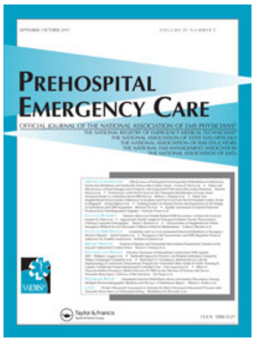

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Reducing 9-1-1 Emergency Medical Service Calls By Implementing A Community Paramedicine Program For Vulnerable Older Adults In Public Housing In Canada: A Multi-Site Cluster Randomized Controlled Trial

Gina Agarwal, MBBS, PhD, Ricardo Angeles, PhD, Melissa Pirrie, MA, Brent McLeod, MPH, Francine Marzanek, BSc, Jenna Parascandalo, BA, Lehana Thabane, PhD

Abstract

Objective: Older adults account for 38–48% of emergency medical service (EMS) calls, have more chronic diseases, and those with low income have lower quality of life. Mobile integrated health and community paramedicine may help address these health inequalities and reduce EMS calls. This study examines the effectiveness of the Community Paramedicine at Clinic (CP@clinic) program in decreasing EMS calls and improving health outcomes in low-income older adults. **Methods:** This was an open-label, pragmatic, cluster-randomized controlled trial conducted within subsidized public housing buildings for older adults in 5 paramedic services across Ontario, Canada. A total of 30 apartment buildings were eligible (>50 units, >60% of units occupied by older adults, unique postal code, available match for pairing). Paired buildings were randomly allocated to intervention (CP@clinic for one year) or control (usual care) via computer-generated randomization. The CP@clinic intervention is a community-based, paramedic-led, health promotion and disease prevention program held weekly in building common rooms. CP@clinic includes risk assessment with validated tools, decision support, health promotion, referrals to resources, and reports back to family doctors. All residents could participate, but only older adults (55 years and older) were included in analyses. The primary outcome was building-level EMS calls from paramedic service databases. Secondary outcomes were individual-level changes in chronic disease risk factors and quality-adjusted-life-years (QALYs). Data were analyzed using Generalized Estimating Equations to account for clustering by sites. **Results:** Intention-to-treat analysis showed no significant difference in EMS calls (mean difference = −0.37/100 apartment units/month, 95%CI: −0.98 to 0.24). Sensitivity analysis excluding data from 2 building pairs with eligibility changes after intervention initiation revealed a significant difference in EMS calls in

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Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/ipec.

The authors report no conflict of interest.

Author Contributions: G. Agarwal, R. Angeles, B. McLeod, and F, Marzanek were involved in the initial protocol development and study design. G. Agarwal, R. Angeles, M. Pirrie, and L. Thabane were involved in the statistical analysis. All authors were involved in the conduction of the study. G. Agarwal, R. Angeles, M. Pirrie, F. Marzanek, J. Parascandalo, and L. Thabane were involved in drafting the paper. All authors gave final approval of the version to be published.

Anonymized patient level data will be made available from the corresponding author on reasonable request. Consent was not obtained for external data sharing but the presented data are anonymized and risk of identification is low. No additional data are available.

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

This trial was approved by the Hamilton Integrated Research Ethics Board.

We would like to acknowledge the management and community paramedics of Hamilton Paramedic Service, Guelph–Wellington Paramedic Service, York Region Paramedic and Seniors Services, City of Greater Sudbury Paramedic Services, and County of Simcoe Paramedic Services. We would also like to acknowledge the support of City Housing Hamilton, County of Wellington Housing, Housing York Inc., Social Housing Department, County of Simcoe, and Greater Sudbury Housing Corporation. This work was supported by the Hamilton Academic Health Sciences Organization (HAHSO) and the Canadian Institutes of Health Research (CIHR) under Grant MOP-133563.

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favor of the intervention buildings (mean difference = −0.90/100 apartment units/month, 95%CI: −1.54 to −0.26). At the individual level, there was a significant QALY increase (mean difference = 0.06, 95%CI: 0.02 to 0.10) and blood pressure decrease (systolic mean change = 3.65 mmHg, 95%CI: 2.37 to 4.94; diastolic mean change = 2.03 mmHg, 95%CI: 1.00 to 3.06). **Conclusions:** CP@clinic showed a significant decrease in EMS calls, decrease in BP, and improvement in QALYs among older adults in subsidizing public housing, suggesting this simple program should be replicated in other communities with public housing. **Trial Registration:** Clinicaltrials.gov, Registration no. NCT02152891. **Key words:** community paramedicine; older adults; low-income; social housing; chronic disease; health promotion

PREHOSPITAL EMERGENCY CARE 2019;23:718–729

INTRODUCTION

Emergency medical service (EMS) calls to 9-1-1 are increasing 5% annually in both the United States and Canada, outpacing population growth and straining overburdened emergency departments (EDs) (1–5). Older adults account for 38–48% of EMS calls (6, 7) and are more likely to have multiple chronic diseases (8), higher falls risk (9), and social isolation (10, 11). Low-income individuals are more likely to have poor physical and mental health (12, 13) and report substantial barriers to accessing preventive health care services (12). Older adults with low income have increased mortality rates (14) and lower health-related quality-of-life (HRQoL) (15), indicating that health inequalities exist due to their age and income level and improved access to preventative care could reduce costly EMS and ED utilization.

