Introduction

It is estimated that 5% of the population accounts for up to 66% of total health care costs in Canada, resulting in these individuals being described as high cost users.(1–4) Previous studies of linked national survey and administrative datasets in Ontario, Manitoba, and Saskatchewan indicate that high cost users are often older individuals with multi-morbidity and poor socioeconomic status.(2,3,5,6) An analysis of Ontario data over three years demonstrated that 31% of high cost users will remain in the top 5% in subsequent years.(7) Numerous jurisdictions have implemented coordinated care planning and/or case management models to address the needs of patients with complex conditions, as well as to support these patients in navigating the health care system and connecting them with community services.(8–12) Studies on the effectiveness of coordinated care plans for high users of the health care system have yielded mixed results with some indicating modest reductions in specific aspects of health care utilization.(8,10,12) Data on the impact of coordinated care plans ~~conducted~~ in Canadian settings are limited. A randomized controlled trial conducted in Montreal found that elderly individuals enrolled in an integrated care program experienced a significant reduction in alternate level of care (ALC) inpatient days with no differences seen in the number of acute inpatient days or emergency department visits when compared to a control group.(12)

In 2012, the Ontario Ministry of Health and Long-Term Care announced the creation of Health Links in each of the 14 Local Health Integration Networks (LHIN) to provide individualized coordinated care plans.(9,13) Eleven Health Links were established in the Hamilton Niagara Haldimand Brant LHIN, which is located in southern Ontario.(14) The objectives of the present study are to determine whether individuals with a coordinated care plan within Hamilton Niagara Haldimand Brant LHIN differ in health care utilization at 6 and 12

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months post care plan date when compared to a propensity-score matched control group. The primary outcomes of interest are the number of emergency department visits, the number of inpatient admissions, and the length of inpatient stay.

Methods

Setting

The Hamilton Niagara Haldimand Brant LHIN plans, funds, and integrates the local health system to provide health care services to approximately 1.45 million people residing in the cities of Hamilton and Burlington, regional municipality of Niagara, and counties of Haldimand, Norfolk, and Brant. Coordinated care planning within the LHIN started in fiscal year 2013-14 and was fully implemented across the 11 Health Links during fiscal year 2015-16.

Model of Coordinated Care Planning

The target population for Health Links is the top 5% of high health care users in the province and includes patients with multiple comorbidities and complex health needs.(15) In Hamilton Niagara Haldimand Brant LHIN, the priority is on patients who have had a minimum of five emergency department visits in the past year. The goal of Health Links' model of care planning is to provide patient-centred, coordinated, and efficient care through a single point of contact. Emphasis is placed on patient engagement and identifying the actions and goals that are the most meaningful to the patient. Coordinated care planning strengthens communication between patients, their providers, and within a patient's multi-disciplinary care team, improves the patient's journey along the continuum of care, and is intended to reduce unnecessary visits to the hospital. A selection of innovative practices entitled Coordinated Care Management are

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available to support Health Links through Health Quality Ontario.(16) Patients who had a history of five or more emergency department visits and who may have had inpatient admissions within the past year were identified and assessed for eligibility for a coordinated care plan within the Health Links model of care. Priority focus populations included individuals with mental health or addiction problems, frail individuals, and people receiving palliative care. Furthermore, individuals at risk for hospitalizations were also considered. These populations included individuals with unstable conditions or declining health, as well as those with challenges around having low support, poor health literacy, low household income, housing issues, and transportation problems. The list of high health care users within the Hamilton Niagara Haldimand Brant LHIN was prepared using data housed at the Integrated Decision Support (IDS), a data warehouse and business intelligence tool, hosted by Hamilton Health Sciences.(17) Furthermore, hospital sites within the LHIN have real-time identification of patients. Patients who are deemed eligible, are invited to participate. If the patient consents to enrolment, the coordinated care plan is started and engages the patient's primary care physician, home services, and community partners.

Participants

Individuals in the Hamilton Niagara Haldimand Brant LHIN, 16 years of age and older, who had a coordinated care plan ('care plan enrollees') initiated between October 1, 2013 and September 30, 2015 were eligible for inclusion. The potential control pool ('potential controls') was comprised of individuals (≥16 years of age) residing in the LHIN who met the enrollment criteria for Health Links, having had five or more emergency department visits within a fiscal year, applied across fiscal years 2013-14, 2014-15, and 2015-16. Individuals were removed from

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the control pool if they ever participated in a coordinated care plan through Health Links. Eligible controls were randomly assigned proxy care plan index dates that mimicked the distribution of the index dates of care plan enrollees to calculate the health care utilization for this group. As the primary outcome measures were first compared at 6 months post-index date (date of the coordinated care plan initiation), care plan enrollees and potential controls who were deceased within this timeframe were excluded from the analysis. In addition, individuals admitted to long-term care post-index date were also excluded as their care was no longer coordinated by Health Links.

