.98-1.02)	1.02 (1.00-1.04)
Childhood trauma (ACE score)	0.99 (0.94-1.05)	0.99 (0.95-1.04)	0.99 (0.94-1.03)
Suicide risk			
No/low (reference)			
Moderate/high	0.81 (0.60-1.10)	1.16 (0.90-1.50)	0.97 (0.74-1.26)
Baseline psychiatric diagnosis			
Other disorders (reference)			
With psychotic features	0.81 (0.58-1.12)	1.19 (0.92-1.56)	0.93 (0.71-1.22)
Inadequate access to health care	1.07 (0.80-1.42)	0.93 (0.72-1.19)	0.88 (0.68-1.13)
Level of functioning (MCAS score)	**0.97 (0.95-0.99)**	**0.98 (0.96-0.99)**	**0.94 (0.93-0.96)**
Family social support (QOLI-20 Family score)	1.00 (0.98-1.02)	1.00 (0.98-1.02)	**0.98 (0.96-1.00)**
Number of comorbidities	**0.94 (0.89-0.98)**	**0.95 (0.92-0.99)**	**0.88 (0.85-0.92)**
Site[c]			
Toronto (reference)			
Montreal	**3.16 (2.06-4.84)**	**3.39 (2.31-4.98)**	**4.43 (3.08-6.38)**
Vancouver	1.48 (0.99-2.22)	1.27 (0.88-1.83)	1.18 (0.83-1.69)
Winnipeg	0.85 (0.58-1.24)	0.83 (0.59-1.16)	**0.55 (0.39-0.78)**
Moncton	0.93 (0.51-1.70)	**2.05 (1.31-3.22)**	1.21 (0.76-1.93)

[a] *Reference class is class 1 ("mostly decline" group)*
[b] *Odds ratios for income reflect a $1000 difference*
[c] *Odds ratios for site are based on LCGA model*

Tables 14 and 15 report the average number of physical health visits per person with each service provider by treatment group and class, respectively. Participants in the TAU group reported a greater number of total visits per person (18.2) than the HF group (16.5). The most frequently contacted service providers in the TAU group were nurses (6.8), family doctors (6.1), and pharmacists (2.8). These three providers were also the most commonly used in the HF group, which reported an average of 5.7 family doctor visits per person, 4.1 pharmacist visits, and 4.0 nurse visits. Of the four classes, class 1 reported the greatest number of visits per person (27.9), while class 4 reported the lowest (4.7). Again, nurses, family doctors, and pharmacists were the top three providers used in all the classes. The ordering slightly differed however, with family doctors being the most common in classes 1 and 2 (10.4 and 5.9, respectively), followed by nurses and pharmacists, while the most common in classes 3 and 4 were nurses (6.7 and 1.9, respectively), followed by family doctors and pharmacists.

Table 14: Average number of physical health visits per person by service provider, by treatment group

	Treatment as Usual	Housing First
Nurse	6.8	4.0
Family doctor	6.1	5.7
Specialist doctor (not psychiatrist or psychologist)	1.4	1.5
Dentist	0.5	0.5
Pharmacist	2.8	4.1
Optometrist	0.1	0.1
Physiotherapist	0.1	0.2
Nutritionist/dietician	0.0	0.0
Occupational therapist	0.2	0.1
Chiropractor	0.0	0.1
Natural healer	0.1	0.0
Radiologist	0.0	0.0
Midwife	0.0	0.0
TOTAL	18.2	16.5

Table 15: Average number of physical health visits per person by service provider, by class

	Class 1	Class 2	Class 3	Class 4
Nurse	7.1	5.3	6.7	1.9
Family doctor	10.4	5.9	4.8	1.5
Specialist doctor (not psychiatrist or psychologist)	2.3	1.6	1.7	0.2
Dentist	0.7	0.5	0.6	0.3
Pharmacist	6.3	4.3	2.5	0.7
Optometrist	0.2	0.1	0.1	0.1
Physiotherapist	0.4	0.1	0.1	0.0
Nutritionist/dietician	0.1	0.1	0.0	0.0
Occupational therapist	0.3	0.0	0.3	0.0
Chiropractor	0.1	0.1	0.0	0.0
Natural healer	0.1	0.0	0.0	0.0
Radiologist	0.0	0.0	0.0	0.0
Midwife	0.0	0.0	0.0	0.0
TOTAL	27.9	18.1	16.8	4.7

6. DISCUSSION

6.1 Interpretation and Significance of Findings

LCGA identified four distinct trajectories of shelter utilization over the course of the AHCS trial. Four participants out of five experienced low shelter use for the entire study, as seen in class 1. The remaining classes of trajectories showed a rise in days of use at different times, ranging from a small increase (class 2) to a larger increase (class 4). The number of shelter days declined to low values by the end of the 24 months for all classes, suggesting that participants generally achieved positive outcomes at the study's end – however, members of classes 3 and 4 experienced significantly more days of shelter use over the follow-up period compared to class 1.

An important predictor of class membership for shelter use trajectories was treatment group. Participants in classes 2, 3 and 4, all of which were associated with greater shelter use than class 1, were all significantly less likely to be in the HF group compared to class 1, as indicated by the odds ratios. The effect of HF on utilization trajectories is further supported by the magnitudes of the ORs. Participants assigned to HF had the lowest odds of demonstrating the worst outcome trajectory (class 4), with the odds of class membership increasing with decreasing shelter use, as shown by the results for class 3 (second worst outcome), and class 2 (second best outcome). These findings add to the evidence base for HF in the reduction of service utilization among homeless individuals.