Paramedic services have recognized that paramedic-led interventions may be effective in countering the increasing demands on EMS (16). Community paramedicine (CP), part of mobile integrated health care (MIH) (17), has emerged in Australia, Canada, and the United States, and is growing internationally. Although the scope of CP still requires definition, some examples include triage-at-dispatch, alternate transport/destination, home visit programs, wellness clinic programs, and remote patient monitoring, all with the common goal of preventing EMS and ED utilization for conditions better managed through primary care and community-based approaches (1, 17). USA-based MIH has focused on chronic disease prevention, health promotion, and disease specific clinical tasks (17). By identifying the root problem and linking individuals with necessary supports, MIH-CP may be able to reduce EMS call volumes and bring demand back in line with capacity (16). There has been a minimal amount of rigorous research conducted in this field, but the results available are promising (2, 16, 18, 19).

A pilot study of the "Community Paramedicine at Clinic" (CP@clinic) program in public housing for older adults demonstrated a 25% decrease in EMS calls (19). CP@clinic includes health risk assessments, health education, referrals to community resources, and reports to the resident's family physician, specifically targeting modifiable risk factors that may lead to future acute health events (e.g., poor diet, high blood pressure [BP], smoking, polypharmacy). Participants described that the unique duality of CPs—emergency expert and health advocate—gave them a sense of security, trust, and comfort (20).

Building on the pilot's success, an RCT was conducted in one urban Canadian community with positive results (21). The current study is the first multi-site RCT of a CP wellness clinic in North America, expanding to sub-urban, rural, and northern communities. The **primary objective** is to evaluate the change in mean EMS calls at the building-level, comparing intervention and control buildings, across multiple community sites. The **secondary objectives** are to evaluate individual-level improvements in HRQoL and chronic disease risk factors among older adults living in the intervention buildings, compared to control building residents. These findings will potentially inform the development of MIH-CP programming and policies in all countries with subsidized public housing, as a mechanism to decrease burden on emergency health services.

METHODS

Study Design and Setting

A detailed RCT protocol has been reported elsewhere (22). In 2015–2016, an open-label, parallel, pragmatic, cluster-RCT was executed, comparing the intervention to usual care in 5 Ontario community sites (urban, suburban, and rural), for one year. After ethical approval, collaborative research agreements were signed by paramedic and housing directors at each site. The trial required intervention delivery and oversight by paramedic services.

Inclusion and Exclusion Criteria

The RCT occurred in mid- and high-rise public housing buildings for low-income older adults, where a portion of the rental fees are subsidized by the government. Subsidized housing buildings in each site, managed by municipal housing authorities, were selected using information collected from each local paramedic service and housing authority.

Inclusion criteria required that each building possess a unique postal code, more than 50 residential units, more than 60% of residents aged 55 years and older, and availability of at least one matched building of similar size and demographics. There were no exclusion criteria.

Participants

The CP@clinic program was open to all intervention building residents, though only data from those 55 years and older were analyzed. Consent was obtained prior to participation. Pre- and post-intervention surveys were administered in intervention and control buildings by trained research staff using consecutive sampling. Letters were mailed to all units, advertisements placed in building common areas, and refreshments provided during surveying sessions to encourage participation from as many building residents as possible. A $10 grocery store gift card was offered to survey participants.

Randomization and Blinding

The unit of randomization was the building. The research team used computer-generated randomization (randomizer.org) to randomly allocate the intervention (CP@clinic) to one building of each matched pair. Control buildings maintained usual care. It was not possible to blind participants to intervention allocation.

Procedures

Intervention. The CP@clinic intervention is described elsewhere (21). Community paramedics led risk assessment, disease prevention and health promotion sessions weekly in common areas of intervention buildings. The one-on-one, drop-in sessions were open to all building residents. After informed consent, participants were assessed for cardiovascular, diabetes, and fall risk, using validated tools. Data was entered directly into the CP@clinic database, which generated decision support advice for the community paramedics to follow. Paramedics counseled attendees on specific lifestyle changes and relevant accessible community resources (e.g., dietitian-led cooking classes, smoking cessation programs). Attendees with a moderate-to-high diabetes risk score were instructed to return for a fasting capillary blood glucose test. The CVD, diabetes risk, and HRQoL assessments were repeated 6 months later. Paramedics gave attendees a session card outlining their modifiable risk factors and discussed resources. Family physicians received faxed session summaries with patient consent. Where urgent medical assistance was indicated, paramedics facilitated immediate connection with the family physician, urgent care, or ED.

Community paramedics were trained for CP@clinic using online modules on chronic diseases, their risk factors, risk assessment using validated tools, and health promotion methods (approximately 4 hours of training); webinars were used for CP@clinic database training (1 hour of training); in-person observation using a train-the-trainer model was expected by each paramedic service for at least 1 clinic session of 2–3 hours duration. Each paramedic service assumed responsibility for staffing and daily operations. The McMaster Community Paramedicine Research Team assumed responsibility for regular process checking, including intervention compliance, integrity, and fidelity.

