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Assessing Changes in Relational Continuity of Care Among Adults with Vulnerable Housing in a Transitional Case Management Program

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Assessing Changes in Relational Continuity of Care Among Adults with Vulnerable Housing in

a Transitional Case Management Program

by

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Abstract

Background

Individuals with vulnerable housing commonly experience barriers to health and social care. Connect 2 Care (C2C) is a case management intervention that connects people with vulnerable housing and high acute care use to community-based care. Relational continuity of care, a proxy for stable patient-provider relationships, is associated with improved patient outcomes in the general population. We assessed whether adults with vulnerable housing experience improved primary care use and relational continuity following C2C engagement, and evaluated predictors of improved continuity.

Methods

We used practitioner claims data to conduct a pre-post cohort study with 390 adults engaged with C2C. Participants must have been homeless or vulnerably housed, had ≥3 emergency department presentations or ≥2 hospitalizations within the past year, and ≥3 primary care visits pre- and post-C2C for continuity analyses. We examined changes in the proportion of low primary care users (<3 visits/year) using McNemar's test. Relational continuity was measured at the provider and site level using the Usual Provider of Care (UPC) and Continuity of Care (COCI) indices. We performed paired t-tests to compare continuity within the year pre- and post-C2C and multivariable logistic regression to identify characteristics associated with improved continuity.

Results

Of 390 participants, 220 had ≥3 primary care visits pre- and post-C2C and 116 were low primary care users. Following C2C engagement, the proportion of low primary care users significantly

decreased by 15% in absolute terms and continuity of care significantly increased. Pre- to post-C2C, there was a mean increase of 0.04 in provider- and site-UPC. Similar increases were observed for the COCI, though only the increase in site-COCI was significant. Stratified analyses demonstrated no differences in effect on care continuity in subgroups across 11 patient characteristics and we did not identify characteristics associated with increased continuity following C2C engagement.

Significance

Our results suggest that Connect 2 Care was associated with improved primary care use and relational continuity of care among individuals with vulnerable housing. These findings add to our understanding of how primary care access may be improved using case management interventions in this population.

Preface

This thesis is original, unpublished, independent work by the author, A. Chiew. The greater

program evaluation and activities for this thesis received ethical approval from the University of

Calgary Conjoint Health Research Ethics Board under the project "Coordinated Care Team for

Vulnerable Patients with Complex Care Needs: An Evaluation" (reference ID: REB16-0896).

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

AHS	Alberta Health Services
C2C	Connect 2 Care
CCI	Charlson Comorbidity Index
CI	Confidence Interval
COCI	Continuity of Care index
CUPS	Calgary Urban Project Society
GP	General Practitioner
ICD	International Classification of Diseases
ICD-9-CA	International Classification of Diseases Ninth Revision
ICD-10-CA	International Classification of Diseases 10th Revision
IQR	Interquartile Range
OR	Odds Ratio
PHN	Personal Health Number
SD	Standard Deviation
UPC	Usual Provider of Care

1.0 Introduction

Individuals who are vulnerably housed may be experiencing unsheltered homelessness, living in temporary accommodations, living in single room occupancy hotels or housing, or at-risk of losing their housing.[1, 2] This population can have complex medical and social needs which represent a major challenge within our healthcare system. Individuals with vulnerable housing have high mortality, higher acute care use, and lower life expectancies than the general population.[3-5] Further, system fragmentation and perceived discrimination can lead to low engagement and a lack of trust with the healthcare system.[6-9] This contributes to patients delaying medical treatment and accessing acute health services when crises arise from unmanaged conditions.[6, 7]

Case management interventions are recommended as a key support for people who are vulnerably housed.[10, 11] These programs improve continuity of care, patient experience, and health outcomes, and reduce acute care use.[10, 12-14] The Connect 2 Care (C2C) program is a transitional case management intervention created to connect patients with vulnerable housing and high acute care use to community-based care.[15] C2C provides timely, patient-oriented care that meets the unique needs of its population through case management, advocacy, and care navigation.[15] An important aspect of C2C is that the program facilitates primary care attachment by removing access barriers.

There is increasing attention to improving primary care access and engagement among people who are vulnerably housed to reduce disparities experienced within the population.[16-19] Providers

within primary care services are well positioned to identify and address social factors influencing health, coordinate access to preventative and rehabilitative services, manage ongoing health concerns and chronic disease conditions, and promote self-management among patients.[20-23] Despite the attention, there is an absence of research focused on changes in primary care among the lowest primary care users, who may face additional access barriers and challenges to primary care attachment. Focusing on low primary care users provides an opportunity to implement interventions tailored to their unique needs. In addition, connecting people who are vulnerably housed to primary care is important to establish relational continuity of care, which is defined as an ongoing relationship with a healthcare provider or care team that helps to bridge episodes of care.[21, 24, 25] Increased relational continuity of care is associated with improved patient experience, health outcomes, and reduced acute care use and costs, particularly among elderly and chronic disease populations.[21, 26-31] However, relational continuity of care has not been well studied or quantified in populations with vulnerable housing. Within the small body of literature, relational continuity of care measurements are inconsistent and lack comparability between studies.

Research that evaluates low primary care users and uses reliable measures of continuity is essential to better assess and understand primary care attachment among individuals with vulnerable housing. This can result in improved primary care experiences and health outcomes among the population, reducing reliance on acute care services. Therefore, we aimed to evaluate changes in primary care use among low primary care users following engagement with the Connect 2 Care program, determine whether relational continuity of care improved following program engagement, and identify predictors associated with changes in continuity among a

population of adults with vulnerable housing and high acute care use. This is the first study to explore how a transitional case management program influences continuity of care in this population, using reliable measures. This study is part of a larger evaluation of the C2C program.[32]

1.1 Study Objectives

This study had three objectives. The first objective was to assess changes in the proportion of low primary care users, defined as patients with fewer than 3 primary care visits in a year, among adults with vulnerable housing following engagement with the C2C program. This objective emerged as we identified a large proportion of low primary care users within our study population. Our second objective was to assess whether adults with vulnerable housing experience improved relational continuity of care following engagement with the C2C program, using visit-based measures. Our research question was, does relational continuity of care improve after engagement with the C2C program among adults with vulnerable housing? We hypothesized that relational continuity of care will increase following engagement with the C2C program. Our final objective was to assess patient characteristics associated with increased relational continuity of care. Our research question was, what are the predictors of increased relational continuity of care among adults with vulnerable housing? This objective was exploratory given the lack of evidence on potential predictors that may be associated with increased continuity of care within this patient population.

2.0 Review of the Literature

2.1 Health Outcomes Among Individuals with Vulnerable Housing

Individuals who are vulnerably housed are at risk of experiencing a range of adverse health outcomes. An 11-year follow-up study of 15,100 Canadians who are vulnerably housed found higher mortality rates and a lower probability of survival compared to the general population, with only 32% of men and 60% of women with vulnerable housing projected to survive to age 75.[4] Another study of 1,192 Canadians with vulnerable housing reported 85% had a chronic health condition, over 50% had a mental health diagnosis, and overall physical and mental health was worse than the general population.[1] This results in greater acute care use and incurs additional costs within our publicly funded healthcare system. Literature over the years has consistently reported that individuals who are homeless have higher rates of emergency department visits and hospitalizations, more inpatient days, and higher healthcare costs.[3, 5, 33, 34] In Alberta, a recent retrospective analysis identified patients with unstable housing and/or substance use disorders as individuals with high health care costs, contributing to the top 1% of health care spending.[35] Therefore, given both the health impacts on the individuals and the burden of care experienced by the health care system, high priority should be placed on improving the health of this population.

2.2 Healthcare Barriers for Individuals with Vulnerable Housing

Despite available services, many individuals with vulnerable housing experience difficulties accessing healthcare.[7-9, 36] Campbell et al. identified patient, provider, and system-level barriers to care among individuals experiencing homelessness in Calgary, Alberta.[36] Barriers include prioritization of basic needs, perceived discrimination, financial barriers, and inability to

navigate the health system.[36] Similar findings are reported throughout qualitative research with homeless adults,[8, 18, 37] as well as in a systematic review by Omerov et al.[9] Interviews with 17 homeless Canadians by Wen et al. found a decreased likelihood to seek healthcare due to feelings of unwelcomeness and discrimination in past encounters with care providers.[8] These barriers significantly impact access to primary care services, leaving many people who are vulnerably housed without a regular source of care and with unmet healthcare needs.[9, 36, 38] A cross-sectional study by Khandor et al. found a lack of primary care attachment among homeless adults in Toronto, Ontario.[38] In this study, over half of the 366 participants reported having no family doctor.[38] Furthermore, the odds of having a family doctor significantly decreased with every additional year spent homeless.[38] Taken together, these findings demonstrate the need for targeted health services that remove barriers to healthcare and facilitate primary care attachment among individuals who are vulnerably housed.

2.3 Case Management Programs

Case management programs provide tailored care coordination to remove access barriers, improve patient experience and health outcomes, and reduce acute care use among individuals who are vulnerably housed.[10, 12, 39, 40] However, individual study results vary, resulting in uncertainty around the full effect of such programs. Three evaluations of a case management program in Toronto, Ontario reported improved continuity of care, mental and physical health, and reduced substance use and acute care use among adults experiencing homelessness.[13, 14, 40] A randomized controlled trial by Sadowski et al. also reported improved quality of life and reduced acute care use among 201 adults experiencing homelessness with case management, though these results were not statistically significant.[41] In contrast, two randomized controlled trials

found no difference in primary care retention, quality of life, substance use or acute care use for adults in vulnerable housing with case management, compared to those without case management.[42, 43] Mixed results are also reported in two systematic reviews, one summarizing literature between 1988 to 2004 by Hwang et al.[39] and one summarizing literature up to 2019 by Ponka et al.[12] Given these mixed results, there is a need for research exploring the factors that influence the impact and success of case management programs among people who are vulnerably housed. This includes patient characteristics, programmatic components, and care goals that modify program effectiveness. Such research is essential to improve the development and implementation of case management programs for populations with vulnerable housing.

2.4 Relational Continuity of Care

Continuity of care broadly refers to the experience of discrete healthcare events as coherent, connected, and consistent with a patient's medical needs and personal context.[44] Continuity of care is an aspect of the care delivery process that focuses on the integration and coordination of services over time from the patient perspective.[21, 44] A multidisciplinary literature review identified three closely related types of continuity of care: management continuity, informational continuity, and relational continuity.[44] Management continuity refers to the timely provision of complementary healthcare services.[25, 44] Informational continuity refers to the availability and use of relevant information on prior events and personal circumstances to make appropriate care plans.[25, 44] Relational continuity, sometimes known as longitudinal or interpersonal continuity, refers to a sustained therapeutic relationship with a healthcare provider or care team.[24, 25, 44]

Relational continuity of care is a core component of primary care and is often characterized by patient loyalty and ongoing clinical responsibility by a healthcare provider.[24, 25, 44] This patient-provider relationship helps to bridge episodes of care and is believed to encourage informational continuity as repeated contact allows a provider to accumulate medical and contextual knowledge about a patient.[25] A mixed-methods evaluation by the Health Quality Council of Alberta identified relational continuity of care to be important from the patient perspective because of the trust and respect it generates for long-term therapeutic relationships.[21] These findings are supported by a literature review summarizing studies between 1966 and April 2005, which found relational continuity to be important to a majority of patients, particularly those experiencing structural and medical vulnerabilities.[45] Results from this review suggest that patients value the knowledge, communication, trust, and confidence that develops as they establish a relationship with a physician or care provider.[45] In addition, previous literature has associated increased relational continuity of care with improved patient satisfaction and health outcomes, fewer hospitalizations and emergency department visits, and reduced healthcare costs.[21, 26-31] A critical review by Saultz and Lochner reported 51 out of 81 care outcomes had significant positive associations with relational continuity.[29] These associations have been found in elderly and chronic disease populations,[26, 27, 46] however, care continuity has not been well studied in populations with vulnerable housing.

Only two studies have quantitatively evaluated aspects of relational continuity of care among people who are vulnerably housed.[43, 47] Quantitative evaluations are necessary to reliably assess relational continuity in the population and compare results between studies. Following a housing first intervention, Whisler et al. conducted chart reviews to measure primary care retention,

which was defined as having at least one visit with the same primary care provider in each 6-month study period over 1 year.[43] However, primary care provider information for the chart reviews was collected through patient self-report. This method of data collection may have failed to capture all primary care visits if patient recall was inaccurate, potentially leading to underestimated primary care retention. Further, retention was evaluated as a binary outcome and did not account for differences in primary care use between patients, which influences the degree of continuity that occurs across multiple visits. In addition, Currie et al. used administrative data to measure continuity of care based on the number of medical services received within 1 week after hospital discharge.[47] This evaluated care continuity during an inpatient to outpatient transition and thus did not consider continuity of care over an extended period. Therefore, the two studies have varying methodological considerations and the different measures of care continuity limits the comparability of results.

The use of established continuity of care indices has been widely adopted throughout the literature.[24, 26, 27] The use of established indices overcomes some of the challenges associated with operationalizing the concept of continuity of care and allows for comparisons between similar studies. Therefore, research using established and reliable continuity of care indices among individuals who are vulnerably housed is needed to improve our assessment and understanding of care continuity within the population.

2.5 Patient Characteristics Associated with Relational Continuity of Care

Currently, there is no literature evaluating the association between patient characteristics and relational continuity of care among people who are vulnerably housed. Understanding patient-level factors that influence relational continuity of care is necessary to optimize care delivery and promote continuity among diverse patients. Studies exploring this association in chronic disease populations have mixed results,[26, 48] which may be due to important population and contextual differences. Among people who are homeless, Whisler et al. found the number of comorbid conditions influenced primary care retention, which may subsequently influence continuity of care.[43] However, it is unknown whether these results are transferable to studies using established continuity of care measures.

Qualitative research with adults experiencing homelessness has identified multiple intersecting factors that influence a person's desire to engage with a physician or care provider.[7, 8, 49] Dickins et al. reported housing status and instability, income, substance use, and the presence of a mental health condition impacted patterns of engagement with primary care services among people experiencing homelessness.[49] In addition, literature has reported that feelings of unwelcomeness, stigma, and discriminatory treatment are often perceived to be a result of patients' homelessness, substance use, mental health, race, and age.[7, 8] Therefore, it is important to consider these factors when assessing primary care engagement and relational continuity of care in the population. Research exploring the association between patient characteristics and continuity of care among people who are vulnerably housed is essential to tailor care for specific patient groups in the population.

3.0 Methods

3.1 Ethical Approval

The larger C2C evaluation and activities for this study received ethical approval from the University of Calgary Conjoint Health Research Ethics Board (reference ID: REB16-0896). All patients provided written informed consent for primary data collection activities and we obtained a waiver of consent to access administrative health data. In addition, all data were de-identified, password protected, stored on the University of Calgary secure computing environment, and accessible to only authorized researchers to ensure data safety. All researchers had privacy and security training to protect the access and usage of information.

3.2 Study Design

This study utilized a quantitative pre-post cohort design with retrospective assessment of administrative data. Retrospective analysis of administrative data provided a feasible, cost-efficient, and reliable measure of primary care visits, which was used to quantify relational continuity of care with established indices. In addition, the pre-post design allowed us to assess continuity of care over an extended period to make conclusions about changes in long-term relational continuity of care following C2C program engagement.

3.3 The Connect 2 Care Intervention

The C2C intervention was formed in 2015 through partnerships between the University of Calgary O'Brien Institute for Public Health, a community health centre (Calgary Urban Project Society [CUPS]), a shelter and housing organization (Calgary Alpha House Society), and the

provincial health system (Alberta Health Services [AHS]). The C2C team operates within Calgary and is comprised of registered nurses and health navigators with expertise in housing, chronic disease management, mental health, harm reduction and addiction, social programs, and community resources. C2C meaningfully engages patients to identify needs and coordinate timely care. C2C provides support relating to advocacy, health navigation, preventative care, mental illness/substance use treatment, and basic survival needs.

