Emergency Department Utilization Among Formerly Homeless Adults with Mental Disorders After 1-year of Housing First: A Randomized Controlled Trial

by

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B.P.N., Kwantlen Polytechnic University, 2009

Thesis Submitted In Partial Fulfillment of the
Requirements for the Degree of
Master of Science

in the
Master of Science Program
Faculty of Health Sciences

SIMON FRASER UNIVERSITY

Spring 2013

Approval

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Degree: **Master of Science (Health Sciences)**

Title of Thesis: ***Emergency Department Utilization Among Formerly Homeless Adults with Mental Disorders After 1-year of Housing First: A Randomized Controlled Trial***

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Abstract

Homeless individuals represent a disadvantaged and marginalized group who experience increased rates of physical illness, mental and substance use disorders. Compared to housed individuals, homeless adults use emergency departments (ED) and other acute healthcare services at a higher frequency. Housing First (HF) has been identified as an effective means of facilitating acute health service reductions among homeless populations. The present analysis is based on (n=297) participants enrolled in the Vancouver At Home Study (VAH) randomized to one of three intervention arms: HF in a congregate setting (CONG), HF in scattered site apartments (SS), or to treatment as usual (TAU), and incorporates linked data from a regional database representing six urban ED's. Compared to TAU, significantly lower ED utilization was observed during the post-randomization period in the SS arm. Our results suggest that HF, particularly the SS model, produces significantly lower ED visits among homeless adults with a mental disorder.

Keywords: Emergency Departments; Housing First; Homeless; Mental Disorders

Acknowledgements

It is a pleasure to thank those who have contributed to this thesis and to those who have supported me through my graduate studies. I am grateful to my supervisory committee for their support, mentorship and constructive feedback through the drafting and final stages of this thesis. Thank you to Dr. Julian Somers, Dr. Michelle Patterson and Dr. Lawrence McCandless for your ongoing critiques, insights and superior guidance, and to Dr. Malcolm Steinberg for being my external examiner. A special thank you to my senior supervisor Dr. Julian Somers for his ongoing mentorship, support of my research ideas and for inviting me on to the At Home project. I would also like to thank all the members of the Somers Research group in particular, Akm Moniruzzaman for his analytical expertise and Lauren Currie for her superb formatting abilities. Additionally I would like to gratefully acknowledge the At Home Study participants, and the Vancouver Coastal Health Research Institute as this thesis would not have been possible with out their contributions. Finally, a big thank you to my family and friends for all of their ongoing support.

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List of Acronyms

ACT	Assertive Community Treatment
AIDS	Acquired Immunodeficiency Syndrome
CEDIS	Canadian Emergency Department Information System
CTAS	Clinical Triage Assessment Scale
CONG	Congregate Housing First
ED	Emergency Department
HF	Housing First
HIV	Human Immunodeficiency Virus
IRR	Incidence Rate Ratio
MAP	Maudsley Addiction Profile
MCAS	Multnomah Community Ability Scale
MINI	Mini International Neuropsychiatric Interview 6.0
PHN	Personal Health Number
SD	Standard Deviation
SS	Scattered Site Housing First
TAU	Treatment As Usual
TB	Tuberculosis
VAH	Vancouver at Home Study

1. Introduction

1.1. Background

Homelessness is associated with a range of negative health consequences (Kidder, Wolitski, Campsmith, & Nakamura, 2007; Kushel, Vittinghoff, & Haas, 2001) including increased rates of acute and chronic physical illness (Frankish, Hwang, & Quantz, 2005), mental and substance use disorders (Fazel, Khosla, Doll, & Geddes, 2008; Folsom et al., 2005) and mortality (Beijer, Andreasson, Agren, & Fugelstad, 2011; Hwang, 2001). However, the health needs of homeless individuals are largely unmet in traditional healthcare settings (Hwang et al., 2010). Stigma, as well as, fragmentation of health services, creates barriers to primary care (D'Amore, Hung, Chiang, & Goldfrank, 2001) and a reliance on emergency health services among many homeless individuals (McCusker et al., 2012). Moreover, “competing priorities” (Gelberg, Gallagher, Andersen, & Koegel, 1997) inherent in surviving on the streets may serve as impediments to receiving care whereby the fulfillment of basic physical needs (Forchuk, Brown, Schofield, & Jensen, 2008) interferes with appropriate health service use, creating patterns of healthcare use which are acute/episodic and more typical of ED care (Forchuk et al., 2008).

Homeless individuals exhibit higher rates of hospitalization (Folsom et al., 2005; O'Toole et al., 2007), ED visits (Kidder et al., 2007; Kushel, Perry, Bangsberg, Clark, & Moss, 2002; O'Toole et al., 2007) and greater use of ambulance services (Ku, Scott, Kertesz, & Pitts, 2010; Oates, Tadros, & Davis, 2009; Pearson, Bruggman, & Haukoos, 2007). Specifically, ED utilization among homeless individuals is three to four times higher than the general population (Kushel et al., 2001; 2002) with the majority of complaints pertaining to acute injuries, substance use or psychiatric issues (Ku et al., 2010).

Several retrospective cohort and cross-sectional studies have looked at comparisons between housed and homeless individuals in relation to ED utilization and have identified a number of predictors, mediators, and moderators between common correlates of homeless individuals (e.g., mental disorder and substance misuse) and ED visits (Hunt, Weber, Showstack, Colby, & Callaham, 2006; Ku et al., 2010; Oates et al., 2009; Pearson et al., 2007). These studies rarely go beyond characterizing the type and frequency of homeless individuals ED utilization; therefore, existing studies provide limited insight relative to the formation of policy initiatives or reformed interventions. Given that factors associated with increased ED use are inherently high in homeless populations (e.g., mental disorders, substance dependence and comorbid physical illness) (Hunt et al., 2006; Kidder et al., 2007; Ku et al., 2010; Kushel et al., 2001; O'Toole, Gibbon, Hanusa, & Fine, 1999) and that living on the street or in unstable housing is a predictor of increased ED use (Kidder et al., 2007; O'Toole et al., 1999; 2007; Wolitski et al., 2010), it is foreseeable that ED utilization among the homeless would be high. Despite this link, few well-controlled studies have examined integrated interventions focused on addressing the health and housing needs of homeless individuals, and their ability to alleviate demands on emergency healthcare services.

Housing First (HF) has been identified as an effective means of facilitating acute health service reductions among homeless individuals (Larimer et al., 2009; Martinez & Burt, 2006; Sadowski, Kee, VanderWeele, & Buchanan, 2009). HF provides accommodation and supports to homeless individuals with mental disorders regardless of compliance with treatment, symptom improvement, or abstinence (Tsemberis, 1999). The HF model is client driven, providing independent living complemented by a multi-disciplinary team of healthcare professionals in a community setting (Tsemberis, 1999).

A small number of non-experimental studies have found that supported housing reduces hospitalizations as well as ED use, and increases housing stability among homeless populations (Desilva, Manworren, & Targonski, 2011; Kessell, Bhatia, Bamberger, & Kushel, 2006; Parker, 2010); however, results were not statistically significant and the generalizability of findings was limited due to non-experimental designs and small samples sizes.

Recent experimental studies have examined the effects of HF programs on chronically homeless individuals with alcohol dependence (Larimer et al., 2009) and dual-diagnoses (Martinez & Burt, 2006) demonstrating significant reductions in healthcare utilization, including ED visits and hospital costs. Furthermore, Sadowski et al. (2009) reported a randomized controlled trial comparing HF to standard hospital discharge procedures among homeless persons recently hospitalized with a chronic illness, and concluded that individuals provided HF showed reductions in acute care admissions, length of stay (days) and ED visits over time. These findings provide significant insights into the importance of supported housing as an intervention to reduce acute health service utilization, particularly ED use, in homeless individuals. Despite positive findings attributed to HF, there is an absence of studies employing rigorous experimental designs that examine the effect of HF on ED utilization and little research in the Canadian context of publicly funded medical care.

2. Literature Review

2.1. Homelessness: Morbidity and Mortality

2.1.1. Physical Health

Compared to housed individuals, homeless individuals have increased rates of physical illness, chronic health conditions and mortality (Frankish et al., 2005; Hwang, 2001; Hwang et al., 2010; Hwang, 2000; Kermode, Crofts, Miller, Speed, & Streeton, 1998; Moore, Gerdtz, Manias, 2007; Schanzer, Dominguez, Shrout, & Caton, 2007). Moreover, as a result of increased health risks and unstable living and environmental conditions, homeless individuals frequently report their health status as poor (O'Toole et al., 1999; Small, 2011). Furthermore, homeless individuals report a multitude of medical illnesses (Eberle, Kraus, & Hulchanski, 2001) ranging from respiratory to dermatological infections (Eberle et al., 2001; Frankish et al., 2005; Notaro, Khan, Kim, Nasaruddin, & Desai, 2012; Stratigos & Katsambas, 2003) with nearly three-quarters of homeless adults reporting at least one health condition (Kermode et al. 1998). In a study by Munoz et al. (2005), assessing the health of homeless men and women in Spain, participants reported circulatory, gastrointestinal, respiratory, and skeletal health issues representing 14% to 23% of their health problems over the previous twelve months. Moreover, as a result of increased exposure to the elements, dermatological conditions, such as frostbite and skin breakdown are common (Nicholson et al., 2010) along with other cutaneous infections (Stratigos & Katsambas, 2003). Chronic conditions such as, heart disease, liver disease, diabetes, Tuberculosis (TB) and infections diseases (Human Immunodeficiency Virus (HIV) / Acquired Immunodeficiency Syndrome (AIDS), Hepatitis B or C) are relatively common in homeless populations (D'Amore et al., 2001; Hwang et al., 2010; Muñoz, Crespo, & Pérez-Santos, 2005; Nicholson et al., 2010). Notaro et al. (2012), in a study examining health status among clinic attendees, reported that TB and Hepatitis were associated with at least four times greater odds amongst homeless individuals compared to non-homeless clinic attendees. Moreover, several studies have

reported the prevalence of chronic diseases among homeless individuals, with estimates ranging between 30% to 60% for any chronic disease and between 10% to 15% for multiple chronic conditions (Hwang et al., 2010; Kushel et al., 2001; 2002; Mason, Jensen, & Boland, 1992). Research has consistently reported that homeless individuals represent a disadvantaged group suffering from a myriad of medical conditions, both acute and chronic, negatively impacting their health status, and driving their need for acute healthcare interventions.