Other variables found to significantly predict class membership for shelter use included age, gender, income, total time homeless, alcohol and drug abuse/dependence, and suicide risk. Although associations were not significant across all classes, results indicate that in general, classes with poorer outcomes (class 3 and 4) were more likely to include older individuals and those with longer time homeless, and less likely to include individuals with alcohol abuse/dependence (perhaps because substance use is discouraged in shelters) or moderate/high suicide risk. The class with a marginally worse outcome than the reference class (class 2) was more likely to consist of males and individuals with drug abuse/dependence or higher income.

Although the effect of site was not of primary interest, individuals with trajectories of greater shelter use (e.g., classes 3 and 4) were more likely to be living in a city with a larger population such as Toronto, compared to Winnipeg or Moncton. This may be an indication that individuals experiencing homelessness gravitate towards larger cities, or could reflect higher living costs of larger cities. It is also possible that a lower usage in smaller cities is due to a lower availability of shelter beds. We were unable to determine this with the available data.

The classes identified in the shelter use analysis are similar but not entirely consistent with those that Gleason et al. have reported.[59] Four classes were found in both analyses, with a similar reference class consisting of over 75% of the sample which had low shelter utilization. Class 4 in the two studies are arguably comparable as well, since both exhibit high emergency shelter utilization for a relatively long time, characteristic of chronic shelter users. However, the two intermediate classes in Gleason et al.'s analysis showed much higher shelter use than the intermediate usage classes in this study. Direct comparisons are difficult, however, as Gleason et al. modelled trajectories of not only shelters, but also outreach services in their LCGA, and none of their participants were provided an intervention such as HF, which served to reduce shelter usage in our participants.

Previous AHCS findings reported significant improvements in residential stability for HF participants compared to TAU participants, including proportion stably housed, proportion never housed, time to achieve stable housing, and length of tenure in stable housing.[8 9] The analysis by Adair et al. also indicated that trajectories of housing stability were generally better for HF participants than TAU participants.[134] Consistent with these findings, the results presented here indicate that HF is associated with lower shelter utilization compared to individuals accessing usual services only.

LCGA also distinguished four trajectories of addiction and mental health visits, and four trajectories of physical health visits, in the AHCS trial. Trajectories in the three analyses of ambulatory visits reflect rather high rates of use in general, as frequencies reached above 60 visits in the past six months. This corroborates evidence from previous studies indicating high ambulatory service use in homeless individuals.[36 71]

In the analysis of addiction and mental health service use excluding intervention services, two participants out of five experienced a parabolic, U-shaped trajectory of visits (class 1, the largest class). The remaining classes showed distinct patterns of utilization, including increasing, decreasing, and stable trajectories. Introducing intervention visits into the analysis noticeably changed the trajectory patterns, as the largest class (class 1) now showed a general decreasing pattern of use, with over half the sample belonging to this class. Class 2 also differed, as the estimated trajectory also became an increasing-then-decreasing pattern with a peak at 12 months, in contrast to the continuously increasing pattern seen for class 2 participants when intervention visits were not modelled. Interestingly, participants in classes 1 and 2 were predicted to end the study with increasing non-intervention visits (Figure 4), whereas all identified classes reached low to no visits at the end when counting all addiction/mental health visits internal and external to the intervention (Figure 5). The trajectories of classes 3 and 4 remained common to both analyses. The analysis of physical health visits suggests that three participants out of 10 experienced a small increase in visits in the first six months, followed by a continuous decline to low visits at 24 months (class 1, the largest class).

Results of the MLR point to the notable influence of HF on class membership of ambulatory visit trajectories. As indicated by the ORs for the analysis of addiction and mental health visits excluding intervention visits, participants of classes 3 and 4 were more likely to be enrolled in HF than class 1, a class with higher service use. These results suggest that HF is protective against trajectories of high or increasing visit rates, but only for services external to the intervention. The analysis conducted for all addiction and mental health visits suggests that the effect of HF on addiction and mental health service use diminishes when intervention visits are included. HF did not appear to have a consistent association with either high or low trajectories of use, unlike the findings for external visits only. This is not unexpected, as a goal of the intervention is to provide services to help ameliorate substance problems and mental illness in clients. These services evidently substitute for addiction and mental health visits that would have otherwise occurred outside the intervention. Furthermore, enrolment in the intervention could have increased participants' access to services they normally would not be able or be motivated to access. These concepts are also reflected in the average number of visits per person by treatment group. When excluding intervention visit counts, HF participants had a lower total

visit count per person than those in TAU. The association reversed, however, when all visits (intervention and non-intervention) were counted - HF participants now had slightly more visits per person than members of the control group.