Patients can be referred to C2C through acute care facilities, community agencies, and health clinics. Referred patients must be ≥ 18 years of age, homeless or in vulnerable housing based on patient self-report, have had ≥ 3 emergency department presentations or ≥ 2 hospitalizations within the past year, and a history of one or more high-risk conditions (e.g., substance use disorder, mental illness with functional impairment, cardiovascular disease, chronic kidney disease, asthma, congestive heart failure).

3.4 Study Population

The study cohort consisted of individuals who met the C2C referral criteria described above and actively engaged with the program. Thus, patients were 18 years or older, homeless or in vulnerable housing, had high acute care use, and a history of one or more high-risk conditions. The cohort was limited to patients with at least 12 months of data following C2C engagement. Data collection in the larger evaluation was stopped on March 15, 2020 to eliminate potential impacts of the COVID-19 pandemic, therefore, only patients with an engagement date up to March 15, 2019 were included. We also excluded patients without a valid Personal Health

Number (PHN), a unique identifier under the Alberta Health Care Insurance Plan, as these patients could not be linked to administrative health data. In addition, we excluded patients admitted to the palliative component of C2C, the Calgary Allied Mobile Palliative Program, as these patients have been identified as a distinct population and were unlikely to survive the full 12-month post period.

3.5 Data Sources

A research database (Research Electronic Data Capture [REDCap]) from C2C was used to obtain C2C participant data. This database contained information on all patients referred to the C2C program, including engagement, engagement status (e.g., active, lost to follow up, or deceased), PHN, sociodemographic details, housing status, risk factors (e.g., mental health diagnosis, substance use), and process metrics (e.g., referrals to community services). Information was collected and documented at patient intake and throughout the patient's engagement with C2C. A retrospective chart review of electronic medical records was performed for all C2C patients in the larger evaluation to substantiate information in the C2C patient database and confirm engagement dates. Patient-level characteristics from this database were used to assess predictors and modifiers of increased continuity of care.

We used administrative health data from AHS to obtain additional patient characteristics not available in the C2C participant database, such as the presence of comorbidities. We used data from the National Ambulatory Care Reporting System, which contains data for all hospital and community-based ambulatory care provided through reporting AHS facilities, and the Discharge

Abstract Database, which contains administrative, clinical, and demographic data from hospital

discharges. In addition, Practitioner Claims from Alberta Health were used to identify primary

care visits to a provider or care centre. The practitioner claims contains patient diagnoses,

practitioner fees and billing codes, anonymized physician identifiers, physician specialty, and

information about the healthcare setting and services provided to a patient at a given visit. The

administrative data sources use a standardized system, the International Classification of

Diseases (ICD), to code diagnoses. The National Ambulatory Care Reporting System and

Discharge Abstract Database use the 10th revision of the Canadian version of the ICD (ICD-10-

CA),[50] whereas the practitioner claims use the ninth revision (ICD-9-CA).[51] These databases

were also used to calculate a total Charlson comorbidity index (CCI) score for each patient,

which used the ICD-10-CA codes for emergency department and inpatient hospital visits within

the 12 months prior to C2C engagement. Administrative datasets are considered a valid source of

clinical information and are often used for health research.[27, 52, 53]

The C2C participant data was linked to each administrative health data source using the patient's

PHN for the larger C2C evaluation. We used this linked data source for our evaluation. The

linked administrative health data was available between July 4, 2014, and December 31, 2020.

3.6 Study Variables

3.6.1 Connect 2 Care Engagement

We considered a patient to be engaged with the C2C program if they had an "Active"

engagement status at any time following referral. The date of program engagement was defined

as the referral date immediately prior to when the "Active" status appeared in a patient's chart review (some patients were referred multiple times before they engaged with the program).

3.6.2 Primary Care Visit

A visit to a primary care provider was defined as any outpatient visit (i.e., at a community site) with a general practitioner (GP) that was identifiable through a practitioner claim, from minor visits to periodic health evaluations. GPs, most commonly family physicians, are often the source of regular primary care in Canada and act as a point of entry for access to specialist services.[54] Thus, GP claims are appropriate to calculate continuity of primary care. Multiple practitioner claims between a patient and GP within the same day were treated as a single primary care visit in order to evaluate only unique patient-physician encounters in our analysis. We included remote visits (e.g., phone calls) and work performed on a patient's behalf (e.g., calls to specialists), as these indicate a degree of patient care. We excluded clients residing in nursing homes and visits with a GP that occurred within an acute care facility, correctional centre, or mental health clinic. Patients in these settings are likely unable to select a primary care provider or move between multiple providers.

3.6.3 Relational Continuity of Care

We defined relational continuity of care as ongoing primary care visits to a physician or practice location. We used C2C participant data linked to practitioner claims data to measure the number of visits made to a physician or practice location within the 12 months before and after the date of C2C engagement. The number of visits were then used to measure relational continuity pre-

and post-C2C engagement, at both the physician and practice level. We measured relational

continuity of care using two validated indices: Breslau's Usual Provider of Care (UPC) Index[55]

and the Bice-Boxerman Continuity of Care Index (COCI).[56] A summary of the index

descriptions and calculations are provided in Table 1.

The UPC reflects the continuity of care a patient experiences with a single usual provider or

practice location.[24] We defined the usual provider or practice as the provider or site seen most

frequently, as identified by the practitioner claims. The COCI identifies the extent to which a

patient visits a single provider or group of providers and the dispersion of care.[56] Literature has

demonstrated high correlation between the UPC and COCI[57] and each index provides a

continuity of care score between 0 and 1. A score of 0 indicates a patient has seen a different

provider or site for all visits, whereas a score of 1 indicates a patient has seen the same provider

or site for all visits. A higher index score corresponds to better continuity of care. We excluded

low primary care users (patients with fewer than 3 visits during our study periods) from

continuity of care analyses because the UPC and COCI are unreliable with very few visits. This

aligns with exclusion criteria in previous studies.[26, 58, 59] Patients with 3 or more primary care

visits during our study periods were thus included and considered "regular primary care users".

To our knowledge, there are no continuity of care scores with clinical significance defined in the

literature. Although UPC index scores are commonly categorized as low (≤0.50), medium (>0.50

to ≤0.80), and high (>0.80),[27, 60] these cut-offs lack inherent clinical meaning and are not

consistently used throughout the literature. Similarly, categorization of COCI index scores varies

within the literature and lacks clinical significance. Therefore, relational continuity of care was analyzed as a continuous variable where possible to prevent loss of information.

Table 1. Measures of relational continuity of care

Continuity of Care Index	Description	Formula
Usual Provider of Care Index	Measures the number of visits to a single usual provider during a defined period The usual provider is specified as the patient's preferred provider or, in the absence of a specific provider, as the provider seen most frequently Can be modified to measure site continuity Ranges from 0 to 1	$$UPC = \frac{n_i}{N}$$ Where n_i is the number of visits to the usual provider during the defined period and N is the total number of visits to all providers during the defined period
Continuity of Care Index	Measures the dispersion and concentration of care among multiple providers during a defined period Can be modified to measure site continuity Ranges from 0 to 1	$$COCI = \frac{\sum_{i=1}^{k} n_i^2 - N}{N(N-1)}$$ Where n_i is the number of visits to the provider i and N is the total number of visits by the patient to all providers during the defined period

3.6.4 Patient Characteristics

We evaluated 11 patient-level characteristics as predictors and modifiers of increased relational continuity of care, which were obtained from the C2C patient database and administrative health data. Specifically, we assessed patients' primary care use (i.e., the number of primary care visits) and total Charlson comorbidity index score within the 12 months prior to C2C engagement, and

16

intake measures of age, gender (Male, Female, or Other), ethnicity (Indigenous, White, or Other), alcohol or substance use (yes/no), housing status (homeless, unstably housed, or stably housed), and the presence of a mental health diagnosis (yes/no), primary care provider (yes/no), and medication insurance (yes/no).

3.7 Statistical Analysis

3.7.1 Descriptive Statistics

We used descriptive analysis to summarize demographic and baseline characteristics of our sample. Normally distributed variables are reported as the mean and standard deviation (SD). Variables with non-normal distributions are reported as the median and interquartile range (IQR). In addition, we used chi-square tests to evaluate differences between study cohorts (i.e., regular and low primary care users), categorizing continuous variables into quartiles to facilitate comparisons.

3.7.2 Changes in Primary Care Use

We used the McNemar test to achieve our first objective and examine changes in primary care use by determining whether the proportion of low primary care users (i.e., those with <3 visits to primary care) was different between the 12 months before and after C2C engagement.

3.7.3 Changes in Relational Continuity of Care

We performed paired t-tests to achieve our second objective and assess whether relational continuity of care improved following engagement with the C2C program. This was a within-

subject comparison evaluating changes in relational continuity of care pre- to post-C2C engagement. We performed stratified analyses to investigate differences in subgroups across the 11 patient characteristics, including primary care use prior to engagement, total CCI, age, gender, ethnicity, alcohol and substance use, housing status, and the presence of a mental health diagnosis, primary care provider, and medication insurance. Continuous variables (i.e., primary care use pre-C2C, total CCI, and age) were categorized into quartiles for this analysis. Improved continuity of care was identified by the presence of a positive mean change in the continuity of care score and a statistically significant p-value at the alpha=0.05 level. The analysis was repeated for each measure of relational continuity of care and data trends were investigated using Spearman's rank coefficients and the Jonckheere-Terpstra test. We also performed sensitivity analyses using the Wilcoxon signed rank test to address potential weaknesses associated with parametric analyses and evaluate differences in pre- and post-C2C continuity of care scores under non-parametric assumptions.

3.7.4 Patient Characteristics Associated with Relational Continuity of Care

We used multivariable logistic regression to achieve our third objective and assess patient characteristics associated with improved relational continuity of care. We used two methods to define improvements in relational continuity of care. First, we categorized continuity of care scores into quartiles using the pre-engagement sample distribution. Patients who moved to a higher continuity of care category from pre- to post-engagement were considered to have improved relational continuity for this analysis. Second, since no established definition exists in the literature, we defined improved relational continuity as an increase of 0.10 or greater in a patient's continuity of care score from pre- to post-engagement. Previous literature has reported

that for each 0.10 increase in a patient's continuity of care score, the risk of drug-drug interactions and the odds of receiving overused procedures significantly decreases.[61, 62] Therefore, we expected our definition of improved relational continuity to capture meaningful differences between patient groups. We compared patients with improved continuity of care scores to patients with decreased or no change in continuity of care scores following C2C engagement. We evaluated primary care use prior to engagement, total CCI, age, gender, ethnicity, alcohol and substance use, housing status, and the presence of a mental health diagnosis, primary care provider, and medication insurance. Continuous variables (i.e., primary care use pre-C2C, total CCI, and age) were categorized into quartiles for this analysis to facilitate meaningful interpretation and comparison of results, given there were no identifiable trends between the variables and changes in relational continuity of care.

We developed separate bivariate logistic regression models to determine whether there were associations between each patient characteristic and the binary outcome of improved relational continuity of care. Characteristics with a p-value less than 0.25 were considered statistically significant in bivariate analyses and included in the multivariable logistic regression model, as traditional p-values often fail to identify important variables.[63] We also identified clinically relevant characteristics for inclusion in the multivariable logistic regression model, regardless of statistical significance in the bivariate analyses. A statistically significant p-value of <0.05 in the multivariable model was used to identify characteristics associated with improved relational continuity of care. In addition, we assessed the presence of effect modification by creating interaction terms and evaluating the associated p-value. Linear combinations of parameters were used to calculate group-specific point estimates and associated p-values for the interaction terms.

The analysis was repeated for each measure of relational continuity of care and for each definition of improved continuity. In addition, we conducted sensitivity analyses using incremental 0.05 changes in continuity of care scores (e.g., 0.15, 0.20, 0.25) to test the impact of varying changes in the definition of improved care continuity. The goodness of fit of each model was tested using the Hosmer-Lemeshow test and results were interpreted through odds ratios (OR).

All analyses were conducted using Stata 17.0 and p-values less than 0.05 were considered statistically significant, except for bivariate analyses which used p-values less than 0.25. One patient within our study population identified as 'Other' gender and was excluded from analyses as the sample size was insufficient to identify differences between gender groups. In addition, we used complete case analysis for all regression modeling and created indicator variables where data were missing. Although there were instances of missing patient characteristic data, all patients within our sample engaged with C2C and all primary care visits were captured in the administrative database. Primary care visit data would only be missing if a patient's PHN had changed or if a patient sought care outside of Alberta during the study period, though this was not expected to influence results.

4.0 Results

4.1 Study Participants

Out of 771 patients referred to the C2C program, 439 engaged with C2C and 49 patients referred for the palliative component were removed. This left a sample of 390 C2C patients that met

referral criteria and engaged with the program between 2015 and 2019. Of the 390 patients, 28 (7.2%) were deceased within 12 months of C2C engagement and did not have sufficient follow-up data for primary care and continuity of care comparisons. These patients were excluded from analyses. In addition, 6 (1.5%) patients did not have an identifiable primary care visit during our study periods and 20 (5.1%) patients only had primary care visits within an acute care facility, correctional centre, mental health clinic, and/or nursing home, and thus were excluded from analyses. The remaining 336 patients had primary care visits within a practitioner's office, Health Canada nursing station, and/or an unregistered facility (i.e., patient's home or other site). Figure 1 demonstrates the creation of study cohorts based on inclusion and exclusion criteria and Table 2 summarizes patient characteristics of the cohorts of regular and low primary care users. Of the included patients, 116 (34.5%) patients were low primary care users with fewer than 3 primary care visits pre- and/or post-C2C engagement. These patients were included in primary care analyses but excluded from continuity of care analyses.