2.1.2. Trauma and Violence

Trauma related injuries are among the top reasons for healthcare interventions among homeless individuals (D'Amore et al., 2001; Eberle et al., 2001), most often associated with victimization (e.g., rape, assaults, and robbery) and related injuries linked to living on the streets (Eberle et al., 2001; Munoz et al., 2005; Frankish et al., 2005; Kushel et al., 2002). Homeless individuals in Canada and the United States (US) report rates of assault between 40% and 60% respectively (D'Amore et al., 2001; Eberle et al., 2001), with US homeless adults associated with an 8.62 times greater risk of assault compared to non homeless adults (D'Amore et al., 2001). Moreover, the disproportionately high rates of victimization and associated injuries reported by homeless individuals are connected with increased ED utilization (Kushel et al., 2002; Padgett, Struening, Andrews, & Pittman, 1995; Small, 2011).

2.1.3. Mortality

Mortality rates among homeless individuals are disproportionally higher than the general population (Beijer et al., 2011; Frankish et al., 2005; Hwang, 2000; Nicholson et al., 2010). Specifically, Beijer et al. (2011) in an analysis of mortality causes in Stockholm, reported that mortality for homeless persons was associated with a relative risk of 3.12 compared to the general population. Moreover, suicide and HIV/AIDS related deaths among homeless persons are nearly 3 and 1.5 times higher respectively, than the general population (Hwang, 2000). Furthermore, Nicholson et al. (2010) utilized the Vulnerability Index (VI), a tool used to identify the risk of mortality among homeless individuals in Calgary, and results indicated that health conditions negatively affect the lives of homeless individuals and increase the risk of pre-mature death.

2.1.4. Mental Disorders & Substance Misuse

It is well documented that homeless persons have increased rates of mental and substance abuse disorders compared to the general population (Fazel et al., 2008; Folsom et al., 2005; Frankish et al., 2005; Hwang, 2001; Kermode et al., 1998; Muñoz et al., 2005; Nicholson et al., 2010). The role of mental disorders and substance misuse on homelessness is contentious, with disorders seen as either predictors or consequences to homelessness. Both substance use and mental disorders were reported as 'major reasons' for homelessness (O'Toole et al., 2007) and homelessness was also strongly associated with substance users and specific types of mental disorders (Folsom et al., 2005). Although, the direction of association is unclear, mental disorders account for a significant burden among homeless individuals. Despite varying prevalence rates of psychiatric disorders among homeless individuals, results from a systematic review and meta analysis, identified alcohol (37.9%) and drug (24.4%) dependence as the highest pooled prevalence rates, followed by psychotic illness (12.7%) and depression (11.4%) (Fazel et al., 2008). Furthermore, in a study by Munoz et al. (2005) comparing housed and homeless individuals, both homeless men and women reported significantly higher scores related to depressive symptoms and suicidal thoughts, as well as increased heroin use. Moreover, Kermode et al. (1998) found that 44% of homeless individuals reported having a mental disorder, as well as high rates of alcohol use (74%) and a history of injection drug use (28%). Moreover, Hwang et al. (2010), in a study of homeless individuals in Toronto, reported 41% suffered from drug problems, 30% reported alcohol misuse and 38% reported mental illness related concerns in the past thirty days. Furthermore, Nicholson et al. (2010) in a Calgary study reported that 32.6% of homeless individuals had ever received treatment for a mental disorder in their lifetime and that 96% reported any drug or alcohol abuse. The presence of mental disorders and substance related conditions remains disproportionality high among homeless persons, and these types of disorders are linked to increased healthcare and ED utilization.

2.2. Homelessness and Emergency Department Use

2.2.1. Predicative Factors

Research suggests that homeless individuals utilize ED's and acute healthcare services at a greater frequency than individuals in stable housing or in the general population (Kidder et al., 2007; Ku et al., 2010; Kushel et al., 2002; Moore et al., 2007; 2012). Rationales for increased use of the ED are linked to convenience, accessibility (Padgett & Brodsky, 1992) and the capacity to provide comfort measures such as shelter, safety, food and clothing (Malone, 1998). Understanding the appropriateness of ED use is challenging, given the heterogeneity among homeless persons and the context under which their ED use occurs; therefore, quantifying this measure has not been clearly accomplished in the literature (Abbuhl & Lowe, 1996). Several studies analyzing homeless individuals ED use have reported an increased propensity for ED use and consistent use across time. For example, Mason et al. (1992) in a study examining homeless males in Utah, found that participants identified ED's as the most common site for healthcare. Similarly, Kushel et al. (2002) in a survey of homeless individuals reported that 40.4% of participants sought care from an ED and nearly 50% utilized it as "…their only source of health care" (p.783). Moreover, Schanzer et al. (2007), in a study following newly homeless individuals in New York City, reported that 34.2% of participants made a visit to the ED and this proportion remained fairly stable over an 18-month period.

Increased acute healthcare utilization (ED and hospitalization) among homeless persons can be attributed to several factors: comorbid health conditions (Kushel et al., 2001; Kushel et al., 2002; O'Toole et al., 1999); mental disorders (Ku et al., 2010; Kushel et al., 2001; O'Toole et al., 2007; Small, 2011); substance misuse (Ku et al., 2010; Kushel et al., 2002); HIV/AIDS (Kidder et al., 2007; Small, 2011); poor health status (Small, 2011); prior psychiatric hospitalization (Kushel et al., 2002); recent discharge from the ED or hospital (Ku 2010); lack of access to primary care (D'Amore et al., 2001; Hwang et al., 2010); victimization (Kushel et al., 2002; Padgett et al., 1995; Small, 2011); unstable housing (Kidder et al., 2007; Ku et al., 2010; Kushel et al., 2002); and homelessness (Mandelberg, Kuhn, & Kohn, 2000; O'Toole et al., 1999; 2007).

Independently these factors are associated with significant disadvantages, but when compounded they provide a complex and challenging collection of pathways contributing to ED use among homeless individuals. Some researchers have adopted the Behavioral Model for Vulnerable Populations (Figure 1) or the original Anderson and Newman model (Aday & Andersen, 1974; Andersen, 1995) to account for the complexity of healthcare access and use among homeless individuals (Gelberg, Andersen, & Leake, 2000; Hwang et al., 2010; Kushel et al., 2002; Padgett et al., 1995; Padgett & Brodsky, 1992; Small, 2011).

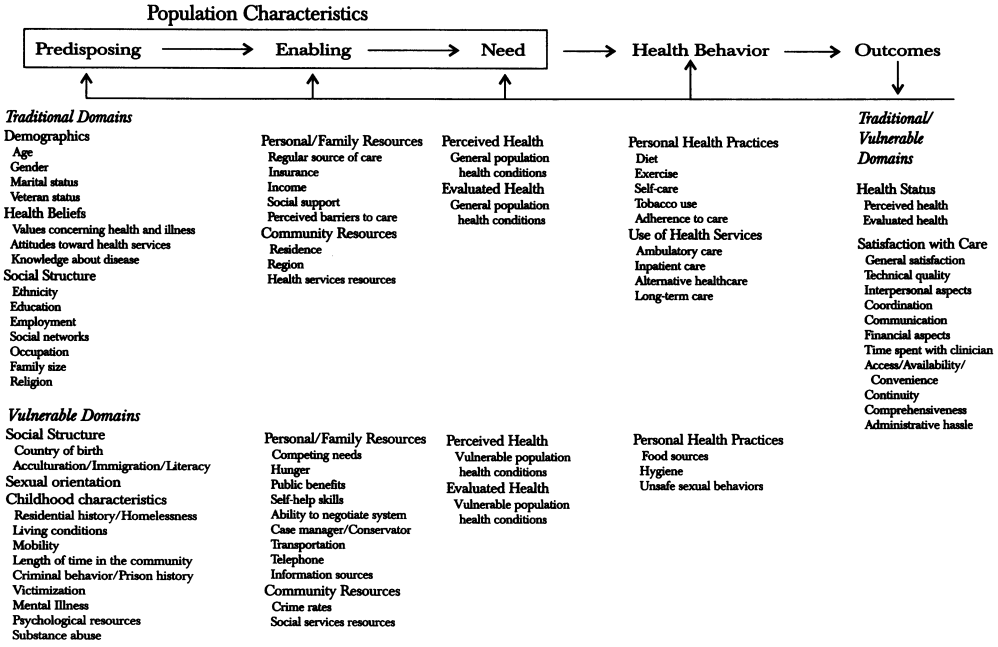

Figure 1 The Behavioral Model For Vulnerable Populations (Gelberg et al., 2000)

Applications of this model emphasize the impact of 'need factors' (e.g., health status and perception of healthcare need) on ED utilization; however, given the heterogeneity among homeless individuals, their ED utilization is not easily explained by single predictors (Kushel et al., 2002; Padgett et al., 1995). Similarly, stress-related factors, such as emotional or mental states present during problem solving stages can impact an individuals decision to utilize the ED over other sources of healthcare (Padgett & Brodsky, 1992). Furthermore, Small (2011) utilized 'vulnerability factors,' such as homeless status, mental disorders and substance abuse, to determine the propensity to

use traditional or acute healthcare services and concluded that five to six vulnerabilities were associated with a 2.53 increased odds of using the ED.

2.2.2. Specific Characteristics: Why homeless individuals present differently

Compared to individuals in stable housing, ED utilization among homeless individuals has defining characteristics. Homeless individuals present more often with injuries, psychiatric or substance related complaints, and receive diagnoses related to alcohol withdrawal, superficial injuries (e.g., laceration/abrasion), and skeletal injuries (e.g., fractures) (Ku et al., 2010; Pearson et al., 2007). Furthermore, compared to non-homeless individuals, homeless individuals were more likely to arrive by ambulance (Oates et al., 2009; Pearson et al., 2007), spend increased time in the ED (Pearson et al., 2007), less likely to be admitted to hospital (Pearson et al., 2007), more likely to be considered “bounce backs” (repeat visits over a short period of time) (Ku et al., 2010), and more often characterized as high or frequent users of the ED (Ku et al., 2010; Kushel et al., 2002; Mandelberg et al., 2000). In a review by LaCalle and Rabin (2010), frequent use of the ED was most commonly defined as four or more visits per person per year, ranging from three to twevle and rising as high as twenty visits per person per year (Ruger, Richter, Spitznagel, & Lewis, 2004), with a lack of consistency across the literature. Mandleberg et al. (2000), in a cross-sectional study comparing frequent ED users (>5 visits) to non frequent users, concluded that homeless status was associated with a 4.5 times greater risk of being a frequent user of the ED. The association between frequent users and homelessness is predicable given that characteristics associated with high frequency use of the ED are inherent in homeless populations (e.g., mental disorder, comorbid conditions, substance use, and poor health status). However, there still remains a significant amount of heterogeneity amongst this classification of ED use; therefore, definitive types or characteristics are less well-defined (LaCalle & Rabin, 2010).