Measures and Sources of Data

The primary outcomes of interest for the analysis were the number of emergency department visits, the number of inpatient admissions, and the length of inpatient stay. These measures were chosen as they were identified as priorities for the Health Links model of care provincially or have been identified to be impacted by care planning in previous studies.(15,18–20) Information was obtained from administrative databases using Integrated Decision Support (IDS.(17) Data captured in IDS includes health care encounters within Hamilton Niagara Haldimand Brant LHIN and all neighbouring LHINs (Erie St. Clair, Mississauga Halton, South West, Toronto Central, Waterloo Wellington). Information within the databases housed at IDS is directly provided through hospital or LHIN submissions. Information on patient characteristics, such as sex, age, Health Link geography, coordinated care plan index date, home care clients status, and long-term care home residence came from the Client Health and Related Information System (CHRIS) and the Health Links Internal Reporting databases for patients on coordinated care plans.(21) Demographic information was cross-referenced with data from the National

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Ambulatory Care Reporting System (NACRS),(22) and the CIHI Discharge Abstract Database (DAD).(23) Data on ambulatory care were abstracted from the NACRS,(22) while data on inpatient admissions, length of inpatient stay, and Charlson Comorbidity Index (24) were obtained from the DAD.(23) Information from NACRS and DAD was used to determine if the individuals had one or chronic conditions tracked by Hamilton Niagara Haldimand Brant LHIN Health Links based on the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA) diagnostic codes (25) (please see Appendix 1 for diagnostic code definitions): arthritis and related disorders, chronic obstructive pulmonary disease, congestive heart failure, diabetes, neoplasm, psychiatric conditions, renal failure, or substance-related disorders.(26) Care plan enrollees were identified through each Health Link's standardized reporting. Information across the databases was linked using an anonymous and unique master patient index number.

Ethical Considerations

The analysis was conducted using administrative data as part of a quality improvement project and did not include personal health information. As such, it was reviewed by the Privacy and Freedom of Information Office at Hamilton Health Sciences and was determined to not require research ethics board approval. The STROBE Checklist was followed in the preparation of this paper.(27)

Statistical Analysis

Care plan enrollees were propensity-score matched to potential controls within the HNHB LHIN in a quasi-experimental study. Propensity score analysis was conducted to

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determine the characteristics that predict the probability of enrollment on a care plan among high care users. Propensity scores were calculated using a stepwise logistic regression model (significance level for entry and stay was 0.15) with the following variables included in the final model: age, Health Link geography, fiscal year quarter of index date, presence of home and community services pre-index date, number of 12 months pre-index date emergency department visits and inpatient stays, and the presence of chronic health conditions (congestive heart failure, chronic obstructive pulmonary disease, psychiatric conditions, substance-related disorders). Care plan enrollees were matched to potential controls using 1:1 greedy matching through the %gmatch macro from the Mayo Clinic within 0.2 standard caliper width of the propensity score.(28,29) The participants were exact matched on sex, whether they had 12 months post-index data available, and whether they had CHF or COPD diagnoses as patients with these two conditions were focus populations. Participants were matched within one standard deviation of the care plan enrollees' mean for health care utilization (number of emergency department visits and inpatient stays within 12 months pre-index date) and two standard deviations of the care plan enrollees' mean for age. The distribution of characteristics between the matched care plan enrollees and matched controls was evaluated with a standardized difference of 10% or less indicating balance.

Differences in 12 months pre- and 12 months post-index date health care utilization were compared between matched care plan enrollees and matched controls using the Wilcoxon signed-rank test. A negative binomial regression model was fit for each health care utilization outcome (number of emergency department visits, number of inpatient hospitalizations, and inpatient length of stay in days) at 6 and 12 months post-index date, controlling for the respective baseline health care utilization at12 months pre-index date. The modelling strategy was selected due to

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the over-dispersion observed in the health care utilization variables. For each of the models, the Pearson's chi-square statistic and scaled deviance indicated good model fit. The results between groups are reported as means adjusted for pre-index date health care utilization and incidence rate ratios (ratio of the adjusted means of the two groups). A p-value of less than 0.05 was considered to be statistically significant. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, North Carolina).