Following these exclusions, our final cohort for continuity of care analyses consisted of 220 engaged C2C patients. The mean age of participants in this cohort (regular primary care users) was 44.8 years (SD 12.0). The cohort was majority male (66.4%), majority White (60.5%), and approximately half were experiencing homelessness (50.9%). In addition, substance use (58.2%), alcohol use (61.8%), and a mental health diagnosis (56.8%) were characteristics present in more than half of patients. At the time of C2C engagement, 41.4% did not have medication insurance and 56.4% did not have a primary care provider. The mean age of low primary care users was 43.3 years (SD 13.5), and the majority were male (80.2%), two-thirds were White (66.4%), and more than half were experiencing homelessness (58.6%). As compared to regular primary care

users, low users had a significantly higher proportion of males (80.2% vs. 66.4%), patients not connected to a primary care provider at the time of C2C engagement (67.2% vs. 56.4%), and a lower total CCI score (median score 1.5 [IQR 3] versus 2 [IQR 4]).
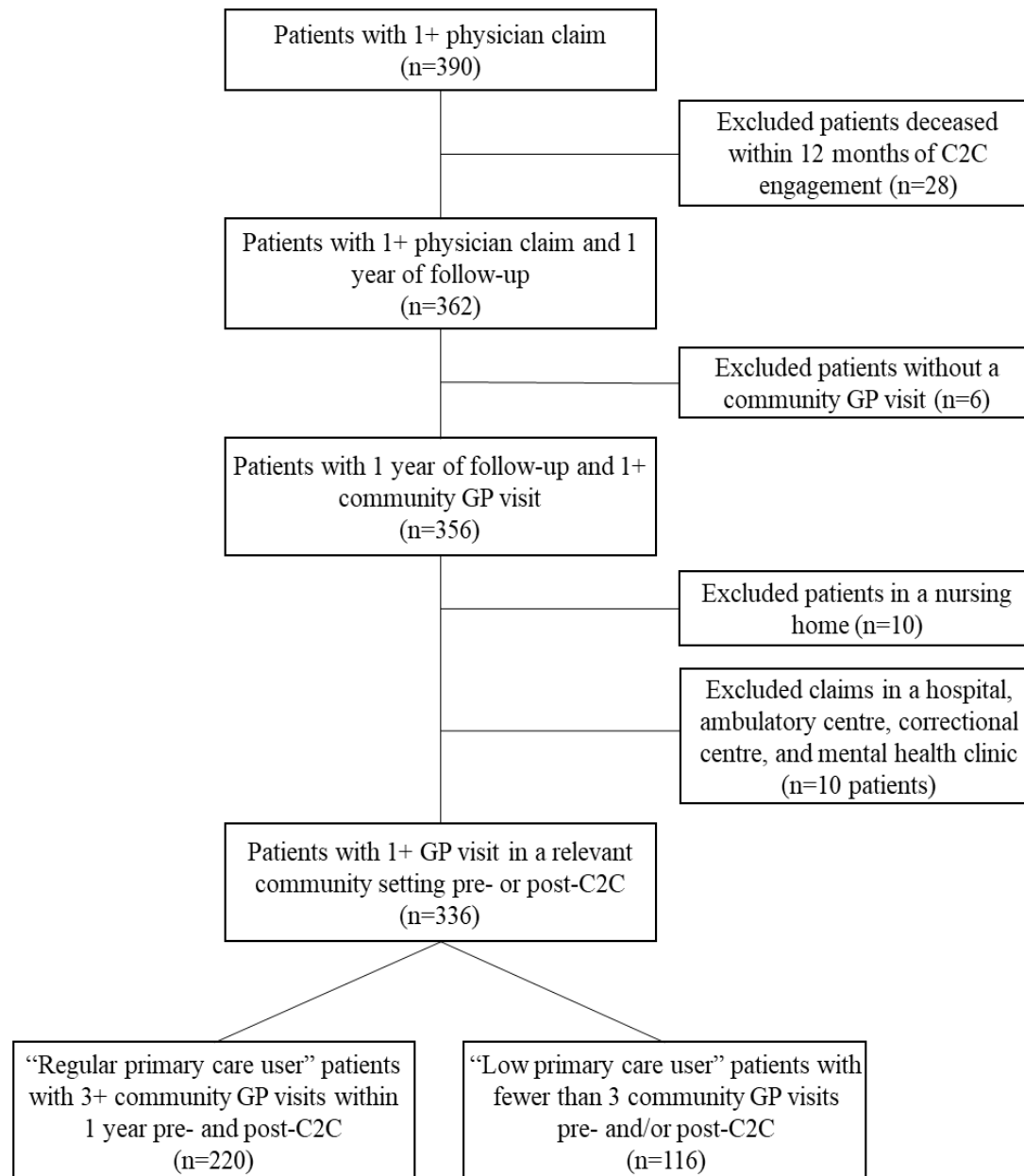
Figure 1. Flow diagram for the creation of study cohorts

Table 2. Characteristics of regular (≥3 GP visits) and low (<3 GP visits) primary care users, compared using chi square tests

Characteristic	Regular Users (n=220)	Low Users (n=116)	P Value
Age – mean (SD)	44.8 (12.0)	43.3 (13.5)	0.34
Gender – no. (%)			
Male	146 (66.4)	93 (80.2)	0.03*
Female	73 (33.2)	23 (19.8)	
Ethnicity – no. (%)			
White	133 (60.5)	77 (66.4)	0.39
Indigenous	74 (33.6)	30 (25.9)	
Other	10 (4.5)	5 (4.3)	
Mental Health Diagnosis – no. (%)			
No	76 (34.5)	48 (41.4)	0.21
Yes	125 (56.8)	58 (50.0)	
Alcohol Use – no. (%)			
No	75 (34.1)	45 (38.8)	0.26
Yes	136 (61.8)	62 (53.5)	
Other Substance Use – no. (%)			
No	82 (37.3)	37 (31.9)	0.26
Yes	128 (58.2)	76 (65.5)	
Connected to Primary Care – no. (%)			
No	124 (56.4)	78 (67.2)	0.03*
Yes	96 (43.6)	36 (31.0)	
Has Medication Coverage – no. (%)			
No	61 (27.7)	39 (33.6)	0.12
Yes	129 (58.6)	55 (47.4)	
Total Comorbidity Score – median [IQR]	2 [4]	1.5 [3]	<0.01*
Housing Status – no. (%)			
Literal Homelessness	112 (50.9)	68 (58.6)	0.06
Unstable Housing	63 (28.6)	36 (31.0)	
Stable Housing	45 (20.5)	12 (10.3)	

*= significant at *p*<0.05

4.2 Changes in Primary Care Use and Low Primary Care Users

Table 3 provides a summary of the number of primary care visits made to a community GP pre- and post-C2C across the study cohorts. Among the 336 patients with eligible primary care visits, the median number of primary care visits was 7 (IQR 13) pre-C2C engagement and 10 (IQR 15) post-C2C engagement, demonstrating an overall increase in primary care use among patients.

Specifically, between the 12 months before and after C2C engagement, 70 (20.8%) patients experienced an increase in primary care use and moved from the low primary care use category (<3 GP visits) to the regular primary care use category (≥3 GP visits), as shown in Table 4. In contrast, 20 (6.0%) patients experienced a decrease in primary care use from pre- to post-C2C and moved from the regular primary care use category to the low primary care use category. Overall, the number of low primary care users decreased by 50 (14.9%) patients from pre- to post-C2C (p<0.01), which was statistically significant.

Table 3. Summary of the number of primary care visits to a community GP pre- and post-C2C, by cohorts of primary care use

	Number of primary care visits		
	Mean (SD)	**Median [IQR]**	**Range**
All primary care users (n=336)			
Pre-C2C	10.6 (11.7)	7 [13]	0 – 82
Post-C2C	13.8 (12.9)	10 [15]	0 – 83
Regular users (n=220)			
Pre-C2C	15.2 (12.0)	12 [12]	3 – 82
Post-C2C	17.2 (12.5)	14 [14]	3 – 68
Low users (n=116)			
Pre-C2C*	2 (2.8)	1 [2]	0 – 17
Post-C2C*	7 (11.2)	4 [8]	0 – 83

Regular use= ≥3 primary care visits; Low use= <3 primary care visits
*Number of visits may be ≥3 as low users had <3 primary care visits during the pre- and/or post-C2C period

Table 4. Change in the proportion of participants with low and regular primary care use from pre- to post-C2C, analyzed using the McNemar test

	Pre-C2C (n=336)	Post-C2C (n=336)	*P* Value
Regular use – no. (%)	240 (71.4)	290 (86.3)	<0.01*
Low use – no. (%)	96 (28.6)	46 (13.7)	

Regular use= ≥3 primary care visits; Low use= <3 primary care visits; *= significant at *p*<0.05

4.3 Changes in Relational Continuity of Care

Table 5 summarizes the relational continuity of care index scores among the 220 patients with ≥3 GP visits pre- and post-C2C. Prior to C2C engagement, the mean continuity of care scores were 0.51 (SD 0.23) and 0.32 (SD 0.26) for the provider-level UPC and COCI, respectively, and 0.69 (SD 0.23) and 0.55 (SD 0.30) for the site-level UPC and COCI, respectively. We found a small but significant increase in mean relational continuity of care across the provider- (Figure 2) and site-level (Figure 3) indices from pre- to post-C2C, with the exception of the provider-COCI. From pre- to post-C2C, there was a mean increase of 0.04 (95% CI: 0.0002-0.073, p=0.049) in provider-UPC, 0.04 (95% CI: -0.006-0.078, p=0.091) in provider-COCI, 0.04 (95% CI: 0.004-0.076, p=0.030) in site-UPC, and 0.05 (95% CI: 0.005-0.099, p=0.029) in site-COCI (Table 6). Stratified analyses demonstrated no differences in the effect of C2C on continuity among subgroups across the 11 patient characteristics investigated. There appeared to be a trend toward greater increases in care continuity among participants with lower comorbidity scores and more stable housing, however, these trends were not significant when investigated statistically.

Table 5. Summary of relational continuity of care indices pre- and post-C2C among patients with ≥3 GP visits (n=220)

Continuity of Care Index	Mean (SD)	Median [IQR]	Range
Provider Continuity			
Pre-C2C UPC	0.51 (0.23)	0.50 [0.36]	0.12-1
Post-C2C UPC	0.55 (0.23)	0.50 [0.39]	0.11-1
Pre-C2C COCI	0.32 (0.26)	0.27 [0.32]	0-1
Post-C2C COCI	0.36 (0.27)	0.28 [0.38]	0-1
Site Continuity			
Pre-C2C UPC	0.69 (0.23)	0.68 [0.40]	0.19-1
Post-C2C UPC	0.73 (0.22)	0.77 [0.35]	0.21-1
Pre-C2C COCI	0.55 (0.30)	0.48 [0.50]	0-1
Post-C2C COCI	0.60 (0.28)	0.60 [0.49]	0-1

UPC= Usual Provider of Care Index; COCI= Continuity of Care Index; *= significant at $p<0.05$

Left panel — Mean Change in Provider UPC Score (95% CI)

Baseline Characteristic	No.	Mean Change in Provider UPC Score (95% CI)
Number of Primary Care Visits		
3-7 primary care visits	64	0.03 (-0.032-0.099)
8-12 primary care visits	51	0.02 (-0.064-0.099)
13-19 primary care visits	51	0.05 (-0.029-0.130)
20+ primary care visits	54	0.05 (-0.029-0.119)
Age		
19-36 years	61	0.06 (-0.004-0.119)
37-45 years	55	0.01 (-0.071-0.093)
46-54 years	51	0.10 (0.019-0.181)
55+ years	53	-0.02 (-0.093-0.048)
Gender		
Female	73	0.03 (-0.037-0.100)
Male	146	0.04 (-0.0001-0.086)
Ethnicity		
White	133	0.02 (-0.024-0.071)
Indigenous	74	0.05 (-0.016-0.106)
Other	10	0.19 (0.022-0.362)
Mental Health Diagnosis		
No	76	0.07 (0.009-0.136)
Yes	125	0.03 (-0.015-0.083)
Alcohol Use		
No	75	0.06 (-0.005-0.115)
Yes	136	0.03 (-0.016-0.080)
Substance Use		
No	82	0.03 (-0.037-0.088)
Yes	128	0.05 (0.001-0.092)
Connected to Primary Care		
No	124	0.05 (0.001-0.093)
Yes	96	0.02 (-0.037-0.082)
Has Medication Coverage		
No	61	0.01 (-0.056-0.076)
Yes	129	0.04 (-0.006-0.092)
Total Comorbidity Score		
0-1	86	0.06 (0.003-0.121)
2	41	0.05 (-0.036-0.129)
3-5	44	0.03 (-0.047-0.115)
6+	49	-0.01 (-0.097-0.069)
Housing Status		
Literal Homelessness	112	0.02 (-0.033-0.066)
Unstable Housing	63	0.04 (-0.034-0.111)
Stable Housing	45	0.08 (0.001-0.166)
Overall		
Overall Group	220	0.04 (0.0002-0.073)

Axis: -0.20, -0.10, 0, 0.10, 0.20, 0.30, 0.40

Right panel — Mean Change in Provider COCI Score (95% CI)

Baseline Characteristic	No.	Mean Change in Provider COCI Score (95% CI)
Number of Primary Care Visits		
3-7 primary care visits	64	0.07 (-0.016-0.149)
8-12 primary care visits	51	0.02 (-0.074-0.109)
13-19 primary care visits	51	0.04 (-0.048-0.123)
20+ primary care visits	54	0.02 (-0.065-0.095)
Age		
19-36 years	61	0.06 (-0.007-0.129)
37-45 years	55	0.00 (-0.095-0.086)
46-54 years	51	0.09 (-0.003-0.186)
55+ years	53	0.00 (-0.092-0.083)
Gender		
Female	73	0.02 (-0.060-0.092)
Male	146	0.05 (0.003-0.101)
Ethnicity		
White	133	0.02 (-0.033-0.082)
Indigenous	74	0.04 (-0.024-0.101)
Other	10	0.21 (0.001-0.421)
Mental Health Diagnosis		
No	76	0.08 (0.003-0.150)
Yes	125	0.04 (-0.016-0.092)
Alcohol Use		
No	75	0.05 (-0.015-0.120)
Yes	136	0.04 (-0.017-0.089)
Substance Use		
No	82	0.03 (-0.039-0.101)
Yes	128	0.04 (-0.008-0.094)
Connected to Primary Care		
No	124	0.06 (0.006-0.108)
Yes	96	0.01 (-0.062-0.079)
Has Medication Coverage		
No	61	0.02 (-0.061-0.093)
Yes	129	0.04 (-0.013-0.100)
Total Comorbidity Score		
0-1	86	0.06 (-0.004-0.122)
2	41	0.03 (-0.068-0.134)
3-5	44	0.03 (-0.064-0.131)
6+	49	0.00 (-0.097-0.097)
Housing Status		
Literal Homelessness	112	0.02 (-0.038-0.075)
Unstable Housing	63	0.03 (-0.055-0.113)
Stable Housing	45	0.09 (-0.007-0.184)
Overall		
Overall Group	220	0.04 (-0.006-0.078)

Axis: -0.20, -0.10, 0, 0.10, 0.20, 0.30, 0.40

Figure 2. Forest plots demonstrating mean changes in provider-level UPC (left) and COCI (right) continuity of care scores from pre- to post-C2C, stratified by patient characteristics at baseline, among patients with ≥3 GP visits (n=220)

Figure 3. Forest plots demonstrating mean changes in site-level UPC (left) and COCI (right) continuity of care scores from pre- to post-C2C, stratified by patient characteristics at baseline, among patients with ≥3 GP visits (n=220)

4.3.1 Sensitivity Analyses

From pre- to post-C2C, we found small median increases of 0.03 (IQR 0.39) in provider-UPC, 0.03 (IQR 0.37) in provider-COCI, 0.02 (IQR 0.36) in site-UPC, and 0.01 (IQR 0.47) in site-COCI. Sensitivity analyses using non-parametric Wilcoxon signed rank tests revealed that the changes in the median site-level UPC ($z=1.99$, $p=0.047$) and COCI ($z=2.09$, $p=0.037$) scores from pre- to post-C2C were statistically significant. However, there were no significant differences in the median provider-level UPC ($z=1.91$, $p=0.056$) and COCI ($z=1.73$, $p=0.084$) scores from pre- to post-C2C. The median changes in the continuity of care index scores and

significance of the Wilcoxon signed rank tests are summarized in Table 6. In addition, we found

no significant differences in subgroups across the 11 patient characteristics, which was

confirmed visually through boxplots. This aligns with our findings from parametric analyses.

Table 6. Mean and median changes in continuity of care from pre- to post-C2C, among participants with ≥3 GP visits (n=220), analyzed using paired t-tests and Wilcoxon signed rank tests

Continuity of Care Index	Mean Change in Score (SD)	95% CI	Paired T-test P Value	Median Change in Score [IQR]	Wilcoxon P Value
Provider UPC	0.04 (0.27)	0.0002-0.073	0.049*	0.03 [0.39]	0.056
Provider COCI	0.04 (0.31)	-0.006-0.078	0.090	0.03 [0.37]	0.084
Site UPC	0.04 (0.27)	0.004-0.076	0.030*	0.02 [0.36]	0.047*
Site COCI	0.05 (0.35)	0.005-0.099	0.029*	0.01 [0.47]	0.037*

UPC= Usual Provider of Care Index; COCI= Continuity of Care Index; *= significant at $p<0.05$

4.4 Patient Characteristics Associated with Relational Continuity of Care

Table 7 demonstrates the number and proportion of participants that experienced an increase in

relational continuity of care from pre- to post-C2C among the 220 participants with ≥3 GP visits.