Control. The usual care control arm consisted of services that residents may access by visiting their family physician and ongoing services in their building by local community agencies. These services constituted the regular primary care with the family physician that may have been provided, at their primary care clinic, which they may or may not have visited. Therefore, blood pressure measurement and diabetes testing, for example, may have been offered as part of symptom specific consultation or chronic disease management, where appropriate.

Data Collection

The primary outcome of building-level EMS calls was available from the paramedic services databases. Secondary outcomes (individual-level) were collected using a survey tool comprised of multiple validated questionnaires, evaluating self-reported health status, health-related knowledge (particularly cardiovascular disease and diabetes), lifestyle behaviors, diabetes status (as measured by the CANRISK tool) (23), self-efficacy for management of cardiovascular conditions and diabetes, and HRQoL (as measured by the EQ-5D-3L tool) (24). BP was measured for CP@clinic attendees only, using a validated automated machine.

Outcomes

The primary outcome (building-level) was number of EMS calls per 100 apartment units per month. In this way, analysis accounted for differences in building size. Secondary outcomes (individual-level) were changes in BP, lifestyle risk-factor measures (physical activity, fruit and vegetable consumption, and body mass index [BMI]), HRQoL, and quality-adjusted-life-years (QALYs).

Statistical Methods

Sample Size. The CP@clinic pilot study decreased EMS calls by 25% (19). The mean monthly number of EMS calls in one site (Hamilton) was 3.64 calls per 100 apartment units per month. Using a more conservative difference of 15% in EMS calls between intervention and control groups (0.55 calls per 100 units per month; SD = 2.20), standard parameters (power = 0.80, alpha = 0.05), and based on clustering in our previous analysis of EMS calls (intracluster correlation coefficient [ICC] for EMS calls for individuals within buildings = 0.07), we needed a minimum of 1108 participants (11 buildings with 100 units in each trial arm). Sample size for the secondary outcome was calculated based on a QALY difference of 0.05 (SD = 0.20), considered clinically significant (25). Using standard parameters, we required a sample size of 251 residents within 11 buildings.

Statistical Analysis. Baseline building and participant characteristics were descriptively analyzed. HRQoL assessments obtained through the EQ-5D-3L were converted to utility values based on a Canadian value set for QALY assessment (26).

Building-level Analysis. Generalized Estimating Equations (GEE) analysis was used to compare mean number of EMS calls per 100 apartment units per month, controlling for building pairing within sites, number of calls the prior year, and building clustering by site. We conducted 4 iterations of analysis: a main analysis including all 15 building pairs and 3 sensitivity analyses accounting for potential sources of data error: (1) excluding outlier data, (2) excluding 2 building-pairs with setting changes affecting their eligibility, and (3) excluding both sources of unreliable data simultaneously. Sensitivity analysis was done to investigate the results further across the different situations, assess how consistent the results were, and to identify reasons for certain patterns in the results.

Individual-level Analysis. We compared changes in risk factors between groups, while adjusting for building clusters and pairing using GEE. We followed an intention-to-treat principle, performing imputation for missing data due to loss-to-follow-up or drop-out. We conducted 3 iterations of analysis: an intention-to-treat analysis in which all missing data were imputed and 2 sensitivity analyses: (1) comparing only CP@clinic attendees and control data as collected and (2) comparing CP@clinic attendees and controls with imputed data. Data imputation was done to take into consideration the impact of missing data by predicting the possible values of the missing data, based on data that were available. We did this to check whether analysis results including the predicted values missing data would be different or similar to the results of the analysis of actual data available. We used GEE to analyze BP changes within individuals, accounting for clustering of individuals within buildings. Post-hoc analysis was used to determine changes across ten visits. All analyses used SPSS version 20 or STATA version 11.

Results

Eligibility criteria were fulfilled by 85 buildings; 30 were matched into 15 intervention-control pairs based on demographics, geography, existing services provided, and EMS call numbers (Table 1, Figure 1), and randomized.

During data collection and analysis, 2 intervention buildings had unanticipated issues. One deemed initially to have a unique postal code was actually a complex setting (assisted-living units in an attached building with the same postal code). Another building had a spike in neighborhood crime activity and EMS calls during the intervention after a nearby police station closed; it was no longer similar to its matched control and older adults were afraid to leave their apartments. Additionally, a frequent EMS caller (39 calls in 12 months) moved into an intervention building during the intervention period, substantially inflating EMS calls. We are unaware of any other significant movement in the resident population that affected our results. We have presented sensitivity analyses considering these issues.

During the intervention period, 794 intervention buildings residents attended CP@clinic; 715 (90.05%) attended at least twice and 644 (81.10%) at least 3 times. Building participation rates ranged from 10% to 82%, averaging 39.48%. Over 17,000 BP measurements were completed and over 700 participants had risk-factor discussions with paramedics. Where additional consent was provided by the attendee and the fax number was known, family physicians received 755 automated faxes, informing them of their patients' BP and risk assessment findings quarterly. Also, same-day faxes were sent directly by paramedics, when appropriate.