Results

Overall, 704 individuals, 16 years of age and older, were enrolled on a coordinated care plan between September 1, 2013 and September 30, 2015 (please see Figure 1: participant flow diagram). Of the care plan enrollees, 104 were ineligible for inclusion due to being admitted to long-term care following their care plan (n=10) or being deceased prior to the initial analysis at 6 months (n=94). Among 27,257 potential controls, 1,808 were ineligible for inclusion due to being admitted to long-term care following their care plan (n=284) or being deceased prior to the initial analysis at 6 months (n=1,524). 600 coordinated care plan enrollees and 25,449 potential controls were eligible for inclusion in the propensity score matching algorithm which resulted in 548 matched pairs (91.3% of 600 care plan enrollees) with at least 6 months post-index data. Of note, at 12 months post-index date, 511 matched care plan enrollees and the corresponding 511 matched controls were alive. Table 1 presents the descriptive characteristics of the matched sample by group at baseline. Standardized differences between the two groups were less than 10%, indicating a good balance of characteristics.

The standardized differences for the unmatched care plan enrollees (n=52) and the unmatched individuals from the potential control group (n=24,901) were compared to the

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matched care plan enrollees (Table 2). Overall, the unmatched controls tended to be female, younger, had less co-morbidities, and experienced lower baseline health care utilization compared to the matched care plan enrollees. The opposite was true of unmatched care plan enrollees who tended to be male, older, had more co-morbidities, and experienced higher health care utilization compared to the matched care plan enrollees. Table 3 provides additional detail on health care utilization for unmatched care plan enrollees and shows that this group also experienced decreases in health care utilization following the index date.

Table 4 presents the unadjusted mean and median health care utilization within each of the groups (matched care plan enrollees and matched controls) comparing the 12 months pre- to 12 months post-index date values. Table 5 presents the adjusted means at six months post-index date for both groups and outlines the incidence rate ratios (IRR), controlling for pre-index date health care utilization. Matched care plan enrollees were found to have a significantly lower number of emergency department visits at six months post-index date (IRR: 0.81, 95% CI: 0.72-0.91, $p<0.01$) compared to the matched control group. Similar findings were seen at 12 months post-index date (IRR: 0.88, 95% CI: 0.79-0.99, $p<0.05$) (Table 6). No significant differences were observed among the groups in the number of inpatient hospitalizations or inpatient length of stay (total, acute, or ALC). Table 7 presents the change from baseline analysis for both groups at 12 months. No statistically significant differences were found between the groups although matched care plan enrollees tended to have greater decreases in emergency department visits and inpatient admissions.

Interpretation

Main Findings

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In this quasi-experimental study of health care utilization among propensity-score matched individuals with a coordinated care plan compared to control patients, it was found that both groups of users (matched care plan enrollees and matched controls) had decreases in health care utilization over a period of 12 months post-index date. In the comparative analysis, it was shown that matched care plan enrollees experienced a larger and statistically significant decrease in the number of emergency department visits at both 6 and 12 months post-index date compared to control patients, when adjusting for baseline emergency department utilization. No differences were observed in the number of inpatient hospitalizations or the length of stay in hospital between groups post-index date. The findings are clinically relevant as one of the objectives of coordinated care planning is to reduce the number of emergency department visits that can be better addressed in other health care settings. As such, it seems that care plan enrollees are experiencing a decrease in the frequency of emergency department visits, which may be attributed to integrated and coordinated care planning.

Explanation and Comparison with Other Studies

The present study indicated that the number of emergency department visits was lower among care plan enrollees compared to matched controls. A similar finding was not shown for hospitalizations. A possible explanation for this may be that coordinated care planning had the greatest impact on reducing the number of less major incidents that did not need an emergency medicine visit, such as managing minor and moderate issues in the community. One of the reasons that the high care user controls improved over time is that high use is not a permanent condition for most people. Based on a previous study of health care use among Ontarians, it was shown that of individuals who were identified to be in the 95th percentile or greater in terms of

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health spending in 2009, around 38% of the individuals were classified to be below the 90th percentile for spending by 2011.(7)