Excluding intervention visits, the number of addiction and mental health visits per person by social workers, nurses, and case managers were notably higher in the TAU group than the HF group, with the most frequently contacted provider being nurses within the TAU group. In contrast, pharmacist visits were higher for HF participants, and the highest within the HF group. When analyzing all addiction and mental health visits, including intervention visits, these trends remained similar. However, a significant difference was seen for visits by mental health workers and case managers, as the HF group now had considerably more average visits per person with these providers. Outside of the intervention, HF participants had the most pharmacist visits, but showed case manager visits to be the most frequent when intervention services were accounted for. This is likely due to increased access to these services as part of the intervention. In both addiction and mental health visits analyses, the class which reported the most visits at baseline (class 1), showed the highest average counts per person for total visits and for many provider-specific visits, while class 4 reported the lowest. In the analysis excluding intervention visits, nurses, pharmacists, and psychiatrists were the most used providers, with nurses being the top provider used, across all four classes. Social workers were also one of the most frequently contacted providers in classes exhibiting greater use trajectories (classes 1, 2, and 3), while addictions counselors were one of the top providers used in the class with the fewest visits (class 4). However, when including intervention visits, classes 1 and 2, which were the classes with the highest use, now reported case managers to be the top provider used. While nurses remained the most used provider in classes 3 and 4, case managers also played a larger role for these classes compared to the previous analysis. The classes identified in the analysis with all visits generally had a much higher use of mental health workers and case managers compared to those identified in the analysis excluding intervention visits, which again suggests increased access to these providers through the intervention.

Similar to the findings for shelter use and non-intervention addiction/mental health visits, individuals belonging to classes with low or a rapid decline in physical health visits (classes 3

and 4) were more likely to be in the HF group. The average number of physical health visits per person was slightly lower for the HF group than TAU. Although TAU participants reported more nurse visits per person, HF participants reported slightly more pharmacist visits per person. Class 1 had the most physical health visits per person when counting total visits and several provider-specific visits, while class 4 had the lowest. The most frequently contacted providers were the same across all four classes: family doctors, nurses, and pharmacists. Class 1 with the highest trajectory of use showed the greatest use of family doctors, while the class with the lowest use trajectory (class 4) reported nurse visits to be the most common.

Other variables significantly predicting class trajectories of ambulatory service use in the three analyses were age, gender, ethnicity, education, drug abuse or dependence, past psychiatric hospitalization, total time homeless, baseline psychiatric diagnosis, level of functioning, family social support, and number of physical comorbidities. Although results were not consistent across all classes, the two analyses on addiction and mental health visit trajectories suggests that classes with lower use trajectories (classes 3 and 4) were less likely to have Indigenous or other minority background, history of psychiatric hospitalization, psychotic disorder at baseline, and/or a higher level of functioning. For physical health visits, classes 3 and 4 with consistently low or decreasing visit trajectories were generally less likely to include individuals who were female or Indigenous/other ethnic minorities, or those who completed higher education, have drug abuse or dependence, a higher level of functioning, more social support from family, or more physical comorbidities. The finding that individuals with more visits are likely to be more educated, have greater functioning, or more family social support, may be due to these individuals being more likely to seek needed care. That is, greater use of ambulatory services can be interpreted more positively as an indicator of better access to necessary supports.

As previously mentioned, the effect of site was not of primary interest. However, several ORs were statistically significant, albeit no apparent trend in the influence of this variable on ambulatory visit trajectories. For example, trajectories of higher ambulatory service use were suspected to be associated with more populated cities, such as Toronto or Montreal, due to stressors such as higher living costs, or possibly because of increased availability of and access

to healthcare and rehabilitation services in larger cities. This could not be validated with the results.

Previous studies looking at patterns of ambulatory visits in homeless populations have reported mixed results. For example, authors have found that HF participants with addiction problems generally experience a decline in use of substance use programs[112], with outcomes dramatically favouring the HF group when compared to participants in traditional "Treatment First" interventions.[109 111] In contrast, increasing use of primary care physicians and outpatient psychiatric services among HF participants have been reported[113], while another study noted decreasing use of the latter service.[112]

Some variables, such as inadequate access to healthcare, childhood trauma, and history of criminal activity did not emerge as significant predictors of trajectory classes in all four service use analyses. It is possible that the indicators used for certain variables, such as childhood trauma, may not be adequate for capturing the complexity of the relevant trait. This is a limitation we were unable to address with the available data. Furthermore, some potentially important predictors with more systemic effects were not incorporated into the model, such as social acceptance and racism/marginalization[59] across sites.

6.2 Strengths and Limitations

This study has several strengths, including large sample size, low attrition, high fidelity scores, and a heterogeneous multi-site sample that enables complex analyses such as LCGA to be performed. Days of shelter utilization were ascertained using a time-line follow-back method, allowing for more precise trajectories to be modelled.

However, some limitations need to be mentioned. Ambulatory services accessed at hospitals, including outpatient clinics, were not included in the analyses, as information discriminating the various types of hospital visits was unavailable. Due to the ambiguous nature of visit purposes with a nurse, pharmacist, or occupational therapist, visits with these providers were incorporated into both addiction/mental health and physical health outcomes. Intervention and non-

intervention visits were only distinguished clearly for the Montreal site at the time of data collection, therefore intervention visits occurring at other sites may have been misclassified as regular visits outside the intervention - however, these visits were subsequently reclassified as intervention visits through approximations based on participant responses. Almost all variables, including suicide risk, history of justice system involvement, and income were ascertained through self-report, which may be susceptible to biases such as recall or social desirability bias. Not all potentially important predictors could be evaluated, and certain variables pertaining to more complex elements, such as childhood trauma, may not have been comprehensively assessed. Due to the two-step methodology of modelling trajectories and then assessing the effects of baseline predictors on these trajectories, any uncertainties in the class assignments from the LCGA were not carried forward into the regression analyses.