TABLE 1. Building-level characteristics for matched pairs

		Average number of units		Average seniors' occupancy (% over 55 years)		Average number of EMS calls/month/100 units at baseline	
Community	Matched pairs	Intervention	Control	Intervention	Control	Intervention	Control
Hamilton	4	287.75	293.00	63	67	11.29	12.31
Guelph	3	60.33	62.33	96	81	3.03	2.44
York	4	104.50	91.75	100	100	2.98	3.56
Simcoe	2	73.00	72.00	77	77	3.88	3.50
Sudbury	2	101.50	101.00	55	66	7.38	9.46

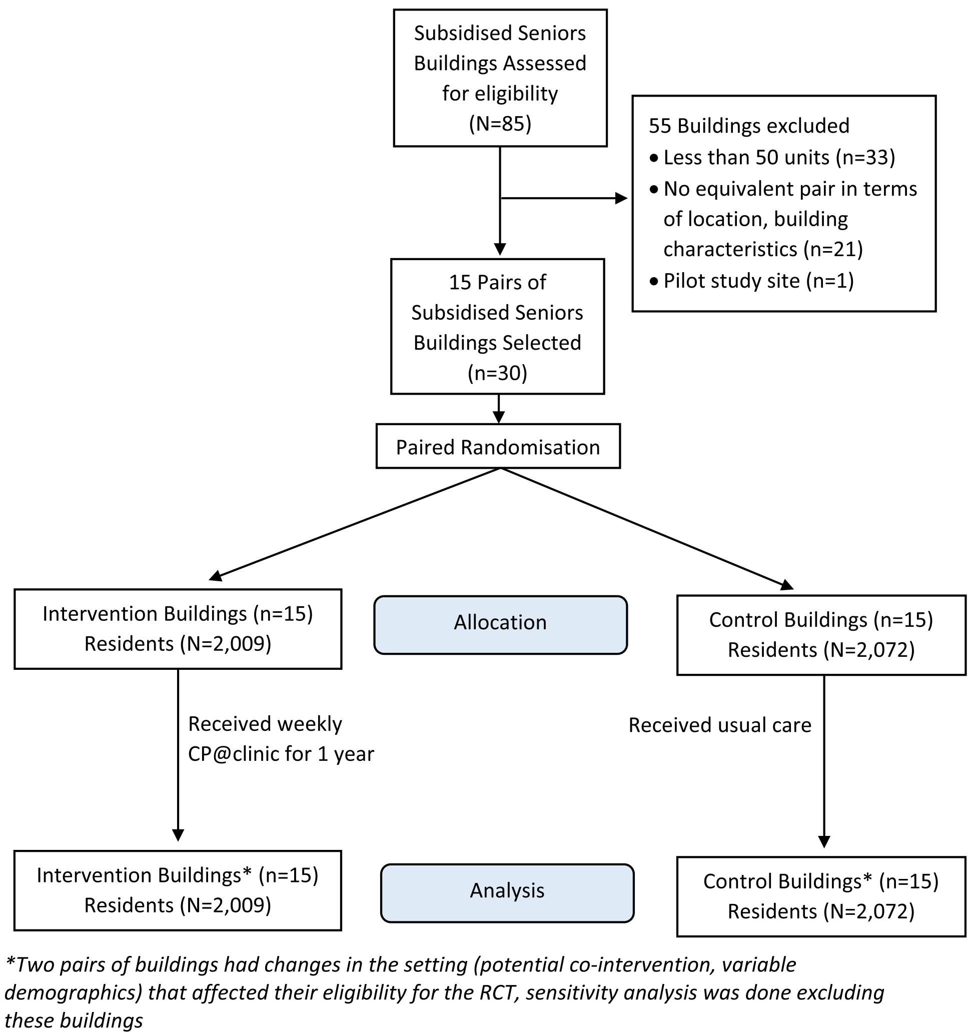


FIGURE 1. CONSORT Flow diagram of the CP@clinic RCT.

Paired analysis of mean monthly EMS calls, controlling for baseline EMS call numbers, demonstrates intervention buildings had lower mean EMS call numbers, compared to controls, across all iterations of analysis (Table 2). The main intention-to-treat analysis did not show significant results. When excluding frequent caller (outlier) data from one intervention building (Sensitivity analysis 1) or data from 2 building-pairs that had setting changes (Sensitivity analysis 2), differences approach significant values ($p = 0.066$ and $p = 0.060$, respectively). After excluding both sources of unreliable data (Sensitivity analysis 3), EMS call difference between intervention and control buildings was statistically

TABLE 2. Primary Outcome: Difference in monthly EMS call rates per 100 apartment units between intervention and control (adjusted for pairing, baseline EMS call rates and building clustering by site)

Comparison	Intervention buildings adjusted mean (SD)	Control building adjusted mean (SD)	Difference between adjusted means	95% CI	*p*-value	% Reduction in EMS calls (mean difference/mean in control)
Intention-to-treat analysis*	4.7 (0.93)	5.11 (0.91)	−0.37	−1.00 to 0.27	0.258	7.24
Sensitivity analysis 1†	4.55 (0.88)	5.11 (0.86)	−0.56	−1.16 to 0.04	0.066	10.96
Sensitivity analysis 2‡	3.96 (0.82)	4.62 (0.80)	−0.66	−1.34 to 0.03	0.060	14.29
Sensitivity analysis 3§	3.73 (0.76)	4.64 (0.76)	−0.90	−1.54 to −0.26	0.006	19.40

*Including all buildings initially randomized ($n = 32$).
†Excluding data of one outlier resident who moved into an intervention building and was a very high user of EMS (39 calls over 12 months).
‡Excluding 2 pairs of buildings with changes in the setting that affected their eligibility (no longer meeting the inclusion criteria).
§Excluding data from the high user patient and 2 pairs of building with changes in the setting.

significant at 0.90 calls per 100 apartment units per month (p = 0.006). The ICC for buildings within sites for this final model was 0.01.