The results of this study are more promising compared to similar interventions. One recent analysis evaluated the effect of multidisciplinary team case management on health care use among high risk patients in the United Kingdom, one year following the implementation of the service compared to a propensity-scored matched control group.(8) The authors concluded that the intervention did not meet its objectives of reducing health care service utilization having observed minimal but not clinically relevant findings. In another study which employed a randomized controlled trial of elderly individuals with disabilities living in Montreal to assess an integrated care program, the authors found that the program resulted in greater accessibility to home health care and a reduction in ALC inpatient days.(12) However, the number of emergency department visits or days of acute care in hospital did not differ between the groups. In a large randomized controlled trial of 15 care coordination programs across the United States, no overall differences in hospitalizations were observed among treatment group individuals compared to patients receiving usual care.(30)

Limitations

It is important to note that although coordinated care plans follow a standard framework in Ontario, they are meant to evolve in an iterative process for each person, thereby being individualized to each enrollee's personal goals and unique circumstances. As such, the population with a coordinated care plan may not be a homogeneous entity within Hamilton Niagara Haldimand Brant LHIN. Individuals with care plans have a wide range of chronic conditions. In addition, people in the potential control pool in the LHIN may have not yet been approached for enrollment on a coordinated care plan or have been invited to participate but

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declined. Of note, it is evident that during the first six months following the index date, more care plan enrollees were deceased (13.4% versus 5.6%) or admitted to long-term care (9.6% versus 1.0%) compared to potential controls. This may perhaps indicate that care plan enrollees have more complex medical and social requirements. Therefore, even though the matched care plan enrollees and controls were equivalent in the measured baseline characteristics, they may have differed in unmeasured factors, such as social determinants of health, which could have led to a masking of the true effect of the care plan. Lastly, it is important to note that 8.3% of the care plan enrollees were not successfully matched to a control. This may affect the generalizability of the results to all Health Links enrollees, particularly those who are higher users prior to enrollment on a coordinated care plan.

Conclusions and Implications for Practice and Future Research

The potential long-term effects of coordinated care planning on health care utilization will be examined over time as the Health Links model of care evolves and additional individuals are enrolled. In addition, further work is being undertaken to explore other aspects of care planning in HNHB LHIN, including the patient experience of enrollees and the return-on-investment of the Health Links model of care. In conclusion, the results show that individuals on coordinated care plans in HNHB LHIN experienced reductions in emergency department visits as early as six months post-index date when compared to a propensity score-matched control group. It is noteworthy to examine this relationship in the future to see if these reductions persist past one year.