Although the randomized controlled design was the primary strength of the original study, this secondary analysis did not use the randomized groups for comparisons, but rather the groups assigned based on trajectory patterns. However, the regression models incorporated a diversity of demographic, socioeconomic, and health variables, which served to limit the degree of confounding present.

7. CONCLUSION

This study explored classes of shelter utilization and ambulatory visits trajectories, and predictors of class membership in a Canadian randomized controlled trial of Housing First. As homelessness can be caused by many factors, homeless individuals often come from various backgrounds and show diverse characteristics. Findings indicate heterogeneity in not only the characteristics of homeless individuals who use health and social services (e.g., demographics, homelessness history, health status), but also in their patterns of service use over time. Such diverse profiles and outcome trajectories reflect the complexity of homelessness. Heterogeneous responses to the intervention highlight the importance of addressing the inherent diversity in the homeless population by identifying individuals with the greatest needs and allocating sufficient resources to treating these individuals.

Results from this study convey the effects of HF and other baseline characteristics on the likelihood of following particular trajectories of shelter and ambulatory service utilization. By identifying the characteristics of subgroups susceptible to more costly trajectories of shelter use and ambulatory visits, this study served to present a different way of characterizing individuals for whom HF is less effective. It is warranted to conduct further research into whether individuals predicted to belong to classes of higher shelter use (e.g., classes 2-4 of the shelters analysis) would benefit from additional interventions. Furthermore, it may be that individuals also require additional treatment to address the underlying reasons for their frequent ambulatory visits (e.g., mental health), and therefore further investigation into the potential benefits is recommended as well. Evaluating the effects of time-varying predictors, such as changes in substance abuse or dependence, is also of interest, as these variables may influence service use patterns over time.

Future studies should examine trajectories of other important services used by homeless individuals, such as incarcerations or emergency department visits, to gain further insight into the patterns that homeless individuals follow as they move through the service system. Longitudinal trajectory modelling could also be applied to other outcomes in homelessness research, such as quality of life or community integration.