Pre-intervention surveys were completed by 358 intervention building and 320 control building residents (see Figure 2). Sociodemographic characteristics were similar between intervention and control survey participants (see Table 3). For both groups, mean age was over 70 years old; most were female (>70%), lived alone (90%), had high school education or lower (68%), family physicians (>90%), mobility problems (>60%), and pain/discomfort (>70%). In the first 232 survey participants, health literacy was found to be very low and the tool overly cumbersome, so it was excluded thereafter. Most risk profile characteristics were similar, except smoking (almost 14% higher in control building residents). HRQoL was poor-to-fair in 38% of intervention and 43% of control building residents.

Of the 320 control building residents who completed the pre-intervention survey, 125 (39.06%) also completed the post-intervention survey (see Figure 2). Similarly, out of 358 intervention-building residents who completed the pre-intervention survey, 197 (55.03%) completed the post-intervention survey. Looking at only those who attended the CP@clinic program, 172 completed the pre-intervention survey and 146 (84.88%) also completed the post-intervention survey. The remaining moved, was deceased, or was lost-to-follow-up. Since a large proportion of the control building residents and non-attendees were lost-to-follow-up, sensitivity analysis was conducted using multiple imputation for missing data.

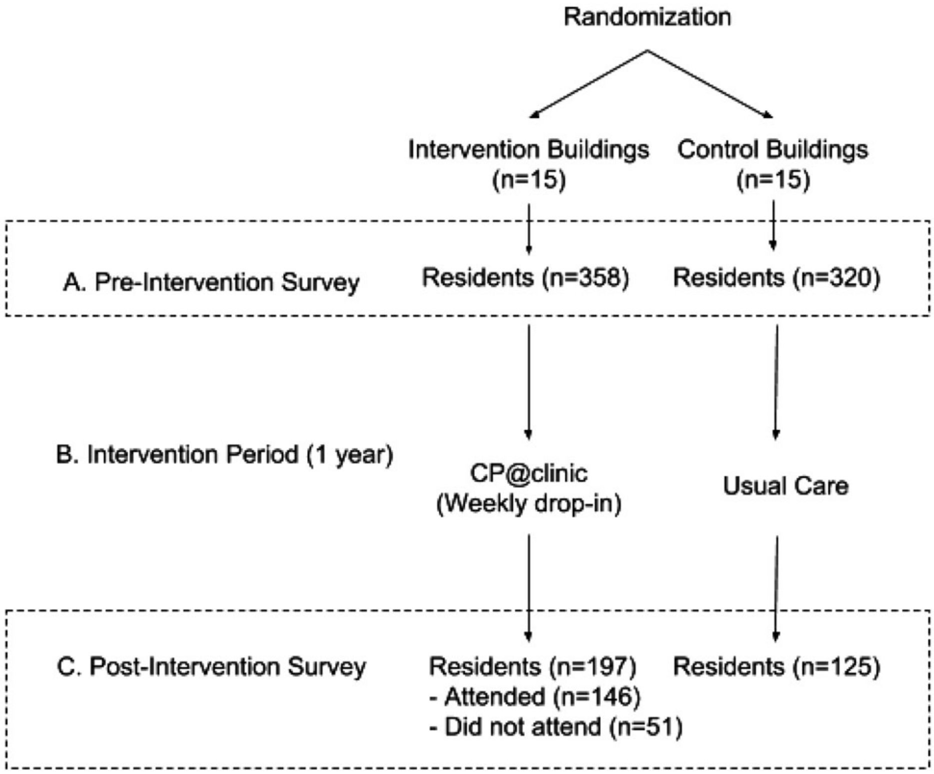
An intention-to-treat analysis in which intervention building residents were compared to control building residents regarding HRQoL changes and risk-factor outcomes from pre-intervention to follow-up is presented in Table 4. All outcomes were in favor of the intervention group, except for the anxiety and depression HRQoL domain. The change in mean BMI and QALY was significantly higher in the intervention group.

A comparison of CP@clinic attendees to control building residents is presented in Table 5. The results showed a similar trend except for one outcome (HRQoL mobility domain) but the effect size was higher. The change in mean BMI and QALY was significantly higher among CP@clinic attendees. In Table 6 (complete case analysis comparing CP@clinic participants and control building residents), effect sizes were higher than the results in Table 5 and more outcomes were significantly different between the 2 groups. Three HRQoL domains (self-care, usual activities, pain, and discomfort) and overall QALY significantly improved among CP@clinic attendees. Furthermore, there was a trend toward significance in CANRISK categories (p = 0.08) indicating that diabetes risk in CP@clinic attendees had improved.