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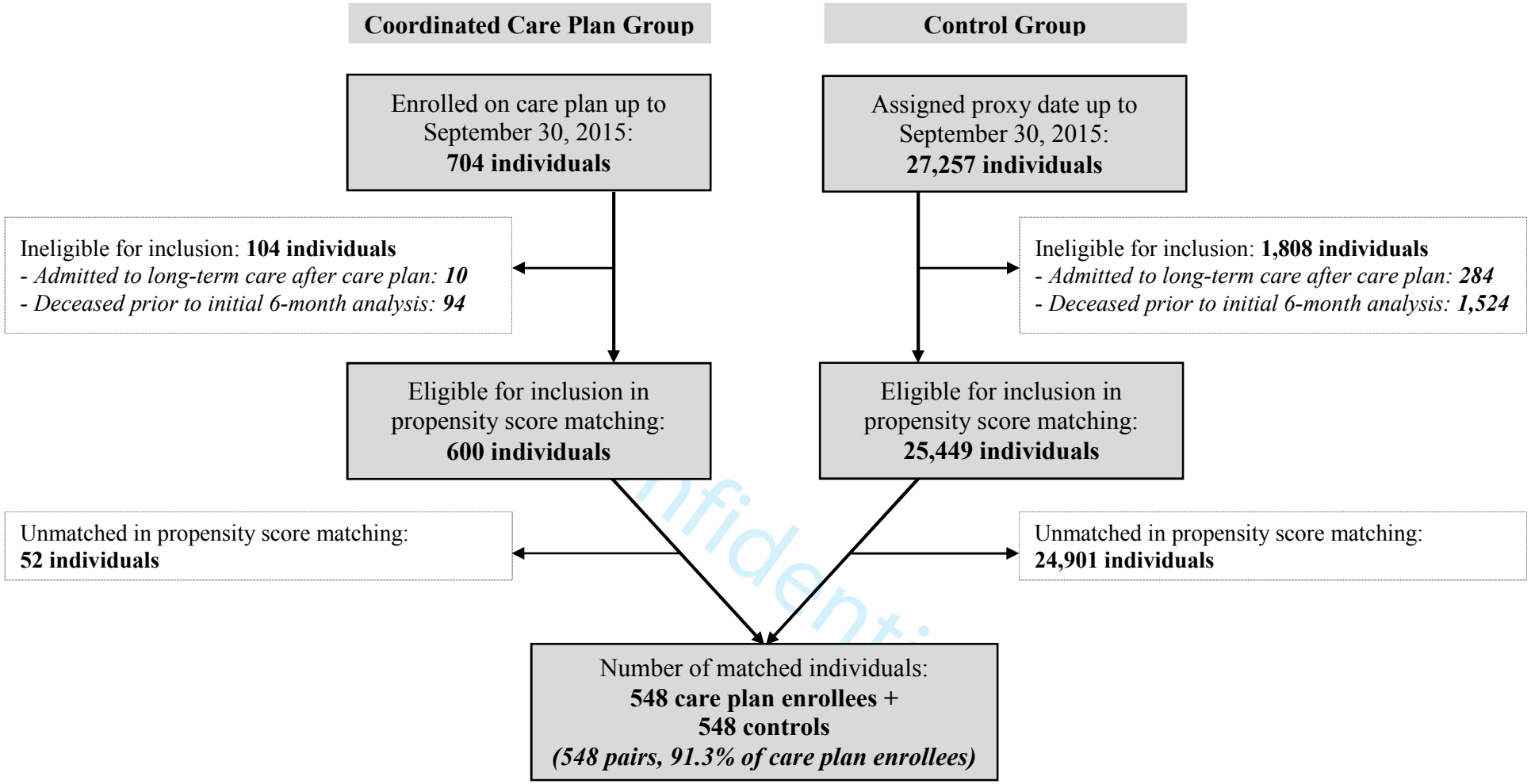
Coordinated Care Plan Group
Control Group
Enrolled on care plan up to September 30, 2015: 704 individuals
Assigned proxy date up to September 30, 2015: 27,257 individuals
Ineligible for inclusion: 104 individuals
- Admitted to long-term care after care plan: 10
- Deceased prior to initial 6-month analysis: 94
Ineligible for inclusion: 1,808 individuals
- Admitted to long-term care after care plan: 284
- Deceased prior to initial 6-month analysis: 1,524
Eligible for inclusion in propensity score matching: 600 individuals
Eligible for inclusion in propensity score matching: 25,449 individuals
Unmatched in propensity score matching: 52 individuals
Unmatched in propensity score matching: 24,901 individuals
Number of matched individuals: 548 care plan enrollees + 548 controls (548 pairs, 91.3% of care plan enrollees)

Table 1. Baseline Characteristics of Matched Care Plan Enrollees and Matched Controls