Among the 220 participants with ≥3 GP visits, 91 (41.4%), 87 (39.5%), 82 (37.3%), and 87

(39.5%) patients experienced an increase in relational continuity of care to a higher quartile

across the provider-UPC, provider-COCI, site-UPC, and site-COCI indices, respectively. In

contrast, we observed 64 (29.1%), 65 (29.6%), 61 (27.7%), and 65 (29.6%) patients decrease to a

lower quartile pre- to post-C2C. 65 (29.6%) and 68 (30.9%) patients remained in the same

provider-level UPC and COCI quartiles, respectively, and 77 (35.0%) and 68 (30.9%) patients

remained in the same site-level UPC and COCI quartiles, respectively. When evaluating

increases in relational continuity of care of 0.10 or greater, 89 (40.5%), 90 (40.9%), 87 (39.5%),

and 93 (42.3%) patients experienced an increase across the provider-UPC, provider-COCI, site-UPC, and site-COCI indices, respectively. The proportion of patients that experienced an increase in continuity of care decreased as we evaluated higher thresholds of increased continuity (Table 7).

Table 7. Number and proportion of regular primary care users (n=220) that experienced an increase in relational continuity of care, by index

Continuity of Care Index	Increased to a Higher Quartile – no. (%)	Increased by ≥0.10 – no. (%)	Increased by ≥0.15 – no. (%)	Increased by ≥0.20 – no. (%)	Increased by ≥0.25 – no. (%)
Provider UPC	91 (41.4)	89 (40.5)	72 (32.7)	60 (27.3)	51 (23.2)
Provider COCI	87 (39.5)	90 (40.9)	76 (34.5)	61 (27.7)	47 (21.4)
Site UPC	82 (37.3)	87 (39.5)	69 (31.4)	60 (27.3)	49 (22.3)
Site COCI	87 (39.5)	93 (42.3)	85 (38.6)	77 (35.0)	65 (29.5)

UPC= Usual Provider of Care Index; COCI= Continuity of Care Index; *= significant at $p<0.05$

4.4.1 Bivariate Logistic Regression Analyses

We looked for trends and commonalities in significant predictors across indices to guide our multivariable analyses. Bivariate analyses demonstrated few significant characteristics associated with an increase in continuity to a higher quartile from pre- to post-C2C. Based on a p-value less than 0.25, ≥55 years of age (Provider-UPC OR 0.47, 95% CI 0.21-1.02, p=0.06; Provider-COCI OR 0.58, 95% CI 0.27-1.26, p=0.17), Indigenous ethnicity (Provider-UPC OR 1.49, 95% CI 0.84-2.65, p=0.18; Provider-COCI OR 1.56, 95% CI 0.87-2.78, p=0.14) and a total CCI of 2 (Provider-UPC OR 0.60, 95% CI 0.28-1.30, p=0.20; Provider-COCI OR 0.48, 95% CI 0.21-1.05, p=0.07) were associated with increased provider-level UPC and COCI scores to a higher quartile, as compared to 19-36 years, White ethnicity, and a total CCI of 0-1, respectively. At the

site level, 'Other' ethnicity (Site-UPC OR 4.41, 95% CI 1.09-17.88, p=0.04; Site-COCI OR 6.86, 95% CI 1.40-33.59, p=0.02) and having 13-19 GP visits pre-C2C (Site-UPC OR 2.13, 95% CI 1.00-4.54, p=0.20; Site-COCI OR 1.60, 95% CI 0.76-3.38, p=0.22) were associated with greater odds of increased UPC and COCI scores, compared to White ethnicity and 3-7 GP visits pre-C2C, respectively. Among the UPC indices, alcohol use was significantly associated with reduced odds of increased continuity at both the provider (OR 0.55, 95% CI 0.31-0.97, p=0.04) and site level (OR 0.67, 95% CI 0.38-1.20, p=0.18). Having a total CCI of 6 or greater also reduced odds of increasing the provider-UPC (OR 0.46, 95% CI 0.22-0.97, p=0.04), provider-COCI (OR 0.56, 95% CI 0.27-1.16, p=0.12), and site-COCI (OR 0.61, 95% CI 0.29-1.27, p=0.19). Our analyses did not identify any characteristics associated with an increase in continuity to a higher quartile across all four indices.

Bivariate analyses demonstrated fewer characteristics associated with an increase in continuity of 0.10 or greater from pre- to post-C2C. At the provider-level, the presence of a mental health diagnosis was the only predictor significantly associated with increased UPC (OR 0.70, 95% CI 0.40-1.25, p=0.23) and COCI (OR 0.70, 95% CI 0.40-1.25, p=0.23) scores by 0.10 or greater, based on a p-value less than 0.25. At the site level, 'Other' ethnicity was the only predictor significantly associated with increased UPC (OR 7.57, 95% CI 1.54-37.10, p=0.01) and COCI (OR 6.04, 95% CI 1.23-29.55, p=0.03) scores. No characteristics were associated with an increase in continuity of 0.10 or greater across all four indices.

4.4.2 Multivariable Logistic Regression Analyses

In our multivariable logistic regression models, we initially included primary care use prior to engagement, total CCI, intake measures of age, gender, ethnicity, alcohol and substance use, and housing status, and the presence of a mental health diagnosis and primary care provider at baseline as statistically significant or clinically relevant covariates. The inclusion of medication insurance at intake resulted in large changes (>10%) to other predictor coefficients within our model and thus was added as a covariate in our final multivariable regression models. Certain patient characteristics were significantly associated with increased relational continuity of care from pre- to post-C2C within these models. Compared to White ethnicity, Indigenous and Other ethnicity demonstrated significantly greater odds of increasing to a higher quartile among the provider-UPC (Indigenous OR 3.44, 95% CI 1.19-9.97, p=0.02), site-UPC (Other OR 8.63, 95% CI 1.24-60.12, p=0.03), and site-COCI (Other OR 23.87, 95% CI 3.34-170.60, p<0.01) indices. In addition, alcohol use was negatively associated with an increase of 0.10 or greater among the provider-UPC (OR 0.13, 95% CI 0.02-0.82, p=0.03), provider-COCI (OR 0.10, 95% CI 0.02-0.60, p=0.01), and site-COCI (OR 0.40, 95% CI 0.17-0.95, p=0.04) indices. No characteristics demonstrated a consistent association with increased relational continuity of care following C2C engagement across the four indices when evaluating an increase to a higher quartile or an increase of 0.10 or greater. However, our relatively small sample size coupled with the inclusion of 11 covariates may have resulted in overfit models and imprecise association estimates, reducing validity and confidence in the significant associations.

To avoid overfitting, we performed multivariable logistic regression analyses evaluating only age, gender, ethnicity, and housing status as well as interactions among these covariates. When

evaluating increased continuity of care to a higher quartile pre- to post-C2C with these new models, few characteristics demonstrated significant associations (Figure 4). Housing status modified the relationship between ethnicity and increases in continuity following C2C engagement. Among patients experiencing homelessness, Indigenous ethnicity demonstrated greater odds of increased provider-UPC continuity (OR 2.39, 95% CI 1.04-5.52, p=0.04) as compared to White ethnicity. Among patients of White ethnicity, we found non-significant positive associations between increased provider-UPC and living in unstable (OR 1.94, 95% CI 0.85-4.43, p=0.12) or stable housing (OR 1.70, 95% CI 0.64-4.47, p=0.29), as compared to being homeless. In contrast, living in unstable housing was negatively associated with an increase in provider-UPC quartile (OR 0.35, 95% CI 0.09-1.34, p=0.13) among Indigenous patients. This modification resulted in a significant difference between Indigenous patients living in unstable housing (OR 0.18, 95% CI 0.04-0.88, p=0.03) as compared to those experiencing homelessness, but no difference between Indigenous patients living in stable housing (OR 0.44, 95% CI 0.10-2.01, p=0.29) as compared to those experiencing homelessness. Despite this evidence of effect modification by housing status, the group-specific odds ratios demonstrated no significant associations between experiencing an increase in continuity to a higher provider-UPC quartile and being Indigenous and unstably housed (OR 0.84, 95% CI 0.22-3.11, p=0.80) or Indigenous and stably housed (OR 1.80, 95% CI 0.55-5.82, p=0.33).

Upon evaluating the site-UPC index, housing status modified the relationship between gender and increased continuity to a higher site-UPC quartile following C2C engagement. Among people experiencing homelessness, we found a negative association between increased continuity and being male (OR 0.61, 95% CI 0.27-1.39, p=0.24) as compared to female. Among females,

there was a negative association between increased continuity and living in unstable housing (OR 0.23, 95% CI 0.05-1.02, p=0.053) or stable housing (OR 0.91, 95% CI 0.28-2.95, p=0.87), compared to homelessness. However, living in unstable housing was positively associated with an increased site-UPC quartile (OR 1.93, 95% CI 0.88-4.22, p=0.10) among males. This modification by housing status resulted in a significant difference between males living in unstable housing (OR 8.45, 95% CI 1.56-45.82, p=0.01) as compared to those experiencing homelessness, and a non-significant difference between males living in stable housing (OR 0.66, 95% CI 0.14-3.12, p=0.60) as compared to those experiencing homelessness. However, the group-specific odds ratios demonstrated no significant associations with increases in continuity to a higher site-UPC quartile following C2C engagement among patients who are male and unstably housed (OR 1.18, 95% CI 0.48-2.89, p=0.72) or male and stably housed (OR 0.37, 95% CI 0.12-1.13, p=0.08). The associations and effect modifiers identified were not common across the different measures and may have been spurious.

In contrast, 'Other' ethnicity appeared as a common predictor across the site-level continuity of care indices. 'Other' ethnicity significantly increased the odds of experiencing increases in both site-level UPC (OR 6.18, 95% CI 1.36-28.11, p=0.02) and COCI (OR 8.15, 95% CI 1.60-41.40, p=0.01) scores to a higher quartile, compared to White ethnicity. Similarly, when evaluating increased continuity of care of 0.10 or greater (Figure 5), 'Other' ethnicity demonstrated significantly greater odds of increasing both site-level UPC (OR 8.76, 95% CI 1.73-44.44, p=0.01) and COCI (OR 7.49, 95% CI 1.46-38.39, p=0.02) scores. Based on these findings, 'Other' ethnicity appeared as a potential predictor of increased site-level continuity of care. No other characteristics were significantly associated with increased continuity of care of 0.10 or

greater following C2C engagement across the different indices. All final models demonstrated satisfactory model fit through the Hosmer-Lemeshow test.

Despite the statistical significance of 'Other' ethnicity, we are uncertain about the true association with relational continuity of care. The wide confidence intervals, small sample size (n=10), and uncertainty around the composition of the 'Other' ethnicity category limits our ability to conclude the variable as a predictor of increased continuity of care. Therefore, we cannot make conclusions about specific patient-level characteristics associated with increases in relational continuity of care to a higher quartile or with increases of 0.10 or greater from pre- to post-C2C.

4.4.2.1 Sensitivity Analyses

Figure 6, Figure 7, and Figure 8 demonstrate patient characteristics associated with increases in continuity of care of 0.15, 0.20, and 0.25, respectively, from pre- to post-C2C across the four indices. When evaluating increases of 0.15 or greater, patients 46-54 years of age had greater odds of experiencing increased provider-COCI continuity by 0.15 or greater (OR 2.57, 95% CI 1.15-5.73, p=0.02), as compared to those 19-36 years of age. In addition, age modified the relationship between Indigenous ethnicity and increases in site-UPC. Among patients 19-36 years of age, Indigenous ethnicity demonstrated greater odds of increasing the site-UPC by 0.15 (OR 3.68, 95% CI 1.09-12.45, p=0.04) compared to White ethnicity. Among patients of White ethnicity, we identified no significant association between increases in site-UPC and being 37-45 years (OR 1.40, 95% CI 0.43-4.54, p=0.57) or ≥55 years of age (OR 1.20, 95% CI 0.41-3.53, p=0.74) as compared to 19-36 years of age. However, White patients 46-54 years of age had

significantly greater odds of increasing site-UPC continuity by 0.15 (OR 3.28, 95% CI 1.09-9.86, p=0.03) as compared to White patients 19-36 years. Though among Indigenous patients, being 46-54 years of age was negatively associated with increases in site-UPC (OR 0.57, 95% CI 0.16-2.06, p=0.39). This modification by age resulted in a significant difference between Indigenous patients 46-54 years of age (OR 0.17, 95% CI 0.03-0.94, p=0.04) as compared to those 19-36 years of age, but no differences between Indigenous patients 37-45 years (OR 0.26, 95% CI 0.04-1.54, p=0.14) or ≥55 years of age (OR 0.79, 95% CI 0.11-5.61, p=0.82) as compared to those 19-36 years of age. While there is evidence of effect modification by age, the group-specific odds ratios demonstrated no significant associations with increases in site-UPC continuity scores of 0.15 or greater among Indigenous patients who are 37-45 years (OR 1.34, 95% CI 0.39-4.57, p=0.64), 46-54 years (OR 2.09, 95% CI 0.65-6.76, p=0.22), or ≥55 years of age (OR 3.52, 95% CI 0.73-16.99, p=0.12).

'Other' ethnicity was significantly positively associated with increases in site-COCI of 0.15 (OR 9.63, 95% CI 1.87-49.53, p=0.01) and 0.20 (OR 10.79, 95% CI 2.11-55.28, p<0.01), though no other characteristics appeared as significant across the indices when evaluating increases of 0.20. Upon evaluating increases of 0.25 or greater, 46-54 years of age demonstrated greater odds of increasing provider-COCI continuity (OR 3.42, 95% CI 1.28-9.16, p=0.01) as compared to 19-36 years of age. In addition, ethnicity modified the relationship between gender and increases in provider-COCI of 0.25 or greater. Among patients of White ethnicity, we identified a non-significant negative association between increases in provider-COCI of 0.25 or greater and being male (OR 0.73, 95% CI 0.28-1.89, p=0.52) compared to female. Among females, Indigenous (OR 0.55, 95% CI 0.16-1.86, p=0.34) and 'Other' ethnicity (OR 0.56, 95% CI 0.05-5.77, p=0.63)

demonstrated non-significant negative associations with increased provider-COCI continuity, compared to White. In contrast, 'Other' ethnicity was positively associated with increased provider-COCI (OR 15.52, 95% CI 1.45-165.91, p=0.02) among males. The modification by ethnicity resulted in a near significant difference between males of 'Other' ethnicity (OR 27.71, 95% CI 1.00-771.51, p=0.05) compared to White males, but no difference between Indigenous males (OR 1.20, 95% CI 0.25-5.78, p=0.82) compared to White males. Upon evaluating the group-specific odds ratios, we found a near significant association with increases in provider-COCI continuity of 0.25 among males of 'Other' ethnicity (OR 11.33, 95% CI 0.99-129.73, p=0.051) and a non-significant association among Indigenous males (OR 0.48, 95% CI 0.15-1.54, p=0.22). Similar to previous analyses, these associations were not consistent across the different indices or definitions of increased continuity. In addition, the large confidence intervals and small sample size of the 'Other' ethnicity category limits our ability to conclude males of 'Other' ethnicity as a predictor of increased continuity of care. All final models demonstrated satisfactory model fit through the Hosmer-Lemeshow test.