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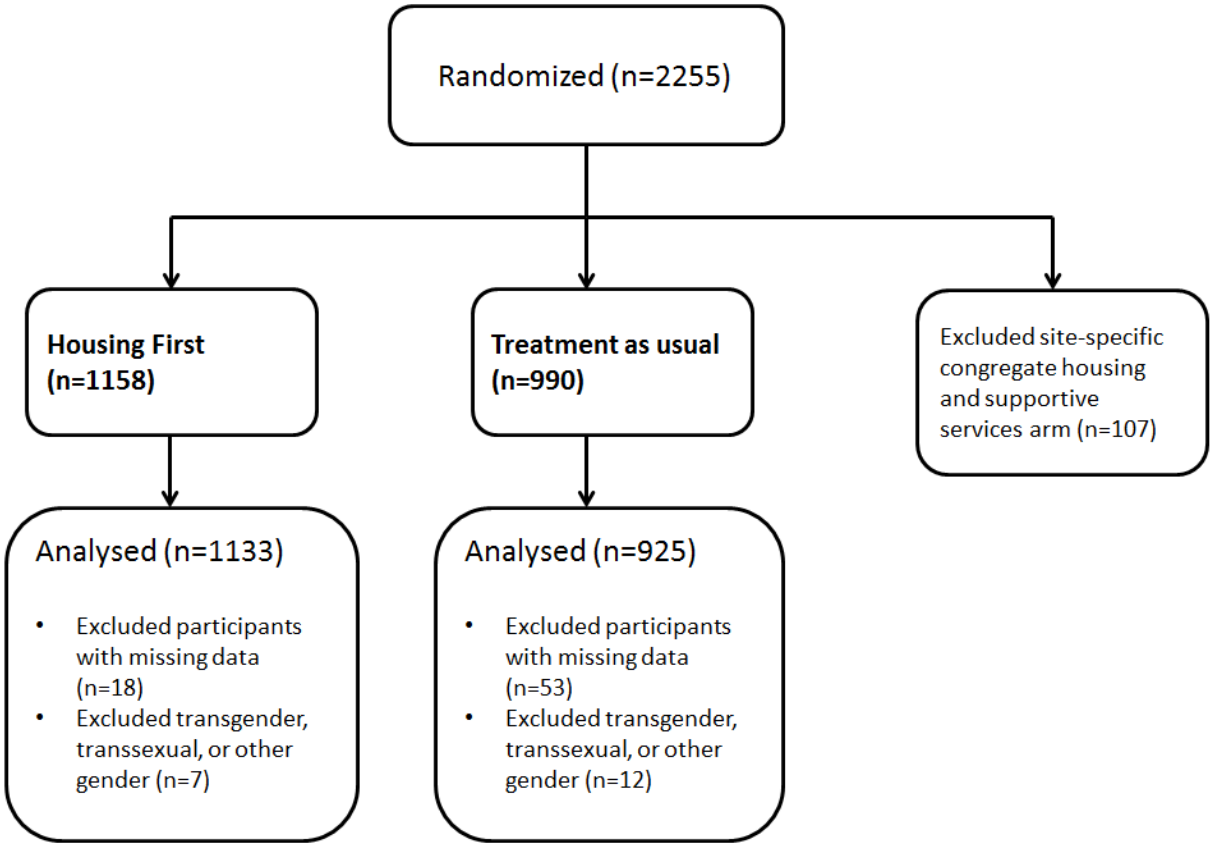
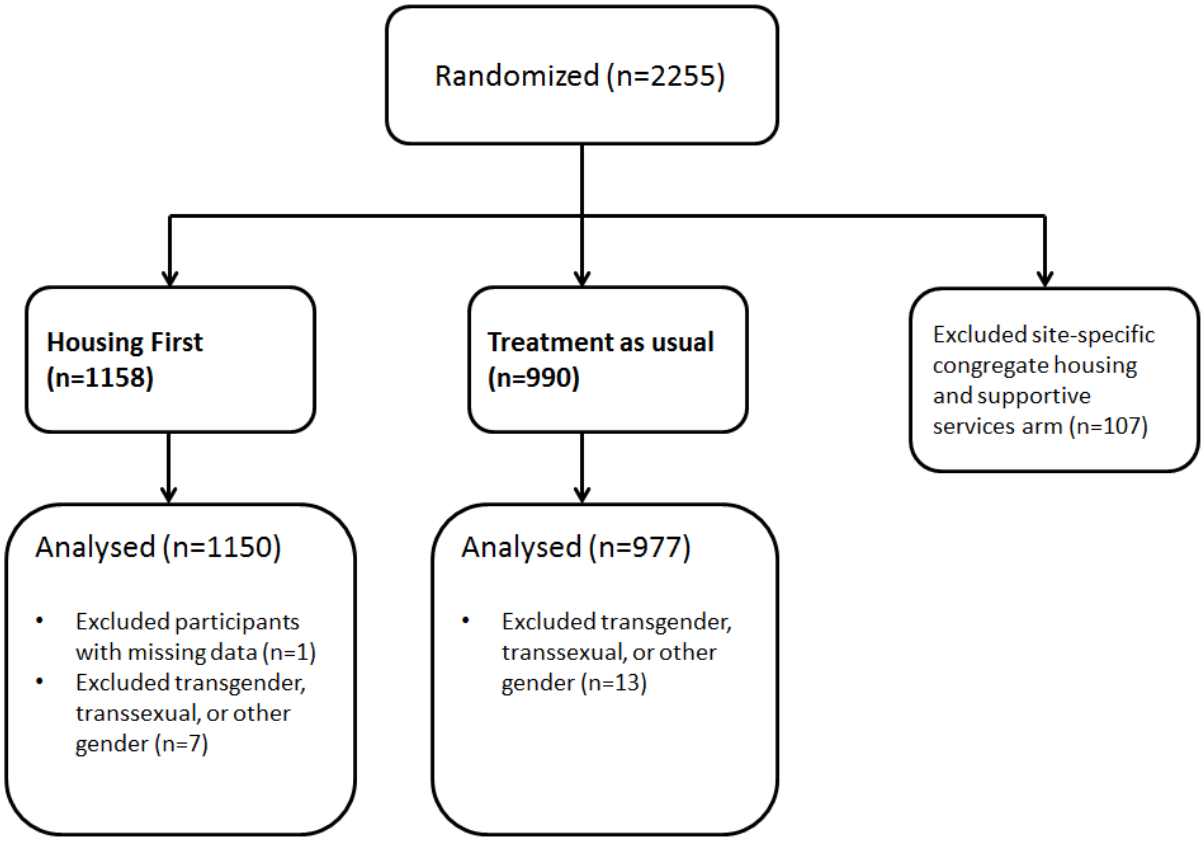
APPENDICES

Appendix 1: Shelter use - Flow diagram of participants included for analysis and comparison of characteristics in the analyzed vs original sample



Variable	Analyzed sample (n=2058)	Original sample (n=2255)
Treatment group (%)		
Treatment as usual	925 (44.9)	990 (43.9)
Housing First	1133 (55.1)	1265 (56.1)
Age (years)	40.9	40.9
Gender (% female)	663 (32.2)	710 (31.5)
Ethnicity (%)		
Indigenous or other minority	1046 (50.8)	1140 (50.6)
Education (%)		
Completed high school or higher education	904 (43.9)	988 (43.8)
Income ($ / prior month)	680.6	688.9
Alcohol abuse or dependence (%)	920 (44.7)	992 (44.0)
Drug abuse or dependence (%)	1089 (52.9)	1199 (53.2)
Past psychiatric hospitalization (%)	780 (38.8)	895 (39.7)
Past criminal involvement (%)	724 (35.4)	820 (36.4)
Total time homeless (years)	58.2	58.2
Childhood trauma (ACE score)	4.5	4.4
Suicide risk (%)		
Moderate/high	745 (36.2)	814 (36.1)
Baseline psychiatric diagnosis (%)		
Severe	959 (46.9)	1096 (48.6)
Inadequate access to health care (%)	950 (46.7)	1037 (46.0)
Level of functioning (MCAS score)	60.2	59.6
Family social support (QOLI-20 Family score)	13.8	13.8
Number of comorbidities	4.8	4.7
Site		
Moncton	195 (9.5)	201 (8.9)
Montreal	463 (22.5)	469 (20.8)
Toronto	530 (25.8)	575 (25.5)
Vancouver	378 (18.4)	513 (22.7)
Winnipeg	492 (23.9)	497 (22.0)