In CP@clinic attendees, 56.80% ($n = 451$) had elevated BP during their first visit. Of those with high BP on their first visit, 67.9% ($n = 306$) had BPs within normal range by their second visit (see Figure 3). After visit one, the proportion of participants with elevated BP continued to decrease gradually and was maintained between 59% and 62%. Furthermore, mean systolic and diastolic BP significantly decreased by 3.65 mmHg (95%CI: 2.37–4.94) and 2.03 mmHg (95%CI: 1.00–3.06), respectively, irrespective of previous hypertension. Improvement was greater among those previously diagnosed with hypertension.

DISCUSSION

The CP@clinic intervention had a positive impact on reducing EMS calls across multiple community



Data Collection	Intervention Building Residents	Control Building Residents
A. Pre-Intervention Survey	Demographics Chronic disease history Quality of life (EQ5D) Health behaviours BMI (self-reported) Diabetes risk (CANRISK) Health Literacy	Demographics Chronic disease history Quality of life (EQ5D) Health behaviours BMI (self-reported) Diabetes risk (CANRISK) Health Literacy
B. Intervention Period	Demographics Chronic disease history Quality of life (EQ5D) Health behaviours BMI (measured) Diabetes risk (CANRISK) Fall risk BP (measured weekly)	No Individual-level measures
C. Post-intervention Survey	Demographics Chronic disease history Quality of life (EQ5D) Health behaviours BMI (self-reported) Diabetes Risk (CANRISK)	Demographics Chronic disease history Quality of life (EQ5D) Health behaviours BMI (self-reported) Diabetes Risk (CANRISK)

FIGURE 2. CP@clinic Data Collection Strategy.

sites in our final sensitivity analysis. Comparing intervention and control buildings, there was a statistically significant mean decrease of 0.9 EMS calls per 100 apartment units per month (95%CI: −1.54; −0.26), representing a 19% relative reduction. We consider the final sensitivity analysis results (excluding some potential sources of data error) to be a true reflection of the RCT's impact. A one call per month reduction may not appear to be a significant decrease, but considering that this figure is only per month and per 100 units, that buildings can commonly be as large as 250 units, and there

TABLE 3. Individual-level characteristics for intervention and control buildings at baseline

Descriptive variables	Intervention building $n = 358$ n (%)	Control building $n = 320$ n (%)
Age years: mean (SD)	73.90 (9.05)	70.44 (7.94)
Female	286 (79.9)	229 (71.6)
Lives alone	322 (90.70)	287 (89.97)
Education		
Some high school or lower	160 (45.1)	146 (45.8)
High school diploma	83 (23.4)	75 (23.5)
Some college/university or higher	56 (15.8)	50 (15.7)
College or university	56 (15.8)	48 (15.0)
Poor health literacy*	80 (84.2)	84 (81.6)
With chronic diseases		
Heart problems	111 (31.1)	80 (25.0)
Hypertension	192 (53.6)	177 (55.3)
High cholesterol	135 (37.7)	119 (37.2)
Stroke	43 (12.0)	39 (12.2)
Diabetes	96 (26.8)	90 (28.1)
Risk factors		
Low physical activity	148 (41.9)	166 (51.9)
Low fruits and vegetable intake	123 (34.6)	106 (33.2)
High alcohol intake	5 (1.4)	11 (3.4)
Smoker	87 (24.5)	122 (38.4)
High BMI	247 (69.6)	221 (69.0)
CANRISK†		
Moderate	104 (39.8)	98 (42.6)
High	151 (57.9)	123 (53.5)
Health status and quality-of-life		
Reported poor to fair health	135 (38.0)	139 (43.5)
With mobility problems	218 (61.4)	192 (60.0)
With self-care problems	83 (23.4)	59 (18.4)
With problems doing usual activities	166 (46.8)	133 (41.6)
With pain/discomfort	249 (70.1)	239 (74.9)
With anxiety/depression	176 (48.5)	154 (48.1)
Has a family doctor	327 (91.3)	298 (93.1)

*For the health literacy assessment $n = 89$; for intervention 143 for control in Hamilton site only.
†Only for participant not previously diagnosed with diabetes.

TABLE 4. Secondary Outcome: Intention-to-treat analysis (Multiple Imputation) of change in health behavior and quality-of-life outcomes between CP@clinic participants in intervention buildings and residents in control buildings that completed the HABiT survey (adjusted for pairing and clustering)

Quality-of-life measures/risk-factor domains	% of participants who improved		OR (95% CI)	p-value
	Intervention $n = 358$ n (%)	Control $n = 320$ n (%)		
Mobility	99 (27.65)	87 (27.18)	1.08 (0.50; 2.35)	0.55
Self-care	45 (12.57)	27 (8.44)	1.85 (0.80; 4.30)	0.15
Usual activities	126 (35.20)	82 (25.63)	1.81 (0.67; 4.89)	0.20
Pain and discomfort	119 (33.24)	87 (27.19)	1.38 (0.63; 3.04)	0.36
Anxiety and depression	106 (29.61)	95 (29.69)	1.00 (0.60; 1.69)	0.96
Physical activity	64 (17.88)	50 (15.63)	1.90 (0.66; 2.14)	0.54
Fruits and vegetable intake	41 (11.45)	29 (9.06)	1.27 (0.65; 2.46)	0.46
CANRISK category	57 (15.92)	31 (9.69)	1.88 (0.56; 6.34)	0.26
	Mean change		**Mean difference (95% CI)**	***p*-value**
	Intervention mean (SD)	**Control mean (SD)**		
BMI	−0.03 (2.65)	0.33 (3.75)	−0.35 (−0.12; −0.82)	0.02
QALY	0.05 (0.19)	0.01 (0.23)	0.04 (0.01; 0.07)	0.02
State of health	0.19 (29.90)	0.15 (30.59)	0.04 (−4.00; 4.08)	0.43