Increase to a Higher Quartile

Associations with Increased Provider UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.76 (0.35-1.65)
46-54 years	51	1.16 (0.53-2.56)
55+ years	53	0.44 (0.19-1.03)
Gender		
Female	73	Reference
Male	146	0.97 (0.52-1.82)
Ethnicity		
White	133	Reference
Indigenous	74	2.39 (1.04-5.52)
Other	10	2.16 (0.38-12.18)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.94 (0.85-4.43)
Stable Housing	45	1.7 (0.64-4.47)
Ethnicity-Housing Interaction		
White-Literal Homelessness	60	Reference
Indigenous-Unstable Housing	14	0.84 (0.22-3.11)
Indigenous-Stable Housing	16	1.80 (0.55-5.82)
Other-Unstable Housing	3	1.06 (0.09-12.87)
Other-Stable Housing*	1	

Associations with Increased Provider COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.80 (0.37-1.70)
46-54 years	51	1.14 (0.53-2.46)
55+ years	53	0.54 (0.24-1.22)
Gender		
Female	73	Reference
Male	146	1.35 (0.73-2.50)
Ethnicity		
White	133	Reference
Indigenous	74	1.58 (0.85-2.95)
Other	10	2.03 (0.53-7.70)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.26 (0.65-2.45)
Stable Housing	45	1.60 (0.77-3.34)

Associations with Increased Site UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.58 (0.26-1.32)
46-54 years	51	0.86 (0.38-1.93)
55+ years	53	1.10 (0.49-2.50)
Gender		
Female	73	Reference
Male	146	0.61 (0.27-1.39)
Ethnicity		
White	133	Reference
Indigenous	74	1.33 (0.70-2.54)
Other	10	6.18 (1.36-28.11)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	0.23 (0.05-1.02)
Stable Housing	45	0.91 (0.28-2.95)
Gender-Housing Interaction		
Female-Literal Homelessness	41	Reference
Male-Unstable Housing	47	1.18 (0.48-2.89)
Male-Stable Housing	28	0.37 (0.12-1.13)

Associations with Increased Site COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.73 (0.33-1.61)
46-54 years	51	1.00 (0.46-2.20)
55+ years	53	1.22 (0.55-2.71)
Gender		
Female	73	Reference
Male	146	1.06 (0.57-1.97)
Ethnicity		
White	133	Reference
Indigenous	74	1.30 (0.69-2.43)
Other	10	8.15 (1.60-41.40)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.36 (0.70-2.63)
Stable Housing	45	1.13 (0.54-2.37)

Figure 4. Forest plots demonstrating patient characteristics associated with increases in continuity of care scores to a higher quartile from pre- to post-C2C, by index, among patients with ≥3 GP visits (n=220)
* Insufficient sample size

Increase of ≥0.10

Associations with Increased Provider UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.04 (0.49-2.21)
46-54 years	51	1.76 (0.82-3.81)
55+ years	53	0.61 (0.27-1.39)
Gender		
Female	73	Reference
Male	146	1.34 (0.72-2.48)
Ethnicity		
White	133	Reference
Indigenous	74	1.19 (0.64-2.21)
Other	10	1.79 (0.47-6.75)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.37 (0.71-2.65)
Stable Housing	45	1.39 (0.66-2.90)

Associations with Increased Provider COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.74 (0.34-1.61)
46-54 years	51	1.46 (0.68-3.16)
55+ years	53	0.75 (0.34-1.67)
Gender		
Female	73	Reference
Male	146	1.34 (0.72-2.47)
Ethnicity		
White	133	Reference
Indigenous	74	1.24 (0.67-2.31)
Other	10	1.96 (0.51-7.48)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.22 (0.63-2.36)
Stable Housing	45	1.95 (0.94-4.06)

Associations with Increased Site UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.77 (0.35-1.69)
46-54 years	51	1.33 (0.61-2.91)
55+ years	53	1.20 (0.53-2.68)
Gender		
Female	73	Reference
Male	146	1.03 (0.55-1.93)
Ethnicity		
White	133	Reference
Indigenous	74	1.57 (0.84-2.94)
Other	10	8.76 (1.73-44.44)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.13 (0.58-2.21)
Stable Housing	45	0.94 (0.45-1.99)

Associations with Increased Site COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.54 (0.24-1.19)
46-54 years	51	1.08 (0.50-2.34)
55+ years	53	1.10 (0.50-2.42)
Gender		
Female	73	Reference
Male	146	0.93 (0.50-1.72)
Ethnicity		
White	133	Reference
Indigenous	74	1.31 (0.70-2.45)
Other	10	7.49 (1.46-38.39)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.79 (0.92-3.46)
Stable Housing	45	1.20 (0.58-2.52)

Figure 5. Forest plots demonstrating patient characteristics associated with increases in continuity of care scores of 0.10 or greater from pre- to post-C2C, by index, among patients with ≥3 GP visits (n=220)

Increase of ≥0.15

Associations with Increased Provider UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.21 (0.55-2.67)
46-54 years	51	1.90 (0.86-4.21)
55+ years	53	0.50 (0.21-1.24)
Gender		
Female	73	Reference
Male	146	1.47 (0.77-2.83)
Ethnicity		
White	133	Reference
Indigenous	74	0.94 (0.49-1.80)
Other	10	2.40 (0.63-9.19)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.20 (0.60-2.40)
Stable Housing	45	1.52 (0.70-3.28)

Associations with Increased Provider COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.29 (0.58-2.90)
46-54 years	51	2.57 (1.15-5.73)
55+ years	53	1.03 (0.44-2.40)
Gender		
Female	73	Reference
Male	146	1.45 (0.76-2.77)
Ethnicity		
White	133	Reference
Indigenous	74	1.05 (0.55-2.01)
Other	10	1.63 (0.42-6.35)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.29 (0.66-2.55)
Stable Housing	45	1.22 (0.57-2.61)

Associations with Increased Site UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.40 (0.43-4.54)
46-54 years	51	3.28 (1.09-9.86)
55+ years	53	1.20 (0.41-3.53)
Gender		
Female	73	Reference
Male	146	0.95 (0.49-1.86)
Ethnicity		
White	133	Reference
Indigenous	74	3.68 (1.09-12.45)
Other	10	3.89 (0.47-32.45)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.08 (0.53-2.21)
Stable Housing	45	0.73 (0.32-1.65)
Age-Ethnicity Interaction		
19-36 years-White	38	Reference
37-45 years-Indigenous	24	1.34 (0.39-4.57)
37-45 years-Other	4	10.46 (0.93-117.06)
46-54 years-Indigenous	23	2.09 (0.65-6.76)
46-54 years-Other*	1	
55+ years-Indigenous	9	3.52 (0.73-16.99)
55+ years-Other*	1	

Associations with Increased Site COCI

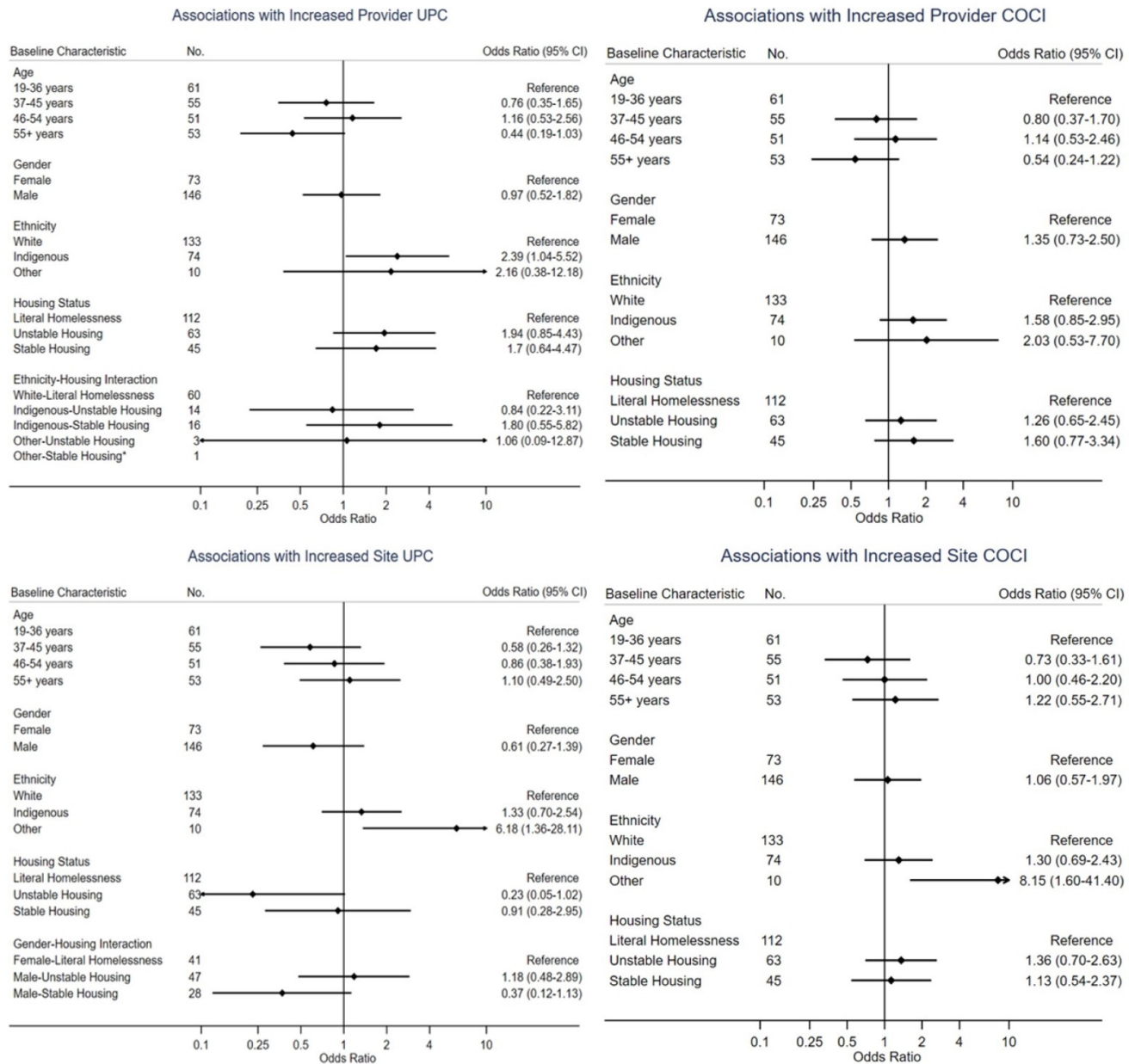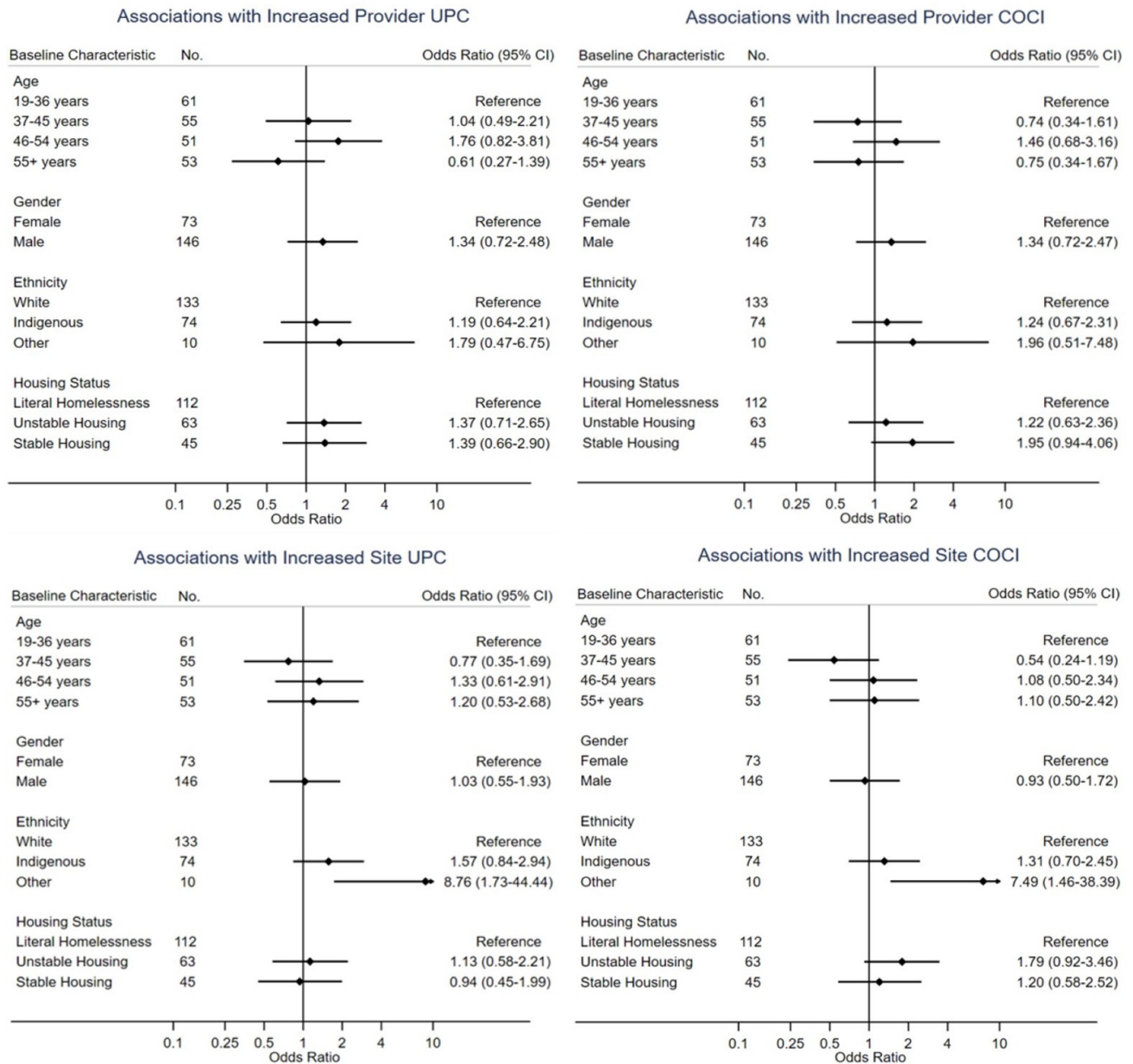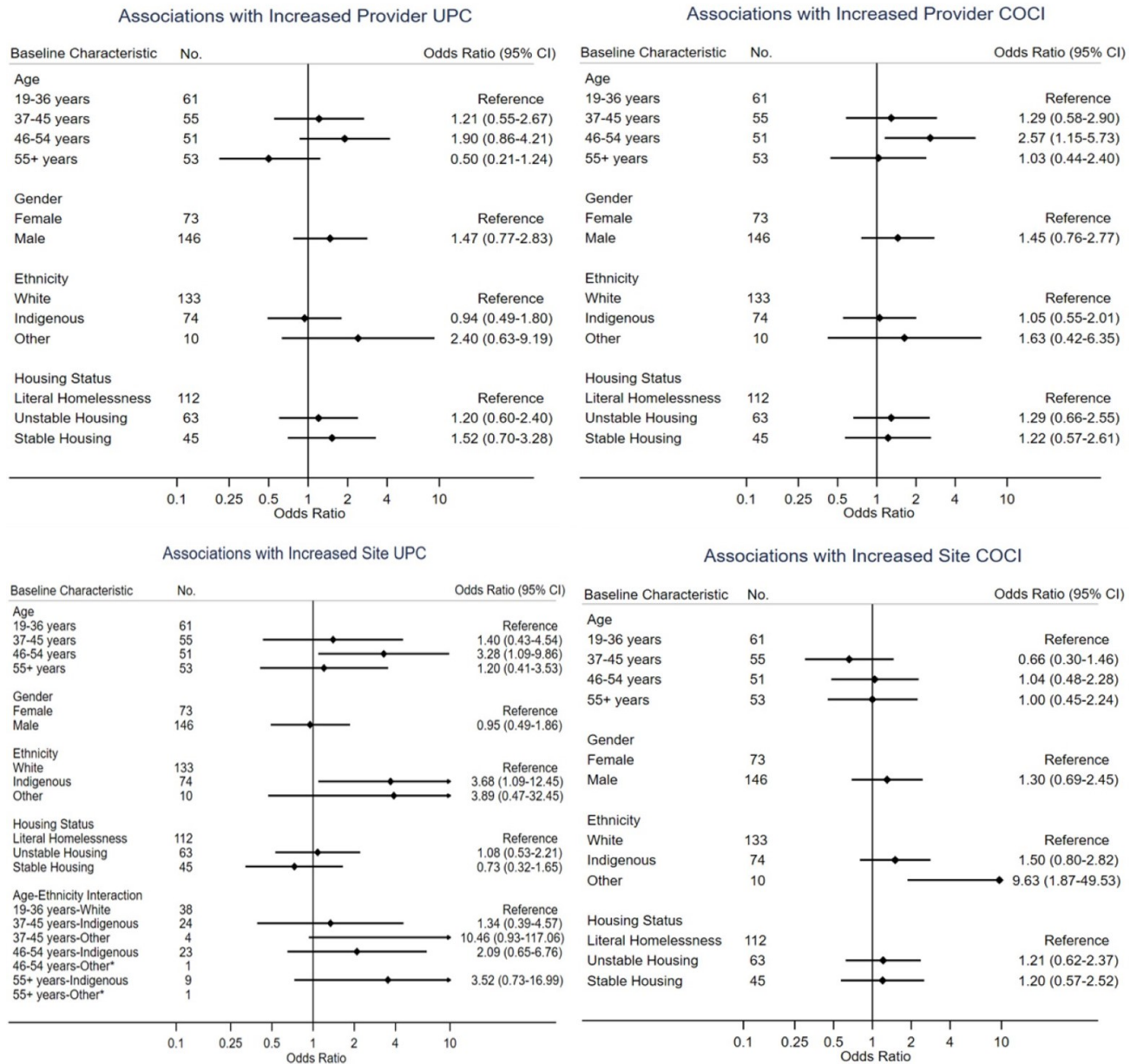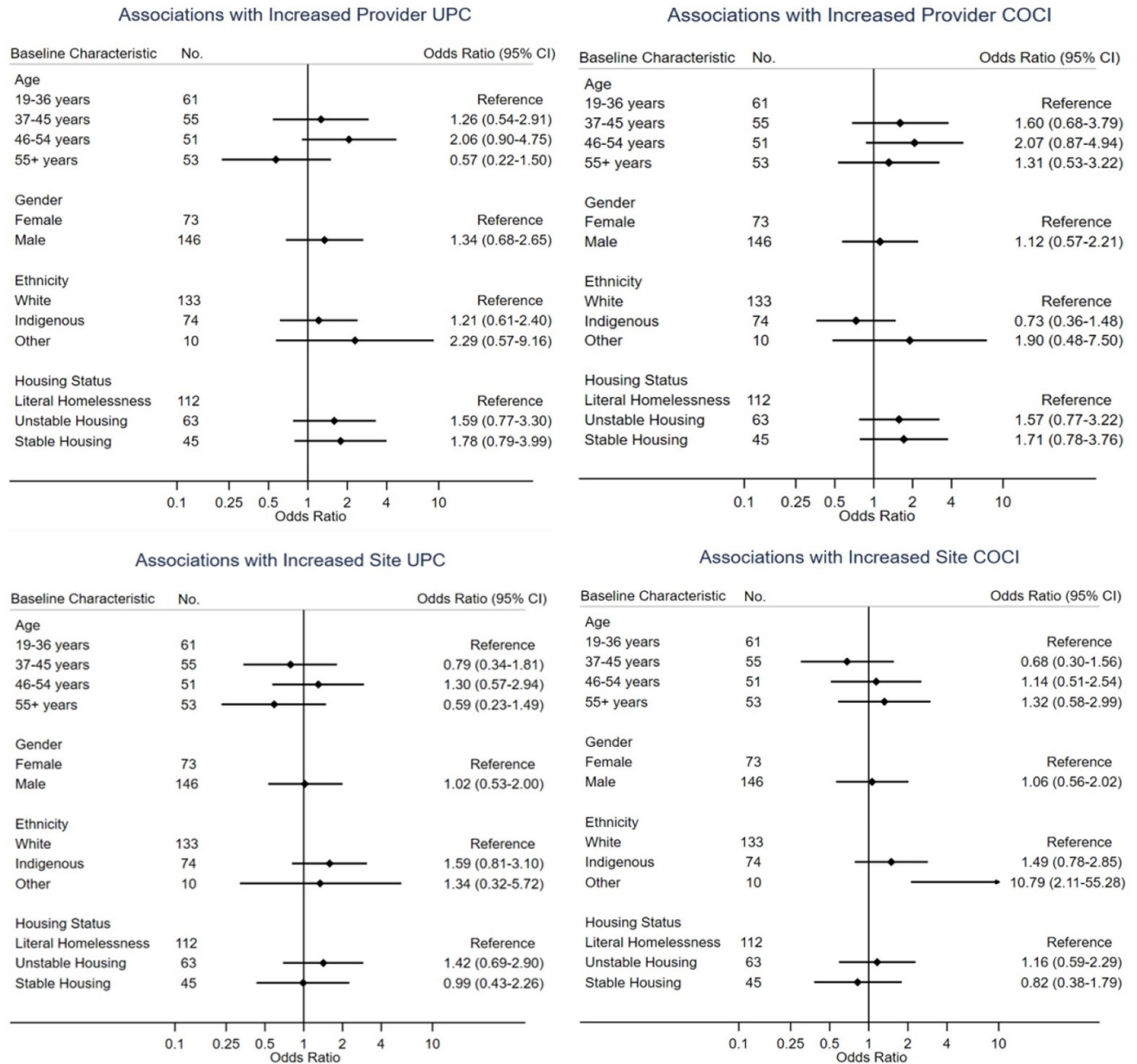| Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.66 (0.30-1.46)
46-54 years	51	1.04 (0.48-2.28)
55+ years	53	1.00 (0.45-2.24)
Gender		
Female	73	Reference
Male	146	1.30 (0.69-2.45)
Ethnicity		
White	133	Reference
Indigenous	74	1.50 (0.80-2.82)
Other	10	9.63 (1.87-49.53)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.21 (0.62-2.37)
Stable Housing	45	1.20 (0.57-2.52)