Baseline Characteristic	Matched Care Plan Enrollees (n=548)	Matched Controls (n=548)	Standardized Difference
Sex, n (%)			
Female	290 (52.9%)	290 (52.9%)	0.00
Age, mean ± SD	67.7 ± 17.1	67.9 ± 17.3	0.01
Health Link, n (%)			
Brant Six Nations	42 (7.7%)	42 (7.7%)	0.00
Burlington	57 (10.4%)	51 (9.3%)	0.03
Haldimand	38 (6.9%)	32 (5.8%)	0.04
Hamilton Central	111 (20.3%)	120 (21.9%)	0.03
Hamilton East	51 (9.3%)	59 (10.8%)	0.04
Hamilton West	35 (6.4%)	38 (6.9%)	0.02
Niagara North East	61 (11.1%)	53 (9.7%)	0.04
Niagara North West	52 (9.5%)	50 (9.1%)	0.01
Niagara South East	9 (1.6%)	8 (1.5%)	0.01
Niagara South West	41 (7.5%)	49 (8.9%)	0.04
Norfolk	51 (9.3%)	46 (8.4%)	0.03
Coordinated Care Plan or Proxy Index Fiscal Year and Quarter, n (%)	7 (1.3%)	6 (1.1%)	0.01
2013-2014 Q3	8 (1.5%)	12 (2.2%)	0.05
2013-2014 Q4	13 (2.4%)	9 (1.6%)	0.04
2014-2015 Q1	34 (6.2%)	30 (5.5%)	0.03
2014-2015 Q2	46 (8.4%)	44 (8.0%)	0.01
2014-2015 Q3	128 (23.4%)	122 (22.3%)	0.02
2014-2015 Q4	163 (29.7%)	162 (29.6%)	0.00
2015-2016 Q1	149 (27.2%)	163 (29.7%)	0.05
2015-2016 Q2			
Co-morbid Conditions, n (%)			
Arthritis	271 (49.5%)	271 (49.5%)	0.00
COPD	244 (44.5%)	244 (44.5%)	0.00
CHF	182 (33.2%)	182 (33.2%)	0.00
COPD and CHF	103 (18.8%)	103 (18.8%)	0.00
Diabetes	219 (40.0%)	206 (37.6%)	0.04
Neoplasm	97 (17.7%)	108 (19.7%)	0.04
Psychiatric Condition	213 (38.9%)	214 (39.1%)	0.00
Renal Failure	173 (31.6%)	161 (29.4%)	0.04
Substance-Related Disorders	122 (22.3%)	121 (22.1%)	0.00
Charlson Comorbidity Index, n (%)			
0	345 (63.0%)	330 (60.2%)	0.05
1	95 (17.3%)	100 (18.3%)	0.02
2	61 (11.1%)	54 (9.9%)	0.03
3+	47 (8.6%)	64 (11.7%)	0.09
Community Care Access Centre (CCAC) Service Prior to Index Date, n (%)	274 (50.0%)	266 (48.5%)	0.02
Emergency Department Visits, mean ± SD			
6 Months Pre-Index Date	4.3 ± 5.1	4.3 ± 4.2	0.00
12 Months Pre-Index Date	7.6 ± 7.8	7.4 ± 7.3	0.02
Inpatient Hospitalizations, mean ± SD			
6 Months Pre-Index Date	1.4 ± 1.5	1.3 ± 1.4	0.00
12 Months Pre-Index Date	2.3 ± 2.0	2.2 ± 2.0	0.07
Inpatient Length of Stay (LOS), mean ± SD			
6 Months Pre-Index Date Total LOS	11.6 ± 19.4	11.8 ± 21.5	0.01
12 Months Pre-Index Date Total LOS	19.6 ± 27.3	18.7 ± 28.3	0.03
6 Months Pre-Index Date Acute LOS	9.4 ± 14.1	9.6 ± 13.9	0.01
12 Months Pre-Index Date Acute LOS	15.9 ± 19.2	15.5 ± 20.6	0.02
6 Months Pre-Index Date ALC LOS	2.2 ± 10.2	2.3 ± 12.2	0.01
12 Months Pre-Index Date ALC LOS	3.7 ± 15.6	3.2 ± 13.8	0.04

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Table 2. Comparison of Unmatched Care Plan Enrollees and Unmatched Controls to Matched Care Plan Enrollees