HABiT = *Health Awareness and Behavior Tool*; CANRISK = *CANadian diabetes RISK assessment*; BMfI = *Body Mass Index*; QALY = *Quality-Adjusted- Life Years*; OR = *odds ratio*; SD = *standard deviation*; CI = *confidence intervals*.

TABLE 5. Secondary outcome: Sensitivity analysis (multiple imputation) of change in health behavior and quality of life outcomes between CP@clinic participants in intervention buildings who attended CP@clinic and residents in control buildings that completed the HABiT survey (adjusted for pairing and clustering)

Quality-of-life measures/risk-factor domains	% of participants who improved: Attended intervention n = 172	% of participants who improved: Control n = 320	OR(95% CI)	p-value
Mobility	33 (19.19)	87 (27.18)	0.71 (0.12; 4.19)	0.64
Self-care	27 (15.70)	27 (8.44)	2.10 (0.60; 7.39)	0.21
Usual activities	59 (34.30)	82 (25.63)	1.83 (0.13; 25.13)	0.57
Pain and discomfort	58 (33.72)	87 (27.19)	1.44 (0.30; 6.99)	0.58
Anxiety and depression	53 (30.81)	95 (29.69)	1.10 (0.25; 4.80)	0.87
Physical activity	30 (17.44)	50 (15.63)	1.15 (0.59; 2.25)	0.67
Fruits and vegetable intake	20 (11.63)	29 (9.06)	1.30 (0.67; 2.55)	0.43
CANRISK category	30 (17.44)	31 (9.69)	2.08 (0.41; 10.60)	0.31
	Mean change			
	Intervention mean (SD)	**Control mean (SD)**	**Mean difference (95% CI)**	***p*-value**
BMI	−0.11 (2.60)	0.33 (3.81)	−0.44 (−0.15; −1.03)	<0.01
QALY	0.08 (0.17)	0.02 (0.14)	0.06 (0.02; 0.10)	<0.01
State of health	2.17 (22.08)	0.15 (30.96)	2.01 (−2.53; 6.60)	0.24

HABiT = *Health Awareness and Behavior Tool*; CANRISK = *CANadian diabetes RISK assessment*; fBMI = *Body Mass Index*; QALY = *Quality-Adjusted-Life Years*; OR = *odds ratio*; SD = *standard deviation*; CI = *confidence intervals*.

TABLE 6. Secondary outcome: Sensitivity analysis (complete case analysis) of change in health behavior and quality-of-life outcomes between CP@clinic participants in intervention buildings who attended CP@clinic and residents in control buildings that completed the HABiT survey (adjusted for pairing and clustering)

Quality-of-life measures/risk-factor domains	% of participants who improved: Attended Intervention (No imputation) n = 146	% of participants who improved: Control (No imputation) n = 125	OR (95% CI)	p-value
Mobility	25 (17·12)	14 (11·20)	1.64 (0·81; 3·31)	0·17
Self-care	22 (15·07)	8 (6·40)	2·57 (1·10; 6·0)	0·03
Usual activities	45 (30·82)	14 (11·20)	3·50 (1·81; 6·76)	<0·01
Pain and discomfort	46 (31·51)	20 (16·00)	2·42 (1·34; 4·37)	<0·01
Anxiety and depression	43 (29·45)	25 (20·00)	1·64 (0·93; 2·88)	0·09
Physical activity	30 (17·44) n = 172	18 (15·0) n = 120	1·20 (0·63; 2·26)	0·58
Fruits and vegetable intake	20 (11·63) n = 172	9 (7·38) n = 122	1·65 (0·72; 3.76)	0·23
CANRISK category	21 (16·15) n = 130	7 (7·86) n = 89	2·26 (0·92; 6·56)	0·08
	Mean change			
	Intervention mean (SD)	**Control mean (SD)**	**Mean difference (95% CI)**	***p*-value**
BMI	−0·09 (2·64)	0·28 (2·22)	−0·37 (−0·98; 0·24)	0·230
QALY	0·08 (0·17)	0·02 (0·18)	0·06 (0·02; 0·10)	0·004
State of health	2·30 (21·57)	0·04 (21·57)	2·26 (−3·00; 7·52)	0·400

HABiT = *Health Awareness and Behavior Tool*; CANRISK = *CANadian diabetes RISK assessment*; BMI =*Body Mass Index*; QALY = *Quality-Adjusted-Life Years*; OR = *odds ratio*; SD = *standard deviation*; CI = *confidence intervals*.

can be up to 200 social housing buildings in some municipalities, the implications of the potential for great impact become evident.