Figure 6. Forest plots demonstrating patient characteristics associated with increases in continuity of care scores of 0.15 or greater from pre- to post-C2C, by index, among patients with ≥3 GP visits (n=220)
* Insufficient sample size

Increase of ≥0.20

Associations with Increased Provider UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.26 (0.54-2.91)
46-54 years	51	2.06 (0.90-4.75)
55+ years	53	0.57 (0.22-1.50)
Gender		
Female	73	Reference
Male	146	1.34 (0.68-2.65)
Ethnicity		
White	133	Reference
Indigenous	74	1.21 (0.61-2.40)
Other	10	2.29 (0.57-9.16)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.59 (0.77-3.30)
Stable Housing	45	1.78 (0.79-3.99)

Associations with Increased Provider COCI

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	1.60 (0.68-3.79)
46-54 years	51	2.07 (0.87-4.94)
55+ years	53	1.31 (0.53-3.22)
Gender		
Female	73	Reference
Male	146	1.12 (0.57-2.21)
Ethnicity		
White	133	Reference
Indigenous	74	0.73 (0.36-1.48)
Other	10	1.90 (0.48-7.50)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.57 (0.77-3.22)
Stable Housing	45	1.71 (0.78-3.76)

Associations with Increased Site UPC

Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.79 (0.34-1.81)
46-54 years	51	1.30 (0.57-2.94)
55+ years	53	0.59 (0.23-1.49)
Gender		
Female	73	Reference
Male	146	1.02 (0.53-2.00)
Ethnicity		
White	133	Reference
Indigenous	74	1.59 (0.81-3.10)
Other	10	1.34 (0.32-5.72)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.42 (0.69-2.90)
Stable Housing	45	0.99 (0.43-2.26)

Associations with Increased Site COCI

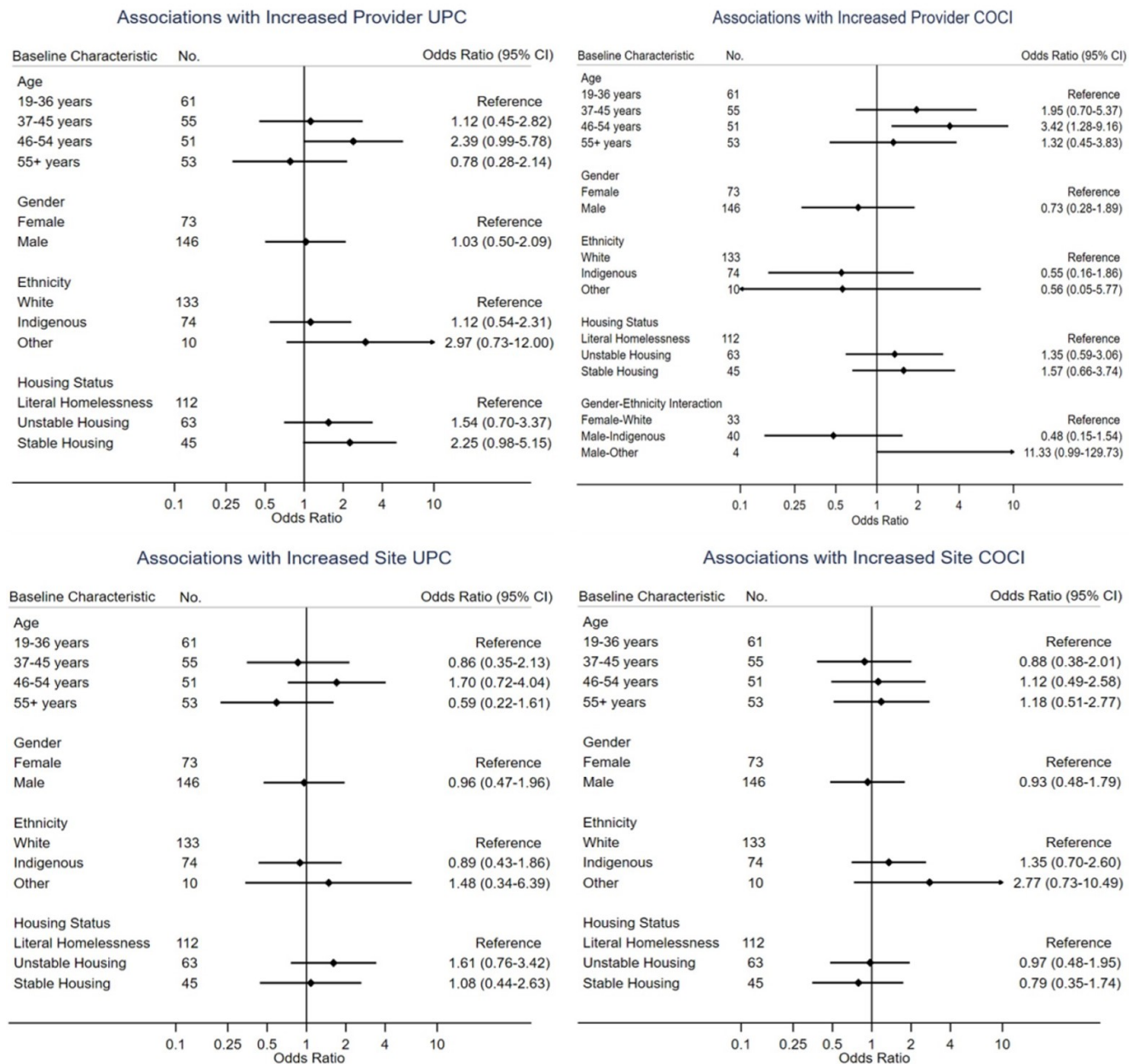| Baseline Characteristic	No.	Odds Ratio (95% CI)
Age		
19-36 years	61	Reference
37-45 years	55	0.68 (0.30-1.56)
46-54 years	51	1.14 (0.51-2.54)
55+ years	53	1.32 (0.58-2.99)
Gender		
Female	73	Reference
Male	146	1.06 (0.56-2.02)
Ethnicity		
White	133	Reference
Indigenous	74	1.49 (0.78-2.85)
Other	10	10.79 (2.11-55.28)
Housing Status		
Literal Homelessness	112	Reference
Unstable Housing	63	1.16 (0.59-2.29)
Stable Housing	45	0.82 (0.38-1.79)

Figure 7. Forest plots demonstrating patient characteristics associated with increases in continuity of care scores of 0.20 or greater from pre- to post-C2C, by index, among patients with ≥3 GP visits (n=220)

Increase of ≥0.25

Associations with Increased Provider UPC

Baseline Characteristic	No.		Odds Ratio (95% CI)
Age			
19-36 years	61		Reference
37-45 years	55		1.12 (0.45-2.82)
46-54 years	51		2.39 (0.99-5.78)
55+ years	53		0.78 (0.28-2.14)
Gender			
Female	73		Reference
Male	146		1.03 (0.50-2.09)
Ethnicity			
White	133		Reference
Indigenous	74		1.12 (0.54-2.31)
Other	10		2.97 (0.73-12.00)
Housing Status			
Literal Homelessness	112		Reference
Unstable Housing	63		1.54 (0.70-3.37)
Stable Housing	45		2.25 (0.98-5.15)

Associations with Increased Provider COCI

Baseline Characteristic	No.		Odds Ratio (95% CI)
Age			
19-36 years	61		Reference
37-45 years	55		1.95 (0.70-5.37)
46-54 years	51		3.42 (1.28-9.16)
55+ years	53		1.32 (0.45-3.83)
Gender			
Female	73		Reference
Male	146		0.73 (0.28-1.89)
Ethnicity			
White	133		Reference
Indigenous	74		0.55 (0.16-1.86)
Other	10		0.56 (0.05-5.77)
Housing Status			
Literal Homelessness	112		Reference
Unstable Housing	63		1.35 (0.59-3.06)
Stable Housing	45		1.57 (0.66-3.74)
Gender-Ethnicity Interaction			
Female-White	33		Reference
Male-Indigenous	40		0.48 (0.15-1.54)
Male-Other	4		11.33 (0.99-129.73)

Associations with Increased Site UPC

Baseline Characteristic	No.		Odds Ratio (95% CI)
Age			
19-36 years	61		Reference
37-45 years	55		0.86 (0.35-2.13)
46-54 years	51		1.70 (0.72-4.04)
55+ years	53		0.59 (0.22-1.61)
Gender			
Female	73		Reference
Male	146		0.96 (0.47-1.96)
Ethnicity			
White	133		Reference
Indigenous	74		0.89 (0.43-1.86)
Other	10		1.48 (0.34-6.39)
Housing Status			
Literal Homelessness	112		Reference
Unstable Housing	63		1.61 (0.76-3.42)
Stable Housing	45		1.08 (0.44-2.63)

Associations with Increased Site COCI

Baseline Characteristic	No.		Odds Ratio (95% CI)
Age			
19-36 years	61		Reference
37-45 years	55		0.88 (0.38-2.01)
46-54 years	51		1.12 (0.49-2.58)
55+ years	53		1.18 (0.51-2.77)
Gender			
Female	73		Reference
Male	146		0.93 (0.48-1.79)
Ethnicity			
White	133		Reference
Indigenous	74		1.35 (0.70-2.60)
Other	10		2.77 (0.73-10.49)
Housing Status			
Literal Homelessness	112		Reference
Unstable Housing	63		0.97 (0.48-1.95)
Stable Housing	45		0.79 (0.35-1.74)

Figure 8. Forest plots demonstrating patient characteristics associated with increases in continuity of care scores of 0.25 or greater from pre- to post-C2C, by index, among patients with ≥3 GP visits (n=220)

5.0 Discussion

5.1 Summary of Findings

In this study we aimed to evaluate whether the novel C2C program impacts primary care use and relational continuity of care, and identify predictors associated with improved continuity among adults who are vulnerably housed. Comparisons between regular and low primary care users identified several differences, with low primary care users more likely to be male, unattached to a primary care provider at program intake, and have a lower total comorbidity score than regular primary care users. Our assessment of primary care use among regular and low users demonstrated an increase in the number of primary care visits and a significant decrease in the proportion of low primary care users by 15% in absolute terms from pre- to post-C2C engagement.