2.2.3. Insurance Status

The roles of publically and privately funded healthcare models have been evaluated in regard to their relationship to ED utilization. Contrary to mainstream

opinions within US healthcare settings, uninsured individuals (e.g., homeless) are no more likely to utilize the ED than insured individuals, and are no more likely to be frequent users (Weber, Showstack, Hunt, Colby, & Callaham, 2005; Weber et al., 2008; Zuckerman & Shen, 2004). However differences do exist between low income individuals under publicly funded (Medicaid, Medicare) versus private insurance schemes, with the former more likely to use an ED or be categorized as frequent users in comparison to those who are uninsured (Weber et al., 2005; 2008; Zuckerman & Shen, 2004). In the Canadian context, the role of insurance coverage, and access to care theoretically has less influence given the presence of universally funded healthcare. Although direct comparisons about homeless persons ED utilization cannot be made between American and Canadian healthcare, the previous results suggest that ED utilization rates in Canada will differ from those examined in the US, and additionally may be higher given the decreased monetary barriers associated with healthcare access. Regardless of homeless individuals' ability to receive care in Canada, they still remain a disadvantaged and marginalized group with significant barriers irrespective of their health insurance status. Moreover, it is important to note that factors associated with various health disadvantages are significantly more predicative of healthcare utilization than insurance coverage status (Kushel et al., 2001).

2.2.4. Housing First: Canada and The United States (US)

HF is based on the premise "that housing is a basic human right…" (Tsemberis, Gulcur, & Nakae, 2004) and can be best described as barrier-free access to housing and supports for homeless individuals, regardless of an individual's compliance or acceptance of treatment. Pathways to Housing, founded by Sam Tsemberis in 1992, is an organization in the US that initiated the HF program. Padgett, Gulcur and Tsemberis (2006) summarized the basic elements of the HF model created by Pathways to Housing:

> (a) Immediate and independent permanent housing that is not contingent on treatment compliance and is retained regardless of the client's temporary departure because of inpatient treatment or incarcerations; (b) choice and harm reduction with respect to mental health treatment and substance use; (c) integrated Assertive Community Treatment (ACT) services (Drake et al., 1998) that work in conjunction with housing staff

> and nurse practitioner to address ongoing housing and health needs (p.76).

The HF model has been successful in several sites across the US, but has not been used as liberally in the Canadian context. Although several studies utilizing the HF approach have been undertaken in the US, there remains insufficient evidence with regard to the effects of HF in Canada. Of the two studies that have utilized HF in Canada (Toronto's Streets To Homes (S2H) & Calgary Housing Foundation) there is evidence to support that HF has a positive health impact on homeless individuals, and is associated with decreased healthcare service use (Falvo, 2009; Nicholson et al., 2010).

Studies in the US have documented the success of HF as an in intervention for homeless individuals with mental disorders (Padgett, Gulcur, & Tsemberis, 2006; Tsemberis et al., 2004). In a study by Gulcur, Stefancic, Shinn, Tsemberis and Fischer (2003), HF was associated with decreased hospitalization, and decreased average hospital costs per day over a 24-month period. Furthermore, Kyle and Dunn (2008) in their review analyzing the affect of HF on various health and services use related outcomes, reported that various studies identified HF as an effective means of improving the health of the homeless, accompanied by reductions in hospitalization. Moreover, in a pilot study by Weinstein, Henwood, Matejkowski and Santana (2011), examining perceived health improvements among clients placed in HF programs, found that the majority of clients believed that HF could assist with their health and social needs. Specifically, 87.5% reported that HF would be beneficial for medical and health problems, 88.6% believed the program could address issues related to mental illness, and 83.0% believed HF could reduce drug use and assist with abstinence (Weinstein et al., 2011). Moreover, HF has established success in the literature in relation to reducing healthcare utilization among the homeless (Larimer et al., 2009; Martinez & Burt, 2006; Sadowski et al., 2009). Specifically, Larimer et al. (2009) in a study of alcohol abusing homeless males, found that HF was not only associated with decreased alcohol consumption, but also decreased health care costs, and savings totaling $3108 per person per month after one year in stable housing. Moreover, Martinez and Burt (2006), in an analysis of homeless adults with concurrent disorders, showed stable housing decreased the average number of ED visits over a 36-month period, and also reduced the probability of hospitalization and admissions per person. Both Larimer et al. (2009)

and Martinez and Burt (2006), identified a reduction in over all costs even after the allocation of funding for housing was accounted for, with reported reductions of $1300/person/year (Martinez & Burt, 2006) and $2449/person/month (Larimer et al., 2009). Furthermore, Sadowski et al. (2009), in a randomized controlled trial comparing HF to standard hospital discharges among hospitalized chronically ill homeless adults, concluded that the benefits over a 12 month period amounted to reduced hospitalizations, length of stay and ED visits. These findings provide significant insights into the importance of HF as an intervention to reduce acute healthcare utilization among homeless individuals; clearly, providing HF significantly alleviates the healthcare system of increased usage and expenditures.

2.3. Summary

There is a well-established connection between homeless persons and ED use. Given the increased burden of physical diseases, mental disorders, and substance misuse among homeless individuals the increased demand and necessity for acute health services is unsurprising. Increased ED use is associated with significant costs to the healthcare system, and interventions to reduce this dynamic are necessary. Research suggests that HF interventions may lead to lower ED usage and reduced acute health service use and costs. There remains a need for further research to enhance existing knowledge on HF as a means to decrease ED use among homeless individuals with mental disorders in Canada.

2.4. Study Objectives

The present study uses a randomized controlled trial to examine the effectiveness of HF as a means to reducing ED utilization among homeless adults with a mental disorder. This study attempts to provide additional and unique insights into the frequency of ED visits and types of chief complaints within the study population. The randomized design provides the opportunity to identify successful interventions related to lower ED utilization. The results are intended to support the refinement of healthcare policy and practices, and to generate knowledge that can contribute to the evolution of

healthcare services for the homeless. The present study aims to address the following objectives:

1. To describe the frequency of ED visits and type(s) of chief complaints among homeless adults with a mental disorder.
2. To examine the rates of ED utilization between participants randomized to HF interventions compared to treatment as usual (TAU).
3. To identify reductions in ED utilization over time according to study arms; and
4. To test whether HF is associated with lower ED utilization among homeless adults with a mental disorder after adjusting for several covariates.

Primary Hypothesis: ED utilization will be lower among homeless individuals randomized to HF, regardless of housing type, compared to TAU.

3. Methods

3.1. Study Design

The VAH is comprised of two randomized controlled trials investigation HF interventions among homeless individuals with mental disorders. The VAH is part of the national *At Home/Chez So*i research demonstration project, a multi-site randomized controlled trial including five Canadian cites with objectives to determine economic, health and social viability of HF in comparison to TAU for homeless adults with a mental disorder. The multi-site study shares core methodological criteria across sites, as well as unique site-specific research focuses (e.g., concurrent disorders). Specifically, researchers are interested in examining health status (mental and physical), housing stability, community integration, recovery, vocational attainment, quality of life as well as healthcare and social service use with data collection based on self report interview measures. In addition to the over all *At Home/Chez Soi* key outcomes, the VAH is unique in its attainment and analysis of ED visits, as this analysis represents an independent objective exclusive to Vancouver. The present analysis is based on (n=297) participants enrolled in Vancouver randomized to one of three intervention arms: HF in a congregate setting (CONG), HF in scattered site apartments (SS), or to treatment as usual (TAU), and incorporates linked data from a centralized regional database representing six urban ED's, to examine the frequency and type(s) of ED visits before (one year) and after (up to two years) randomization.

3.2. Recruitment and Data Collection

Participants were recruited based on referral from over forty community agencies serving homeless adults in Vancouver (Goering et al., 2011; Patterson, Somers, & Moniruzzaman, 2012). Eligibility criteria were screened by telephone and a subsequent in-person interview was conducted to formally assess eligibility and to obtain written

informed consent. Eligible participants were enrolled in the study and completed a series of detailed in-person or phone-based interviews at 3 month intervals for 24 months in order to asses: housing, health status, community functioning, quality of life, and health/social/justice service utilization (Goering et al., 2011). All participants received a cash honorarium for the screening questionnaire and baseline questionnaire ($35.00), as well as for subsequent interviews. Previous publications provide additional details concerning randomization, interview timelines and instruments not included in the current study (Goering et al., 2011; Patterson et al., 2012; Zabkiewicz, Patterson, Frankish, & Somers, 2012).

Participants were presented with the opportunity to provide separate consent for researchers to receive administrative data including health service utilization. Consent did not influence participants' eligibility for access to services, and participants randomized to experimental interventions were free to withdraw from the research protocol without loss of housing and supports. This present analysis used participant personal health numbers (PHN) from consenting participants in order to generate an extract of ED data spanning April 2007 to October 2012 from a centralized database representing six urban hospitals located in the greater Vancouver area. The data extract consists of information pertaining to ED utilization, presenting complaints, discharge diagnosis, discharge disposition, clinical triage assessment score (CTAS) and mode of arrival. Administrative ED data was available for 223 participants, which was used to examine ED visits before (one year) and after (up to two years) randomization.

3.3. Study Population

Participants were recruited between October 2009 and June 2011 and were screened for eligibility based on: legal adults status (19 years or older), housing status (absolutely homeless or precariously housed), and presence of a mental disorder as defined by the Mini International Neuropsychiatric Interview (MINI 6.0) (Goering et al., 2011; Lecrubier et al., 1997). Additional inclusion criteria included: a score of 62 or lower on the Multnomah Community Ability Scale (MCAS) (Barker, Barron, McFarland, & Bigelow, 1994) and a current psychotic or bipolar disorder, plus one of the following: two or more psychiatric hospitalizations (in any one year of the last five), substance use

disorder, or recent justice system involvement (arrest or incarceration) (Goering et al., 2011).

3.4. Measures

3.4.1. Overview

The following variables, derived from the baseline self-report questionnaires, were included in the current analysis: gender, age, ethnicity, level of education, lifetime duration of homelessness, age first homeless, multiple (3 or more) chronic health conditions, infectious disease ([HIV], Hepatitis C, Hepatitis B), severity of mental disorder ("severe" or "less severe"), substance dependence, access to health services, and unmet health needs. ED data included number of ED visits (pre and post) and chief complaints for all independent visits observed.

3.5. Dependent Variable

3.5.1. ED Visits

The primary outcome variable, ED visits (counts), was obtained via linking participant PHN's with the Vancouver Coastal Health Research Institute ED regional database. As such, ED visits were examined as a continuous variable (counts) and represented as visits per person before (one year) and after (up to two years) randomization.