Although our trial was a pragmatic trial, there were certain external factors that occurred that we have discussed in detail in the following sections regarding limitations. We feel that this is appropriate methodologically, since exclusion of the single extreme outlier is standard statistical practice (27).

The results have far-reaching implications for health systems, MIH, and CP internationally. As described earlier, there is scarce published CP research and no prior multi-site RCTs for a wellness clinic CP program (16).This RCT demonstrates that a CP wellness clinic program conducting risk assessments and directing people appropriately to their family physicians can impact the broader health system; as per CP@clinic protocol, 715 residents who attended were provided with health education and directed towards their family physicians for chronic disease risks; and 755 regular reports were faxed to family physicians, potentially enabling them to provide optimal care for their patients. This also enhances continuity of care and improves patient satisfaction/outcomes (28). Importantly there was a 19% relative reduction in EMS calls, increasing resources available to provide better care for patients elsewhere within the health system (e.g.,

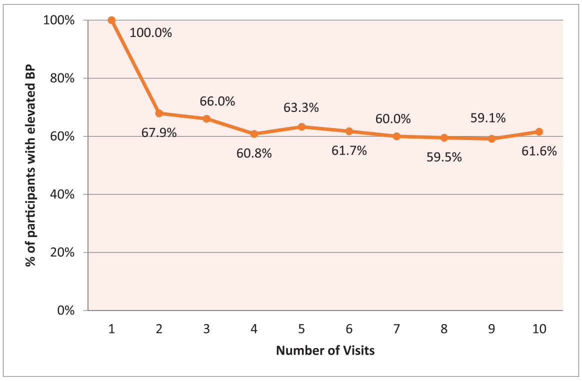


FIGURE 3. Prevalence of high blood pressure across CP@clinic visits in residents who had high blood pressure during their first CP@clinic visit.

reallocation of ambulances for those who are in greater need). Overall, the focus of CP@clinic on health promotion, prevention, and redirection to more appropriate health system resources may provide relief to the strained healthcare system, especially EMS and ED services.

Looking at individual impact, CP@clinic program effects are evident when analyzing data collected specifically from attendees. Although the program focused on health promotion and disease prevention, it had a positive effect on HRQoL domains and there was a QALY gain. The ability of community paramedics to connect with older adults in this circumstance (20), and the resultant improvement in HRQoL complements the family physician's efforts in a synergistic fashion. We postulate that this improvement in HRQoL and QALYs is a step toward better coping skills and increased resiliency in vulnerable older adults though further research is necessary. The improvement in CANRISK score in attendees versus non-attendees, demonstrates the effect of tailored lifestyle counseling in a population known to have poor health literacy (29). The BP of participants significantly improved and in those with high BP on their first visit, 40.5% had their BP normalize after multiple visits. These results could be indicative of this population's readiness to accept appropriate help from primary care and community resources when provided in an accessible manner. The long term benefits of these results have yet to be seen, but with individuals changing their lifestyles and taking a preventive approach, major cardiovascular health issues and other chronic disease complications are expected to decrease.

The CP@clinic program offers a novel and clinically important solution to increasing EMS and ED usage in high-income countries. The RCT included both rural and urban paramedic services, had a structured program using online training modules and database with built-in decision support that could be replicated as an "out-of-the-box" program in other communities, and services have sustained the program post-intervention. The program has also been voluntarily adopted by other services that were not part of the RCT as awareness of the program's effectiveness spreads. However, this study has some limitations. Two buildings had their eligibility status change during the intervention, which was beyond the control of the research team and not reflective of the performance of the intervention, so both intention-to-treat and sensitivity analyses were reported. Similarly, one building had an outlier resident who made very frequent EMS calls. There were differences in the prevalence of smoking and alcohol intake between the buildings; 14% higher smoking rates and 2% higher rates of alcohol intake in controls. However, this was a product of our randomization and accordingly was not included in the primary analysis. If indeed the control group was "less healthy," the intervention could have had a greater effect; therefore, one may suppose our results to be more conservative. There were a large proportion of participants who we could not contact during post-intervention because they either moved or died. Our City Housing partners have advised us that the buildings were not different in terms of movement of people or death rates. It is possible that attendees were more likely to be contacted at the end of the program than those who did not attend. We have accounted for this in our sensitivity analysis. The strength of this program may be to avoid individuals from becoming frequent callers, instead of changing the behaviors of those who are already frequent callers. Housing buildings were required to have at least 50 units to optimize paramedic time and resources; paramedic services in very remote locations may not have these types of dwellings available.

CONCLUSION

CP@clinic can facilitate health care access for older adults residing in subsidized public housing experiencing health inequalities. This program and the style of CP might be generalizable to subsidized housing across Canada, as well as in the United States and United Kingdom where there have public housing projects and council housing blocks, respectively. Further work is required to determine the sustained effects and optimal frequency of program delivery as it integrates within the health system. Further work is required to determine the sustained effects and optimal frequency of program delivery as it integrates within the health system.

The CP@clinic strategy has the potential to improve health system access for this hard-to-reach population and reduce utilization of emergency services.

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