In addition, we found a small but significant increase in mean relational continuity of care at the provider- and site-level from pre- to post-C2C, with the exception of the provider-COCI. Between the 12 months before and after C2C engagement, there was a mean increase of 0.04 in provider-UPC, provider-COCI, and site-UPC, and a mean increase of 0.05 in site-UPC. However, mean changes in relational continuity of care did not differ by subgroups across the 11 patient characteristics investigated. Furthermore, we did not identify specific patient characteristics consistently associated with increased relational continuity of care when evaluating increases in continuity to a higher quartile and increases of 0.10, 0.15, 0.20, and 0.25 from pre- to post-C2C.

5.2 Changes in Primary Care Use and Low Primary Care Users

Individuals with vulnerable housing experience several patient, provider, and system-level barriers that contribute to low rates of primary care engagement.[18, 64] Within our study, the median number of primary care visits in the year prior to C2C engagement was 7 (mean 10.6, SD 11.7) and a considerable proportion of our study population were low primary care users, with 34.5% having fewer than 3 GP visits in a year. As we focused on GPs as primary care providers, we may not have captured other sources of primary care (e.g., nurse practitioners) and utilization may be underestimated. However, these observations align with primary care use reported in previous literature,[65, 66] highlighting the need to tailor interventions to this patient group. A study on homeless veterans enrolled in medical and primary care clinics in the United States reported between 1.63-5.96 primary care visits per person over a 6-month period, which decreased over time.[65] Similarly, a Canadian study on individuals who are homeless or vulnerably housed found 34.5% of participants without concurrent mental health and substance use concerns had not visited a primary care provider in the past 12 months, upon study intake.[66] This number decreased to 23.4% when assessing participants with self-reported concurrent mental health and substance use concerns, though primary care use among this sample increased over a four-year period.[66]

Given the low rates of primary care use, there is increasing emphasis on improving primary care access and engagement among people who are vulnerably housed.[16-19] The decrease in the number of low primary care users observed in our study suggests the C2C program is associated with improved primary care use among individuals with vulnerable housing and low primary care use. Within the literature, there is limited and inconsistent evidence on the impact of case

management programs on primary care use among populations with vulnerable housing. In addition, many studies evaluate case management as part of housing support programs rather than independent case management programs, which may influence the support a patient receives within the program.

A recent study examining a critical time intervention reported a significant increase in visits to a community psychiatrist but no difference in GP visits among people experiencing homelessness with mental health needs within the 1-year post-intervention.[40] Given the study population, differences with these findings may represent a greater need for psychiatric care to manage the mental health needs of engaged patients, as opposed to primary care through GPs. When coupled with housing support, research has found an increase in primary care visits among veterans with a history of homelessness receiving case management, as compared to those without case management, which aligns with our findings.[67] In contrast, a 7-year follow-up study of adults who are homeless with mental health needs in Toronto reported differing effects of housing first case management on primary care use, based on patients' level of need.[17] The authors found that housing first case management supports had no impact on the number of primary care visits among moderate-need patients, but significantly decreased primary care visits among high-need patients.[17] The difference in results may be partially due to the 7-year study period, which provides insight into long-term trends in primary care use far beyond the 1-year period used within our study. In addition, the housing first assertive case management model used for high-need patients incorporated many community-based housing, health, and social supports (e.g., psychiatrists, case managers, and peer support workers) and may decrease the need for primary care visits. Despite the limited evidence, important aspects of case management such as health

service orientation and outreach have been demonstrated to increase access to primary care among people experiencing homelessness,[16, 19] complementing the findings of our study. However, literature evaluating changes in primary care use among the population lack a focus on the lowest primary care users.[15, 32]

Our findings of an absolute decrease of 15% in the number of low primary care users highlights how primary care engagement may be improved using case management interventions among people who are vulnerably housed with the lowest use. This finding may demonstrate the importance of case management in overcoming barriers among patients who face the greatest challenges accessing primary care. In addition, utilizing these interventions to improve primary care use has considerable implications for the health and wellbeing of the population, given the health inequities experienced by people who are vulnerably housed[4] and the role of primary care providers in promoting and sustaining wellness.[20]

Within the general population, access to primary care has been associated with improved patient outcomes, such as reduced mortality, and decreased acute care utilization and costs.[68] Primary care providers are considered the first point of contact with the health system and are vital to address social factors contributing to poor health, manage ongoing health needs, and coordinate access to community-based services for patients.[20-23] Importantly, primary care providers can also mitigate barriers to complementary care.[21] The Health Quality Council of Alberta identified several strategies employed by primary care providers to overcome health system barriers to care, which include arranging publicly funded services for patients with insufficient income or

health coverage, helping patients obtain costly medication through compassionate drug programs, and utilizing multidisciplinary teams, particularly for patients with complex needs.[21] In addition, primary care providers are well positioned to provide health education and empower patients to take control of their health.[20] Research with people experiencing homelessness has suggested that empowerment and self-management among patients may be a means to address unmet health care needs, as patients gain confidence asking questions, providing feedback to providers, and becoming their own advocate.[7] Therefore, increasing primary care use among people who are vulnerably housed, especially those with the lowest primary care use, offers opportunities to improve health outcomes and reduce reliance on acute care services by providing more timely care before medical crises arise, minimizing barriers to health and social care, and promoting self-management. Moreover, establishing continuity of primary care may contribute to sustaining these outcomes long-term.

The increase in primary care use demonstrated within our study may be a result of the valuable trust, communication, and relationships formed between patients and the C2C team, allowing C2C team members to fully understand and overcome patients' barriers to care.[69] A relationship-based approach has been noted as an essential feature of case management and patient navigation programs to facilitate access to primary care.[70, 71] Forming supportive and meaningful connections with patients, informing and involving them in their care plans, and empowering them to self-manage effectively supports people to overcome barriers to primary care.[70, 71] These relationships may be particularly vital among people with vulnerable housing, who often experience feelings of unwelcomeness, discrimination, and distrust with healthcare providers.[8, 9]

5.3 Changes in Relational Continuity of Care

Improving engagement with primary care services is important to promote and sustain relational continuity of care, improved health outcomes, and positive care experiences among people with vulnerable housing. Compared to the general Alberta population, regular primary care users within our study demonstrated a lower continuity of care score at intake, with a mean provider-UPC score of 0.51 compared to 0.60 among Alberta residents.[72] To close this gap, case management is a suggested approach to promote primary care retention and continuity of care among people with vulnerable housing, as case managers can identify appropriate primary care providers, facilitate access, and arrange appointments.[14, 40, 43, 73] This study is the first to explore how a transitional case management program influences continuity of care among people who are vulnerably housed, using established quantitative measures. However, related quantitative research with the population has reported conflicting results.[43] An evaluation of a housing first intervention providing case management found no difference in primary care retention, defined as ongoing contact with a consistent primary care provider, among homeless individuals with mental health needs in the year after intervention enrolment.[43] Despite this difference, our findings are supported by qualitative research with the population and demonstrate an alignment with patient perceptions of care continuity.[14] Interviews conducted with people experiencing homelessness within a brief case management intervention reported the intervention promoted continuity of care by improving access, timeliness, and coordination of care.[14] Based on these findings and the results of our study, transitional case management interventions appear to effectively increase relational continuity of care among people who are vulnerably housed, though the increase observed in the present study was small. This may reflect an area of

improvement for case management programs, as greater attention to primary care attachment and follow-up may promote greater increases in continuity.

Clinically, the observed mean increase of 0.04 among the UPC index suggests that a case manager can facilitate one additional visit per year to a usual provider or practice location for patients with 25 total visits to any primary care provider or practice location. While this is a small increase, it is unknown how changes in continuity of care impact patient-related outcomes such as primary care experiences, health outcomes, or acute care use among people who are vulnerably housed. Therefore, future research should evaluate the association between changes in relational continuity of care and changes in patient satisfaction and health outcomes to understand the impact of continuity in this population. Furthermore, we observed increases in relational continuity of care at both the provider and site level. It is possible that provider and site continuity increased simultaneously, as increasing continuity with a consistent provider may result in increased continuity with the provider's practice location, and vice versa. However, these findings may demonstrate the importance of accessing and forming trusting connections with both primary care providers and clinical settings among patients with vulnerable housing. Given the prevalent feelings of unwelcomeness within the health system, primary care services should work towards creating trusting patient-provider relationships and inclusive, welcoming clinical spaces to promote attachment with providers and practice locations.

In addition, we did not detect significant differences in the effect of C2C on care continuity between subgroups. Our findings suggest that the effect of the C2C program may not vary across

diverse patient groups and thus may be beneficial to promote an increase in continuity among the broad population of people with vulnerable housing and high acute care use. However, the small sample size within the present study may have reduced our ability to identify differences. Therefore, future research should be conducted with a larger sample size to allow for a more rigorous examination of the influence of factors that modify the effect of case management on continuity of care across patient groups.

5.4 Predictors of Increased Relational Continuity of Care

Exploring patient-level predictors of increased relational continuity of care is essential to tailor care for specific patient groups. Although a few predictors appeared as significant throughout our analyses, these associations were not consistent across the measures of continuity and may have been spurious. Unfortunately, there is an absence of evidence on predictors of relational continuity of care in people who are vulnerably housed, particularly among those enrolled in case management programs. Previous literature on homeless populations have suggested housing status, gender, race, age, substance use, and mental health as patient-level factors that influence care provider engagement.[8, 49] In addition, the number of comorbid conditions has been reported to influence primary care retention,[43] which may subsequently impact continuity of care. In non-homeless populations, literature has identified older age and having a long-term condition to predict increases in perceived continuity of care over time, whereas greater socioeconomic deprivation and Black and South Asian ethnicities were predictors of decreased continuity.[74] Beyond care provider engagement, the literature has also identified several factors influencing acceptability of health and social interventions among people with vulnerable housing.[75] Gender, age, and lived experience of homelessness have been reported to influence preferences, trust, and

safety with health and social service professionals, impacting acceptance and effectiveness of interventions.[75] Therefore, the effect of the C2C program may have differed across patients with unique characteristics, preferences, and values. Based on the evidence, we would have expected some patient-level characteristics to influence changes in relational continuity following C2C engagement in our study population.

There may be several underlying reasons for the lack of predictors identified in the present study. First, it is important to note that our sample size was relatively small with only 220 patients with 3 or more primary care visits and we may have been underpowered to detect significant associations. In addition, while 'Other' ethnicity (i.e., being non-Indigenous and non-White) was significantly positively associated with increased continuity of care in our analyses, the small sample size and wide confidence intervals undermine the validity of the estimates and may not reflect a true effect. We are also uncertain of the composition of this ethnicity category and the diversity that may or may not be present within the patient group, which represents a limitation of our data collection as we only identified individuals as Indigenous, White, or Other. Given these limitations, we cannot conclude that people who are vulnerably housed with non-Indigenous and non-White ethnicities will experience an increase in relational continuity of care after engaging with a transitional case management program.

Moreover, our evaluation of effect modification further reduced the sample size of subgroups and limited our ability to draw conclusions. Our results suggest that the C2C program may be less effective among Indigenous patients living in unstable housing than Indigenous patients who

are homeless or living in stable housing, but more effective among males living in unstable housing than males who are homeless or living in stable housing. Despite significant differences between the odds ratios of these groups, the effect of unstable housing on ethnicity and gender did not influence the likelihood of experiencing increased continuity of care following C2C engagement. However, the majority of Indigenous patients in our study population were experiencing homelessness (n=44, 59.5%), with only 14 (18.9%) and 16 (21.6%) living in unstable and stable housing, respectively. Among males, 71 were experiencing homelessness (48.6%), 47 (32.2%) were living in unstable housing, and 28 (19.2%) were living in stable housing. The small sample sizes of these subgroups may have limited our ability to detect significant associations with increased continuity of care. Nonetheless, the significant differences observed between groups may demonstrate the patient-oriented nature of C2C, in which C2C team members account for individual circumstances, cultural and gender identities, and related factors throughout their interactions with patients.[69] This tailored support may have influenced the effectiveness of C2C among different patient groups without significantly impacting changes in continuity of care. However, these differences between groups were not consistent across the different measures and thresholds of increased continuity and may have been spurious.

Taken together, we were unable to detect specific predictors that influence changes in relational continuity of care following C2C engagement. Similar to previous analyses, these findings suggest that the effect of the C2C program may not vary across patients with demographic or clinical differences. Therefore, the C2C program may be agnostic to who it serves by providing adaptive and tailored care that meets the unique needs of each patient and effectively promotes primary care use. Our findings may thus reflect the value and far-reaching benefits of case

management programs for the diverse population of people with vulnerable housing. However, our ability to observe differences and draw strong conclusions may have been influenced by our small sample size and we recommend that future research be conducted with a sufficiently large sample to gain greater statistical power for more thorough analyses. Despite this limitation, our study provides novel and foundational insight into potential predictors of increased relational continuity of care among people who are vulnerably housed in a transitional case management program. Promoting and sustaining case management interventions within health and social systems may be a promising approach to improve relational continuity among the diverse population of adults with vulnerable housing and high acute care use.

6.0 Limitations

This study has additional limitations that should be considered. A main limitation of this study is the use of visit patterns to measure relational continuity of care. The UPC and COCI do not capture important aspects of care that may impact relational continuity with a primary care provider or site. These includes beliefs, attitudes, and patient-provider relationship strength, which would be better captured through qualitative approaches. Thus, our results could be used in tandem with qualitative literature that captures patient perspectives and various aspects of care to gain an in-depth understanding of care continuity in the population. In addition, our exclusion criteria may have introduced selection bias. By excluding patients without a valid PHN, we do not consider patients that are highly transient or face additional access barriers that limit health system utilization. However, only 5% (n=20) of our sample was excluded for this reason so we do not expect this to significantly bias our results. Regardless, the presence of selection bias will reduce generalizability of our results to populations with vulnerable housing.

Our results may also be influenced by time-varying confounders unrelated to C2C, such as natural changes in health. If such factors promote continuity of care, this could overestimate the impact of the C2C intervention. Similarly, the lack of a comparison group limits causal inference on the relationship between C2C and changes in primary care use and relational continuity of care. The presence of a comparison group would allow us to better evaluate the effectiveness of case management programs for people who are vulnerably housed with high acute care use by demonstrating the outcomes that would have occurred without the intervention. However, the current pre-post study design offers temporality and provides a foundational understanding of the relationship between case management and continuity of care in this population.

7.0 Principal Implications

The current study provides novel insight into the relationship between case management, primary care use, and relational continuity of care among people who are vulnerably housed. Our findings suggest that C2C and similar transitional case management programs improve primary care use and relational continuity of care among the diverse population of adults who are vulnerably housed. The observed decrease in low primary care users and increase in relational continuity of care demonstrates a potentially important role for case management interventions in improving primary care engagement among this population. The coordination, advocacy, outreach, and navigation support offered by case management may be especially beneficial for people with vulnerable housing and low primary care use, who may experience additional barriers to primary care attachment. As general practitioners offer regular care and access to

specialist services, facilitating greater engagement and continuity among people with vulnerable housing is essential to manage ongoing health and social needs, reduce reliance on resource-intensive acute care settings, and rebuild valuable trust between this population and the health system. Promoting the uptake of case management programs for people who are vulnerably housed and integrating elements of case management into primary care services may help reduce the significant health disparities experienced by the population.

8.0 Future Directions

Throughout this investigation we aimed to evaluate whether a transitional case management program impacts relational continuity of care, though it remains unknown how changes in continuity influence patient outcomes. Future research should evaluate the association between changes in relational continuity of care and changes in acute care use and health outcomes to understand the impact of care continuity in this population. We also recommend that future research be conducted with larger sample sizes and comparison groups where possible to further explore these relationships across various patient characteristics not captured in the present study. This would include considerations for diverse ethnicities and gender identities. Finally, qualitative research methodologies should be used to identify barriers and facilitators to improving continuity of care among this population. This would provide valuable knowledge to enhance existing interventions and inform the implementation of new strategies to improve primary care attachment and care continuity among people who are vulnerably housed.