3.5.2. ED Chief Complaints[1]

Chief complaints are based on the Canadian Emergency Department Information System (CEDIS) Presenting Complaint List (V2.0) and include the following categories: Cardiovascular, ENT- Ears, ENT- Mouth;Throat;Neck, ENT-Nose, Environmental, Gastrointestinal, Genitourinary, Mental Health, Neurologic, Obstetrics/Gynecology

[1] Descriptive variable – excluded from multivariable analysis.

(OB/GYN), Ophthalmology, Orthopedic, Respiratory, Skin, Substance Misuse, Trauma, General and Minor, Unknown. Complete descriptions and sub groupings of all indicators are available in Appendix (B). To maintain accuracy within grouping categories, presenting complaints were collapsed with clinically similar categories to allow (e.g., Trauma and Orthopedic) for proportional representation of categories. The CEDIS is a nationally accepted list adopted by the Canadian Association of emergency physicians and Canadian Institute for Health Information, and previous versions/adaptions can be obtained from Grafstein, Bullard, Warren, and Unger (2008).

3.6. Independent Variables

In this study the primary independent variable (study arm) and other explanatory variables, such as age, gender, lifetime duration of homelessness, chronic health conditions, severity of mental disorder ("severe" or "less severe"), multiple mental disorders (two or more) and substance misuse, were used as covariates to explain ED utilization in the post randomization period. Self-report data pertains to all items, except housing intervention/study arm (CONG, SS, TAU). The selection of covariates has been informed by previous literature (e.g., chronic medical conditions, mental disorder and substance misuse) identifying factors associated with ED use among homeless samples. Additionally, covariate selection will include utilizing test statistics from bivariate associations with the outcome as inclusion criteria for the multivariable model.

3.6.1. Housing Intervention - Study Arms (Primary Independent Variable)

Two HF interventions were examined in this study: HF in congregate (CONG) setting with onsite supports or HF in scattered site (SS) independent housing with an assertive community treatment (ACT) team.

The SS intervention provided housing based on participant choice from private market rental accommodation, in which a maximum of 20% of the total units were allocated to participants. Participants were assigned to an ACT team, and received a

minimum of once weekly visits from a multidisciplinary team (e.g., psychiatrist and nurse) based on a participant/ staff ratio of 10:1 (Goering et al., 2011).

The CONG intervention consisted of 100 single room units with a private bathroom, located in a former motel. On-site support services included one front desk staff 24-hours a day staff, and a multidisciplinary team of healthcare professionals, peer support workers and case managers with a client/staff ratio of 12:1 (Goering et al., 2011). The intention of these supports and services was to be comparable in range and intensity to those provided by an ACT team approach. A sense of community was encouraged in the building and included three meals a day, a shared dining area, and a range of recreational and therapeutic activities. All service providers received training in HF and participated in fidelity assessments to ensure delivery of the interventions per protocol (Goering et al., 2011). See separate publications for more detailed descriptions (Goering et al., 2011; Patterson et al., 2012; Zabkiewicz et al., 2012).

Treatment as usual (TAU) consisted of existing services and supports available to homeless adults with mental illness living in Vancouver. TAU participants did not receive any supports through the study; however, they could go on to receive housing and other supports through existing services.

3.6.2. Socio-demographic Characteristics

Socio-demographic characteristics solicited from the baseline questionnaire and included in the analysis were: age at enrolment (years), gender (male or female), ethnicity (Aboriginal; Caucasian; mixed/other), education (less than high school), and marital status (single (never married); married; separate/divorced/ widowed).

3.6.3. Housing Status and Homelessness History

Participant housing status was established prior to study enrolment, and characterized as either absolutely homeless or precariously housed. Absolute homelessness is defined as “currently having no fixed place to stay for more than seven nights and little likelihood of obtaining accommodation in the up coming month or being discharged from an institution, prison, jail, or hospital with no fixed address” (Goering et

al., 2011, p.18). Precariously housed is defined as “people whose primary residence is in a Single Room Occupant (SRO), rooming house or hotel/motel” (Goering et al., 2011, p.18) who have also had two or more episodes meeting criteria for absolute homelessness in the past year.

Homelessness history was measured according to the following indicators: age of first homelessness (in years) and lifetime duration of homelessness (in months) measured as continuous variables.

3.6.4. Mental Disorder and Substance Use Status

The presence of a mental disorder was assessed utilizing the MINI 6.0 and confirmed via physician diagnosis when available. The MINI 6.0, is a brief structured diagnostic interview tool with high reliability and validity used to assess current diagnostic symptoms based on DSM-IV and ICD-10 psychiatric disorders (Goering et al., 2011; Lecrubier et al., 1997). Self report diagnostic criteria were assessed for the following: major depressive episodes, suicidality, manic and hypomanic episodes, post-traumatic stress disorders, alcohol dependence/abuse, substance dependence/abuse, psychotic disorders, and generalized anxiety disorders. Two clusters of mental disorders were identified as being either “severe” or “less severe.” The “severe” cluster of mental disorders includes at least one of (current): psychosis, mood disorder with psychotic features, and hypomanic or manic episode. The “less severe” cluster of mental disorders includes at least one of (current): major depressive episode, panic disorder, and post-traumatic stress disorder. The variables “severe” and “less severe” cluster of mental disorders, mental disorders (two or more), and sucidiality (high or moderate) were included as categorical variables (yes or no).

Current (past month) substance dependence and daily illicit drug use (excluding alcohol) were assessed utilizing the MINI 6.0 and Maudsley Addiction Profile (MAP) (Marsden et al., 2000), respectively. The MAP screened for the frequency and use of the following illicit substances: cannabis, heroin, illicit methadone, cocaine, crack, amphetamine, benzodiazepines and alcohol). The variables past month substance dependence and past month daily illicit drug use (excluding alcohol) were included as categorical variables (yes or no).

3.6.5. Physical Health Status

The presence of chronic health conditions was assessed via self-report participant responses (yes or no) for the following diagnoses: asthma, chronic bronchitis/emphysema, tuberculosis (TB), hepatitis C, hepatitis B, HIV/AIDS, other sexually transmitted diseases (STD), migraine headaches, epilepsy or seizures, stroke, alzheimer or dementia, back problems, dental problems, foot problems, skin problems, lice/scabies/bed bugs or similar, arthritis, ulcer, bowel problems, kidney/bladder, high blood pressure, thyroid, heart disease, diabetes, liver disease, cancer, and anemia. Traumatic brain injuries were assess with the following questions: “have you ever had an injury to the head which knocked you out of left you dazed, confuse or disoriented?” (yes or no) and “were you, in fact, knocked out of unconscious after any of these head injuries” (yes or no). Chronic comorbid medical conditions were categorized as, “chronic medical conditions (3 or more), or “blood borne infectious disease (HIV, Hepatitis C or B) and represented as categorical variables (yes or no).

3.6.6. Health Service Access

Access to health services was represented as categorical responses (yes or no) and assessed via self-report to the following three questions: “Do you have a regular medical doctor?”; “is there a place when you go when you are sick or need advice about your health?”; “In the past 6 months, was there ever a time when you felt that you needed health care but didn't receive?.” Additional clarifying questions were solicited where appropriate to determine rationales for no healthcare contact.

3.7. Statistical Analysis

3.7.1. Overview

Analyses focused on descriptive variables as well as ED characteristics for the eligible sample, using an intention to treat analysis, and 3-arm study design. Analysis of the data consisted mainly of descriptive statistics, parametric and nonparametric tests of significance and Negative Binomial Regression (NBR) analysis to test for significant differences between intervention arms in relation to ED visits during the post

randomization period. All analysis was conducted using IBM SPSS statistics (Release version 19.0, August 2010 and STATA 12 (StataCorp.2011).

3.7.2. Descriptive Analysis

Comparisons by study arm (CONG, SS, TAU) of socio-demographic factors, severity of mental disorder, comorbid health conditions and ED visits were conducted using parametric or nonparametric tests. Parametric tests, Student's T-test and One-Way ANOVA, were utilized for continuous variables (ED visits) among study arms. Nonparametric tests, Pearson's Chi-square or Fishers Exact test were used to examine relationships between categorical variables (gender, ethnicity) and study arms. All reported p-values were two sided with alpha level 0.05

3.7.3. Multivariable Analysis

NBR was utilized to determine the independent association between the dependent (number of ED visits in post randomization period) and independent variables, with the primary independent variable being study arm. NBR was chosen over poison regression due to over-dispersion of data, resulting in unequal variance and mean, and therefore meeting assumptions of NBR rather than Poisson. Similarly, a log likelihood test was performed comparing Poisson regression to NBR and resulted in a p-value of 0.000, identifying improved goodness of fit for NBR. In order to control varying exposure period (range: 1.3 to 2 years), the log-transformed exposure time was included as an offset variable in the regression analysis. Participants who died were censored at the time of their deaths. Covariates with p-value (<0.10) in bivariate associations with the outcome were chosen for the multivariable model. Covariates in the multivariable model included: number of ED visits in pre-enrolment year (continuous), gender (male or female), ethnicity (Aboriginal; Caucasian; Other), multiple (3 or more) co-morbid health conditions (yes or no), having a place to go when sick (yes or no), access to a regular medical doctor (yes or no), needed health care, but didn't receive it (yes or no) and study arm (CONG, SS, and TAU). The exponentiation of coefficients from the final model provided Incidence Rate Ratios (IRR) along with 95% Confidence Intervals as measures of association (effect size), to determine the degree of difference between groups, and were reported as unadjusted and adjusted IRRs (per person). The choice of IRR as

effect size is aligned with the selection of NBR, as this method of measuring associations is best suited to the log link function present in NBR. All reported p-values are two sided with alpha level 0.05. Sensitivity analysis for missing values (0-4%) of covariates was performed, using the multiple imputation chained equation method to impute the missing values 20 times and then averaged over imputations (van Buuren, 2007). No meaningful differences were observed; therefore, participants with missing values were not included in multivariable NBR. Institutional ethics approval was granted from Simon Fraser University and University of British Columbia and additional approval was obtained from the Vancouver Health Authority Research Institute.

4. Results

4.1. Descriptive Analysis of Analyzed Cohort

Within the total sample of 297 participants, 75% (n=223) consented to the use of administrative data and had a valid PHN and therefore were eligible for inclusion in our analysis. Participants were excluded for the following reasons: no consent provided for accessing the administrative database (n=38), PHN unavailable (n=30) and less than one year of follow-up data (n=6) (Appendix A). Minimum and maximum follow-up time was 1.3 and 2.0 years respectively, with a mean of 1.9 years for the analyzed sample. The allocation of treatment status for the study sample was as follows: CONG: 89; SS: 73; TAU: 61.