Appendix 2: Ambulatory visits - Flow diagram of participants included for analysis and comparison of characteristics in the analyzed vs original sample



Variable	Analyzed sample (n=2127)	Original sample (n=2255)
Treatment group (%)		
Treatment as usual	977 (45.9)	990 (43.9)
Housing First	1150 (54.1)	1265 (56.1)
Age (years)	41.0	40.9
Gender (% female)	685 (32.2)	710 (31.5)
Ethnicity (%)		
Indigenous or other minority	1079 (50.7)	1140 (50.6)
Education (%)		
Completed high school or higher education	945 (44.4)	988 (43.8)
Income ($ / prior month)	678.6	688.9
Alcohol abuse or dependence (%)	948 (44.6)	992 (44.0)
Drug abuse or dependence (%)	1118 (52.6)	1199 (53.2)
Past psychiatric hospitalization (%)	809 (38.0)	895 (39.7)
Past criminal involvement (%)	748 (35.2)	820 (36.4)
Total time homeless (months)	58.1	58.2
Childhood trauma (ACE score)	4.5	4.4
Suicide risk (%)		
Moderate/high	772 (36.3)	814 (36.1)
Baseline psychiatric diagnosis (%)		
Psychotic disorder	997 (46.9)	1096 (48.6)
Inadequate access to health care (%)	980 (46.1)	1037 (46.0)
Level of functioning (MCAS score)	60.1	59.6
Family social support (QOLI-20 Family score)	13.8	13.8
Number of comorbidities	4.7	4.7
Site		
Moncton	200 (9.4)	201 (8.9)
Montreal	468 (22.0)	469 (20.8)
Toronto	563 (26.5)	575 (25.5)
Vancouver	385 (18.1)	513 (22.7)
Winnipeg	511 (24.0)	497 (22.0)

Appendix 3: Shelter use - Mplus Code

Latent class growth analysis code

```
Title:
  LCGA for shelter use - log transformed
 Data:
  File is shelteruse_predictors_final.dat ;
Variable:
  Names are
     subjectnumber total1 total2 total3 total4 total5 total6 total7 total8
     total9 total10 total11 total12 total13 total14 total15 total16 total17
     total18 total19 total20 total21 total22 total23 total24 total25 total26
     total27 group_expN grouptotal diag csi gain_yr gain_mn qoli_fam qoli_leisure
     qoli_living qoli_safe qoli_social qoli_global ace comorbid_count ras_confhope
     ras_askhelp ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
     access_recode age_enrol mcas income totalhomeless longesthomeless
     suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
     employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
     cogimp_recode agefirsthomeless alcohol_recode drug_recode site_recode
     exp_group knownclass psyc_hosp psychotic needlevel studycenter;
  Usevariables are
     total4 total5 total6 total7 total8
     total9 total10 total11 total12 total13
     total14 total15 total16 total17
     total18 total19 total20 total21
     total22 total23 total24 total25 total26
     total27 montreal toronto vancouver winnipeg;
  Missing are all (-9999) ;
  Idvariable is subjectnumber;
  Classes = c(4);
Define:
  total4 = log(total4 + 0.01);
  total5 = log(total5 + 0.01);
  total6 = log(total6 + 0.01);
  total7 = log(total7 + 0.01);
  total8 = log(total8 + 0.01);
  total9 = log(total9 + 0.01);
  total10 = log(total10 + 0.01);
  total11 = log(total11 + 0.01);
  total12 = log(total12 + 0.01);
  total13 = log(total13 + 0.01);
  total14 = log(total14 + 0.01);
  total15 = log(total15 + 0.01);
  total16 = log(total16 + 0.01);
  total17 = log(total17 + 0.01);
  total18 = log(total18 + 0.01);
  total19 = log(total19 + 0.01);
  total20 = log(total20 + 0.01);
  total21 = log(total21 + 0.01);
  total22 = log(total22 + 0.01);
  total23 = log(total23 + 0.01);
  total24 = log(total24 + 0.01);
  total25 = log(total25 + 0.01);
  total26 = log(total26 + 0.01);
```

```
  total27 = log(total27 + 0.01);
  montreal=0;
  if (site_recode eq 2) then montreal=1;
  toronto=0;
  if (site_recode eq 3) then toronto=1;
  vancouver=0;
  if (site_recode eq 4) then vancouver=1;
  winnipeg=0;
  if (site_recode eq 5) then winnipeg=1;
Analysis:
  Type = mixture;
  Processors = 8(STARTS);
  Starts = 5000 1250;
Model: %overall%
  i s q t| total4@0 total5@0.1 total6@0.2 total7@0.3 total8@0.4
     total9@0.5 total10@0.6 total11@0.7 total12@0.8 total13@0.9 total14@1
     total15@1.1 total16@1.2 total17@1.3 total18@1.4 total19@1.5 total20@1.6
     total21@1.7 total22@1.8 total23@1.9 total24@2 total25@2.1 total26@2.2
     total27@2.3;
  i-t@0;
  i s q t on montreal toronto vancouver winnipeg;
  c on montreal toronto vancouver winnipeg;
Output: tech1 tech8;
SAVEDATA:
  FILE is D:\Mplus files\CLASSoutput;
  save = cprobabilities;
PLOT: type = plot3;
series = total4 total5 total6 total7 total8
     total9 total10 total11 total12 total13
     total14 total15 total16 total17
     total18 total19 total20 total21 total22
     total23 total24 total25 total26 total27 (s);
```