Baseline Characteristic	Matched Care Plan Enrollees (n=548)	Unmatched Care Plan Enrollees (n=52)	Standardized Difference	Unmatched Controls (n=24,901)	Standardized Difference
Sex, n (%)					
Female	290 (52.9%)	23 (44.2%)	0.14	13,912 (55.9%)	0.05
Age, mean years ± SD	67.7 ± 17.1	70.6 ± 15.9	0.17	50.5 ± 21.8	0.88
Co-morbid Conditions, n (%)					
Arthritis	271 (49.5%)	30 (57.7%)	0.14	8,434 (33.9%)	0.26
COPD	244 (44.5%)	27 (51.9%)	0.12	4,397 (17.7%)	0.48
CHF	182 (33.2%)	23 (44.2%)	0.19	1,710 (6.9%)	0.52
Diabetes	219 (40.0%)	28 (53.9%)	0.23	4,646 (18.7%)	0.38
Neoplasm	97 (17.7%)	8 (15.4%)	0.05	2,201 (8.8%)	0.21
Psychiatric Condition	213 (38.9%)	27 (51.9%)	0.22	5,725 (23.0%)	0.28
Renal Failure	173 (31.6%)	20 (38.5%)	0.12	1,838 (7.4%)	0.48
Substance Abuse Condition	122 (22.3%)	17 (32.7%)	0.20	3,272 (13.1%)	0.19
Charlson Comorbidity Index, n (%)					
0	345 (63.0%)	18 (34.6%)	0.48	22,696 (91.1%)	0.54
1	95 (17.3%)	12 (23.1%)	0.12	1,055 (4.2%)	0.32
2	61 (11.1%)	12 (23.1%)	0.28	658 (2.6%)	0.25
3+	47 (8.6%)	10 (19.2%)	0.27	492 (2.0%)	0.22
Emergency Department Visits, mean number ± SD					
6 Months Pre-Index Date	4.3 ± 5.1	15.6 ± 22.0	0.71	2.7 ± 2.8	0.39
12 Months Pre-Index Date	7.6 ± 7.8	29.9 ± 37.1	0.83	4.4 ± 4.5	0.50
Inpatient Hospitalizations, mean number ± SD					
6 Months Pre-Index Date	1.4 ± 1.5	2.8 ± 2.5	0.70	0.3 ± 0.8	0.89
12 Months Pre-Index Date	2.3 ± 2.0	5.4 ± 4.0	0.97	0.5 ± 1.1	1.12
Inpatient Length of Stay (LOS), mean days ± SD					
6 Months Pre-Index Date Total LOS	11.6 ± 19.4	24.7 ± 29.8	0.52	2.2 ± 8.6	0.63
12 Months Pre-Index Date Total LOS	19.6 ± 27.3	43.3 ± 42.6	0.66	3.5 ± 12.7	0.76
6 Months Pre-Index Date Acute LOS	9.4 ± 14.1	21.5 ± 24.7	0.60	1.9 ± 6.7	0.68
12 Months Pre-Index Date Acute LOS	15.9 ± 19.2	37.6 ± 35.3	0.77	3.0 ± 9.5	0.85
6 Months Pre-Index Date ALC LOS	2.2 ± 10.2	3.2 ± 12.3	0.09	0.3 ± 3.7	0.24
12 Months Pre-Index Date ALC LOS	3.7 ± 15.6	5.7 ± 15.1	0.13	0.5 ± 6.4	0.27

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Table 3. Unadjusted Means and Medians at Pre- and Post-Index Date for Unmatched Care Plan Enrollees

	12 Months Pre-Index Date (n=52)		12 Months Pre-Index Date* (n=42)		6 Months Post-Index Date (n=52)		12 Months Post-Index Date (n=42)	
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)
Emergency Department Visits	29.9 ± 37.1	13.0 (30.5)	35.1 ± 39.5	15.0 (42.0)	14.2 ± 26.9	4.0 (8.5)	26.5 ± 42.2	6.5 (32.0)
Inpatient Hospitalizations	5.4 ± 4.0	5.0 (6.0)	5.4 ± 4.3	5.0 (7.0)	1.5 ± 1.9	1.0 (3.0)	2.4 ± 3.1	1.0 (4.0)
Total Inpatient Length of Stay	43.3 ± 42.6	33.0 (45.5)	45.0 ± 45.9	35.0 (51.0)	21.7 ± 38.7	2.0 (23.5)	31.8 ± 55.3	10.0 (28.0)
Acute Inpatient Length of Stay	37.6 ± 35.3	31.0 (47.0)	38.6 ± 38.0	31.0 (51.0)	12.9 ± 20.3	2.0 (18.5)	20.4 ± 35.8	7.5 (17.0)
ALC Inpatient Length of Stay	5.7 ± 15.1	0.0 (2.5)	6.5 ± 16.6	0.0 (4.0)	8.8 ± 25.0	0.0 (0.0)	11.4 ± 28.6	0.0 (8.0)

*Data for care plan enrollees who had 12 months-post data

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Table 4. Unadjusted Means and Medians at 12 Months Pre- and Post-Index Date by Group for Individuals Alive at 12 Months Post-Index Date