Table 1 illustrates the socio-demographics, mental disorder and health access characteristics for the full study cohort (n=297) and eligible sample (n=223) at enrolment.

Table 1 Socio-demographic and mental disorder characteristics for the full sample (n=297) and eligible sample (n=223) at baseline

Variable	Full sample (n=297) n (%)	Eligible (n=223)[2] n (%)
Study Arm Congregate (CONG) Scattered Site (SS) Treatment As Usual (TAU)	 107 (36) 90 (30) 100 (34)	 89 (40) 73 (33) 61 (27)
Male Gender	218 (74)	163 (74)
Age at Randomization (years) Mean (SD)	 39.7 (11.2)	 39.4 (10.9)
Ethnicity		

[2] The eligible sample did not differ significantly (p-value >0.05) from the full sample in any of the characteristics listed in the table.

Variable	Full sample (n=297) n (%)	Eligible (n=223)[2] n (%)
Aboriginal Caucasian Mixed/Other	44 (15) 170 (57) 83 (28)	35 (16) 119 (53) 69 (31)
Incomplete High School	179 (61)	134 (61)
Single/Never Married	214 (73)	158 (72)
Lifetime Duration of Homelessness (months) Mean (SD)	62.0 (67.0)	57.9 (63.9)
Age of first homelessness Mean (SD)	28.7 (12.5)	28.3 (12.3)
Mental Disorder (less severe cluster)	133 (45)	96 (43)
Mental Disorder (severe cluster)	272 (92)	201 (90)
Mental Disorders (2 or more)	148 (50)	108 (48)
Substance Dependence (past month)	183 (61)	141 (63)
Suicidality (high or moderate)	93 (31)	72 (32)
Chronic Medical Conditions (3 or more)	189 (64)	141 (63)
Blood-borne Infectious Disease (HIV, Hepatitis B or C)	87 (30)	65 (29)
Daily Illicit Drug Use (past month)[3]	82 (28)	66 (30)
Have a regular medical doctor	177 (60)	142 (64)
Place you to go when you are sick	231 (79)	173 (79)
Needed healthcare, but didn't receive it	129 (45)	92 (43)

The eligible sample (n=223) was predominately, single (72%), male (74%), and self-identified as Caucasian (53%), with a mean age of 39.4 years. Over half of the participants did not complete high school (61%), and experienced on average 5 years (57.9 months) of homelessness in their lifetime. Ninety percent of participants met diagnostic criteria for the "severe" cluster of mental disorders, 50% experienced two or more mental disorders, and 63% reported current substance dependence. Sixty-four percent of participants reported receiving care from a family doctor, and 79% reported a

[3] Excluding alcohol

place to go when medical ill, however nearly half (43%) reported needing health care but not receiving it.

The presence of multiple chronic medical conditions (three or more) was common among participants (63%), and 29% reported having an infectious disease (HIV, Hepatitis B or C). Ninety-one percent of the analyzed sample self-reported having any physical illness with the various physical illnesses represented accordingly: diabetes (6.3%), heart disease (4.9%), kidney/bladder problems (12.6%), bowel problems (9.9%), ulcers (13.0%), arthritis (34.5%), skin problems (26.5%), foot problems (39.5%), dental problems (54.7%), back problems (50.7%), migraine (33.2%), epilepsy or seizure (15.2%), asthma (16.1%), chronic bronchitis/emphysema (17.5%), TB (3.1%), head injury-disoriented (62.3%), and head injury-unconscious (52.0%).

4.2. Emergency Department Characteristics

Table 2 describes the ED utilization and chief complaints for participants (n=223) as mean (standard deviation [SD]) and proportion, before and after randomization. In the year prior to enrolment, participants (n=223) made on average, 4.8 ED visits per person, with a total of 1079 visits.

Table 2 Number of ED Visits and Chief Complaints Before and After Randomization among the eligible sample (n=223)

Variable	Mean (SD)
ED visits before randomization per year	4.8 (8.4)
ED visits after randomization per year[4]	4.7 (8.9)
ED reduction per year	0.1 (9.4)
Total # of ED visits before randomization (past year) (n)	1079
Total # of ED visits after randomization (1st year) (n)	1166
High Users (≥4 visits)	
ED visits before randomization (past year) (%)	40.4
ED visits after randomization (1st year) (%)	39.5

[4] -Yearly estimation was derived using the number of ED visits in post period divided by the post-period

Variable	Mean (SD)
# Of chief complaints before randomization (past year)	
Cardiovascular	0.11 (0.53)
Environmental	0.01 (0.12)
Gastro-intestinal and Genitourinary	0.37 (1.66)
General and Minor	0.94 (3.03)
Ears, Nose and Throat	0.16 (0.59)
Psychiatric	1.54 (2.43)
Neurological	0.36 (1.33)
Orthopedic and Trauma	0.41 (1.40)
Respiratory	0.10 (0.53)
Substance Misuse	0.23 (0.98)
Skin	0.54 (1.51)
% Of chief complaints before randomization (past year)	N (%)
Cardiovascular	25 (2.5)
Environmental	3 (0.3)
Gastrointestinal	61 (6.0)
Genitourinary	20 (2.0)
Ears, Nose and Throat	34 (3.3)
General and Minor	202 (19.8)
Psychiatric	334 (32.8)
Neurological	76 (7.5)
Orthopedic and Trauma	87 (8.6)
Respiratory	22 (2.2)
Substance Misuse	45 (4.4)
Skin	109 (10.7)
% Of chief complaints after randomization (1st year)	N (%)
Cardiovascular	48 (4.2)
Environmental	5 (0.4)
Gastrointestinal	91 (7.9)
Genitourinary	22 (1.9)
Ears, Nose and Throat	75 (6.5)
General and minor	210 (18.2)
Psychiatric	348 (30.2)
Neurological	101 (8.8)
Orthopedic and Trauma	107 (9.3)
Respiratory	18 (1.6)
Substance Misuse	50 (4.3)
Skin	79 (6.8)

The majority of ED complaints were related to psychiatric issues (32.8%) and general/minor complaints (19.8%) with a smaller proportion of skin (10.7%), orthopedic and trauma (8.6%), neurologic (7.5%), and substance (4.4%) related conditions. The results indicate high utilization rates pertaining to psychiatric as well as general/minor complaints in both the pre and post randomization periods (Figure 2).

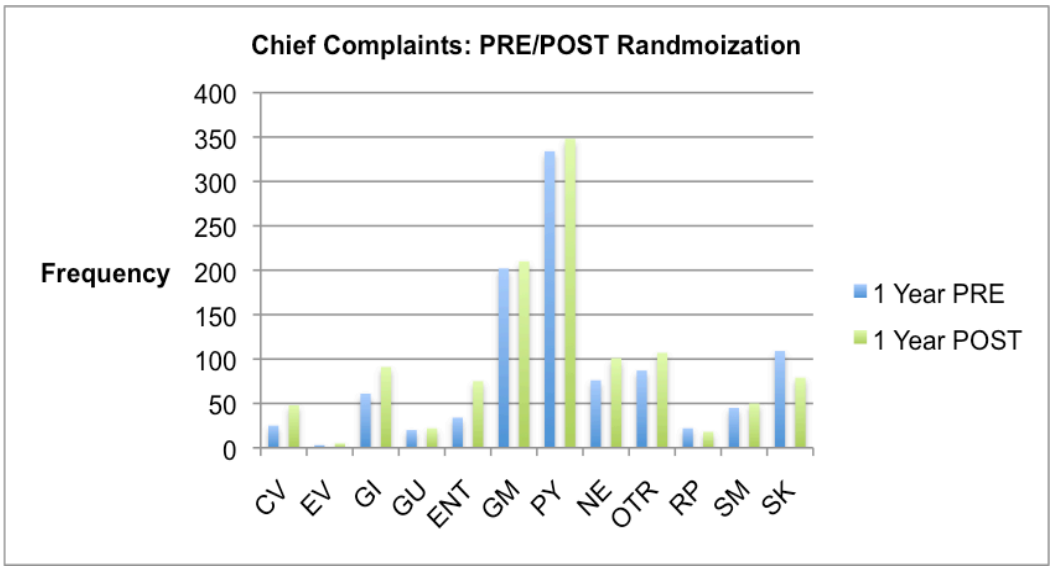

Figure 2 Frequencies of Chief Complaints Before and After Randomization[5]

The two most common categories of complaints were psychiatric and general/minor. Examples of psychiatric complaints are: bizarre behaviour, hallucinations, suicidal ideation, and anxiety. Examples of general/minor complaints are: medication requests/refills, fast track antibiotics, minor complaints unspecified and dressing changes (for more complete lists of examples please see Appendix B).

After randomization (up to 2 years), participants made on average, 4.7 ED visits per person per year with a total of 1166 visits in the first year post randomization. Furthermore, high users defined as greater than or equal to 4 visits per person per year, represented 40.4% and 39.5% respectively of sample in the year before and after randomization.

[5] CV = Cardiovascular; EV = Environmental; GI = Gastrointestinal; GU = Genitourinary; ENT = Ears, Nose and Throat; GM = General/Minor; PY = Psychiatric; NE = Neurologic; OTR = Orthopedic and Trauma; RP = Respiratory; SM = Substance Misuse; SK = Skin

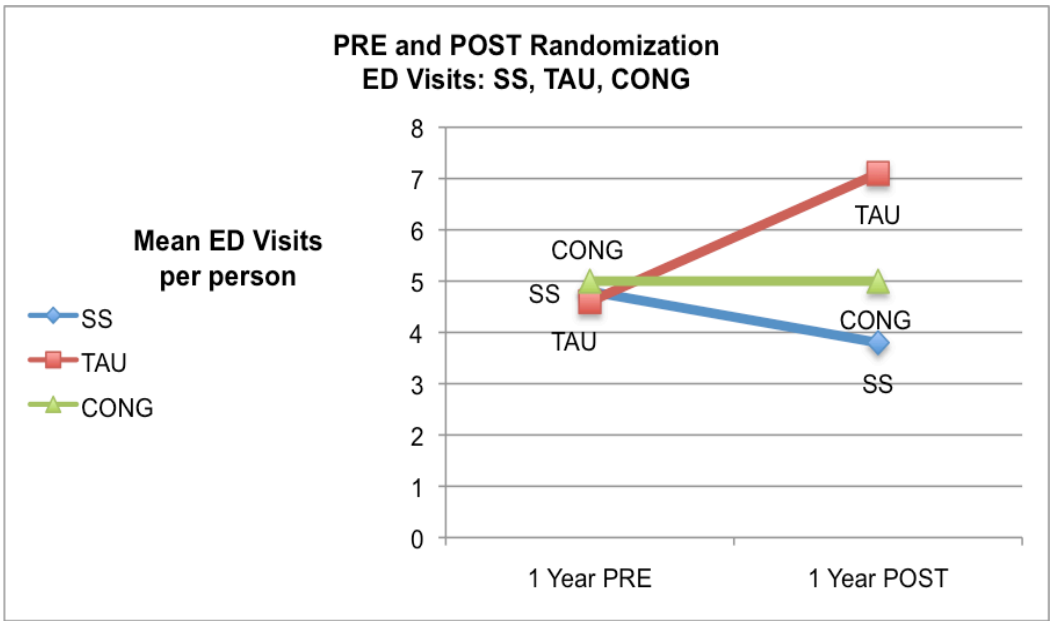

Figure 3 Change in ED visits Before and After Randomization by Study Arms

In the year after randomization we observed a reduction of 1 (0.94) ED visit per person in SS, no change in CONG (-0.01), and an increase of 2.5 (-2.5) visits per person in TAU (Figure 3).