9.0 Conclusion

In conclusion, engagement with a transitional case management program was associated with increased primary care use and relational continuity of care over a 1-year follow-up period among adults who are vulnerably housed with high acute care use. These findings add to our understanding of how primary care engagement may be improved among this population to reduce health inequities, particularly among those with the lowest primary care use who may experience the greatest barriers to primary care attachment. Promoting and sustaining case management interventions within health and social systems may be a promising approach to improve primary care access and attachment among people with vulnerable housing and high acute care use. Further research examining similar programs and changes in patient outcomes is required to understand the full effect of case management and the impact of care continuity within the population.

References

1.	Hwang SW, Aubry T, Palepu A, Farrell S, Nisenbaum R, Hubley AM, et al. The health and housing in transition study: A longitudinal study of the health of homeless and vulnerably housed adults in three Canadian cities. Int J Public Health. 2011;56(6):609-23.
2.	Kneebone R. Social policy trends: Types of homelessness. The School of Public Policy Publications; 2022.
3.	Hwang SW, Weaver J, Aubry T, Hoch JS. Hospital costs and length of stay among homeless patients admitted to medical, surgical, and psychiatric services. Med Care. 2011;49(4):350-4.
4.	Hwang SW, Wilkins R, Tjepkema M, O'Campo PJ, Dunn JR. Mortality among residents of shelters, rooming houses, and hotels in Canada: 11 year follow-up study. BMJ (Clinical research ed). 2009;339:b4036.
5.	Miyawaki A, Hasegawa K, Figueroa JF, Tsugawa Y. Hospital readmission and emergency department revisits of homeless patients treated at homeless-serving hospitals in the USA: Observational study. J Gen Intern Med. 2020;35(9):2560-8.
6.	Fine AG, Zhang T, Hwang SW. Attitudes towards homeless people among emergency department teachers and learners: A cross-sectional study of medical students and emergency physicians. BMC Med Educ. 2013;13:112.
7.	Corrigan P, Pickett S, Kraus D, Burks R, Schmidt A. Community-based participatory research examining the health care needs of African Americans who are homeless with mental illness. J Health Care Poor Underserved. 2015;26(1):119-33.
8.	Wen CK, Hudak PL, Hwang SW. Homeless people's perceptions of welcomeness and unwelcomeness in healthcare encounters. J Gen Intern Med. 2007;22(7):1011-7.
9.	Omerov P, Craftman Å G, Mattsson E, Klarare A. Homeless persons' experiences of health- and social care: A systematic integrative review. Health Soc Care Community. 2020;28(1):1-11.
10.	Pottie K, Kendall CE, Aubry T, Magwood O, Andermann A, Salvalaggio G, et al. Clinical guideline for homeless and vulnerably housed people, and people with lived homelessness experience. CMAJ. 2020;192(10):E240-e54.
11.	Shoemaker ES, Kendall CE, Mathew C, Crispo S, Welch V, Andermann A, et al. Establishing need and population priorities to improve the health of homeless and vulnerably housed women, youth, and men: A delphi consensus study. PloS One. 2020;15(4):e0231758.
12.	Ponka D, Agbata E, Kendall C, Stergiopoulos V, Mendonca O, Magwood O, et al. The effectiveness of case management interventions for the homeless, vulnerably housed and persons with lived experience: A systematic review. PloS One. 2020;15(4):1-21.
13.	Stergiopoulos V, Gozdzik A, Nisenbaum R, Durbin J, Hwang SW, O'Campo P, et al. Bridging hospital and community care for homeless adults with mental health needs: Outcomes of a brief interdisciplinary intervention. Can J Psychiatry. 2018;63(11):774-84.
14.	Lamanna D, Stergiopoulos V, Durbin J, O'Campo P, Poremski D, Tepper J. Promoting continuity of care for homeless adults with unmet health needs: The role of brief interventions. Health Soc Care Community. 2018;26(1):56-64.
15.	Calgary Urban Project Society. Outreach programs, C2C and CAMPP. Available from: https://www.cupscalgary.com/programs-services/health/outreachprograms

16.   O'Toole TP, Johnson EE, Borgia ML, Rose J. Tailoring outreach efforts to increase primary care use among homeless veterans: Results of a randomized controlled trial. J Gen Intern Med. 2015;30(7):886-98.

17.   Mejia-Lancheros C, Lachaud J, To MJ, Lee P, Nisenbaum R, O'Campo P, et al. The long-term effects of a housing first intervention on primary care and non-primary care physician visits among homeless adults with mental illness: A 7-year rct follow-up. J Prim Care Community Health. 2021;12:21501327211027102.

18.   Gunner E, Chandan SK, Marwick S, Saunders K, Burwood S, Yahyouche A, et al. Provision and accessibility of primary healthcare services for people who are homeless: A qualitative study of patient perspectives in the UK. Br J Gen Pract. 2019;69(685):e526-e36.

19.   Health Quality Ontario. Interventions to improve access to primary care for people who are homeless: A systematic review. Ont Health Technol Assess Ser. 2016;16(9):1-50.

20.   Alberta Health Services. Primary care 2022. Available from: https://www.albertahealthservices.ca/info/Page4058.aspx

21.   Health Quality Council of Alberta. Understanding patient and provider experiences with relationship, information, and management continuity. Calgary, Alberta, Canada: Health Quality Council of Alberta; 2016.

22.   Andermann A. Taking action on the social determinants of health in clinical practice: A framework for health professionals. CMAJ. 2016;188(17-18):E474-e83.

23.   Declaration of alma-ata. WHO Chron. 1978;32(11):428-30.

24.   Saultz JW. Defining and measuring interpersonal continuity of care. Ann Fam Med. 2003;1(3):134-43.

25.   Reid R, Haggerty J, McKendry R. Defusing the confusion: Concepts and measures of continuity of health care. 2002.

26.   Lin IP, Wu SC. Effects of long-term high continuity of care on avoidable hospitalizations of chronic obstructive pulmonary disease patients. Health policy (Amsterdam, Netherlands). 2017;121(9):1001-7.

27.   Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur A-M, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ. 2007;177(11):1362.

28.   Saultz JW, Albedaiwi W. Interpersonal continuity of care and patient satisfaction: A critical review. Ann Fam Med. 2004;2(5):445-51.

29.   Saultz JW, Lochner J. Interpersonal continuity of care and care outcomes: A critical review. Ann Fam Med. 2005;3(2):159-66.

30.   Bazemore A, Petterson S, Peterson LE, Bruno R, Chung Y, Phillips RL, Jr. Higher primary care physician continuity is associated with lower costs and hospitalizations. Ann Fam Med. 2018;16(6):492-7.

31.   Chen CC, Cheng SH. Care continuity and care coordination: A preliminary examination of their effects on hospitalization. Med Care Res Rev. 2021;78(5):475-89.

32.   McBrien KA, Nguyen V, Garcia-Jorda D, Rondeau K, Polachek A, Kamran H, et al. Connect 2 Care, a novel community outreach program for vulnerably housed patients with high acute care use: A mixed-methods study protocol. Front Public Health. 2021;9:1487.

33.   Garrett N, Bikah Bi Nguema Engoang JA, Rubin S, Vickery KD, Winkelman TNA. Health system resource use among populations with complex social and behavioral needs in an urban, safety-net health system. Healthc (Amst). 2020;8(3):100448.

34.   Latimer EA, Rabouin D, Cao Z, Ly A, Powell G, Aubry T, et al. Costs of services for homeless people with mental illness in 5 Canadian cities: A large prospective follow-up study. CMAJ Open. 2017;5(3):E576-E85.
35.   Wick J, Campbell DJT, McAlister FA, Manns BJ, Tonelli M, Beall RF, et al. Identifying subgroups of adult high-cost health care users: A retrospective analysis. CMAJ Open. 2022;10(2):E390-e9.
36.   Campbell DJ, O'Neill BG, Gibson K, Thurston WE. Primary healthcare needs and barriers to care among Calgary's homeless populations. BMC Fam Pract. 2015;16:139.
37.   Purkey E, MacKenzie M. Experience of healthcare among the homeless and vulnerably housed a qualitative study: Opportunities for equity-oriented health care. Int J Equity Health. 2019;18(1):101.
38.   Khandor E, Mason K, Chambers C, Rossiter K, Cowan L, Hwang SW. Access to primary health care among homeless adults in Toronto, Canada: Results from the street health survey. Open Med. 2011;5(2):e94-e103.
39.   Hwang SW, Tolomiczenko G, Kouyoumdjian FG, Garner RE. Interventions to improve the health of the homeless: A systematic review. Am J Prev Med. 2005;29(4):311-9.
40.   Reid N, Mason J, Kurdyak P, Nisenbaum R, de Oliveira C, Hwang S, et al. Evaluating the impact of a critical time intervention adaptation on health care utilization among homeless adults with mental health needs in a large urban center. Can J Psychiatry. 2022;67(1):57-66.
41.   Sadowski LS, Kee RA, VanderWeele TJ, Buchanan D. Effect of a housing and case management program on emergency department visits and hospitalizations among chronically ill homeless adults: A randomized trial. JAMA. 2009;301(17):1771-8.
42.   de Vet R, Beijersbergen MD, Jonker IE, Lako DAM, van Hemert AM, Herman DB, et al. Critical time intervention for homeless people making the transition to community living: A randomized controlled trial. Am J Community Psychol. 2017;60(1-2):175-86.
43.   Whisler A, Dosani N, To MJ, O'Brien K, Young S, Hwang SW. The effect of a housing first intervention on primary care retention among homeless individuals with mental illness. PloS One. 2021;16(2):e0246859.
44.   Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R. Continuity of care: A multidisciplinary review. BMJ (Clinical research ed). 2003;327(7425):1219-21.
45.   Pandhi N, Saultz JW. Patients' perceptions of interpersonal continuity of care. J Am Board Fam Med. 2006;19(4):390-7.
46.   Almaawiy U, Pond GR, Sussman J, Brazil K, Seow H. Are family physician visits and continuity of care associated with acute care use at end-of-life? A population-based cohort study of homecare cancer patients. Palliat Med. 2014;28(2):176-83.
47.   Currie LB, Patterson ML, Moniruzzaman A, McCandless LC, Somers JM. Continuity of care among people experiencing homelessness and mental illness: Does community follow-up reduce rehospitalization? Health Serv Res. 2018;53(5):3400-15.
48.   Everett CM, Morgan P, Smith VA, Woolson S, Edelman D, Hendrix CC, et al. Interpersonal continuity of primary care of veterans with diabetes: A cohort study using electronic health record data. BMC Fam Pract. 2018;19(1):1-11.
49.   Dickins KA, Buchholz SW, Ingram D, Braun LT, Hamilton RJ, Earle M, et al. Supporting primary care access and use among homeless persons. Soc Work Public Health. 2020;35(6):335-57.
50.   Alberta Health Services. Alberta health services data repository for reporting (ahsdrr) and data stores data asset inventory. 2016.

51.   Alberta Health. Practitioner claims, physician claims, physician billing. 2020.

52.   Cunningham CT, Cai P, Topps D, Svenson LW, Jetté N, Quan H. Mining rich health data from Canadian physician claims: Features and face validity. BMC Res Notes. 2014;7:682.

53.   Virnig BA, McBean M. Administrative data for public health surveillance and planning. Annu Rev Public Health. 2001;22:213-30.

54.   Hutchison B, Levesque JF, Strumpf E, Coyle N. Primary health care in Canada: Systems in motion. Milbank Q. 2011;89(2):256-88.

55.   Breslau N, Reeb KG. Continuity of care in a university-based practice. J Med Educ. 1975;50(10):965-9.

56.   Bice TW, Boxerman SB. A quantitative measure of continuity of care. Med Care. 1977;15(4):347-9.

57.   Pollack CE, Hussey PS, Rudin RS, Fox DS, Lai J, Schneider EC. Measuring care continuity: A comparison of claims-based methods. Med Care. 2016;54(5):e30-4.

58.   Chen CC, Chen SH. Better continuity of care reduces costs for diabetic patients. Am J Manag Care. 2011;17(6):420-7.

59.   Dreiher J, Comaneshter DS, Rosenbluth Y, Battat E, Bitterman H, Cohen AD. The association between continuity of care in the community and health outcomes: A population-based study. Isr J Health Policy Res. 2012;1(1):21.

60.   Durbin A, Balogh R, Lin E, Wilton AS, Lunsky Y. Emergency department use: Common presenting issues and continuity of care for individuals with and without intellectual and developmental disabilities. J Autism Dev Disord. 2018;48(10):3542-50.

61.   Romano MJ, Segal JB, Pollack CE. The association between continuity of care and the overuse of medical procedures. JAMA Intern Med. 2015;175(7):1148-54.

62.   Guo JY, Chou YJ, Pu C. Effect of continuity of care on drug-drug interactions. Med Care. 2017;55(8):744-51.

63.   Hosmer DW. Applied logistic regression. Lemeshow S, Sturdivant RX, editors. Hoboken, N.J.: Hoboken, N.J. : Wiley3rd ed. / David W. Hosmer, Stanley Lemeshow, Rodney X. Sturdivant.; 2013.

64.   O'Carroll A, Wainwright D. Making sense of street chaos: An ethnographic exploration of homeless people's health service utilization. Int J Equity Health. 2019;18(1):113.

65.   O'Toole TP, Buckel L, Bourgault C, Blumen J, Redihan SG, Jiang L, et al. Applying the chronic care model to homeless veterans: Effect of a population approach to primary care on utilization and clinical outcomes. Am J Public Health. 2010;100(12):2493-9.

66.   Zhang L, Norena M, Gadermann A, Hubley A, Russell L, Aubry T, et al. Concurrent disorders and health care utilization among homeless and vulnerably housed persons in Canada. J Dual Diagn. 2018;14(1):21-31.

67.   Gabrielian S, Yuan AH, Andersen RM, Rubenstein LV, Gelberg L. VA health service utilization for homeless and low-income veterans: A spotlight on the VA supportive housing (VASH) program in greater los angeles. Med Care. 2014;52(5):454-61.

68.   Kolber M, Korowynk C, M. AG. Evidence pertaining to a healthy primary care workforce. 2020.

69.   Garcia-Jorda D, Fabreau GE, Li QKW, Polachek A, Milaney K, McLane P, et al. Being a member of a novel transitional case management team for patients with unstable housing: An ethnographic study. BMC Health Serv Res. 2022;22(1):232.

70.   Peart A, Lewis V, Brown T, Russell G. Patient navigators facilitating access to primary care: A scoping review. BMJ Open. 2018;8(3):e019252.

71.   Hudon C, Chouinard MC, Aubrey-Bassler K, Muhajarine N, Burge F, Bush PL, et al. Case management in primary care for frequent users of health care services: A realist synthesis. Ann Fam Med. 2020;18(3):218-26.

72.   Canadian Institute for Health Information. Continuity of care with family medicine physicians: Why it matters. 2014.

73.   Gentil L, Grenier G, Bamvita JM, Fleury MJ. Satisfaction with health and community services among homeless and formerly homeless individuals in Quebec, Canada. Health Soc Care Community. 2020;28(1):22-33.

74.   Levene LS, Baker R, Walker N, Williams C, Wilson A, Bankart J. Predicting declines in perceived relationship continuity using practice deprivation scores: A longitudinal study in primary care. Br J Gen Pract. 2018;68(671):e420-e6.

75.   Magwood O, Leki VY, Kpade V, Saad A, Alkhateeb Q, Gebremeskel A, et al. Common trust and personal safety issues: A systematic review on the acceptability of health and social interventions for persons with lived experience of homelessness. PloS One. 2019;14(12):e0226306.