		12 Months Pre-Index Date		12 Months Post-Index Date			
		Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	Mean Difference ± SD	*P*-value[1]
Emergency Department Visits	*Matched Care Plan Enrollees (n=511)*	7.7 ± 8.0	6.0 (6.0)	5.6 ± 7.8	3.0 (6.0)	-2.07 ± 6.51	<0.01
	Matched Controls (n=511)	7.4 ± 7.4	6.0 (5.0)	5.6 ± 6.8	4.0 (5.0)	-1.84 ± 6.81	<0.01
Inpatient Hospitalizations	*Matched Care Plan Enrollees (n=511)*	2.3 ± 2.0	2.0 (2.0)	1.4 ±2.1	1.0 (2.0)	-0.83 ± 2.27	<0.01
	Matched Controls (n=511)	2.1 ± 2.0	2.0 (2.0)	1.4 ± 1.8	1.0 (2.0)	-0.73 ± 2.31	<0.01
Total Inpatient Length of Stay	*Matched Care Plan Enrollees (n=511)*	18.7 ± 24.8	10.0 (23.0)	12.7 ± 27.2	2.0 (16.0)	-6.06 ± 33.47	<0.01
	Matched Controls (n=511)	18.0 ± 27.6	9.0 (24.0)	12.6 ± 25.4	3.0 (15.0)	-5.38 ± 34.96	<0.01
Acute Inpatient Length of Stay	*Matched Care Plan Enrollees (n=511)*	15.6 ± 19.2	9.0 (21.0)	9.7 ± 16.6	1.0 (13.0)	-5.87 ± 21.87	<0.01
	Matched Controls (n=511)	14.9 ± 20.0	8.0 (20.0)	9.4 ± 16.8	3.0 (12.0)	-5.51 ± 23.45	<0.01
ALC Inpatient Length of Stay	*Matched Care Plan Enrollees (n=511)*	3.2 ± 11.5	0.0 (0.0)	3.0 ± 16.7	0.0 (0.0)	-0.19 ± 20.21	0.14
	Matched Controls (n=511)	3.1 ± 13.7	0.0 (0.0)	3.2 ± 14.9	0.0 (0.0)	0.12 ± 20.03	0.93

[1] The means between pre- and post-index date were compared using the Wilcoxon signed-rank test within each group

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Table 5. Adjusted Means and Incidence Rate Ratios for 6 Month Health Care Utilization by Group

	Adjusted Means (95% CI) *Matched Care Plan Enrollees (n=548)*	Adjusted Means (95% CI) *Matched Controls (n=548)*	Incidence Rate Ratios (95% CI) *Reference Group: Matched Controls*
Emergency Department Visits	2.52 (2.32-2.74)	3.11 (2.87-3.37)	0.81* (0.72-0.91)
Inpatient Hospitalizations	0.73 (0.65-0.83)	0.84 (0.74-0.95)	0.87 (0.73-1.04)
Total Inpatient Length of Stay	7.94 (6.39-9.86)	8.02 (6.46-9.96)	0.99 (0.73-1.34)
Acute Inpatient Length of Stay	5.78 (4.71-7.08)	5.78 (4.71-7.08)	1.00 (0.75-1.33)
ALC Inpatient Length of Stay	2.05 (1.18-3.58)	2.19 (1.26-3.81)	0.94 (0.43-2.06)

*$p<0.01$

[1] All models are adjusted for baseline 12–month utilization for given outcome measure

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Table 6. Adjusted Means and Incidence Rate Ratios for12-Month Health Care Utilization by Group

	Adjusted Means (95% CI) *Matched Care Plan Enrollees (n=511)*	Adjusted Means (95% CI) *Matched Controls (n=511)*	Incidence Rate Ratios (95% CI) *Reference Group: Matched Controls*
Emergency Department Visits	4.62 (4.26-5.01)	5.25 (4.85-5.68)	0.88* (0.79-0.99)
Inpatient Hospitalizations	1.27 (1.13-1.43)	1.32 (1.18-1.49)	0.96 (0.82-1.13)
Total Inpatient Length of Stay	11.80 (9.78-14.23)	12.18 (10.10-14.69)	0.97 (0.74-1.26)
Acute Inpatient Length of Stay	8.79 (7.36-10.49)	9.05 (7.58-10.81)	0.97 (0.76-1.25)
ALC Inpatient Length of Stay	2.98 (1.88-4.71)	3.16 (2.00-5.00)	0.94 (0.49-1.80)

*$p<0.05$

[1] All models are adjusted for baseline 12–month utilization for given outcome measure

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Appendix 1. International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA) Diagnostic Code Definitions

Condition	ICD-10-CA Diagnostic Code
Arthritis and related disorders	M00-03, M05-19, M22-25, M32-36, M45-48, M70-71, M75-77 M79, M99
Chronic obstructive pulmonary disease	J40-44, J47
Congestive heart failure	I50
Diabetes	E10-14
Neoplasm	C00-97
Psychiatric conditions	F20-29, F31-33, F40-41, F50, F60-62
Renal failure	N17-19
Substance-related disorders	F10-19

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