A series of comparisons addressed the distribution of relevant variables among the three study arms: CONG, SS, and TAU. Results are presented in Table 3 and indicate that, in each instance, there were no significant differences among study arms at baseline.

Table 3 Comparisons of socio-demographic, mental disorder, physical illness, and ED related characteristics by study arms among participants (n=223)

Variable	CONG (89) n (%)	SS (73) n (%)	TAU (61) n (%)	p-value
Age at enrolment (in years) Mean (SD)	40.1 (11.2)	39.6 (10.2)	38.2 (11.1)	0.557
Lifetime duration of homelessness (in months) Mean (SD)	57.8 (65.4)	63.1 (71.5)	52.3 (52.0)	0.631
Age of first homelessness Mean (SD)	29.4 (12.9)	28.0 (11.7)	26.9 (12.2)	0.480

Variable	CONG (89) n (%)	SS (73) n (%)	TAU (61) n (%)	p-value
Number of ED visits before randomization (past year) Mean (SD)	5.0 (8.5)	4.8 (8.0)	4.6 (8.8)	0.951
Male gender	66 (74)	54 (76)	43 (72)	0.905
Ethnicity Aboriginals Caucasian Other	 17 (19) 46 (52) 26 (29)	 11 (15) 40 (55) 22 (30)	 7 (12) 33 (54) 21 (34)	 0.774
Single/Never Married	63 (72)	49 (67)	46 (77)	0.471
Education (less than high school)	58 (66)	39 (55)	37 (61)	0.369
Multiple mental disorders (≥2)	44 (49)	34 (47)	30 (49)	0.957
Less severe cluster of mental disorder	39 (44)	31 (42)	26 (43)	0.982
Severe cluster of mental disorder	80 (90)	65 (89)	56 (92)	0.863
Suicidality (high or moderate)	28 (31)	23 (31)	21 (34)	0.916
Substance dependence	56 (63)	47 (64)	38 (62)	0.966
Multiple physical illness (≥3)	58 (65)	43 (60)	40 (66)	0.718
Blood-borne infectious diseases (HIV, Hepatitis B or C)	27 (31)	21 (29)	17 (28)	0.950
Have a regular medical doctor	59 (66)	45 (62)	38 (63)	0.823
Place to go when you are sick	72 (83)	58 (80)	43 (73)	0.353
Needed healthcare, but didn't receive it	36 (41)	27 (39)	29 (50)	0.404
Daily Illicit Drug Use (excluding alcohol)	30 (34)	18 (25)	18 (29)	0.455

4.3. Multivariable Analysis:

The number of ED visits in the post randomization period was compared between study arms and in relation to additional covariates. The unadjusted and adjusted incidence rate ratio (IRR) for each comparison is presented in Table 4.

Variables with p-values <0.10 in the univariate analysis were included in the multivariable model.

Table 4 Negative Binomial Regression Analysis to estimate the Incidence Rate Ratio (IRR) of ED visits during the post-randomization period in relation to Study Arm and Participant Characteristics (n=223)

Variable	Unadjusted IRR (95% CI)	p-value[6]	Adjusted IRR[7] (95% CI)	p-value[6]
Study Arms				
Congregate (CONG)	0.91 (0.58, 1.43)	0.688	0.76 (0.49, 1.17)	0.212
Scattered Site (SS)	0.63 (0.39, 1.02)	*0.058*	0.55 (0.35, 0.86)	**0.008**
Treatment As Usual (TAU)	Reference	-	Reference	-
Age at enrolment (per year)	0.99 (0.98, 1.01)	0.436		
Age of first homelessness	1.01 (0.99, 1.03)	0.216		
Male gender	0.70 (0.46, 1.07)	*0.099*	0.83 (0.57,1.21)	0.321
Ethnicity				
Aboriginals	2.08 (1.18, 3.63)	**0.010**	1.29 (0.76, 2.21)	0.345
White	1.50 (0.99, 2.26)	*0.054*	1.35 (0.91, 2.00)	0.134
Other	Reference	-		
Education Incomplete High School)	1.27 (0.87, 1.85)	0.213		
Single/Never Married	0.95 (0.63, 1.43)	0.805		
Lifetime duration of homelessness (per month)	1.00 (1.00, 1.00)	0.599		
Number of ED visit before randomization (past year)	1.09 (1.06, 1.12)	**<0.001**	1.07 (1.04, 1.10)	**<0.001**
Substance dependence (yes vs. no)	0.98 (0.67, 1.44)	0.923		
Less severe cluster of mental disorders	1.33 (0.92, 1.92)	0.132		
Severe cluster of mental disorders	1.09 (0.59, 2.02)	0.790		
Mental Disorders (≥ 2)	1.22 (0.85, 1.77)	0.279		

[6] -Bold indicates significant (p <0.05) and italic indicates marginally significant (p ≥ 0.05 and p <0.10).

[7] -Variables with p value < 0.10 in bivariate analysis were included in the multivariable model.

Variable	Unadjusted IRR (95% CI	p-value[6]	Adjusted IRR[7] (95% CI)	p-value[6]
Suicidality (high or moderate)	1.31 (0.88, 1.94)	0.173		
Chronic Medical Conditions (3 or more)	1.72 (1.18, 2.51)	**0.005**	1.23 (0.83, 1.81)	0.303
Blood-borne Infectious Disease (HIV, Hepatitis B or C)	0.99 (0.66, 1.48)	0.961		
Have a regular medical doctor	1.19 (0.82, 1.75)	0.362		
Place to go when you are sick	2.06 (1.32, 3.23)	**0.002**	1.30 (0.85, 1.99)	0.236
Needed healthcare, but didn't receive it	1.61 (1.11, 2.33)	**0.011**	1.06 (0.73, 1.52)	0.771
Daily Illicit Drug Use	0.87 (0.58, 1.31)	0.506		

In comparison to TAU (reference), SS was associated with significantly lower ED utilization in the post randomization period (Adjusted IRR = 0.55 [0.35, 0.86]). CONG was associated with marginally lower ED utilization, in comparison to TAU, but was not statistically significant (Adjusted IRR = 0.76 [0.49, 1.17]). ED utilization in the year prior to enrolment was significantly associated with ED utilization in the post randomization period (Adjusted IRR = 1.07 [1.04, 1.10]). In the adjusted model, several variables exhibited no significant relationship with ED utilization following randomization, despite significance in the unadjusted model: aboriginal ethnicity, three or more chronic medical conditions, having a place to go when sick, and needing healthcare but not receiving it.

[6] -Bold indicates significant ($p < 0.05$) and italic indicates marginally significant ($p \geq 0.05$ and $p < 0.10$).

[7] -Variables with p value < 0.10 in bivariate analysis were included in the multivariable model.

5. Discussion:

Our findings confirm that HF programs, particularly those using a SS format with ACT services, promote lower ED utilization among homeless adults with mental disorders. The significance of this finding is likely the result of a combination of various factors beginning with the provision of stable housing, followed by improvements in quality of life and health status. Furthermore, this result also suggests that systemic factors, such as community norms and increased access to health services and supports, may also mediate the probability of ED use. In addition the success of the SS format with ACT services also underscores the importance of providing support and services tailored to client needs and delivered in an intensified format by a multidisciplinary team.

At baseline, participants were homeless on average for 5 years and the vast majority (90%) met criteria for psychotic disorder with or without substance dependence, reflecting the primary eligibility criteria for HF programs. A critique of previous studies utilizing HF/supported housing models to describe healthcare utilization has been the under-representation of samples with a variety of diagnostic criteria and severity of illness (Kyle & Dunn, 2008). The majority of our sample (90%) met criteria for a severe mental disorder, and 48% met criteria for 2 or more mental disorders at baseline. In addition, a greater part of our sample reported problematic substance use and chronic medical conditions. Even after controlling for severity of mental disorder and a range of other variables, our analysis revealed reductions in ED utilization over time in association with HF. Furthermore, it is important to note that mental disorder severity and chronic medical conditions were not predictive of ED utilization in the post randomization period.

Although a number of variables were significantly associated with ED use in the univariate model, the majority of these variables became non-significant when included alongside HF in a multivariable model. Consistent with the ED utilization literature

(Kushel et al., 2001; 2002), our adjusted model indicated that participants' prior ED utilization (year prior to enrolment), was predicative of ED utilization in the post randomization period. This finding may suggest that our sample includes homeless individuals with consistently high ED utilization rates over time, a subgroup known as 'frequent users' (Kushel et al., 2002; O'Toole et al., 2007). There are inconsistencies within the literature in defining frequent users of the ED, with visits ranging from 2-20 per person per year (Ruger et al., 2004), with an accepted cut off rate of four or more visits per person per year (Hunt et al., 2006; LaCalle & Rabin, 2010). High users (≥4) accounted for approximately 40% of visits in the twelve months before and after randomization, representing a large proportion of the eligible sample. A review by Althaus et al. (2011) analyzing frequent users reported that practices including case-management, tracking frequent users over time, and using algorithms to correctly identify usage patterns, can effectively reduce ED utilization within this subgroup, including among homeless individuals. Moreover, analysis of frequent users and HF interventions would be beneficial, given the previous association with case-management and the high proportion of ED use per person within our sample. Additionally, further analysis of frequent user characteristics, would benefit health service utilization research and policy initiatives, as this type of utilization is associated with increased demands and costs to the healthcare system

Compared to TAU, participants in CONG and SS had respectively on average, 0.76 (Adjusted IRR) and 0.55 (Adjusted IRR) the number of ED visits per person following randomization. The effectiveness of both interventions (CONG and SS) is likely attributable to the intensive and highly supported ratio of skilled and trained health professionals associated with ACT models of care, with staff to client ratios of 10:1 (SS) and 12:1 (CONG), diminishing barriers impeding access to appropriate healthcare and support services.