Multiple imputation code

```
Title:
  Shelters - Multiple imputation
Data:
  File is shelters_MLRdataset.dat ;
Variable:
  Names are
     subjectnumber total1 total2 total3 total4 total5 total6 total7 total8
     total9 total10 total11 total12 total13 total14 total15 total16 total17
     total18 total19 total20 total21 total22 total23 total24 total25 total26
     total27 group_expN grouptotal diag csi gain_yr gain_mn qoli_fam qoli_leisure
     qoli_living qoli_safe qoli_social qoli_global ace comorbid_count ras_confhope
     ras_askhelp ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
     access_recode age_enrol mcas income totalhomeless longesthomeless
     suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
     employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
     cogimp_recode agefirsthomeless alcohol_recode drug_recode site_recode
     exp_group knownclass psyc_hosp psychotic class needlevel studycenter;
  Usevariables are
     total1 total2 total3 total4 total5 total6 total7 total8
```

```
    total9 total10 total11 total12 total13 total14 total15 total16 total17
    total18 total19 total20 total21 total22 total23 total24 total25 total26
    total27 diag csi gain_yr gain_mn qoli_fam qoli_leisure
    qoli_living qoli_safe qoli_social qoli_global ace comorbid_count ras_confhope
    ras_askhelp ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
    access_recode age_enrol mcas income totalhomeless longesthomeless
    suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
    employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
    cogimp_recode agefirsthomeless alcohol_recode drug_recode
    psyc_hosp psychotic class needlevel;
  Auxiliary are
    subjectnumber group_expN exp_group studycenter site_recode;
  Missing are all (-9999) ;
Data Imputation:
  Impute = ace qoli_fam comorbid_count access_recode (c) income totalhomeless
    arrest_recode (c) educ_recode (c) psyc_hosp (c) psychotic (c);
  Ndatasets = 20;
  Save = sheltersMLR_missimp*.dat;
Analysis: type = basic;
Output: TECH8;
```

Multinomial logistic regression code

```
Title:
  Shelters - Multinomial Logistic Regression
Data:
  File is sheltersMLR_missimplist.dat ;
  Type = Imputation;
Variable:
  Names are
    total1 total2 total3 total4 total5 total6 total7 total8
    total9 total10 total11 total12 total13 total14 total15 total16 total17
    total18 total19 total20 total21 total22 total23 total24 total25 total26
    total27 diag csi gain_yr gain_mn qoli_fam qoli_leisure
    qoli_living qoli_safe qoli_social qoli_global ace comorbid_count ras_confhope
    ras_askhelp ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
    access_recode age_enrol mcas income totalhomeless longesthomeless
    suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
    employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
    cogimp_recode agefirsthomeless alcohol_recode drug_recode
    psyc_hosp psychotic class needlevel
    subjectnumber group_expN exp_group studycenter site_recode;
  Usevariables are
    age_enrol mcas income totalhomeless qoli_fam access_recode
    suicide gender_recode psyc_hosp psychotic exp_group
    alcohol_recode drug_recode arrest_recode comorbid_count ace aboriginal
    otherethnic doneHS donebus c_new;
  Nominal is c_new;
  Missing = all(-9999);
Define:
  IF class EQ 1 THEN c_new = 4;
  IF class EQ 4 THEN c_new = 1;
  IF class EQ 2 THEN c_new = 2;
  IF class EQ 3 THEN c_new = 3;
```

```
  aboriginal=0;
  if (ethnic_recode eq 2) then aboriginal=1;
  otherethnic=0;
  if (ethnic_recode eq 3) then otherethnic=1;
  doneHS=0;
  if (educ_recode eq 2) then doneHS=1;
  donebus=0;
  if (educ_recode eq 3) then donebus=1;
  income = income/1000;
  totalhomeless = totalhomeless/12;
Model:
  c_new ON age_enrol mcas income totalhomeless qoli_fam access_recode
    suicide gender_recode psyc_hosp psychotic exp_group
    alcohol_recode drug_recode arrest_recode comorbid_count ace aboriginal
    otherethnic doneHS donebus;
Output: CINTERVAL;
```

Appendix 4: Ambulatory visits - Mplus Code

Note: The same codes were used for all ambulatory visits analyses. The codes for physical health visits are shown below as an example.

Latent class growth analysis code

```
Title:
  LCGA for past 6-month physical health service use
Data:
  File is physicalhealth_nointervention_outcomewithpredictors.dat ;
Variable:
  Names are
    subjectnumber site needlevel total1 total2 total3 total4 total5 diag
    csi gain_yr gain_mn qoli20_family qoli20_leisure qoli20_living qoli20_safety
    qoli20_social qoli20_global ace comorbid_count ras_confhope ras_askhelp
    ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
    access_recode age_enrol mcas income totalhomeless longesthomeless
    suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
    employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
    cogimp_recode agefirsthomeless alcohol_recode drug_recode psychosp
    psychotic grp_tau exp_group;
  Usevariables are
    total1 total2 total3 total4 total5 montreal vancouver winnipeg moncton;
  Useobservations are gender_recode eq 0 or gender_recode eq 1;
  Missing are all (-9999) ;
  Idvariable is subjectnumber;
  Classes = c(4);
Define:
  total1 = log(total1 + 0.01);
  total2 = log(total2 + 0.01);
  total3 = log(total3 + 0.01);
  total4 = log(total4 + 0.01);
  total5 = log(total5 + 0.01);
  montreal=0;
  if (site eq 2) then montreal=1;
```

```
  moncton=0;
  if (site eq 1) then moncton=1;
  vancouver=0;
  if (site eq 4) then vancouver=1;
  winnipeg=0;
  if (site eq 5) then winnipeg=1;
Analysis:
  Type = mixture;
  Processors = 8(STARTS);
  Starts = 2000 500;
Model: %overall%
  i s q| total1@0 total2@1 total3@2 total4@3 total5@4;
  i-q@0;
  i s q on montreal vancouver winnipeg moncton;
  c on montreal vancouver winnipeg moncton;
Output: tech1 tech8 CINTERVAL;
SAVEDATA:
  FILE is C:\Users\chuche\Documents\Thesis Datasets\CLASSoutput_physicalhealth;
  save = cprobabilities;
PLOT: type = plot3;
series = total1 total2 total3 total4 total5 (s);
```

Multiple imputation code

```
Title:
  Multiple Imputation - Physical Health Visits
Data:
  File is physicalhealth_MLRdataset.dat ;
Variable:
  Names are
     subjectnumber site needlevel total1 total2 total3 total4 total5 diag
     csi gain_yr gain_mn qoli20_family qoli20_leisure qoli20_living qoli20_safety
     qoli20_social qoli20_global ace comorbid_count ras_confhope ras_askhelp
     ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
     access_recode age_enrol mcas income totalhomeless longesthomeless
     suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
     employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
     cogimp_recode agefirsthomeless alcohol_recode drug_recode psychosp
     psychotic grp_tau exp_group class;
  Usevariables are
     site needlevel total1 total2 total3 total4 total5 diag
     csi gain_yr gain_mn qoli20_family qoli20_leisure qoli20_living qoli20_safety
     qoli20_social qoli20_global ace comorbid_count ras_confhope ras_askhelp
     ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
     access_recode age_enrol mcas income totalhomeless longesthomeless
     suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
     employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
     cogimp_recode agefirsthomeless alcohol_recode drug_recode psychosp
     psychotic class;
  Auxiliary are
     subjectnumber grp_tau exp_group;
  Missing are all (-9999) ;
Data Imputation:
  Impute = ace qoli20_family comorbid_count access_recode (c)
```

```
    income totalhomeless arrest_recode (c) educ_recode (c)
    psychosp (c) psychotic (c);
  Ndatasets = 20;
  Save = physicalhealth_missimp*.dat;
Analysis:
  Type = basic ;
Output: TECH8;
```

Multinomial logistic regression code

```
Title:
  Multinomial Logistic Regression - Physical Health Visits
Data:
  File is physicalhealth_missimplist.dat ;
  Type = Imputation;
Variable:
  Names are
    site needlevel total1 total2 total3 total4 total5 diag
    csi gain_yr gain_mn qoli20_family qoli20_leisure qoli20_living qoli20_safety
    qoli20_social qoli20_global ace comorbid_count ras_confhope ras_askhelp
    ras_goals ras_relothers ras_notdomsymptoms sf12 insufficient_food
    access_recode age_enrol mcas income totalhomeless longesthomeless
    suicide gender_recode ethnic_recode educ_recode marital_recode veteran_recode
    employ_recode psychosp1_recode psychosp2_recode subtreat_recode arrest_recode
    cogimp_recode agefirsthomeless alcohol_recode drug_recode psychosp
    psychotic class subjectnumber grp_tau exp_group;
  Usevariables are
    age_enrol mcas income totalhomeless qoli20_family access_recode
    suicide gender_recode psychosp psychotic exp_group
    alcohol_recode drug_recode arrest_recode comorbid_count ace aboriginal
    otherethnic doneHS donebus c_new;
  Nominal is c_new;
  Missing = all(-9999);
Define:
  IF class EQ 1 THEN c_new = 1;
  IF class EQ 2 THEN c_new = 4;
  IF class EQ 3 THEN c_new = 3;
  IF class EQ 4 THEN c_new = 2;
  aboriginal=0;
  if (ethnic_recode eq 2) then aboriginal=1;
  otherethnic=0;
  if (ethnic_recode eq 3) then otherethnic=1;
  doneHS=0;
  if (educ_recode eq 2) then doneHS=1;
  donebus=0;
  if (educ_recode eq 3) then donebus=1;
  income = income/1000;
  totalhomeless = totalhomeless/12;
Model:
  c_new ON age_enrol mcas income totalhomeless qoli20_family access_recode
    suicide gender_recode psychosp psychotic exp_group
    alcohol_recode drug_recode arrest_recode comorbid_count ace aboriginal
    otherethnic doneHS donebus;
Output: CINTERVAL;
```