The 'appropriateness' of healthcare utilization is highly subjective, as such a clear and concise definition is not established in the literature (Han & Wells, 2003; Lowe & Abbuhl, 2001; Padgett & Brodsky, 1992). Theoretically, ED's are reserved for life threatening or urgent health issues (e.g., trauma, acute injuries), which cannot be addressed via community-based healthcare; consequently, providers deem non-urgent (e.g., medication refills, non-specific complaints, dressing change, etc.) uses of the ED

as inappropriate. In the case of 'non-urgent' complaints some healthcare providers interpret high frequency utilization of the ED as inappropriate, ultimately having an impact on the care individuals receive. Therefore, understanding 'appropriateness' of ED use in the context of homelessness is especially salient given the heterogeneity among individuals and circumstances under which their ED use occurs. Abbuhl & Lowe (1996) advocate that ED's might be the only existing 'safety net' for some homeless persons, questioning whether their increased utilization of the ED should be deemed inappropriate, or rather whether the health services provided/available should in fact be considered inappropriate.

In an effort to accurately review appropriateness, certain studies have taken into account the context of alternative sources of care when examining ED use (Han & Wells, 2003), and have developed assessment protocols with reliability and validity measures (Sempere-Selva, Peiró, Sendra-Pina, Martínez-Espín, & López-Aguilera, 2001). For example, Han et al. (2003) used a multifaceted program (Health Care for the Homeless Program [HCHP]) including case-management (as an alternative), to evaluate inappropriate ED utilization[9] among homeless adults in the US. Results demonstrated that contact with the HCHP program (at least one visit) was associated with decreased inappropriate ED utilization and that the frequency of ED visits (e.g., high users) was associated with more inappropriate ED utilization. In relation to our study, these conclusions suggest that contact with ED's may have been for more 'appropriate' reasons due to the provision of case-management and housing supports in both the CONG and SS arms. Similarly, the association between number of ED visits and increased inappropriate use suggests that ED use by TAU participants may be linked with less acute complaints, and leading to more inappropriate types of visits. Moreover, Sempere-Selva et al. (2001) in study describing appropriateness of ED use within a

[9] "Inappropriate use of ED's during the last 6 months was confirmed if homeless adults did not meet at least one of the following conditions: orthopedic treatments, wound management (other than cleaning or bandaging minor abrasions), chest pain, other severe pain, dyspnea with rapid onset, patients presenting high-risk conditions (e.g., human immunodeficiency virus,/acquired immune deficiency syndrome, asthma, pregnancy), arrived by ambulance, vital signs out-side acceptable limits (e.g., temperature: <96.0F or >101.5F; respiration: <12 or >20 per minute; [pulse: <60 or >110 per minute; blood pressure: systolic <90 or >160mmHg, diastolic <60 or >110 mmHg), or hospitalizations" (Han & Wells, 2003, p.531-532).

universal health care system, found that inappropriate ED utilization by individuals was associated with physician referrals and lack of confidence in primary care providers. These results suggest, that an individual's preference for the ED is based upon perceived inadequacies in care and/or encouragement from primary care providers, which may explain the variation in ED utilization among our sample of homeless adults with a mental disorder.

Compared to TAU, CONG resulted in lower reductions in ED use than the SS intervention. This result may be partially attributable to the proximity of our CONG housing site to a major urban ED. A study by Li, Grabowski, McCarthy and Kelen (2003), describing geographical and demographic factors associated with ED utilization, concluded that close proximity (<0.40 miles) to an ED is highly associated with ED utilization. Given this finding and the fact that the CONG site was within walking distance of an urban ED, it may not be surprising that utilization rates were not significantly decreased. By contrast, SS housing was in multiple neighbourhoods across a larger geographical area, with varying proximity to ED's. Despite the close proximity of our CONG site to an ED, our multivariable model showed moderately lower ED use in the post randomization period for CONG compared to TAU.

Fakhoury, Murray, Shepard and Priebe (2002), in a review of the literature on supported housing, suggested that client-staff interactions, staff organization and staffing levels may have an impact on housing related outcomes for clients with mental disorders. Although, ED utilization was not addressed in their review, the aforementioned concepts may explain the differences exhibited in ED use among participants in CONG versus SS. Directives from staff, insufficient staffing levels or unknown circumstances may have triggered clients to seek care from outside sources (e.g., ED), even with the provision of onsite supports and services. Despite maintaining accuracy and fidelity within our models, critiques of literature surrounding supported housing studies, suggest that inconsistencies in the delivery of supported housing make it challenging to fully compare the effectiveness of different types of supported housing models (Fakhoury, Murray, Shepherd, & Priebe, 2002; Rog, 2004; Tabol, Drebing, & Rosenheck, 2010) (CONG vs. SS). Nevertheless, the conclusion remains "…that housing with supports in any form is a powerful intervention…." (Rog, 2004, p.342) that should not be overlooked.

The distribution of chief complaints reported in our study is consistent with those in the literature, with the exception of trauma and substance related complaints, which were more prevalent in other studies (D'Amore et al., 2001; Ku et al., 2010; Pearson et al., 2007). Psychiatric as well as general/minor complaints accounted for nearly half of all concerns one year before and after randomization, 52.6% and 48.4% respectively. Similarly, the proportion of visits attributable to various other complaints (neurologic, substance misuse, orthopedic and trauma) remained consistent over time, indicative of the symptom severity within our sample.

Similar results are presented in a report by the Canadian Institute of Health Information demonstrating that mental and behavioural disorders (35%), as well as abnormal findings (16%) (e.g., general/minor complaints) accounted for the top two of five reasons for ED visits by homeless individuals between 2005 and 2006 in various Canadian provinces (Figure 4).

Homeless	Percentage
Mental and behavioural disorders	35
Symptoms, signs and abnormal clinical findings	16
Injury, poisoning and consequences of external causes	14
Contact with health services	14
Diseases of musculoskeletal system andconnective tissue	5
Others	**Percentage**
Injury, poisoning and consequences of external causes	25
Symptoms, signs and abnormal clinicalfindings	19
Diseases of respiratory system	11
Contact with health services	8
Diseases of musculoskeletal system and connective tissue	6

Figure 4 Top Five Reasons For Homeless ED Visits in Canada[10]

The high proportion of general and minor complaints within our sample may be explained by a finding from Gelberg et al. (2000), who reported that homeless individuals seek care for 'conditions with less immediate needs,' instead of urgent or acute

[10] http://www.cihi.ca/cihi-ext-portal/internet/en/document/types+of+care/specialized+services/mental+health+and+addictions/release_30aug07_table1

complaints. This assumption is corroborated within our sample, in that nearly 20% sought care for general and minor complaints (pre and post), consisting mainly of medication refills, dressing changes and fast track antibiotics, and that less than 5% and 10% sought care for cardiac or trauma related concerns respectively, which are generally perceived as more acute. Given the increased rates of victimization and trauma related injuries reported by homeless individuals in previous studies, and the high proportion of head injures (with or without loss of consciousness) within our sample, it is surprising that homeless adults had a small number of visits related to acute complaints. This discrepancy may be related to differing rates in victimization profiles, under-reporting of injuries, or challenges accessing the ED for acute and/or trauma related complaints. Future research examining and identifying trauma and injury related complaints, as well as the under representation of ED use related to acute complaints is necessary.

Despite stable rates of psychiatric and other complaints (general/minor, neurologic, skin, orthopedic and trauma), the SS intervention showed an average decrease of one visit per person per year in the post randomization period. Contrary to this decrease, in the first year post randomization an average increase of 2.5 ED visits per person was observed in TAU suggesting that homeless status or lack of stable housing predicts ED utilization (Kidder et al., 2007; Mandelberg et al., 2000). Moreover, the change observed in TAU may be related to an aging and persistently ill group, whose health continues to decline over time creating an increased propensity to access acute health services. Moreover, natural variation in accessing the ED may change over time, suggesting that a longer duration of follow-up may provide important insights and a better explanation of the change observed in TAU post randomization. Additionally, the increase in TAU may be attributable to a diverse and dynamic variety of factors related to changes in environment or access to services, or simply disadvantages associated with living on the streets; therefore, further investigations into the type(s) of visits associated with this increase as well as the identification of defining characteristics (e.g., presence of mental disorder or substance dependence) associated with individuals in this group are necessary.

Our findings emphasize the importance of providing housing and supports to homeless persons with mental disorders. The importance of housing stability, and

regular access to health professionals and community based health services has been shown to alleviate the relatively high utilization of ED visits within our sample.

5.1. Strengths:

This is one of the few randomized controlled trials examining the longitudinal effects of HF on ED utilization, and the first to report results in a Canadian context. Further, it is the first experiment to contrast congregate and scattered site versions of HF alongside usual care. And it is one of the few studies to examine the association between HF and ED utilization among chronically homeless, mentally ill individuals with complex health and social needs, who comprise the core constituency served by HF programs in large urban centers. Inclusion criteria were satisfied through semi-structured interviews, and dependent measures were obtained from a comprehensive centralized administrative database.

5.2. Limitations:

Sources of data regarding ED utilization were restricted to individuals with PHN's from the province of BC and therefore do not reflect participants who lacked appropriate documentation. Although the services provided in both CONG and SS settings were evaluated for consistency, it is possible that differences in services arose and are unaccounted for in the present analysis. The potential influence of *inclusion benefit* (i.e., derive an improvement due to participation in the study) among participants randomized to intervention arms versus non-participation in the study may have influenced the results of the ED outcome, due to the positive impact of both involvement in the trial and contact with individuals associated with the study interventions/interviews. Finally, the close proximity of the CONG site to a major urban ED is a confounding factor and may have influenced utilization by participants.

5.3. Future Research:

This study has provided significant insights into HF interventions and implications for health policy initiatives. Additional research is needed to further improve understanding of the relationship between HF and ED utilization, including analysis of frequent ED users, hospitalizations, discharge diagnosis, mode of arrival, and associated costs. The ability to identify characteristics associated with frequent ED use, such as type of mental disorder and type of presenting complaints would greatly contribute to the literature and future policy initiatives. Similarly, the ability to examine rates of hospitalization, length of stay and reason for admission in association with HF interventions are salient to both clinical and academic audiences. The future contributions of similar scholarly pieces are essential to understanding the scope of health access, service utilization patterns and health status among homeless persons with mental disorders, whilst enhancing the growing literature concerning HF.

5.4. Conclusions:

Our results demonstrate that HF produces significant reductions in ED utilization among homeless adults with mental disorders. In our adjusted model, SS with ACT services resulted in significantly lower ED visits during the post randomization period, compared to TAU. Reductions in ED use have direct implications for the cost of providing healthcare, and indirectly, suggest improved health and well being among our sample. Our results add to the literature demonstrating that HF reduces acute health service use among homeless adults with a mental disorder, and extend these findings to a Canadian context. Further implementation of HF is strongly indicated, particularly in the SS model with ACT services. Research examining trends and types of ED utilization according to various factors (e.g., diagnosis, age, gender, etc.) among homeless adults enrolled in HF is also needed.

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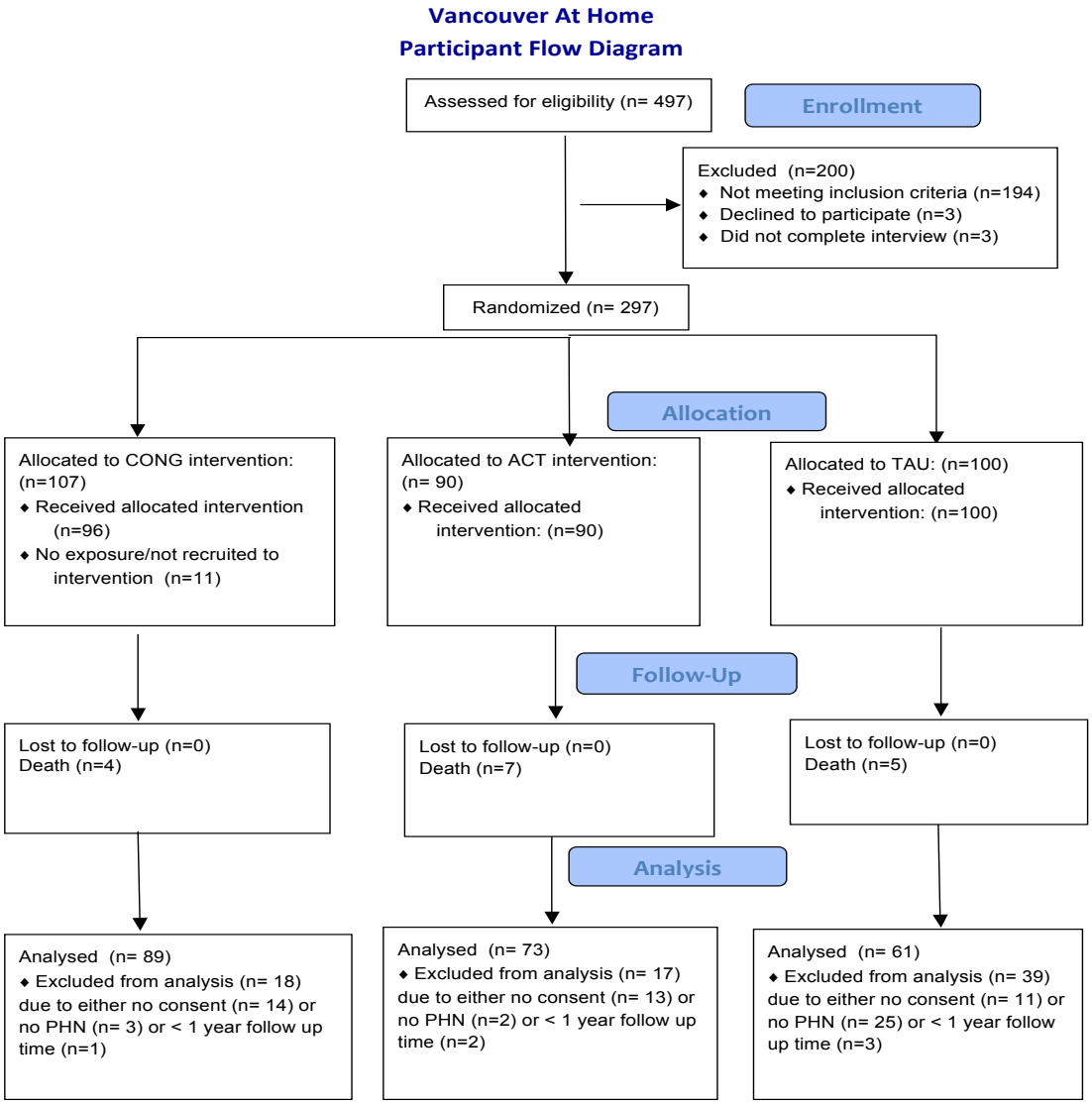
Appendices

Appendix A: Consort Diagram At Home & ED



Appendix B: Canadian Emergency Department Information System Presenting Complaint List[11]

Canadian Emergency Department Information System (CEDIS) Presenting Complaint List (V2.0) Effective Date: April 2012					
Cardiovascular (001–050)	**#**	**Environmental (201–250)**	**#**	**Genitourinary (301–350) cont'd**	**#**
Cardiac arrest (non-traumatic)	001	Frostbite/cold injury	201	Polyuria	309
Cardiac arrest (traumatic)	002	Noxious inhalation	202	Genital trauma	310
Chest pain—cardiac features	003	Electrical injury	203	**Mental Health (351–400)**	**#**
Chest pain—non-cardiac features	004	Chemical exposure	204	Depression/suicidal/deliberate self-harm	351
Palpitations/irregular heart beat	005	Hypothermia	205	Anxiety/situational crisis	352
Hypertension	006	Near drowning	206	Hallucinations/delusions	353
General weakness	007	**Gastrointestinal (251–300)**	**#**	Insomnia	354
Syncope/pre-syncope	008	Abdominal pain	251	Violent/homicidal behaviour	355
Edema, generalized	009	Anorexia	252	Social problem	356
Bilateral leg swelling/edema	010	Constipation	253	Bizarre behaviour	358
Cool pulseless limb	011	Diarrhea	254	Concern for patient's welfare	359
Unilateral reddened hot limb	012	Foreign body in rectum	255	Pediatric disruptive behaviour	360
ENT—Ears (051–100)	**#**	Groin pain/mass	256	**Neurologic (401–450)**	**#**
Earache	051	Nausea and/or vomiting	257	Altered level of consciousness	401
Foreign body, ear	052	Rectal/perineal pain	258	Confusion	402
Loss of hearing	053	Vomiting blood	259	Vertigo	403
Tinnitus	054	Blood in stool/melena	260	Headache	404
Discharge, ear	055	Jaundice	261	Seizure	405
Ear injury	056	Hiccoughs	262	Gait disturbance/ataxia	406
ENT—Mouth, Throat, Neck (101–150)	**#**	Abdominal mass/distention	263	Head injury	407
Dental/gum problem	101	Anal/rectal trauma	264	Tremor	408
Facial trauma	102	Oral/esophageal foreign body	265	Extremity weakness/symptoms of CVA	409
Sore throat	103	Feeding difficulties in newborn	266	Sensory loss/paresthesia	410
Neck swelling/pain	104	Neonatal jaundice	267	Floppy child	411
Neck trauma	105	**Genitourinary (301–350)**	**#**	**OB/GYN (451–500)**	**#**
Difficulty swallowing/dysphagia	106	Flank pain	301	Menstrual problems	451
Facial pain (non-traumatic/non-dental)	107	Hematuria	302	Foreign body, vagina	452
ENT—Nose (151–200)	**#**	Genital discharge/lesion	303	Vaginal discharge	453
Epistaxis	151	Penile swelling	304	Sexual assault	454
Nasal congestion/hay fever	152	Scrotal pain and/or swelling	305	Vaginal bleed	455
Foreign body, nose	153	Urinary retention	306	Labial swelling	456
URTI complaints	154	UTI complaints	307	Pregnancy issues, <20 weeks	457
Nasal trauma	155	Oliguria	308	Pregnancy issues, >20 weeks	458

[11] http://caep.ca/resources/ctas/cedis

Canadian Emergency Department Information System (CEDIS)
Presenting Complaint List (V2.0) (cont'd)
Effective Date: April 2012

OB/GYN (451–500) cont'd	#
Vaginal pain/dyspareunia	460
Ophthalmology (501–550)	**#**
Chemical exposure, eye	502
Foreign body, eye	503
Visual disturbance	504
Eye pain	505
Red eye, discharge	506
Photophobia	507
Diplopia	508
Periorbital swelling	509
Eye trauma	510
Re-check eye	511
Orthopedic (551–600)	**#**
Back pain	551
Traumatic back/spine injury	552
Amputation	553
Upper extremity pain	554
Lower extremity pain	555
Upper extremity injury	556
Lower extremity injury	557
Joint(s) swelling	558
Pediatric gait disorder/painful walk	559
Respiratory (651–700)	**#**
Shortness of breath	651
Respiratory arrest	652
Cough/congestion	653
Hyperventilation	654
Hemoptysis	655
Respiratory foreign body	656
Allergic reaction	657
Stridor	658
Wheezing—no other complaints	659
Apneic spells in infants	660

Skin (701–750)	#
Bite	701
Sting	702
Abrasion	703
Laceration/puncture	704
Burn	705
Blood and body fluid exposure	706
Pruritus	707
Rash	708
Localized swelling/redness	709
Wound check	710
Other skin conditions	711
Lumps, bumps, calluses	712
Redness/tenderness, breast	713
Rule out infestation	714
Cyanosis	715
Spontaneous bruising	716
Foreign body, skin	717
Substance Misuse (751–800)	**#**
Substance misuse/intoxication	751
Overdose ingestion	752
Substance withdrawal	753
Trauma (801–850)	**#**
Major trauma—penetrating	801
Major trauma—blunt	802
Isolated chest trauma—penetrating	803
Isolated chest trauma—blunt	804
Isolated abdominal trauma—penetrating	805
Isolated abdominal trauma—blunt	806
General and Minor (851–900)	**#**
Exposure to communicable disease	851
Fever	852
Hyperglycemia	853
Hypoglycemia	854

General and Minor (851–900) cont'd	#
Direct referral for consultation	855
Dressing change	856
Removal staples/sutures	857
Cast check	858
Imaging tests	859
Medical device problem	860
Prescription/medication request	861
Ring removal	862
Abnormal lab values	863
Pallor/anemia	864
Post-operative complications	865
Minor complaints NOS	866
Inconsolable crying	867
Congenital problem in children	868
Newly Born	869
Unknown	**999**

Sources
Canadian Association of Emergency Physicians (CAEP); Canadian Institute for Health Information (CIHI).